Quantification Protocol for Energy Efficiency Projects

Carbon Competitiveness Incentive Regulation

Version 2.0

June 2018

Title:	**Quantification Protocol for Energy Efficiency Projects**
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Disclaimer

This document is not a substitute for the legal requirements. Emission offset project developers must comply with all applicable laws, including but not limited to those set out in the *Climate Change and Emissions Management Act* (the Act), the Carbon Competitiveness Incentive Regulation (the Regulation), and Part 1 of the Standard for Greenhouse Gas Emission Offset Project Developers (the Standard).

If there is a conflict between this quantification protocol and the Act, the Regulation or Part 1 of the Standard, the Act, Regulation or Standard prevails over the quantification protocol.

All quantification protocols are subject to review as deemed necessary, and will be revised periodically to ensure they reflect best available scientific knowledge and practices. For information regarding the withdrawal and replacement of quantification protocols, see the Standard.

Summary of Revisions

Version	Date	Summary of Revisions

Version 2.0	June 2018	• Quantification Protocol for Energy Efficiency in Commercial and Institutional Buildings Version 1.0 and Quantification Protocol for Energy Efficiency Projects Version 1 have been combined into one, the Quantification Protocol for Energy Efficiency Projects Version 2.0 (this document).
		• The **Protocol Scope** was updated to provide clarification on eligible sectors and project types.
		• The **Protocol Scope** was updated to exclude eligibility for the displacement of combustion emissions from fuels subject to the carbon levy under the Climate Leadership Act. Displacement of combustion emissions from fuels with a carbon levy exemption certificate is an eligible activity under this protocol.
		• **Project-level additionality** requirements have been added for all projects applying this protocol.
		• The **Baseline Condition** has been updated to a selection process to be performed by the project developer.
		  o Requirements for end of life equipment have been explicitly listed and included.
		• The **Quantification** section has been updated:
		  o Fuel extraction and processing emissions have been included.
		  o Emissions must be quantified separately for each project and baseline energy source in the updated **Quantification Methodology** section.
		  o Equations have been added for the quantification of net reductions, offset-eligible reductions, and identification and exclusion of levied emissions sources.
		  o The **Accuracy Approaches** section has been updated to align the approaches with reasonable assurance verification requirements.
		• A flexibility mechanism has been added for the **Record Keeping** requirements where custody of meters or records does not reside with the project developer.

1.0	October 2010	Quantification Protocol for Energy Efficiency in Commercial and Institutional Buildings was published.
1.0	September 2007	Quantification Protocol for Energy Efficiency Projects was published.

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Alberta Climate Change Office Related Publications

- Alberta's Climate Leadership Plan[1]
- *Climate Change and Emissions Management Act*
- *Climate Leadership Act*
- Carbon Competitiveness Incentive Regulation
- Standard for Greenhouse Gas Emission Offset Project Developers
- Standard for Verification
- Carbon Offset Emission Factors Handbook

[1] https://www.alberta.ca/climate-leadership-plan.aspx

1.0 Introduction

This document establishes the approved methodology for quantifying greenhouse gas (GHG) emission reductions from the implementation of energy efficiency activities in eligible areas as outlined in the scope of this protocol. This quantification protocol can be used by emission offset project developers to quantify GHG emission reductions resulting from the implementation of energy conservation measures (ECMs) such as changes in process, management practices and/or facility improvements in new and retrofit projects. Emission offsets are generated from the reduction of GHG emissions from energy use in the project condition compared with the baseline condition. The baseline and project conditions are established by the project developer according to the procedures described in this protocol.

This quantification protocol is written for those familiar with energy efficiency projects and the implementation and monitoring of ECMs. Familiarity with, and general understanding of, the terminology, processes, standards and operation associated with these measures is required. For Commercial and Institutional building project application the protocol requires a Certified Measurement and Verification Professional (CMVP) or a Certified Energy Manager (CEM) with at least three years of experience in implementing and quantifying energy efficiency projects to assess and approve the operating conditions of the project as detailed in the project plan and each project report. Projects that have not met protocol requirements will not be accepted for compliance under the regulation.

1.1 Protocol Scope and Description

This protocol applies to the quantification of direct and indirect GHG emission reductions resulting from the implementation of ECMs in new and existing processes and/or facilities. A summary of the eligibility of project activities, sectors, and facility types under this protocol is provided in Table 1. Listed eligible project types apply to both new and existing, and to both single location stand-alone and aggregated projects with multiple sub-project locations.

Table 1: Eligible and Ineligible Project Activities

Eligible Projects	Ineligible Projects

• Energy efficiency in commercial and institutional buildings
• Energy efficiency in industrial and manufacturing processes or buildings
• Energy efficiency in agriculture, forestry, mining, and oil and gas facilities and operations
• Energy efficiency in other facilities, operations, infrastructure and/or pieces of equipment that consume energy including Combined Heat and Power (cogeneration) activities, except for those listed under ineligible projects
	• Energy efficiency in residential buildings
	• Energy efficiency in transportation and mobile equipment
	• Renewable energy generation including hydro, solar, wind, and distributed renewable energy
	• Activities other than energy efficiency (e.g., fuel switching)
	• Efficiency-related activities eligible under other Alberta quantification protocols including, but not limited to:
	  o waste heat recovery
	  o engine fuel management/pneumatics
	  o cattle feed use efficiency

For the purposes of this protocol, eligible commercial and institutional buildings include, but are not limited to:

- hotels, motels, and resorts,
- retail malls and stores,
- office buildings,
- arenas,
- hospitals and clinics,
- schools, universities, and campus residences,
- community centres, libraries, and fire/ambulance service buildings, and
- warehouses and storage facilities.

Eligible industrial, manufacturing, agriculture, forestry, mining, oil and gas, and other facilities include, but are not limited to:

- food and beverage processing and manufacturing,
- breweries, wineries, and distilleries,
- chemicals and plastics manufacturing,
- machinery, equipment, appliance, and component manufacturing,
- agricultural heating, lighting, ventilation, watering and irrigation equipment,
- paper and wood products manufacturing,
- mining and mineral product manufacturing,
- oil and gas processing facilities, and
- municipal infrastructure such as water pumping stations, street lighting and traffic signals.

Sectors and/or facilities not noted above may be eligible to generate emission offsets under this protocol. To be eligible, project activities must not be listed as ineligible in Table 1 and must meet all the protocol and offset system eligibility criteria.

This protocol was reviewed and revised to align with the current Government of Alberta *Climate Leadership Act* to ensure no policy overlap, namely with the carbon levy. Therefore, applicable transportation and heating fuels to which the carbon levy applies are ineligible to generate emission offsets under this protocol. GHG emission sources that are eligible to generate emission offsets under this protocol are summarized in Table 2. Fossil fuels that are subject to the carbon levy must be tracked and reported to ensure overall project eligibility.

The GHG emissions affected by the activities described in this protocol include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). A complete list of GHGs regulated under the Regulation and the applicable Global Warming Potential (GWP) for each gas is available in the Carbon Offset Emission Factors Handbook for Alberta offset projects (the Handbook).

Table 2: Eligible and Ineligible Emission Sources

Eligible Emission Sources	Ineligible Emission Sources
• Emissions from the generation of Alberta grid electricity • Combustion emissions from fuels exempted from the carbon levy with a carbon levy exemption certificate. The exemption certificate must be available to the verifier and/or government auditor upon request • Extraction, processing, and/or production emissions associated with fuels regardless of whether the carbon levy applies to the combustion emissions from such fuels	• Combustion emissions from fuels subject to the carbon levy including: o Diesel, o gasoline, o natural gas, o propane, o any other type of fuel to which the carbon levy applies under the *Climate Leadership Act*.

Protocol Approach

This protocol has adapted calculation methodologies for energy conservation projects from the methods published by the Efficiency Valuation Organization in its International Performance Measurement and Verification Protocol (IPMVP)[2]. The IPMVP is a recognized international standard for measuring, monitoring, and verifying energy conservation projects. It provides guidance adhering to widely accepted fundamental principles of measurement and verification, and project reporting.

1.2 Protocol Applicability

Project developers must demonstrate that their emission offset project meets the requirements as specified in the Regulation and published standards for the Alberta emission offset system and this quantification protocol.

For a project to be eligible under this protocol, project developers must provide sufficient evidence to demonstrate that:

(1) The project conserves energy through the implementation of one or more energy conservation measures, and not through any other activity (such as a decrease in production). All energy conservation measures implemented must be listed in project documentation;

(2) The project is an eligible project as outlined in Table 1 and results in the reduction of an emission source listed as eligible in Table 2; a project developer is recommended to contact the Alberta Climate Change Office if they have a project activity that may meet the protocol eligibility but is not listed in Table 1;

(3) The project activity(ies) applies Additionality (Section 2) and Barrier (Section 3) assessment to assess eligibility under this protocol;

(4) This protocol does not include eligibility for the displacement of emissions from fuels subject to the carbon levy. It is still a requirement to monitor, measure and quantify these emissions with a reasonable level of assurance. However, displacement of emissions for heating or transportation fuels not subject to

[2] Copies of the IPMVP protocol can be obtained at www.evo-world.org

the carbon levy may be eligible for consideration under this protocol with a carbon levy exemption certificate under the *Climate Leadership Act*;

(5) The project must meet the requirements for offset eligibility as specified in the applicable regulation and standards for the Alberta emissions offset system;

(6) The quantification of emission reductions achieved by the project is based on actual measurement and monitoring (except where indicated in this protocol), and is consistent with the requirements of this protocol;

(7) One of four (4) quantification options are available based on the nature of the project being undertaken and must be justified in project documentation:

Option A – Retrofit Isolation: Key Parameter Measurement; monitoring involves measurements of the key parameters which affect the energy use of the energy conservation measure-affected systems.

Option B – Retrofit Isolation: All Parameter Measurement; monitoring involves measuring the energy use of the energy conservation measure-affected systems.

Option C – Whole Facility; energy use for the entire facility is monitored.

Option D – Calibrated Simulation; energy use is determined using an accurate and calibrated simulation of the facility or facility component;

(8) The project and baseline provide the same function and quality of products or services; Fuel and electricity inputs are of the same type in the project and baseline;

(9) If applicable, production outputs from the facility including products, commodities, and other outputs remain of the same quality and type in the project and baseline; and

(10) If applicable, where the project facility contains a biological or chemical process, the project does not result in an increase in non-biogenic GHG emissions from this process in comparison with the baseline condition, as indicated by an affirmation from the project developer and supported by evidence such as engineering calculations and/or monitored process data. If such processes do not exist, are not altered, or associated emissions are lower in the project than in the baseline, the project developer must exclude quantification of the associated source or sink. Otherwise, the project developer must provide and justify an appropriate emissions model for the biological or chemical process altered at the facility and include the emission increases in quantification.

1.3 Protocol Flexibility

It is recognized that there is variability in project implementation and availability of data. The following flexibility option has been developed to support implementation of energy efficiency projects:

(1) Where the project involves the selection and implementation of more than two ECMs during new facility design and construction, the project developer may use the streamlined baseline selection process for new facilities with multiple ECMs in Section 2.3, if fully justified and supported.

(2) Where the project involves the selection and implementation of more than two ECMs implemented in an existing facility, the project developer may use the streamlined baseline selection process facilities with multiple ECMs as applicable in Section 2.3, if fully justified and supported.

The project developer must indicate and justify why flexibility provisions have been used.

1.4 Glossary of Terms

Common terms used in this protocol are defined below. Common concepts from the IPMVP that are used in this protocol are also noted and defined.

Additionality	The concept that greenhouse gas emission reductions resulting from the emission offset project must be beyond business as usual/sector common practice and any regulatory requirement. That is, the implementation of the project must result in greenhouse gas emissions that are lower than in the baseline condition.
Adjusted-Baseline Energy (IPMVP)	The energy use of the baseline period plus routine adjustments to project reporting period conditions. The adjusted baseline-energy is normally found by first developing a model which correlates actual baseline period energy data with appropriate independent variable(s) in the baseline period. Each project reporting period's independent variable(s) are then inserted into this baseline model to produce the adjusted-baseline energy.
Barriers	Any factor or consideration that would significantly discourage a decision to attempt implementation of a project activity or its associated baseline candidates.
Baseline Candidates	Alternative technologies or practices within a project that could provide the same product and/or service as a project activity.
Baseline Energy	The theoretical energy use by the baseline facility or facility component that would have occurred during the reporting period under quantification. Equivalent to adjusted-baseline energy plus any non-routine adjustments in the IPMVP. Baseline energy values are used in the quantification of baseline emissions for a particular reporting period.
Baseline Period (IPMVP)	The period of time chosen to represent operation of the facility or facility component before implementation of an energy conservation measure. Monitored data is collected during this period such as energy data, independent variables, and static factors. This period is the greater of one year or the time required to reflect one full operating cycle of a facility or facility component with variable operations.
Baseline Period Energy (IPMVP)	The energy use occurring during the baseline period without adjustments. It should be noted that the IPMVP refers to this as "baseline energy" in some situations. This protocol only refers to energy use during the baseline period as "baseline period energy" to avoid confusion with the energy use that would have occurred in the baseline during the project reporting period (referred to as "baseline energy" in this protocol).
Certified Energy Manager (CEM)	A designation administered by the Association of Energy Engineers.
Confidence Interval	A range of values so defined that there is a specified probability that the value of a parameter lies within it. For example, a simulation parameter is estimated as x (value) with ± y (precision) at 95% confidence.

