Energy Efficiency and Fuel Switching

Offset Protocol

Energy Efficiency

Fuel Switching to Less GHG-Intensive or Renewable Energy Sources

Version 1

May 2017

This document was prepared as an offset protocol for implementation when regulations are promulgated under Section 30(1)(g) of the *Management of Greenhouse Gas Act*. Until such regulations are promulgated, the provincial government will not have an operational carbon offsets system. Stakeholders may wish to review this document to identify potential future carbon offsets opportunities that may be available at that time. Questions or comments on the document may be sent to climatechange@gov.nl.ca.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF EQUATIONS

FORWARD

The Newfoundland and Labrador Energy Efficiency and Fuel Switching Protocol (the Protocol) was developed pursuant to the *Management of Greenhouse Gas Act* and regulations promulgated under the *Act*. Note that there are no regulations promulgated at this time.[1] In the event of a discrepancy between the requirements of the *Act* and its regulations and the Protocol, the *Act* and regulations shall prevail.

A copy of the *Act* may be found at: http://www.assembly.nl.ca/legislation/sr/statutes/m01-001.htm

A copy of the regulation may be found at: (to be provided in future)

Additional guidance related to the implementation of offsets in Newfoundland and Labrador may be found at: (to be provided in future)

The Protocol was developed by The Delphi Group, with the support of Dillon Consulting. The protocol development team engaged local stakeholders during the development of the Protocol. A technical methodological document outlining the process that was undertaken by the protocol development team, including stakeholder input, is available upon request.

In implementing projects under the Protocol, it is the responsibility of project proponents to ensure that all regulatory requirements and the requirements outlined in the Protocol are met, including that validators and verifiers are properly accredited.

Project proponents and stakeholders seeking further information should contact:

Name
Title
Department
Government of Newfoundland and Labrador
Telephone:

In considering projects under the Protocol, project proponents may wish to review, at a minimum, the following legislation, including regulations and initiatives that emanate from this legislation:

- *Electric Power Control Act;*
- *Energy Corporation Act and Hydro Corporation Act;*
- *Public Utilities Act;*
- *Labrador Inuit Land Claims Agreement Act;* and,
- *Forestry Act.*

Project proponents may wish to review, at a minimum, the following program related initiatives:

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[1] Note that while regulations under the *Act* are mentioned in various places in the Protocol document, none are currently in place that address GHG offsets. As regulations are developed, affected sections of the Protocol will be updated accordingly.

- Residential Energy Efficiency Program (REEP). Note that this program is scheduled to terminate on March 31, 2017;
- The Home Energy Savings Program (HESP). Note that this program is scheduled to begin taking applications in July 2017;
- The net metering program announced in 2016/17 that is currently being considered by the Public Utilities Board; and,
- The existing moratorium on new small-scale hydroelectricity projects on the island of Newfoundland.

ACKNOWLEDGEMENT

The protocol development team would like to acknowledge the use of the following as key reference sources for the development of the Protocol:

- International Performance Measurement and Verification Protocol (IPMVP).[2]
- Energy Efficiency protocols approved under the Alberta Offset Credit System.[3]
- The B.C. GHG Offset Protocol: Fuel Switch from Higher-GHG Intensive to Lower GHG-Intensive Fuels, Public Consultation Draft, May 30, 2017.[4]

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[2] 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. Available at: http://evo-world.org
[3] Available at: http://aep.alberta.ca/climate-change/guidelines-legislation/specified-gas-emitters-regulation/offset-credit-system-protocols.aspx
[4] Available at: http://www2.gov.bc.ca/assets/gov/environment/climate-change/stakeholder-support/bc_fs_20160530.pdf

1 SUMMARY DESCRIPTION OF THE PROTOCOL

The purpose of the Energy Efficiency and Fuel Switching Offset Protocol (the Protocol) is to establish project eligibility requirements and the approved methodology for quantifying greenhouse gas (GHG) emission reductions associated with the following project types in Newfoundland and Labrador:

1. Implementation of Energy Conservation Measures (ECMs)

   Project type (1) involves the implementation of energy conservation measures (ECMs) at a facility (e.g., a residential, commercial, or institutional building or manufacturing/industrial facility). ECMs are an activity or set of activities designed to increase the energy efficiency of a facility, system, or piece of equipment. ECMs may also conserve energy without changing efficiency. ECMs may involve, but are not limited to, the following:

   - Installation of energy efficient appliances, technologies, equipment, and/or processes.
   - Improvements to the envelope of a building.
   - Optimization of facility/process control systems.
   - Waste heat recovery and use.

   ECMs implemented at facilities for the purpose of conserving electricity from the Newfoundland and Labrador provincial grid are not eligible to generate offset credits under the Protocol[5]. ECMs implemented at facilities connected to an isolated grid may be eligible to generate offset credits, provided the project meets the eligibility criteria of the Protocol.

2. Fuel Switching from Fossil Fuels to Less GHG-Intensive Fossil Fuels or Renewable Energy

   Project type (2) involves replacing one energy source for another in an energy generation process. Offset projects of this type result in GHG emission reductions when the original fuel is a fossil fuel (e.g., diesel, fuel oil, gasoline, propane, or kerosene) that is replaced by a less GHG-intensive fossil fuel or renewable energy (e.g., solar, wind, wood, or waste biomass sources such as agricultural, food processing, and forestry residues and wastes). Fuel switching projects may involve, but are not limited to, the following:

   - Switching from fossil fuel-fired heating (e.g., fuel oil) to less GHG-intensive heating (e.g., propane), or electric heating powered by the provincial grid, or renewable energy.
   - Switching from fossil fuel-fired electricity generation to less GHG-intensive electricity generation, or renewable electricity generation where the electricity supplies an isolated grid.

[5] Due to the near-zero GHG intensity of the Newfoundland and Labrador provincial electrical grid.

- Switching from electricity delivered by an isolated grid that is used for electric heating to fossil fuel-fired heating (e.g., fuel oil) or biomass heating (e.g., wood chips).

For fuel switching projects, the following are not eligible project fuel and energy types:[6]

- Biomass that has a beneficial use in the baseline[7], for example, trees that would have been processed into paper products, or agricultural residues left on land to provide the soil with nutrients. Note that waste biomass from, for example, pulp and paper operations and other sources, is an eligible project fuel;
- Biofuels such as ethanol and biodiesel.[8]
- Mixed municipal solid waste (MSW);[9] and,
- Biogas from landfills, wastewater treatment, or any other source.[10]

3. A Combination of Project Types (1) and (2)

   Project type (3) involves both the implementation of ECMs as well as a fuel switching component. For example, a project that involves a building envelope upgrade as an ECM and a fuel switch to a less GHG-intensive heating source.

The Protocol allows new build facilities and retrofitted existing facilities to generate offset credits. Projects covered under the Protocol must comply with all necessary requirements of the *Management of Greenhouse Gas Act* (the *Act*) and any associated regulations. Emission reductions of the following GHGs are applicable: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

Note that GHG emission reductions resulting from activities other than those listed above (e.g., reduction in emissions from flaring, venting, fugitive sources, chemical processes) are not eligible to use the Protocol. These project types would require a separate protocol with methodologies tailored to those activities.

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[6]These fuel and energy types involve additional complexities that have not been addressed in the Protocol. These fuel and energy types are typically addressed in separate protocols in regulated and voluntary offset systems.

[7] Biomass that has beneficial uses in the baseline (i.e., not waste biomass) can result in increases in emissions outside of the project boundary ("leakage"). For example, if trees processed into paper products in the baseline are now used for energy in the project, the paper supplied to market in the baseline would need to be supplied by another facility, assuming demand for paper remains unchanged. Baseline emissions would need to account for emissions associated with paper production at another facility, which would not be easily quantifiable by the project proponent.

[8] Biofuel projects are typically treated in a separate protocol in regulated and voluntary offset systems. Consideration must be given to emissions associated with agricultural practices and land-use changes resulting from energy crop production. In addition, biofuels are not commercially available in the Province of Newfoundland and Labrador at this time.

[9] Note that the organic portion of MSW is an eligible project fuel, provided the eligibility requirements in Section 2.4 are satisfied. Mixed MSW adds complexities to GHG quantification as it contains biogenic (e.g., food waste) and non-biogenic (e.g., plastics) components. Accurately quantifying GHG emissions arising from the non-biogenic fraction of mixed MSW requires specialized methodologies that are best included in a separate protocol tailored to these activities.

[10] Biogas projects are typically treated in a separate protocol in regulated and voluntary offset systems, as they involve activities and emissions sources (e.g., fugitives, venting, flaring) not typically included in energy efficiency or fuel switching protocols.

1.1 GUIDANCE

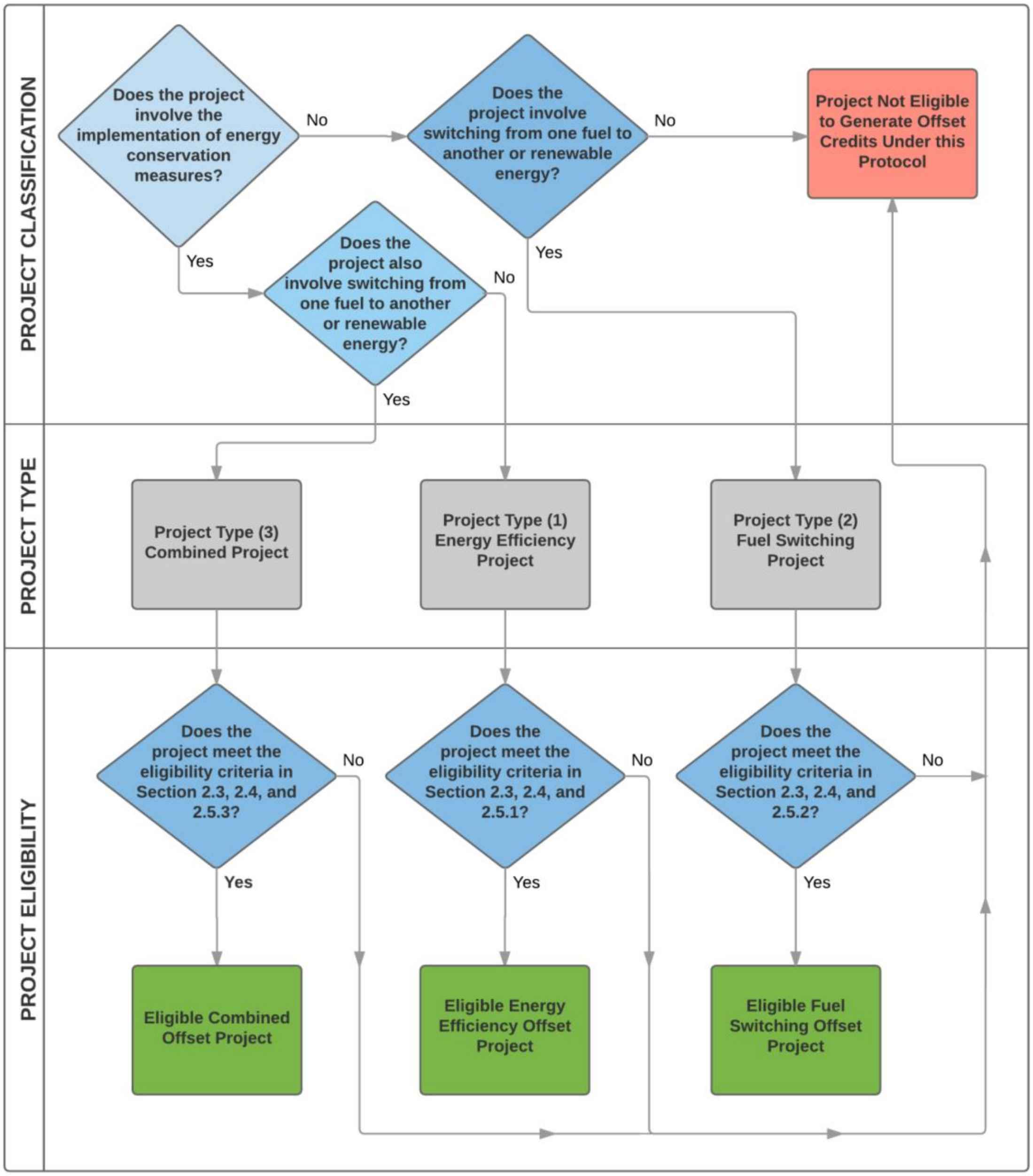

Figure 1: Project Eligibility and Type Decision Tree Diagram

Projects are eligible to generate offset credits under the Protocol where they satisfy the eligibility criteria listed in the Protocol. The decision tree in Figure 1 may be used by project proponents to define their project type and determine whether their project is eligible to generate offset credits. In implementing projects under the Protocol, it is the responsibility of project proponents to ensure that all regulatory requirements and the requirements outlined in the Protocol are met. The Government of Newfoundland and Labrador will award offset credits to projects that meet these requirements, including the requirement for project validation and verification by an accredited third-party auditor.

For an eligible offset project to be able to be awarded offset credits by the Government of Newfoundland and Labrador, a project plan and periodic project reports must be prepared according to the requirements of the Protocol and any associated regulations. The project plan must be validated, and the project reports verified, by an independent third-party auditor, as per the regulations associated with the *Act*.

The project plan is a stand-alone document that defines the objectives of the project, demonstrates how a project will achieve GHG reductions, and that verifiable GHG reductions can be quantified for the project. It is created prior to project implementation, or when the project first registers with the offset system.

Project reports along with accompanying documents and data are the key components demonstrating that a project was carried out in the manner outlined and validated in the project plan. The results of the quantification of project reductions over a reporting period selected by the project proponent (typically one year) are presented in the project report, and verified by a third-party auditor.

Project plans and reports must demonstrate that the project satisfies all of the requirements of the Protocol and any associated regulations.

The project must satisfy the eligibility criteria in Section 2: Protocol Applicability. This section also provides guidance related to combining discrete projects (referred to as project instances) into either an aggregated project or a program of activities. Flexibility mechanisms are provided to allow project proponents flexibility in their approach to certain project monitoring and GHG quantification requirements.

Section 3: Project Condition provides the requirements for justifying and documenting the offset project. GHG sources, sinks, and reservoirs (SSRs) that may be associated with the project (depending on the project type) are identified and defined.

In order to quantify project emission reductions, a baseline scenario that represents what would have most likely occurred in the absence of the project must be selected by the project proponent. Section 4: Establishment of Baseline Scenario provides requirements and guidance for selecting the appropriate baseline scenario. SSRs that may be associated with the baseline are identified and defined.

Only those SSRs that are deemed relevant according to good practice guidance need to be quantified to determine project reductions. Section 5: Compare Project and Baseline SSRs and Select Relevant SSRs lists SSRs that must be quantified and those that may or may not need to be quantified, depending on the project type and project-specific circumstances.

Section 6: Quantification of GHG Emission Reductions provides the quantification methodology and equations that must be used to quantify project reductions.

Section 7: Monitoring provides the requirements for monitoring activity levels and other parameters that are used to quantify project reductions.

1.2 DEFINITIONS

"Additionality" means that GHG emission reductions must be generated from actions that are beyond all existing federal, provincial, and municipal regulatory requirements (whether GHG-related regulations or other) and business as usual activities or sector common practice.

"Affected Source, Sink, or Reservoir" means a GHG source, sink, or reservoir influenced by a project activity, through changes in market demand or supply for associated products or services, or through physical displacement. There are no affected sources, sinks or reservoirs in the Protocol.

"Aggregated Project" means group of discrete project instances (as per the definition below) that are combined, approved and administered under a single offset project. All project instances must be identified in the project plan prior to validation.

"Baseline Scenario" means a hypothetical scenario of what would have most likely occurred in the absence of the project.

"Biofuel" means any liquid fuel that is derived from biomass.

"Biomass" means non-fossilized organic material originating from plants and/or animals, including any product made from these, such as wood and wood products, as well as products, by-products, residues, and waste from agriculture, forestry and related industries.

"Conservative" means that project GHG reductions must not be overestimated. Where data and assumptions are uncertain, and where measures to reduce uncertainty are not cost-effective, conservative values and assumptions must be used. Conservative values and assumptions are those that are more likely to underestimate rather than overestimate project reductions.

"Controlled Source, Sink, or Reservoir" means a GHG source, sink, or reservoir whose operation is under the direction and influence of the project proponent through financial, policy, management, or other instruments.

"GHG Sink" means a physical unit or process that removes a GHG from the atmosphere.

"GHG Source" means a physical unit or process that releases a GHG into the atmosphere.

"GHG Reservoir" means a physical unit or component of the biosphere, geosphere, or hydrosphere with the capability to store or accumulate a GHG removed from the atmosphere by a GHG sink or a GHG captured from a GHG source.

"Energy" means the output or useful product of an energy generation process.

"Energy Generation" means a process that results in one or any combination of the following:

- generation of electricity; and/or

- addition or removal of energy from a substance, be it solid, liquid or gas, including but not necessarily limited to:
    - generation of steam;
    - generation of heated air or water (e.g., for industrial process use, space heating, domestic hot water);
    - generation of chilled air or water (e.g., for industrial process use, space cooling); and/or
    - compression (e.g., compression of gas such as air, thereby raising its pressure and possibly temperature in the process).

"Facility" means a residential, commercial, or institutional building or manufacturing/industrial facility containing an energy generation process (or multiple processes), and/or components (e.g., equipment, systems, processes, technologies) that consume energy. Note that this definition of facility differs from that in the *Management of Greenhouse Gas Act* and is meant for use in the Protocol only.

"Fossil Fuel" means a fuel with a high carbon and hydrogen content, formed from decayed organic material over geological time scales.

"Fuel" means a solid, liquid, or gaseous material that is combusted in an energy generation process.

"Functional Equivalence" means the baseline scenario and project must provide the same function and quality of products or services to enable meaningful comparison.

"Isolated Grid" means an electricity generation and distribution system that is not connected to the provincial grid. In the Protocol, isolated grid always refers to a local grid supplied with electricity by a single diesel generating station.

"Materiality Threshold" means a quantitative threshold for verification purposes where the aggregate or individual effects of errors, omissions or misrepresentations could have resulted in an overestimation of project reductions by more than 5% (to be confirmed by regulation).

"Monitoring" means the continuous or periodic assessment and documentation of GHG emissions and removals or other GHG-related data.

