

**QUANTIFICATION PROTOCOL FOR  
LOW-IMPACT, WATER-POWERED ELECTRICITY GENERATION**

***ABRIDGED***

Submitted to:  
Alberta Environment

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### **Disclaimer**

The following document presents an abridged version of the Low-Impact, Water-Powered Electricity Generation 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

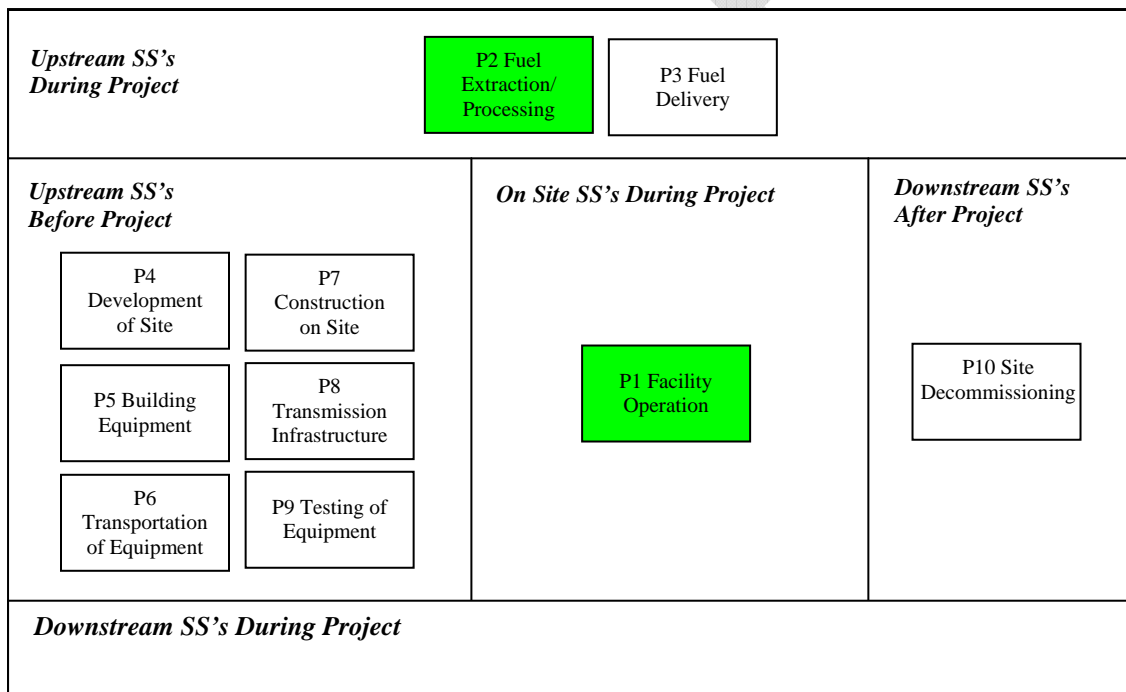
This protocol is applicable to the quantification of reductions in greenhouse gas (GHG) emissions resulting from the implementation of facilities that convert the potential energy of river flow into low-impact, water-powered electricity generation. Henceforth, these facilities will be referred to as ‘low-impact, hydro electric facilities.’ The protocol quantifies the emission reductions based on the generation of an equivalent quantity of electricity from fossil fuel based sources, either at grid-connected or off-grid facilities.

This quantification protocol is written for the low-impact, hydro electric facility project operator or project proponent. Some familiarity with, or general understanding of, the operation of hydro electric facilities and associated practices, is expected.

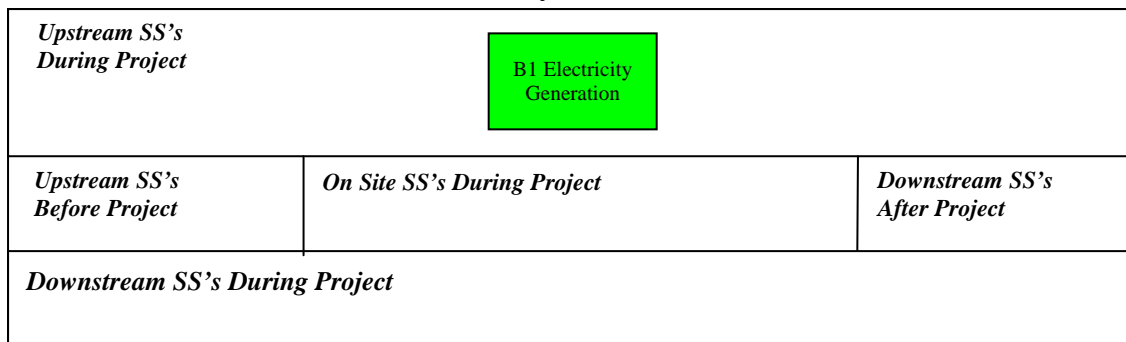
Under the project condition, low-impact, hydro electric facilities energize either loads connected to the electrical utility grid or to off-grid loads. The baseline condition includes the generation of electricity by other facilities linked to the electrical loads to cover the net generation capacity of the low-impact, hydro electric facility.

