QUANTIFICATION PROTOCOL FOR DIVERSION OF BIOMASS TO ENERGY FROM BIOMASS COMBUSTION FACILITIES:

ABRIDGED

Submitted to:

Alberta Environment

and

Alberta Agriculture, Food and Rural Development

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Disclaimer

The following document presents an abridged version of the Diversion of Biomass to Energy from Biomass Combustion Facilities protocol prepared for Alberta Environment and Alberta Agriculture, Food and Rural Development 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 quantification protocol is applicable to the quantification of direct and indirect reductions of greenhouse gas emissions resulting from the implementation of energy from biomass combustion facilities. The greenhouse gas emissions may result from the combustion of biomass for the generation of electricity to offset electrical power from the grid, and/or thermal energy to offset offsite use of non-renewable energy sources, and also include the avoidance of methane emissions during the decomposition of the waste in stockpile, storage or landfill. The biomass may represent part or all of the feedstock to the renewable energy facility.

Typically this involves the establishment of an energy from biomass facility where biomass is delivered for combustion. The biomass may come from a variety of sources and may include biomass that would have otherwise decomposed anaerobically either in stockpile, storage or landfill. The remaining material, post combustion, will be sent to landfill for final disposal, land applied as a liming agent or otherwise used. **FIGURE 1.1** offers a project element life cycle chart for a typical project.

To demonstrate that a project is covered by the scope of the protocol, the project proponent must demonstrate that the biomass would have undergone anaerobic decomposition but is now being combusted. As evidence, the project proponent must demonstrate that the baseline condition of either stockpiling, storing or landfilling the biomass was the most likely alternative to combustion. Further, they must show that this waste is combusted at an energy from biomass facility.

The baseline condition for projects applying this protocol is the storage or disposal of biomass in a manner that would facilitate its anaerobic decomposition, either in long-term storage or landfill. The requirement for disposal of the biomass in this manner may depend on relevant forest management, waste management and air quality requirements. These requirements may be expressed directly in an operating permit or similar, as part of industry best practises, or as part of a specific regulatory requirement. Facilities that cannot show that the biomass materials would have undergone anaerobic decomposition, or where the biomass was not combusted, cannot apply this quantification protocol. **FIGURE 1.2** offers an element life cycle chart for a typical baseline configuration.

The baseline condition described above may include generation of thermal or electrical energy. To calculate the offset of emissions based on energy generated from the biomass, the baseline condition must also consider thermal and electrical energy generation that is functionally equivalent to energy generated under the project condition.

The approach to quantifying the baseline will be projection-based. This dynamic approach accounts for the market forces, weather and energy demand and operational parameters without adding multiple streams of material management. There are suitable models covering the activities under the applicable baseline condition that can provide reasonable certainty.