Combined Heat and Power (CHP or Co-generation)	CHP or Co-generation is an activity that combines the generation of useful thermal energy and electricity in one energy efficient process.
Cycle (IPMVP)	The period of time between the start of successive similar operating modes of a facility or facility component whose energy use varies in response to operating procedures or independent variables. For example, the cycle of most buildings is 12 months, since their energy use responds to outdoor weather, which varies on an annual basis. Another example is the weekly cycle of an industrial process, which operates differently on Sundays than during the rest of the week.
Energy Conservation Measure (ECM) (IPMVP)	An activity or set of activities designed to increase the energy efficiency of a facility or facility component. ECMs may also conserve energy without changing efficiency. Several ECMs may be carried out in a facility at one time, each with a different thrust. An ECM may involve one or more of: physical changes to facility equipment, revisions to operating and maintenance procedures, software changes, or new means of training or managing users of the space or operations and maintenance staff. An ECM may be applied as a retrofit to an existing system or facility, or as a modification to a design before construction of a new system or facility.
Estimate (IPMVP)	A process of determining a parameter used in quantification other than measuring it in the baseline and project periods. These methods may range from arbitrary assumptions (which are not acceptable in the Alberta emission offset system) to engineering estimates derived from manufacturer's rating of equipment performance. Equipment performance tests that are not made in the place where they are used during the project period are estimates, for purposes of adherence with IPMVP.
Existing Facility	A facility (as defined below) that has been in continuous operation for the greater of at least one year or one full operating cycle immediately prior to the implementation of the energy conservation measure(s) associated with a project activity.
New Facility	A facility (as defined below) constructed to include the energy conservation measure(s) associated with a project activity. Potential ECMs are evaluated during facility planning and design, and implemented during facility construction (in the case physical ECMs such as equipment) or at start-up (in the case of operational or management practice ECMs).
Facility	A structure such as a building, manufacturing facility, industrial operation, or infrastructure that contains energy consuming components (e.g., equipment, systems, processes, technologies). A stand-alone energy consuming component (e.g., infrastructure such as street lighting) is also considered a facility for the purpose of this protocol.
Facility Component	Components of a facility such as equipment, systems, processes, technologies, or other things that consume energy (electricity and/or fuels).
Functional Equivalence	The project and baseline must provide the same function and quality of products and/or services to enable meaningful comparison.

Independent Variable (IPMVP)	A parameter that is expected to change regularly and have a measurable impact on the energy use of a facility or facility component. Independent variables may be monitored during the baseline period and project reporting period, and uses to make routine adjustments.
Measurement Boundary (IPMVP)	A notional boundary drawn around facility components to segregate those which are relevant to monitoring and quantification from those which are not.
Non-Routine Adjustments (IPMVP)	The individually engineered calculations to account for changes in static factors within the measurement boundary after the baseline period (i.e., during the project reporting period). When non-routine adjustments are applied, they are sometimes called "baseline adjustments" in the IPMVP (i.e., "baseline adjustments" in the IPMVP does not include routine adjustments).
Project Activity	A specific action or intervention targeted at changing greenhouse gas emission sources and/or sinks. The implementation of an ECM is considered a project activity. Each ECM implemented at the project facility is considered a project activity, i.e. projects that consist of the implementation of more than one ECM have a project activity corresponding with each ECM.
Precision (IPMVP)	The amount by which a measured value is expected to deviate from the true value. Precision is expressed as a "±" tolerance. Any precision statement about a measured value should include a confidence statement. For example, a meter's precision may be rated by the meter manufacturer as ±10% with a 95% confidence level.
Reporting Period/Project Period	A period of time covered by a project claim as documented in the Project Report and as independently verified prior to being registered on the registry. Also known as Project/Reporting Period in IPMVP.
Routine Adjustments (IPMVP)	The calculations made to account for changes in selected independent variables within the measurement boundary after the baseline period.
Secondary Effects (IPMVP)	An effect caused by a project activity but not measured within the measurement boundary. The effect may be positive or negative (i.e., result in an increase or decrease in energy consumption). Referred to as "interactive effects" in the IPMVP.
Static Factors (IPMVP)	Those characteristics of a facility that affect energy use within the chosen measurement boundary, but which are not used as the basis for any routine adjustments. These characteristics include fixed, environmental, operational and maintenance characteristics. They may be constant or varying.

2.0 Baseline Condition

The baseline condition represents the activity and associated greenhouse gas emissions that would have occurred had the project not been implemented. The baseline condition must be selected and justified by the project developer according to the selection process detailed below.

This baseline selection process in Sections 2.1 and 2.2 must be completed for projects at both new and existing facilities and for each ECM implemented at the facility/process, except where the project involves the implementation of more than two ECMs during the design and construction of a new facility. In this case, project developers may use the applicable flexibility mechanism and follow the streamlined baseline selection process in Section 2.3.

The baseline selection process may result in a project ECM being selected as the baseline condition. In this case, the ECM is ineligible. However, other ECMs implemented at the project facility may be eligible for emission offsets. A project activity may contain a mix of eligible and ineligible ECMs and still be eligible for emission offsets but for only those that meet the requirements under this protocol. Only eligible ECMs may be included in the emission offsets quantification.

2.1 Baseline Candidates Identification

The project developer must assess and select a baseline condition using the barriers assessment process outlined in Section 2.3. At minimum, the baseline candidates listed below in Table 3 must be identified for inclusion in the barriers assessment.

Table 3: Baseline Candidates for Existing and New Facilities

Facility Type	Baseline Candidates
Existing Facilities	Baseline candidates that must be evaluated include: • project activity, • continuation of historic practices, and • functionally equivalent alternatives.
New Facilities	Baseline candidates that must be evaluated include: • project activity, • standard industry practice, and • functionally equivalent alternatives.

Project activity is an ECM which is implemented at the project facility. Each ECM implemented at the project facility is considered a project activity, i.e. projects that consist of the implementation of more than one ECM have a project activity corresponding with each ECM. The baseline selection process must be completed for each project activity/ECM implemented at the project facility.

Historic practices are the facility conditions (i.e., existing facility components, process configurations, operating procedures) immediately prior to the implementation of a project activity.

Functionally equivalent alternatives include technologies or practices that provide products and/or services of a type and quality that are functionally equivalent to a project activity. The project developer must include at least one alternative in the barriers assessment, but should include more where multiple viable alternatives to the project activity are present. Alternatives must be in compliance with any applicable federal, provincial, or municipal regulations.

Standard industry practice represents the most common practice in the construction of new facilities (i.e., constructed within the five years prior to project implementation) in the project sector in Alberta, with respect

to operational practices and/or facility components. The standard practice selected must be functionally equivalent to the project activity. It may be informed by knowledge of recently constructed facilities (where information is available) and/or by an expert such as a professional engineer in the sector or an expert with experience in engineering, procurement, and construction (EPC) of similar facilities. The standard practice selected must be in compliance with any applicable federal, provincial, or municipal regulations, and must meet any minimum standards or codes (such as building codes for projects implemented in commercial and institutional buildings).

2.2 Barriers Assessment and Baseline Selection

Baselines candidates are to be evaluated by performing a comparative assessment against the following barriers:

- Financial barriers: occur when there are financial constraints such as a negative or extremely long return on investment that affects a company's willingness to invest in the activity. This excludes any potential revenues from emission offsets.
- Technological barriers: may occur where a technology is not readily available (e.g., pre-commercial) or carries additional risks beyond standard practice. A technology that is readily available and easy to implement does not face significant technological barriers.

For each baseline candidate and each barrier type, the project developer must state, with supporting information, whether a barrier exists, its relative magnitude, and how that barrier would reduce the likelihood that the baseline candidate under consideration would be implemented. The results across all barriers for a given baseline candidate must then be combined to provide an overall rating. In combining individual barriers into an overall rating, project developers may apply different weightings to different barriers (i.e. some barrier types being deemed more significant than others), as long as a rationale is provided for the weighting approach that is relevant for the types of activities and sector in question, and as long as the weighting approach is applied consistently to all baseline candidates. The results of the barriers assessment should be presented in a table similar in format to Table 4 below.

Table 4: Barriers Assessment Results

Barrier	Baseline Candidate #1	Baseline Candidate #2	Baseline Candidate #3
Financial	**Low Barrier**	No Barrier	**High Barrier**
Technological	No Barrier	No Barrier	**Medium Barrier**
Overall	**Very Low**	**No Barrier**	**Medium**

The baseline candidate that faces the least overall barriers is the applicable baseline condition[3]. In the above example, Baseline Candidate #2 would be chosen as the baseline condition as it faces no barriers to implementation. Where multiple scenarios are deemed equally likely, the scenario that would result in the lowest baseline emissions must be selected as the baseline scenario. If it is determined the baseline candidate that has been assessed and chosen actually represents the project activity the project is ineligible.

[3] Some greenhouse gas quantification protocols differentiate between "static" and "dynamic" baselines during baseline selection. This concept is represented in this protocol by routine and non-routine baseline adjustments, as described in Sections 4.1.4.1 and 4.1.4.2.

Forms of evidence that must be presented to justify the barriers assessment are summarized in Table 5 below. One or more of each type of acceptable evidence listed below must be cited for each barrier. This evidence forms part of the project documentation and must be kept and available upon verification or re-verification for the project duration; however, it is optional to include detailed evidence in the project plan and/or report where the information is deemed to be confidential to the project developer and/or other parties.

Table 5: Evidence for Barriers Assessment

Barrier	Examples	Acceptable Evidence
Financial	• Negative, long, or insufficient return on investment • Limited or no access to capital • High capital cost	• Financial metric calculation such as internal rate of return (IRR), net present value (NPV), payback period, or other industry metric. The calculation must include capital and energy (electricity and/or fuel) costs, at a minimum. The project developer must affirm that the value of the financial metric calculated is insufficient and would prevent the activity from securing internal or external financing. • A letter or communication from a financing or investment entity stating that the activity does not meet investment criteria, or investment would be contingent on emission offsets revenue being generated. • A letter or communication from an internal decision-maker responsible for capital allocation confirming that the activity does not meet internal investment criteria, or investment would be contingent on emission offsets revenue being generated.
Technological	• Lack of local expertise for implementation and operation • Technology is pre-commercial or not widely available in Alberta • Risk of technological failure causing disrupted operations	• Reports, case studies, or written documentation from an independent expert from industry, educational institutions (e.g., universities, colleges), industry associations, and/or labour organizations that indicate one of the following: o A lack of available expertise in Alberta related to implementing and operating the activity. o The technology is not commercially available or has not been demonstrated at the scale of the project activity. • Reports, case studies, or written documentation from an independent expert from the sectors noted above that demonstrates the technology is unreliable or has disrupted operations in other facilities.

2.2.1 End of Life Facility Components

Where the baseline condition selected is the continuation of historic practices, project developers must affirm and provide a justification with evidence that if a project activity were not to be implemented, the facility component(s) targeted by the ECM would have been operational during the entire offset crediting period. The evidence must show that the existing component(s) would not have reached the end of its useful lifetime and required replacement in any year contained within the offset crediting period. The affirmation must be supported by one of any of the following evidence:

- The original manufacture or installation date and the typical lifetime of the component. The original manufacture or installation date may be supported by purchase records, equipment labels, or any other form of evidence justified by the project developer. The typical lifetime of the component(s) may be supported by manufacturers specifications, company practices for comparable components, common practices within the sector, or any other form of evidence justified by the project developer, along with evidence that the equipment is in good working order and capable of being operated to the end of its typical lifetime.
- A statement from a qualified expert in the sector. This may include, but is not limited to, a professional engineer, or a technician, technologist, or operator with significant experience (10 or more years) in the sector in which the project takes place, or with the component(s) under consideration.
- Any other form of evidence where justified by the project developer and deemed acceptable by the independent third-party verifier upon review of the Project Plan.

Where this cannot be shown, continuation of historic practices can only be used as the baseline condition in reporting periods up to and including what would have been the final year of the baseline component's useful lifetime. The barriers assessment and baseline selection procedure detailed above must be carried out again by the project developer to determine the appropriate baseline condition for reporting years after the year in which the baseline component would have reached the end of its useful lifetime. Baseline candidates that must be considered are the same as noted previously, with the exception of the historic baseline, which is no longer justifiable. The historic baseline is replaced by the following:

- Lifetime extension of pre-project component(s) through retrofit. The project developer must consider whether the retrofit would have an effect on the efficiency of the component. If there is an effect on component efficiency, this must be taken into account in baseline emissions quantification.
- Replacement of the component with a newly manufactured component of the same type. This must consider whether the efficiency of the new component would be different than the end of life component being replaced, due to, regulatory requirements or continual improvements in component efficiency since the original component was manufactured.