"Offset Project" means a specific project activity, or set of project activities, intended to reduce GHG emissions, increase the storage of carbon, or enhance GHG removals from the atmosphere. An offset project may be a stand-alone project, an aggregated project, or a program of activities.

"Project Activity" means a specific action or intervention targeted at changing GHG emissions, removals, or storage. It may include modifications or alterations to existing production, process, consumption, service, or management systems, as well as the introduction of new systems.

"Project Instance" means, in relation to a program of activities or aggregated project, a discrete instance (in physical location or geographic boundary) of a project activity that may be combined with other project instances to form a program of activities or aggregated project.

"Provincial Grid" means those parts of the Newfoundland and Labrador electrical generation, transmission, and distribution system connected to the Island Interconnected System and the Labrador Interconnected System.

"Program of Activities" means a group of discrete project instances that are combined, approved and administered under a single offset project. Project instances may be added to the program over time, subsequent to validation.

"Project Proponent" means an individual or organization that has overall control and responsibility for an offset project.

"Regulation" means a regulation under the *Management of Greenhouse Gas Act* (the *Act*). As of the time of writing, there are no regulations in place that address matters related to offsets.

"Related Source, Sink, or Reservoir" means a GHG source, sink, or reservoir that has material or energy flows into, out of, or within the project. It is generally upstream or downstream of the project activity, and can be either on or off the project site. It may include activities related to design, construction, and decommissioning of an offset project.

"Renewable Energy" means energy from sources that constantly renew themselves or that are regarded as practically inexhaustible. Renewable energy includes, but is not limited to: energy derived from solar, wind, geothermal, hydro, biomass, tides, sea currents and ocean thermal gradients.

"Stand-Alone Project" means a type of offset project where all the instances of the project activity are identified in the project plan at validation, and where all buildings, facilities, and equipment:

- are located or used on a single site, contiguous or adjacent sites;
- are managed or controlled by the same entity; and,
- function as a single integrated site.

"Waste Biomass" means biomass debris, residues, and waste from forestry, agriculture, and related operations that would be disposed of and not used for any beneficial purpose (e.g., energy generation, as a fertilizer) in the absence of the project.

1.2.1 Relevant Definitions from the International Performance Measurement and Verification Protocol (IPMVP)

The quantification methodology in the Protocol is based on the International Performance Measurement and Verification Protocol (IPMVP)[11] The following definitions from the IPMVP are relevant to the Protocol.

"Adjusted-Baseline Energy" means the energy use of the baseline period, adjusted to a different set of operating conditions.

"Baseline Adjustments" means the non-routine adjustments arising during the reporting period from changes in any energy governing characteristic of the facility within the measurement boundary, except for the named independent variables used for routine adjustments.

"Baseline Energy" means the energy use occurring during the baseline period without adjustments.

"Baseline Period" means the period of time chosen to represent the operation of the facility or system before implementation of the project. This period is typically long enough to reflect one full operating cycle of a system or facility that has variable operations.

"Confidence Level" means the probability that any measured value will fall within a stated range of precision.

"Constant" means a term used to describe a physical parameter which does not change during a period of interest. Minor variations may be observed in the parameter while still describing it as constant. The magnitude of variations that are deemed to be minor must be reported in the project plan.

"Cycle" means the period of time between the start of successive similar operating modes of a facility or piece of equipment 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 weekends than during the rest of the week.

"Energy Conservation Measure (ECM)" means an activity or set of activities designed to increase the energy efficiency of a facility, system, or piece of equipment. ECMs may also conserve energy without changing efficiency. Several ECMs may be carried out at a facility at one time. 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.

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[11] 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.

"Estimate" means a process of determining a parameter used to calculate energy use through methods other than measuring it in the baseline and project periods. These methods may range from assumptions to engineering estimates derived from the 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 the purposes of adherence with the IPMVP.

"Independent Variable" means a parameter that is expected to change regularly and have a measurable impact on the energy use of a system or facility.

"Interactive Effects" means energy effects created by a project activity but not measured within the measurement boundary.

"Measurement Boundary" means a notional boundary drawn around equipment and/or systems to segregate those which are relevant to determining project and baseline energy use from those which are not.

"Non-Routine Adjustments" means the individually engineered calculations to account for changes in static factors within the measurement boundary after the baseline period. When non-routine adjustments are applied to the baseline energy, they are sometimes called baseline adjustments. For the Protocol, non-routine adjustments also account for changes in the surplus (additionality) characteristics of the project.

"Precision" means 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 manufacturer as ±10% with a 95% confidence level.

"Routine Adjustments" means the calculations made by a formula shown in the project plan to account for changes in selected independent variables within the measurement boundary since the baseline period.

"Static factors" means 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 may include fixed, environmental, operational, and maintenance characteristics.

1.3 ABBREVIATIONS AND ACRONYMS

"CEMS"	Continuous Emissions Monitoring Systems
"CH_4"	Methane
"CO_2"	Carbon dioxide
"ECM"	Energy Conservation Measure
"GHG"	Greenhouse Gas
"GJ"	Gigajoule
"HDD"	Heating Degree Day
"HHV"	Higher Heating Value
"IPMVP"	The International Performance Measurement and Verification Protocol
"km"	Kilometre
"LHV"	Lower Heating Value
"MJ"	Megajoule
"MWh"	Megawatt hour
"N_2O"	Nitrous oxide
"PoA"	Program of activities
"SSR"	Sources, Sinks and Reservoirs

2 PROTOCOL APPLICABILITY

Project eligibility requirements are designed to be as broad and non-restrictive as possible, while still ensuring that projects with relevant aspects not covered by the provided quantification methodologies are clearly identified as being ineligible to use the Protocol.

This section makes no attempt to judge eligible project types with regards to GHG emission reduction potential or any potential non-GHG impacts, positive or negative. An eligible project will be required to assess and report on the GHG emission reductions achieved in a manner that complies with the Protocol and associated normative references, such as ISO 14064-2. The Government of Newfoundland and Labrador will award offset credits to projects that meet these requirements, once project documentation has been validated and verified by an accredited third-party auditor.

Offset projects may be a stand-alone project, where project activities occur on a single site (or adjacent sites) and have a set start date, or offset projects may consist of project activities at multiple sites with differing start dates. Sections 2.1 and 2.2 below outline two specific approaches, termed aggregation and program of activities, which allow for the eligibility of offset projects that include project activities at a number of dispersed project sites (each referred to as a project instance). The key difference between the two approaches is that proponents of aggregated projects must identify all project instances at the time of project registration, whereas a program of activities allows for the inclusion of additional project instances over time, after the project is registered.

2.1 AGGREGATION

To reduce transaction costs and enable development of recognized emission reductions from smaller and dispersed emission sources, projects may be aggregated and registered as a single, larger offset project. Project instances under aggregated projects must be similar in scope and all project instances must be identified at project registration. This approach is often advantageous where individual project instances achieve modest reductions but when grouped together can benefit from economies of scale related to the costs associated with developing, documenting, and verifying an offset project. Since all project instances must be registered at the same time, all project instances will have the same duration and crediting period.

2.2 PROGRAM OF ACTIVITIES

The Protocol has been developed so that it may be applied to a Program of Activities (PoA), where, similar to aggregation, GHG emissions from a number of different project instances are quantified and reported together as a single programmatic offset project. However, a PoA also allows for project instances to be added over time. This approach is useful where a technology or practice will be rolled out to the marketplace gradually over time, and where the number of project instances identified at the beginning of the project would not generate enough offset credits to justify the costs associated with implementing, documenting, and verifying the project. It may also be useful in cases where interest in project participation increases over time.

The Protocol does not include specific requirements for programmatic offset projects that are distinct from stand-alone or aggregated projects. Specific requirements and approaches to developing and documenting programmatic offset projects are typically found in parallel guidance documents. This guidance would address, for instance, how to structure a GHG project plan such that additional project instances can be added to the PoA over time and successfully verified. At the time of writing, there is no parallel guidance document in Newfoundland and Labrador. As a substitute at this time, readers may refer to the guidance document in British Columbia found at: http://www.pacificcarbontrust.com/assets/Uploads/Guidance-Documents/BC-Program-of-Activities-Guidance-Final-V1.0.pdf

2.3 General Eligibility Criteria

There are seven key overarching criteria that typically apply to provincial regulated offset systems and projects (e.g., in the existing offset systems in Alberta, British Columbia, and Quebec, and the system under development in Ontario). These criteria have been considered in developing the methodologies presented in the Protocol, and are provided in this section for information only. The criteria are typically contained within the regulations related to emissions offsets in jurisdictions with existing offset systems.

Table 1: General Eligibility Criteria for All Offset Projects

Eligibility Criteria	Criteria Description
Within Scope	A GHG reduction must occur from sources, sinks, or reservoirs occurring within Newfoundland and Labrador.
	The GHG reduction project must have started no earlier than January 1, 2017. Please note that this start date may be revised following the approval of regulations in the future.
	Project reductions must relate to one or more of carbon dioxide, methane and nitrous oxide.
Real	The project proponent must provide a technical description of how the project will achieve a GHG reduction.
	The baseline scenario developed by the project proponent must result in a conservative estimate of the GHG reduction. A conservative estimate means that project GHG reductions must not be overestimated. Where data and assumptions are uncertain, and where measures to reduce uncertainty are not cost-effective, conservative values and assumptions must be used. Conservative values and assumptions are those that are more likely to underestimate rather than overestimate project reductions.
Quantifiable	The project proponent must describe how a monitoring plan is to be developed and the quantification protocol to be used in estimating the annual project reduction.
	Where applicable, the project proponent must also develop a plan to ensure permanence and compensate for the effects of leakage. This issue does not generally apply to energy efficiency and fuel switching projects.
Additional	The project must: (i) be distinct from its baseline scenario; and (ii) face financial, technological, regulatory, or social / cultural barriers, as described in Section 4.1.1.1. The incentive of the GHG reduction potentially being recognized as an offset must overcome or partially overcome these barriers. Project proponents must be able to justify these claims.
	Project proponents must consider existing or proposed federal, provincial and municipal regulatory requirements and incentives. The project must not result from actions otherwise required by law.

Verifiable	Project plans must be validated and project reports must be verified by an independent third-party auditor, pursuant to the following qualifications: The auditor to conduct validation of project plans and verification of project reports must be accredited: • By a member of the International Accreditation Forum, • In accordance with ISO 14065, • Through a program developed under ISO 17011. Please note that there are no regulations in place at this time, and requirements related to validation and verification may be modified depending on future regulatory provisions.
Counted Once	A GHG reduction can only be recognized as an offset if it has never been: (i) claimed (i.e., registered and retired) as an offset in any other regulated or voluntary offset system; or (ii) counted as a GHG reduction for GHG reporting purposes (e.g., in a facility report submitted for compliance purposes, in a provincial or national inventory report).
Clear Ownership	The project proponent must provide an assertion that, with respect to the GHG reductions to be achieved by carrying out the project, it has a defensible claim of ownership.

2.4 PROTOCOL-SPECIFIC ELIGIBILITY CRITERIA

Eligible existing and new facilities for all project types include, but are not limited to, the following:

- Fossil fuel-fired electricity generating stations supplying electricity to an isolated grid;
- Fossil fuel-fired electricity generating stations supplying electricity to the provincial grid, excluding the Holyrood Thermal Generating Station (HTGS) (eligibility for HTGS may be periodically reviewed in the future if and as appropriate);
- Industrial and manufacturing facilities that are not regulated under the *Management of Greenhouse Gas Act*;
- Residential buildings including, but not limited to:
  - Detached dwellings;
  - Attached dwellings and row houses;
  - Apartment and condominium buildings;
- Commercial and institutional buildings including, but not limited to:
  - Hotels, motels, and resorts;
  - Warehouses, distribution centres, and garages;
  - Retail malls and stores;
  - Office buildings;
  - Arenas;
  - Hospitals, clinics, and long term care homes;
  - Schools, Memorial University, College of the North Atlantic and other post-secondary institutions including campus residences; and,

- Community centres, libraries, historical properties and museums, and fire/ambulance service buildings.

For the purposes of the Protocol, eligible baseline scenario fuel and energy types are restricted to the following:

- Diesel;
- Fuel oil;
- Gasoline;
- Propane;
- Kerosene; and,
- Electricity delivered by an isolated grid for end-use consumption.

Electricity delivered by the provincial grid for end-use consumption, and any other fuel or energy type not listed above, are not eligible baseline scenario fuel and energy types.

The Protocol only applies to projects that meet all of the following criteria:

1. Project reductions result from reductions in CO_2, CH_4, and N_2O.
2. The project activity involves one of the following:
    1. The implementation of one or more energy conservation measures (ECMs) as defined in Section 1.2.1, where the project also meets the eligibility criteria in Section 2.5.1 and Section 2.5.1.1 (where applicable).
    2. Fuel switching from fossil fuel-fired energy generation to less GHG-intensive fossil fuel or renewable energy, where the project meets the eligibility criteria in Section 2.5.2 and Section 2.5.2.1 (where applicable).
    3. A combination of (1) and (2), where the project meets the eligibility criteria in Section 2.5.3, with the exception of eligibility criterion (5) under Section 2.5.1, which is not applicable to combined projects.
3. Where applicable, the project and baseline must have functionally equivalent outputs from energy generation processes within the project boundary (e.g., inputs are used to generate heat in both the project and baseline).
4. The quantification of emission reductions achieved by the project is based on actual measurement and monitoring, except where indicated in the Protocol.

2.5 PROJECT TYPE-SPECIFIC ELIGIBILITY CRITERIA

2.5.1 ENERGY EFFICIENCY PROJECT ELIGIBILITY CRITERIA

In addition to the criteria listed in Section 2.4, energy efficiency projects must meet the following eligibility criteria:

5. Inputs and outputs must be equivalent between the project and baseline, as indicated by an affirmation from the project developer that:

1. Fuel inputs to the project are of the same type as in the baseline (e.g., diesel in the baseline and diesel in the project). Otherwise the project is of type (2) or (3) and must be assessed against the applicable eligibility criteria for those project types.
2. Electricity delivered to the project is of the same source as in the baseline (e.g., isolated grid electricity delivered to the baseline facilities remains isolated grid electricity in the project and is not switched to provincial grid electricity). Otherwise the project is of type (2) or (3) and must be assessed against the applicable eligibility criteria for those project types.

2.5.1.1 INDUSTRIAL/MANUFACTURING FACILITY ELIGIBILITY CRITERIA

In addition to the criteria listed in Sections 2.4 and 2.5.1, energy efficiency projects undertaken at industrial/manufacturing facilities must meet the following eligibility criteria:

6. Outputs from the facility such as manufactured, industrial, and other commercial products must remain of the same type in the project and baseline, as indicated by an affirmation from the project developer.
7. A suitable unit of production can be defined and measured in order to apply the baseline adjustments described in Section 6.5.3.
8. At facilities with biological or chemical processes, the project activity must not cause any increase in non-biogenic GHG emissions from such processes, as indicated by an affirmation from the project developer and supported by evidence such as detailed process descriptions, emissions monitoring and/or detailed engineering calculations.[12] Otherwise, these emissions must be accounted for under the applicable flexibility mechanism described in Section 2.6.2.1.

2.5.2 FUEL SWITCHING PROJECT ELIGIBILITY CRITERIA

Eligible project fuel and energy types are restricted to the following:

- Gasoline
- Propane;
- Wood and wood-derived products (e.g., chips, pellets);
- Waste biomass that meets the eligibility criteria in Section 2.5.2.1;
- Electricity delivered by the provincial grid for end-use consumption; and,
- Renewable energy (including electricity and other forms of energy such as heat, e.g., passive solar heating).

[12] In some cases, non-biogenic emissions associated with biological or chemical processes may increase due to activities other than the project activity, such as an increase in production. Where it is demonstrated that there is no causal relationship between the project activity and emissions from these sources, as per eligibility criteria (8), the project satisfies the eligibility criteria. Otherwise, these emissions must be accounted for under the flexibility mechanism described in Section 2.6.2.1.

Biogas (from landfills, wastewater treatment, or any other source), and any other fuel or energy type not listed above, are not eligible project fuel and energy types.

In addition to the criteria listed in Section 2.4, fuel switching projects must meet the following eligibility criterion:

9. The project activity involves the adoption of one of the following, as indicated by an affirmation from the project developer:
    1. Combustion-based or energy conversion equipment that does not require additional material or energy inputs during its operation beyond:
        i. A primary fuel source.
        ii. An auxiliary fuel source (e.g., for start-ups), where auxiliary fuel consumption shall not exceed one percent of the total fuel consumption in the project, on an annual basis.
        iii. The substance that will receive or give up energy during the process, if applicable (e.g., the water that will heated).
        iv. Maintenance related materials, such as lubricating fluids, spare parts, etc.
    2. Non-combustion renewable energy technologies (including, but not limited to, wind, solar photovoltaics, solar thermal, and geothermal) that do not require additional material or energy inputs during operation beyond:
        i. A primary renewable energy source (e.g., wind, solar radiation)
        ii. The substance that will receive or give up energy during the process, if applicable (e.g., the water that will heated).
        iii. Maintenance related materials, such as lubricating fluids, spare parts, etc.
    3. Use of electricity from the provincial grid.

2.5.2.1 Biomass Fuel Switching Projects

Eligible biomass types are restricted to wood, wood-derived products (e.g., chips, pellets), and waste biomass.

Eligible waste biomass types are restricted to the following:

- Debris and residues from forest harvesting operations (e.g., branches, tree tops, roots);
- Residues and waste from wood product and pulp and paper product facilities (e.g., sawdust, bark, shavings, chips, wood waste);
- Agricultural crop residues (e.g., plant matter remaining after harvest);
- Processing residues and waste from food product processing facilities (agricultural processing and fisheries/aquaculture processing waste); and,
- Waste biomass from land flooded to create hydroelectric reservoirs.
- The organic fraction of municipal solid waste.

In addition to the criterion listed in Section 2.5.2, fuel switching projects that use waste biomass must meet the following eligibility criterion:

10. Project proponents must demonstrate that the biomass is a waste that would have been disposed of in the absence of the project and not have been used for any beneficial purpose. Waste biomass that would have been applied to agricultural land as fertilizer is therefore not an eligible waste biomass.[13]

2.5.3 COMBINED PROJECT ELIGIBILITY CRITERIA

Combined energy efficiency and fuel switching projects must meet the eligibility criteria in Section 2.4, Section 2.5.1.1 (where applicable), Section 2.5.2, and Section 2.5.2.1 (where applicable).

