QUANTIFICATION PROTOCOL FOR WIND-POWERED ELECTRICITY GENERATION

ABRIDGED

Submitted to:

Alberta Environment

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Disclaimer

The following document presents an abridged version of the Wind-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 energy in wind- into electrical energy as the end product. These cover several technologies and will be referred to simply as "wind 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 electric facility project operator or project proponent. Some familiarity with, or general understanding of, the operation of a wind electric facility, and associated practices, is expected.

Under the project condition, wind 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 wind electric facility.

FIGURE 1.1: Project Element Life Cycle Chart

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

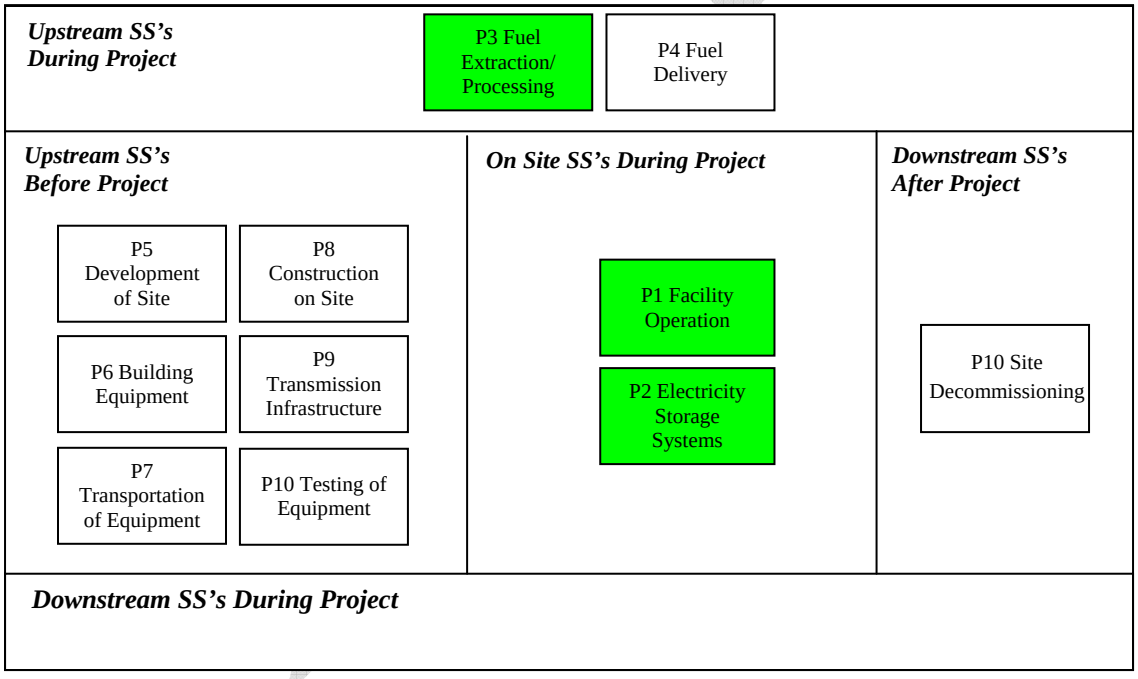
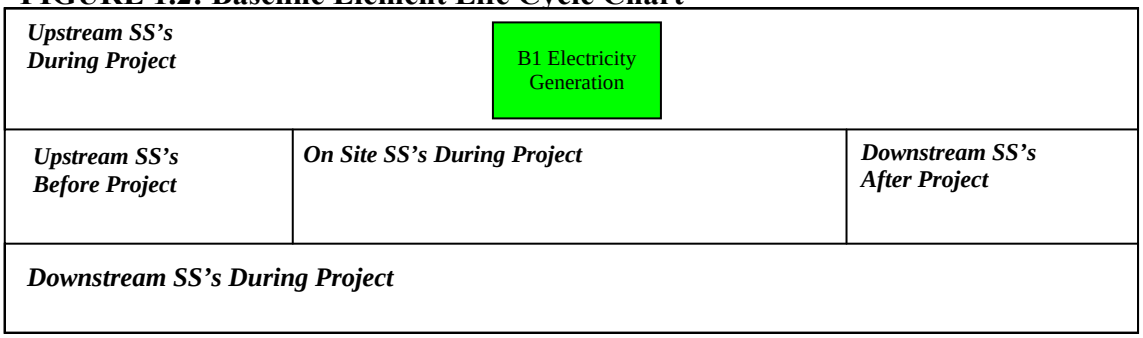


FIGURE 1.2: Baseline Element Life Cycle Chart



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 wind electric project must meet the eligibility requirements for solar electric 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 generation 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.