2.3 Streamlined Baseline Selection for New and Existing Facilities with Multiple ECMs

The optional approach in this section may be used for new or existing facilities where multiple energy conservation measures (more than two) such as efficient facility components, management practices, and/or process optimization are implemented at an existing facility or selected at the design phase and implemented during facility construction or start-up. This approach may be used instead of the approach included in Sections 2.1 and 2.2 where project developers make use of the applicable flexibility mechanism and are able to clearly demonstrate usage of the industry standard practices as their baseline condition.

The baseline for each ECM is the standard industry practice, as defined above in Section 2.1. The standard practice identified must be confirmed as applicable to the facility type and sector by an expert such as a professional engineer in the sector, an expert with experience in engineering, procurement, and construction (EPC) of similar facilities, or the CMVP / CEM providing sign-off on project documentation for buildings.

The project developer must list all ECMs implemented at the project facility, identify the associated standard industry practice, and perform a financial barrier assessment for each ECM in comparison with the associated standard industry practice. Results should be presented as per Table 6. It is optional to include the financial assessment in the project plan or report where the information is confidential to the project developer and/or other parties, but must be retained in project documentation for verification, re-verification and record keeping requirements.

Table 6: Baseline Assessment for Projects with Multiple ECMs

Energy Conservation Measure	Baseline Condition	Financial Barrier Assessment
ECM #1	Functionally equivalent standard industry practice to ECM #1	Financial barrier assessment (as per the process in Table 5) of ECM #1 and standard industry practice.
ECM #2	Functionally equivalent standard industry practice to ECM #2	Financial barrier assessment (as per the process in Table 5) of ECM #2 and standard industry practice.
ECM #3	Functionally equivalent standard industry practice to ECM #3	Financial barrier assessment (as per the process in Table 5) of ECM #3 and standard industry practice.

Where the standard industry practice faces lower financial barriers than the project ECM, then standard industry practice is the baseline condition. If the ECM faces lower financial barriers than standard industry practice, then the ECM is ineligible for emission offsets.

2.4 Identification of Sources and Sinks (SSs) for the Baseline

Greenhouse gas emission sources and sinks (SSs) that are relevant to the baseline condition have been identified and arranged by their relation to the facility site and the stage at which greenhouse gas emissions occur, as seen in Figure 1. Based on this diagram, the baseline sources and sinks were then organized into life cycle categories in Figure 2. Descriptions of each of the sources and sinks and their classification as controlled, related or affected are provided in Table 7.

Sources/sinks for an activity are assessed based on guidance provided by ISO 14064-2:2006 Greenhouse gases - Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements, as follows:

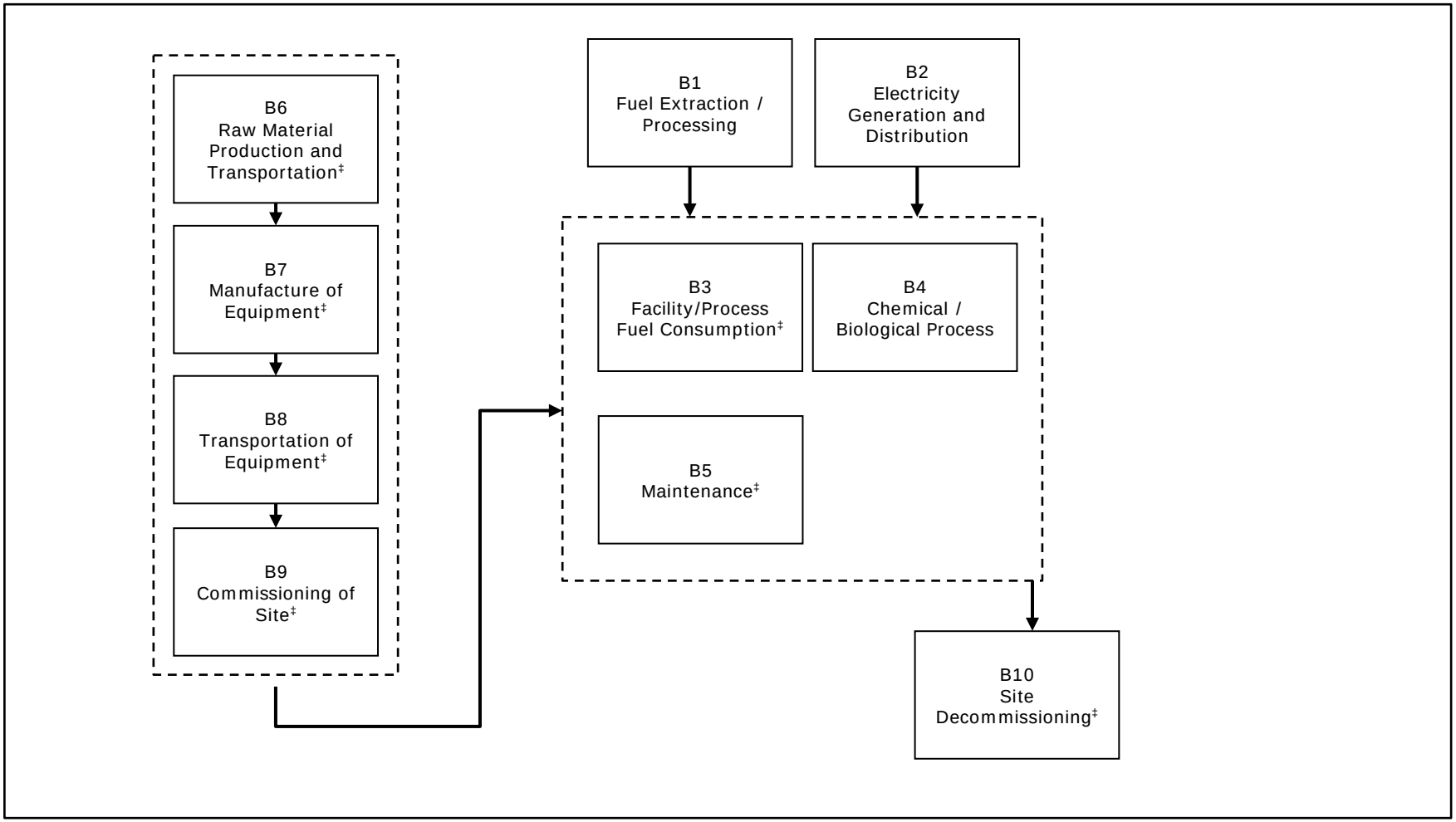
Controlled: The behaviour or operation of a controlled source/sink is under the direction and influence of a project developer through financial, policy, management or other instruments.

Related: A related source/sink has material and/or energy flows into, out of or within a project but is not under the reasonable control of the project developer.

Affected: An affected source/sink is influenced by the project activity through changes in market demand or supply for projects or services associated with the project.

For a list of sources and sinks that must be quantified for eligible projects, see Quantification Section 4.0.

Figure 1: Process Flow Diagram for Baseline Condition



‡ This SS may involve combustion of fuels to which a carbon levy applies. Reduction of such levied fuels is ineligible for emission offset generation; however, monitoring and quantification of levy fuel emissions for this SS is required if the SS has been identified as "Included" in Table 9.

Figure 2: Baseline Element Life Cycle Chart

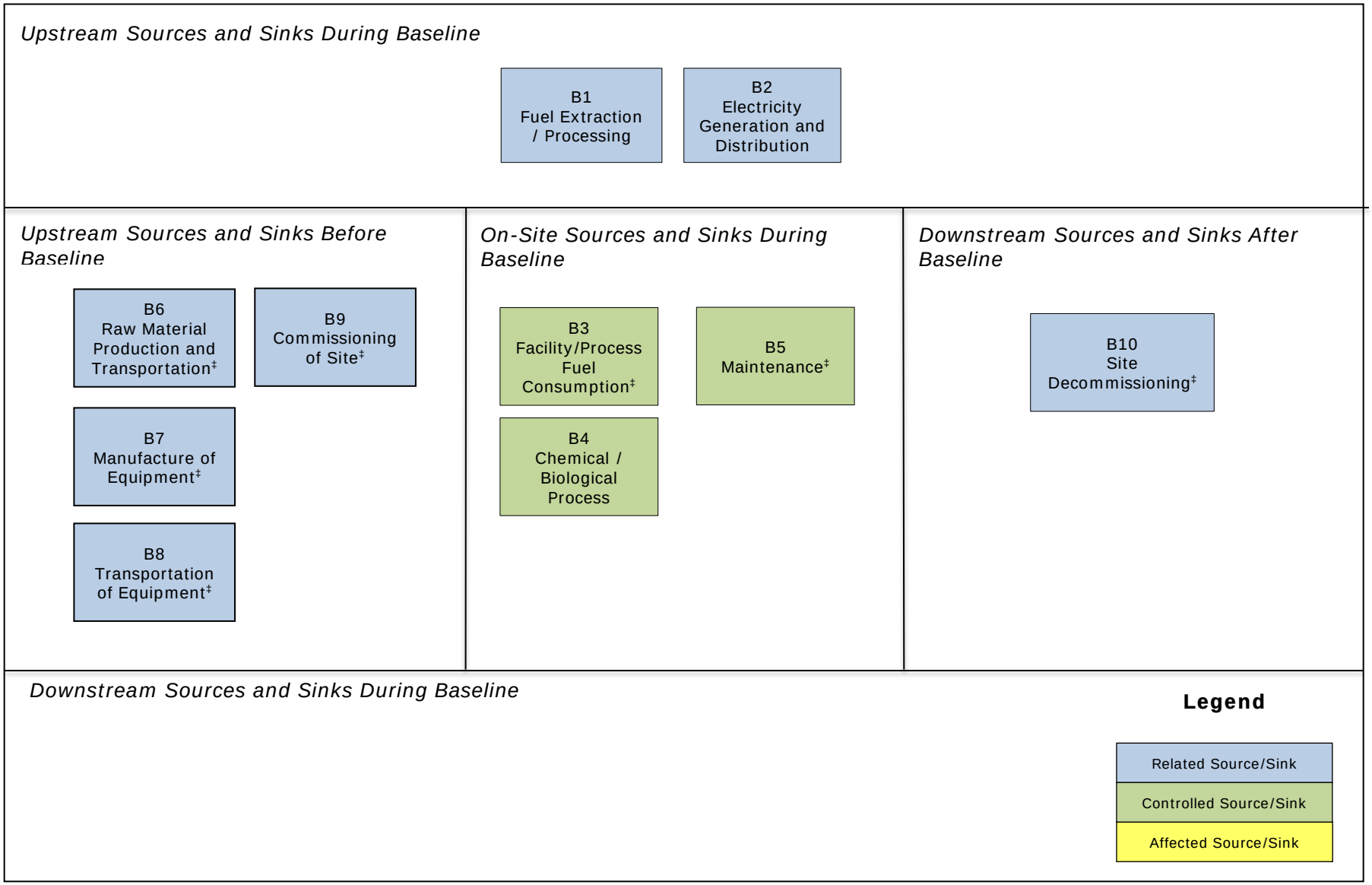


Table 7: Description of Baseline Sources and Sinks (SSs)

Sources and Sinks	Description	Controlled, Related or Affected
Upstream Sources and Sinks Before the Baseline		
B6 Raw Material Production and Transportation‡	Raw materials are used to manufacture baseline equipment. Usually produced offsite and transported to the manufacturing facility. GHG emissions will arise from the use of fossil fuels and electricity during these processes. These raw materials may include, but are not limited to: cement, plastic, aluminum, steel and / or rubber.	Related
B7 Manufacture of Equipment‡	GHG emissions will arise from the manufacturing process of the equipment used in the baseline. Such emissions will likely be associated with the fossil fuels and electricity consumed during the manufacturing process.	Related
B8 Transportation of Equipment‡	Equipment used in the baseline must be transported to the baseline site. GHG emissions will primarily be attributed to the combustion of fossil fuels during the transportation process.	Related
B9 Commissioning of Site‡	The development of the site and installation of equipment will result in GHG emissions, primarily from the use of fossil fuels and electricity during this process.	Related
Upstream Sources and Sinks During the Baseline		
B1 Fuel Extraction / Processing	Each of the fuels used on-site during the baseline will need to be extracted and processed. GHG emissions are associated with the various processes involved in the extraction, production, refinement, and storage of the fuels.	Related
B2 Electricity Generation and Distribution	Electricity may be required for operating the baseline facility. This power may be sourced from the Alberta electricity grid. GHG emissions will result primarily from the combustion of fuels used to generate electricity. This emission source is also used in the quantification of electricity-related secondary effects resulting from the implementation of the project ECM(s).	Related

Sources and Sinks	Description	Controlled, Related or Affected
On-Site Sources and Sinks During the Baseline		
B3 Facility/Process Fuel Consumption ‡	Fuel(s) may be required on-site to operate baseline facility or process components. GHG emissions will primarily be attributed to the on-site combustion of fossil fuels. This emission source is also used in the quantification of fuel combustion secondary effects resulting from the implementation of project ECM(s).	Controlled
B4 Chemical / Biological Process	GHG emissions may arise with the operation and maintenance of a chemical or biological process at the baseline facility.	Controlled
B5 Maintenance‡	The facility and components within the facility will require will require maintenance (both routine and non-routine). GHG emissions may arise from the use of fuels and/or electricity during maintenance.	Controlled
Downstream Sources and Sinks During the Baseline		
No downstream sources and sinks during the baseline were identified.		
Downstream Sources and Sinks After the Baseline		
B10 Site Decommissioning‡	Once the site is no longer in operation, the site will most likely need to be decommissioned. GHG emissions may arise from the use of fuels and/or electricity during equipment disassembly, disposal, and other required activities during the decommissioning process.	Related

‡ This SS may involve combustion of fuels to which the carbon levy applies. Reduction of such levied fuels is ineligible for emission offset generation; however, monitoring and quantification of levy fuel emissions for this SS is required if the SS has been identified as "Included" in Table 9.

