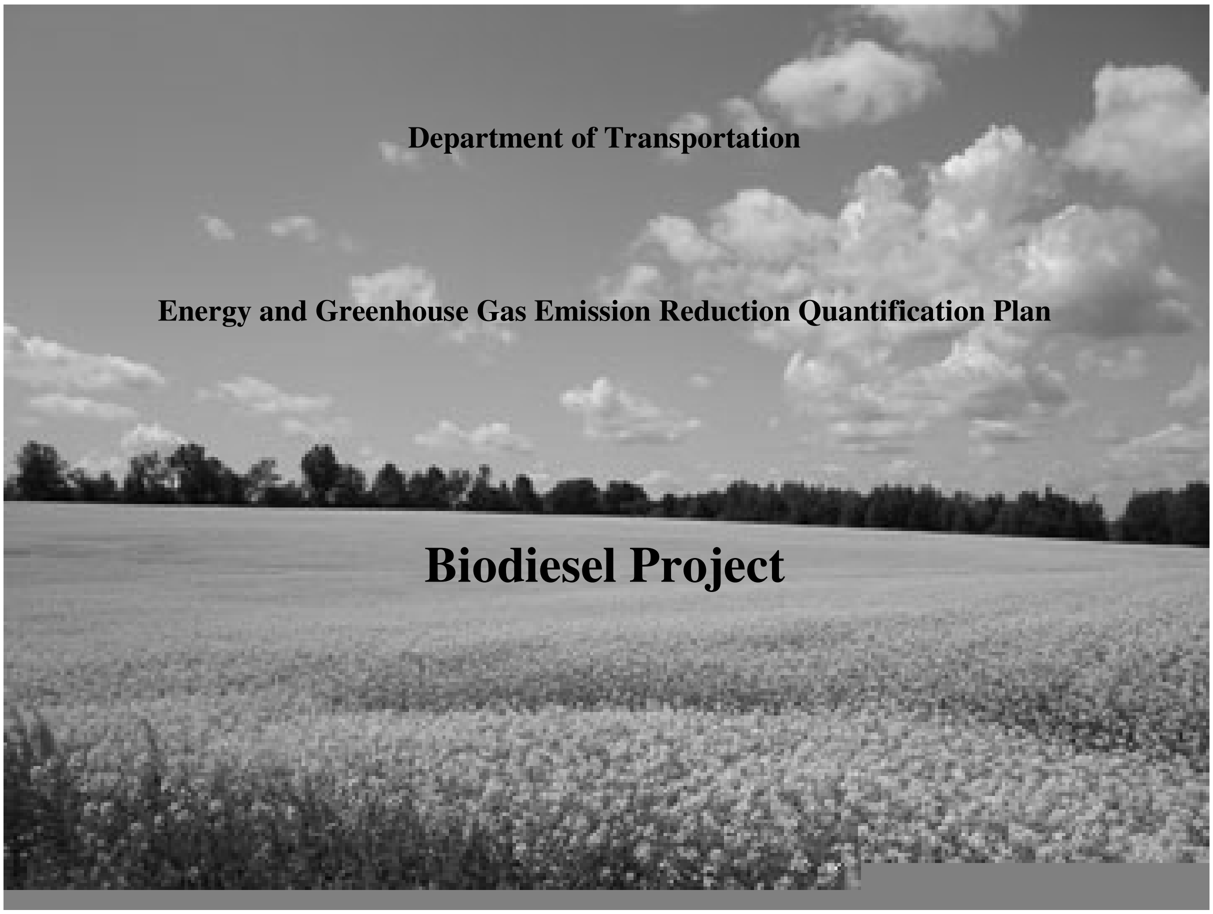


Prepared by CSA Standards in Conjunction with the Department of Transportation

1 General

1.1 Background

The New Brunswick Climate Change Action Plan 2007-2012 provides a greenhouse gas (GHG) emissions reduction target of 1.2 million tonnes (Mt) CO_2e from transportation related activities. The NB Climate Change Action Plan 2007-2012 also states that the Climate Change Secretariat aims to track and report on GHG emissions trends and progress regarding the implementation of all climate change initiatives in this action plan. Furthermore, the provincial authorities have decided to quantify the emission reductions according to the ISO 14064 framework.

