

**QUANTIFICATION PROTOCOL FOR  
GREEN BUILDING PROJECTS - RESIDENTIAL**

***ABRIDGED***

Submitted to:  
Alberta Environment

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### **Disclaimer**

The following document presents an abridged version of the Residential Green Building Projects protocol prepared for Alberta Environment which has completed an initial round of technical review. This document has been prepared as a means of supporting a broader stakeholder consultation process. As such, this document should not be used as a quantification protocol.

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## 1.0 Project and Methodology Scope and Description

The opportunity for generating carbon offsets with this protocol arises from the direct and indirect reductions of greenhouse gas (GHG) emissions resulting from the implementation of new building methods, and upgrades to the building envelope that result in overall efficiencies in energy use per square meter. Process changes may include the building envelope components of the building and may impact upon on-site heat, electrical and power requirements.

This quantification protocol is applicable to the quantification of direct and indirect reductions of greenhouse gas (GHG) emissions resulting from building envelope energy efficiencies in new residential buildings or the retrofit of existing residential buildings. It includes reductions in GHG emissions due to any heat/power savings and/or production, and electricity savings related to the project.

**FIGURE 1.1** offers a typical element life cycle chart for a typical project as defined in this protocol.

This protocol does not prescribe the configuration or nature of the processes that result in energy efficiencies. Rather, this protocol serves as a generic ‘recipe’ for project proponents to follow in order to meet the measurement, monitoring and GHG quantification requirements.

There are separate baseline conditions for new buildings and retrofits of existing buildings. The baseline for new buildings is based on an energy use level that is equivalent to a 72 rating in the EnerGuide/EcoEnergy rating system<sup>1</sup>. To assess the EnerGuide/ EcoEnergy level the building has achieved, an energy audit will need to be conducted upon completion of construction of the new building.

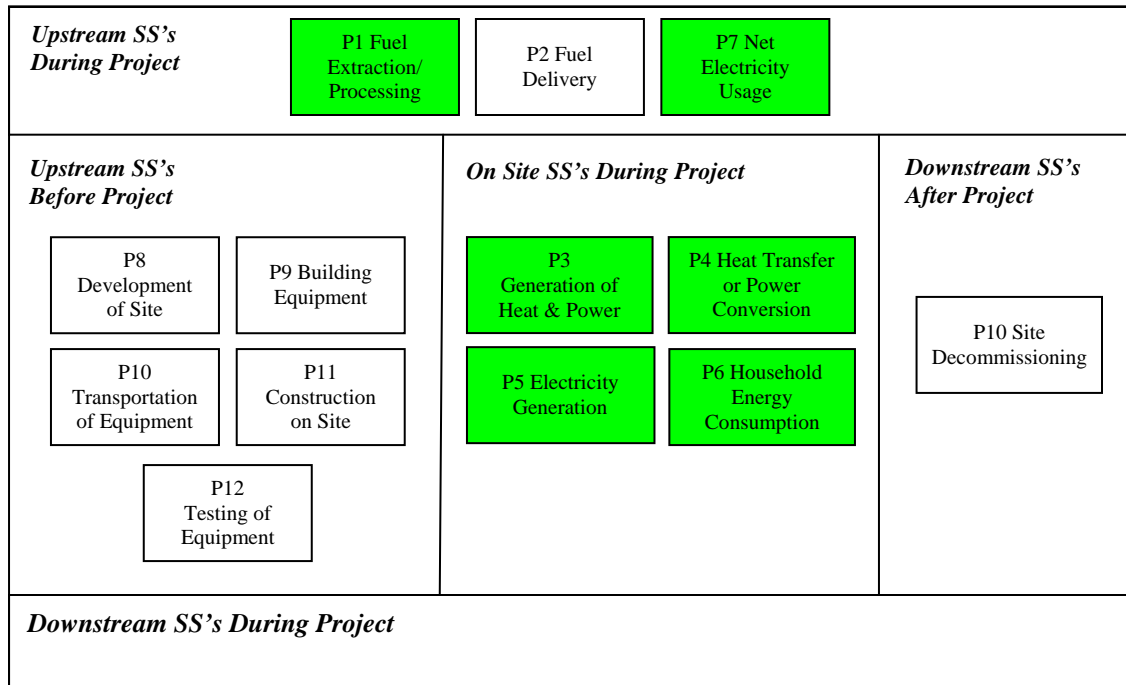
The baseline condition for the retrofits of existing buildings in this protocol is defined as the building energy use prior to any retrofits and/or improvements. The energy and emissions footprint, per square meter, of the baseline configuration is established as part of an EnerGuide/EcoEnergy or equivalent energy audit that is completed before any changes have been made to the building.

