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This document presents an assessment of the biodiesel distribution infrastructure in Canada. The overall objective of the Assessment study is to recommend the most efficient infrastructure pathway for the effective distribution of biodiesel throughout Canada. The focus of the Assessment study is to establish a link between biodiesel supply and the end-user.

The Assessment study proposes solutions and alternatives around the various roadblocks during this early market development and transitional phase. The Assessment study also prepares for the longer-term eventuality when biodiesel will be distributed through the infrastructure of the major integrated petroleum producers and marketers.

In laying down a pathway for a distribution infrastructure, the Assessment study will be used as a resource document by biodiesel stakeholders who are committed to developing a Canadian market. Specifically the Assessment study will be used as a framework document for the following:

- Developing government policy objectives and programs,
- Identifying needs for further research and development,
- Providing guidelines for industry investment.

Reflecting a cross-country consultation with Canadian biodiesel stakeholders, the report presents a national and concerted approach to building a biodiesel distribution infrastructure which recognizes regional distinctions.

**DEFINITIONS**

**Biodiesel** for the purpose of this document refers to a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated B100, and meeting the requirements of ASTM D6751.

**Infrastructure** for the purpose of this document refers to the tools which are needed to take the pure biodiesel (B100) from the producer into the marketplace for distribution to the public. This includes the physical infrastructure for storage of the B100, the blending of the B100 into biodiesel blends (BXX) and the quality assurance and education infrastructure necessary to provide the marketplace with a quality fuel.

For more definitions, see Appendix E.
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Although demand for renewable fuels is growing in Canada, the biodiesel market has only been developed to a very small degree in the country. Despite the fact that national production is increasing, the infrastructure is not yet adequate to ensure efficient, cost-effective and adapted distribution. In order to make the product available nationally, this Assessment study offers an itinerary or a “Roadmap” to follow in creating an infrastructure on a national level. It includes an analysis of the modes of transportation, storage, blending and distribution that should be adopted in the context of a growing biodiesel industry in Canada over the coming years.

The Assessment study reflects the results of a two-phase consultation process that took place from September 2005 to February 2006 with various industry representatives throughout Canada. Some 100 participants, including feedstock suppliers, biodiesel producers, major petroleum companies, independent distributors, users, associations and government representatives were consulted in order to identify the constraints and conditions for building an effective distribution infrastructure across the country.

The focus of the Assessment study is only on infrastructure challenges and barriers related to logistics – specifically, the distribution and storage of B100 and the blending and distribution of biodiesel blends. The issues and challenges related to increasing production and demand and the introduction of incentives used to promote the development of the industry will not be addressed in this report.

**CURRENT CANADIAN BIODIESEL INDUSTRY AND FUTURE MARKET POTENTIALS**

The Assessment study first presents an overview of today’s biodiesel industry in Canada. It assesses the federal and provincial programs and incentives put in place to stimulate growth in the industry by making the price of biodiesel more competitive. At the provincial level, these incentives generally take the form of tax exemptions or refunds (B.C., Alberta, Manitoba, Québec, Nova Scotia). However, given that some provinces have not adopted any specific measures in support of biodiesel, there are significant price disparities from one province to another, making it difficult to develop the market on a national level. With respect to production capacity, it has increased significantly in Canada, from 10 M litres/year in early 2005 to approximately 100 M litres/year by the end of 2006.

Several plant construction projects are being assessed. One of the obstacles for the development of this industry is that the biodiesel distribution infrastructure is virtually undeveloped in Canada. Restricted almost exclusively to demonstration projects, biodiesel distribution has so far been organized on a case-by-case basis according to specific agreements and procedures. This situation has led to the adoption of certain practices, including storage and blending (splash blending) at the user’s site, which can potentially affect product quality. Most biodiesel transportation is currently carried out by truck (local market) or by rail car.

The potential market for biodiesel is extensive in Canada because it affects almost all application sectors for distillates (road and off-road transportation, agricultural and industrial applications, heating, etc.). The total Canadian consumption of distillates was 30.7 billion litres in 2005. Therefore, based on a hypothesis of a 100% penetration of the total distillate market with a 5% biodiesel blend (B5), the theoretical market for pure biodiesel in Canada would be approximately 1.5 billion litres (~800 M litres for the on-road sector and ~700 M litres for other applications). However, it is unlikely that all these markets, in every region of the country, would find a cost-effective justification for introducing biodiesel. On-road applications are the most likely to switch to biodiesel — in fact, they are directly targeted by the incentives in place — although other niche markets could be targeted in certain regions (the importance of agricultural applications in the Prairies (28%) and heating in Atlantic provinces (35%), for example). If we take into account the constraints related to the Canadian climate, B5 is likely to be the most widely used biodiesel concentration in the country all year long.

Oxidation stability is a concern with biodiesel. Once oxidation stability is addressed and the biodiesel sold into the Canadian marketplace is shown to have adequate oxidation stability it will gain a greater market presence. Biodiesel could become a very interesting solution for addressing the decrease in lubricity with Ultra-Low Sulphur Diesel (ULSD). However, the constraints related to ULSD, particularly with respect to terminal accessibility (pressure caused by the increase in the number of different products), could create an obstacle in introducing biodiesel in the petroleum product distribution infrastructure.
EXISTING CANADIAN INFRASTRUCTURE FOR DISTILLATE PRODUCT DISTRIBUTION

Biodiesel is a biofuel that can be handled by the same distribution system as petroleum products. However, given its particular features, the existing infrastructure must undergo some adaptations. This report also proposes an analysis of the current distribution infrastructure for petroleum products.

In Canada, three major corporations have activities from coast to coast and eight regional refiner-marketers represent the remaining larger distributors. There are also approximately 120 independent marketers offering petroleum products under their own brand. The petroleum industry uses the Canadian General Standard Board (CGSB) specifications for commerce in petroleum products in Canada.

Upstream distribution: There are 19 Canadian refineries producing distillates and about 70 primary terminals generally located near major markets and transportation modes. The choice of transportation mode (pipeline, railcar, tanker truck or marine tanker) largely depends on geographic factors and varies region to region. Infrastructure and equipment also varies according to the regional needs and constraints.

Downstream distribution: There are many hundreds of secondary terminals or depots in Canada. From secondary terminal, product is generally moved by tanker truck to retail outlets and direct delivery to end-users.

Blending is generally done by in-line injection or by sequential blending at the primary terminals; in-tank and splash blending are the blending techniques used at the secondary terminals.

Distillates do not require heated equipment (for storage or blending) at any terminal level.

Within the Canadian petroleum industry there are currently varying degrees of interest regarding biodiesel. Many independent marketers have demonstrated an interest in the biofuel and have assumed up to now a leading role in biodiesel distribution. With some exceptions, the major petroleum companies have not yet shown a commitment to participate in the biodiesel distribution infrastructure. It should be noted that the terminals are currently operating at full capacity. Moreover, petroleum companies have some difficulty justifying necessary investments at the terminal level without sufficient critical mass of biodiesel on the market.