FIGURE 1.1: Project Element Life Cycle Chart

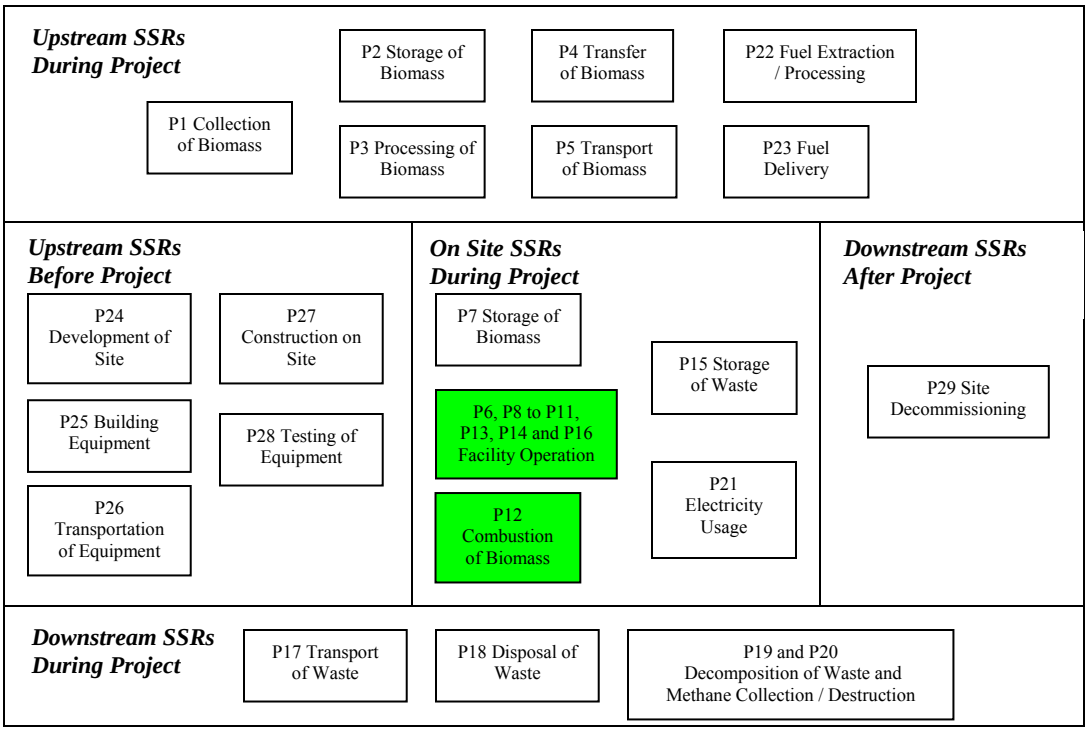
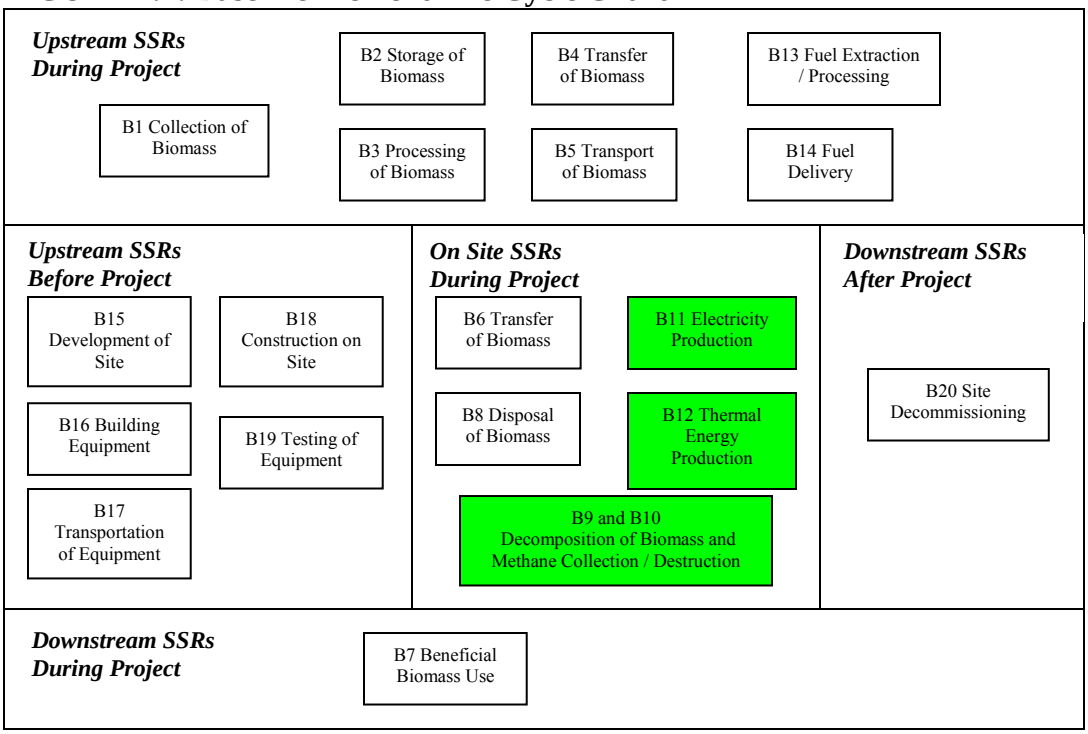


FIGURE 1.2: Baseline Element Life Cycle Chart



* 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. Biomass claimed to have been diverted from stockpile, storage or landfill to the energy from biomass combustion facility would have undergone anaerobic decomposition either in long-term storage or in a landfill as confirmed by an attestation from the biomass supplier;
2. 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;

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

1. Where the conditions for functional equivalence for certain components of the baseline and project condition or other justification for excluding SSRs cannot be assured, the respective SSRs may be added back to the protocol as indicated. Calculation methodologies, data requirements, etc., have been specified for each of these SSRs;
2. Grouping of SSRs is possible where one meter covers the fuel supply to multiple SSRs. In this case the highest level of quality assurance / quality control must be employed, and all of the fuel or electricity must be attributed to the SSR such that the most reasonable emissions values are attained;
3. 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; and
4. Measurement and data management procedures may be modified by the project proponent to account for the available equipment as long as the specified minimum standards for data quantity, frequency and quality are met. Where these standards cannot be met, the project proponent must justify why the changes to the methodology provided are reasonable.