2.6 PROTOCOL FLEXIBILITY

2.6.1 GENERAL FLEXIBILITY MECHANISMS

The Protocol is intended to have applicability to a wide range projects. To facilitate this, the following general flexibility mechanisms are available for all project types:

1. Where justified and appropriately documented, project-specific emission factors may be used by the project proponent (subject to validation and verification) instead of the default factors noted in the Protocol.
2. To account for the wide variety of potential project applications, project-specific monitoring / metering approaches may be used by the project proponent where they conform to the general requirements stipulated in the Protocol. Such project-specific approaches may also include the aggregation of multiple emission sources together where project metering treats those emission sources as one larger combined entity (e.g., multiple energy sources producing electricity that is tracked by a single meter).
3. The project proponent may exclude some additional SSRs from quantification beyond those excluded by default in the Protocol, based on project-specific circumstances and in conformance with relevant good practice guidance (and subject to validation and verification). This is particularly the case for renewable energy projects, where default fuel combustion related SSRs may not be applicable, and for projects that do not use biomass, which can exclude all of the biomass-related SSRs.

2.6.2 PROJECT TYPE-SPECIFIC FLEXIBILITY MECHANISMS

The following flexibility mechanism is available for all projects:

4. The Protocol allows any of the four approaches in the IPMVP to be used in order to provide flexibility for project proponents (refer to Appendix A and Sections 4.7 to 4.9 of the IPMVP, Volume 1). These approaches are intended to balance the level of detail in monitoring requirements with the degree of conservativeness in calculations to ensure that GHG emission reductions quantified under each approach are both accurate and

[13] This refers to biomass such as agricultural residues or biomass-derived products such as compost that would have been applied to, or left to decompose on, agricultural land in the absence of the project.

verifiable. Project proponents may choose among these four approaches depending on project-specific considerations. Further details are provided in Section 6 of the Protocol.

2.6.2.1 Energy Efficiency Projects at Industrial/Manufacturing Facilities

For energy efficiency projects at industrial or manufacturing facilities that do not meet eligibility criterion (8) in Section 2.5.1.1, the following flexibility mechanism is available:

5. The project proponent must provide and justify an appropriate model for baseline and project emissions from biological or chemical processes altered at the facility. Emissions must be quantified under SSRs P15/B14 as described in Sections 3.8.1 and 4.2.1, and included in the quantification of project reductions.

2.6.2.2 Fuel Switching Projects

The following flexibility mechanism is available for fuel switching projects:

6. A project proponent may elect to quantify emissions associated with fossil fuel transport within the province under SSRs P11/B11 as described in Sections 3.8.1 and 4.2.1; otherwise, the Protocol allows these emissions to be conservatively excluded from consideration.

2.6.2.3 Combined Projects

The flexibility mechanisms in Sections 2.6.2.1 (where applicable) and 2.6.2.2 may be applied to combined projects.

3 PROJECT CONDITION

3.1 DESCRIPTION OF THE PROJECT

In addition to any project description requirements stipulated by any regulations associated with the *Act* or other offset system requirements, the project proponent must describe the following:

- Whether the project is: 1) stand-alone or aggregated, or 2) a program of activities (PoA);
- Project components (e.g., equipment, systems, processes, technologies, ECMs);
- How GHG emission reductions will be achieved; and,
- Material and energy inputs, outputs, and flows within the project boundary.

The project boundary describes the boundaries within which the project activity takes place. This could be a physical site boundary for projects implemented in buildings or industrial facilities. It could also be a smaller portion of the facility within which the project activity takes place. Activities that occur within the project boundary (e.g., fuel combustion) are directly controlled by the project proponent, whereas activities that occur outside of the project boundary (e.g., fuel delivery) are related to, but typically not directly controlled by the project proponent.

3.2 PROJECT START DATE

The project start date is the first date on which emission reduction activities become eligible to generate offset credits. The project start date must be no earlier than January 1, 2017. Please note that this start date may be revised following the approval of regulations in the future.

3.3 PROJECT CREDITING PERIOD

The project crediting period is eight years with provision for an additional five-year crediting period contingent on an assessment by the regulator as to whether the project is still additional and the baseline still applies, after which the emission offset project will end. Please note that the crediting period may be revised following the approval of regulations in the future.

3.4 PROJECT REPORT PERIOD

The project report period is one or more consecutive 12-month periods.

3.5 MATERIALITY

The materiality threshold for the Protocol is 5 percent. Please note that materiality may be revised following the approval of regulations in the future.

3.6 IDENTIFICATION OF THE PROJECT LOCATION

3.6.1 STAND-ALONE OR AGGREGATED PROJECTS

Project identification information, including geographical information about the location where the project will be carried out and any other information allowing for the unique identification of all emission reduction activities at all identified project sites must be provided by project proponents.

Project documentation must include global positioning system (GPS) coordinates for the location(s) where the project will be carried out. Other information allowing for the unique identification of the project location(s) may also be included (e.g., aerial photographs, satellite imagery, street address).

3.6.2 PROGRAM OF ACTIVITIES

For all project instances implemented at the time of validation, project plans must provide GPS coordinates for the location of each project instance. Other information allowing for the unique identification of the project location(s) may also be included (e.g., aerial photographs, satellite imagery, street address).

Proponents of PoAs must describe in detail in the project plan the approach that will be used for identification of project instances that are not determinable when the project plan is validated. Project plans must include a description of how this approach will enable future audits and inspections to identify each individual project instance and ensure that the reported project activities have been implemented.

3.7 PROJECT JUSTIFICATION

Project proponents must assert that there are financial, technological, or other barriers to carrying out the project that are overcome or partially overcome by the incentive of having the project reductions recognized as offset credits under the *Act* and associated regulations. Proponents must provide justification for this assertion.

3.8 IDENTIFICATION OF PROJECT SOURCES, SINKS, AND RESERVOIRS (SSRS)

3.8.1 IDENTIFICATION OF SSRS FOR THE PROJECT

To assist with identifying SSRs for the project, a generic activity and material / energy flow diagram is provided in Figure 2. The model is intended to cover a broad range of project scenarios. Using the model, as well as available good practice guidance and considering the range of likely project types, SSRs were identified. Identified SSRs are illustrated in Figure 3 and described in more detail in Table 2. Note that a particular project may only involve a sub-set of these SSRs, depending on the project type and other project-specific details.

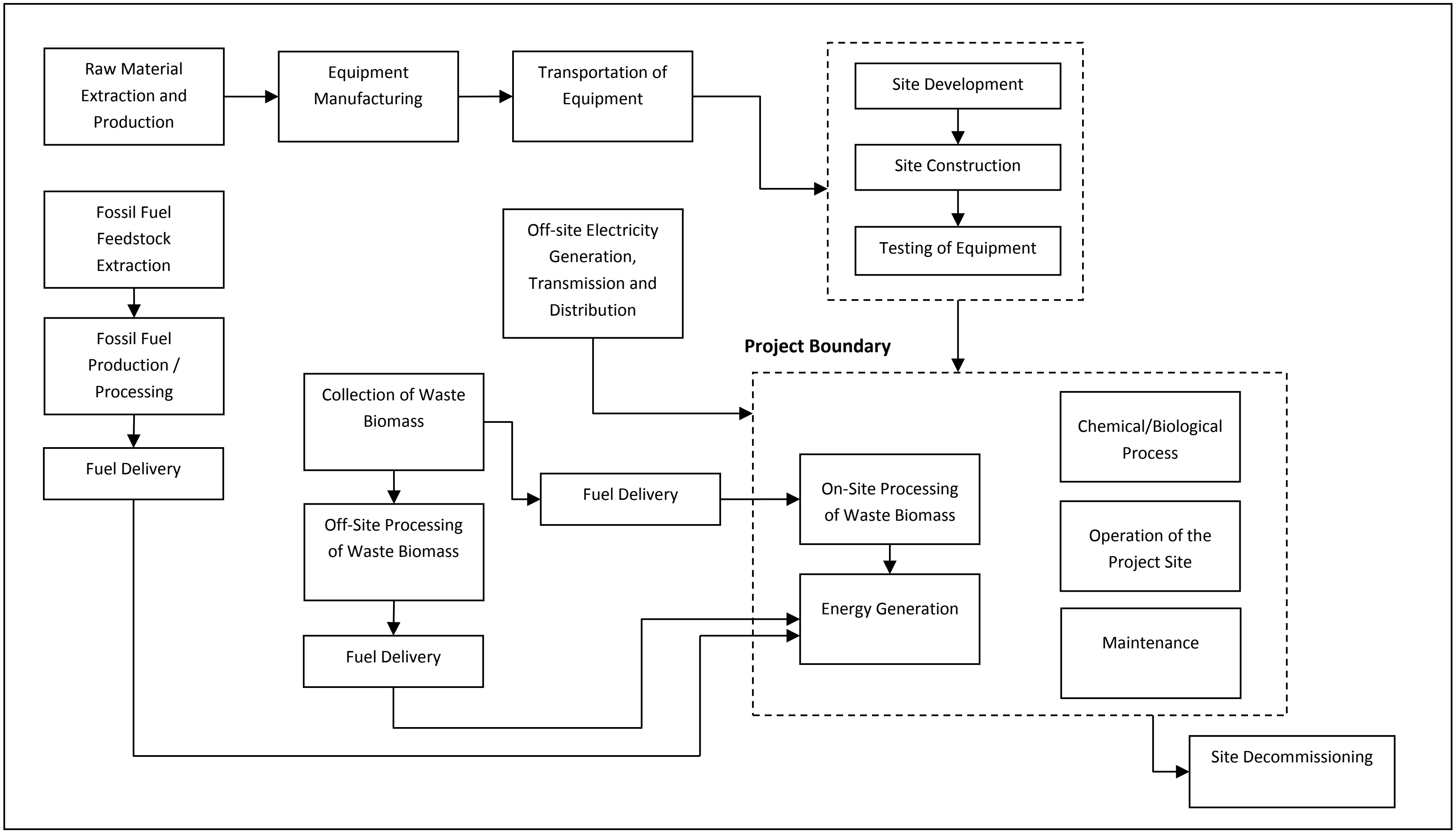

Figure 2: Generic Activity, Material, and Energy Diagram for the Project Condition

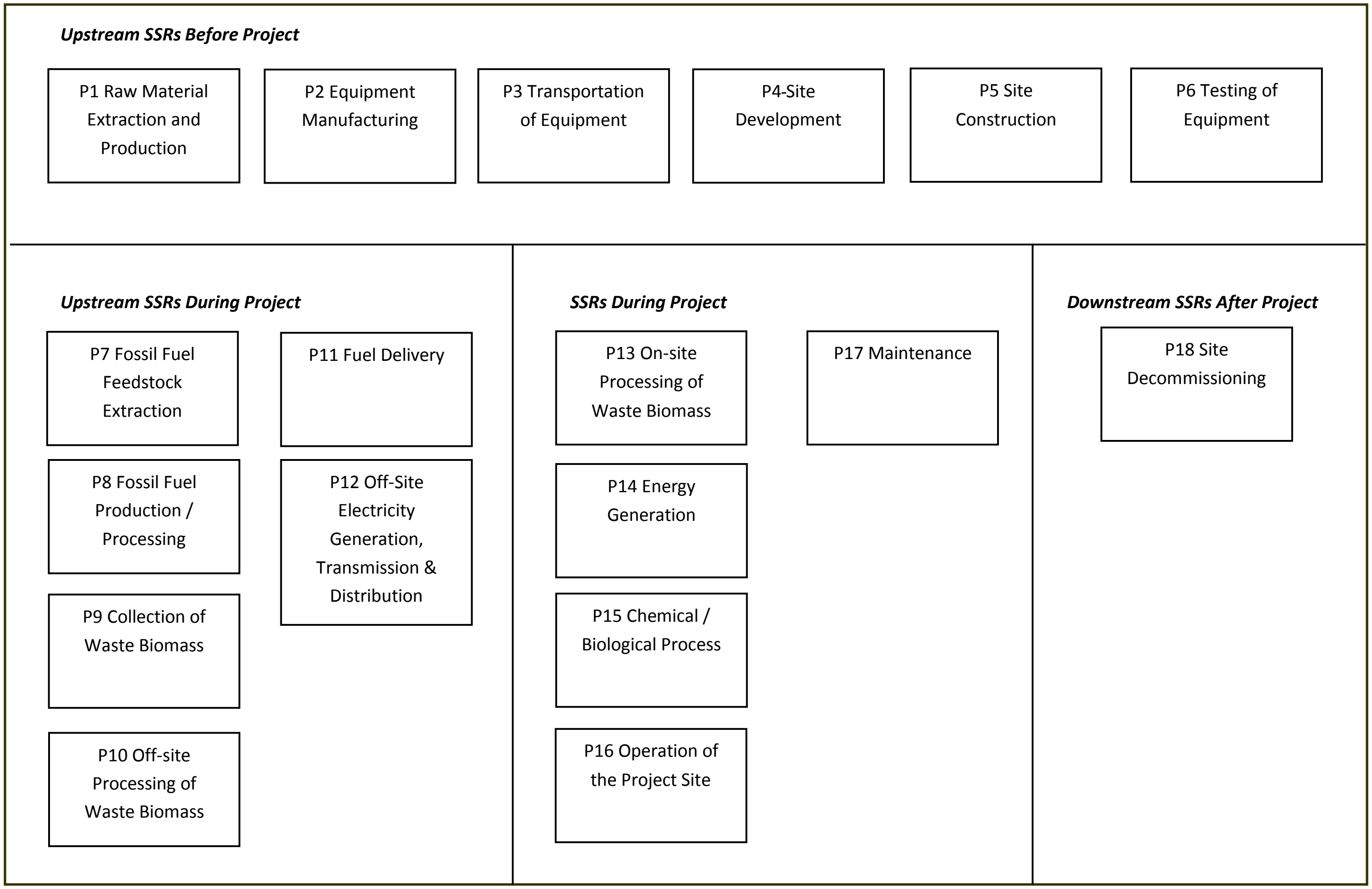

Figure 3: Project Condition SSR Diagram

3.8.2 Description of Project SSRs

Identified project SSRs are listed in detail in Table 2.

Explanation of SSRs Categorization

All SSRs were categorized as controlled, related or affected based on their relation to the project proponent. Controlled means directly controlled by the proponent; related means connected to controlled SSRs by material or energy flows; affected means influenced by a project activity through changes in market demand or supply for associated products or services, or through physical displacement (there are no affected SSRs in the Protocol).

Table 2: List of Project SSRs

Number	Source, Sink or Reservoir (SSR)	Description	Controlled, Related or Affected
Upstream SSRs before project operation			
P1	Raw Material Extraction and Production	All activities related to the extraction, processing and production of all raw materials for the project equipment, technologies, and/or processes. For example: steel for wind turbines; metals for solar photovoltaic panels; building insulation material. GHG emissions may arise from the combustion of fossil fuels and/or consumption of electricity.	Related
P2	Equipment Manufacturing	Project equipment, materials, and/or technologies may be manufactured either at the project site or off-site. These may be sourced as pre-made standard equipment or custom built to specification. GHG emissions would be attributed primarily to the consumption of fossil fuels and/or electricity used to power equipment and processes for fabrication and assembly.	Related
P3	Transportation of Equipment	Equipment, materials, and or technologies manufactured off-site will need to be delivered to the project site. GHG emissions would be attributed primarily to the consumption of fossil fuels used to power the transportation equipment. Transportation may be completed by truck, air, and/or tanker.	Related
P4	Site Development	The project site may need to be developed. This could include civil infrastructure such as access to electricity, water supply, sewer, etc. This may also include clearing, grading, and building access roads. GHG emissions would primarily be attributed to the consumption of fossil fuels used to power the equipment required to develop the site such as graders, backhoes, trenching machines, etc. GHG emissions may also include the reduction of carbon sinks where forests are cleared.	Related
P5	Site Construction	The process of construction at the project site will require a variety of heavy equipment, smaller power tools, cranes, generators, etc. GHG emissions would be primarily attributed to the consumption of fossil fuels and/or electricity used to power this equipment.	Related

Number	Source, Sink or Reservoir (SSR)	Description	Controlled, Related or Affected
P6	Testing of Equipment	Project equipment and/or technology may need to be tested to ensure it is operational. This may involve running the equipment using fossil fuels and/or electricity. This may result in GHG emissions.	Related
Upstream SSRs during project operation			
P7	Fossil Fuel Feedstock Extraction	Fossil fuels used at the project site will need to be produced from an extracted feedstock (e.g., crude oil). GHG emissions are typically associated with the energy consumed to extract the feedstock (e.g. from an oil reservoir).	Related
P8	Fossil Fuel Production / Processing	Fossil fuels used at the project site will need to be produced from a feedstock through processing and refining. GHG emissions are typically associated with the energy consumed to process the fuel into a usable form.	Related
P9	Collection of Biomass	Biomass may need to be harvested, collected from the forest floor or agricultural facilities, or other sources using heavy equipment, conveyors, and other machinery. This may result in GHG emissions associated with the consumption of fossil fuels used to power the collection equipment.	Related
P10	Off-site Processing of Biomass	Biomass may need to be processed off-site using chippers, pelletizers, mechanical processes, heavy equipment, conveyors, drying equipment, etc. This equipment may be powered by fossil fuels, resulting in GHG emissions.	Related
P11	Fuel Delivery	Fuels used at the project site will need to be delivered. GHG emissions would be attributed primarily to the consumption of fossil fuels in the province used to power the transportation equipment. Transportation may be completed by truck, air, and/or tanker.	Related
P12	Off-site Electricity Generation, Transmission, & Distribution	Electricity may be required to operate equipment at the project site. Generation of this electricity may result in GHG emissions, depending on the source of the electricity.	Related
SSRs during project operation			
P13	On-site Processing of Biomass	If biomass is not pre-processed off-site before being delivered to the project site, it may need to be processed at the project site using chippers, pelletizers, mechanical processes, heavy equipment, conveyors, drying equipment, etc. This equipment may be powered by fossil fuels, resulting in GHG emissions.	Controlled

Number	Source, Sink or Reservoir (SSR)	Description	Controlled, Related or Affected
P14	Energy Generation	A process may occur at the project site that results in one or any combination of the following: • generation of electricity; and/or, • addition or removal of energy from a substance, be it solid, liquid or gas, including but not necessarily limited to: o generation of steam; o generation of heated air or water (e.g., for industrial process use, space heating, domestic hot water); o generation of chilled air or water (e.g., for industrial process use, space cooling); and/or o compression (e.g., compression of gas such as air, thereby raising its pressure and possibly temperature in the process). GHG emissions will be associated with energy generation where fuels are combusted.	Controlled
P15	Chemical / Biological Process	GHG emissions may be associated with the operation and maintenance of a chemical or biological process at the project site, such as a fermentation process at a brewery or distillery, or a process at a chemicals facility.	Controlled
P16	Operation of the Project Site	GHG emissions may be associated with interactive effects (refer to Sections 6.1 and 6.1.1), where the project activity causes a change in energy consumption and/or generation that is not accounted for under other SSRs. The emissions associated with the interactive effect are included under P16 where the effect is positive (i.e., site energy consumption and/or generation is increased by the project activity).	Controlled
P17	Maintenance	GHG emissions may occur during scheduled and non-scheduled maintenance of the project facility and its equipment. Examples include running back-up equipment such as generators.	Controlled
Downstream SSRs during project operation			
Downstream SSRs after project operation			
P18	Site Decommissioning	Once the project is no longer operational, the project site may need to be decommissioned. This may involve the disassembly of the equipment, demolition of project facility structures, disposal of materials, environmental restoration, re-grading, planting or seeding, and transportation of materials off-site. GHG emissions would be primarily attributed to the consumption of fuels and/or electricity used to power equipment.	Related

4 ESTABLISHMENT OF BASELINE SCENARIO

Baseline emissions are an estimate of the quantity of emissions that would have occurred had the project not been implemented. To estimate these emissions, it is necessary to identify and select a baseline scenario representing what would have most likely occurred in the absence of the project.