QUALITY ASSURANCE, TECHNICAL CONSIDERATIONS AND TRANSPORTATION MODES

To ensure its sustainability, the biodiesel industry must be able to offer the promise of quality that is similar to those existing in the petroleum industry. In fact, it is important that biodiesel be seen as a trouble-free product. To reach that point, the industry must comply with strict standards set by recognized standardization bodies so that consumers receive a high-quality standard product. The very credibility of biodiesel depends on the industry’s compliance with those standards. A consensus is currently being reached in the industry to ensure that all biodiesel sold in Canada complies with the following standards: ASTM D6751 for the B100 biodiesel blend stock and CAN/CGSB 3.520 for low blends (B1-B5). These standards are enacted by ASTM International and the CGSB, respectively. The CGSB has adopted the 3.520 standard including blending with ULSD.

A draft standard for B6 to B20 blends has been previously introduced at CGSB. There is no activity to move the proposed B6 to B20 standard at CGSB at this time. There is a proposed B6 – B20 standard in the balloting process at ASTM. The development of a B6 – B20 standard at CGSB will not proceed until a B6 – B20 standard is successfully passed at ASTM.

To be effective, the infrastructure that will be put in place must also take into account the biodiesel blend product quality to ensure specifications are met at the point of delivery. One of the factors that most affects the development – or adaptation – of the delivery infrastructure is cold weather biodiesel properties. Given that biodiesel has a higher cloud point than diesel, extra care must be taken in cold weather concerning storage, blending and transportation practices, which must be adapted, particularly with respect to B100.

For example, unless B100 is stored in underground tanks, it must be stored in insulated and heated tanks, pipes and pumping equipment during the winter months (based on the regional temperature and the cloud point of the biodiesel produced). B100 must be transported in insulated heated tanks during winter months.

The choice of blending techniques (in-line blending, in-tank blending, splash blending and sequential blending) also becomes crucial for maintaining product quality at every stage of the distribution process, particularly in cold weather. The technique of in-line injection blending is highly recommended for biodiesel. In general, these techniques are only used in primary terminals.

Several other technical considerations also have a definite impact on maintaining quality and therefore on the development of the distribution infrastructure.
These considerations include material compatibility, the solvent and cleaning effect of biodiesel, the product’s sensitivity to air and water (microbial contamination), oxidation stability during long-term storage, etc.:

- B100 is typically stored separately in a clean and dry environment, free from water and light to avoid the possibility of contamination or oxidation.
- The composition of storage tanks and pipes is less critical. However, pumping equipment and blending systems are critical in maintaining the integrity of the biodiesel as some “yellow metals” found in pumps are not compatible.
- It is recommended in ASTM D6751 that B100 not be stored for a period beyond six months. With sufficient stability additive and periodic monitoring for product quality B100 can be stored for longer periods up to a year.
- Dedicated storage tanks will be needed for storage of B100.
- If an existing tank is changed to accommodate B100 storage, it must be cleaned and flushed prior to use.

The biodiesel that enters the distribution system must comply with the quality standards. One way of ensuring this is to conduct regular laboratory tests on biodiesel samples. Canadian laboratories do not all conduct regular tests on methyl esters and as a result, it is essential that accreditation and test proficiency programs be developed in the near future for laboratories. Incidentally, the most practical means of attaining proficiency for biodiesel testing labs is to be part of the Alberta Research Council (ARC) or ASTM biodiesel testing cross check programs.

To help maintain biodiesel quality throughout the marketing and distribution chain, there is a producer and marketer quality accreditation program developed by the National Biodiesel Accreditation Commission (NBAC), the BQ-9000. The Canadian Renewable Fuels Association (CRFA) endorses this program, which was created to provide a quality system specific to the biodiesel industry. It was born out of a desire to provide a tangible means of giving consumer and vehicle manufacturer confidence in the production and distribution of biodiesel B100. This cooperative and voluntary program has two types of accreditation: Accredited Producers and Certified Marketers. The program addresses sampling, testing, storage and shipping issues related to the production of ASTM D6751 grade biodiesel. It also addresses issues affecting biodiesel quality at the marketer level such as the receiving, testing and storage of biodiesel B100 to ensure that B100 product quality has been maintained through the distribution system. It is clear that if the buyers of biodiesel demand that a Certificate of Analysis (COA) be provided under the BQ-9000 program for each batch of biodiesel produced, the maintenance of product quality at every stage of the distribution process would improve considerably.

With respect to the modes of transportation that can be used to transport biodiesel (B100) or blends, they are the same as those used for petroleum products (tanker truck, rail car and marine tanker) with the exception of oil pipelines, which cannot transport biodiesel due to possible cross-contamination with jet fuel.

Transportation of biodiesel also requires compliance with specific conditions:

- The tanks on the vehicles used to transport B100 must be made of compatible materials. Hoses and seals must also be compatible.
- Tanks used to deliver B100 must be totally or partially dedicated (separate compartments). Otherwise, proper inspection and washout of transport are needed. Hoses and seals must also be properly cleaned.
- It is important to check previous load carried and residual.
- During winter months, isolated and heated equipment must be used when shipping B100. In most cases, electrical tracing and steam heating systems are used at terminal level.

**PATHWAY FOR THE DEVELOPMENT OF THE CANADIAN BIODIESEL DISTRIBUTION INFRASTRUCTURE**

It is impossible to predict the scope or the scale of the biodiesel market in Canada or to know which niche markets (on-road or off-road applications) will be favoured in the country. It is unknown how or at what rate the industry will develop in the coming years but it is clear that it will need to be supported by a distribution infrastructure and that the introduction of biodiesel in the petroleum product distribution infrastructure will require adaptations and investments.

Given that it is impossible to generalize about the required adaptations and overall costs for the entire country, the Assessment study has developed two scenarios that provide an idea of the route that biodiesel could – or should – take in the current distribution infrastructure.

Providing indications and a cost estimate for the facilities at a typical Canadian terminal (whether primary or secondary) will enable petroleum companies and distributors to determine the gap between their current infrastructure and the adaptations required for biodiesel. All players will therefore be able to choose the scenario that best meets their needs while reflecting the realities of their region and target markets. They will also be able to make the investment decisions needed to meet their requirements.

**Scenario 1** – The best practice in a mature market would involve storing B100 in primary terminals with all the necessary equipment (dedicated, insulated and heated tanks, fuel in-line injection blending systems). This is the best way of ensuring maximum quality control of the product. The entire downstream distribution process, including secondary terminals, would only be concerned with biodiesel blends.
Scenario 2 – In regions where access to primary terminals is limited or even impossible, B100 could be stored in secondary terminals, which would require all necessary equipment (dedicated, insulated and heated tanks and, if possible, the addition of fuel in-line injection blending systems). In this scenario, biodiesel blends would be prepared at the secondary terminal rack before being transported to retail outlets.