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

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



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



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

1. The metering of net electricity production must be made at a point downstream of both generation and any storage system, typically to where generated electricity is connected to its loads.
2. The low-impact, hydro electric project must meet the eligibility requirements for water-powered electricity generation projects as set forth under the Environmental Choice program. Proof of compliance may be indicated by an attestation of project developer or confirmation by the EcoLogo program or with an audit/verification report prepared by a third party. Compliance with the certification criteria needs only be proven once through the life of the project; and
3. The quantification of reductions achieved by the project is based on actual measurement and monitoring (except where indicated in this protocol) as indicated by the proper application of this protocol.

It is important to understand that GHG emission reductions are one of many environmental benefits associated with renewable low-impact electricity generation. The aggregation of the environmental benefits of one megawatt-hour of renewable electricity generation are commonly referred to as 'green tags' and traded as Renewable Energy Certificates (RECs). To avoid the 'double counting' of the environmental benefits bundled in RECs and emission offsets, the electricity generation to which any traded RECs are associated with should not be included in the quantification of GHG offsets from an eligible project.

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

1. For projects with a dedicated end-user of some or all of the electricity generation, where the run of river power facility is connected by a dedicated line to that facility, site specific electricity generation emission factors, reflecting the source of generation displaced under the project condition, may be substituted for the generic grid 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 flexibility provisions have been applied, the proponent must describe the provisions used, and justify their application through a detailed methodology, calculations, and all supporting documentation.

## 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.

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

$$\text{Emissions}_{\text{Baseline}} = \text{Emissions}_{\text{Electricity Generation}}$$

$$\text{Emissions}_{\text{Project}} = \text{Emissions}_{\text{Facility Operation}} + \text{Emissions}_{\text{Fuel Extraction and Processing}}$$

Where:

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

$\text{Emissions}_{\text{Electricity Generation}}$  = emissions under SS B1 Electricity Generation

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

$\text{Emissions}_{\text{Facility Operation}}$  = emissions under SS P1 Facility Operation

$\text{Emissions}_{\text{Fuel Extraction and Processing}}$  = emissions under SS P2 Fuel Extraction and Processing

**TABLE 1.1: Quantification Procedures**

1.0 Project / Baseline SS	2. Parameter / Variable	3. Unit
<b>Project SS's</b>		
P1 Facility Operation	<b>Emissions<sub>Facility 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>Facility Operation</sub>	kg of CO <sub>2</sub> ; CH <sub>4</sub> ; N <sub>2</sub> O
	Volume of Each Type of Fuel / Vol Fuel <sub>i</sub>	L, m <sup>3</sup> or other
	CO <sub>2</sub> Emissions Factor for Each Type of Fuel / EF Fuel <sub>i</sub> CO <sub>2</sub>	Kg CO <sub>2</sub> per L, m <sup>3</sup> or other
	CH <sub>4</sub> Emissions Factor for Each Type of Fuel / EF Fuel <sub>i</sub> CH <sub>4</sub>	kg CH <sub>4</sub> per L, m <sup>3</sup> or other
	N <sub>2</sub> O Emissions Factor for Each Type of Fuel / EF Fuel <sub>i</sub> N <sub>2</sub> O	kg N <sub>2</sub> O per L, m <sup>3</sup> or other
P2 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 CO <sub>2</sub> e
	Volume of Each Type of Fuel Combusted for P1 / Vol Fuel <sub>i</sub>	m <sup>3</sup>
	CO <sub>2</sub> Emissions Factor for Fuel Type of Production and Processing / EF Fuel <sub>CO2</sub>	kg CO <sub>2</sub> per m <sup>3</sup>
	CH <sub>4</sub> Emissions Factor for Each Type of Fuel Including Production and Processing / EF Fuel <sub>i</sub> CH <sub>4</sub>	kg CH <sub>4</sub> per m <sup>3</sup>
	N <sub>2</sub> O Emissions Factor for Each Type of Fuel Including Production and Processing / EF Fuel <sub>i</sub> N <sub>2</sub> O	kg N <sub>2</sub> O per m <sup>3</sup>
<b>Baseline SS's</b>		
B1 Electricity Generation	<b>Emissions<sub>Electricity Generation</sub></b> = <b>Electricity * EF<sub>Elec</sub></b>	
	Emissions <sub>Electricity</sub>	kg of CO <sub>2</sub> e
	Incremental Electricity Exported from the Project Site / Electricity	kWh
	Emissions Factor for Electricity / EF <sub>Elec</sub>	kg of CO <sub>2</sub> e per kWh

**APPENDIX A: Glossary of New Terms**

**Electricity Grid:** Infrastructure that brings power from the plant to the end users through high-voltage transmission systems which carry electricity from the power plants and transmit it hundreds of miles away, and lower-voltage distribution systems which draw electricity from the transmission lines and distribute it to individual customers.

**Low-impact, Hydro Electric Facility:**

A facility that uses a mechanical method to capture and convert the potential energy of water into electricity where the river flow on its own provides the pressure to spin the turbine. In the case of a project activity is implemented in an existing reservoir, where a water control device is already operating on the same waterway, there should be no change in the volume of the reservoir due to the generation facility.

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