4.1 BASELINE APPROACH SELECTION AND JUSTIFICATION

4.1.1 TYPES OF BASELINES APPLICABLE TO THE PROTOCOL

The following general types of baseline scenarios are applicable to the Protocol:

- Project-specific; and,
- Simulation-based.

The project-specific baseline is applicable to retrofits of existing facilities and the simulation-based baseline is applicable to new build facilities.

Project proponents must select an appropriate baseline for each year of the crediting period, and identify the baseline(s) in the project plan. For existing facilities, a situation may arise where it is appropriate to use a project-specific historic baseline in the initial years of the crediting period and then a different project-specific baseline in the latter years of the crediting period, as described in more detail below. In such situations, the baseline must be identified for each year of the crediting period.

4.1.1.1 PROJECT-SPECIFIC

Project proponents must identify and select a project-specific baseline for projects that involve retrofitting existing facilities. The procedure listed below must be followed by project proponents to select an appropriate baseline scenario.

1. Project plans must provide a list of plausible alternatives to the project that provide the same function (i.e., product or service) as the project (e.g., heating, electricity generation, steam generation). These are referred to as baseline candidates. Baseline candidates that must be considered include the following:
    - The project condition;
    - Continuation of current, pre-project, practices (i.e., historic baseline);
    - Alternative energy generation equipment and/or components (e.g., equipment, systems, processes, technologies) that provide the same product or service as the project components (e.g., lighting or heating a building, generating electricity to supply an isolated grid); and,
    - For fuel switching and combined projects, all commercially available fuel types in the geographical region in which the project occurs.

2. Project plans must identify potential barriers that would prevent the implementation of baseline candidates. Project proponents must consider, at minimum, financial, regulatory, technical and social / cultural barriers that each identified baseline scenario candidate may face.

    - Financial: a baseline candidate may face barriers related to capital costs, operating costs, and other costs such as labour or maintenance. Funding from government programs or other sources may increase the viability of certain baseline candidates.
    - Regulatory: a baseline candidate could be in violation of existing or proposed regulatory requirements or laws.[14]
    - Technical: a baseline scenario candidate may require technical expertise that is not available or cost-prohibitive in the geographical region where the project takes place. A technical solution may not be applicable to, or implementable at, the project facility.
    - Social / Cultural: social acceptance of particular energy generation processes, fuel / energy type, or other baseline components may be a barrier, as evidenced at minimum by qualitative consideration of common practice / extent of market share of the different baseline candidates.

    Project proponents must also consider whether there are additional baseline-specific barriers that should be included. Examples of such barriers include, but are not limited to, the following:

    - Infrastructure: lack of infrastructure may present a barrier in terms of types of fuels available at the site, transmission and distribution equipment, necessary structures, etc.
    - Institutional / Political: resistance to the baseline at an institutional level or political level may present a barrier.
    - Fuel Procurement: challenges in procuring or cost of obtaining a reliable supply of certain types of fuel may present a barrier.

3. Project plans must present a comparative assessment of barriers that face each of the baseline scenario candidates. Project proponents must identify both the presence of a barrier and estimate the magnitude of the barrier for each baseline scenario candidate identified. The magnitude of a barrier may be characterized qualitatively using descriptive explanations and justifications for the characterization. In the project plan, project proponents must substantiate and explain the cumulative effects of the barriers on the viability of each baseline scenario candidate. The results of the cumulative effects must be presented so that a third-party auditor could form an opinion as to which of the baseline scenario candidates is most likely to occur.
4. The project proponent must select the most appropriate baseline scenario based on the results of the comparative assessment completed above, where the scenario facing the fewest barriers from a qualitative assessment would be the baseline. Where multiple scenarios are deemed equally likely, the scenario that would result in the lowest baseline emissions shall be selected as the baseline scenario.

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[14] For example, a fuel may be available in a region (e.g., wood) but its use as a heating fuel could be restricted by air pollution regulations. The fuel would be listed as a baseline candidate, but would face a regulatory barrier and hence would not be the most appropriate baseline scenario.

Where the project condition is selected as the baseline, then the project is not eligible for offsets (i.e., there are no projected emission reductions beyond 'business-as-usual').

Where the baseline selected is the continuation of current, pre-project, practices (i.e., historic baseline), project proponents must assert and provide evidence that if the project were not to proceed, current assets including energy generation equipment and/or energy consuming facility components (e.g., equipment, systems, processes, technologies) would have been operational during the crediting period under consideration. The evidence must show that the existing asset would not have reached the end of its useful lifetime in a year of the crediting period under consideration. The assertion may be supported by any of the following evidence:

- The original manufacture or installation date and the typical lifetime of the asset. The original manufacture or installation date may be supported by records, equipment labels, or any other form of evidence justified by the project proponent. The typical lifetime of the asset may be supported by manufacturer specifications, company practices for comparable assets, common practices within the sector, or any other form of evidence justified by the project proponent, 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 (i.e., 10+ years) in the sector in which the project takes place, or with the assets under consideration.
- Any other form of evidence where justified by the project proponent and deemed acceptable by a third-party auditor.

The historic baseline can only be used for quantifying reductions in reporting periods up to and including the final year of the baseline asset's useful lifetime. After this point, it is no longer justifiable to assume an historic baseline.

A situation may arise where it is appropriate to use an historic baseline in the initial years of the crediting period and then a different project-specific baseline in the latter years of the crediting period. This approach would be applicable where an existing asset would have reached the end of its useful lifetime during the project crediting period, and would have been replaced or retrofitted (to extend its lifetime). In a situation where the asset would have been replaced with a new asset of the same type, it is not certain that the new asset would have exactly the same characteristics (e.g., efficiency) as the old asset. Alternatively, it is possible that a decision would have been made to replace the asset with an asset of a different type, which delivers the same product or service in a different manner (e.g., electric heating is installed to replace a fossil-fuel-fired boiler at its end-of-life).

The procedure listed above must be carried out again by the project proponent to determine the appropriate baseline scenario for reporting years after the year in which the baseline asset would have reached the end of its useful lifetime. Baseline candidates that must be considered are the same as above, 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 asset(s) through retrofit. For energy efficiency and combined projects, the project proponent must consider whether the retrofit would have an effect on the efficiency of the asset. If there is an effect on asset efficiency, this must be taken into account in baseline emissions quantification.

- Replacement of the asset with an asset of the same type. This must consider whether the efficiency of the new asset would be different than the end-of-life asset due to, e.g., regulatory requirements or continual improvements in asset efficiency since the original asset was manufactured.

For a program of activities or aggregated project, the procedure described above must be completed for each project instance.

4.1.1.2 Simulation-Based Baseline

Historical data are not available for new facilities and therefore an historic baseline is not applicable to new facilities. A simulation-based baseline is a type of project-specific baseline involving the construction of a model or simulation based on relevant good practice guidance.

Buildings Example: buildings registered under the Leadership in Energy and Environmental Design (LEED) program must conduct baseline energy model simulations based on codes and standards. Baseline energy consumption is calculated based on assumptions using an approved energy simulation software.[15] This would be an eligible method for estimating baseline energy use under the Protocol, where justifications for the baseline assumptions are provided (further discussed below).

The simulation-based baseline does not require the barriers test described in Section 4.1.1.1 with respect to energy generation equipment and/or components (e.g., equipment, systems, processes, technologies); however, a barriers test that assesses all commercially available fuel types in the geographical region in which the project occurs is required for any fuel switching components of the project. It would be too onerous for project proponents to complete a barriers test for every energy generating and/or energy consuming component of a new facility.

The project plan must provide a justification for assumptions related to baseline energy use and efficiency, based on relevant regulations, codes, standards, and/or current industry practice. The project plan must establish and justify the baseline energy consumption based on current practice in the construction of new facilities and the energy efficiency requirements contained in regulations, codes, and/or standards relevant to the Province of Newfoundland and Labrador. For buildings, these include, but are not limited to, the latest versions of the National Building Code of Canada, National Energy Code of Canada for Buildings[16] (NECB) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Energy Standard for Buildings (Section 90.1).[17]

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[15] For reference, the Canada Green Building Council (CaGBC) provides a list of approved simulation software for LEED Canada. Note that this protocol does not prescribe any specific software. Any software used by the project proponent must be justified as good practice by the project proponent. For example, the CaGBC list of approved software could be referenced by a project proponent. The list may be found online: http://www.cagbc.org/cagbcdocs/LEED_Canada_approved_software-EN.pdf

[16] Note that Newfoundland and Labrador has not adopted the NECB at this time.

[17] Note that a 2015 study found that for buildings in NL, insulation levels, lighting power densities and HVAC equipment efficiency were generally better than the values required by ASHRAE 90.1-2007 and often approaching ASHRAE 90.1-2010 or NECB 2011 values. Caneta Research Inc. (March 31, 2015). 2011 National Energy Code for Buildings: Archetype Building Analysis for Newfoundland and Labrador. Available online: http://www.ecc.gov.nl.ca/publications/climate_change/necb_archetype_analysis.pdf

Justification for the selection of the appropriate edition of the standard or building code must be provided in the offset project plan and should speak to the relevant version being used based on the project/building characteristics and year of design or commissioning.

New industrial/manufacturing facilities must provide a justification of the baseline energy consumption per unit of production based on current industry practice.

4.2 IDENTIFICATION OF SSRS FOR THE BASELINE

4.2.1 IDENTIFICATION OF RELEVANT SSRS FOR THE BASELINE

To assist with applying the procedures for identifying SSRs for the baseline, a generic activity and materials / energy flow diagram is provided in Figure 4. Using this model, as well as available good practice guidance, SSRs were identified. Identified SSRs are illustrated in Figure 5 and described in more detail in Table 3. Note that a particular baseline may only involve a sub-set of these SSRs.

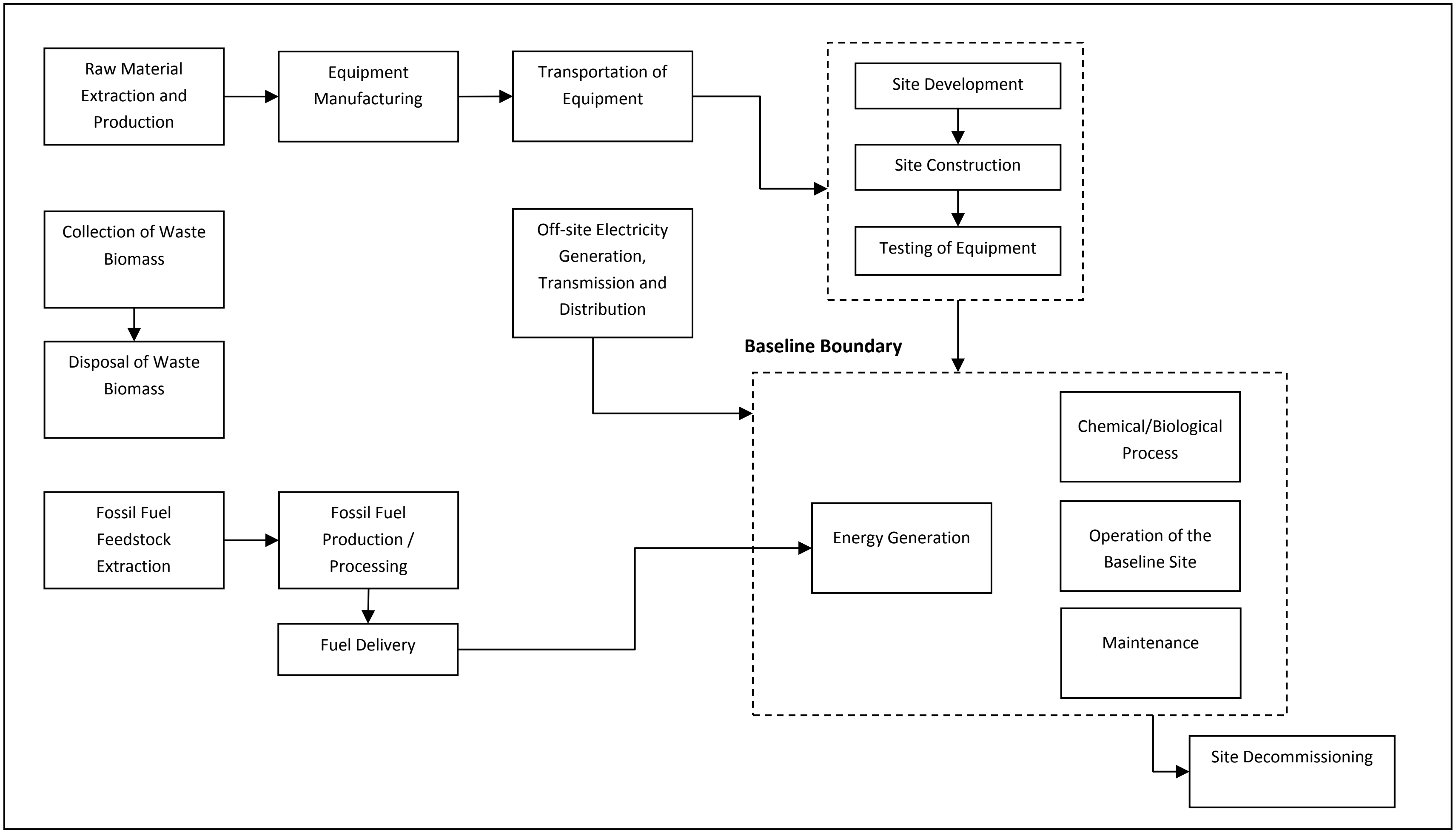

Figure 4: Generic Activity, Material, and Energy Diagram for the Baseline Scenario

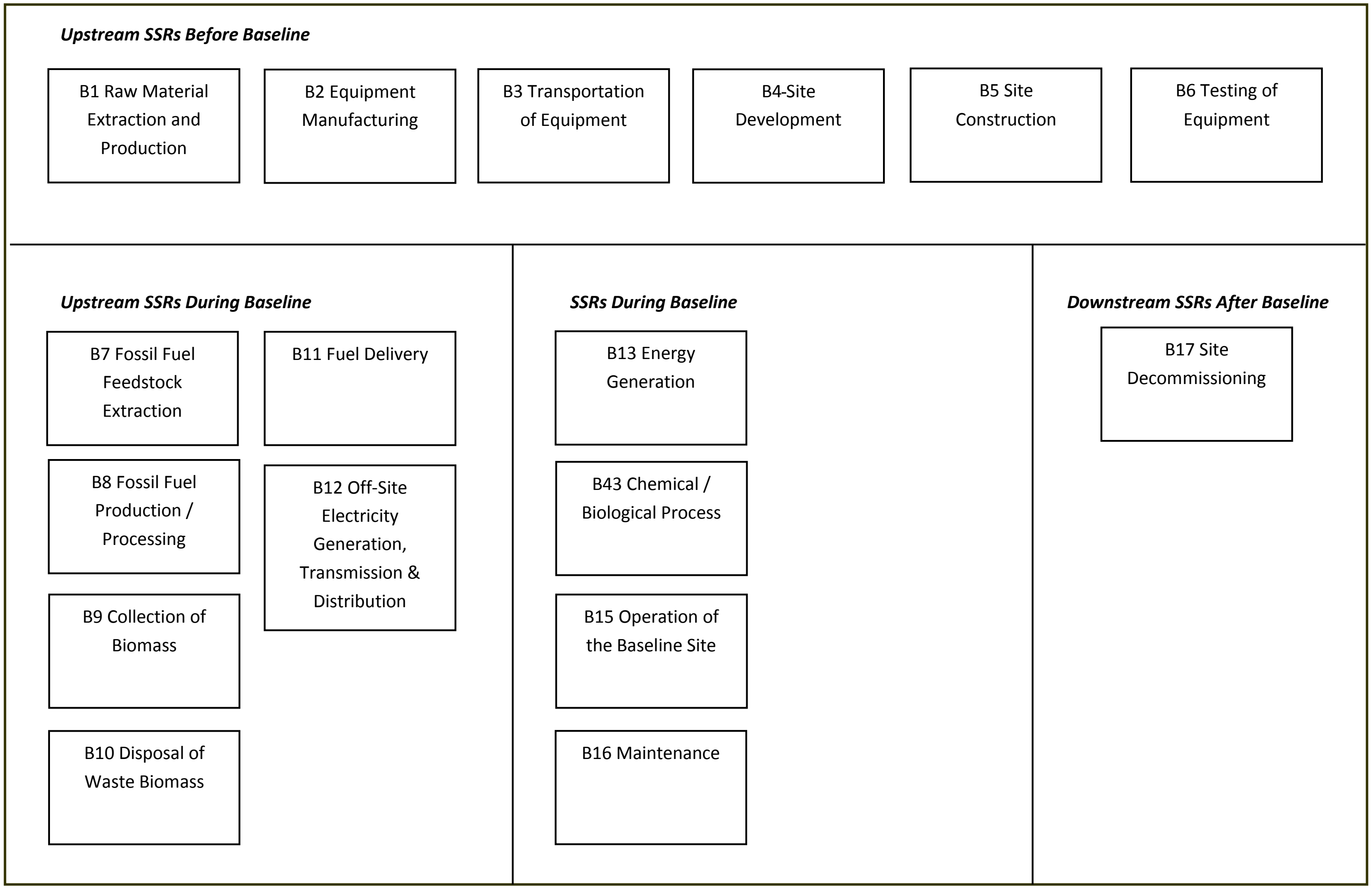

Figure 5: Baseline Scenario SSR Diagram

4.2.2 DESCRIPTION OF BASELINE SSRS

Identified baseline SSRs are listed in detail in Table 3.