3.0 Project Condition

3.1 Additionality

Current eligibility under this protocol requires additionality to be assessed on a project-specific basis. Where the project involves the implementation of multiple ECMs (each referred to as a project activity), the additionality assessment must be satisfied for each ECM.

The following additionality tests must be satisfied, in addition to what is required by Regulation, standard or technical guidance, to prove that the project activity is additional and therefore eligible under this protocol:

- Legal additionality: A project is considered additional as long as the emissions reductions are from an action that is not required by law. This includes law (by-law), regulation or directive (federal, provincial or municipal) that directly affects or requires an activity. This may also include laws where the primary purpose is not reduction or control of greenhouse gas emissions but requires the activity. If a project activity is required, then it is not additional. The project developer must perform a scan of relevant applicable law (by-law), regulation or directive (federal, provincial or municipal) to confirm that each project activity is not required. The scan must be documented in the Project Plan and independently verified.
- Sector level adoption test: A project is considered additional if the emission reduction activity is not common practice in the sector. Sector level adoption test should be assessed at the start of the project and periodically as the project is occurring. For the purposes of the Alberta emission offset system, the Government established a set 40% sector level adoption as a start to representing the point at which an activity is considered business as usual and non-additional in the emission offset system. Project developers may use the Technical Guidance for the Assessment of Additionality to determine the activity adoption level(s), which may allow for assessment to expand beyond Alberta and activities above the 40% rate. All guidance must be referenced in the project documentation. Demonstration with evidence, that a project is the first implementation of the project activity in Alberta can also satisfy this requirement.

One or more of the following evidence types must be cited for the sector level adoption test:

- Surveys, statistics, market data, and reports available from utilities, government sources, industry associations, universities, research institutions, companies, technology vendors, or similar sources.
- Written documentation of independent expert judgements from industry, educational institutions (e.g., universities, colleges), industry associations or others. The CMVP or CEM providing sign-off on offset project documentation may be used as an “independent expert” source of evidence.

It must be demonstrated that the evidence cited for this test is relevant to assessing market adoption rate in the first year of the project crediting period, by one of the following means:

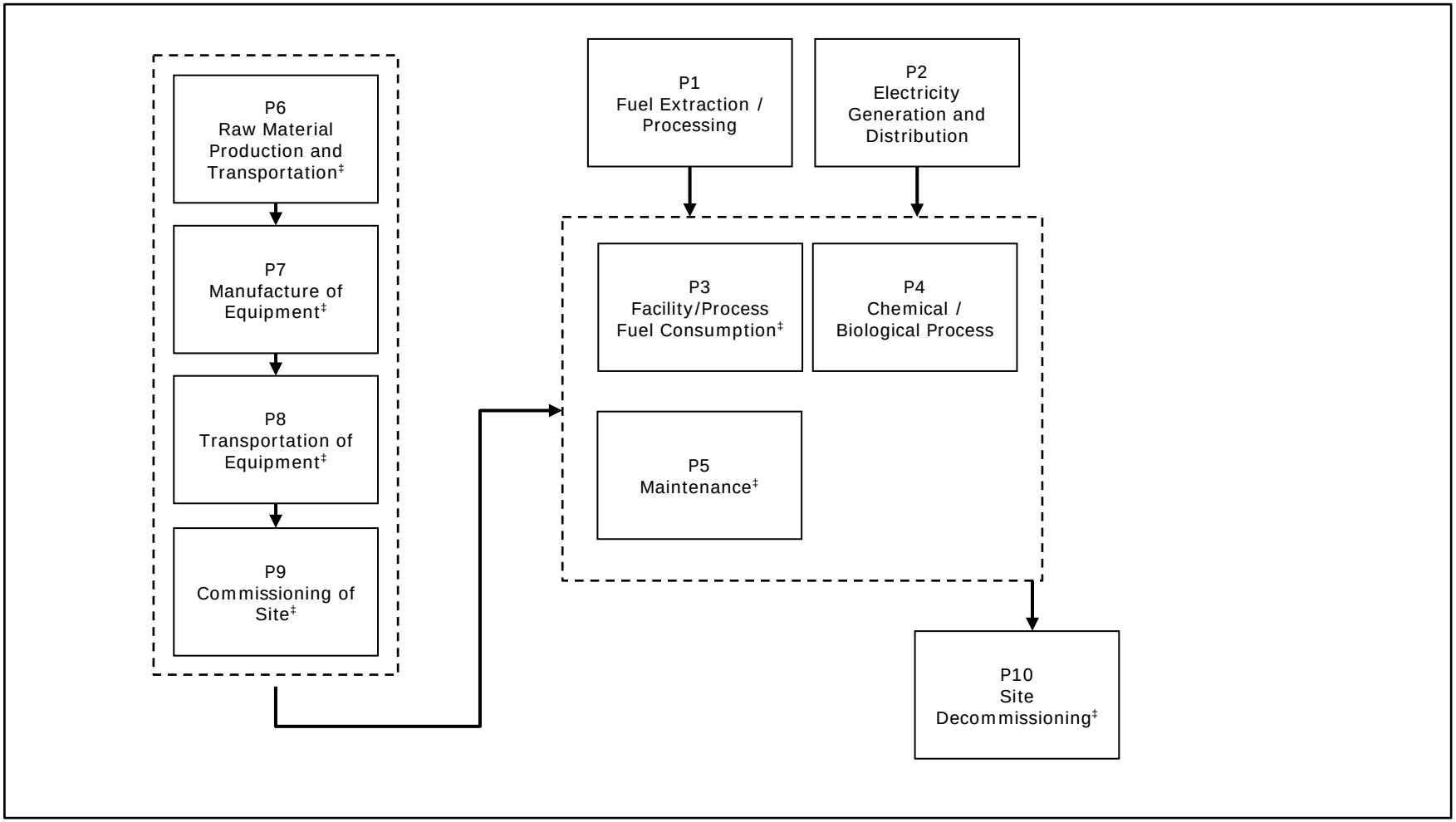
- Use of a source of evidence that explicitly states that it is applicable to: the first year of the project crediting period, to a year within 2 years prior to the start of the project crediting period, or to a year following the first year of the project crediting period.
- Providing written documentation from an independent expert from industry, educational institutions (e.g., universities, colleges), industry associations or others that indicates the relevance of the evidence to assessing market adoption rate.

The verifier upon review of the project reporting should confirm the date of evidence type is in first year of crediting (emission reduction activity) or within a minimum of 2-years of the activity to ensure applicability.

3.2 Identification of Sources and Sinks (SS's) for the Project

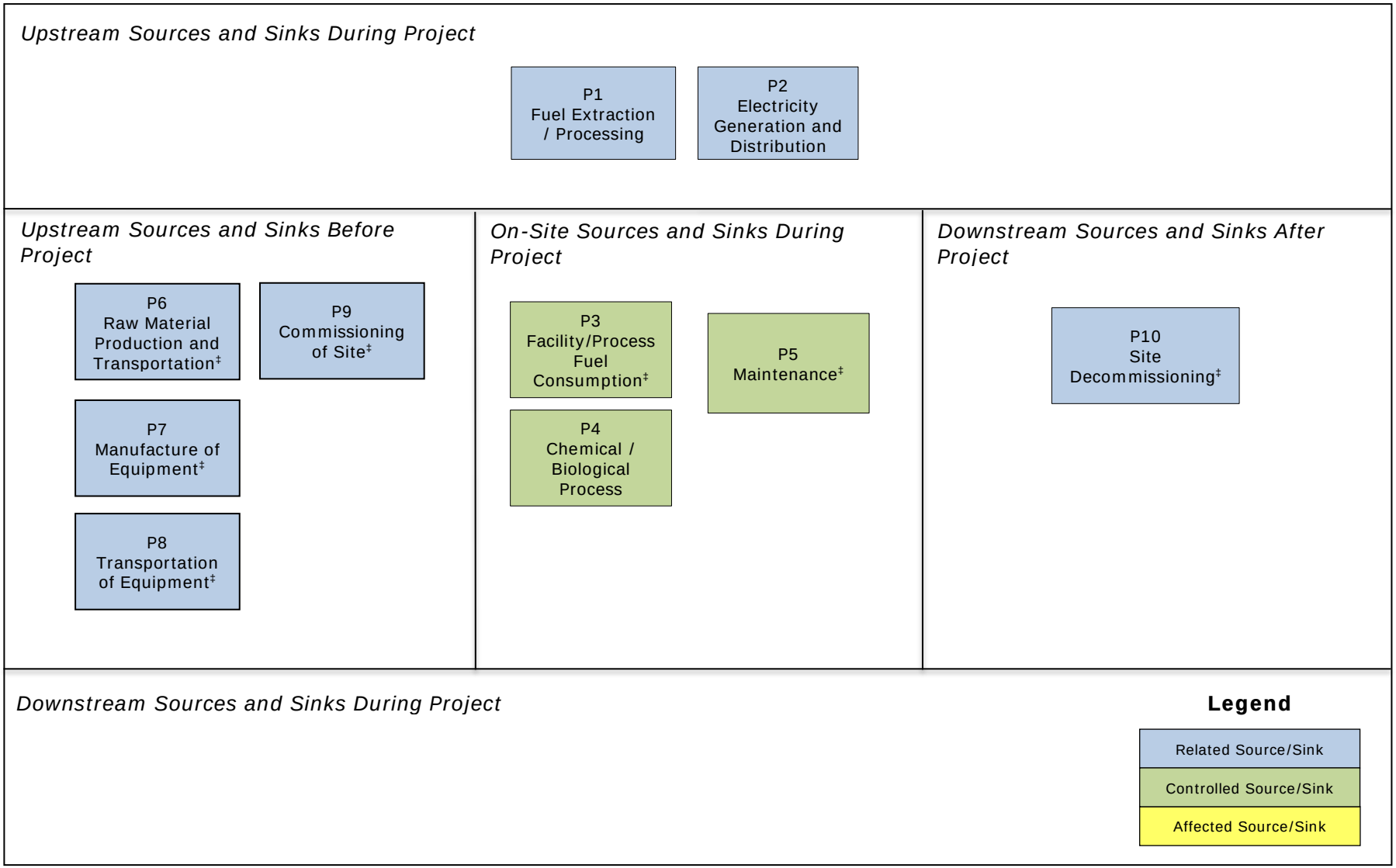
In a manner analogous to the baseline condition, greenhouse gas emission sources and sinks relevant to the project condition have been identified and arranged by their relation to the project site and the stage at which the greenhouse gas emissions occur, as seen in Figure 3. Based on this diagram, the project sources and sinks were then organized into life cycle categories in Figure 4. Descriptions of each of the sources and sinks and their classification as controlled, related or affected are provided in Table 8. For a list of sources and sinks that must be quantified, see Quantification Section 4.0.

Figure 3: Process Flow Diagram for Project Condition



‡ This SS may involve combustion of fuels to which a carbon levy applies. Reduction of such levied fuels is ineligible for emission offset generation; however, monitoring and quantification of levy fuel emissions for this SS is required if the SS has been identified as "Included" in Table 9.

Figure 4: Project Element Life Cycle Chart



‡ This SS may involve combustion of fuels to which a carbon levy applies as of January 1, 2017. Conservation of such levied fuels is an ineligible project activity; however, monitoring and quantification of levied fuel emissions for this SS is required if the SS has been identified as "Included" in Table 9.