**FIGURE 1.2** offers an element life cycle chart for the typical baseline configuration.

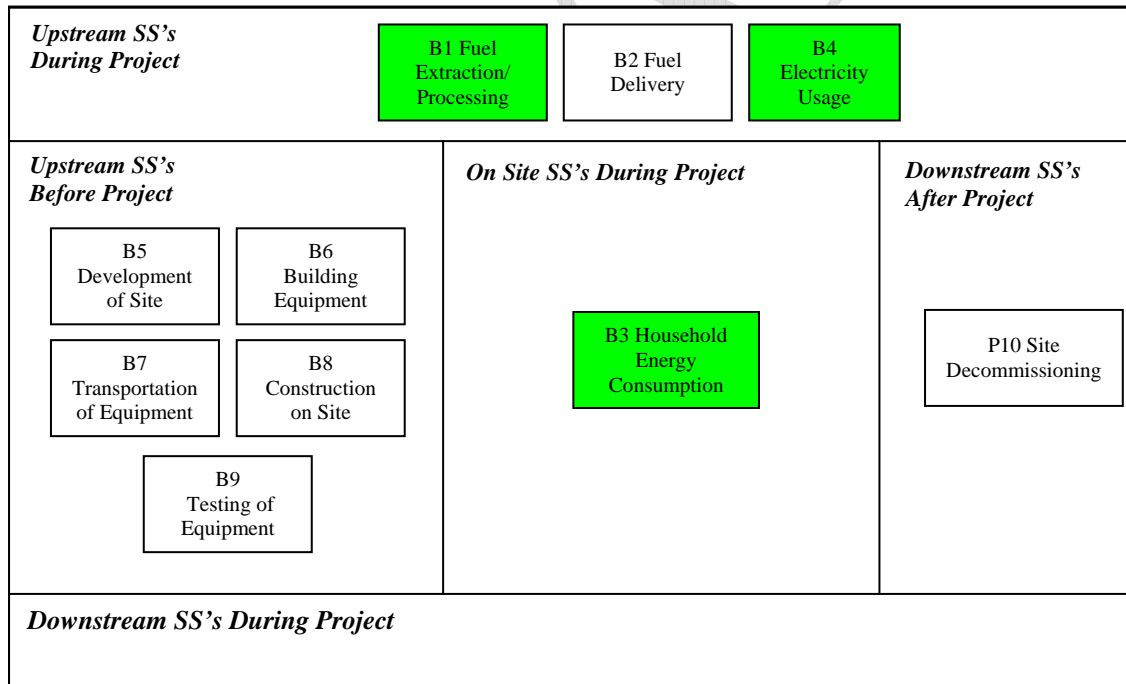
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<sup>1</sup> More info on the Energuide rating system for new homes <http://oee.nrcan.gc.ca/residential/personal/new-homes/upgrade-packages/rating.cfm?attr=4>

**FIGURE 1.1: Project Element Life Cycle Chart**



**FIGURE 1.2: Project Element Life Cycle Chart**



\*(Sources, sinks and reservoirs selected for measurement and monitoring under this protocol are highlighted)

To demonstrate that a project meets the requirements under this protocol, the project proponent must supply sufficient evidence to demonstrate that:

1. New buildings meet or exceed the EnerGuide/ EcoEnergy rating for new homes of 75 as confirmed by an energy audit;
2. Retrofits to existing buildings must improve energy efficiency (electricity and fuel) reductions by 10% as established by the difference between pre- and post-retrofit energy audit;
3. The quantification of reductions achieved by the project is based on actual measurement conducted as part of the EnerGuide/EcoEnergy energy audit. For existing buildings this will include both a pre-construction and post- construction energy audit. New buildings reductions will be established based on a post-construction energy audit and compared to the established baseline for a new building with an EnerGuide / EcoEnergy rating of 72; and
4. The project must meet the requirements for offset eligibility as specified in the applicable regulation and guidance documents for the Alberta Offset System.

Flexibility in applying the quantification protocol is provided to project developers in the following ways.

1. The requirement for an energy audit may be waived in situations where the baseline energy use per square meter can be justified using available records. The period for which the records should cover must be justified as suitable to account for seasonal effects in energy demand;
2. Reductions in onsite electricity or fuel use would be dealt with outside the scope of the protocol as part of the energy efficiency protocol and renewable energy protocols. The benefit of including onsite energy production (i.e. solar, small hydro, wind, biomass, etc) would be dealt with under appropriate protocols. However, the project developer must justify the separation of this component of the project to ensure that the emission reductions are properly quantified between the two projects and that double counting does not occur;
3. For the purpose of this protocol, the unit of production will be square meter. Another suitable unit of production can be defined for incorporating functional equivalence within the calculation methodology as indicated by reasoned qualitative and quantitative analysis; and
4. Site specific emission factors may be substituted for the generic emission factors indicated in this protocol document. The methodology for generation of these emission factors must be sufficiently robust as to ensure reasonable accuracy.