Table 3: List of Baseline SSRs

Number	Source, Sink or Reservoir (SSR)	Description	Controlled, Related or Affected
Upstream SSRs before baseline operation			
B1	Raw Material Extraction and Production	All activities related to the extraction, processing and production of all raw materials for the baseline equipment, technologies, and/or processes. GHG emissions may arise from the combustion of fossil fuels and/or consumption of electricity.	Related
B2	Equipment Manufacturing	Baseline equipment, materials, and/or technologies may be manufactured either at the baseline site or off-site. These may be sourced as pre-made standard equipment or custom built to specification. GHG emissions would be attributed primarily to the consumption of fossil fuels and/or electricity used to power equipment and processes for fabrication and assembly.	Related
B3	Transportation of Equipment	Equipment, materials, and or technologies manufactured off-site will need to be delivered to the baseline site. GHG emissions would be attributed primarily to the consumption of fossil fuels used to power the transportation equipment. Transportation may be completed by truck, air, and/or tanker.	Related
B4	Site Development	The baseline site may need to be developed. This could include civil infrastructure such as access to electricity, water supply, sewer, etc. This may also include clearing, grading, and building access roads. GHG emissions would primarily be attributed to the consumption of fossil fuels used to power the equipment required to develop the site such as graders, backhoes, trenching machines, etc. GHG emissions may also include the reduction of carbon sinks where forests are cleared.	Related
B5	Site Construction	The process of construction at the baseline site will require a variety of heavy equipment, smaller power tools, cranes, generators, etc. GHG emissions would be primarily attributed to the consumption of fossil fuels and/or electricity used to power this equipment.	Related
B6	Testing of Equipment	Baseline equipment and/or technology may need to be tested to ensure it is operational. This may involve running the equipment using fossil fuels and/or electricity. This may result in GHG emissions.	Related
Upstream SSRs during baseline			

Number	Source, Sink or Reservoir (SSR)	Description	Controlled, Related or Affected
B7	Fossil Fuel Feedstock Extraction	Fossil fuels used in the baseline will need to be produced from an extracted feedstock (e.g., crude oil). GHG emissions are typically associated with the energy consumed to extract the feedstock (e.g. from an oil reservoir).	Related
B8	Fossil Fuel Production / Processing	Fossil fuels used in the baseline will need to be produced from a feedstock through processing and refining. GHG emissions are typically associated with the energy consumed to process the fuel into a usable form.	Related
B9	Collection of Biomass	Biomass may need to be harvested, collected from the forest floor or agricultural facilities, or other sources using heavy equipment, conveyors, and other machinery. This may result in GHG emissions associated with the consumption of fossil fuels used to power the collection equipment.	Related
B10	Disposal of Waste Biomass	Waste biomass may be disposed of in a landfill or stockpile in the baseline. This would typically result in GHG emissions; however, these emissions are not eligible for offset credits under this version of the Protocol.	Related
B11	Fuel Delivery	Fuels used at the baseline site will need to be delivered. GHG emissions would be attributed primarily to the consumption of fossil fuels used to power the transportation equipment within the province. Transportation may be completed by truck, air, and/or tanker.	Related
B12	Off-site electricity Generation, Transmission & Distribution	Electricity may be required to operate equipment in the baseline. Generation of this electricity may result in GHG emissions, depending on the source of the electricity.	Related
SSRs during baseline			
B13	Energy Generation	A process may occur in the baseline that results in one or any combination of the following: • generation of electricity; and/or, • addition or removal of energy from a substance, be it solid, liquid or gas, including but not necessarily limited to: o generation of steam; o generation of heated air or water (e.g., for industrial process use, space heating, domestic hot water); o generation of chilled air or water (e.g., for industrial process use, space cooling); and/or o compression (e.g., compression of gas such as air, thereby raising its pressure and possibly temperature in the process). GHG emissions will be associated with energy generation where fuels are combusted.	Controlled

Number	Source, Sink or Reservoir (SSR)	Description	Controlled, Related or Affected
B14	Chemical / Biological Process	GHG emissions may be associated with the operation and maintenance of a chemical or biological process in the baseline, such as a fermentation process at a brewery or distillery, or a process at a chemicals facility.	Controlled
B15	Operation of the Baseline Site	GHG emissions may be associated with interactive effects (refer to Sections 6.1 and 6.1.1), where the project activity causes a change in energy consumption and/or generation that is not accounted for under other SSRs. The emissions associated with the interactive effect are included under B15 where the effect is negative (i.e., site energy consumption and/or generation is decreased by the project activity).	Controlled
B16	Maintenance	GHG emissions may occur during scheduled and non-scheduled maintenance of the baseline facility and its equipment. Examples include transportation to and from the facility and running back-up equipment such as generators.	Controlled
Downstream SSRs during baseline			
Downstream SSRs after baseline			
B17	Site Decommissioning	Once the baseline site is no longer operational, it may need to be decommissioned. This may involve the disassembly of the equipment, demolition of facility structures, disposal of materials, environmental restoration, re-grading, planting or seeding, and transportation of materials off-site. GHG emissions would be primarily attributed to the consumption of fossil fuels and/or electricity used to power equipment.	Related

5 COMPARE PROJECT AND BASELINE SSRS AND SELECT RELEVANT SSRS

5.1.1 RELEVANT SSRS

Table 4 presents all identified project and baseline SSRs and indicates which are relevant to the quantification.

Table 4: Identification of Relevant SSRs

SSR	Controlled, Related or Affected		Relevant?	Justification
	Baseline	Project		
Upstream SSRs Before Operation				
P1/B1 Raw Material Extraction and Production	Related	Related	Not Relevant	All one-time only upstream and downstream emission sources before and after operation are considered immaterial and excluded.
P2/B2 Equipment Manufacturing	Related	Related	Not Relevant	All one-time only upstream and downstream emission sources before and after operation are considered immaterial and excluded.
P3/B3 Transportation of Equipment	Related	Related	Not Relevant	All one-time only upstream and downstream emission sources before and after operation are considered immaterial and excluded.
P4/B4 Site Development	Related	Related	Not Relevant	All one-time only upstream and downstream emission sources before and after operation are considered immaterial and excluded.
P5/B5 Site Construction	Related	Related	Not Relevant	All one-time only upstream and downstream emission sources before and after operation are considered immaterial and excluded.
P6/B6 Testing of Equipment	Related	Related	Not Relevant	All one-time only upstream and downstream emission sources before and after operation are considered immaterial and excluded.
Upstream SSRs During Operation				
P7/B7 Fossil Fuel Feedstock Extraction	Related	Related	Not Relevant	Conservatively excluded as emissions are greater for the baseline than the project and may occur in other jurisdictions where the facilities are regulated or not under the control of the project proponent.

SSR	Controlled, Related or Affected		Relevant?	Justification
	Baseline	Project		
P8/B8 Fossil Fuel Production / Processing	Related	Related	Not Relevant	Conservatively excluded as emissions are greater for the baseline than the project and may occur in other jurisdictions where the facilities are regulated or not under the control of the project proponent.
P9/B9 Collection of Biomass	Related	Related	Not Relevant	Activities and hence emissions associated with this SSR are expected to be similar in the project and baseline, and are therefore excluded.
B10 Disposal of Waste Biomass	Related	n/a	Not Relevant	Emissions associated with the disposal of waste biomass are not eligible to generate offset credits under this version of the Protocol.
P10 Off-site Processing of Biomass	n/a	Related	Relevant*	*This SSR is only potentially relevant for fuel switching and combined projects that utilize biomass and where the biomass is processed off-site. Include: Project Fuel switching and combined projects: where the project requires off-site processing of biomass that would not have occurred in the baseline scenario, and the processing equipment consumes fossil fuels.
P11/B11 Fuel Delivery	Related	Related	Proponent Choice or Relevant	Proponent Choice If the project proponent determines it is not cost-effective to account for this SSR, it may be conservatively excluded from the project and baseline for the following project types: • Energy efficiency projects. • Fuel switching projects other than those where biomass is a project fuel. • Combined projects other than those where biomass is a project fuel. Otherwise, the proponent may choose to include this SSR in both the project and baseline. Include: Project; Exclude: Baseline For fuel switching or combined projects that utilize biomass, this SSR is included if the biomass would not have been transported to the project site in the absence

SSR	Controlled, Related or Affected		Relevant?	Justification
	Baseline	Project		
				of the project. Otherwise, this SSR may be excluded from quantification.
P12/B12 Off-site Electricity Generation, Transmission & Distribution	Related	Related	Relevant*	*These SSRs are only relevant for projects and/or baseline scenarios where electricity from an isolated grid is consumed. The Protocol considers the provincial grid carbon neutral and therefore these SSRs are not relevant for projects and/or baseline scenarios where electricity from the provincial grid is consumed.
SSRs During Operation				
P13 On-site Processing of Biomass	n/a	Related	Relevant*	*These SSRs are only potentially relevant for fuel switching and combined projects that utilize biomass and where biomass is processed on-site. <u>Include: Project; Exclude: Baseline</u> Fuel switching and combined projects: where the project requires processing of biomass on-site that would not have been processed in the baseline, and the processing equipment consumes fossil fuels.
P14/B13 Energy Generation	Controlled	Controlled	Relevant	
P15/B14 Chemical / Biological Process	Controlled	Controlled	Relevant*	*These SSRs are only relevant for projects that make use of flexibility mechanism (5) in Section 2.6.2.1.
P16/B15 Operation of the Project / Baseline Site	Controlled	Controlled	Relevant*	*These SSRs are only potentially relevant where IPMVP Option A or B are used and the project activity causes a change in energy consumption and/or generation outside of the measurement boundary (refer to Sections 6.1 and 6.1.1). <u>Proponent Choice</u> If the project proponent determines it is not cost-effective to account for this SSR, it may be conservatively excluded from the project and baseline if project emissions would be less than baseline emissions. <u>Include: Project or Baseline</u> The project activity causes an interactive effect that is not significant (as defined in Section 6.1.1). The emissions associated with the interactive effect are quantified under P16 where the effect is positive (i.e., site energy consumption and/or generation outside the measurement boundary is increased by the project activity) or B15 where the effect is negative (i.e., site energy consumption and/or generation outside the measurement boundary is decreased by the project activity).

<table>
<tr><th rowspan="2">SSR</th><th colspan="2">Controlled, Related or Affected</th><th rowspan="2">Relevant?</th><th rowspan="2">Justification</th></tr>
<tr><th>Baseline</th><th>Project</th></tr>
<tr><td>P17/B16 Maintenance</td><td>Controlled</td><td>Controlled</td><td>Relevant*</td><td>*These SSRs are only potentially relevant where maintenance involves activities that generate GHG emissions.

<u>Proponent Choice</u>

If the project proponent determines it is not cost-effective to account for this SSR, it may be excluded from the project and baseline if project emissions would be equal to or less than baseline emissions.

<u>Include: Project and Baseline</u>

Where maintenance involves activities that generate GHG emissions <u>and</u> these activities occur at a different level in the project and baseline scenario.</td></tr>
<tr><td colspan="5">Downstream SSRs During Operation</td></tr>
<tr><td colspan="5">Downstream SSRs After Operation</td></tr>
<tr><td>P18/B17 Site Decommissioning</td><td>Related</td><td>Related</td><td>Not Relevant</td><td>All one-time only upstream and downstream emission sources before and after operation are considered immaterial and excluded.</td></tr>
</table>

6 QUANTIFICATION OF GHG EMISSION REDUCTIONS

6.1 QUANTIFICATION APPROACH

The quantification approach of the Protocol is based on the methodologies and concepts in the International Performance Measurement and Verification Protocol (IPMVP).[18] The IPMVP presents a framework and four options for transparently, reliably, and consistently determining project and baseline energy use. The IPMVP was designed for measuring energy effects associated with the implementation of ECMs. This makes it particularly relevant to energy efficiency and combined projects eligible under the Protocol. While not specifically designed for fuel switching projects, the methodologies in the IPMVP are also relevant to such projects.

The IPMVP identifies four options for determining project and baseline energy use (refer to Appendix A and Sections 4.7 to 4.9 of the IPMVP, which outlines Option A, B, C, or D). The options differ based on the location of the measurement boundary and whether parameters are estimated versus measured. The measurement boundary may be drawn around the energy generation equipment and/or facility components within a facility (e.g., equipment, systems, processes, technologies) affected by the project activity, as in Section 4.7 (Option A - Retrofit Isolation: Key Parameter Measurement and Option B - Retrofit Isolation: All Parameter Measurement). The measurement boundary may also be drawn around the whole facility, as in Section 4.8 (Option C - Whole Facility). Where data are unreliable or unavailable, data from a calibrated simulation can replace the missing data for part or all of the facility, as in Section 4.9 (Option D - Calibrated Simulation).

These four measurement and quantification options are outlined in Table 5 on the next page. It should be noted that Table 5 is only a brief summary of the four options presented in IPMVP. Additional guidance is provided in Volume 1 and Volume 3 of the IPMVP. IPMVP Volume 1 provides guidance to assist project proponents in determining which option is best suited for their project.

The project type, whether the project involves a new build or retrofit, and availability of information will dictate which approach is most suitable for a particular project. Justification for the option selected must be provided by the project proponent in the project plan.

[18] 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.

Table 5: IPMVP Energy Measurement and Quantification Options

Option	Calculation Methodology	Example Applications
A. Retrofit Isolation: Key Parameter Measurement		
Involves field measurement of the key performance parameter(s) that define the system(s) affected by the project activity. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter, and the length of the reporting period. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, industry standards, or detailed engineering calculations. Documentation of the source and justification of the estimated parameter is required.	Engineering calculation 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. Interactive effects must be examined.	A high-efficiency boiler project where the annual fuel use efficiency (AFUE) of the baseline and project boilers are determined using historical data, manufacturer's specifications, or industry best practice. Project fuel use is monitored during the reporting period and baseline fuel use is calculated using the AFUE of the project and baseline boilers.
B. Retrofit Isolation: All Parameter Measurement		
Involves field measurement of the energy use of the system(s) affected by the project activity. 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 measurement proxies of energy use. Routine and non-routine adjustments as required. Interactive effects must be examined.	Suitable for the same applications as Option A. The main consideration for project proponents is the increased cost associated with increased metering requirements. This option is well suited to systems with variable loads such as variable speed fan and pump drives, chillers, boilers, etc., and where the additional cost of performing a calibrated simulation (Option D) cannot be justified.
C. Whole Facility		
Involves measuring energy use at the whole facility or sub-facility level. Continuous measurements of the entire facility's energy use are taken throughout the reporting period.	Analysis of whole facility baseline and reporting period utility meter data. Routine adjustments as required, using techniques such as simple comparison or regression analysis. Non-routine adjustments as required.	Multifaceted energy management program affecting many systems in a facility.

Option	Calculation Methodology	Example Applications
D. Calibrated Simulation		
Involves simulation of the energy use of the whole facility, or of a sub-facility. Simulation routines are demonstrated to adequately model actual energy performance in the facility. This option requires considerable skill in calibrated simulation.	Energy use simulation calibrated with hourly or monthly utility billing data. (Energy end use metering may be used to help refine input data).	Multifaceted management program affecting many systems 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, determined through the calibrated simulation, is compared to a simulation of reporting period energy use. Option D is useful where baseline data do not exist or are unavailable. Such a situation may arise for: • A new build project; or, • A facility expansion needing to be assessed separately from the rest of the facility.

6.1.1 INTERACTIVE EFFECTS FOR OPTIONS A AND B

This section is only relevant for projects where ECMs are implemented, i.e., project type (1) and (3). Fuel switching projects without an energy efficiency / conservative component do not need to assess interactive effects.

Where retrofits affect only a portion of the facility, Options A and B allow for the 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 interactive effects by the IPMVP. Interactive effects are energy effects caused by a project activity, but not measured within the measurement boundary. For example, a reduction in lighting load often reduces HVAC system energy use, but a typical measurement boundary would encompass just the electricity use of the lights. In this case, the effect on the HVAC system energy use would not be included within the measurement boundary, and is thus an interactive effect.

When the measurement boundary is selected, care must be taken to ensure that energy flows indirectly affected by the project activity through interactive effects are considered. The project plan must list all potential interactive effects of the project activity (positive or negative) on any energy system at the project facility, along with an estimate of the likely magnitude of each. The method of estimating each impact must be described, along with any factors affecting the accuracy of each estimate.

Where interactive effects are significant or unmeasurable, the measurement boundary must be expanded to include the interactive effects, and Option C or D must be used. Significant means that not including interactive effects would lead to a material overstatement of project reductions (where omission of an interactive effect would result in a lowering of emission reductions, it may be excluded at the project proponent's discretion).

Where interactive effects are determined to not be significant (as per the definition above), Option A or B may be used. Emissions associated with the interactive effects must be quantified under SSR P16 where the effect is positive (i.e., site energy consumption and/or generation outside the measurement boundary is increased by the project activity) or B15 where the effect is negative (i.e., site energy consumption and/or generation outside the measurement boundary is decreased by the project activity).