Table 8: Project Condition Sources and Sinks (SSs)

Sources and Sinks	Description	Controlled, Related or Affected
Upstream Sources and Sinks Before Project		
P6 Raw Material Production and Transportation‡	Raw materials are used in the manufacture of equipment, or in the implementation of the ECM(s). Usually produced offsite and transported to the manufacturing facility. GHG emissions will arise from the use of fossil fuels and electricity during these processes. These raw materials may include, but are not limited to: cement, plastic, aluminum, steel and / or rubber.	Related
P7 Manufacture of Equipment‡	GHG emissions will arise from the manufacturing process of the equipment used to implement the ECM(s). Such emissions will likely be associated with the fossil fuels and electricity consumed during the manufacturing process.	Related
P8 Transportation of Equipment‡	Equipment used in the implementation of the ECM(s) must be transported to the project site. GHG emissions will primarily be attributed to the combustion of fossil fuels during the transportation process.	Related
P9 Commissioning of Site‡	The development of the site and installation of equipment will result in GHG emissions, primarily from the use of fossil fuels and electricity during this process.	Related
Upstream Sources and Sinks During Project		
P1 Fuel Extraction / Processing	Each of the fuels used on-site during the project will need to be extracted and processed. GHG emissions are associated with the various processes involved in the extraction, production, refinement, distribution and storage of the fuels.	Related
P2 Electricity Generation and Distribution	Electricity may be required for operating the project facility. This power may be sourced from the Alberta electricity grid. GHG emissions will result primarily from the combustion of fuels used to generate electricity. This emission source is also used in the quantification of electricity-related secondary effects resulting from the implementation of the project ECM(s).	Related
On-Site Sources and Sinks During Project		

Sources and Sinks	Description	Controlled, Related or Affected
P3 Facility/Process Fuel Consumption‡	Fuel(s) may be required on-site to operate project facility or process components. GHG emissions will primarily be attributed to the on-site combustion of fossil fuels. This emission source is also used in the quantification of fuel combustion secondary effects resulting from the implementation of project ECM(s).	Controlled
P4 Chemical / Biological Process	GHG emissions may arise with the operation and maintenance of a chemical or biological process at the project facility.	Controlled
P5 Maintenance‡	The facility and components within the facility will require will require maintenance (both routine and non-routine). GHG emissions may arise from the use of fuels and/or electricity during maintenance.	Controlled
Downstream Sources and Sinks After Project		
P10 Site Decommissioning‡	Once the site is no longer in operation, the site will most likely need to be decommissioned. GHG emissions may arise from the use of fuels and/or electricity during equipment disassembly, disposal, and other required activities during the decommissioning process.	Related

‡ This SS may involve combustion of fuels to which the carbon levy applies. Conservation of such fuels is an ineligible project activity; however, monitoring and quantification of levied fuel emissions for this SS is required if the SS has been identified as "Included" in Table 9.

4.0 Quantification

The Baseline and Project condition Sources and Sinks (SSs) were assessed against each other to determine the scope for the greenhouse gas emission reductions quantified under this protocol. SSs were either included or excluded depending on how they were impacted by the project condition. SSs that are not expected to change between the baseline and project condition have been excluded from quantification. It is assessed that excluded activities will occur at the same magnitude and emission rate during the baseline and project and will therefore not be impacted by the project.

Emissions that increase or decrease materially as a result of the project must be included and associated greenhouse gas emissions must be quantified as part of the project condition.

All sources and sinks are identified in Table 7 and Table 8. Each source and sink is listed as included or excluded and justification for these choices is provided in Table 9.

Table 9: Comparison of Sources and Sinks (SSs)

Identified Sources and Sinks	Baseline (C, R, A)[1]	Project (C, R, A)[1]	Included or Exclude from Quantification	Justification
Upstream Sources and Sinks Before Baseline/Project				
P6 / B6 Raw Material Production and Transportation	R	R	Excluded	Emissions from raw material production and transportation are not material given the minimal raw material typically required.
P7 / B7 Manufacture of Equipment	R	R	Excluded	Emissions from manufacture of equipment are not material given the minimal equipment typically required.
P8 / B8 Transportation of Equipment	R	R	Excluded	Emissions from transportation of equipment are not material given the minimal transportation of equipment typically required.
P9 / B9 Commissioning of Site	R	R	Excluded	Emissions from commissioning of site are not material given the minimal commissioning typically required.
Upstream Sources and Sinks During Baseline/Project				
P1 / B1 Fuel Extraction / Processing	R	R	**Included**	Included as a project activity may result in a reduction in fuel consumption and thus a material reduction in upstream GHG emissions.
P2 / B2 Electricity Generation and Distribution	R	R	**Included**	Included as a project activity may result in a reduction in electricity consumption and thus a material reduction in GHG emissions.
On-Site Sources and Sinks During Baseline/Project				

Identified Sources and Sinks	Baseline (C, R, A)[1]	Project (C, R, A)[1]	Included or Exclude from Quantification	Justification
P3 / B3 Facility/Process Fuel Consumption	C	C	**Included**	Included as a project activity will result in a reduction in fuel consumption and thus a material reduction in GHG emissions.
P4 / B4 Chemical / Biological Process	C	C	**Included***	Excluded where the emissions in the project and baseline are assumed to be equivalent, or emissions are greater in the baseline than in the project.
P5 / B5 Maintenance	C	C	Excluded	Excluded as emissions from maintenance are not expected to be material.
Downstream Sources and Sinks After Project				
P10 / B10 Decommissioning of Site	R	R	Excluded	Excluded as emissions from decommissioning are not expected to be material.

[1] Where C = Controlled, R = Related, A = Affected.

* The SS P4/B4 emissions is to be **Included** in project monitoring and quantification where it is applicable to the project activity but may be justifiably excluded if it does not apply to the project activity.

4.1 Quantification Methodology

Quantification of included sources and sinks for each greenhouse gas emission will be completed using the methodologies described below in Table 10. The results are used to complete the equations below for net emissions reduction, offset-eligible reductions, and net levied emissions.

Project developers may group multiple ECM project activities at one facility, or more than one sub-project occurring at multiple facilities (called aggregation), under one project plan for registration and verification purposes. The quantification approaches below are intended to be extendable, meaning individual projects may be quantified together using repeated instances of the equations. Projects quantified under an aggregated approach are subject to the requirements of this protocol at an individual sub-project level, including being able to satisfy the quantification approaches described below as a stand-alone quantification exercise.

4.1.1 Net Emissions Reduction

Net emissions reductions are the reductions resulting from a comparison of project and baseline emissions for all SSs included in the quantification (as per Table 9). In cases where the carbon levy applies to emission sources, the emissions from the levied emission sources are quantified and reported, but do not contribute to the emission offset calculation in section 4.1.2. Net emission reductions must be calculated using the equation below:

$$\textbf{Net Emission Reductions} = \textbf{Emissions}_{\textbf{Baseline}} - \textbf{Emissions}_{\textbf{Project}}$$

Where baseline emissions are calculated according to the following:

$$\textbf{Emissions}_{\textbf{Baseline}} = \text{Emissions}_{\text{Fuel Extraction/Processing}} + \text{Emissions}_{\text{Electricity Generation and Distribution}} + \text{Emissions}_{\text{Facility/Process Fuel Consumption}} + \text{Emissions}_{\text{Chemical / Biological Process}}$$

Baseline emission sources include the following:

$\text{Emissions}_{\text{Baseline}}$ =
- sum of the emissions under the baseline condition
- \+ emissions under SS B1 Fuel Extraction / Processing
- \+ emissions under SS B2 Electricity Generation and Distribution
- \+ emissions under SS B3 Facility/Process Fuel Consumption
- \+ emissions under SS B4 Chemical / Biological Process, where applicable. Otherwise, this term is set equal to zero.

Where project emissions are calculated according to the following:

$$\textbf{Emissions}_{\textbf{Project}} = \text{Emissions}_{\text{Fuel Extraction/Processing}} + \text{Emissions}_{\text{Electricity Generation and Distribution}} + \text{Emissions}_{\text{Facility/Process Fuel Consumption}} + \text{Emissions}_{\text{Chemical / Biological Process}}$$

Project emission sources include the following:

$Emissions_{Project}$	=	sum of the emissions under the project condition
	+	emissions under SS P1 Fuel Extraction / Processing
	+	emissions under SS P2 Electricity Generation and Distribution
	+	emissions under SS P3 Facility/Process Fuel Consumption
	+	emissions under SS P4 Chemical / Biological Process, where applicable. Otherwise, this term is set equal to zero.

4.1.2 Offset-Eligible Reductions

Offset-eligible reductions are the emission reductions eligible for the quantification of emission offsets. They are calculated from a comparison of project and baseline emissions for all offset-eligible SSs. Offset-eligible reductions must be calculated using the equation below:

$$\textbf{Offset -Eligible Emissions Reductions} = \textbf{Emissions}_{\textbf{Non-Levied Baseline}} - \textbf{Emissions}_{\textbf{Non-Levied Project}}$$

Where eligible baseline emissions are calculated according to the following equation:

$$\textbf{Emissions}_{\textbf{Non-Levied Baseline}} = Emissions_{Fuel\ Extraction/Processing} + Emissions_{Electricity\ Generation\ and\ Distribution} + Emissions_{Facility/Process\ Fuel\ Consumption\ levy\ exempt} + Emissions_{Chemical\ /\ Biological}$$

Where:

$\textbf{Emissions}_{\textbf{Non-Levied Baseline}}$	=	sum of the emissions under the baseline condition that are not subject to the carbon levy.
	+	emissions under SS B1 Fuel Extraction / Processing
	+	emissions under SS B2 Electricity Generation and Distribution
	+	emissions under SS B3 Facility/Process Fuel Consumption for fuels used at the project facility or process for which the project developer has a carbon levy exemption certificate. If the project developer does not have a carbon levy exemption certificate, then this term is set equal to zero.
	+	emissions under SS B4 Chemical / Biological Process, where applicable. Otherwise, this term is set equal to zero.

Where eligible project emissions are calculated according to the following equation:

$$Emissions_{Non\text{-}levied\ Project} = Emissions_{Fuel\ Extraction\ /\ Processing} + Emissions_{Electricity\ Generation\ and\ Distribution} + Emissions_{Facility/Process\ Fuel\ Consumption,\ levy\ exempt} + Emissions_{Chemical\ /\ Biological\ Process}$$

Where:

$Emissions_{Non\text{-}levied\ Project}$	=	sum of the emissions under the project condition that are not subject to the carbon levy
	+	emissions under SS P1 Fuel Extraction / Processing
	+	emissions under SS P2 Electricity Generation and Distribution
	+	emissions under SS P3 Facility/Process Fuel Consumption for fuels used at the project facility or process for which the project developer has a carbon levy exemption certificate. If the project developer does not have a carbon levy exemption certificate, then this term is set equal to zero.
	+	emissions under SS P4 Chemical / Biological Process, where applicable. Otherwise, this term is set equal to zero.

4.1.3 Levied Emissions Reductions

(reported but not included in offset eligible reductions calculation):

Emissions from levied fuels are required to be quantified and reported. Levied emissions must be calculated for each fuel combustion-related included SS, as per the equations below.

$$\textbf{Levied Emissions Reductions} = \textbf{Emissions}_{\textbf{Levied Baseline}} - \textbf{Emissions}_{\textbf{Levied Project}}$$

$\textbf{Emissions}_{\textbf{Levied Baseline}}$	=	$Emissions_{Facility/Process\ Fuel\ Consumption}$

Where,

$Emissions_{Levied\ Baseline}$	=	sum of the emissions under the baseline condition that are subject to the carbon levy.
	=	emissions under SS B3 Facility/Process Fuel Consumption

$\textbf{Emissions}_{\textbf{Levied Project}}$	=	$Emissions_{Facility/Process\ Fuel\ Consumption}$

Where,

$Emissions_{Levied\ Project}$	=	sum of the emissions under the project condition that are subject to the carbon levy
	=	emissions under SS P3 Facility/Process Fuel Consumption

Table 10: Quantification Procedures

Sources and Sinks	Parameter / Variable	Unit	Measured / Estimated	Method	Frequency	Justify Measurement of Estimation Frequency
Baseline Sources and Sinks(SS)						
B1 Fuel Extraction / Processing		$\text{Emissions}_{\text{Fuel Extraction/Processing}} = \sum [(\text{Vol. Fuel}_{\text{B-Primary,i}} + \text{Vol. Fuel}_{\text{B-Secondary,i}}) * \text{EF}_{\text{FEP,i,CO}_2}] / 1000 + \sum [(\text{Vol. Fuel}_{\text{B-Primary,i}} + \text{Vol. Fuel}_{\text{B-Secondary,i}}) * \text{EF}_{\text{FEP,i,CH}_4}] / 1000 * \text{GWP}_{\text{CH}_4} + \sum [(\text{Vol. Fuel}_{\text{B-Primary,i}} + \text{Vol. Fuel}_{\text{B-Secondary,i}}) * \text{EF}_{\text{FEP,i,N}_2\text{O}}] / 1000 * \text{GWP}_{\text{N}_2\text{O}}$				
	$\text{Emissions}_{\text{Fuel Extraction / Processing}}$ Emissions from fuel extraction and processing in the baseline	tonnes of CO_2e	N/A	N/A	N/A	Calculated values are determined annually
	$\text{Vol. Fuel}_{\text{B-Primary,i}}$ Volume of fossil fuel i consumed in the baseline within the measurement boundary	L, m^3, or other	Estimated as per the IPMVP guidance	Volume estimated according to the IPMVP guidance (refer to Section 4.1.4)	Annual	Calculated values are determined annually
	$\text{Vol. Fuel}_{\text{B-Secondary,i}}$ Volume of fossil fuel i consumed in the baseline outside the measurement boundary (secondary effects)	L, m^3, or other	Estimated as per the IPMVP guidance	Volume estimated according to the IPMVP guidance (refer to Section 4.1.4)	Annual	Calculated values are determined annually