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

2.0 Quantification of Identified Sources, Sinks and Reservoirs

Quantification of the reductions, removals and reversals for the sources, sinks and reservoirs selected for measurement and monitoring under this protocol will be completed using the methodologies outlined in **TABLE 2.1**, below. These calculation methodologies serve to complete the following three equations for calculating the emission reductions from the comparison of the baseline and project conditions.

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

$$\text{Emissions}_{\text{Baseline}} = \text{Emissions}_{\text{Decomp Biomass}} + \text{Emissions}_{\text{Electricity}} + \text{Emissions}_{\text{Thermal Heat}}$$

$$\text{Emissions}_{\text{Project}} = \text{Emissions}_{\text{Facility Operation}} + \text{Emissions}_{\text{Combustion of Biomass}}$$

TABLE 2.1: Quantification Procedures

1. Project/Baseline SSR	2. Parameter / Variable	3. Unit
Project SSRs		
P6, P8 to P11, P13, P14 and P16 Facility Operation	$Emissions_{Facility\ Operation} = \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ CO2}); \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ CH4}) ; \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ N20})$	
	$Emissions_{Facility\ Operation}$	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
P12 Combustion of Biomass	$Emissions_{Combustion\ of\ Biomass} = (Mass_{Biomass} * EF_{CH4}) ; (Mass_{Biomass} * EF_{N2O})$	
	$Emissions_{Combustion\ of\ Biomass}$	kg of CH_4 ; N_2O
	Mass of Total Amount of Biomass Processed at the Facility / $Mass_{Biomass}$	kg
	CH_4 Emissions Factor for Biomass / EF_{CH4}	kg CH_4 per kg
	N_20 Emissions Factor for Biomass / EF_{N2O}	kg N2O per kg
Baseline SSRs		
B9 and B10 Decomposition of Biomass and Methane Collection/ Destruction	$Emissions_{Decomp\ of\ Biomass} = (Mass_{Biomass} * MCF * DOC * DOC_F * F * 16/12 - R) * (1 - OX)$	
	$Emissions_{Decomp\ of\ Biomass}$	kg of CH_4
	Mass of Biomass Diverted from Stockpile, Storage or Landfill / $Mass_{Biomass}$	kg
	Methane Correction Factor / MCF	-
	Degradable Organic Carbon / DOC	-
	Fraction of Degradable Organic Carbon Dissimilated / DOC_F	-
	Fraction of CH_4 in Landfill Gas / F	-
	Recovered CH_4 at Landfill / R	kg of CH4
	Oxidation Factor / OX	-
B11 Electricity Production	$Emissions_{Electricity} = Electricity * EF_{Elec}$	
	$Emissions_{Electricity}$	kg of CO2e
	Electricity Produced at Site / Electricity	kWh
	Emissions Factor for Electricity / EF_{Elec}	kg of CO2e per kWh
B12 Thermal Energy Produced	$Emissions_{Thermal\ Heat} = \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ CO2}); \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ CH4}) ; \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ N20})$	
	$Emissions_{Thermal\ Heat}$	kg of CO_2 ; CH_4 ; N_2O

APPENDIX A: Glossary of New Terms

The following definitions are critical to the appropriate interpretation of this quantification protocol.

Biomass	For the purposes of this protocol document, biomass is defined to include forest and mill residues, agricultural crops and wastes, wood and wood wastes, animal wastes, livestock operation residues, and organic municipal and industrial wastes. This may include materials recovered from existing long-term storage or landfill disposal sites.
Combustion:	For the purposes of this protocol document, combustion is limited to the aerobic combustion of the biomass in the presence of air, such as in a typical fluidized bed boiler system. No synthetic gas products are produced.
Disposal Site	Disposal sites are defined as the locations where the biomass would undergo anaerobic decomposition as part of a long-term storage, or uncontrolled or controlled landfill.
Landfill	A landfill is a site at which materials are stored where they can undergo anaerobic decomposition. This may include the materials being buried, piled, mixed with other waste materials, or otherwise. Landfills classified as either controlled or uncontrolled are included in this definition. The designation of controlled or uncontrolled refers to the level of permitting and technical controls in place at the disposal site. Uncontrolled landfills may exist where although there is no expressly stated goal to leave the materials in place, there is a track record of material residing in that place for extended periods (greater than 10 years) and there are no plans or regulatory requirements for the material to be transferred to another disposal site.