6.2 GHGS TO BE QUANTIFIED

The combustion of fuel, whether a fossil fuel, biomass, or a co-fired mixture of biomass and fossil fuels, will result in emissions of CO_2, CH_4, and N_2O. CO_2, CH_4, and N_2O are to be quantified for all relevant emissions sources, except for waste biomass combustion emissions where CO_2 is not to be quantified because CO_2 in this case is from a biogenic waste source. In the absence of the project, the waste would have degraded (e.g., in a landfill, on a farm, in a stockpile) and released GHG emissions as part of the natural carbon cycle.[19] For this reason, combustion of waste biomass does not lead to a net increase in CO_2 emissions to the atmosphere, and is therefore considered carbon neutral. Good practice guidance recommends quantifying CH_4 and N_2O emissions from the combustion of waste biomass as a conservative approach (assuming all biomass would degrade to CO_2). CH_4 and N_2O are to be quantified for waste biomass combustion under the Protocol to align with this guidance.

Biomass that is not waste and has been harvested to be used directly for energy generation (e.g., wood and wood products) is not considered carbon neutral under the Protocol. For this type of biomass to be considered carbon neutral there would need to be sustainable forest management practices in place in the jurisdiction where biomass is harvested. These practices aim to avoid deforestation and ensure that as trees are felled they are replaced with seedlings. Where forests are not sustainably managed, combusting harvested wood can lead to a net increase in GHG emissions (because the CO_2 is not recycled back into new trees). Therefore, CO_2, CH_4, and N_2O must be quantified for combustion of wood and wood products that are not waste.

Specific gases that must be quantified for fuel combustion emissions are summarized in Table 6.

Table 6: GHGs to be Quantified for the Combustion of Fossil Fuels, Biomass, and Co-Fired Fuels

Fuel Used	GHG	Quantification Required?
Fossil Fuel Only	CO_2	Yes
	CH_4, N_2O	Yes
Waste Biomass Only	CO_2	No – CO_2 is from a biogenic waste source
	CH_4, N_2O	Yes
Wood and Wood Products	CO_2	Yes
	CH_4, N_2O	Yes
Co-Fired (Biomass + Fossil Fuel)	CO_2	Yes – CO_2 from Fossil Fuel and Wood components No – CO_2 from Waste Biomass
	CH_4, N_2O	Yes

[19] The carbon cycle is the circulation and transformation of carbon back and forth between living things and the environment. It describes the movement of carbon as it is emitted to the atmosphere by GHG sources, removed from the atmosphere by GHG sinks, and accumulated in GHG reservoirs.

6.3 GENERALIZED QUANTIFICATION EQUATION

For each relevant SSR, a calculation method is provided and justified for quantifying associated GHG emissions. A universally accepted emission factor-based equation has been used for most SSRs to calculate emissions, as follows:

Equation 1: Generalized Equation

$$T_{i,j} = EF_{i,j} \times AL_i \times CF$$

Where,

$T_{i,j}$ = Total emissions of GHG j (tonnes of CO_2; tonnes of CH_4; tonnes of N_2O) for SSR i

$EF_{i,j}$ = Emission factor for GHG j and SSR i [e.g., tonne CO_2 / (activity level)]

AL_i = Activity level, which is the quantity of input, output or other measure of activity for SSR i (e.g., volume of fuel combusted, distance traveled, electricity generated, etc.)

CF = Conversion factor to be used when the units of the activity level do not match those of the emission factor. Where both the activity level and emission factor denominator are expressed in the same units, CF would be set to 1.[20]

In most cases, emissions will be calculated using this equation or a variation of this equation. Where the methodologies described below require selecting an emission factor from a recognized source, the emission factors contained in Appendix B: Emission Factors should be used. If other sources are used for emission factors, justification should be provided by the project proponent.

Following the calculation of individual GHGs, total GHG emissions in units of tonnes of CO_2e are then calculated using the following generalized, universally accepted equation:

Equation 2: Total Emissions for SSR i

$$T_i = \sum_j (T_{i,j} \times GWP_j)$$

Where,

[20] For example, if the emission factor for biomass combustion is in units of tonne-GHG/GJ and the biomass combusted is measured in tonne then a conversion factor with units of GJ/tonne (i.e., the biomass heating value) would be required to calculate the tonne-GHG emissions.

T_i = Total emissions in units of tonnes CO_2e for SSR i

T_{ij} = Total GHG emissions for SSR i and GHG j

GWP_j = Global warming potential for GHG j

The global warming potentials contained in Appendix C: Global Warming Potentials must be used.

6.4 Quantification of Project Emissions

6.4.1 P10 Off-site Processing of Biomass

Where biomass used in the project is processed off-site, GHG emissions associated with off-site processing of are calculated using Equation 3.

Equation 3: GHG Emissions – P10 Off-site Processing of Biomass

$$T_{P10,j} = T_{P10,FC,j} + T_{P10,elec,j}$$

Where,

$T_{P10,j}$ = Total emissions of GHG j (emissions of CO_2, CH_4, and N_2O are to be quantified) associated with off-site processing of biomass [tonne]

$T_{P10,FC,j}$ = Total emissions of GHG j (emissions of CO_2, CH_4, and N_2O are to be quantified) associated with fuel combustion for processing biomass [tonne]

$T_{P10,elec,j}$ = Total emissions of GHG j (emissions of CO_2, CH_4, and N_2O are to be quantified) associated with electricity consumption for processing biomass [tonne]

Emissions are calculated for each relevant GHG, and then converted to total CO_2e emissions using Equation 2.

6.4.1.1 GHG Emissions Associated with Fuel Combustion for Processing Biomass

GHG emissions associated with fuel combustion for processing biomass are calculated using Equation 4.

Equation 4: GHG Emissions – Fuel Combustion for Processing Biomass

$$T_{P10,FC,j} = EF_{FC,j} \times AL_{FC}$$

Where,

$T_{P10,FC,j}$ = Total emissions of GHG j (emissions of CO_2, CH_4, and N_2O are to be quantified) associated with fuel combustion for processing biomass [tonne]

$EF_{FC,j}$ = Emission factor for GHG j for fuel combustion [e.g., tonne/L diesel]

AL_{FC} = Quantity of fuel combusted for processing biomass [e.g., L diesel]

Emissions are calculated for each relevant GHG, and then converted to total CO_2e emissions using Equation 2. Emissions must be calculated for all fuel types used. If the off-site facility processes biomass for use at facilities in addition to the project facility, the proportion of fuel combusted at the facility that can be attributed to the project may not be known. In such situations, the activity level for fuel combusted to produce the biomass used by the project may be calculated using Equation 5.

Equation 5: Activity Level – Quantity of Fuel Combusted for Processing Biomass

$$AL_{FC} = AL_{FC,Facility} \times \frac{Biomass_{Project}}{Biomass_{Total}}$$

Where,

AL_{FC} = Quantity of fuel combusted for processing biomass used by the project [e.g., L diesel]

$AL_{FC,Facility}$ = Total quantity of fuel combusted at the off-site processing facility [e.g., L diesel]

$Biomass_{Project}$ = Mass of biomass used by the project [e.g., tonne biomass]

$Biomass_{Total}$ = Total mass of biomass processed at the off-site processing facility [e.g., tonne biomass]

6.4.1.2 Emissions Associated with Electricity Consumption for Processing Biomass

GHG emissions associated with electricity consumption for processing biomass must be quantified if the source of electricity is an isolated grid. If the source of electricity is an on-site generator, emissions must be quantified under SSR P14 Energy Generation. Emissions are calculated using Equation 6.

Equation 6: GHG Emissions – Electricity Consumed for Processing Biomass

$$T_{P10,elec,j} = EF_{Isolated\ Grid,j} \times AL_{elec}$$

Where,

$T_{P10,elec,j}$ = Total emissions of GHG j (emissions of CO_2, CH_4, and N_2O are to be quantified) associated with electricity consumption for processing biomass [tonne]

$EF_{Isolated\ Grid,j}$ = Emission factor for GHG j for electricity generation, transmission, and distribution by the isolated grid [tonne/MWh]

AL_{elec} = Electricity consumed for processing biomass [MWh]

Emissions are calculated for each relevant GHG, and then converted to total CO_2e emissions using Equation 2. If the off-site facility processes biomass for use at facilities in addition to the project facility, the activity level for electricity consumed to produce the biomass used by the project may not be known. In such situations, the activity level for fuel combusted to produce the biomass used by the project may be calculated using Equation 7.

Equation 7: Activity Level – Electricity Consumed for Processing Biomass

$$AL_{elec} = AL_{elec,Facility} \times \frac{Biomass_{Project}}{Biomass_{Total}}$$

Where,

AL_{elec} = Quantity of fuel combusted for processing biomass used by the project [e.g., MWh]

$AL_{elec,Facility}$ = Total electricity consumed by the off-site processing facility [e.g., L diesel]

$Biomass_{Project}$ = Mass of biomass used by the project [e.g., tonne biomass]

$Biomass_{Total}$ = Total mass of biomass processed at the off-site processing facility [e.g., tonne biomass]

6.4.2 P11 Fuel Delivery

Each of the fuels used at the project site will need to be delivered. GHG emissions associated with P11 Fuel Delivery in the province must be quantified for fuel switching or combined projects that utilize biomass on-site, where the biomass would not have been transported to the project site in the absence of the project. For all other project types, the project proponent may choose to include or exclude this SSR and its associated baseline SSR.

GHG emissions associated with fuel delivery are calculated using Equation 8.

Equation 8: GHG Emissions – P11 Fuel Delivery

$$T_{P11,j} = EF_{Transp,j} \times AL_{Transp}$$

Where,

$T_{P11,Transp,j}$ = Total emissions of GHG j (emissions of CO_2, CH_4, and N_2O are to be quantified) associated with fuel transportation to the project site [tonne]

$EF_{Transp,j}$ = Emission factor for GHG j for fuel transportation [e.g., tonne/L diesel]

AL_{Transp} = Quantity of fuel consumed for fuel transportation [e.g., L diesel]

Emissions are calculated for each relevant GHG, and then converted to total CO_2e emissions using Equation 2.

The activity level may be determined using monitored fuel consumption data for transport vehicles used to delivery fuel to the project. Alternatively, where monitored fuel consumption data are not available, Equation 9 may be used to determine the activity level.

Equation 9: Activity Level – Transportation Fuel Consumed

$$AL_{Transp} = FE \times D \times \left(\frac{F}{L}\right)$$

Where,

AL_{Transp}	= Quantity of fuel consumed for fuel delivery [e.g., L diesel];
FE	= Average fleet fuel economy of the fuel transport vehicle [e.g., L diesel/km];
D	= Transport distance by the transport vehicle per fuel load [e.g., km by tanker, km by truck]
F	= Fuel delivered to the project site [e.g., L of diesel, tonnes of biomass]
L	= Fuel cargo load per fuel transport vehicle type x [e.g., L of diesel or tonnes of biomass / truck load]

FE and L must be based on the specific types of vehicles transporting fuel in the project. Where multiple vehicles types are used with differing FE and L, the calculation must be performed separately for each vehicle type.

6.4.3 P12 Off-site Electricity Generation, Transmission, and Distribution

GHG emissions associated with electricity consumed by the project must be quantified if the source of electricity is an isolated grid. If the source of electricity is an on-site generator, emissions must be quantified under SSR P14 Energy Generation. GHG emissions associated with off-site generation, transmission, and distribution of electricity are calculated using Equation 10.

Equation 10: GHG Emissions – P12 Off-site Electricity Generation, Transmission, and Distribution

$$T_{P12,j} = EF_{Isolated\ Grid,j} \times AL_{elec}$$

Where,

$T_{P12,j}$	= Total emissions of GHG j (tonnes of CO_2, tonnes of CH_4, tonnes of N_2O are to be quantified) due to electricity consumption
$EF_{Isolated\ Grid,j}$	= Emission factor for electricity generation, transmission, and distribution for GHG j [e.g., tonne CO_2 / MWh]
AL_{elec}	= Electricity consumed by the project site [MWh]

Emissions are calculated for each relevant GHG and then converted to total CO_2e using Equation 2.

6.4.4 P13 On-site Processing of Biomass

See Equation 4 for fuel combustion in Section 6.4.1.1. The activity level is the quantity of fuel combusted for processing biomass. Where monitoring is conducted at the whole facility level (i.e., fuel consumption is not monitored for individual pieces of equipment), then emissions associated with fuel combustion for P13 must be quantified under P14.

If off-site electricity from an isolated grid is consumed to process biomass on-site, then these emissions must be accounted for under P12 Off-site Electricity Generation, Transmission, and Distribution.

6.4.5 P14 Energy Generation

GHG emissions associated with energy generation result from the combustion of fossil fuels and/or biomass. Project proponents may directly measure emissions associated with this SSR using a Continuous Emissions Monitoring System (CEMS), or use an emission factor-based method to quantify emissions. If the project proponent chooses to use the emission factor-based method, Equation 11 is used to calculate emissions associated with energy generation.

Equation 11: GHG Emissions – P14 Energy Generation

$$T_{P14,j} = EF_{FC,j} \times AL_{FC}$$

Where,

$T_{P14,j}$	= Total emissions of GHG j (CO_2, CH_4, N_2O are to be quantified) associated with energy generation [tonne];
$EF_{FC,j}$	= Emission factor for fuel combustion for GHG j [e.g., tonne CO_2 / L of diesel];
AL_{FC}	= Quantity of fuel combusted for energy generation [e.g., L of diesel]

Emissions are calculated for each relevant GHG and then converted to total CO_2e using Equation 2. Emissions must be calculated for all fuel types used.

6.4.6 P15 Chemical/Biological Process

This SSR is only relevant for projects that make use of flexibility mechanism (5) in Section 2.6.2.1. The project proponent must provide and justify an appropriate model for non-biogenic emissions from the biological or chemical processes at the facility. The suitable unit of production identified under eligibility criteria (7) must be included in the model where there is a statistical relationship between the unit of production and non-biogenic emissions.

6.4.7 **P16 OPERATION OF THE PROJECT SITE**

Project GHG emissions may be associated with interactive effects where the effect is positive (i.e., site energy consumption and/or generation outside the measurement boundary is increased by the project activity).

If the interactive effect causes an increase in the amount of isolated grid electricity consumed at the project site, emissions must be accounted for under P12 Off-site Electricity Generation, Transmission, and Distribution. The project proponent must describe the method for estimating the activity level (amount of electricity).

If the interactive effect causes an increase in the amount of fuel combusted at the project site, emissions must be accounted for under this SSR (P16) using Equation 11 for fuel combustion in Section 6.4.5. The project proponent must describe the method for estimating the activity level (amount of fuel combusted).

6.4.8 **P17 MAINTENANCE**

GHG emissions may be associated with activities during maintenance, such as combustion of fuels in a back-up generator. See Equation 11 for fuel combustion in Section 6.4.5. The activity level is the quantity of fuel combusted during maintenance activities.

6.5 QUANTIFICATION OF BASELINE EMISSIONS

6.5.1 **B11 FUEL DELIVERY**

See quantification methodology for P11 Fuel Delivery in Section 6.4.2. The activity level must be determined using Equation 9 as monitored transportation fuel consumption data are not available for the baseline. The parameter F in Equation 9, fuel delivered to the baseline site, is equal to AL_{FC} in Equation 12, which is calculated using Equation 13.

6.5.2 **B12 OFF-SITE ELECTRICITY GENERATION, TRANSMISSION, AND DISTRIBUTION**

See quantification methodology for P12 Off-site Electricity Generation, Transmission, and Distribution in Section 6.4.3. If the project activity involves conservation of off-site electricity that would have been generated by an isolated grid in the baseline, then the baseline quantity of electricity consumed must be determined in accordance with the IPMVP Option selected by the project proponent. Routine and non-routine adjustments must be considered by using Equation 13 below.

6.5.3 **B13 ENERGY GENERATION**

GHG emissions associated with energy generation in the baseline result from the combustion of fossil fuels. Equation 12 is used to calculate emissions associated with energy generation.

Equation 12: GHG Emissions – B13 Energy Generation

$$T_{B13,j} = EF_{FC,j} \times AL_{FC}$$

Where,

$T_{B14,j}$ = Total emissions of GHG j (CO_2, CH_4, N_2O are to be quantified) associated with energy generation [tonne];

$EF_{FC,j}$ = Emission factor for fuel combustion for GHG j [e.g., tonne CO_2 / L of diesel];

AL_{FC} = Quantity of fuel combusted for energy generation [e.g., L of diesel]

Emissions are calculated for each relevant GHG and then converted to total CO_2e using Equation 2. Emissions must be calculated for all fuel types that would have been used in the baseline.

The activity level is determined using Equation 13.

Equation 13: Activity Level – Quantity of Fuel Combusted for Energy Generation

$$AL_{FC} = Baseline\ Energy \pm Routine\ Adjustments \pm Non\text{-}Routine\ Adjustments$$

Where,

AL_{FC} = Quantity of fuel combusted for energy generation [e.g., L of diesel]

Baseline Energy = The energy use occurring during the baseline period without adjustments, as per the IPMVP [e.g., L of diesel]

Routine Adjustments = As per the IPMVP and discussed further below [e.g., L of diesel]

Non-Routine Adjustments = As per the IPMVP and discussed further below [e.g., L of diesel]

Baseline energy is determined in accordance with the IPMVP. The methodology used to determine baseline energy will depend on the IPMVP Option (A, B, C, or D) selected by the project proponent.

6.5.3.1 Routine and Non-Routine Baseline Adjustments

As per the IPMVP, the baseline energy may require adjustments in order to isolate the energy effects of the project activity from the effects of other factors affecting the energy using systems that differ between the project timeframe and the timeframe of the baseline period (as defined in the IPMVP). These adjustments are referred to as routine and non-routine adjustments.

Routine Baseline Adjustments may be necessary for any energy-governing factors that are expected to change routinely during the reporting period, such as weather or production volume. Numerous techniques can be used to define the adjustment methodology, from using a constant value (no adjustment) to applying a number of multiple parameter non-linear equations, each correlating energy with one or more independent variables. For projects implemented at industrial/manufacturing facilities, the suitable unit of production identified under eligibility criteria (7) must be included as a routine adjustment.