Sources and Sinks	Parameter / Variable	Unit	Measured / Estimated	Method	Frequency	Justify Measurement of Estimation Frequency
	EF_{FEP,i,CO_2} CO_2 emission factor for extraction and processing of fossil fuel i	kg CO_2 per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
	EF_{FEP,i,CH_4} CH_4 emission factor for extraction and processing of fossil fuel i	kg CH_4 per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
	EF_{FEP,i,N_2O} N_2O emission factor for extraction and processing of fossil fuel i	kg N_2O per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
	i Fuel type index value	-	-	Index value to identify fuel type	Per Report	Assigned value to be identified for each reporting period
	GWP_{CH_4, N_2O} Global Warming Potential	Unitless	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
B2 Electricity Generation and Distribution	$Emissions_{Electricity\ Generation\ and\ Distribution} = (Electricity_{B\text{-}Primary} + Electricity_{B\text{-}Secondary}) * EF_{Grid}$					

Sources and Sinks	Parameter / Variable	Unit	Measured / Estimated	Method	Frequency	Justify Measurement of Estimation Frequency
	Emissions $_{\text{Electricity Generation and Distribution}}$ Emissions from electricity generation and distribution in the baseline	tonnes of CO_2e	N/A	N/A	N/A	Calculated values are determined annually
	Electricity $_{\text{B-Primary}}$ Quantity of electricity consumed in the baseline within the measurement boundary	MWh	Estimated as per the IPMVP guidance	Quantity estimated according to the IPMVP guidance (refer to Section 4.1.4)	Annual	Calculated values are determined annually
	Electricity $_{\text{B-Secondary}}$ Quantity of electricity consumed in the baseline outside the measurement boundary (secondary effects)	MWh	Estimated as per the IPMVP guidance	Quantity estimated according to the IPMVP guidance (refer to Section 4.1.4)	Annual	Calculated values are determined annually
	EF $_{\text{Grid}}$ Emission factor for on-site grid electricity use (including line losses)	t CO_2e per MWh	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook

Sources and Sinks	Parameter / Variable	Unit	Measured / Estimated	Method	Frequency	Justify Measurement of Estimation Frequency
B3 Facility/Process Fuel Consumption	$$\text{Emissions}_{\text{Facility/Process Fuel Consumption}} = \sum[(\text{Vol. Fuel}_{\text{B-Primary,i}} + \text{Vol. Fuel}_{\text{B-Secondary,i}}) * \text{EF}_{\text{Comb,i,CO}_2}] / 1{,}000{,}000 + \sum[(\text{Vol. Fuel}_{\text{B-Primary,i}} + \text{Vol. Fuel}_{\text{B-Secondary,i}}) * \text{EF}_{\text{Comb,i,CH}_4}] / 1{,}000{,}000 * \text{GWP}_{\text{CH}_4} + \sum[(\text{Vol. Fuel}_{\text{B-Primary,i}} + \text{Vol. Fuel}_{\text{B-Secondary,i}}) * \text{EF}_{\text{Comb,i,N}_2\text{O}}] / 1{,}000{,}000 * \text{GWP}_{\text{N}_2\text{O}}$$					
	$\text{Emissions}_{\text{Facility/Process Fuel Consumption}}$ Emissions from fossil fuel combustion in the baseline	tonnes of CO_2e	N/A	N/A	N/A	Calculated values are determined annually
	$\text{Vol. Fuel}_{\text{B-Primary,i}}$ Volume of fossil fuel i consumed in the baseline within the measurement boundary	L, m^3, or other	Estimated as per the IPMVP guidance	Volume estimated according to the IPMVP guidance (refer to Section 4.1.4)	Annual	Calculated values are determined annually
	$\text{Vol. Fuel}_{\text{B-Secondary,i}}$ Volume of fossil fuel i consumed in the baseline outside the measurement boundary (secondary effects)	L, m^3, or other	Estimated as per the IPMVP guidance	Volume estimated according to the IPMVP guidance (refer to Section 4.1.4)	Annual	Calculated values are determined annually
	$\text{EF}_{\text{Comb,i,CO}_2}$ CO_2 emission factor for combustion of fossil fuel i	g CO_2 per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook

Sources and Sinks	Parameter / Variable	Unit	Measured / Estimated	Method	Frequency	Justify Measurement of Estimation Frequency
	EF_{Comb,i,CH_4} CH_4 emission factor for combustion of fossil fuel i	g CH_4 per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
	EF_{Comb,i,N_2O} N_2O emission factor for combustion of fossil fuel i	g N_2O per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
	GWP_{CH_4, N_2O} Global Warming Potential	Unitless	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
Project Sources and Sinks (SS)						
P1 Fuel Extraction / Processing	$$Emissions_{Fuel\ Extraction\ /\ Processing} = \sum [(Vol.\ Fuel_{P\text{-}Primary,i} + Vol.\ Fuel_{P\text{-}Secondary,i}) * EF_{FEP,i,CO_2}] / 1000 + \sum [(Vol.\ Fuel_{P\text{-}Primary,i} + Vol.\ Fuel_{P\text{-}Secondary,i}) * EF_{FEP,i,CH_4}] / 1000 * GWP_{CH_4} + \sum [(Vol.\ Fuel_{P\text{-}Primary,i} + Vol.\ Fuel_{P\text{-}Secondary,i}) * EF_{FEP,i,N_2O}] / 1000 * GWP_{N_2O}$$					
	$Emissions_{Fuel\ Extraction\ /\ Processing}$ Emissions from fuel extraction and processing in the project	tonnes of CO_2e	N/A	N/A	N/A	Calculated values are determined annually

Sources and Sinks	Parameter / Variable	Unit	Measured / Estimated	Method	Frequency	Justify Measurement of Estimation Frequency
	Vol. Fuel $_{P\text{-}Primary,i}$ Volume of fossil fuel i consumed in the project within the measurement boundary	L, m^3, or other	Measured or Estimated as per the IPMVP guidance	Volume is measured or estimated according to the IPMVP guidance (refer to Section 4.1.4)	Continuous, Periodic or Annual	Frequency depends on the IPMVP Option selected and project-specific considerations. The IPMVP provides best practice guidance on measurement and estimation.
	Vol. Fuel $_{P\text{-}Secondary,i}$ Volume of fossil fuel i consumed in the project outside the measurement boundary (secondary effects)	L, m^3, or other	Estimated as per the IPMVP guidance	Volume estimated according to the IPMVP guidance (refer to Section 4.1.4)	Annual	Calculated values are determined annually
	EF $_{FEP,i,CO_2}$ CO_2 emission factor for extraction and processing of fossil fuel i	kg CO_2 per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
	EF $_{FEP,i,CH_4}$ CH_4 emission factor for extraction and processing of fossil fuel i	kg CH_4 per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook

Sources and Sinks	Parameter / Variable	Unit	Measured / Estimated	Method	Frequency	Justify Measurement of Estimation Frequency
	EF_{FEP,i,N_2O} N_2O emission factor for extraction and processing of fossil fuel i	kg N_2O per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
	i Fuel type index value	-	-	Index value to identify fuel type	Per Report	Assigned value to be identified for each reporting period
	GWP_{CH_4, N_2O} Global Warming Potential	Unitless	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
P2 Electricity Generation and Distribution	$Emissions_{Electricity\ Generation\ and\ Distribution} = (Electricity_{P\text{-}Primary} + Electricity_{P\text{-}Secondary}) * EF_{Grid}$					
	$Emissions_{Electricity\ Generation\ and\ Distribution}$ Emissions from electricity generation and distribution in the project	tonnes of CO_2e	N/A	N/A	N/A	Calculated values are determined annually
	$Electricity_{P\text{-}Primary}$ Quantity of electricity consumed by the project within the measurement boundary	MWh	Measured or Estimated as per the IPMVP guidance	Quantity is measured or estimated according to the IPMVP guidance (refer to Section 4.1.4)	Continuous, Periodic or Annual	Frequency depends on the IPMVP Option selected and project-specific considerations. The IPMVP provides best practice guidance on measurement and estimation.

Sources and Sinks	Parameter / Variable	Unit	Measured / Estimated	Method	Frequency	Justify Measurement of Estimation Frequency
	Electricity $_{P\text{-}Secondary}$ Quantity of electricity consumed by the project outside the measurement boundary (secondary effects)	MWh	Estimated as per the IPMVP guidance	Quantity estimated according to the IPMVP guidance (refer to Section 4.1.4)	Annual	Calculated values are determined annually
	EF $_{Grid}$ Emission factor for on-site grid electricity use (including line losses)	t CO_2e per MWh	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
P3 Facility/Process Fuel Consumption	$$\text{Emissions}_{\text{Facility/Process Fuel Consumption}} = \sum [(\text{Vol. Fuel}_{\text{Project-Primary,i}} + \text{Vol. Fuel}_{\text{Project-Secondary,i}}) * \text{EF}_{\text{Comb,i,CO}_2}] / 1{,}000{,}000 + \sum [(\text{Vol. Fuel}_{\text{Project-Primary,i}} + \text{Vol. Fuel}_{\text{Project-Secondary,i}}) * \text{EF}_{\text{Comb,i,CH}_4}] / 1{,}000{,}000 * \text{GWP}_{\text{CH}_4} + \sum [(\text{Vol. Fuel}_{\text{Project-Primary,i}} + \text{Vol. Fuel}_{\text{Project-Secondary,i}}) * \text{EF}_{\text{Comb,i,N}_2\text{O}}] / 1{,}000{,}000 * \text{GWP}_{\text{N}_2\text{O}}$$					
	Emissions $_{Facility/Process\ Fuel\ Consumption}$ Emissions from fossil fuel combustion in the project	tonnes of CO_2e	N/A	N/A	N/A	Calculated values are determined annually

Sources and Sinks	Parameter / Variable	Unit	Measured / Estimated	Method	Frequency	Justify Measurement of Estimation Frequency
	Vol. Fuel $_{P\text{-}Primary,i}$ Volume of fossil fuel i consumed in the project within the measurement boundary	L, m^3, or other	Measured or Estimated as per the IPMVP guidance	Volume is measured or estimated according to the IPMVP guidance (refer to Section 4.1.4)	Continuous, Periodic or Annual	Frequency depends on the IPMVP Option selected and project-specific considerations. The IPMVP provides best practice guidance on measurement and estimation.
	Vol. Fuel $_{P\text{-}Secondary,i}$ Volume of fossil fuel i consumed in the project outside the measurement boundary (secondary effects)	L, m^3, or other	Estimated as per the IPMVP guidance	Volume estimated according to the IPMVP guidance (refer to Section 4.1.4)	Annual	Calculated values are determined annually
	EF $_{Comb,i,CO_2}$ CO_2 emission factor for combustion of fossil fuel i	g CO_2 per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
	EF $_{Comb,i,CH_4}$ CH_4 emission factor for combustion of fossil fuel i	g CH_4 per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook
	EF $_{Comb,i,N_2O}$ N_2O emission factor for combustion of fossil fuel i	g N_2O per L, m^3, or other	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook

Sources and Sinks	Parameter / Variable	Unit	Measured / Estimated	Method	Frequency	Justify Measurement of Estimation Frequency
	i Fuel type index value	-	-	Index value to identify fuel type	Per Report	Assigned value to be identified for each reporting period
	GWP $_{CH_4, N_2O}$ Global Warming Potential	Unitless	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	Must use most current factors published in the Carbon Offset Emission Factors Handbook

4.1.4 IPMVP Guidance and Requirements

The quantification and monitoring approaches of this protocol incorporate, by reference, the methodologies and concepts in the International Performance Measurement and Verification Protocol (IPMVP). The IPMVP presents a framework and four options for transparently, reliably, and consistently reporting energy use reductions associated with energy efficiency projects.

Note that this protocol does not incorporate the equations used to determine "energy savings" contained in the IPMVP. Project and baseline sources and sinks must be quantified and reported separately under this protocol and emission reductions must be quantified according to the equations above, and may not be substituted with the equations in the IPMVP.

Project developers may wish to review the following sections of the IPMVP, Volume 1 (2012) for further information:

- Chapter 4.5 Savings Verification, including 4.5.1 Measurement Boundary, 4.5.2 Measurement Period Selection, and 4.5.3 Basis for Adjustments,
- Chapter 4.6 Overview of IPMVP Options,
- Chapter 4.7 Options A & B: Retrofit Isolation,
- Chapter 4.8 Option C: Whole Facility,
- Chapter 4.9 Option D: Calibrated Simulation, and
- Chapter 8.2 Baseline Adjustments (Non-Routine).