This document quantifies the impact of the Department of Transportation's *Biodiesel Project* on GHG emission reductions. The project has received $215,000 of funding through the Climate Action Fund to undertake a biodiesel trial project, including the construction and operation of a biodiesel dispensing facility in Woodstock, New Brunswick. Since the project involved is expected to result in emission reductions below 25,000 tonnes of CO_2e, this specific quantification follows a track 2 quantification that is consistent with ISO 14064-2 principles, but one that does not go into the same level of detail and level of rigour to be compliant with ISO 14064-2 requirements. This is a simplified approach to estimating emissions that is meant to be easier and less time intensive to implement than the track 1 approach. Although track 2 projects are not eligible for generating tradable emission offsets (since they are not meant to be verified by a third party), the rational behind such a two-track approach is that smaller volume projects (such as this one) will not generate enough emission reductions to economically justify the cost and time required for project quantification, verification, serialization, and subsequent registration.

1.2 The Importance of Reporting Emission Reductions

Efforts have been undertaken to report on the emission reductions accrued from this project so that the emission reduction assertion is viewed as credible. There are a number of reasons that underlie the need to adequately document and report efforts to reduce emissions.

- The basic premise of climate change policy is to take actions that lead to *real* reductions in GHG emissions to the atmosphere. In this respect, it is critical to understand what would have occurred in absence of the project, and to adequately describe what the project is and how it will reduce emissions relative to this "baseline". This in turn increases the rigour and transparency of an emission reduction assertion.
- It is important that there is accountability to how funds are invested and the environmental and economic benefits resulting from this investment. In this regards, it is important that estimates or measurements are provided of both the environmental and economic impacts of a project
- The emission reductions resulting from a project can ultimately be "retired" (i.e. used to reduce a company's or government's emissions), or sold in the carbon market. In terms of this latter option, how rigorous the emission reduction assertion is will help dictate the market price of the emission reduction – i.e. offsets created from a high quality project will be deemed more valuable than for a project seen of lower quality.

1.3 ISO Principles Followed in Emission Reduction Estimation

The following principles from the ISO-14064 standards were followed in the estimation of emission reductions resulting from the implementation of this project:

Transparency: We have tried to make the estimation of emission reductions as transparent as possible by explaining all data sources used and providing all equations and emission factors used in the estimation

Accuracy and rigour: We have followed or adapted best practices (where available) in order to help ensure accuracy and rigour in the emission estimations

Conservativeness: In order to not overestimate emission reductions, we have been conservative in our assumptions

1.4 Best practice guidance

Other than the requirements identified in ISO 14064-2, the following documents were used as a best practice guidance document:

- Biofuel Quantification Protocol, Specified Gas Emitters Regulation, Carbon Offset Solutions; Alberta Environment, CCC

1.5 Program and intended user

This quantification is intended to be used to:

- Report to the Climate Change Secretariat on the greenhouse gas emissions reductions that have occurred due to this program as part of the Climate Change Action Plan 2007-2012 reporting requirements.
- Report back to the people of New Brunswick on the impact of the actions taken to reduce GHG emissions

This quantification does not take into account any other program requirements.

1.6 Project proponent

The project proponent is the Department of Transportation, Government of New Brunswick.

The contact details for a representative from the project proponent are:

Gary Spencer

Phone: 506-453-2601
Email Address: Gary.Spencer@gnb.ca

Gary Spencer is an Assistant Director with the Vehicle Management Agency, Department of Transportation.

2 Biodiesel emission reduction program

2.1 Current situation in New Brunswick

The Department of Transportation is currently focusing on using biodiesel in school buses, snow-plows, and other similar types of vehicles. However, it is noted that biodiesel can be used in any diesel engine and, hence, any type of diesel-powered vehicle. In 2007, 480 million litres of diesel were consumed in New Brunswick, the majority of which was consumed by heavy trucks. This in turn resulted in emissions of approximately 1.2 million tonnes of CO_2e to the atmosphere. Before the implementation of this project, there was no known use of biodiesel in the province of New Brunswick.