These scenarios are based on the following claims:

- That B5 biodiesel will likely become the basic blend in Canada throughout the year and for all types of usage;
- That B20 will remain a specialty blend, available on a seasonal basis only and for knowledgeable users (vehicle fleet managers, etc.) who own their own storage facilities;
- That biodiesel sold in Canada must comply with quality standards (ASTM and CGSB) during the entire distribution process;
- That the in-line blending technique is the best technique for guaranteeing product quality;
- That all infrastructure designed for B100 (transport, storage and blending) must be dedicated, insulated and heated.

The Assessment study also presents 22 recommendations broken down into 5 categories which can be applied in a general sense – regardless of region or end-use market. These recommendations are based on the fundamental principal that in order to ensure successful development of the industry, biodiesel must meet quality standards and product integrity must be maintained throughout the distribution chain – from the biodiesel producer to the final user. The complete version of the report proposes a series of activities to support these recommendations.

## Quality Assurance and Compliance Issues

- All biodiesel in Canada must meet ASTM D6751 for pure biodiesel (B100).
- Promote understanding and use of the ASTM D6751 standard at all levels of distribution.
- Develop relevant laboratory training programs.
- Develop proficiency testing programs for labs, encourage labs to participate in these programs.
- Testing of biodiesel blends.
- Educate terminal managers and fuel marketers to demand that a Certificate of Analysis (COA) be provided for every finished batch of B100.
- Promote understanding and use of standards at all levels of distribution for biodiesel blends using CGSB standards.
- Develop CGSB specifications for the heating oil market.
- BQ-9000 needs to be applied consistently throughout the industry in order to promote understanding and use of BQ-9000 at all levels of distribution and to educate the end-users to include the BQ-9000 requirement in Request for Proposals (RFP) documents.

## Storage of Biodiesel

- Dedicated tanks should be used for the storage of B100.
- Storage of B100 in the winter months in Canada will require heating of the tanks and heat tracing of the lines.
- Storage tank peripheral equipment should be made of compatible materials (i.e. seals and metals).

## Biodiesel Blending

- The preferred means of biodiesel blending is conducted at primary terminals using in-line injection blending equipment.
- Splash blending is less costly option for biodiesel blends but puts the product integrity at risk.
- Provide access to testing tools to determine on-site blending ratios.
- Conduct further research regarding cold weather blending practices.

## Transportation of Biodiesel

- Further examine pipeline transportation issues (research).
- Should use dedicated equipment for the transportation of B100.
- Refer to B100 transportation guidelines (see section 4.4).

## Technical Considerations

- Build a knowledge infrastructure and create a common (neutral) repository for needed technical information.
- Document and disseminate case studies, promote best practices for handling and storage all the way through the distribution chain and provide end-user biodiesel information.
- Develop a series of fleet manager workshops on a national basis.

In addition to these formal recommendations, the Assessment study proposes a series of general tips that could promote the development of the distribution infrastructure. These tips deal primarily with government measures, creating demand, and information needs.

The scenarios and series of recommendations proposed in the Assessment study represent the most effective pathway to address the inherent challenges and obstacles in building a biodiesel distribution infrastructure in Canada. In particular, the Assessment study emphasizes the pivotal role of quality assurance and product integrity, as well as the importance of appropriate equipment and process.

The success of the Assessment study will ultimately depend on the level of engagement of the various industry stakeholders (producers, distributors, government and users) and the extent to which they recognize and respect the Assessment study parameters.
1.1 OVERALL VISION

To alleviate greenhouse gas emissions contributing to climate change and to promote renewable energy sources, Canada has taken a number of measures to increase biodiesel production and to stimulate development of the country’s biodiesel industry. Although its use until recently has been marginal due to production costs higher than those for diesel fuel, biodiesel is now increasingly in demand, especially with higher petroleum prices and the introduction of incentives by several provinces to make the price of biodiesel more competitive with diesel fuel. Judging from the sharp increase in worldwide demand for this biofuel, the market for biodiesel has clearly reached a turning point in its history.

An efficient distribution infrastructure will be required to accommodate the growing demand for biodiesel in the next five to ten years. The main objective of this Assessment study is to propose strategic solutions favouring the development of an efficient distribution system to support the growth of this emerging industry.

More specifically, the Assessment study highlights the specific challenges and solutions to biodiesel distribution and recommends the path to follow to set up transportation systems and storage and blending facilities allowing the product to flow smoothly from producers to blending terminals and on to end-users. The vision behind this approach is to make biodiesel readily available at the lowest possible cost to the largest number of Canadians.

1.2 IMPLEMENTING THE VISION

The Assessment study was developed based on the following approach. During a first phase of consultation in September and October 2005, 44 industry representatives and 32 different organizations were interviewed in order to “take the pulse” of key stakeholders in the biodiesel industry in each province. The consultation focused on the stakeholders’ involvement and vision for the biodiesel industry as well as perceived barriers to the successful development of the biodiesel industry in each region.

During January and February 2006, a second phase of consultation brought together parties at five regional workshops in Halifax (January 19), Winnipeg (January 24), Vancouver (January 27), Montréal (February 2) and Toronto (February 16) with the common objective of discussing the Assessment study content. In total, approximately one hundred participants (listed in Appendix A) attended the consultation, including feedstock suppliers, biodiesel producers, major petroleum companies, independent distributors, end-users, associations and government representatives, with a view to identifying constraints and conditions for an effective biodiesel distribution infrastructure regionally and nationally.

The profile of the participants varied from workshop to workshop, reflecting the regional context in terms of petroleum and biodiesel end-use markets (on-road, off-road, etc.), the price of biodiesel (incentives or lack of) and existing petroleum logistics (infrastructure in place, rural versus urban markets). No particular end-use group was targeted during the course of this consultation. This document and its recommendations reflect these regional considerations.

The Assessment study was drafted by a project team working under a steering committee of key industry players (Appendix B) to ensure that the pathway is relevant and useful for planning, developing and implementing an effective distribution infrastructure.

The Assessment study is built on an objective-driven and results-oriented approach. It puts forward concrete recommendations and steps which are supported by costing information and scheduling guidelines to direct the industry through the coming phases of its development.

1.3 CONSULTATION WITH CANADIAN BIODIESEL STAKEHOLDERS

The content and guidelines presented in the Assessment study reflect the two-phase 2005 and 2006 consultation process previously described.

During the workshops the participants were invited to reflect on challenges and possible solutions to facilitate the integration of biodiesel into the existing infrastructure. To facilitate this discussion, the participants were asked to respond to key questions regarding six themes fundamental to the growth and the stability of the biodiesel industry in Canada: biodiesel production; fuel standards and quality assurance; storage and blending; transportation modes; financial incentives, tax issues and legislation; and information and training.
Figure 1 was developed to facilitate the regional workshop discussions. As the diagram suggests, the biodiesel distribution network can be divided into four components:

- **Biodiesel Production** including feedstock providers.
- **Upstream Distribution**: Primary terminals (located at refinery or at a remote location) for storage and injection blending.
- **Downstream Distribution**: Secondary or regional terminals for storage and blending (primarily splash blending) and retail outlets (card locks, gas stations).
- **End-Users**: On-road (with or without fuelling infrastructure), off-road (rail, marine, on-farm use, and industrial), building heating (home, commercial and industrial) and small power generation.