The IPMVP identifies four options for determining monitoring and quantification of energy efficiency projects. The options differ based on the location of the measurement boundary and whether certain parameters are estimated versus measured. The measurement boundary may be drawn around individual facility components affected by a project activity, as in Options A & B: Retrofit Isolation. The measurement boundary may also be drawn around the whole facility, as in Option C: Whole Facility. Where baseline period data are unreliable or unavailable, a calibrated simulation can be used to estimate the missing data for a facility component or the whole facility, as in Option D: Calibrated Simulation.

The four measurement and quantification options as defined by the IPMVP are summarized in Table 13 below. Table 13 is only a brief summary of the four options presented in the IPMVP. Additional guidance provided in Volume 1 and 3 of the IPMVP may be useful to project developers in developing project documentation.

Table 11: IPMVP Energy Measurement and Quantification Options[4]

IPMVP Option	Calculation Methodology	Typical Applications
Option A. Retrofit Isolation: Key Parameter Measurement		
Involves field measurement of the key performance parameter(s) which define the energy use of the ECM-affected component(s). Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter, and the length of the project period. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter(s) is required.	Engineering calculations of baseline and reporting period energy from: • short-term or continuous measurements of key operating parameter(s); and, • estimated values. Routine and non-routine adjustments as required (refer to Section 4.1.4.1). Secondary effects must be examined (refer to Section 4.1.4.3).	A lighting retrofit where power draw is the key performance parameter that is measured periodically. Operating hours of the lights are estimated based on building schedules and occupant behaviour.
Option B. Retrofit Isolation: All Parameter Measurement		
Involves field measurement of the energy use of the ECM-affected component(s). Measurement frequency ranges from short-term to continuous, depending on the expected variations in energy use and the length of the reporting period.	Short-term or continuous measurements of baseline and reporting period energy, and / or engineering calculations using measurements of energy use proxies. Routine and non-routine adjustments as required (refer to Section 4.1.4.1). Secondary effects must be examined (refer to Section 4.1.4.3).	Application of a variable-speed drive and controls to a motor to adjust pump flow. Measure electric power with a kW meter installed on the electrical supply to the motor, which reads the power every minute. In the baseline period, this meter is in place for a week to verify constant loading. The meter is in place throughout the project period to track variations in power use.

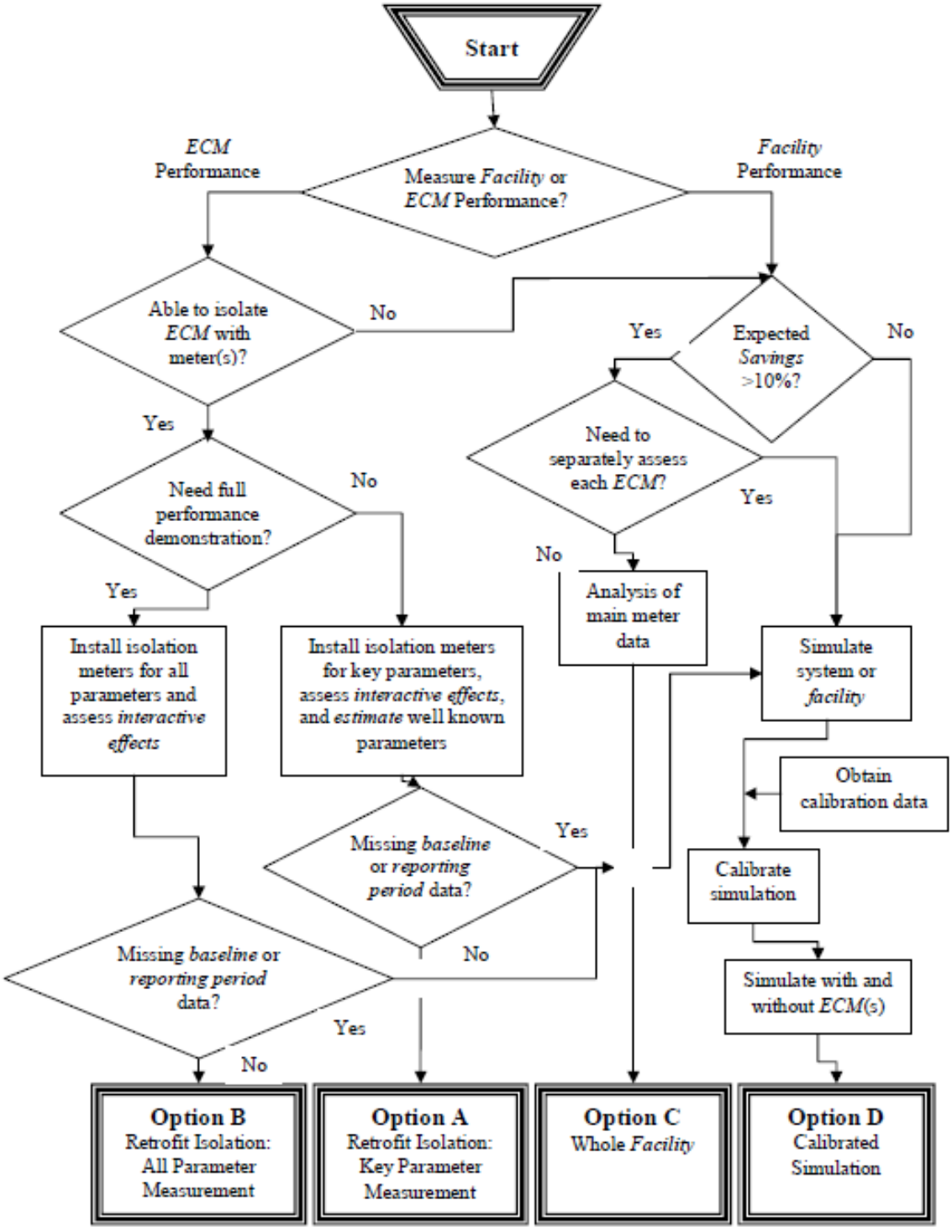
[4] Adapted from IPMVP Volume 1, 2012.

Option C. Whole Facility		
Involves measuring energy use at the whole facility level. Continuous measurements of the entire facility's energy use are taken throughout the project period.	Analysis of whole facility baseline period and project period (utility) meter data. Routine adjustments as required, using techniques such as simple comparison or regression analysis. Non-routine adjustments as required (refer to Section 4.1.4.1).	Multifaceted energy management program affecting many components in a facility. Measure energy use with the utility meters for the baseline period and throughout the project period.
Option D. Calibrated Simulation		
Involves simulation of the energy use of the whole facility, or of a facility component. Simulation routines are demonstrated to adequately model actual energy performance measured during the reporting period. This option usually requires considerable skill in calibrated simulation.	Energy use simulation, calibrated with reporting period hourly or monthly utility billing data. Energy end use metering may be used to help refine input data. Secondary effects must be examined if the measurement boundary is drawn around a facility component rather than the whole facility (refer to Section 4.1.4.3).	Multifaceted energy management program affecting many components in a facility but where no meter existed in the baseline period. Energy use measurements, after installation of meters, are used to calibrate a simulation. Baseline energy use is determined using the simulation calibrated to project period conditions.

Guidance on Option Selection

The IPMVP states that the selection of the option is a decision based on various factors including project conditions, analysis required, budget and professional judgment. The following figure (from IPMVP Volume 1) presents a diagram meant to assist project developers in determining which option is best suited for their type of project.

Figure 5: IPMVP Suggested Option Selection Process



In addition, the IPMVP provides the following table to further assist project developers in selecting an option. Table 13 below presents key characteristics that suggest commonly favoured options. Project developers must identify the IPMVP Option selected in project documentation and provide justification for the selection.

Table 12: Suggested Option Selection Based on Project Key Characteristics

ECM	Suggested Option			
	A	**B**	**C**	**D**
Need to assess ECM's individually	X	X		X
Need to assess only total facility performance			X	X
Expected savings less than ten percent of utility meter	X	X		X
Significance of some energy driving variables in unclear		X	X	X
Interactive effects of ECM are significant or unmeasurable			X	X
Many future changes expected with measurement boundary	X			X
Long term performance assessment needed	X		X	
Baseline data not available				X
Non-technical persons must understand reports	X	X	X	
Metering skill available	X	X		
Computer simulation skill available				X
Experience reading utility bills and performing regression analysis available			X	

Note that where a facility includes a mix of ECMs or other activities, including some that are eligible to use this protocol and others that are ineligible (e.g., ECM does not meet applicability requirements, ECM determined to be the baseline, ECM not additional, etc.), it is necessary to assess ECMs individually. A whole facility approach (Option C or the whole facility variant of Option D) is not appropriate in this case.

4.1.4.1 Baseline Data for Existing Facilities with Continuation of Historic Practices Baseline

For existing facilities that have selected a continuation of historic practices baseline, data collected during a baseline period is typically used to calculate baseline energy use during the reporting period. The baseline period is a period of time chosen to represent operation of the facility or facility component(s) before implementation of an energy conservation measure. The period must be the greater of one year or the time required to reflect one full operating cycle of a facility or facility component with variable operations.

Data collected during this period can include energy data, as well as independent variables and static factors such as weather, building occupancy, and production volumes. The type of data to be

collected must be determined by the project developer taking into consideration the IPMVP Option selected and parameters that will be used to calculate baseline energy use.

Refer to Chapter 4.5.2 Measurement Period Selection of the IPMVP for further information and guidance related to the baseline period.

Baseline energy use for projects at existing facilities is typically determined using baseline period data adjusted to reporting period conditions. Typical adjustments include routine and non-routine adjustments as defined below.

The project developer must provide calculation detail and justification for all routine and non-routine adjustments in project documentation.

Routine Adjustments

Routine adjustments are adjustments made to the baseline period energy use for any energy governing factors expected to change routinely during the project period, such as weather, building occupancy, and production volumes for facilities in the industrial, manufacturing, agriculture, forestry, mining, oil and gas, and other sectors.

Project developers must determine whether routine adjustments for production volumes are necessary by considering the IPMVP Option selected and the relationship between the ECM-affected component(s) and production. In general, adjustments for production are required for whole facility approaches (Options C and D). Retrofit isolation approaches (Options A and B) may or may not require adjustments for production. Adjustments for production are not required where there is no direct link between the quantity of energy consumed by the ECM-affected component(s) and production volumes.[5] Where the quantity of energy consumed by the ECM-affected component(s) varies with changes in production, routine adjustments for production volumes must be made.

A variety of techniques can be used to perform the adjustments. Techniques may be as simple as a constant value (no adjustment) or as complex as several multiple parameter non-linear equations each correlating energy with one or more independent variables. Valid mathematical techniques must be used to derive the adjustment method.

Non-Routine Adjustments

Non-routine adjustments are made for energy-governing factors that are not usually expected to change during the reporting period, such as the facility size, the design and operation of installed equipment, or the type of facility occupants. These static factors must be monitored for change throughout the project period.

Project developers should review the IPMVP protocol for examples of routine and non-routine adjustments.

4.1.4.2 Baseline Data for All Other Facilities

For new facilities as well as existing facilities not using a continuation of historic practices baseline, project developers must calculate baseline energy use by using a model or simulation, as per IPMVP Option D: Calibrated Simulation. Baseline input assumptions for the simulation must be relevant to the baseline condition for each ECM, and may still include historic facility data to the extent that it is available and relevant for the chosen baseline. Any simulation assumptions that are not project-specific should be based on current industry practice, codes, standards and other best practice guidance. Project developers should refer to the IPMVP for further guidance on simulating the baseline for new facilities.

[5] For example, a facility overhead lighting energy efficiency project would not need to make routine adjustments for production volumes, unless changes in production influenced the amount of time that the lights needed to be on.

For new commercial and institutional buildings, equipment specifications, building codes, standards, and simulation software can be used as to calculate baseline energy. Examples of relevant standards include the latest versions of the National Building Code of Canada, National Energy Code of Canada for Buildings (NECB) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Energy Standard for Buildings (Section 90.1).

For industrial, manufacturing, and other sectors, the baseline simulation may be developed using equipment specifications, production volumes, codes, standards, and current industry practice. Engineering design work and modelling completed prior to facility commissioning may be used to develop the simulation.

The simulation developed must be calibrated with monitored data from the greater of one year of operations or the time required to reflect one full operating cycle of the facility or facility component. Project developers must determine whether production volumes are a relevant independent variable included in the simulation; refer to the guidance in Section 4.1.4.1, above.

4.1.4.3 Secondary Effects

Where energy efficiency projects only affect a portion of a facility, Options A, B, and D allow for narrowing of the measurement boundary to reduce the effort required to monitor independent variables and static factors. Narrowing the measurement boundary introduces the possibility of leakage, referred to as secondary effects ("interactive effects" in the IPMVP). Example secondary effects for various ECMs are listed in Table 13.