2.2 Description of project and project timeline

The Department of Transportation will be undertaking a project using biodiesel in 12 vehicles, including school buses, snow ploughs and other vehicles. These vehicles along with their technical specifications and usage are summarized in table 1.

Table 1 Summary of vehicles for which biodiesel has been tested

Date of start of testing (i.e. using biodiesel)	Make	Model	Vintage year	Type	Engine	Usage in kms (previous 12 months)
8-Sep-09	International	3800	2009	Bus 72 pass	IH Max force7	17,784
17-Mar-09	Freightliner	FL-80	1998	Bus 72 pass	Cummins 6 BT	18,259
2-Mar-09	International	3800	2002	Bus 72 pass	IH 444E	16,738
15-Feb-09	Freightliner	FS-65	2005	Bus 72 pass	Cat C7	23,620
6-Feb-09	International	3800	2006	Bus 72 pass	IH VT365	19,983
4-Apr-09	John Deere	310-SE	1997	Backhoe	John Deere	401 hrs
4-Apr-09	Chevrolet	C3500	1998	Crew Cab	6.5 Liter GM	22,204
4-Apr-09	GMC	C7	1999	Sign Truck	Cat-3126	20,000
17-Mar-09	Champion	720A	1995	Grader	Cummins 8.3	703 hours
2-Mar-09	Sterling	LT9511	2000	Plow Truck	Cat- C10	30,375
15-Feb-09	International	2574	2002	Plow Truck	Cat- C10	23,966
6-Feb-09	International	7600	2005	Plow Truck	Cummins ISM	42,518

As shown in the table, the testing of these vehicles started February 6, 2009, and by April, twelve (12) vehicles were part of the program to use biodiesel.

2.3 Description of technology

The vehicles and engines that took part in this pilot project did not require any modifications before entering the biodiesel testing. The biodiesel used in the pilot project was sourced from Ontario and then in turn supplied to Clark Oil, a local fuel distributor. This distributor then mixed the product in order to supply the dispensing facility used to fuel the vehicles that were a part of the pilot project. Specially, these vehicles were fueled with a mix of 95 percent regular diesel, and 5 percent biodiesel (i.e. B-5 biodiesel).

2.4 GHG reductions strategy

The basic strategy to reduce emissions is to switch fuels to a less carbon intensive fuel (i.e. from diesel to biodiesel).

2.5 Co-benefits of project

Other than the reduction of GHG emissions, the co-benefits of this project can be summarized as follows:

1. Reductions in air pollution resulting from a reduction in fuel use, including SO_2, CO, VOC, and particulate matter.[1]
2. Increased economic production and employment (if biodiesel is sourced in the province)
3. Know-how gained from implementing project and the resulting possibility to build upon project for wider-scale implementation and initiatives.

3 Selection and justification of the baseline scenario

A baseline scenario is used to establish what the quantified emissions would be in terms of what would occur under "business as usual" (BAU) conditions. It is therefore important to establish what the baseline scenario is. The common practice is to identify multiple possibilities for the baseline scenario, and then to identify the one most likely to occur through the process of barrier analysis (see below). It must be shown that the project would not likely occur in order to prove that this would be "additional").

The following scenarios were identified for the purposes of this project:

1) Using regular diesel in vehicles
2) Using a biodiesel mix in vehicles (i.e. the project)

A barrier test is used to help identify barriers to any of these scenarios occurring. A barrier test in a common technique used to help justify a baseline scenario and to substantiate the claim that a project is in fact additional to the business as usual.

[1] The U.S. National Renewable Energy Laboratory undertook inventory and air quality modeling to understand the effects of a 20% (b20) and 100% (b100) mix of biodiesels in terms of the operation of heavy duty diesel vehicles. Based on this analysis, it was concluded that relative to a standard diesel fuel, on average, emission rates changed as follows: for b20 NO2 (+2.4%), PM (-8.9%), CO (-13.1%), VOC (-17.9%), and SO2 (-20%), whereas for b100 the emission impacts were: NO2 (+13.2%), PM (-55.3%), CO (-42.7%), VOC (-63.2%), and SO2 (-100%). From *Impacts of Biofuels on Air Quality and Human Health* (http://www.nrel.gov/docs/fy03osti/33793.pdf).