The following present the top concerns and issues raised by the participants on these key questions during the regional workshops.

### Production of Biodiesel
- Competitiveness and reliable access to quality supply are required pre-conditions for building a domestic biodiesel distribution industry.

### Fuel Standards and Quality Assurance
- Quality is an industry-wide issue and is part of doing business. Biodiesel stakeholders perceive quality as due diligence.
- BQ-9000 is designed to maintain B100 quality and integrity. There is currently no system for biodiesel blend testing or quality maintenance (the system is not geared to downstream blending testing).
- Critical mass will make testing more economically viable. Until then these costs can be prohibitive.

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1. Others concerns and issues raised by participants on these key questions are summarized in Appendix C.
**Blending and Storage**
- The introduction of biodiesel will require significant investment in terms of additional (dedicated) storage tanks which are insulated and heated for B100 as well as a supporting heated infrastructure (pipes, etc.). The cost and time delays associated with the permit process are potential barriers.
- The large petroleum producers do not perceive current demand levels for biodiesel as sufficient to justify investment. When critical mass is achieved, they envisage B100 stored at the primary terminal. Secondary terminals are not a viable option with the exception of remote areas. “It is a primary terminal world.”
- The current practice is splash blending by the distributor. Best practices need to be disseminated and adopted.
- There is general agreement that blending should not occur at the end-user and that blending will move further upstream (primary terminal) as the industry evolves.

**Transportation Modes**
- A dedicated system delivery is required for B100 to avoid contamination. There are material compatibility issues.
- Solvency and possible cross-contamination with other products (i.e. jet-fuel) is a barrier to the longer-term opportunity of transporting biodiesel through pipelines.

**Financial Incentives, Legislation, Tax Measures**
- A variety of incentives exist across the country for biodiesel. Most provinces only offer the incentive to local producers within the province of origin. British Columbia, Manitoba, Ontario, Québec, and Nova Scotia offer incentives related to biodiesel tax breaks, while Alberta and Saskatchewan provide funding incentives. Renewable fuel standard exists in British Columbia (5% for biodiesel by 2010), while Ontario, Manitoba, and Saskatchewan are currently discussing potential standards.
- “We need a ramp-up strategy for financial incentives to bridge the business challenge.”

**Information and Training**
- Information and training programs are needed all the way through the distribution chain in terms of handling and storing biodiesel – best practices.
- Promote biodiesel to end-user markets. Build the demand.
- “In order to be treated as an industry, we need to start acting as an industry.”
Before outlining the steps to take in developing a distribution infrastructure, we must first provide as accurate a description as possible of today’s biodiesel industry. It is clear that, though surging forward in several countries, the biodiesel industry in Canada is still in its infancy. However, the situation is changing, particularly with the recent jump in the price of oil. Renewable fuels such as biodiesel and ethanol offer increasingly interesting and popular additions to diesel and gasoline respectively. More and more users, particularly municipalities and mass transit authorities, show a growing interest in biodiesel and want to convert their vehicle fleets. Governments are also looking for ways to promote biofuel use on a larger scale. The federal and some provincial governments are implementing programs and tangible tax measures to promote the industry’s development. The Government of Canada has made a commitment to move forward with its Renewable Fuel Standard (RFS) for gasoline and diesel fuel and announced its intention for inclusion of 5% ethanol content in gasoline by 2010 and 2% renewable diesel content in the distillate pool which includes on-road and off-road diesel as well as furnace fuel by no later than 2012.

### 2.1 EXISTING INCENTIVES

Regardless of what drives governments to promote biodiesel (energy security, Kyoto Protocol targets, pollution, local economics, new markets for farm produce, etc.), it is clear that countries, provinces and states that adopt incentives witness substantial growth of the industry within their borders. A good example is the USA, where the industry has grown exponentially since various subsidies and tax measures were passed to increase biodiesel production and stimulate demand for the product. In 2002, the Canadian government exempted the 4 ¢/litre diesel excise tax on biodiesel. This will expire on April 1, 2008, and be replaced by an ecoEnergy for Biofuels program, passed in the 2007 federal budget. This is a nine year program starting April 1, 2008 where each individual project can receive declining funds for seven years. The rate for biodiesel will be 20 ¢/litre for the first three years declining to 6 ¢/litre in the final year. These rates are a maximum and subject to a profitability clawback of 20%. The profitability will be determined on an industry average. The exact parameters used in the industry average are yet to be announced. In 2002, the Ontario government exempted biodiesel from its 14.3 ¢/litre road tax. Since 2004, the B.C. government has exempted biodiesel from its road tax, varying from 15 to 21 ¢, for blends of at least B5 and up to B50. Since March 2006, the B.C. government has also added a 5% biodiesel renewable fuel standard by 2010. Alberta has added a 4 year Bioenergy Program of 14 ¢/litre for producers within the province. This replaces the previous Alberta road tax exemption. Saskatchewan has added the Saskatchewan Biofuels Investment Opportunity fund at $80 million also for Saskatchewan producers. The Québec government put in place a fuel road tax refund for B100 (eventually extended to blends). The Manitoba government has exempted both its road and sales tax on biodiesel, which results in an 11.5¢/litre advantage at current prices. Finally, the Nova Scotia government has recently announced a road tax exemption of 15.4 ¢/litre for biodiesel produced in the province. (For further details, see Table 1).

These government initiatives, combined with the effect of the recent hike in the price of oil, have made biodiesel more competitive and have promoted the emergence of new production plants in the country. Biodiesel production in Canada, which had so far been produced mainly from micro-production or pilot plants, is thus increasingly available on the Canadian market. Moreover, it can be easily imported, especially from the USA. Our neighbours have some 110 biodiesel plants in operation churning out annually about 4,470 million litres. Strong growth in U.S. biodiesel production capacity is projected over the coming years.

### Table 1 – Existing Incentives for Biodiesel in Canada

<table>
<thead>
<tr>
<th>Province</th>
<th>Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal</td>
<td>_SEC_Direct Producer Incentive for Renewable Fuels: 14.0 ¢/L, 4-years - replaces road tax exemption of 9.0 ¢/L, ecoABC Initiative Biofuels Opportunities for Producers Initiative Agric-Opportunities Program Agricultural Bioproducts Innovation Program</td>
</tr>
<tr>
<td>British Columbia</td>
<td>Road tax exemption: 15.0 to 21.0 ¢/L, (depending of the region) for biodiesel (exemption for biodiesel portion of a blend), Innovative Clean Energy Fund, $25 million – under review, expected mid to late 2007</td>
</tr>
<tr>
<td>Alberta</td>
<td>Prefer federal approach, Bioenergy Program, direct producer incentive for renewable fuels: 14.0 ¢/L, 4-years – replaces road tax exemption of 9.0 ¢/L, Bio-Metabolizing Commercialization and Market Development Program Bio-Energy Infrastructure Development Program</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>Biofuels Investment Opportunity fund at $80 million for Saskatchewan producers</td>
</tr>
<tr>
<td>Manitoba</td>
<td>Biofuels Investment Opportunity fund at 11.5 ¢/L, B100, No current sunset date but expected to be harmonized with ethanol soon, None</td>
</tr>
<tr>
<td>Ontario</td>
<td>RFS for ethanol only, Fuel road tax refund for B100, None for biodiesel</td>
</tr>
<tr>
<td>Québec</td>
<td>RFS for ethanol only, Fuel road tax refund for B100, None</td>
</tr>
<tr>
<td>Atlantic Canada</td>
<td>New Brunswick RFS under review, Nova Scotia: 15.4 ¢/L, for biodiesel produced in NS, None</td>
</tr>
<tr>
<td>The North</td>
<td>Biofuels Investment Opportunity fund at $80 million for Saskatchewan producers</td>
</tr>
</tbody>
</table>