Table 13: Examples of Secondary Effects of Selected Energy Conservation Measures

Energy Conservation Measure	Secondary Effects
Lighting efficiency improvement	Heating, Cooling
Lighting operating period control	Heating, Cooling
Electric motor replacement with higher efficiency motor	Effect of higher motor speed on system performance and horsepower needs
Chiller or refrigeration replacement with higher efficiency units	Condenser fan, condenser pump

When the measurement boundary is selected, care should be taken to ensure that energy flows affected by the energy conservation measures but outside the measurement boundary are considered. Project documentation must list all potential secondary effects of an energy conservation measure (positive or negative) on facility components, along with an estimate of the likely magnitude of each. The method of estimating each listed impact must be described, noting the factors affecting the accuracy of each estimate.

Where secondary effects are determined to be material, emissions associated with the secondary effects must be quantified under SS P2 / B2 Electricity Generation and Distribution where the effect is on facility electricity consumption and SS P3 / B3 Facility Fuel Consumption where the effect is on facility fuel consumption. Material means that not including the secondary effect could lead to a material overstatement of offset-eligible reductions.

4.2 Accuracy Approaches

The accuracy of emission reductions estimates is affected by uncertainty in measurement and modelling. Three common sources of uncertainty that arise during the quantification of energy efficiency projects including:

- Modelling and Simulation: uncertainty is contained in estimates derived from mathematical modeling such as regression analysis.
- Sampling: where sampling is used to provide estimates, uncertainty arises because samples typically do not measure all values of a parameter.
- Metering: meters do not measure with complete accuracy and also need to be correctly calibrated, installed and maintained.

Project developers must present in their project documentation an analysis of all quantifiable uncertainties expected in the quantification of offset-eligible reductions (i.e., emission offsets). Project developers must provide a clear description and explanation of how modelling and simulation is performed. This must include a discussion of the data used to develop any simulation or model in terms of its source and representativeness of typical baseline and project operating conditions. This analysis must use statistical techniques such as those contained in IPMVP Appendix B Uncertainty or other good practice guidance identified by the project developer; the project developer must explain why the selected techniques are appropriate. The project developer must identify and explain the reason for any missing or unreliable data and explain how these were dealt with in the development and use of the model.

The results of the uncertainty analysis must show the estimated offset-eligible reductions value (from Section 4.1.2) together with a two-sided prediction interval for that value at 90% confidence.

- Where the prediction interval is within ±5% of the estimated offset-eligible reductions value then the project developer may claim emission offsets for the amount calculated in Section 4.1.2.
- Otherwise, the project developer must calculate a one-sided prediction interval at 95% confidence for the offset-eligible emission reductions in Section 4.1.2 and claim the lower bound of this interval as emission offsets.

The following may be assumed for the uncertainty analysis with respect to the measurement and estimation of parameters and data:

- Emission factors, global warming potentials, and conversion factors may be assumed to have an uncertainty of zero.
- Measured data that comes from an independent source (e.g., government weather data) may be assumed to have an uncertainty of zero
- Metering uncertainty is zero where measurement equipment meets the minimum characteristics shown in Table 14 and where the equipment has been calibrated, installed and maintained in accordance with the manufacturer's instructions.

Table 14: Minimum Meter Accuracy Requirements

Meter Type	Confidence Interval	Precision	Additional Information
Whole facility energy meters	N/A	N/A	Utility Quality Metering
Electrical sub-meters	95%	±2%	
Liquid flow meters		±10%	

Liquid flow meters (used to compute energy flow)	±3%	No more than 15% of the expected measured values will exceed the selected meter's range, and no more than 1% of the expected measured values will exceed it by more than 20% the meter's range maximum or minimum.
Air flow meters	±10%	
Air flow meters (used to compute energy flow)	±3%	
Steam flow meters	5%	
Simple temperature	3%	
Differential temperature readings with matched sensors	0.5%	
Pressure or differential pressure	3%	
Operating hours	0.1%	

5.0 Documents and Records

Project developers are required to retain copies of all required documentation to support any and all greenhouse gas assertions from their project or all sub-projects in aggregated projects. The project developer must establish and apply quality management procedures to manage data and information. Documentation in the form of documents and records is a key element to project development and verification or re-verification. The project plan must be specific and detail the documentation requirements for the project. The verification process relies on the quality and availability of documentation and the project plan must be clear on the types of documentation that will be available to the verifier or government re-verifier. The project developer is required to provide the verifier with objective evidence of project operations and implementation. Attestation is not considered objective evidence and will not be accepted under the regulation. The types of documents and records required to demonstrate that an emission offset project meets regulatory and protocol requirements will vary and should be clearly outlined in the project plan.

Documents and records are required to be:

- legible, identifiable, traceable,
- centrally located,
- dated,
- easily located/searched,
- orderly, and,
- prevented from loss.

In the case of aggregated projects, the sub-project operator and the project developer must both retain records as required above.

5.1 Documents

Emission offset project documents are the instructions or plan on how a certain activity is carried out. Documents can be interdependent and are likely instructing or explaining how an activity should be carried out. Documents that may be required to demonstrate that an emission offset project meets program criteria include: documentation meeting project plan reporting requirements; operating procedures; specifications; drawings; regulations; standards; guidelines; etc. Documents may occasionally change or be updated and project developers must be able to demonstrate that they are using the most current (or applicable) version. The offset project documents should include a list of records that will be available for verification. The offset project documents must also indicate how records will be managed (i.e. retention, storage and access).

In support of this requirement, project data must be managed in a manner that substantiates that:

- emissions and reductions that have been recorded pertain to the project;
- all emissions and reductions that should have been recorded have been recorded;
- emissions and reductions quantification has been recorded appropriately;
- emissions and reductions have been recorded in the correct reporting period;
- emissions and reductions have been recorded in the appropriate category; and
- must have an auditable data management system.

Project documents are required to prove eligibility, baseline conditions and project quantification. Documents include but are not limited to the project.

In addition to the criteria outlined in this protocol, the project developer will be required to provide documents to show that offset system criteria in the Standard under the regulation have been met.

5.2 Records

Records are required to prove implementation of the project as planned. Records show what has been done and do not change. They must not be altered or updated in the way that documents may be. Records include but are not limited to invoices, contracts, metered results, maintenance logs, calculations, databases, photographs, and calibrations. Records must be retained according to the requirements outlined in Section 5.0 and as indicated in the project plan. In the case of an aggregated project, all sub-project developers and the emission offset project developer must both retain sufficient records demonstrate that the project operations and offset criteria are met. Table 15 outlines examples of records that may be required to support this protocol. Records must be available and be disclosed to a verifier upon request.

For energy efficiency projects, the monitoring plan will be specific to the energy conservation measures implemented and the quantification approach selected. The monitoring plan must be designed based on the requirements presented in this protocol based on Section 5.3.

Measurement system design and installation must follow best practice in the industry, as defined in relevant standards and by the manufacturer of the measurement, communication and logging equipment. Meters must be selected and operated to meet the accuracy requirements specified in this protocol.

The monitoring plan must include the information in Table 15 for all metered parameters measured.

Table 15: Record Keeping Requirements for Metered Parameters

Record Requirements for Metered Parameters
Purpose of measurement, type of meter, units or measure, physical location, frequency of measurement
Manufacturer of sensor, model, serial number
Frequency of regular reading or polling of the sensor
Memory capacity of any instrument temporarily storing data
Contingency procedures in case of memory overflow
Meter reading process (if readings are done manually)
Manufacturer of data logger, model, serial number
Sensor and logger range and precision
The expected range of values to be measured
Frequency of calibration, calibration method(s)
Maintenance procedures
Address of data telemetry point, archive place for data and frequency of archiving
Monitoring/measurement roles and responsibilities

Meter systems may be designed to measure an accumulated quantity, or an instantaneous quantity by regular periodic sampling. Accumulating meters can have their values read on an irregular basis without impeding the quality of the resultant data because they report cumulative energy. However, when instantaneous readings are taken periodically, the frequency of meter reading is critical to the quality of the resultant data.

The measurement period for instantaneous quantities must be matched to the expected rate of change of the quantity.

Table 16: Project Documentation Record Keeping Requirements

Records retained based on regulation requirements
Raw baseline and project period energy data, independent variable data, and static factors within the measurement boundary
A record of all adjustments made to raw baseline data with justifications
All analysis of baseline data used to create mathematical model(s)
All data and analysis used to support Option A estimates
Expected end of life date of equipment removed or renovated under the project
Efficiency standards or common practices relevant to each energy conservation measure at the date of project commitment
Metering equipment specifications (model number, serial number, manufacturer's calibration procedures)
A record of changes in static factors along with all calculations for non-routine adjustments
If Calibrated Simulation Option D is used: all input data, output data. Also, the software name and version number, if public domain software is used. If private software is used (even if available for purchase), a copy of the software must remain available for the verifier's free use and evidence retained of why it is suited to the simulation task
All calculations of and greenhouse gas emissions and emission reductions
Measurement equipment maintenance activity logs
Measurement equipment calibration records
Initial and annual verification records and results
All records or contracts outlining ownership of the emission offsets
Copy of carbon levy exemption certificate(s), if applicable to the project.
Copy of any certificate of professional energy advisor reviewing a commercial and institutional buildings project
Record of review demonstrating certified professional advisor signed off on project plan for commercial and institutional buildings project

5.3 Project Monitoring Plan

A monitoring plan is to be established for all monitoring and reporting activities associated with the project activity being registered in the emission offset system. The monitoring plan will serve as a basis

for verification and confirm that the monitoring and reporting requirements have been and will continue to be met, and that consistent, rigorous monitoring and record keeping is ongoing at the project site. The monitoring plan must cover all aspects of monitoring and reporting contained in this protocol and must specify how data for all relevant parameters listed above will be collected and recorded. As described in Section 1 Project Eligibility, fuels that are subject to the Alberta Carbon Levy must be monitored and reported to ensure project eligibility.

At a minimum the monitoring plan shall stipulate:

- the frequency of data acquisition,
- a record keeping plan,
- the frequency of instrument calibration activities, and
- the role of individuals performing each specific monitoring activity.

The monitoring plan should include QA/QC provisions to ensure that data acquisition is carried out consistently and with precision.

The monitoring plan must include detailed monitoring procedures that the project developer will follow to demonstrate that project energy efficiency management practices comply with the requirements.

Project developers are responsible for monitoring the performance of the project and ensuring that the operation of all project-related equipment is consistent with the manufacturer's recommendations.

5.4 Quality Assurance and Quality Control (QA/QC)

QA/QC must also be applied and documented in the project plan to ensure confidence that all measurements and calculations have been made correctly. Procedures may include, but are not limited to:

- protecting monitoring equipment (sealed meters and data loggers),
- protecting records of monitored data (hard copy and electronic storage),
- checking data integrity on a regular and periodic basis (manual assessment, comparing redundant metered data, and detection of outstanding data/records),
- comparing current estimates with previous estimates as a 'reality check',
- providing sufficient training to operators to perform maintenance and calibration of monitoring devices,
- establishing minimum experience and requirements for operators in charge of project and monitoring, and
- performing recalculations to make sure no mathematical errors have been made.

The project developer must demonstrate that the project plan and subsequent project report(s) are developed or reviewed by a Certified Measurement and Verification Professional (CMVP), or a Certified Energy Manager (CEM) with at least three years of experience in implementing and quantifying energy efficiency projects for all Commercial and Institutional Buildings projects.

5.5 Liability

Emission offset projects must be implemented according to a government-approved protocol and in accordance with all government regulations. The Government of Alberta reserves the right to re-verify emission offsets and associated projects registered or submitted for compliance under the Regulation and may request corrections based on findings.

5.6 Aggregated Projects Requirements

Small energy efficiency projects may be combined and aggregated into one single project for purposes of verification, registration on the Alberta Emissions Offset Registry and emission offset transactions.

In the case of an aggregated project, the project developer must retain copies of all relevant documentation for all sub-projects comprised of the larger aggregated project. Each sub-project/facility must also keep and maintain records for their specific operation in accordance with the requirements in this protocol and the regulation.

The aggregator must track and disclose to the registry all sub-project spatial location information for each sub-project being registered during the planning and reporting stages. A sub-project tracking form can be obtained directly from the registry and will track the activity(ies), emission offsets claimed per vintage year, legal land description and unique address related information per sub-project.

6.0 References

Alberta Environment and Parks. Carbon Offset Emission Factors Handbook.

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). (2016). ANSI/ASHRAE/IES Standard 90.1-2016 -- Energy Standard for Buildings Except Low-Rise Residential Buildings.

Efficiency Valuation Organization. (2006). International Performance Measurement and Verification Protocol. Concepts and Practices for Determining Energy Savings in New Construction. Volume 1, Part I. EVO 30000 – 1:2006.

Efficiency Valuation Organization. (2012). International Performance Measurement and Verification Protocol. Concepts and Options for Determining Energy and Water Savings. Volume 1. EVO 10000 – 1:2012.

National Research Council Canada. (2015). National Building Code of Canada.

National Research Council Canada. (2015). National Energy Code of Canada for Buildings.

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