Non-Routine Baseline Adjustments are essential for ensuring that the project and baseline conditions are functionally equivalent. Non-routine baseline adjustments may be necessary when unexpected or one-time changes occur to energy-governing factors within the measurement boundary that are otherwise static. Static factors are determined from actual or assumed physical changes in equipment or operations, rather than independent variables. Static factors must be monitored for change throughout the reporting period, and may include, but are not limited to, the following:

- The amount of space being heated or air conditioned (facility size).
- The type of products being produced or number of production shifts per day.
- Building envelope characteristics (insulation, windows, doors, air tightness).
- The amount, type, or use of the facility's equipment (design and operation of installed equipment).
- The indoor environmental standard (e.g., light levels, temperature, ventilation rate).
- The occupancy type or schedule.

The project proponent must provide a calculation approach and justification for all routine and non-routine adjustments.

6.5.4 **B14 Chemical/Biological Process**

See quantification methodology for P15 Chemical/Biological Process in Section 6.4.6.

6.5.5 **B15 Operation of the Baseline Site**

Baseline GHG emissions may be associated with interactive effects where the effect is negative (i.e., site energy consumption and/or generation outside the measurement boundary is decreased by the project activity).

If the interactive effect causes a decrease in the amount of isolated grid electricity that would have been consumed in the baseline, emissions must be accounted for under B12 Off-site Electricity Generation, Transmission, and Distribution. The project proponent must describe the method for estimating the activity level (amount of electricity).

If the interactive effect causes a decrease in the amount of fuel that would have been combusted at the baseline site, emissions must be accounted for under this SSR (B15) using Equation 12 for fuel combustion in Section 6.5.3. The project proponent must describe the method for estimating the activity level (amount of fuel combusted).

6.5.6 B16 Maintenance

See quantification methodology for P17 Maintenance in Section 6.4.8.

6.6 Leakage

Refer to Section 6.1.1.

6.7 Reversals

Not applicable.

6.8 Project Reductions

Total project emissions are calculated as shown in Equation 14 and total baseline emissions are calculated by using Equation 15 (except that some terms may not be required where SSRs have been excluded due to project-specific circumstances).

Equation 14: Total Project Emissions

Project Emissions = $T_{P10} + T_{P11} + T_{P12} + T_{P13} + T_{P14} + T_{P15} + T_{P16} + T_{P17}$

Where,

T_{P10} = GHG emissions from project SSR P10 Off-site Processing of Biomass in tonne CO_2e/year

T_{P11} = GHG emissions from project SSR P11 Fuel Delivery in tonne CO_2e/year

T_{P12} = GHG emissions from project SSR P12 Off-site Electricity Generation, Transmission, and Distribution in tonne CO_2e/year

T_{P13} = GHG emissions from project SSR P13 On-site Processing of Biomass in tonne CO_2e/year

T_{P14} = GHG emissions from project SSR P14 Energy Generation in tonne CO_2e/year

T_{P15} = GHG emissions from project SSR P15 Chemical/Biological Process in tonne CO_2e/year

T_{P16} = GHG emissions from project SSR P16 Operation of the Project Site in tonne CO_2e/year

T_{P17} = GHG emissions from project SSR P17 Maintenance in tonne CO_2e/year

Equation 15: Total Baseline Emissions

Baseline Emissions = T_{B11} + T_{B12} + T_{B13}+ T_{B14} + T_{P15}+ T_{P16} + T_{B17}

Where,

T_{B11} = GHG emissions from project SSR B11 Fuel Delivery in tonne CO_2e/year

T_{B12} = GHG emissions from project SSR B12 Off-site Electricity Generation, Transmission, and Distribution in tonne CO_2e/year

T_{B13} = GHG emissions from project SSR B13 Energy Generation in tonne CO_2e/year

T_{B14} = GHG emissions from project SSR B14 Chemical/Biological Process in tonne CO_2e/year

T_{B15} = GHG emissions from project SSR B16 Operation of the Baseline Site in tonne CO_2e/year

T_{B16} = GHG emissions from project SSR B17 Maintenance in tonne CO_2e/year

Total emission reductions for the project are then calculated using Equation 16:

Equation 16: Total Emission Reductions

Emission Reduction = Baseline Emissions – Project Emissions

Net emission reductions are reported as positive values and net emissions increases are reported as negative values.

7 MONITORING

7.1 PROJECT MONITORING APPROACHES

Monitoring approaches that must be followed to quantify project emissions are listed in Table 7. Conversion factors may be required in some equations to convert between units of gram, kilogram, and tonne. GHG emissions associated with all SSRs must be reported as tonne-CO_2e using Equation 2.

Table 7: Project Monitoring Approaches

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
P10 Off-site Processing of Biomass	$T_{P10,FC,j} = EF_{FC,j} \times AL_{FC}$					
	$EF_{FC,j}$ Fuel combustion emission factors	Liquid Fuels: kg-CO_2/L g-CH_4/L g-N_2O/L Biomass: kg-CO_2/kg g-CH_4/kg g-N_2O/kg	Estimated	Default emission factors are selected from the tables provided inAppendix B: Emission Factors.	Annually	Only CH_4 and N_2O are required to be quantified if waste biomass is the fuel combusted.

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
	AL_{FC} Quantity of fuel combusted for processing biomass	L, kg	Estimated	Estimated: annual fuel consumption by the facility associated with processing project biomass is estimated using periodic (e.g., monthly or per delivery) fuel sales invoices.	Annually	If the off-site facility processes biomass for use at facilities in addition to the project facility, the proportion of fuel combusted at the facility that can be attributed to the project may not be known. In such situations, the activity level for fuel combusted to produce the biomass used by the project is determined using the equation below.
	$$AL_{FC} = AL_{FC,Facility} \times \frac{Biomass_{Project}}{Biomass_{Total}}$$					
	$AL_{FC,\ Facility}$ Total quantity of fuel combusted at the off-site processing facility	L, kg	Estimated	Total annual fuel consumption by the facility estimated using periodic (e.g., monthly or per delivery) fuel sales invoices.	Annually	-
	$Biomass_{Project}$ Mass of biomass used by the project	tonne	Measured or Estimated	Measured: weigh scales at the project facility. Estimated: biomass delivery sales invoices.	Per delivery	This frequency of monitoring is required as this parameter must also be monitored for the primary project activity, SSR P14 Energy Generation

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
	$Biomass_{Total}$ Total mass of biomass processed at the off-site facility	tonne	Measured or Estimated	Measured: total mass of biomass product produced at the facility measured by weigh scales. Estimated: total of biomass sales invoices for all biomass product sold by the facility.	Annually	-
	$$T_{P10,elec,j} = EF_{Isolated\ Grid,j} \times AL_{elec}$$					
	$EF_{Isolated\ Grid}$ Emission factor for the isolated grid	$t\text{-}CO_2/MWh$ $t\text{-}CH_4/MWh$ $t\text{-}N_2O/MWh$	Estimated	Estimated according to the methodology under A.2. Isolated Grid Emission Factor inAppendix B: Emission Factors.	Annually	-
	AL_{elec} Electricity consumed for processing biomass	MWh	Measured or Estimated	Measured: metered annual electricity consumption by the facility associated with processing project biomass. Estimated: as per additional comments.	Annually	If the off-site facility processes biomass for use at facilities in addition to the project facility, the proportion of electricity consumed at the facility that can be attributed to the project may not be known. In such situations, the activity level for electricity consumed to produce the biomass used by the project is determined using the equation below.

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
	$$AL_{elec} = AL_{elec,Facility} \times \frac{Biomass_{Project}}{Biomass_{Total}}$$					
	$AL_{elec,Facility}$ Total electricity consumed by the off-site facility	MWh	Measured	Metered total annual electricity consumption by the facility.	Annually	-
	$Biomass_{Project}$ Mass of biomass used by the project	tonne	Measured or Estimated	Measured: weigh scales at the project facility. Estimated: biomass delivery sales invoices.	Per delivery	This frequency of monitoring is required as this parameter must also be monitored for the primary project activity, SSR P14 Energy Generation
	$Biomass_{Total}$ Total mass of biomass processed at the off-site facility	tonne	Measured or Estimated	Measured: total mass of biomass product produced at the facility measured by weigh scales. Estimated: total of biomass sales invoices for all biomass product sold by the facility.	Annually	-
P11 Fuel Delivery	$$T_{P11,j} = EF_{Transp,j} \times AL_{Transp}$$					
	$EF_{Transp,j}$ Emission factor for fuel transportation	$g\text{-}CO_2/L$ $g\text{-}CH_4/L$ $g\text{-}N_2O/L$	Estimated	Default emission factors are selected from the tables provided in Appendix B: Emission Factors.	Annually	-

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
	AL_{Transp} Quantity of fuel consumed for fuel transportation	L	Estimated	If available, determined from fuel invoices for the transport vehicle(s) billed to, or available to, the project proponent. Otherwise, per additional comment.	Per delivery	Where monitored fuel consumption data are not available, the equation below may be used to determine the activity level.
	$$AL_{Transp} = FE \times D \times \left(\frac{F}{L}\right)$$					
	FE Average fleet fuel economy	L/km	Estimated	Provided by the delivery company based on vehicle specifications and fuel consumption records.	Annually	-
	D Transport distance	km	Measured or Estimated	Measured: using odometer readings provided by the delivery company. Estimated: using distances between origin and destination and taking into account route travelled.	Annually	-
	F Fuel delivered to the project site	tonne, L	Measured or Estimated	Measured: weigh scales at the project facility. Estimated: fuel delivery sales invoices.	Per delivery	-

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
	L Fuel cargo load per vehicle	tonne, L	Estimated	Provided by the delivery company, reflecting the average fuel cargo load for vehicles used to deliver project fuel.	Annually	-
P12 Off-site Electricity Generation, Transmission, and Distribution	$T_{P12,j} = EF_{Isolated\ Grid,j} \times AL_{elec}$					
	$EF_{Isolated\ Grid,j}$ Emission factor for the isolated grid	t-CO_2/MWh t-CH_4/MWh t-N_2O/MWh	Estimated	Estimated according to the methodology under A.2. Isolated Grid Emission Factor in Appendix B: Emission Factors.	Annually	-
	AL_{elec} Electricity consumed by the project site.	MWh	Measured	Measured directly using an electricity meter at the project site.	Continuous	-
P13 On-site Processing of Biomass	$T_{P13,FC,j} = EF_{FC,j} \times AL_{FC}$					

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
	$EF_{FC,j}$ Fuel combustion emission factors	Liquid Fuels: kg-CO_2/L g-CH_4/L g-N_2O/L Biomass: kg-CO_2/kg g-CH_4/kg g-N_2O/kg	Measured or Estimated	Measured: analytically determined through measurement of fuel carbon content. Estimated: default emission factors are selected from the tables provided inAppendix B: Emission Factors.	Annually	Only CH_4 and N_2O are required to be quantified if waste biomass is the fuel combusted.
	AL_{FC} Quantity of fuel combusted for processing biomass	L, kg	Measured or Estimated	Measured: mass or volumetric flow meter to the project equipment. Estimated: fuel is estimated using periodic (e.g., monthly or per delivery) fuel sales invoices.	Continuous (Measured) Per Delivery (Estimated)	Where monitoring is conducted at the whole facility level (i.e., fuel consumption is not monitored for individual pieces of equipment), then emissions associated with P13 must be quantified under P14.
P14 Energy Generation	$T_{P14,j} = EF_{FC,j} \times AL_{FC}$					

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
	T_{P14, CO_2} T_{P14, CH_4} T_{P14, N_2O} GHG emissions associated with P14 Energy Generation	t-CO_2 t-CH_4 t-N_2O	Measured or Estimated	Measured: emissions associated with P14 may be directly measured with Continuous Emissions Monitoring Systems (CEMS) Estimated: using the emission-factor based method in the equation above, according to the methods below.	Continuous (Measured) Annually (Estimated)	A combined approach where CEMS is used to measure CO_2 emissions and the emission factor approach to estimate CH_4 and N_2O emissions may be used. In projects where co-fired biomass and fossil fuels, it is unlikely that CEMS equipment will be able to discriminate between biogenic and non-biogenic CO_2 emissions. The emission factor approach must be used in this situation.
	$EF_{FC,j}$ Fuel combustion emission factors	Liquid Fuels: kg-CO_2/L g-CH_4/L g-N_2O/L Biomass: kg-CO_2/kg g-CH_4/kg g-N_2O/kg	Measured or Estimated	Measured: Analytically determined through measurement of fuel carbon content. Estimated: selected from tables provided inAppendix B: Emission Factors.	Annually	Only CH_4 and N_2O are required to be quantified if waste biomass is the fuel combusted.

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
	AL_{FC}	L, kg	Measured	Measured: mass or volumetric flow meter to the project equipment. Estimated: fuel consumption is estimated using periodic (e.g., monthly or per delivery) fuel sales invoices.	Continuous (Measured) Per Delivery (Estimated)	-
P15 Chemical / Biological Process	The project proponent must provide and justify the quantification methodology including project parameters and/or activity levels. The suitable unit of production identified under eligibility criteria (7) must be monitored. The project proponent must describe the unit of production and the monitoring method and frequency.					
P16 Operation of the Project Site	The project proponent must describe the method for estimating the activity level. The project proponent may choose to estimate the activity level for each reporting period, or more frequently. The emission factor is selected from tables provided inAppendix B: Emission Factors.					
P17 Maintenance	The monitoring methodology above for P13 On-site Processing of Biomass is applicable to P17, where the activity level is the quantity of fuel combusted during maintenance activities. The emission factor is selected from tables provided inAppendix B: Emission Factors.					

7.2 BASELINE MONITORING

7.2.1 BASELINE PERIOD

For IPMVP Options A, B, and C, the IPMVP requires monitoring energy use and energy-governing factors for a period of time before project implementation (referred to as the baseline period in the IPMVP), and the Protocol incorporates this requirement. The baseline period is the period of time chosen to represent the operation of an existing facility before the implementation of a project activity. This period is long enough to reflect one full operating cycle of a system or facility that has variable operations. The baseline period must not be confused with the timeframe over which baseline emissions are assessed when quantifying net emission reductions for a project. Baseline emissions are to be estimated over the same timeframe as the project, even if the baseline calculations use information gathered during the "baseline period". This is accomplished by applying baseline scenario adjustments, as described in Section 6.5.3.1.

Where applicable, the baseline period over which data is collected must meet the following conditions:

- The baseline period must be representative of all operating modes of the facility, i.e. the period must span a full operating cycle from maximum energy use to minimum. Building energy use requires a full year of baseline data to define a complete operating cycle. For other types of facilities, operating cycles are not always defined by a full year of data. For example, the energy use of a compressed air system may be governed by facility production levels, which vary on a weekly cycle and therefore sets of weekly data would be required to determine the baseline. Where operating cycles are not defined by a full year of data, project proponents must justify the baseline period selected.
- The baseline period must only include time periods for which all fixed and variable energy-governing factors are known about the facility. Extending the baseline period backwards in time to include multiple cycles of operation requires knowledge of all energy-governing factors throughout the longer baseline period in order to properly account for routine and non-routine adjustments.
- The baseline period must fairly represent all operating conditions of a normal operating cycle.

The baseline period must coincide with the period immediately before the commitment by a project proponent to undertake the project activity. Periods further back in time may not reflect the conditions existing before project implementation and may therefore not provide a proper baseline period for measuring the effect of the project.

7.3 BASELINE MONITORING APPROACHES

Monitoring approaches that must be followed to quantify baseline emissions are provided below in Table 8. Conversion factors may be required in some equations to convert between units of gram, kilogram, and tonne. GHG emissions associated with all SSRs must be reported as tonne-CO_2e using Equation 2.

Table 8: Baseline Monitoring Approaches

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
B11 Fuel Delivery	$T_{B11,j} = EF_{Transp,j} \times AL_{Transp}$					
	$EF_{Transp,j}$ Emission factor for fuel transportation	g-CO_2/L g-CH_4/L g-N_2O/L	Estimated	Default emission factors are selected from the tables provided in Appendix B: Emission Factors.	Annually	-
	AL_{Transp} Quantity of fuel consumed for fuel transportation	L	Estimated	Estimated using the equation below.	Annually	Monitored transportation fuel consumption data are not available for the baseline.
	$AL_{Transp} = FE \times D \times \left(\frac{F}{L}\right)$					

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
	FE Average fleet fuel economy	L/km	Estimated	Provided by the delivery company based on vehicle specifications and fuel consumption records.	One-time Only or Annually	Where the project includes a fuel switching component, and the baseline fuel is no longer being delivered to the project site, the fuel economy may be estimated one-time only using historical records. If such records are unavailable, the project proponent may estimate FE based on the vehicle type and literature values. If the baseline fuel is still delivered in the project condition, FE in the baseline is equal to FE in the project, and is updated annually.
	D Transport distance	km	Measured or Estimated	Measured: using odometer readings provided by the delivery company. Estimated: using historical odometer readings distances between origin and destination and taking into account route travelled.	One-time Only or Annually	Where the project includes a fuel switching component, and the baseline fuel is no longer being delivered to the project site, the transport distance may be estimated one-time only using historical odometer records, or distances between origin and destination taking into account the route travelled. If the baseline fuel is still delivered in the project condition, D in the baseline is equal to D in the project, and is updated annually.

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
	F Total fuel delivered	tonne, L	Estimated	The parameter F is equal to AL_{FC} in Equation 12, which is calculated using Equation 13.	Annually	-
	L Fuel cargo load per vehicle	tonne, L	Estimated	Provided by the delivery company, reflecting the average fuel cargo load for vehicles used to deliver project fuel.	Annually	Where the project includes a fuel switching component, and the baseline fuel is no longer being delivered to the project site, the fuel cargo load per vehicle may be estimated one-time only using historical records. If such records are unavailable, the project proponent may estimate L based on the vehicle type and literature values or a statement from an expert in the sector. If the baseline fuel is still delivered in the project condition, L in the baseline is equal to L in the project, and is updated annually.
B12 Off-site Electricity Generation	$T_{B12,j} = EF_{Isolated\ Grid,j} \times AL_{elec}$					

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
	$EF_{Isolated\ Grid,j}$ Emission factor for the isolated grid	$t\text{-}CO_2/MWh$ $t\text{-}CH_4/MWh$ $t\text{-}N_2O/MWh$	Estimated	Estimated according to the methodology under A.2. Isolated Grid Emission Factor in Appendix B: Emission Factors.	Annually	-
	AL_{elec} Electricity consumed by the project site.	MWh	Estimated	Determined in accordance with the IPMVP Option selected by the project proponent. Routine and non-routine adjustments must be considered by using Equation 13.	Annually	Applicable where the project activity involves conservation of off-site electricity that would have been generated by an isolated grid in the baseline.
B13 Energy Generation	$T_{B13,j} = EF_{FC,j} \times AL_{FC}$					
	$EF_{FC,j}$ Fuel combustion emission factors	Liquid fuels: $kg\text{-}CO_2/L$ $g\text{-}CH_4/L$ $g\text{-}N_2O/L$	Estimated	Estimated: selected from tables provided inAppendix B: Emission Factors.	Annually	
	AL_{FC}	L	Estimated	Estimated as per the IPMVP and according to Equation 13.	Annually	-
B14 Chemical / Biological Process	The project proponent must provide and justify the quantification methodology including baseline parameters and/or activity levels.					