2. Though making recommendations to the government regarding the best measures to put in place to promote development of the biodiesel industry in Canada goes beyond the scope of this Assessment study, the feasibility of developing an efficient distribution infrastructure for biodiesel and the extent to which this is achieved depend largely on the existence and nature of incentives in place.
2.2 CURRENT PRODUCTION

In Canada, biodiesel production has increased significantly in recent years due to higher demand. The first industrial scale plant in Canada was inaugurated, in November 2005, in Québec (Rothsay Biodiesel) and a second plant was inaugurated, in February 2007, in Ontario (Biox Corporation). The two plants have a capacity of 35 million litres and 60 million litres respectively. Adding the capacity of Milligan Bio Tech (Saskatchewan) the actual annual biodiesel production capacity in Canada is now close to 100 million litres (see Figure 2).

The biodiesel industry is not attracting equal interest or progressing at the same rate from one region of Canada to another:

- In the Rockies (particularly British Columbia), even though substantial biodiesel production units are not yet in operation, there is great interest in the biofuel among users. In 2004, the B.C. government adopted a biodiesel tax incentive between 15 and 21 ¢ (depending on the region) which, when combined with the federal excise tax relief of 4 ¢, places British Columbia in the strongest position of all the provinces to offer competitively-priced biodiesel. The demand for biodiesel is steadily growing, especially in urban centres like Vancouver and the Lower Fraser Basin region. Dynamic programs like BC BioFleet are an indication of the commitment the province has demonstrated over the past years. Additionally, British Columbia has a RFS planned of 5% biodiesel by 2010. Alberta has added a 4 year Bioenergy Program of 14¢/litre for producers within the province. This replaces the previous Alberta road tax exemption.

- In the Prairies, biodiesel has sparked great interest among canola producers, who aim to add value to their products. The Manitoba Biodiesel Advisory Council, Saskatchewan Biodiesel Development Task Force and similar organizations play a major role in developing the industry, which holds great promise for the rural economy. Manitoba recently decided to implement a series of incentives to promote biodiesel. Saskatchewan announced the Saskatchewan Biofuels Investment Opportunity, which is a 4-year $80 million program designed for Saskatchewan biofuel producers with a $10 million max contribution per plant available. Additionally both Saskatchewan and Manitoba have started discussions on a potential biodiesel RFS. A few pre-industrial plants are operating in the two provinces, with a total annual output of about 2 million litres. There are a handful of planned industrial plants for the future.

- In Ontario, the biodiesel market is increasing, driven in part by major tax incentives adopted by the province in 2002. Fleet Challenge Ontario estimated the province’s consumption of biodiesel at 6.9 million litres in 2005. Several municipalities and public vehicle fleets use biodiesel, including Hamilton, Kingston, Toronto, Waterloo Oshawa and Ottawa. Hydro Toronto has been using biodiesel since July 2002. Brampton mass transit authority has already converted part of its fleet, and the Toronto Transit Commission recently announced that they had switched all their 1,491 buses to B5 biodiesel blend, since April 2006. The Biox Corporation plant in Hamilton, Ontario has a production capacity of 60 million litres a year.

Although Alberta has not as yet demonstrated the same level of interest as seen in British Columbia, the City of Calgary has supported biodiesel and the Alberta Biodiesel Association was recently formed.

- In Ontario, the biodiesel market is increasing, driven in part by major tax incentives adopted by the province in 2002. Fleet Challenge Ontario estimated the province’s consumption of biodiesel at 6.9 million litres in 2005. Several municipalities and public vehicle fleets use biodiesel, including Hamilton, Kingston, Toronto, Waterloo Oshawa and Ottawa. Hydro Toronto has been using biodiesel since July 2002. Brampton mass transit authority has already converted part of its fleet, and the Toronto Transit Commission recently announced that they had switched all their 1,491 buses to B5 biodiesel blend, since April 2006. The Biox Corporation plant in Hamilton, Ontario has a production capacity of 60 million litres a year.
In recent years, Québec has been the stage of large scale biodiesel demonstration projects (BioBUS and BioMer). The Conseil québécois du biodiesel works actively to promote the use of biodiesel in the province. Although Québec has the first industrial scale plant in operation in Canada (Rothsay Biodiesel), the province consumes practically no biodiesel and the output is sold on USA, Ontario and B.C. markets. This situation may change following the introduction in March 2006 of a provincial incentive for the reimbursement of the road tax for B100 (eventually extended to blends). Recently, two independent marketers (Olco and Pétroles Sonic) announced that they are going to distribute biodiesel starting in the summer of 2007.

Except for a few micro-producers, there is minimal biodiesel production in Atlantic Canada. However, there is fairly strong interest in biodiesel in this region, especially among community organizations. The Falls Brook Centre in New Brunswick, for instance, has undertaken a number of biodiesel demonstration and micro-production projects. Only Nova Scotia of the four Atlantic Provinces presently offers an incentive to promote the use of biodiesel. Nova Scotia offers 15.4¢ for biodiesel produced in the province. Prince Edward Island, however, is supporting the construction of a biodiesel plant to provide a new market for the province’s canola producers, and all Atlantic provinces are considering how to implement Renewable Fuel standards.

### 2.3 CURRENT DISTRIBUTION NETWORK

The present industry focus has been mainly on developing production capacity to meet the growing demand for biodiesel. However, it is clear that in order to effectively meet that demand, it is just as important that solutions be found quickly to make biodiesel readily available at the lowest possible cost to the largest number of Canadians.

At the present time, there is practically no distribution infrastructure for biodiesel in the country. The biodiesel sold in Canada is mainly consumed by users with their own fuel storage facilities (public vehicle fleets, mass transit authorities, etc.) and the biodiesel is either delivered directly by the producer or through independent distributors that have set up distribution systems for specific projects or customers. A Canadian biodiesel transportation network is not yet established. Aside from a dozen of independent service stations in Ontario and B.C., biodiesel is not marketed in Canada. The distribution infrastructure therefore represents the missing link between an increasing supply and a more and more pressing demand for the product.

**Current Practices – Storage**

Currently, the storage of B100 is carried out primarily by biodiesel producers, who have dedicated insulated and heated tanks that are specially adapted to their product. Distributors store B100 on a case-by-case basis depending on ongoing projects, available facilities and client needs. Given that small volumes of fuel are generally being stored for short periods, temporary solutions are the most common.

- There is currently no storage of B100 in primary terminals.
- During the warm seasons, distributors occasionally store B100 in their secondary terminals by using small existing tanks (non-insulated and non-heated), which have previously been cleaned.
- Distributors who do not have available tanks in their secondary terminals sometimes use tanker trucks (non-insulated and non-heated) to temporarily store B100. In cold weather, the trucks can be installed in heated garages.
- Some projects require the use of small mobile tanks (togs or totes) that are transported on site (to the distributor or directly to the end-user) for the temporary storage of B100. In cold weather, these tanks can also be installed in heated areas.
- For seasonal use, some users of B100 temporarily store biodiesel (for their operations) in their own (non-insulated and non-heated) facilities, which have previously been cleaned.

**Current Practices – Blending**

Due to a lack of infrastructure for biodiesel blending in Canada, much of the blending has been in the form of less favourable blending techniques such as in-tank or splash blending on on-site locations whereas there are more effective and safer blending techniques that can be used to guarantee product integrity (see Section 4.3).

**Current Practices – Transportation**

In Canada, the current estimated split among the actual delivery modes of B100 is: ~50% via tanker truck, ~47% via rail car and ~3% via marine tanker. This is primarily due to current market conditions (the location of production plants and end-use markets, limited domestic demand and product exports to the USA and Europe). Because of operational considerations and specific challenges, B100 and biodiesel blends are not currently transported via pipeline in Canada. B100 and biodiesel blends are transported primarily by dedicated (or washed) tanker trucks and rail cars. During the cold season, distributors generally avoid transporting B100 in non-heated trucks and prefer instead to deliver low-concentration blends (B2-B5).

Even though most of these practices of storage, blending, and transportation are excellent solutions that have been adapted to the context of an emerging industry, some of these will not be economically feasible if the biodiesel industry matures and develops. They are in fact too costly in the event of an increase in the volume of biodiesel to be stored, blended and distributed. In addition, these practices do not fully comply with the conditions required for biodiesel, which could potentially have an impact on maintaining product quality (see Section 4.4).
2.4 POTENTIAL MARKETS FOR BIODIESEL

Biodiesel is a biofuel that can be used instead of distillate products such as light diesel fuels and heating oil. Distillates have several uses, the most important of which is road transport (transport trucks, public and private vehicle fleets, passenger cars, public transport, etc.). They are also used for certain off-road applications such as space heating, transportation by train or by boat and agricultural or industrial applications. Distillates can also be used to produce energy, primarily in generators.

These could all be promising sectors for biodiesel. To gain a better idea of the potential market that biodiesel could focus on in the future, it is important to understand current consumption trends of distillate products in Canada.

A cross-Canada overview shows that of the 30.7 billion litres5 of distillates consumed in 2005 (see Figure 3), road transport accounted for 56%, commercial and residential heating 15% and all other sectors combined 29% – maritime 4%, rail 7%, agricultural 7%, industrial 11% (see Figure 4). While road transport represents the largest sector overall, a closer look at consumption patterns shows significant inter-regional differences in the use of distillates (see Figure 5).

In the Atlantic Provinces, for instance, where homes are primarily oil-heated, the heating oil market accounts for 35% of distillate consumption while this sector only accounts for 2% in the Rockies region. In Ontario, on-road applications largely dominate with 65% of consumption while in the Prairies, agriculture is a very significant sector, accounting for about 28% of the total. In Québec, road transport is the largest sector (51%) though residential heating remains quite substantial (30%).

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5. Reference: Statistics Canada. Catalogue No. 57-003-XIB. The 2005 data, the most up-to-date available (May 2007).
Retail sales volume of distillate for road transport (not shown in Figure 5) varies greatly from province to province, ranging from 19% in the Rockies to 37% in Québec (ranging from 23 to 30% in the other regions). The Canadian average is 27%.

The following presents a closer look at distillate consumption by region in 2005:

- **In the Atlantic Canada**, annual usage of diesel fuel is approximately 3.9 billion litres, of which 35% is consumed by the heating sector, 38% is used for road transport and 13% by the marine sector.

- **In Québec**, diesel fuel consumption totals about 5.7 billion litres, of which 51% is for road transport and 29% for heating. The remaining off-road consumption is mainly in the industrial, rail and agricultural sectors.

- **In Ontario**, annual usage of diesel fuel is approximately 8.5 billion litres, of which a significant 65% share is consumed by the road transport sector—9% above the national average of 56%. Another 14% is consumed by the heating sector—below the share in Atlantic Canada and Québec but above that out West. The industrial and rail sectors consume 10% and 6% respectively.

- **In the Prairies region** (Manitoba, Saskatchewan, Nunavut and Territories), annual usage of diesel fuel is approximately 3.2 billion litres, of which 51% is consumed by the road transport sector, 28% is used in the agricultural sector and 12% in industrial end-use markets. Note that the heating sector in this region accounts for only 2% of diesel fuel usage compared to 35% in Atlantic Canada.

- **In the Rockies region** (Alberta and British Columbia), annual usage of diesel fuel is approximately 9.2 billion litres, of which 61% is consumed by the road transport sector. Another 15% and 10% of diesel fuel is used by the industrial and rail sectors respectively. The agricultural and marine markets consume 8% and 4% respectively. Similar to the Prairies, the heating sector (furnace oil) in this region accounts for a minor share of diesel fuel usage (2%).

These regional differences clearly impact the configuration of petroleum product infrastructure and distribution modes in each region. They will have just as strong an impact on biodiesel which, during the coming years, must find a niche in each region to succeed in breaking into the market and building critical mass. It is difficult to predict at the moment how the market will evolve but it is likely that the best sector in which to introduce biodiesel will be on-road applications (an important market for distillates with 56% of consumption). In fact, most incentives that have been put in place for biodiesel target this sector by individual province. However, with the introduction of Ultra-Low Sulphur Diesel (ULSD) could alter the distillate market (see following section). In several regions in Canada, the demand for certain off-road applications could generate, in the short term, sufficient critical mass for the industry (for example, the agricultural sector in the Prairies and heating oil in the provinces in Eastern Canada). Clearly, there is no set rule from coast to coast. It depends on the supply and demand for the product, the measures that have been put in place and price competitiveness.

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6. Given that biodiesel is generally more expensive than the distillates it replaces, incentives are an important factor with respect to market development as they make the price of the product more competitive.
If we take into account the constraints related to the climate found throughout Canada, B5 is the biodiesel concentration that is likely to be used most widely in the country all year long (see Table 2). However, to gain an idea of the theoretical biodiesel market in Canada, we simply need to look closely at the total consumption of distillates. Based on a hypothesis of a 100% penetration of this market with a 5% biodiesel blend (B5), the theoretical market for pure biodiesel in Canada would be approximately ~1.5 billion litres (~800 M litres for the on-road sector and ~700 M litres for off-road applications). With a current national production level of ~100 million litres, it is clear that the industry is not yet mature enough for this optimistic scenario. However, regardless of how much the biodiesel market grows in the coming years, the increase in biofuel volumes will require an effective distribution infrastructure that is adapted to the product. This will be studied in detail in the coming chapters.

### 2.5 IMPACT OF ULSD ON THE DIESEL FUEL MARKET: CONSTRAINTS AND OPPORTUNITIES FOR BIODIESEL

Currently, there are three types of diesel in Canada based on the quantity of sulphur limits and other specifications. Ultra low Sulphur Diesel (ULSD) which is used for on-road use has less than 15 ppm (15 mg/kg). Low Sulphur Diesel (LSD) which has a limit of 500 ppm can be used for off-road diesel. Regular Sulphur Diesel (RSD) has a higher level of sulphur (without exceeding the 5,000 ppm limit) and is used for furnace fuel.

ULSD became a fuel standard for on-road use in Canada in June of 2006. The Sulphur in Diesel Fuel Regulations, which set regulated limits for on-road diesel, were first published in Part II of the Canada Gazette on July 31, 2002. These regulations continued the sulphur limit for diesel fuel used for on-road diesel use at 500 ppm until June 1, 2006, at which time the production limit was reduced to 15 ppm thereafter. The regulations did not address off-road applications such as rail, marine, construction and farm use at that time. There was a three-month phase in period for implementation to allow retail sales to turn over all of their fuel to the new, low sulphur levels, and it was available in the Canadian marketplace after September 2006.

The regulatory limit in Canada for production of off-road went to 500 ppm sulphur in June 2007. There is an allowance for point-of-sales for inventory turnover for this up until October 1, 2007. After that date, all off-road diesel must be below 500 ppm sulphur. In the future, as of 2010 the sulphur limit for off-road decreases to that of ULSD at 15 ppm. The timing for this has the regulation for 15 ppm sulphur for production of off-road diesel coming into effect on June 2010 and allowing for inventory turnover has a point-of-sales implementation date of September 30, 2010.

Some refineries have already chosen to use ULSD for off-road use, either for logistical reasons or to minimize the risk of ULSD being contaminated in pipeline shipment. In some cases, some refineries for logistical reasons use RSD for furnace fuel. To differentiate between the two, tax regulations require dying RSD purple (coloured diesel) and on-road diesel is transparent (white diesel). In most provinces, coloured diesel is either tax-free or taxed at a lower rate than white diesel.

### Table 2 – Potential Markets for B5 and B20 Usage for Different Applications

<table>
<thead>
<tr>
<th>Diesel Blend</th>
<th>B5</th>
<th>B20</th>
<th>Notes for B20</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Road Applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customers with their own installation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>X</td>
<td>X</td>
<td>For End-Users with their own infrastructures</td>
</tr>
<tr>
<td>Winter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retail Market</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Card Lock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>X</td>
<td></td>
<td>If sufficient demand</td>
</tr>
<tr>
<td>Winter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-Road Applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating Oil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>N.A.</td>
<td>X</td>
<td>Customers equipped with interior tank</td>
</tr>
<tr>
<td>Winter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rail</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>X</td>
<td></td>
<td>If sufficient demand</td>
</tr>
<tr>
<td>Winter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>X</td>
<td></td>
<td>If sufficient demand</td>
</tr>
<tr>
<td>Winter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Power Generation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>X</td>
<td></td>
<td>Except if storage longer than 6 months</td>
</tr>
<tr>
<td>Winter</td>
<td>X</td>
<td>Only for customers equipped with interior tank and for storage less than 6 months</td>
<td></td>
</tr>
</tbody>
</table>

7. For more details, see Table 3.
The full impact of ULSD on the diesel fuel market in Canada is not yet fully known, although it is in use in Canada. What is known is that the aromatic content in ULSD is lower than that of LSD. This will impact the characteristics of the fuel by lowering its solvency. The relative aromatic content of diesel fuel varies today and is dependent upon the crude feedstock from which it was produced. It is also known that the aromatic content will be lowered on a relative basis in almost all refineries. Prior to the National Renewable Energy Laboratory (NREL) Oxidation Stability Study8 which was funded by the NBB and NRCan in 2006, the assumption was that the aromatic content of the ULSD would have a large part to play in oxidation stability. The findings of the NREL Study showed that the biodiesel is the dominating factor in oxidation stability and that aromatic content of the ULSD is overshadowed by the biodiesel used in the blend.

The other key impact which is of greater concern is that aromatic compounds in diesel fuel have favourable cloud point characteristics. The fact that the aromatic content has decreased with ULSD means that the cloud point is a more critical blending parameter in blending diesel fuel. In other words, there are less of the more favourable blending components with superior cloud points. The resulting effect is that the blending required to meet cloud point in some of the colder regions in Canada is more constrained. In some cases, some refineries may choose to run a higher diet of synthetic crude from the oil sands, which are known to have higher aromatic content.

The fact that prior to the implementation of ULSD many petroleum companies were preoccupied by the implementation of ULSD affected to some degree the interest by Canadian refiners in biodiesel. The implementation of the ULSD was a large effort and the impact to each refinery was different depending on refinery design and solution chosen to implement ULSD. The CAN/CGSB 3.520 specification for biodiesel blends in Canada from B1 – B5 is now in place.10 This was finalized based on the findings of the NREL Study and additional statements of support from engine manufacturers (OEMs). ULSD has lower lubricity, which may create unsuspected possibilities for biodiesel for both on-road and off-road applications.

In fact, biodiesel could possibly become the ideal blending component for meeting the ULSD fuel standard. The process that reduces the sulphur in diesel fuel to very low levels also removes some of the lubricity properties normally found in the diesel fuels with higher sulphur levels.

It is known that the lubricity of ULSD is lower than that of LSD. This provides some opportunity for the superior lubricity properties of biodiesel to be employed. In Eastern Canada, refineries typically add lubricity additive at the refinery. However, in Western Canada, some refineries add lubricity additive at the terminals. Biodiesel has superior lubricity properties and in most cases is almost sulphur free. Both of these properties make it an attractive blend fuel for ULSD.

ON-ROAD APPLICATIONS
• Since September 2006 (Lower sulphur regulations for on-road diesel), all on-road diesel in Canada contains only fuel which is less than 15 ppm (15 mg/kg). The target for Canadian refinery on-road diesel fuel production is 8 ppm. The reason for this is to allow for the possibility of sulphur contamination through the distribution system (mainly pipeline). In the event that the sulphur contamination is such that it exceeds 15 ppm, biodiesel would be an ideal blend stock to bring the fuel back to within specification since it is virtually sulphur free.

• The LSD used for on-road diesel previously had a higher aromatic content than that of the ULSD. This change is different for each refinery as compared to the aromatics content in the LSD they produced prior to producing ULSD. Aromatic components in diesel are good solvents. This is in part because they are more polar than straight-chained components. Biodiesel being a methyl ester is also more polar than straight-chained components. This means that the propensity of biodiesel blends with ULSD to form deposits can be greater than with LSD. The result is that the oxidative stability with biodiesel blends with ULSD may be lower than biodiesel blends with LSD all things being equal. However, as mentioned the NREL Study findings indicate that this affect is less pronounced than was originally suspected. There are stability additives available in the marketplace to address oxidative stability and ensure that the oxidation stability specification requirement in the ASTM D6751 B100 Biodiesel Blend Stock specification is met.