Figure 1 Barrier analysis of baseline scenarios

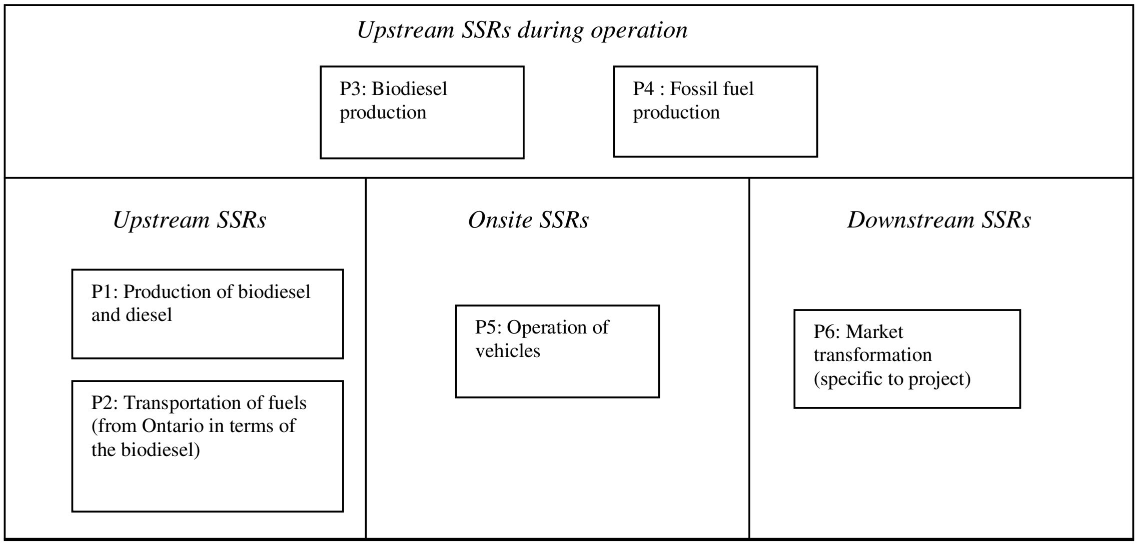
Possible baselines / Barriers	1. Using regular gasoline/diesel	2. Using biodiesel (i.e. the project)
Regulatory barriers	There now is federal-level energy policy that encourages the use of biodiesel. Specifically, in July 2007, the Canadian government announced that it would provide up to $1.5 billion in incentives over nine years to producers of renewable alternatives to gasoline and diesel fuel in order to increase production needed to meet the 2012 targets of 2% renewable content in diesel fuel and heating oil by 2012.	No barriers
Common practice barriers	No barriers	Using biodiesel is not common practice, partly because there are no large scale providers of biodiesel in the province
Financial barriers	No barriers	It is presumed that biodiesel is more expensive than regular diesel or regular gasoline. The Canadian Canola Growers association for example provides estimates that biodiesel from canola ranges from $0.48 to $0.81 to produce. This is above the cost of gasoline.
Barriers due to the geographical location	No barriers	There are geographical barriers since, although it is known that some biodiesel facilities are in development in New Brunswick, it is not known how readily available biodiesel is or if even if the facilities are in the production phase. For this project, the project proponent has in fact purchased the biodiesel from a facility in Ontario.
Barriers due to public perception	No barriers	No barriers
Market barriers	No barriers	No barriers
Technological barriers	No barriers	Operational biodiesel facilities still need to be developed in New Brunswick.

Based on this assessment, it is concluded that the project is indeed additional to the business as usual – i.e. it would not happen in absence of the additional carbon-specific funding allocated towards it. The primary reason is that there is not any operational biodiesel production capacity in New Brunswick or a market for its use or supply.

4 Identification of SSRs attributable to the project and baseline

Sources, sinks, and reservoirs (SSRs) are defined in order to determine the full breathe of emissions attributable to the project being implemented.[2] The following SSRs were identified associated with both the project and the baseline.