SSR	Parameter / Variable	Units	Measured / Estimated / Calculated	Method	Frequency	Additional Comments
B15 Operation of the Baseline Site	The project proponent must describe the method for estimating the activity level. The project proponent may choose to estimate the activity level for each reporting period, or more frequently. The emission factor is selected from tables provided inAppendix B: Emission Factors.					
B16 Maintenance	The project proponent must provide and justify the activity levels used to quantify emissions associated with B16. Evidence must be provided, such as historical maintenance schedules that are altered by the project activity, fuel consumption records for historical auxiliary systems that are no longer required, etc. The emission factor is selected from tables provided inAppendix B: Emission Factors.					

APPENDIX A: IPMVP SUMMARY AND GUIDANCE

A.1. Introduction

Volume I of the IPMVP describes the common practices of energy project measurement and quantification. The IPMVP was designed for measuring energy effects associated with the implementation of ECMs; however, it has also been applied to fuel switching and renewable energy projects. Volume III of the IPMVP provides guidance and examples for renewable energy projects.

The Protocol incorporates the principles and methods of the IPMVP. It should be noted, however, that some differences in terminology between the Protocol and the IPMVP exist. IPMVP terminology are represented in Figure 6 below, which shows the energy use at a facility pre- and post-project implementation.

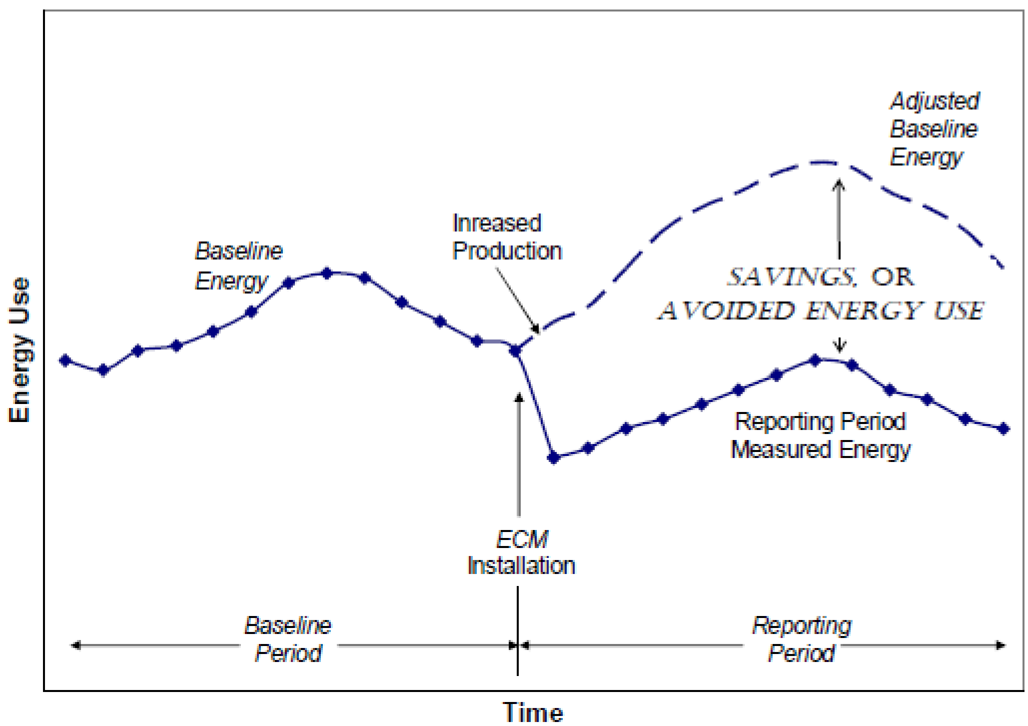

Figure 6: Example Energy Efficiency Project Energy Use[21]

Baseline Energy refers to the energy use (or generation) at a facility during the pre-project *Baseline Period*. This is different than the *Baseline Scenario* in the Protocol, which is a hypothetical scenario that represents what would

[21] Figure 2 in Efficiency Valuation Organization (2012).

have occurred in the absence of the project over the same time period as the project. Options A, B, and C in the IPMVP require monitoring energy use and energy-governing factors during the baseline period. These data are used when calculating the *Adjusted Baseline Energy*, which is the energy use (or generation) in what the Protocol refers to as the baseline scenario. This is the same as AL_{FC} in Equation 13. In the example above, baseline energy is adjusted for an increase in production during the reporting period to when determining the *Adjusted Baseline Energy*.

The *Reporting Period* in the Protocol and the IPMVP represent the same timeframe – the period after the project has been implemented where project monitoring and reporting takes place. *Reporting Period Measured Energy* is the monitored energy use (or generation) of the project used in the quantification of project emissions (where applicable).

The IPMVP provides equations for calculating energy *Savings* or *Avoided Energy Use,* which is the difference between *Adjusted Baseline Energy* and *Reporting Period Measured Energy*. The Protocol does not use the terms *Savings* or *Avoided Energy Use* as they are most applicable to energy efficiency projects rather than fuel switching projects. Rather than calculate energy *Savings*, as per the IPMVP, the Protocol incorporates the methods in the IPMVP for determining *Adjusted Baseline Energy* and uses this value when quantifying baseline scenario emissions. This allows for project and baseline emissions to be reported separately under the applicable SSR, with project emission reductions then quantified as the difference between the total of baseline SSRs and project SSRs, which is standard practice in offset project reporting.

A.2. Overview of IPMVP Options

The IPMVP provides four quantification approaches, referred to as Options:

- Option A: Retrofit Isolation, Key Parameter Measurement
- Option B: Retrofit Isolation, All Parameter Measurement
- Option C: Whole Facility
- Option D: Calibrated Simulation

Options A and B allow the narrowing of the measurement boundary in order to reduce the effort required to monitor independent variables and static factors, where projects affect only a portion of the facility. Options A and B focus on measuring the performance of specific, easily isolated systems. Option B requires full field measurement of energy, while Option A allows some stipulation of parameters in the final energy computation. Both options may be supported by engineering calculations or models.

These approaches are most applicable to projects at existing facilities where a single component (or small number of components) is replaced with a more efficient component (in energy efficiency projects), with a component that uses a different energy source (in fuel switching projects), or both (in combined projects). Example projects where these approaches are suitable include: a boiler efficiency improvement; lighting efficiency upgrades; a generator efficiency improvement; fuel switching projects where a different fuel is used in a piece of equipment such as a boiler or generator; and, renewable energy projects including solar photovoltaics, solar water heating, wind power, and biomass combustion.

Option C measures the change in whole facility energy use through utility or metering data. Option C often provides a simple and cost effective approach that ensures that all facility energy losses and transformations are accounted for. Example projects where this approach is suitable include: implementation of multiple ECMs at an existing facility where the ECMs are not easily isolated; and, implementation of renewable energy systems not easily isolated, such as passive solar heating and daylighting.

Option D relies on detailed, calibrated simulation analysis to determine the performance of a system or whole building that is complex, interactive, and dependent on many operating parameters. Option D can be applied to new buildings or where a model has previously been developed as part of the initial project design for a retrofit to an existing building. It can also be used for existing buildings without energy meters in the baseline period.

A.3. Guidance on IPMVP Option Selection

Table 9 below and the text that follows provide guidance on IPMVP option selection. The project proponent is responsible for selecting the IPMVP option that is to be used, and project proponents must describe the rationale for selecting a particular option.

Table 9: Guidance on IPMVP Option Selection

Offset Project Characteristic	**Applicable IPMVP Option**			
	A	**B**	**C**	**D**
The project takes place at a new facility				×
Baseline period data are not available				×
Significance of some independent variables is unclear		×	×	×
Interactive effects are significant or unmeasurable			×	×

Option A: Best Applications

- The uncertainty created by estimations is acceptable.
- Estimation of some parameters is more cost-effective than measurement in Option B or simulation in Option D.

Option B: Best Applications

- Isolation meters exist or it is cost-effective to add them.

- Measurement of all parameters is more cost-effective than simulation in Option D.
- Energy use or operations within the measurement boundary are variable.

Option C: Best Applications

- There are many types of ECMs in one facility.
- The ECMs involve activities whose individual energy use is difficult to separately measure.
- Where retrofit isolation techniques are excessively complex, for example, when interactive effects or interactions between ECMs are substantial.
- Major future changes to the facility are not expected during the reporting period.
- A system of tracking static factors can be established to enable possible future non-routine adjustments.
- Good correlations can be found between energy use and other independent variables.

Option D: Best Applications

- Baseline period energy data do not exist. This situation may arise for:
    - A new build facility.
    - A facility expansion needing to be assessed separately from the rest of the facility.
    - A centrally metered campus of facilities where no individual facility meter exists in the baseline period, but where individual meters will be available after project implementation.
- Major future changes to the facility are expected during the reporting period, and there is no way to track the changes and/or their impact on energy use.
- Simulation software predicts metered calibration data with acceptable accuracy.

APPENDIX B: EMISSION FACTORS

B.1. Fuel Combustion Emission Factor

If the project proponent chooses to use an emission factor-based method for quantifying emissions associated with fuel combustion, one of the following methods described below must be used.

CO_2

The project proponent will be required to determine CO_2 emissions from the fossil fuel component of the fuels combusted. The table below lists the two acceptable methods for determining the emission factor, in decreasing order of accuracy.

Table 10: Approaches to Determine the CO_2 Emission Factor for Fossil Fuel Combustion

Number	Method
1	Analytically determine emission factor by carbon content of the fuel
2	Default emission factor based on fuel type

Method 1

The project proponent analytically determines the emission factor by measuring the carbon content of the fuel. Once the quantity of carbon in the fuel has been determined, using the molecular weights of carbon, oxygen, and CO_2, the quantity of CO_2 emitted during combustion can be determined.

Depending on the fuels involved, other standard chemical engineering approaches and equations, such as the ideal gas law may also need to be used.

Method 2

An emission factor from A.3. Emission Factor Tables is used. In selecting an appropriate emission factor, the project proponent must ensure that the factor selected is relevant to the fuel type and equipment used. If an appropriate factor cannot be identified (e.g., where the project fuel type varies in characteristics and doesn't match well with the emission factors for default fuel types found in the literature), the first method must be used instead.

CH_4 and N_2O

In addition to the fuel type, the estimation of the CH_4 and N_2O emissions depend on factors such as the characteristics of the combustion technology, the pollution control equipment in use, operational practices, etc. The estimation of CH_4 and N_2O emissions is therefore more difficult and uncertain than for CO_2.

Proponent proponents must use one of the methods in the table below to determine the CH_4 and N_2O emission factors.

Table 11: Approaches to determine the CH_4 and N_2O Emission Factors for Fuel Combustion

Number	Method
1	Determination of the emission factor through modeling
2	Default emission factor based on fuel type, sector, and technology type

Method 1

This method involves detailed modeling of the fuel, combustion equipment, and facility (where applicable). The project proponent must justify the methodology used to determine the emission factor, for example, by using best available practices.

Method 2

The most appropriate emission factor is chosen by considering the fuel used and sector in which it is being used. An emission factor is selected from the tables in A.3. Emission Factor Tables.

B.2. Isolated Grid Emission Factor

This method is applicable where an emission factor is required for an isolated grid. The emission factor for the isolated grid is calculated using historical monitored data for fuel consumption and electricity generation. The emission factor is calculated using Equation 17.

Equation 17: Emission Factor – Isolated Grid

$$EF_{Isolated\ Grid,j} = \sum_{y} \frac{AL_{FC,y} * EF_{FC,j}}{AL_{EG,y}}$$

Where,

$EF_{Isolated\ Grid,j}$ = Emission factor for GHG j for electricity generation, transmission, and distribution by the isolated grid supplying the project with electricity [tonne/MWh];

$AL_{FC,y}$ = Amount of fossil fuel combusted in year y by the isolated grid generating unit(s) [e.g., L diesel];

$EF_{FC,j}$ = Emission factor for GHG j (tonnes of CO_2, tonnes of CH_4, tonnes of N_2O are to be quantified) for combustion of fossil fuel in the isolated grid generating unit(s) [e.g., tonne/L diesel]. The emission factor method in A.1. Fuel Combustion Emission Factor may be used, or an emission factor may be selected from the tables in A.3. Emission Factor Tables;

$AL_{EG,y}$ = Net electricity generated and delivered to the isolated grid in year y by the electricity generating unit(s) connected to the isolated grid [MWh];

y = Either the three most recent years for which data are available at the time of project report submission or the applicable project reporting year if data for the reporting year are available at the time of submission.

B.3. Emission Factor Tables

The fuel combustion emission factors listed in this section are sourced from the Government of Newfoundland and Labrador`s *Guidance Document for Reporting Greenhouse Gas Emissions for Large Industry in Newfoundland and Labrador*.[22] Electricity delivered by the provincial grid for end-use consumption is considered to have an emission factor of zero.

Table 12: Emission Factors for Refined Petroleum Products, Stationary Combustion

Fuel/Sector	**Emission Factor (kg/L)**		
	CO_2 (kg/L)	**CH_4 (g/L)**	**N_2O (g/L)**
Light Fuel Oil			
Electric Utilities	2.725	0.18	0.031
Industrial	2.725	0.006	0.031
Residential	2.725	0.026	0.006
Forestry, Construction, Public Administration, and Commercial / Institutional	2.725	0.026	0.031
Heavy Fuel Oil (Residual Fuel Oil No. 5 & No. 6)			
Electric Utilities	3.124	0.034	0.064
Industrial	3.124	0.12	0.064
Residential, Forestry, Construction, Public Administration, and Commercial / Institutional	3.124	0.057	0.064
Diesel	2.663	0.133	0.4
Kerosene			

[22] Available online: http://www.ecc.gov.nl.ca/climate_change/greenhouse-gas-data/GHG_Reporting_Guidance_Document.pdf

Fuel/Sector	Emission Factor (kg/L)		
	CO_2 (kg/L)	CH_4 (g/L)	N_2O (g/L)
Electric Utilities	2.534	0.006	0.031
Industrial	2.534	0.006	0.031
Residential	2.534	0.026	0.006
Forestry, Construction, Public Administration and Commercial/Institutional	2.534	0.026	0.031
Propane			
Residential	1.51	0.027	0.108
All Other Uses	1.51	0.024	0.108
Gasoline	2.289	2.7	0.05

Table 13: Emission Factors for Biomass, Stationary Combustion

Fuel/Sector	Emission Factor (kg/L)		
	CO_2 (kg/kg)	CH_4 (g/kg)	N_2O (g/kg)
Wood and Wood Products, harvested specifically for energy (at 0% moisture content)	1.81	0.576	0.077
Waste Biomass Sources			
Wood waste, crop residues, food waste, and all other eligible waste biomass sources defined in Section 2.5.2.1.[23]	0	0.576	0.077

The transportation emission factors listed on the next page are sourced from Environment and Climate Change Canada's National Inventory Report.[24]

[23] Emission factor data are unavailable for most waste biomass sources. The CH_4 and N_2O emission factors for wood waste may be assumed for all other waste biomass sources.

[24] Environment and Climate Change Canada. (2016). National Inventory Report 1990 – 2014: Greenhouse Gas Sources and Sinks in Canada. Available online: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/9492.php

Table 14: Emission Factors for On-Road and Off-Road Mobile Combustion

Fuel/Sector	Emission Factor (g/L)		
	CO_2 (kg/L)	CH_4 (g/L)	N_2O (g/L)
ROAD TRANSPORT			
Gasoline Vehicles			
Light-Duty Gasoline Vehicles (LDGVs)			
Tier 2	2,316	0.14	.022
Tier 1	2,316	0.23	0.47
Tier 0	2,316	0.32	0.66
Oxidation Catalyst	2,316	0.52	0.20
Non-catalytic Controlled	2,316	0.46	0.028
Light-Duty Gasoline Trucks (LDGTs)			
Tier 2	2,316	0.14	0.022
Tier 1	2,316	0.24	0.58
Tier 0	2,316	0.21	0.66
Oxidation Catalyst	2,316	0.43	0.20
Non-catalytic Controlled	2,316	0.56	0.028
Heavy-duty Gasoline Vehicles (HDGVs)			
Three-way Catalyst	2,316	0.068	0.20
Non-catalytic Controlled	2,316	0.29	0.047
Uncontrolled	2,316	0.49	0.084
Motorcycles			
Non-catalytic Controlled	2,316	0.77	0.041
Uncontrolled	2,316	2.3	0.048
Diesel Vehicles			
Light-duty Diesel Vehicles (LDDVs)			
Advanced Control	2,690	0.051	0.22
Moderate Control	2,690	0.068	0.21
Uncontrolled	2,690	0.10	0.16
Light-duty Diesel Trucks (LDDTs)			
Advanced Control	2,690	0.068	0.22
Moderate Control	2,690	0.068	0.21
Uncontrolled	2,690	0.085	0.16
Heavy-duty Diesel Vehicles (HDDVs)			
Advanced Control	2,690	0.11	0.151
Moderate Control	2,690	0.14	0.082
Uncontrolled	2,690	0.15	0.075
Propane Vehicles	1,515	0.64	0.028
OFF-ROAD TRANSPORT			
Off-road Gasoline	2,316	2.7	0.050
Off-road Diesel	2,690	0.15	1.0

APPENDIX C: GLOBAL WARMING POTENTIALS

Global warming potentials (GWPs) from the IPCC's Fourth Assessment Report (AR4)[25] must be used when quantifying carbon dioxide equivalent emissions.

Table 15: AR4 Global Warming Potentials

Greenhouse Gas	Global Warming Potential
CO_2	1
CH_4	25
N_2O	298

[25] Intergovernmental Panel on Climate Change (IPCC). (2007). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland.