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

Submitted to:

Alberta Environment

and

Alberta Agriculture, Food and Rural Development

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1.1 Protocol 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.

Comment [KSD1]: Reordered this statement to take emphasis off projects that are simply a diversion of waste from landfill.

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 process flow diagram for a typical project.

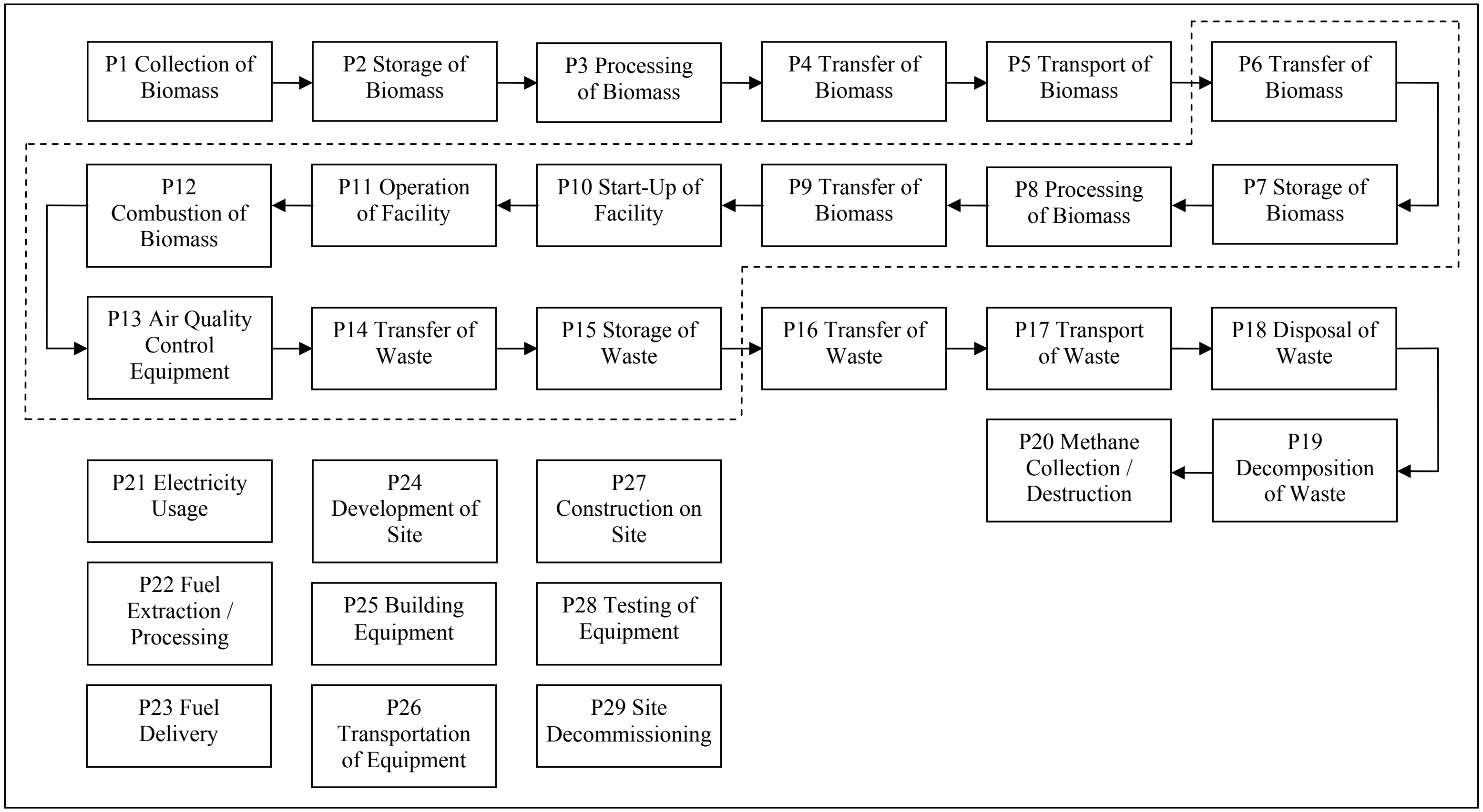
To demonstrate that a project is covered by the scope of the protocol, the project proponent must demonstrate that the biomass would have undergone anaerobic decomposition but is now being combusted. As evidence, the project proponent must demonstrate that the baseline condition of either stockpiling, storing or landfilling the biomass was the most likely alternative to combustion, as illustrated in **FIGURE 1.2**. Further, they must show that this waste is combusted at an energy from biomass facility.

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.

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

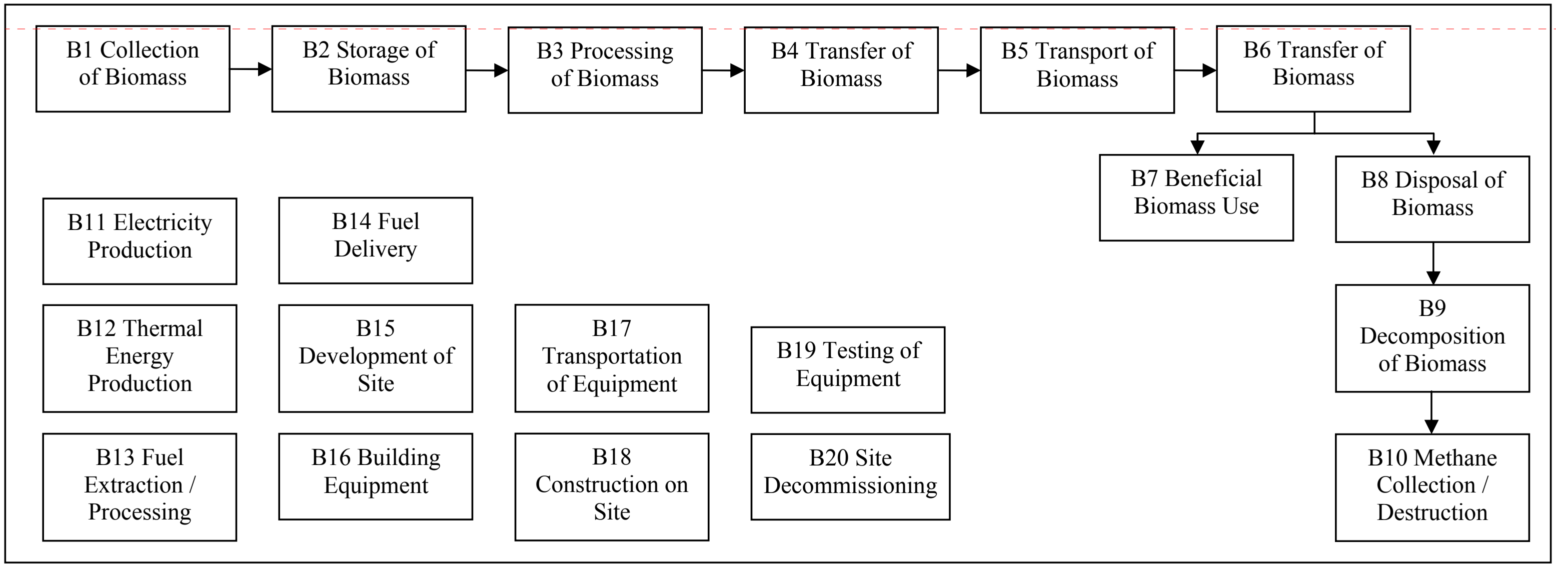
1. Biomass claimed to have been diverted from stockpile, storage or landfill to the energy from biomass combustion facility would have undergone anaerobic decomposition either in long-term storage or in a landfill as confirmed by an attestation from the biomass supplier;
2. The quantification of reductions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

FIGURE 1.1: Process Flow Diagram for Project Condition



Comment [KSD2]: Included P3 to capture the processing of biomass at the point of origin (i.e. chipping) to reduce transportation volume.

FIGURE 1.2: Process Flow Diagram for Baseline Condition



Comment [KSD3]: Included B3 to capture the processing of biomass at the point of origin (i.e. chipping) to reduce transportation volume.

Included B7 to capture the previous use of biomass (that was not diverted from landfill) within the process flow diagram

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. The application of this principle led to the simplified process flow diagrams provided in **FIGURE 1.3** and **FIGURE 1.4**;
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.

The project proponent will have to justify their approach in detail to apply any of these flexibility mechanisms.

This quantification protocol is written for the energy from biomass project developer or proponent. Some familiarity with, or general understanding of, waste management practices including energy from biomass is expected.

1.2 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.
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.

FIGURE 1.3: Simplified Process Flow Diagram for Project Condition

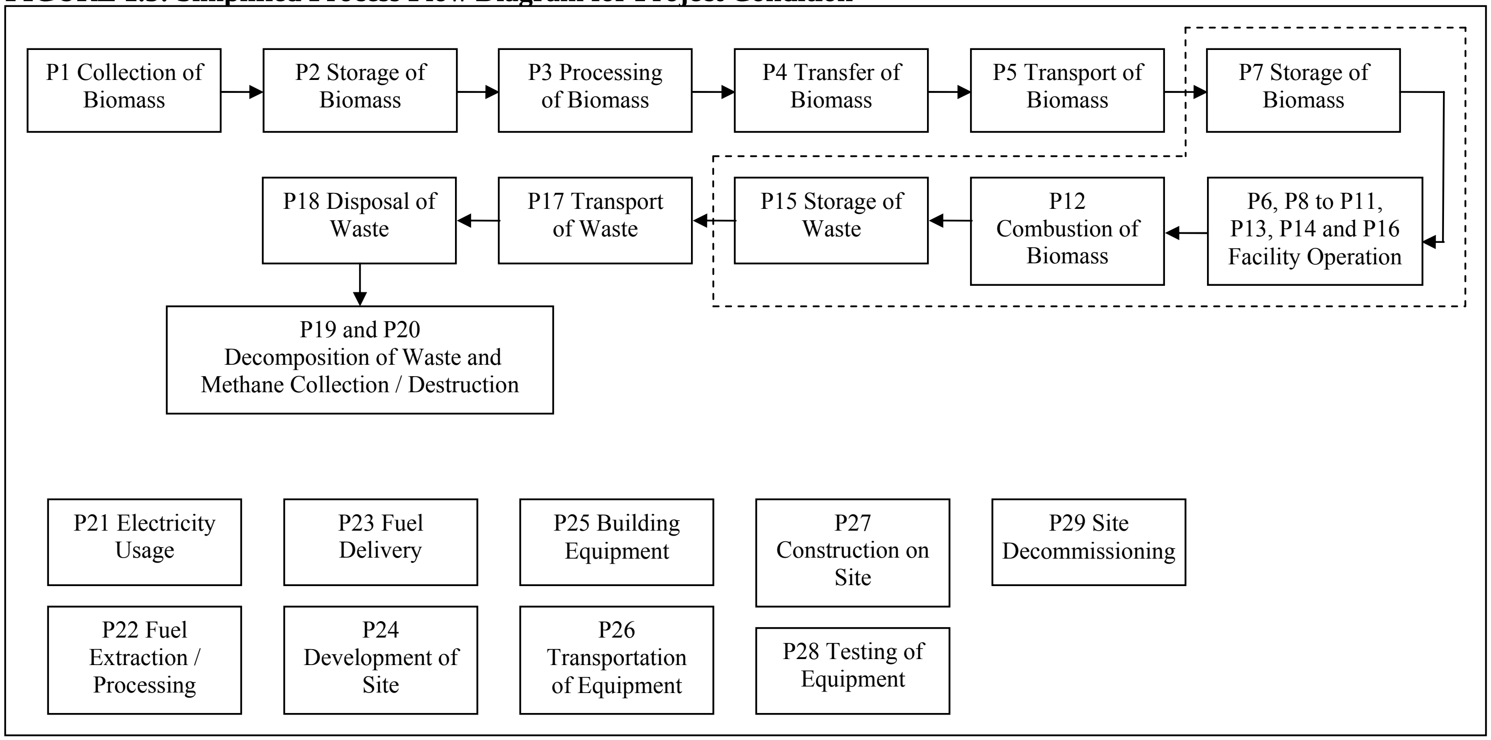
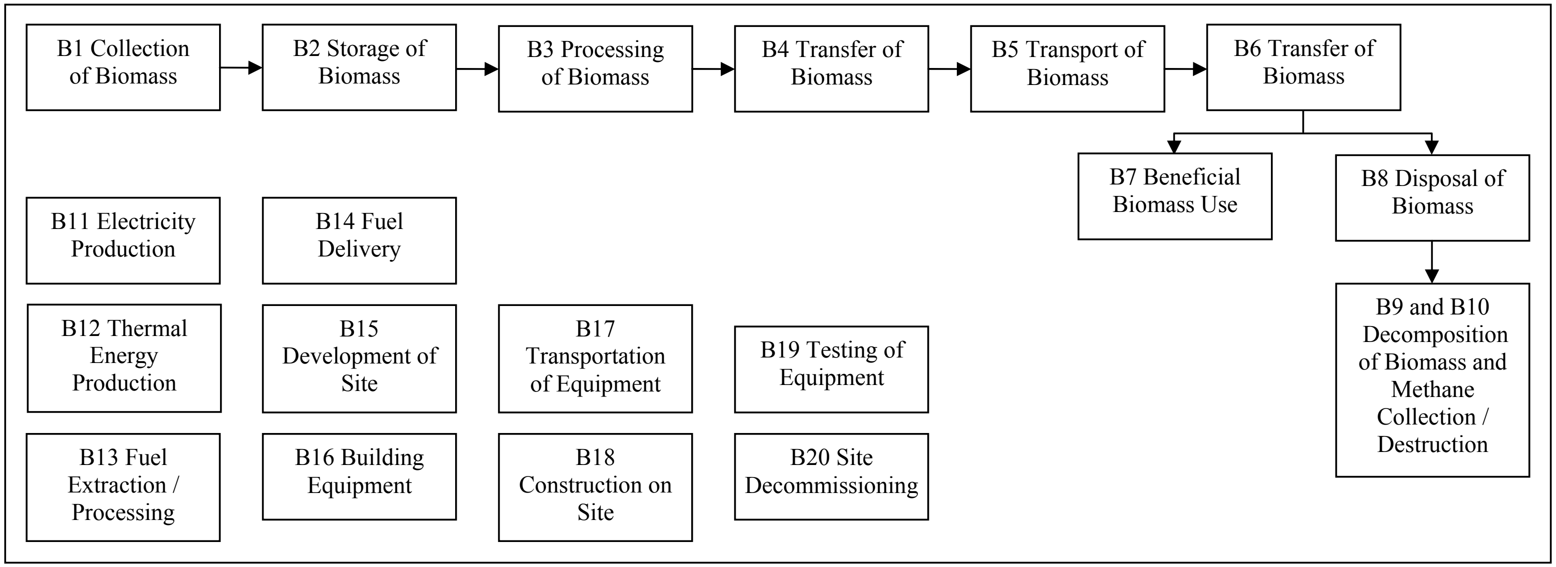


FIGURE 1.4: Simplified Process Flow Diagram for Baseline Condition



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.

2.0 Quantification Development and Justification

The following sections outline the quantification development and justification.

2.1 Identification of Sources, Sinks and Reservoirs (SSRs) for the Project

SSRs were identified for the project by reviewing the relevant process flow diagrams, consulting with stakeholders (i.e. project proponents) and reviewing the good practise guidance. This iterative process confirmed that the SSRs in the process flow diagrams covered the full scope of eligible project activities under the protocol.

Based on the process flow diagrams provided in **FIGURE 1.1** and **FIGURE 1.3**, the project SSRs were organized into life cycle categories in **FIGURE 2.1**. Descriptions of each of the SSRs and their classification as controlled, related or affected are provided in **TABLE 2.1.**

FIGURE 2.1: Project Element Life Cycle Chart

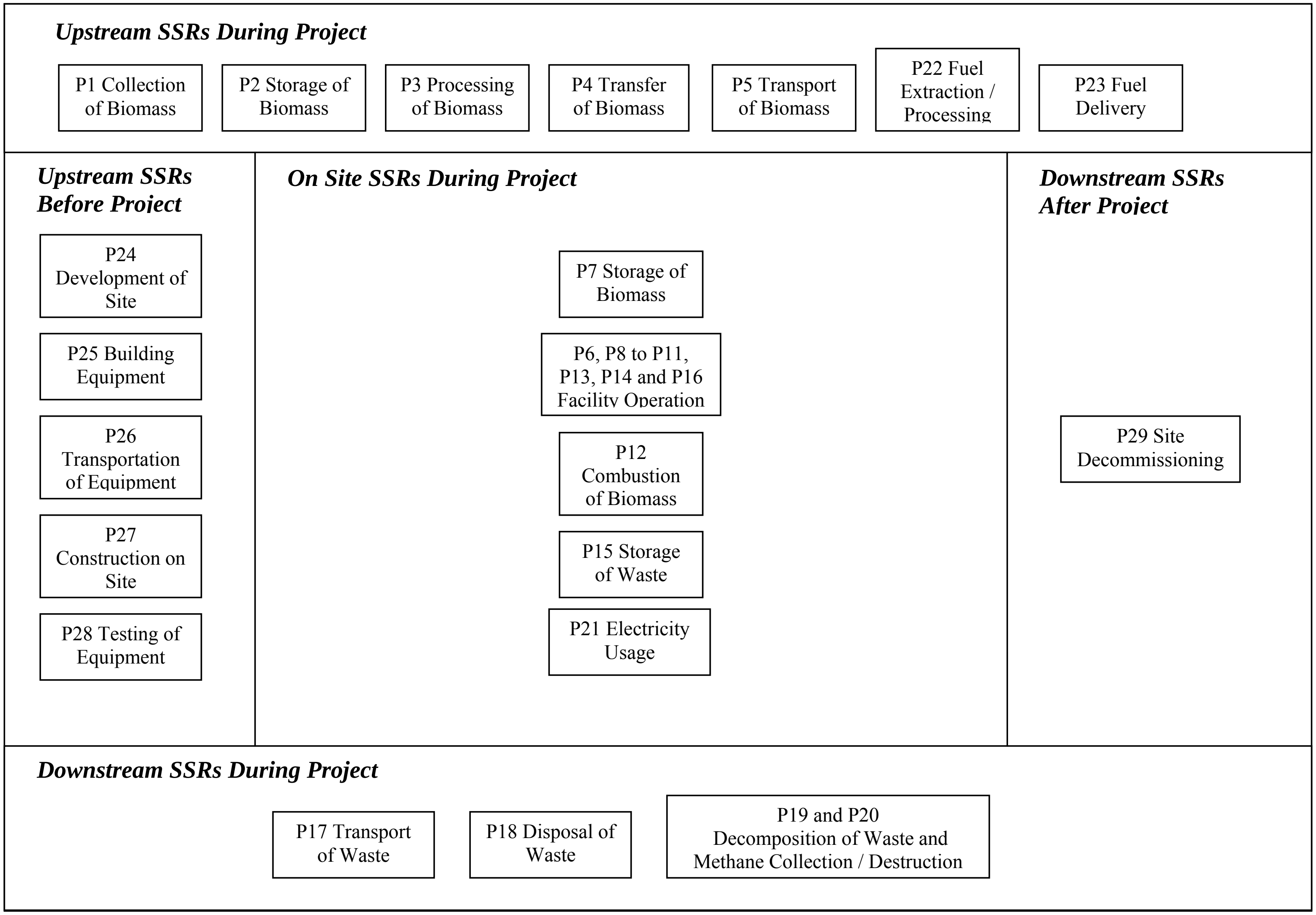


TABLE 2.1: Project SSRs

1. SSR	2. Description	3. Controlled, Related or Affected
Upstream SSRs during Project Operation		
P1 Collection of Biomass	Biomass may be collected from the forest floor, agricultural facilities, landfills or from industrial facilities into storage piles using heavy equipment or conveyors. Collection of biomass from the forest floor is typically a component of the forest management plan or an additional function to gather the material for use. This would typically be completed by diesel fuelled bulldozers. Collection of biomass from agricultural facilities, such as tree farms, would be completed by heavy equipment such as tractors or bulldozers as part of the site operational plan. Collection of biomass from a landfill is a resource recovery procedure. It reduces the quantity of waste in the landfill and serves to extend the life cycle of existing landfills. This is typically accomplished using heavy equipment such as bulldozers and excavators. Collection of biomass from industrial facilities is typically done as a means of keeping the work area clean. The biomass would either be mechanically or manually collected, and conveyed or moved in batches by heavy equipment. For the majority of situations, collection activities are fuelled by diesel, gasoline, or natural gas, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities of each of the energy inputs would be contemplated to evaluate functional equivalence with the baseline condition.	Related
P2 Storage of Biomass	Biomass may be stored in piles where anaerobic decomposition may occur, resulting in the emission of methane gas. These piles may consist of storage piles at forestry, agricultural or industrial sites. Any energy inputs to this SSR, for wetting of biomass or agitation of biomass, would be covered under ***P3 Transfer of Biomass*** as these elements are typically related. The characteristics of these storage piles, in terms of size, shape, composition and duration of storage are all pertinent to evaluate functional equivalence with the baseline condition.	Related
P3 Processing of Biomass	Biomass may be processed off site using a series of mechanical processes, heavy equipment and conveyors. This equipment would be fuelled by diesel, gasoline or natural gas, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities and types for each of the energy inputs would be tracked.	Related

Comment [KSD4]: New definition.

P4 Transfer of Biomass	Biomass may be transferred from storage piles into containers (truck trailers, rail cars or storage bins) or onto conveyors for transport to the project site. This may involve the use of heavy equipment such as loaders and cranes, or other mechanized devices. This equipment would be fuelled by diesel, gasoline, natural gas or electricity, resulting in GHG emissions. Other fuels may also be used in some rare cases. Any energy inputs associated with ***P2 Storage of Biomass***, such as wetting of biomass or agitation of biomass, are to be included here. Further, if the material is conveyed to the project site, then the related energy inputs would be captured under this SSR. Quantities for each of the energy inputs would be contemplated to evaluate functional equivalence with the baseline condition.	Related
P5 Transport of Biomass	Biomass may be transported to the project site by truck, barge and/or train. The related energy inputs for fuelling this equipment are captured under this SSR, for the purposes of calculating the resulting greenhouse gas emissions. Type of equipment, number of loads and distance travelled would be used to evaluate functional equivalence with the baseline condition.	Related
P22 Fuel Extraction / Processing	Each of the fuels used throughout the on-site component of the project will need to be sourced and processed. This will allow for the calculation of the greenhouse gas emissions from the various processes involved in the production, refinement and storage of the fuels. The total volumes of fuel for each of the on-site SSRs are considered under this SSR. Volumes and types of fuels are the important characteristics that may need to be tracked.	Related
P23 Fuel Delivery	Each of the fuels used throughout the on-site component of the project will need to be transported to the site. This may include shipments by tanker or by pipeline, resulting in the emissions of greenhouse gases. It is reasonable to exclude fuel sourced by taking equipment to an existing commercial fuelling station as the fuel used to take the equipment to the site is captured under other SSRs and there are no other delivery emissions as the fuel is already going to the commercial fuelling station. Distance and means of fuel delivery as well as the volumes of fuel delivered are the important characteristics that may need to be tracked.	Related
Onsite SSRs during Project Operation		
P7 Storage of Biomass	Biomass may be stored on-site in piles where anaerobic decomposition may occur, resulting in the emission of methane gas. These piles are typically maintained as small mounds with short residency times on-site due to lack of storage, in order to maintain the functional order of the facility and/or to mitigate risks from self-combustion. The characteristics of these storage piles, in terms of size, shape, composition and duration of storage may all need to be tracked.	Controlled

P6, P8 to P11, P13, P14 and P16 Facility Operation	Biomass may be transferred from transportation bins to the processing systems using a combination of loaders, cranes, conveyors and other mechanized devices. This equipment would be fuelled by diesel, gasoline or natural gas, resulting in GHG emissions. Other fuels may also be used in some rare cases. Any energy inputs associated with ***P7 Storage of Biomass***, such as wetting of biomass or agitation of biomass, are to be included here. Quantities and types for each of the energy inputs would be tracked.	Controlled
	Biomass may be processed on site using a series of mechanical processes, heavy equipment and conveyors. This equipment would be fuelled by diesel, gasoline or natural gas, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities and types for each of the energy inputs would be tracked.	
	Biomass may be transferred from processing (or from the storage piles if there are no processing systems) to the combustion facility using a combination of loaders, cranes, conveyors and other mechanized devices. This equipment would be fuelled by diesel, gasoline or natural gas, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities and types for each of the energy inputs would be tracked.	
	Greenhouse gas emissions may occur that are associated with the start-up of the biomass power facility. This may include the running of auxiliary equipment or burning of various fuels to warm up the equipment. These start-up periods may be after both scheduled and non-scheduled shut-downs of the facility. Quantities and types for each of the energy inputs would be tracked.	
	Greenhouse gas emissions may occur that are associated with the operation and maintenance of the biomass power facility. This may include running any auxiliary or monitoring systems. Quantities and types for each of the energy inputs would be tracked.	
	The operation of air quality control equipment on site may be powered by diesel, gasoline or natural gas. Other fuels may also be used in some rare cases. Quantities and types for each of the energy inputs would be tracked.	
	Waste may be transferred from the combustion process to a storage area using a combination of loaders, cranes, conveyors and other mechanized devices. This equipment would be fuelled by diesel, gasoline or natural gas, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities and types for each of the energy inputs would be tracked.	

	Waste may be transferred from the waste storage area to containers for the transportation of the waste offsite using a combination of loaders, cranes, conveyors and other mechanized devices. This equipment would be fuelled by diesel, gasoline or natural gas, resulting in GHG emissions. Other fuels may also be used in some rare cases. Any energy inputs associated with ***P15 Storage of Waste***, such as wetting, sorting or agitation of the waste, are to be included here. Quantities and types for each of the energy inputs would be tracked.	
P12 Combustion of Biomass	The combustion of biomass yields greenhouse gas emissions. The carbon dioxide component of these emissions is deemed to be biogenic, however the remaining components must be considered. Quantity of biomass combusted would be tracked.	Controlled
P15 Storage of Waste	Waste, representing predominantly non-combustible inert materials such as fly ash, sand and rocks, may be stored on-site in piles where limited anaerobic decomposition may occur, resulting in the emission of methane gas. These piles are typically maintained with short residency times on site in order to maintain the order of the facility. The characteristics of these storage piles, in terms of size, composition, shape and duration of storage may all need to be tracked.	Controlled
P21 Electricity Usage	Electricity may be required for operating the facility. This power may be sourced either from internal generation, connected facilities or the local electricity grid. Metering of electricity may be netted in terms of the power going to and from the grid. Quantity and source of power are the important characteristics that may need to be tracked as they directly relate to the quantity of greenhouse gas emissions.	Controlled
Downstream SSRs during Project Operation		
P17 Transport of Waste	Waste materials may be transported to disposal sites by truck, barge and/or train. The related energy inputs for fuelling this equipment are captured under this SSR, for the purposes of calculating the resulting greenhouse gas emissions. Type of equipment, number of loads and distance travelled would be used to evaluate functional equivalence with the baseline condition.	Related
P18 Disposal of Waste	Waste may be disposed of at a disposal site (typically landfill or land application location) by transferring the waste from the transportation container, spreading, burying, processing, otherwise handling the waste using a combination of loaders, conveyors and other mechanized devices. This equipment would be fuelled by diesel, gasoline or natural gas, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities and types for each of the energy inputs may need to be tracked.	Related

P19 and P20 Decomposition of Waste and Methane Collection / Destruction	Waste may decompose in the disposal facility resulting in the production of methane. Under two alternatives, the fly ash (either with or without the other waste products from the facility) may either be used as a soil amendment or as a concrete amendment. Disposal site characteristics and mass disposed of at each site may need to be tracked. A methane collection and destruction system may be in place at the disposal site. If such a system is active in the area of the landfill where this waste is being disposed, then this methane collection must be accounted for in a reasonable manner. The characteristics of the methane collection and destruction system may need to be tracked	Related
Other		
P24 Development of Site	The site of the energy from biomass facility may need to be developed. This could include civil infrastructure such as access to electricity, natural gas and water supply, as well as sewer etc. This may also include clearing, grading, building access roads, etc. There will also need to be some building of structures for the facility such as storage areas, storm water drainage, offices, vent stacks, firefighting water storage lagoons, etc., as well as structures to enclose, support and house the equipment. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels and electricity used to power equipment required to develop the site such as graders, backhoes, trenching machines, etc.	Related
P25 Building Equipment	Equipment may need to be built either on-site or off-site. This includes all of the components of the storage, handling, processing, combustion, air quality control, system control and safety systems. These may be sourced as pre-made standard equipment or custom built to specification. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels and electricity used to power equipment for the extraction of the raw materials, processing, fabricating and assembly.	Related
P26 Transportation of Equipment	Equipment built off-site and the materials to build equipment on-site, will all need to be delivered to the site. Transportation may be completed by truck, train and/or barge. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels to power the equipment delivering the equipment to the site.	Related
P27 Construction on Site	The process of construction at the site will require a variety of heavy equipment, smaller power tools, cranes and generators. The operation of this equipment will have associated greenhouse gas emission from the use of fossil fuels and/or electricity.	Related
P28 Testing of Equipment	Equipment may need to be tested to ensure that it is operational. This may result in running the equipment using test biomass fuels or fossil fuels in order to ensure that the equipment runs properly. These activities will result in greenhouse gas emissions associated with the combustion of fossil fuels and the use of electricity.	Related

P29 Site Decommissioning	Once the facility is no longer operational, the site may need to be decommissioned. This may involve the disassembly of the equipment, demolition of on-site structures, disposal of some materials, environmental restoration, re-grading, planting or seeding, and transportation of materials off-site. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels and electricity used to power equipment required to decommission the site.	Related

2.2 Identification of Baseline

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.

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.

The baseline condition is defined including the relevant SSRs and processes as shown in **FIGURE 1.4**. More detail on each of these SSRs is provided in Section 2.3, below.

2.3 Identification of SSRs for the Baseline

Based on the process flow diagrams provided in **FIGURE 1.2** and **FIGURE 1.4**, the baseline SSRs were organized into life cycle categories in **FIGURE 2.2**. Descriptions of each of the SSRs and their classification as either ‘controlled’, ‘related’ or ‘affected’ is provided in **TABLE 2.2.**

FIGURE 2.2: Baseline Element Life Cycle Chart

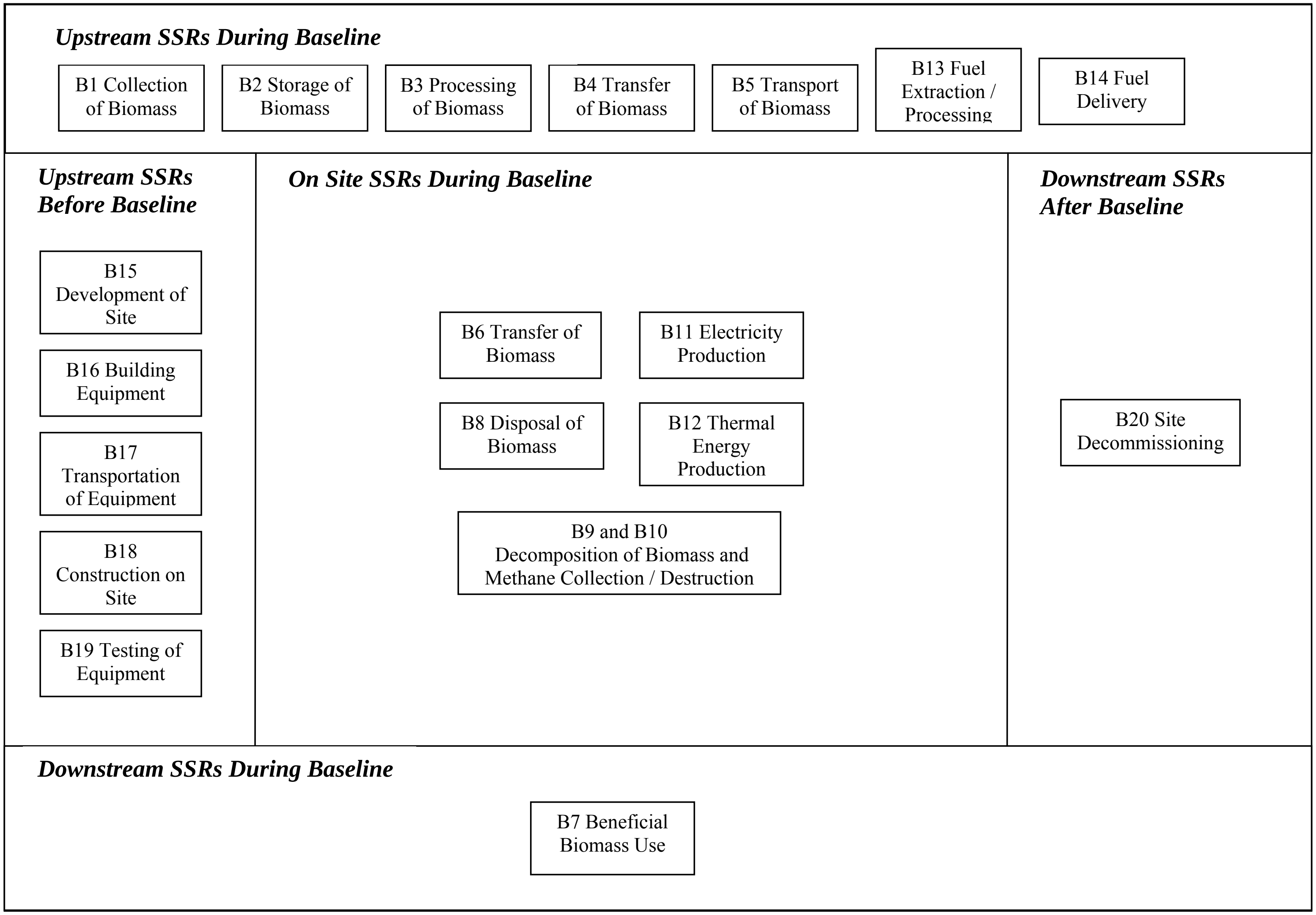


TABLE 2.2: Baseline SSRs

1. SSR	2. Description	3. Controlled, Related or Affected
Upstream SSRs during Baseline Operation		
B1 Collection of Biomass	Biomass may be collected from either the forest floor, agricultural facilities or from industrial facilities into storage piles using heavy equipment or conveyors. Collection of the biomass from the forest floor is typically a component of the forest management plan or an additional function to gather the material for use. This would typically be completed by diesel fuelled bulldozers. Collection of biomass from agricultural facilities, such as tree farms, would be completed by heavy equipment such as tractors or bulldozers as part of the site operational plan. Collection of biomass from industrial facilities is typically done as a means of keeping the work area clean. The biomass would either be mechanically or manually collected, and conveyed or moved in batches by heavy equipment. For the majority of situations, collection activities are fuelled by diesel, gasoline, natural gas or electricity, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities of each of the energy inputs would be contemplated to evaluate functional equivalence with the project condition.	Related
B2 Storage of Biomass	Biomass may be stored in piles where anaerobic decomposition may occur, resulting in the emission of methane gas. These piles may consist of storage piles at forestry, agricultural or industrial sites. Any energy inputs to this SSR, for wetting of biomass or agitation of biomass, would be covered under ***P3 Transfer of Biomass*** as these elements are typically related. The characteristics of these storage piles, in terms of size, shape, composition and duration of storage are all pertinent to evaluate functional equivalence with the project condition.	Related
B3 Processing of Biomass	Biomass may be processed off site using a series of mechanical processes, heavy equipment and conveyors. This equipment would be fuelled by diesel, gasoline or natural gas, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities and types for each of the energy inputs would be tracked.	Related

B4 Transfer of Biomass	Biomass may be transferred from storage piles into containers (truck trailers, rail cars or storage bins) on onto conveyors for transport to the disposal site. This may involve the used of heavy equipment such as loaders and cranes, or other mechanized devices. This equipment would be fuelled by diesel, gasoline, natural gas or electricity, resulting in GHG emissions. Other fuels may also be used in some rare cases. Any energy inputs associated with ***B2 Storage of Biomass***, such as wetting of biomass or agitation of biomass, are to be included here. Further, if the material is conveyed to the project site, then the related energy inputs would be captured under this SSR. Quantities for each of the energy inputs would be contemplated to evaluate functional equivalence with the project condition.	Related
B5 Transport of Biomass	Biomass may be transported to the disposal site by truck, barge and/or train. The related energy inputs for fuelling this equipment are captured under this SSR, for the purposes of calculating the resulting greenhouse gas emissions. Type of equipment, number of loads and distance travelled would be used to evaluate functional equivalence with the project condition.	Related
B13 Fuel Extraction / Processing	Each of the fuels used throughout the on-site component of the project will need to be sourced and processed. This will allow for the calculation of the greenhouse gas emissions from the various processes involved in the production, refinement and storage of the fuels. The total volumes of fuel for each of the on-site SSRs are considered under this SSR. Volumes and types of fuels are the important characteristics to be tracked.	Related
B14 Fuel Delivery	Each of the fuels used throughout the on-site component of the project will need to be transported to the site. This may include shipments by tanker or by pipeline, resulting in the emissions of greenhouse gases. It is reasonable to exclude fuel sourced by taking equipment to an existing commercial fuelling station as the fuel used to take the equipment to the site is captured under other SSRs and there is no other delivery.	Related
Onsite SSRs during Baseline Operation		
B11 Electricity Production	Electricity will be produced off-site to match the electricity being produced by the energy from biomass facility. This electricity will be produced at an emissions intensity as deemed appropriate by the Program Authority. Measurement of the gross quantity of electricity produced by the facility will need to be tracked to quantify this SSR. The gross quantity of electricity produced should be net of any electricity sold as Renewable Energy Credits (RECs) as defined by the Environmental Choice Program.	Controlled

B12 Thermal Energy Production	The production of thermal energy may be required to meet the demands of facilities being provided with thermal energy from the project site. This thermal energy may have been derived from waste heat recovery systems resulting in an energy burden on the systems from which the heat is being recovered or directly from combustion of fossil fuels. Energy requirements, fuel volumes and fuel types will need to be tracked.	Controlled
B6 Transfer of Biomass	Biomass may be transferred from transportation containers to the disposal systems using a combination of loaders, cranes, conveyors and other mechanized devices. This equipment would be fuelled by diesel, gasoline, natural gas or electricity, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities and types for each of the energy inputs would be tracked.	Controlled
B8 Disposal of Biomass	Biomass may be disposed of at a disposal site by transferring the biomass from the transportation container, spreading, burying, processing, otherwise handling the biomass using a combination of loaders, conveyors and other mechanized devices. This equipment would be fuelled by diesel, gasoline, natural gas or electricity, resulting in GHG emissions. Other fuels may also be used in some rare cases. Quantities and types for each of the energy inputs would be tracked if the SSR is to be included.	Controlled
B9 and B10 Decomposition of Biomass and Methane Collection / Destruction	Waste may decompose in the disposal facility resulting in the production of methane. Disposal site characteristics and mass disposed of at each site are to be tracked A methane collection and destruction system may be in place at the disposal site. If such a system is active in the area of the landfill where this waste is being disposed, then this methane collection must be accounted for in a reasonable manner. The characteristics of the methane collection and destruction system must be tracked	Controlled
Downstream SSRs during Baseline Operation		
B7 Beneficial Use of Biomass	Biomass may be put to beneficial use. Biomass may be included in new, refurbished, processed or recycled products. This may also include use in electrical and power generation. The greenhouse gas emissions are associated with the energy inputs and processes required would need to be tracked.	Related
Others		
B15 Development of Site	The site may need to be developed under the baseline condition. This could include civil infrastructure such as access to electricity, natural gas and water supply, as well as sewer etc. This may also include clearing, grading, building access roads, etc. There will also need to be some building of structures for the facility such as storage areas and offices, etc., as well as structures to enclose, support and house any equipment. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels and electricity used to power equipment required to develop the site such as graders, backhoes, trenching machines, etc.	Related

Comment [KSD5]: New definition.

B16 Building Equipment	Equipment may need to be built either on-site or off-site. This can include the baseline components for the storage, handling and processing of the biomass. These may be sourced as pre-made standard equipment or custom built to specification. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels and electricity used to power equipment for the extraction of the raw materials, processing, fabricating and assembly.	Related
B17 Transportation of Equipment	Equipment built off-site and the materials to build equipment on-site, will all need to be delivered to the site. Transportation may be completed by truck, train and/or barge. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels to power the equipment delivering the equipment to the site.	Related
B18 Construction on Site	The process of construction at the site will require a variety of heavy equipment, smaller power tools, cranes and generators. The operation of this equipment will have associated greenhouse gas emission from the use of fossil fuels and electricity.	Related
B19 Testing of Equipment	Equipment may need to be tested to ensure that it is operational. These activities may result in greenhouse gas emissions associated with the combustion of fossil fuels and the use of electricity.	Related
B20 Site Decommissioning	Once the facility is no longer operational, the site may need to be decommissioned. This may involve the disassembly of the equipment, demolition of on-site structures, disposal of some materials, environmental restoration, re-grading, planting or seeding, and transportation of materials off-site. Greenhouse gas emissions would be primarily attributed to the use of fossil fuels and electricity used to power equipment required to decommission the site.	Related

2.4 Selection of Relevant Project and Baseline SSRs

Each of the SSRs from the project and baseline condition were compared and evaluated as to their relevancy using the guidance provided in Annex VI of the “Guide to Quantification Methodologies and Protocols: Draft”, dated March 2006 (Environment Canada). The justification for the exclusion, or conditions upon which SSRs may be excluded is provided below. All other SSRs listed previously are included. This information is summarized in **TABLE 2.3**, below.

TABLE 2.3: Comparison of SSRs

1. Baseline Options	2. Baseline (C, R, A)	2. Project (C, R, A)	4. Include or Exclude from Quantification	5. Justification for Exclusion
Upstream SSRs				
P1 Collection of Biomass	N/A	Related	Exclude	Under the majority of project and baseline configurations, the collection of biomass will be functionally equivalent. These SSRs may therefore be excluded.
B1 Collection of Biomass	Related	N/A		
P2 Storage of Biomass	N/A	Related	Exclude	Under the majority of project and baseline configurations, the storage of biomass will be functionally equivalent. In addition, under the majority of project configurations, the storage of biomass under conditions conducive to anaerobic digestion (i.e. in piles, windrows or in landfill) under the project condition is for less than six months. The generation of methane from typical biomass materials over a period of less than 6 months is considered to be negligible.
B2 Storage of Biomass	Related	N/A		
P3 Processing of Biomass	N/A	Related	Exclude	Under the majority of project and baseline configurations, the transfer of biomass will be functionally equivalent and therefore these SSRs may therefore be excluded.
B3 Processing of Biomass	Related	N/A		
P4 Transfer of Biomass	N/A	Related	Exclude	Under the majority of project and baseline configurations, the transfer of biomass will be functionally equivalent and therefore these SSRs may therefore be excluded.
B4 Transfer of Biomass	Related	N/A		
P5 Transport of Biomass	N/A	Related	Exclude	Under the majority of project and baseline configurations, the transfer of biomass will be functionally equivalent and therefore these SSRs may therefore be excluded.
B5 Transport of Biomass	Related	N/A		
P22 Fuel Extraction / Processing	N/A	Related	Exclude	These SSRs are not relevant to the project as the emissions from these practises are covered under proposed greenhouse gas regulations.
B13 Fuel Extraction / Processing	Related	N/A	Exclude	
P23 Fuel Delivery	N/A	Related	Exclude	These SSRs are not relevant to the project as the emissions from these practises are covered under proposed greenhouse gas regulations.
B14 Fuel Delivery	Related	N/A	Exclude	
Onsite SSRs				
P7 Storage of Biomass	N/A	Controlled	Exclude	As per the discussion on ***P2 and B2 Storage of Biomass***, the majority of project configurations limit the storage of biomass under conditions conducive to anaerobic digestion (i.e. in piles, windrows or in landfill) to less than six months. The emissions from the storage under this SSR will be similarly minimal and therefore are excluded. However, this SSR may be included as a flexibility mechanism in cases where extended storage occurs, i.e. greater than six months.
P6, P8 to P11, P13, P14 and P16 Facility Operation	N/A	Controlled	Include	N/A

Comment [KSD6]: Excluding these SSRs.

P12 Combustion of Biomass	N/A	Controlled	Include	N/A
P15 Storage of Waste	N/A	Controlled	Exclude	As per the discussion on ***P2 and B2 Storage of Biomass***, the project proponent can demonstrate that the storage of waste under conditions conducive to anaerobic digestion (i.e. in piles, windrows or in landfill) under the project condition was for less than six months. The waste material is of much smaller volumes compared to the biomass processed by the facility. Further, it is rendered essentially inert and would therefore undergo anaerobic digestion to a lesser extent than the non-combusted biomass. Therefore, the emissions from the storage of waste under this SSR will be small and therefore may be excluded.
P21 Electricity Usage	N/A	Controlled	Exclude	This SSR is not relevant to the project as the emissions from the electricity consumed at the facility are covered under proposed greenhouse gas regulations.
B11 Electricity Production	Controlled	N/A	Include	N/A
B12 Thermal Energy Production	Controlled	N/A	Include	N/A
B6 Transfer of Biomass	Controlled	N/A	Exclude	The greenhouse gas emissions covered under this SSR result from the operation of equipment and machinery at the disposal site for transferring waste from the transportation containers. The incremental operation of this equipment to deal with the biomass is the primary concern. Emissions under this SSR represent incremental emissions under the baseline condition. Therefore, inclusion of this SSR in the calculation increases the emission reduction claim, so excluding this SSR is reasonable.
B8 Disposal of Biomass	Controlled	N/A	Exclude	Excluded as the volume of biomass being disposed of represents less than 5% of the annual waste disposed of at the disposal facility under the majority of configurations.
B9 and B10 Decomposition of Biomass and Methane Collection / Destruction	Controlled	N/A	Include	N/A
Downstream SSRs				
P17 Transport of Waste	N/A	Related	Exclude	Under the majority of project configurations, the volume of waste generated is less than 2% of the total biomass processed at the facility. Further, the distance to the disposal site is typically less than 50 kilometres, one way. Therefore, for a typical project the total emissions from transport of waste would be less than 2 tonnes per year and therefore immaterial. Therefore, this SSR is excluded.

P18 Disposal of Waste	N/A	Related	Exclude	The greenhouse gas emissions covered under this SSR result from the operation of equipment and machinery at the disposal site. The incremental operation of this equipment to deal with the biomass is the primary concern. Given the nominal volumes of material being disposed of as waste, as discussed in ***P16 Transport of Waste,*** this SSR can be excluded.
P19 and P20 Decomposition of Waste and Methane Collection / Destruction	N/A	Related	Exclude	The waste from energy from biomass facilities is essentially inert as the non-combustible component of the biomass material. As such, the disposal of waste in the landfill would not contribute to methane production, and would have no impact on methane collection and destruction systems. Therefore, this SSR is excluded.
B7 Beneficial Biomass Use	Related	N/A	Exclude	Excluded as greenhouse gas emissions under the baseline condition serve only to increase the stated emission reduction. The emissions under this SSR may also be covered under proposed greenhouse gas regulations.
Other				
P24 Development of Site	N/A	Related	Exclude	Energy from biomass facilities are similar in scope to other fossil fuel power facilities that would be built to provide a similar power source. Thus, the emissions from development of the site would be similar.
P25 Building Equipment	N/A	Related	Exclude	Energy from biomass facilities are similar in scope to other fossil fuel power facilities that would be built to provide a similar power source. Thus, the emissions from building the equipment for the site would be similar.
P26 Transportation of Equipment	N/A	Related	Exclude	Energy from biomass facilities are similar in scope to other fossil fuel power facilities that would be built to provide a similar power source. Thus, the emissions from transportation of equipment to the site would be similar.
P27 Construction on Site	N/A	Related	Exclude	Energy from biomass facilities are similar in scope to other fossil fuel power facilities that would be built to provide a similar power source. Thus, the emissions from construction on the site would be similar.
P28 Testing of Equipment	N/A	Related	Exclude	Energy from biomass facilities are similar in scope to other fossil fuel power facilities that would be built to provide a similar power source. Thus, the emissions from testing of equipment would be similar, if not lower due to the biogenic source of the predominant fuel source.

Comment [KSD7]: Exclusion of this SSR is new. It represents a conservative approach to addressing this point.

P29 Site Decommissioning	N/A	Related	Exclude	Energy from biomass facilities are similar in scope to other fossil fuel power facilities that would be built to provide a similar power source. Thus, the emissions from site decommissioning would be similar, if not lower due to the lower toxicity of the facility fuel compared to fossil fuel power facilities.
B15 Development of Site	Related	N/A	Exclude	Excluding emissions from the development of the site for the baseline scenario represents a conservative approach of accounting for these emissions.
B16 Building Equipment	Related	N/A	Exclude	Excluding emissions from the building of equipment for the baseline scenario represents a conservative approach of accounting for these emissions.
B17 Transportation of Equipment	Related	N/A	Exclude	Excluding emissions from the transportation of equipment to the site for the baseline scenario represents a conservative approach of accounting for these emissions.
B18 Construction on Site	Related	N/A	Exclude	Excluding emissions from the construction on the site for the baseline scenario represents a conservative approach of accounting for these emissions.
B19 Testing of Equipment	Related	N/A	Exclude	Excluding emissions from the testing of equipment at the site for the baseline scenario represents a conservative approach of accounting for these emissions.
B20 Site Decommissioning	Related	N/A	Exclude	Excluding emissions from the decommissioning of the site for the baseline scenario represents a conservative approach of accounting for these emissions.

2.5 Quantification of Reductions, Removals and Reversals of Relevant SSRs

2.5.1 Quantification Approaches

Quantification of the reductions, removals and reversals of relevant SSRs for each of the greenhouse gases will be completed using the methodologies outlined in **TABLE 2.4**, below and for the SSRs under the flexibility mechanisms in **APPENDIX A**. These calculation methodologies serve to complete the following three equations for calculating the emission reductions from the comparison of the baseline and project conditions.

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

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

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

Where:

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

$\text{Emissions}_{\text{Decomp Biomass}}$ = emissions under SSR B9 and B10 Decomposition of Biomass and Methane Collection / Destruction.

$\text{Emissions}_{\text{Electricity}}$ = emissions under SSR B11 Electricity Production.

$\text{Emissions}_{\text{Thermal Heat}}$ = emissions under SSR B12 Thermal Energy Produced.

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

$\text{Emissions}_{\text{Facility Operation}}$ = emissions under SSR P6, P8 to P11, P13, P14 and P16 Facility Operation.

$\text{Emissions}_{\text{Combustion of Biomass}}$ = emissions under P12 Combustion of Biomass

TABLE 2.4: Quantification Procedures

1. Project/ Baseline SSR	2. Parameter / Variable	3. Unit	4. Measured / Estimated	5. Method	6. Frequency	7. Justify measurement or estimation and frequency
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	N/A	N/A	N/A	Quantity being calculated in aggregate form as fuel and electricity use on site is likely aggregated for each of these SSRs.
	Volume of Each Type of Fuel / Vol $Fuel_i$	L, m^3 or other	Measured	Direct metering or reconciliation of volume in storage (including volumes received).	Continuous metering or monthly reconciliation.	Both methods are standard practise. Frequency of metering is highest level possible. Frequency of reconciliation provides for reasonable diligence.
	CO_2 Emissions Factor for Each Type of Fuel / EF $Fuel_{i\ CO2}$	Kg CO_2 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	CH_4 Emissions Factor for Each Type of Fuel / EF $Fuel_{i\ CH4}$	kg CH_4 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	N_20 Emissions Factor for Each Type of Fuel / EF $Fuel_{i\ N2O}$	kg N2O per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
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	N/A	N/A	N/A	Quantity being calculated.

	Mass of Total Amount of Biomass Processed at the Facility / Mass $_{Biomass}$	kg	Measured	Direct measurements of mass of representative units of biomass received at the energy from biomass facility for combustion measured either at the facility or at load origin, prorated to number of loads received.	Measurement of weight of a representative number of loads as well as absolute number of loads of biomass as received at the biomass facility.	Measuring the mass of each load as it is received can be too much of a burden and delivery cycles tend to be uniform. This represents the industry practise.
	CH_4 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CH4}$	kg CH_4 per kg	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	$N_2$0 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ N2O}$	kg N2O per kg	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
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	N/A	N/A	N/A	Quantity being calculated.
	Mass of Biomass Diverted from Stockpile, Storage or Landfill / Mass $_{Biomass}$	kg	Measured	Direct measurements of mass of representative units of biomass received at the energy from biomass facility for combustion measured either at the facility or at load origin, prorated to number of loads received.	Measurement of weight of a representative number of loads as well as absolute number of loads of biomass as received at the biomass facility.	Measuring the mass of each load as it is received can be too much of a burden and delivery cycles tend to be uniform. This represents the industry practise.

	Methane Correction Factor / MCF	-	Estimated	Calculated based on IPCC and Environment Canada guidelines, provided in Appendix B and C.	Annual	Values calculated based on values published by IPCC. Reference values adjusted periodically as part of internal IPCC review of its methodologies.
	Degradable Organic Carbon / DOC	-	Estimated	Calculated based on IPCC and Environment Canada guidelines, provided in Appendix B and C.	Annual	Values calculated based on values published by IPCC. Reference values adjusted periodically as part of internal IPCC review of its methodologies.
	Fraction of Degradable Organic Carbon Dissimilated / DOC_F	-	Estimated	Calculated based on IPCC and Environment Canada guidelines, provided in Appendix B and C.	Annual	Values calculated based on values published by IPCC. Reference values adjusted periodically as part of internal IPCC review of its methodologies.
	Fraction of CH_4 in Landfill Gas / F	-	Estimated	From IPCC guidelines.	Annual	Reference values adjusted periodically as part of internal IPCC review of its methodologies.
	Recovered CH_4 at Landfill / R	kg of CH4	Measured	Direct metering.	Annual	Mass of methane collected and destroyed.
	Oxidation Factor / OX	-	Estimated	From IPCC guidelines.	Annual	Reference values adjusted periodically as part of internal IPCC review of its methodologies.
B11 Electricity Production	$Emissions_{Electricity} = Electricity * EF_{Elec}$					
	$Emissions_{Electricity}$	kg of CO2e	N/A	N/A	N/A	Quantity being calculated.
	Electricity Produced at Site / Electricity	kWh	Measured	Direct metering of all electricity produced at the facility, net of parasitic load.	Continuous metering	Continuous direct metering represents the industry practise and the highest level of detail.

	Emissions Factor for Electricity / EF_{Elec}	kg of CO2e per kWh	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
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	N/A	N/A	N/A	Quantity being calculated.
	Volume of Each Type of Fuel / Vol $Fuel_i$	L, m^3 or other	Measured	Calculated relative to metered quantity of thermal energy delivered to the customer by the project facility, converted to an equivalent volume of fuel.	Continuous metering	Method is standard practise.
	CO_2 Emissions Factor for Each Type of Fuel / EF $Fuel_{i\ CO2}$	kg CO_2 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	CH_4 Emissions Factor for Each Type of Fuel / EF $Fuel_{i\ CH4}$	kg CH_4 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	N_2O Emissions Factor for Each Type of Fuel / EF $Fuel_{i\ N2O}$	kg N2O per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.

2.5.2. Contingent Data Approaches

Contingent means for calculating or estimating the required data for the equations outlined in section 2.5.1 are summarized in **TABLE 2.5**, below and for the SSRs under the flexibility mechanisms in **APPENDIX D**.

2.6 Management of Data Quality

In general, data quality management must include sufficient data capture such that the mass and energy balances may be easily performed with the need for minimal assumptions and use of contingency procedures. The data should be of sufficient quality to fulfill the quantification requirements and be substantiated by company records for the purpose of verification.

The project proponent shall establish and apply quality management procedures to manage data and information. Written procedures should be established for each measurement task outlining responsibility, timing and record location requirements. The greater the rigour of the management system for the data, the more easily an audit will be to conduct for the project.

2.6.1 Record Keeping

Record keeping practises should include:

a. Electronic recording of values of logged primary parameters for each measurement interval;
b. Printing of monthly back-up hard copies of all logged data;
c. Written logs of operations and maintenance of the project system including notation of all shut-downs, start-ups and process adjustments;
d. Retention of copies of logs and all logged data for a period of 7 years; and
e. Keeping all records available for review by a verification body.

2.6.2 Quality Assurance/Quality Control (QA/QC)

QA/QC can also be applied to add confidence that all measurements and calculations have been made correctly. These include, but are not limited to:

a. Protecting monitoring equipment (sealed meters and data loggers);
b. Protecting records of monitored data (hard copy and electronic storage);
c. Checking data integrity on a regular and periodic basis (manual assessment, comparing redundant metered data, and detection of outstanding data/records);
d. Comparing current estimates with previous estimates as a 'reality check';
e. Provide sufficient training to operators to perform maintenance and calibration of monitoring devices;
f. Establish minimum experience and requirements for operators in charge of project and monitoring; and
g. Performing recalculations to make sure no mathematical errors have been made.

TABLE 2.5: Contingent Data Collection Procedures

1. Project/ Baseline SSR	2. Parameter / Variable	3. Unit	4. Measured / Estimated	5. Contingency Method	6. Frequency	7. Justify measurement or estimation and frequency
Project SSRs						
P6, P8 to P11, P13, P14 and P16 Facility Operation	Volume of Each Type of Fuel / Vol Fuel $_i$	L, m^3 or other	Estimated	Reconciliation of volume of fuel purchased within given time period.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
P12 Combustion of Biomass	Mass of Total Amount of Biomass Processed at the Facility / Mass $_{Biomass}$	kg	Estimated	Reconciliation of average mass of biomass accepted over previous 6 months for which data is available multiplied by the ratio of the electrical and thermal energy generated in that month divided by the average MWh of electrical and thermal energy generated over those six months.	Monthly	Quantity of biomass processed at the facility is roughly proportionate to the amount of electrical and thermal power generated at the facility.
Baseline SSRs						
B9 and B10 Decomposition of Biomass and Methane Collection/ Destruction	Mass of Biomass Diverted from Stockpile, Storage or Landfill / Mass $_{Biomass}$	kg	Estimated	Reconciliation of average mass of biomass diverted from stockpile, storage or landfill over previous 6 months for which data is available multiplied by the ratio of the electrical and thermal energy generated in that month divided by the average MWh of electrical and thermal energy generated over those six months.	Monthly	Quantity of biomass diverted from landfill is fairly uniform from month to month as the supply of biomass is typically covered under long term supply contracts. Further, the overall quantity processed by the facility is roughly proportionate to the amount of electrical and thermal power generated at the facility.

B11 Electricity Production	Electricity Usage / Electricity	kWh	Estimated	Reconciliation of power requirements for facility as per equipment output ratings.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
B12 Thermal Energy Produced	Volume of Each Type of Fuel / Vol Fuel $_i$	L, m^3 or other	Estimated	Calculated relative to metered quantity of thermal heat billed to the customer.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.

APPENDIX A:

Quantification Procedures for Flexibility Mechanisms

1. Project/ Baseline SSR	2. Parameter / Variable	3. Unit	4. Measured / Estimated	5. Contingency Method	6. Frequency	7. Justify measurement or estimation and frequency
Flexibility Mechanisms						
P1 Collection of Biomass	$Emissions_{Collection\ of\ Biomass} = \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ CO2}); \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ CH4}); \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ N20})$					
	$Emissions_{Collection\ of\ Biomass}$	kg of CO_2 ; CH_4 ; N_2O	N/A	N/A	N/A	Quantity being calculated in aggregate form as fuel and electricity use on site is likely aggregated for each of these SSRs.
	Volume of Each Type of Fuel / Vol $Fuel_i$	L, m^3 or other	Measured	Direct metering or reconciliation of volume in storage (including volumes received).	Continuous metering or monthly reconciliation.	Both methods are standard practise. Frequency of metering is highest level possible. Frequency of reconciliation provides for reasonable diligence.
	CO_2 Emissions Factor for Each Type of Fuel / EF $Fuel_{i\ CO2}$	kg CO_2 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	CH_4 Emissions Factor for Each Type of Fuel / EF $Fuel_{i\ CH4}$	kg CH_4 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	N_20 Emissions Factor for Each Type of Fuel / EF $Fuel_{i\ N2O}$	kg N2O per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
P2 Storage of Biomass	$Emissions_{Storage\ of\ Biomass} = (Mass_{Biomass} * k * Lo * exp(- k * t))$					
	$Emissions_{Storage\ of\ Biomass}$	kg of CH_4	N/A	N/A	N/A	Quantity being calculated.

	Mass of Biomass Stored / Mass $_{Biomass}$	Mg	Measured	Direct measurements of mass of biomass material stored at the collection or generation site that is to be diverted from stockpile, storage or landfill.	Monthly	Estimation of the maximum mass of biomass material stored at the energy from biomass site at any given time.
	Methane Generation Rate Constant / k	1 / yr	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	Methane Generation Potential / Lo	kg of CH_4 / Mg	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	Time / t	yr	Measured	Number of days in the year.	Annual	Number of days in a year is an absolute value.
P4 Transfer of Biomass	Emissions $_{Transfer\ of\ Biomass}$ = ∑ (Vol. Fuel $_i$ * EF Fuel $_{i\ CO2}$); ∑ (Vol. Fuel $_i$ * EF Fuel $_{i\ CH4}$) ; ∑ (Vol. Fuel $_i$ * EF Fuel $_{i\ N20}$)					
	Emissions $_{Transfer\ of\ Biomass}$	kg of CO_2 ; CH_4 ; N_2O	N/A	N/A	N/A	Quantity being calculated in aggregate form as fuel and electricity use on site is likely aggregated for each of these SSRs.
	Volume of Each Type of Fuel / Vol Fuel $_i$	L, m^3 or other	Measured	Direct metering or reconciliation of volume in storage (including volumes received).	Continuous metering or monthly reconciliation.	Both methods are standard practise. Frequency of metering is highest level possible. Frequency of reconciliation provides for reasonable diligence.
	CO_2 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CO2}$	kg CO_2 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	CH_4 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CH4}$	kg CH_4 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.

	N_20 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ N2O}$	kg N2O per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
P5 Transport of Biomass	Emissions $_{Transport\ of\ Biomass}$ = ∑ (Emissions $_{Truck}$ + Emissions $_{Boat}$ + Emissions $_{Train}$)					
	Emissions $_{Truck}$ = ∑ (# Loads $_{Truck\ i}$ * Distance $_{Truck\ i}$ * Fuel Eff $_{Truck\ i}$ * EF Fuel $_{CO2}$) ; ∑ (# Loads $_{Truck\ i}$ * Distance $_{Truck\ i}$ * Fuel Eff $_{Truck\ i}$ * EF Fuel CH_4) ; ∑ (# Loads $_{Truck\ i}$ * Distance $_{Truck\ i}$ * Fuel Eff $_{Truck\ i}$ * EF Fuel N_2O)					
	Emissions $_{Truck}$	kg of CO_2 ; CH_4 ; N_2O	N/A	N/A	N/A	Quantity being calculated.
	Number of Loads for Each Truck on Each Route / # Loads $_{Truck\ i}$	-	Measured	Number of loads recorded.	Every load recorded upon arrival at the energy from biomass facility.	Measuring the percent of total load weight would be an incremental industry practise.
	Distance Driven by Each Truck / Distance $_{Truck\ i}$	km	Measured	Distance each load travels.	Annual	The distance of each route is measured once a year.
	Fuel Efficiency of Each Type of Truck / Fuel Eff $_{Truck\ i}$	L per 100 km	Estimated	Volume of fuel use is divided by distance travelled.	Monthly	This method is conservative as it incorporates all travel time and idling.
	CO_2 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CO2}$	kg CO_2 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	CH_4 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CH4}$	kg CH_4 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	N_20 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ N2O}$	kg N2O per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.

	$Emissions_{Barge} = \sum(\% \text{ of Load} * Distance_{Barge\ i} * \text{Fuel } Eff_{Barge\ i} * \text{EF } Fuel_{CO2})\ ;\ \sum(\% \text{ of Load} * Distance_{Barge\ i} * \text{Fuel } Eff_{Barge\ i} * \text{EF } Fuel_{CH4})\ ;\ \sum(\% \text{ of Load} * Distance_{Barge\ i} * \text{Fuel } Eff_{Barge\ i} * \text{EF } Fuel_{N2O})$					
	$Emissions_{Barge}$	kg of CO_2 ; CH_4 ; N_2O	N/A	N/A	N/A	Quantity being calculated.
	Percent of the Total Load Weight on the Barge / % of Load	-	Measured	Percent of the total load weight on the boat measured as the mass of biomass as compared to the total mass of cargo.	Every load recorded upon arrival at the energy from biomass facility.	Measuring the percent of total load weight would be an incremental industry practise.
	Distance Travelled by each Barge / $Distance_{Barge\ i}$	km	Measured	Distance each load travels.	Annual	The distance of each route is measured once a year.
	Fuel Efficiency of Each Type of Barge / Fuel $Eff_{Barge\ i}$	L per 100 km	Estimated	Volume of fuel use is divided by distance travelled.	Monthly	This method is conservative as it incorporates all travel time and idling.
	$Emissions_{Train} = \sum(\% \text{ of Load} * Distance_{Train\ i} * \text{Fuel } Eff_{Train\ i} * \text{EF } Fuel_{CO2})\ ;\ \sum(\% \text{ of Load} * Distance_{Train\ i} * \text{Fuel } Eff_{Train\ i} * \text{EF } Fuel_{CH4})\ ;\ \sum(\% \text{ of Load} * Distance_{Train\ i} * \text{Fuel } Eff_{Train\ i} * \text{EF } Fuel_{N2O})$					
	$Emissions_{Train}$	kg of CO_2 ; CH_4 ; N_2O	N/A	N/A	N/A	Quantity being calculated.
	Percent of the Total Load Weight on the Train / % of Load	-	Measured	Percent of the total load weight on the train measured as the mass of biomass as compared to the total mass of cargo.	Every load recorded upon arrival at the energy from biomass facility.	Measuring the percent of total load weight would be an incremental industry practise.
	Distance Travelled by Each Train / $Distance_{Train\ i}$	km	Measured	Distance each load travels.	Annual	The distance of each route is measured once a year.
	Fuel Efficiency of Each Type of Train / Fuel $Eff_{Train\ i}$	L per 100 km	Estimated	Volume of fuel use is divided by distance travelled.	Monthly	This method is conservative as it incorporates all travel time and idling.

P7 Storage of Biomass	Emissions $_{Storage\ of\ Biomass\ (2)}$ = (Mass $_{Biomass}$ * k * Lo * exp (- k * t))					
	Emissions $_{Storage\ of\ Biomass\ (2)}$	kg of CH_4	N/A	N/A	N/A	Quantity being calculated.
	Mass of Biomass / Mass $_{Biomass}$	Mg	Measured	Direct measurements of mass of biomass material stored at the energy from biomass site.	Monthly	Estimation of the maximum mass of biomass material stored at the energy from biomass site at any given time.
	Methane Generation Rate Constant / k	1 / yr	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	Methane Generation Potential / Lo	kg of CH_4 / Mg	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	Time / t	yr	Measured	Number of days in the year.	Annual	Number of days in a year is an absolute value.
B1 Collection of Biomass	Emissions $_{Collection\ of\ Biomass}$ = ∑ (Vol. Fuel $_i$ * EF Fuel $_{i\ CO2}$); ∑ (Vol. Fuel $_i$ * EF Fuel $_{i\ CH4}$) ; ∑ (Vol. Fuel $_i$ * EF Fuel $_{i\ N20}$)					
	Emissions $_{Collection\ of\ Biomass}$	kg of CO_2 ; CH_4 ; N_2O	N/A	N/A	N/A	Quantity being calculated in aggregate form as fuel and electricity use on site is likely aggregated for each of these SSRs.
	Volume of Each Type of Fuel / Vol Fuel $_i$	L, m^3 or other	Measured	Direct metering or reconciliation of volume in storage (including volumes received).	Continuous metering or monthly reconciliation.	Both methods are standard practise. Frequency of metering is highest level possible. Frequency of reconciliation provides for reasonable diligence.
	CO_2 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CO2}$	kg CO_2 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	CH_4 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CH4}$	kg CH_4 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.

	N_20 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ N2O}$	kg N2O per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
B2 Storage of Biomass	Emissions $_{Storage\ of\ Biomass}$ = (Mass $_{Biomass}$ * k * Lo * exp (- k * t))					
	Emissions $_{Storage\ of\ Biomass}$	kg of CH_4	N/A	N/A	N/A	Quantity being calculated.
	Mass of Biomass / Mass $_{Biomass}$	Mg	Estimated	Estimated from direct measurements of mass of biomass material stored at the energy from biomass site.	Measurement of each load of biomass as it is received at the biomass facility.	Estimation of the maximum mass of biomass material stored at the energy from biomass site at any given time.
	Methane Generation Rate Constant / k	1 / yr	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	Methane Generation Potential / Lo	kg of CH_4 / Mg	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	Time / t	yr	Measured	Number of days in the year.	Annual	Number of days in a year is an absolute value.
B4 Transfer of Biomass	Emissions $_{Transfer\ of\ Biomass}$ = ∑ (Vol. Fuel $_i$ * EF Fuel $_{i\ CO2}$); ∑ (Vol. Fuel $_i$ * EF Fuel $_{i\ CH4}$) ; ∑ (Vol. Fuel $_i$ * EF Fuel $_{i\ N20}$)					
	Emissions $_{Transfer\ of\ Biomass}$	kg of CO_2 ; CH_4 ; N_2O	N/A	N/A	N/A	Quantity being calculated in aggregate form as fuel and electricity use on site is likely aggregated for each of these SSRs.
	Volume of Each Type of Fuel / Vol Fuel $_i$	L, m^3 or other	Measured	Direct metering or reconciliation of volume in storage (including volumes received).	Continuous metering or monthly reconciliation.	Both methods are standard practise. Frequency of metering is highest level possible. Frequency of reconciliation provides for reasonable diligence.

	CO_2 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CO2}$	kg CO_2 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	CH_4 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CH4}$	kg CH_4 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	N_20 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ N2O}$	kg N2O per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
B5 Transport of Biomass	Emissions $_{Transport\ of\ Biomass}$ = ∑ (Emissions $_{Truck}$ + Emissions $_{Boat}$ + Emissions $_{Train}$)					
	Emissions $_{Truck}$ = ∑ (# Loads $_{Truck\ i}$ * Distance $_{Truck\ i}$ * Fuel Eff $_{Truck\ i}$ * EF Fuel $_{CO2}$) ; ∑ (# Loads $_{Truck\ i}$ * Distance $_{Truck\ i}$ * Fuel Eff $_{Truck\ i}$ * EF Fuel CH_4) ; ∑ (# Loads $_{Truck\ i}$ * Distance $_{Truck\ i}$ * Fuel Eff $_{Truck\ i}$ * EF Fuel N_2O)					
	Emissions $_{Truck}$	kg of CO_2 ; CH_4 ; N_2O	N/A	N/A	N/A	Quantity being calculated.
	Number of Loads for Each Truck on Each Route / # Loads $_{Truck\ i}$	-	Measured	Number of loads recorded.	Every load recorded upon arrival at the energy from biomass facility.	Measuring the percent of total load weight would be an incremental industry practise.
	Distance Driven by Each Truck / Distance $_{Truck\ i}$	km	Measured	Distance each load travels.	Annual	The distance of each route is measured once a year.
	Fuel Efficiency of Each Type of Truck / Fuel Eff $_{Truck\ i}$	L per 100 km	Estimated	Volume of fuel use is divided by distance travelled.	Monthly	This method is conservative as it incorporates all travel time and idling.
	CO_2 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CO2}$	kg CO_2 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.

	CH_4 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ CH4}$	kg CH_4 per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	N_20 Emissions Factor for Each Type of Fuel / EF Fuel $_{i\ N2O}$	kg N2O per L, m^3 or other	Estimated	From Environment Canada reference documents.	Annual	Reference values adjusted annually as part of Environment Canada reporting on Canada's emissions inventory.
	Emissions $_{Boat}$ = ∑ (% of Load * Distance $_{Boat\ i}$ * Fuel Eff $_{Boat\ i}$ * EF Fuel $_{CO2}$) ; ∑ (% of Load * Distance $_{Boat\ i}$ * Fuel Eff $_{Boat\ i}$ * EF Fuel $_{CH4}$) ; ∑ (% of Load * Distance $_{Boat\ i}$ * Fuel Eff $_{Boat\ i}$ * EF Fuel $_{N2O}$)					
	Emissions $_{Boat}$	kg of CO_2 ; CH_4 ; N_2O	N/A	N/A	N/A	Quantity being calculated.
	Percent of the Total Load Weight on the Boat / % of Load	-	Measured	Percent of the total load weight on the boat measured as the mass of biomass as compared to the total mass of cargo.	Every load recorded upon arrival at the energy from biomass facility.	Measuring the percent of total load weight would be an incremental industry practise.
	Distance Travelled by each Boat / Distance $_{Boat\ i}$	km	Measured	Distance each load travels.	Annual	The distance of each route is measured once a year.
	Fuel Efficiency of Each Type of Boat / Fuel Eff $_{Boat\ i}$	L per 100 km	Estimated	Volume of fuel use is divided by distance travelled.	Monthly	This method is conservative as it incorporates all travel time and idling.
	Emissions $_{Train}$ = ∑ (% of Load * Distance $_{Train\ i}$ * Fuel Eff $_{Train\ i}$ * EF Fuel $_{CO2}$) ; ∑ (% of Load * Distance $_{Train\ i}$ * Fuel Eff $_{Train\ i}$ * EF Fuel $_{CH4}$) ; ∑ (% of Load * Distance $_{Train\ i}$ * Fuel Eff $_{Train\ i}$ * EF Fuel $_{N2O}$)					
	Emissions $_{Train}$	kg of CO_2 ; CH_4 ; N_2O	N/A	N/A	N/A	Quantity being calculated.

	Percent of the Total Load Weight on the Train / % of Load	-	Measured	Percent of the total load weight on the train measured as the mass of biomass as compared to the total mass of cargo.	Every load recorded upon arrival at the energy from biomass facility.	Measuring the percent of total load weight would be an incremental industry practise.
	Distance Travelled by Each Train / $Distance_{Train\ i}$	km	Measured	Distance each load travels.	Annual	The distance of each route is measured once a year.
	Fuel Efficiency of Each Type of Train / $Fuel\ Eff_{Train\ i}$	L per 100 km	Estimated	Volume of fuel use is divided by distance travelled.	Monthly	This method is conservative as it incorporates all travel time and idling.

APPENDIX B:

Calculation of DOC

Calculation of DOC

The following calculations were conducted according to the information outlined in the "National Inventory Report – Greenhouse Gas Sources and Sinks in Canada, 1990-2004", Environment Canada, April 2006.

Estimates of the degradable organic carbon (DOC) present in a waste stream can be calculated using the following equation:

$$L_0 = MCF * DOC * DOC_F * F * 16/12 * 1000 \text{ kg } CH_4/\text{t } CH_4$$

Where:
- L_O = CH_4 generation potential (kg CH_4/ t waste)
- MCF = CH_4 correction factor (fraction)
- DOC = degradable organic carbon (t C/t waste)
- DOC_F = fraction DOC dissimilated
- F = fraction CH_4 in landfill gas
- 16/12 = stoichiometric factor

According to the IPCC Guidelines, the MCF for managed landfill sites has a value of 1.0. The fraction of CH_4 (F) emitted from a landfill ranges from 0.4 to 0.6 and was assumed to be 0.5. The IPCC default DOC_F value of 0.77 was used. The DOC values in the following table were calculated using average Lo values for each province published by Environment Canada (2006).

TABLE A1: Estimates of DOC by Province

Province	Lo (value after 1990)	DOC (calculated)
British Columbia	108.8	0.21
Alberta	100.0	0.19
Saskatchewan	106.8	0.21
Manitoba	92.4	0.18
Ontario	90.3	0.18
Quebec	127.8	0.25
New Brunswick	117.0	0.23
Prince Edward Island	117.0	0.23
Nova Scotia	89.8	0.17
Newfoundland and Labrador	102.2	0.20
Northwest Territories and Nunavut	117.0	0.23
Yukon	117.0	0.23

APPENDIX C:

Parameters for Use in Calculations Based on Diversion from Landfills by Landfill Type

TABLE C1: Landfill Type-Based Factors

	Mixed-Waste Landfills				Wood Waste Landfills
Parameter	**Managed**	**Unmanaged – Deep (>= 5m waste)**	**Unmanaged – Shallow (< 5m waste)**	**Uncategorized**	
Methane Correction Factor (MCF)	1.0	0.8	0.4	0.6	0.8[a]
Fraction of CH_4 in landfill gas (F)	0.5				
Fraction of degradable organic carbon dissimilated (DOC_F)	0.77				0.5
Fraction of degradable organic carbon (DOC)	See Appendix A				0.3

a - the default condition for a wood waste landfill is an unmanaged, deep landfill (Environment Canada, 2006). This parameter may be changed if the emissions are being calculated for an alternate type of wood waste landfill.

APPENDIX D:

Contingent Data Collection Procedures for Flexibility Mechanisms

1. Project/ Baseline SSR	2. Parameter / Variable	3. Unit	4. Measured / Estimated	5. Contingency Method	6. Frequency	7. Justify measurement or estimation and frequency
Flexibility Mechanisms						
P1 Collection of Biomass	Volume of Each Type of Fuel / Vol Fuel $_i$	L, m^3 or other	Measured	Reconciliation of volume of fuel purchased within given time period.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
P2 Storage of Biomass	N/A	N/A	N/A	N/A	N/A	N/A
P4 Transfer of Biomass	Volume of Each Type of Fuel / Vol Fuel $_i$	L, m^3 or other	Measured	Reconciliation of volume of fuel purchased within given time period.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Electricity Usage / Electricity	kWh	Measured	Reconciliation of power requirements for facility as per equipment output ratings.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
P5 Transport of Biomass	Number of Loads for Each Truck on Each Route / # Loads $_{Truck\ i}$	-	Measured	Mass of material received divided by average load per truck for a sample of 10 loads over a seven day period.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Distance Driven by Each Truck / Distance $_{Truck\ i}$	km	Measured	Total number of kilometers driven by truck over the period divided by two times the number of loads.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Fuel Efficiency of Each Type of Truck / Fuel Eff $_{Truck\ i}$	L per km	Estimated	Average fuel efficiency for a truck in that class as published by industry association.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Percent of the Total Load Weight on the Boat / % of Load	-	Measured	Total number of kilometers driven by truck over the period divided by two times the number of loads.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.

	Distance Travelled by Boat / $Distance_{Boat\ i}$	km	Measured	Total number of kilometers coverd by the boat on that route over the period divided by two times the number of loads.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Fuel Efficiency of Each Type of Boat / Fuel $Eff_{Boat\ i}$	L per km	Estimated	Average fuel efficiency for a boat of that type as published by industry association.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Percent of the Total Load Weight on the Train / % of Load	-	Measured	Percent of the total load weight on the train measured as the mass of biomass as compared to the total mass of cargo.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Distance Travelled by Each Train / $Distance_{Train\ i}$	km	Measured	Total number of kilometers coverd by the boat on that route over the period divided by two times the number of loads.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Fuel Efficiency of Each Type of Train / Fuel $Eff_{Train\ i}$	L per km	Estimated	Average fuel efficiency for a boat of that type as published by industry association.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
P7 Storage of Biomass	N/A	N/A	N/A	N/A	N/A	N/A
B1 Collection of Biomass	Volume of Each Type of Fuel / Vol $Fuel_{i}$	L, m^3 or other	Measured	Reconciliation of volume of fuel purchased within given time period.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
B2 Storage of Biomass	N/A	N/A	N/A	N/A	N/A	N/A

B4 Transfer of Biomass	Volume of Each Type of Fuel / Vol Fuel $_i$	L, m^3 or other	Measured	Reconciliation of volume of fuel purchased within given time period.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Electricity Usage / Electricity	kWh	Measured	Reconciliation of power requirements for facility as per equipment output ratings.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
B5 Transport of Biomass	Number of Loads for Each Truck on Each Route / # Loads $_{Truck\ i}$	-	Measured	Mass of material received divided by average load per truck for a sample of 10 loads over a seven day period.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Distance Driven by Each Truck / Distance $_{Truck\ i}$	km	Measured	Total number of kilometres driven by truck over the period divided by two times the number of loads.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Fuel Efficiency of Each Type of Truck / Fuel Eff $_{Truck\ i}$	L per km	Estimated	Average fuel efficiency for a truck in that class as published by industry association.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Percent of the Total Load Weight on the Boat / % of Load	-	Measured	Total number of kilometres driven by truck over the period divided by two times the number of loads.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Distance Travelled by Boat / Distance $_{Boat\ i}$	km	Measured	Total number of kilometres covered by the boat on that route over the period divided by two times the number of loads.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Fuel Efficiency of Each Type of Boat / Fuel Eff $_{Boat\ i}$	L per km	Estimated	Average fuel efficiency for a boat of that type as published by industry association.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.

	Percent of the Total Load Weight on the Train / % of Load	-	Measured	Percent of the total load weight on the train measured as the mass of biomass as compared to the total mass of cargo.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Distance Travelled by Each Train / Distance $_{Train\ i}$	km	Measured	Total number of kilometers covered by the boat on that route over the period divided by two times the number of loads.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.
	Fuel Efficiency of Each Type of Train / Fuel Eff $_{Train\ i}$	L per km	Estimated	Average fuel efficiency for a boat of that type as published by industry association.	Monthly	Provides reasonable estimate of the parameter, when the more accurate and precise method cannot be used.