If applicable, the proponent must indicate and justify why flexibility provisions have been used.

Considering the changes that are occurring in this sector around energy management, a review of the protocol's baseline and rating system selection will be part of each periodic review and update of the protocol. The review is meant as an opportunity to maintain the

environmental integrity of the protocol and as such, any changes will reflect a higher standard of measurement.

## 2.0 Quantification of Identified Sources, Sinks and Reservoirs

These calculation methodologies serve to complete the following three equations for calculating the emission reductions from the comparison of the baseline and project conditions.

$$\text{Emission Reduction} = \text{Emissions}_{\text{Baseline}} - \text{Emissions}_{\text{Project}}$$

$$\text{Emissions}_{\text{Baseline}} = \text{Emissions}_{\text{Fuel Extraction / Processing}} + \text{Emissions}_{\text{Household Energy Consumption}} + \text{Emissions}_{\text{Electricity Usage}}$$

$$\text{Emissions}_{\text{Project}} = \text{Emissions}_{\text{Fuel Extraction / Processing}} + \text{Emissions}_{\text{Total Onsite Energy Use}} + \text{Emissions}_{\text{Net Electricity Usage}}$$

Where:

$\text{Emissions}_{\text{Baseline}}$  = sum of the emissions under the baseline condition.

$\text{Emissions}_{\text{Fuel Extraction / Processing}}$  = emissions under SS B1 Fuel Extraction and Processing

$\text{Emissions}_{\text{Household Energy Consumption}}$  = emissions under SS B3 Household Energy Consumption

$\text{Emissions}_{\text{Electricity Usage}}$  = emissions under SS B4 Electricity Usage

$\text{Emissions}_{\text{Project}}$  = sum of the emissions under the project condition.

$\text{Emissions}_{\text{Fuel Extraction / Processing}}$  = emissions under SS P1 Fuel Extraction and Processing

$\text{Emissions}_{\text{Total Onsite Energy Use}}$  = emissions under SS P3 Generation of Heat And Power; SS P4 Heat Transfer or Power Conversion; SS P5 Electricity Generation; SS P6 Household Energy Consumption

$\text{Emissions}_{\text{Net Electricity Usage}}$  = emissions under SS P7 Electricity Usage