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

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

$$\text{Emissions}_{\text{Project}} = \text{Emissions}_{\text{Fuel Extraction and Processing}} + \text{Emission Emissions}_{\text{Facility Operation}} + \text{Emissions}_{\text{On-Site Electricity Storage Systems}}$$

Where:

Emissions $_{\text{Baseline}}$ = sum of the emissions under the baseline condition.
Emissions $_{\text{Electricity Generation}}$ = emissions under SS B1 Electricity Generation

Emissions $_{\text{Project}}$ = sum of the emissions under the project condition.
Emissions $_{\text{Facility Operation}}$ = emissions under SS P1 Facility Operation
Emissions $_{\text{Electricity Storage Systems}}$ = emissions under SS P2 Electricity Storage Systems
Emissions $_{\text{Fuel Extraction and Processing}}$ = emissions under SS P3 Fuel Extraction and Processing

TABLE 1.1: Quantification Procedures

1.0 Project / Baseline SS	**2. Parameter / Variable**	**3. Unit**
Project SS's		
P1 Facility Operation	**Emissions $_{\text{Facility Operation}}$ = ∑ (Vol. Fuel $_{i}$ * EF Fuel $_{i\ CO2}$) ; ∑ (Vol. Fuel $_{i}$ * EF Fuel $_{i\ CH4}$) ; ∑ (Vol. Fuel $_{i}$ * EF Fuel $_{i\ N2O}$)**	
	Emissions $_{\text{Facility Operation}}$	kg of CO_2 ; CH_4 ; N_2O
	Volume of Each Type of Fuel / Vol Fuel $_{i}$	L, m^3 or other
	CO_2 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CO2}$	kg CO_2 per L, m^3 or other
	CH_4 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CH4}$	kg CH_4 per L, m^3 or other
	N_20 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ N2O}$	kg N2O per L, m^3 or other
	Emissions $_{\text{Electricity Storage Systems}}$	kg of CO_2 ; CH_4 ; N_2O; HFC_i
	Volume of Each Type of Fuel / Vol Fuel $_{i}$	L, m^3 or other
	CO_2 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CO2}$	Kg CO_2 per L, m^3 or other
	CH_4 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CH4}$	kg CH_4 per L, m^3 or other
	N_20 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ N2O}$	kg N2O per L, m^3 or other
	Mass of Each Type of HFC / Mass HFC $_{i}$	kg HFC_i
	Global Warming Potential for Each Type of HFC / EF HFC $_{i}$	kg CO_{2E} per kg HFC_i consumed
P3 Fuel Extraction and Processing	**Emissions $_{\text{Fuel Extraction / Processing}}$ = ∑ (Vol. Fuel $_{i}$ * EF Fuel $_{i\ CO2}$) ; ∑ (Vol. Fuel $_{i}$ * EF Fuel $_{i\ CH4}$) ; ∑ (Vol. Fuel $_{i}$ * EF Fuel $_{i\ N2O}$)**	
	Emissions $_{\text{Fuel Extraction / Processing}}$	kg of CO2e
	Volume of Each Type of Fuel Combusted for P1 and P2 / Vol $_{\text{Fuel i}}$	m^3
	CO_2 Emissions Factor for Each Type of Fuel Including Production and Processing / EF Fuel $_{i\ CO2}$	kg CO_2 per m^3
	CH_4 Emissions Factor for Each Type of Fuel Including Production and Processing / EF Fuel $_{i\ CH4}$	kg CH_4 per m^3
	N_20 Emissions Factor for Each Type of Fuel Including Production and Processing / EF Fuel $_{i\ N2O}$	kg N2O per m^3
Baseline SS's		
B1 Electricity Generation	**Emissions $_{\text{Electricity Generation}}$ = Electricity * EF $_{\text{Elec}}$**	
	Emissions $_{\text{Electricity}}$	kg of CO2e
	Incremental Electricity Exported from the Project Site / Electricity	kWh
	Emissions Factor for Electricity / EF $_{\text{Elec}}$	kg of CO2e 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.
Electricity Storage Systems:	Power generated at the facility may need to be stored before being transmitted to the electricity grid. A system to store this power, such as a battery, will be installed at the wind powered electrical energy generation facility.
Wind Electric Facility:	A facility consisting of electrical energy generating, conversion, storage, and management equipment, sub-systems, and their connections up to the point where the generating or storage system connects to its AC or DC loads or to the electricity grid.