Figure 2 Sources, Sinks, Reservoirs Associated with Project and Baseline



The following table presents if these SSRs are related or owned by the project proponent[3]:

Table 2 Defining Attributable SSRs

SSR	Owned, related or affected
P1: Production of biodiesel and diesel	Related
P2: Transportation of fuels	Related
P3: Biodiesel production	Related
P4 : Fossil fuel production	Related
P5 : Operation of vehicles	Owned
P6: Market transformation	Affected

Since this is a track 2 project, attention is only given to emissions that are "owned" by the project – namely, emission reductions directly attributable to the project.

[2] A source means any process or activity that releases a greenhouse gas into the atmosphere, whereas a sink means any process, activity or mechanism that removes a greenhouse gas from the atmosphere and a reservoir means a physical unit or component of the biosphere, geosphere or hydrosphere with the capability to store or accumulate GHGs (from http://www.ec.gc.ca/creditscompensatoires-offsets/default.asp?lang=En&n=7CAD67C6-1&offset=12&toc=show).

[3] Emission reductions that are "owned" by the project proponent can be claimed for the purposes of emission reduction and be retired or sold. Emission reductions which are "related", alternatively, refer to those emissions that are affected by the project indirectly (e.g. emissions associated with manufacturing the equipment). Emission reductions that are "affected" generally refer to the wider impacts of fuller implementation of a policy or a program (i.e. the emission reduction benefits accrued with fuller adoption of the renewable energy or technology)

5 Quantification of GHG emissions and/or removals

Estimation is provided of the baseline emissions, the project emissions, and the emission reductions accrued from the project. Possible emission reductions are considered for 8 years, the lifetime of the project according to general practices in GHG accounting and reporting.

5.1 Estimated baseline emissions

The basic approach to determine baseline emissions is to take the biodiesel fuel mix (i.e. b-5 diesel) consumed by a vehicle as part of the program and determine the emissions if all this fuel was diesel. This is the best approach available seeing the significant variation that can occur in the fuel consumption rate (FCR) of a vehicle over time due to such factors as variations in how the vehicle is operated, length of vehicle usage, characteristics of use in terms of stop-and-go cycles, etc. This is illustrated by considering the variation in fuel consumption according to each vehicle/equipment type.

Table 3 Variations in fuel consumption, by asset

Asset	Activity metric	Descrip	Months of data	Total monthly activity	Total fuel (litres)	Average FCR (litres/act)	Standard deviation in FCR	Average variation (%)
13444	Km	Bus	10	18,619	6,965	0.37	0.06	15.6%
18800	Km	Bus	10	24,453	8,367	0.34	0.05	13.7%
12488	Km	Bus	11	18,202	6,288	0.35	0.06	16.7%
12868	Hours	Backhoe	12	450	3,142	6.98	2.16	30.9%
14777	Km	5-tonne boom truck	10	16,723	5,153	0.31	0.04	13.5%
16612	Km	Plow truck	8	20,252	15,545	0.77	0.35	45.7%
17335	Km	Bus	9	21,347	6,721	0.31	0.13	40.0%
19159	Km	Bus	10	19,968	6,363	0.32	0.04	13.6%
21404	Km	Bus	8	16,814	4,701	0.28	0.09	32.0%
13558	Km	1-Ton CC	12	25,990	4,436	0.17	0.08	48.3%
16187	Km	Plow truck	11	31,941	18,358	0.57	0.19	33.4%
19088	Km	Plow truck	12	42,575	27,443	0.64	0.21	33.2%

Depending on the type of asset, the FCR can vary 15% to as high as 50% over the course of a year. Thus, using historical fuel consumption rates as a baseline is not accurate as this will not capture differences in use of that particular asset (as described).

Thus, the approach to estimate baseline emissions was to take the b-5 fuel mix consumed as part of the project, factor in assumed efficiency effects, and estimate emissions from this.[4]

[4] Biodiesel contains approximately 10 percent less energy by unit of mass compared to regular diesel, and thus an efficiency correction factor of 10 percent is used to scale down the amount of diesel that would be used in the baseline according to the percentage of the biodiesel used in the project. For example, if the mix is 5 percent, then if 100 litres of biodiesel were used in the project, this would be equivalent to 99.5 litres in the baseline

As described, at the time of reporting, the biodiesel had been running from 3 to 7 months, depending on which asset. The details of this in terms of baseline fuel use and baseline emissions are shown in table 4:

Table 4. Baseline fuel use and emissions

Asset	Months of data	Total baseline fuel consumption (litres of diesel)	Total baseline GHG emissions (tonnes CO2e)
13444	6	3,134	8.74
18800	6	4,879	13.61
12488	3	1,749	4.88
12868	7	1,720	4.80
14777	7	3,947	11.01
16612	4	3,391	9.46
17335	6	3,962	11.05
19159	6	4,417	12.32
21404	2	1,077	3.00
13558	5	1,407	3.93
16187	5	2,423	6.76
19088	7	7,999	22.32
Total		**40,106**	**112**

5.2 Estimated project emissions

Project emissions are calculated by multiplying the amount of biodiesel consumed by the emission factor for the biodiesel. The emission factor for biodiesel is dependent on the percentage mix between diesel and biodiesel. Since biodiesel created from biomass is assumed to have an emission factor of 0 kg CO_2e/litre (since the origin is biogenic), the calculation method is relatively straightforward – diesel mixed with 5 percent biodiesel has an emission factor 95 percent of regular diesel, or 2.65 kgs CO_2e per litre of B5 biodiesel mix. Using this approach, project emissions are estimated (see table 5)

Table 5 Project fuel use and emissions

Asset	Months of data	Total project fuel consumption (litres of biodiesel)	Total project GHG emissions (tonnes CO2e)
13444	6	3,150	8.35
18800	6	4,903	13.00
12488	3	1,758	4.66
12868	7	1,729	4.58
14777	7	3,967	10.51
16612	4	3,408	9.03
17335	6	3,982	10.55
19159	6	4,439	11.77
21404	2	1,082	2.87
13558	5	1,415	3.75
16187	5	2,435	6.46
19088	7	8,039	21.31
Total		**40,308**	**107**

5.3 Quantification of GHG emission reductions and removal enhancements

Emission reductions are quantified as the difference between baseline emissions and project emissions. However, in order to understand the total yearly impacts of the biodiesel trails as well as the lifetime emission reductions (i.e. 8 years according to the general rule that emission reductions are estimated for an eight year period from project implementation), the original emission reductions need to be extrapolated. This is shown in table according to each asset.

Table 5 Estimated emission reductions

Asset	Months of data	Initial measument of emission reductions (tonnes CO_2e)	Estimated annual emission reductions (tonnes CO_2e)	8 year project lifetime emission reduction (tonnes CO_2e)
18800	6	-0.40	-0.79	-6.33
12488	6	-0.62	-1.23	-9.85
12868	3	-0.22	-0.88	-7.06
14777	7	-0.22	-0.37	-2.98
16612	7	-0.50	-0.85	-6.83
17335	4	-0.43	-1.28	-10.27
19159	6	-0.50	-1.00	-8.00
21404	6	-0.56	-1.11	-8.92
13558	2	-0.14	-0.82	-6.52
16187	5	-0.18	-0.43	-3.41
19088	5	-0.31	-0.73	-5.87
Total		**-4.1**	**-9.5**	**-76.0**

5.4 Data and method to improve accuracy and rigour of emission estimates

This report has reported emission reductions based on a limited data set, extrapolating this to a full year and then to the entire 8 year reporting period for the emission reduction project. Ultimately, however, the project proponent will have to collect a full years of data and estimate emissions based on this data. This should be repeated for each that the project is in operation until the end of the eight year period.

It is also advised that efforts be undertaken to understand the fuller lifecycle emissions of the biodiesel sourced in New Brunswick. This will help identify that emission reductions can be achieved by sourcing the biodiesel from local production sources, rather than importing from Ontario. Although these emissions and any associated emission reductions would not be technically owned by the project proponent, they are related to the project proponent and ultimately should be considered.

6 Verification Statement

A verification of emission reductions is not required for track 2 projects since it would not be economical to verify these by a third party.