**TABLE 1.1: Quantification Procedures**

1. Project / Baseline SSR	2. Parameter / Variable	3. Unit
<b>Project SSRs</b>		
P1 Fuel Extraction and Processing	<b>Emissions<sub>Fuel Extraction / Processing</sub></b> = $\sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{CO}_2}) ; \sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{CH}_4}) ; \sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{N}_2\text{O}})$	
	Emissions <sub>Fuel Extraction / Processing</sub>	kg of CO2e
	Volume of Each type of Fuel Combusted for P4 and P6 / Vol. Fuel	L, m <sup>3</sup> or other
	CO <sub>2</sub> Emissions Factor for Each Fuel Including Production and Processing / EF Fuel <sub>CO<sub>2</sub></sub>	kg CO <sub>2</sub> per L, m <sup>3</sup> or other
	CH <sub>4</sub> Emissions Factor for Each Fuel Including Production and Processing / EF Fuel <sub>CH<sub>4</sub></sub>	kg CH <sub>4</sub> per L, m <sup>3</sup> or other
	N <sub>2</sub> O Emissions Factor for Each Fuel Including Production and Processing / EF Fuel <sub>N<sub>2</sub>O</sub>	kg N <sub>2</sub> O per L, m <sup>3</sup> or other
P3 Generation of Heat and Power, P4 Heat Transfer or Power Conversion, P5 Electricity Generation and P6 Household Energy Consumption	<b>Emissions<sub>Total Onsite Energy Use</sub></b> = $\sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{CO}_2}) ; \sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{CH}_4}) ; \sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{N}_2\text{O}})$	
	Emissions <sub>Total Onsite Energy Use</sub>	kg of CO <sub>2</sub> ; CH <sub>4</sub> ; N <sub>2</sub> O
	Volume of Each Type of Fuel Consumed to Generate Heat and Power / Vol. Fuel <sub>i</sub>	L, m <sup>3</sup> or other
	CO <sub>2</sub> Emissions Factor for Combustion of Each Type of Fuel / EF Fuel <sub>iCO<sub>2</sub></sub>	kg CO <sub>2</sub> per L, m <sup>3</sup> or other
	CH <sub>4</sub> Emissions Factor for Combustion of Each Type of Fuel / EF Fuel <sub>iCH<sub>4</sub></sub>	kg CH <sub>4</sub> per L, m <sup>3</sup> or other
	N <sub>2</sub> O Emissions Factor for Combustion of Each Type of Fuel / EF Fuel <sub>iN<sub>2</sub>O</sub>	kg N <sub>2</sub> O per L, m <sup>3</sup> or other
P7 Net Electricity Usage	<b>Emissions<sub>Electricity</sub></b> = Electricity * EF <sub>Elec</sub>	
	Emissions <sub>Electricity</sub>	kg of CO2e
	Incremental Electricity Used at the Site for Unit Operation / Electricity	kWh
	Emissions Factor for Electricity / EF <sub>Elec</sub>	kg of CO2e per kWh
<b>Baseline SSRs</b>		
B1 Fuel Extraction and Processing	<b>Emissions<sub>Fuel Extraction / Processing</sub></b> = $\sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{CO}_2}) ; \sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{CH}_4}) ; \sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{N}_2\text{O}})$	
	Emissions <sub>Fuel Extraction / Processing</sub>	kg of CO2e
	Volume of Each type of Fuel Combusted for P4 and P6 / Vol. Fuel	L, m <sup>3</sup> or other
	CO <sub>2</sub> Emissions Factor for Each Fuel Including Production and Processing / EF Fuel <sub>CO<sub>2</sub></sub>	kg CO <sub>2</sub> per L, m <sup>3</sup> or other
	CH <sub>4</sub> Emissions Factor for Each Fuel Including Production and Processing / EF Fuel <sub>CH<sub>4</sub></sub>	kg CH <sub>4</sub> per L, m <sup>3</sup> or other
	N <sub>2</sub> O Emissions Factor for Each Fuel Including Production and Processing / EF Fuel <sub>N<sub>2</sub>O</sub>	kg N <sub>2</sub> O per L, m <sup>3</sup> or other
B3 Household Energy Consumption	<b>Emissions<sub>Unit Operation</sub></b> = $\sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{CO}_2}) ; \sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{CH}_4}) ; \sum (\text{Vol. Fuel}_i * \text{EF Fuel}_{i\text{N}_2\text{O}})$	
	Emissions <sub>Unit Operation</sub>	kg of CO <sub>2</sub> ; CH <sub>4</sub> ; N <sub>2</sub> O
	Volume of Each Type of Fuel for Unit Operation / Vol. Fuel <sub>i</sub>	L, m <sup>3</sup> or other
	CO <sub>2</sub> Emissions Factor for Combustion of Each Type of Fuel / EF Fuel <sub>iCO<sub>2</sub></sub>	kg CO <sub>2</sub> per L, m <sup>3</sup> or other
	CH <sub>4</sub> Emissions Factor for Combustion of Each Type of Fuel / EF Fuel <sub>iCH<sub>4</sub></sub>	kg CH <sub>4</sub> per L, m <sup>3</sup> or other
	N <sub>2</sub> O Emissions Factor for Combustion of Each Type of Fuel / EF Fuel <sub>iN<sub>2</sub>O</sub>	kg N <sub>2</sub> O per L, m <sup>3</sup> or other
B4 Electricity Usage	<b>Emissions<sub>Electricity</sub></b> = Electricity * EF <sub>Elec</sub>	
	Emissions <sub>Electricity</sub>	kg of CO2e
	Incremental Electricity Exported from the Site / Electricity	kWh
	Emissions Factor for Electricity / EF <sub>Elec</sub>	kg of CO2e per kWh

**APPENDIX A: Glossary of New Terms**

Energy Audit:	Is an assessment of how much energy a building consumes and includes details on efficiency of the building's insulation, heating and cooling systems, and can include recommendations on ways to make the building more energy-efficient
EnerGuide/EcoEnergy programs:	Are Government of Canada programs program that offer Canadians financial incentives and information on retrofitting their homes to make them more energy efficient.
Green Building:	Are buildings that incorporate practices that increase the efficiency of buildings and their use of energy, water, and materials, and reduce building impacts on human health and the environment, through better siting, design, construction, operation, maintenance, and removal.
Unit of Production:	For the purpose of this protocol, the unit of production will be square meter. As mentioned in the flexibility provisions, with thorough justification the project proponent may change the unit of production to a more appropriate unit.