• The key benefits which biodiesel brings relative to ULSD as a blending component are lubricity and cetane.

9. For more details on cloud point and blending techniques associate with biodiesel, see Sections 4.2 and 4.3.
10. For more details, see Chapter 4.

| Table 3 – Canadian Sulphur in Diesel Fuel Regulations* |
|---|---|---|---|---|
| September 1st, 2006 | 22 ppm | 5,000 | 5,000 | 5,000 |
| October 15, 2006 | 15 ppm | 5,000 | 5,000 | 5,000 |
| October 1st, 2007 | 15 ppm | 500 | 500 | 500 |
| October 1st, 2010 | 15 ppm | 500 | 500 | 15 |
| June 1st, 2012 | 15 ppm | 15 | 15 | 15 |

* Amendments to the Regulations (that introduced limits for off-road, rail and marine diesel fuels) published October 19, 2005, in Part II of Canada Gazette.

OFF-ROAD APPLICATIONS

- For many refineries when adding assets to meet the diesel desulphurization for on-road diesel, plans were included in the refinery engineering to allow for expansion to accommodate the future lower sulphur of 500 ppm for off-road and then 15 ppm. When this specification comes into effect it may offer an additional opportunity for biodiesel to contribute to this pool.
- In 2012, the locomotive and marine diesel pool must meet the 15 ppm limit. Generally, locomotive diesel is made from less costly components, which is why its price is typically lower than that of on-road or other off-road diesel fuel. The added cost to the refinery to desulphurize these distillate components could be minimized with blending of biodiesel.
- The added cost to desulphurize marine diesel is yet another refinery cost. More importantly, the residual component can not be desulphurized in the same way that distillate components could, which means that refineries will need to seek other lower sulphur components to blend with to make marine fuel. Moreover, this will further constrain refinery diesel markets. This would be an ideal application for the use of biodiesel as a blending component. As the sulphur specifications for off-road diesel fuel, rail and marine move to the 15 ppm levels, the opportunity for biodiesel will increase by virtue of the high cost of desulphurizing the components which make up these fuels.

However, certain consequences of introducing ULSD are less than ideal for the biodiesel industry. They also represent an obstacle for distributing the product. One of the main issues related to the introduction of ULSD and the development of the distribution infrastructure is accessibility to terminals. Due to the ULSD introduction schedule and the transition to 500 ppm in 2007 and then 15 ppm in 2010 for off-road, petroleum companies will have to store a higher number of differentiated products (15 ppm diesel, 500 ppm diesel, regular diesel, and ethanol) at secondary terminals, which will restrict the space available for storing biodiesel blends in those terminals. However, in an effort to standardize products and distribution and to lower investment costs related to infrastructure (additional tanks), to promote product sharing between terminals and to minimize pressure on terminals, petroleum companies may choose to bring the government’s deadline forward and to offer ULSD diesel more quickly for all applications (on-road and off-road). If this occurs, biodiesel could become a more attractive option for petroleum companies.

2.6 HIGHLIGHTS REGARDING THE CANADIAN BIODIESEL INDUSTRY

The following provide a brief overview of the key contents of Chapter 2:

- The Canadian biodiesel industry is still in an infancy stage.
- Biodiesel is more costly to produce than diesel fuel under market conditions.
- Biodiesel is now increasingly in demand, especially with higher petroleum prices and introduction of government incentives to make the price more competitive.
- Energy security, Kyoto Protocol targets, pollution, local economics, new markets for farm produce, etc. are also good arguments in favour of biodiesel.
- Federal and some provincial governments have implemented programs and incentives to make biodiesel more competitive.
- In December 2006, the Canadian production capacity was about 100 M litres per year (Rothsay Biodiesel, Biox Corporation, Milligan Bio-tech, etc.).
- At the present time, there is practically no distribution infrastructure for biodiesel in Canada. It is a major roadblock to responding to the increasing demand.
- Different application sectors for distillate products (on-road and off-road) are potential markets for biodiesel. The size of these sectors can vary substantially from one region to another. Therefore, although on-road applications may generate sufficient critical mass for the industry in most regions in Canada, some off-road applications, namely for heating in the provinces in Eastern Canada and agricultural applications in the Prairies, could become just as interesting in those regions.
- Based on a hypothesis of a 100% penetration of the total distillate market with a 5% biodiesel blend (B5), the theoretical market for pure biodiesel in Canada would be approximately 1.5 billion litres (~800 M litres for the on-road sector and ~700 M litres for off-road applications).
- If we take into account the climate constraints found throughout Canada, B5 is likely to be the most widely used biodiesel concentration in the country all year long.
- Introduction of ULSD created both constraints and opportunities for biodiesel. Now that some concerns about oxidation stability have been addressed, biodiesel could possibly become the ideal blending component for meeting the ULSD fuel standard for on-road applications. Biodiesel can also provide a solution for the petroleum industry to accelerate the implementation of the ULSD standard for off-road applications.
Biodiesel is a biofuel that can be blended in varying concentrations with diesel fuel or heating oil and could, in theory, penetrate the same markets, as was explained in the previous chapter, and be handled by the same distribution system as petroleum products. This is why the issue of biodiesel distribution cannot be discussed without an overview of the petroleum industry in Canada¹¹ and, more specifically, distribution within the distillate sector¹².

### 3.1 OVERVIEW

In Canada, three major corporations—Imperial Oil (Esso), Petro-Canada and Shell—have oil exploration, extraction, refining, and national wholesale and retail activities from coast to coast. Regional refiner-marketers such as Ultramar, Irving, Federated Co-operatives, Arco, Chevron, Husky, Sunoco and Parkland represent the remaining larger distributors in the oil refining and wholesaling sector in Canada. Barring a few exceptions, most primary terminals for petroleum products belong to one of the aforementioned companies. They also carry out a large part (~ 60%) of distillate retailing in Canada. There are approximately 120 independent marketers offering petroleum products under their own brand (e.g., Canadian Tire, Sonic, McEwen, Wilson Fuels, Domo, Co-op, Cascadia and UPI, etc.). The market share of independents varies greatly from region to region. Independents share is minimal in the West (3 to 4% of the market in B.C.) but large in Central Canada, sharing 20 to 25% of the Québec and Ontario market. In the Atlantic Provinces, independents occupy less than 10% of the market except for heating oil, where their share rises to an estimated 30%.

### 3.2 UPSTREAM DISTRIBUTION

As per the petroleum industry definition, upstream distribution includes crude oil gathering at the well head (or import in the East), crude oil storage, refinery processing, and the finish product storage at the primary terminal. For the purpose of the Assessment study, biodiesel plants and transport to refineries or primary terminals are also included in the upstream distribution process (distributing biodiesel through the distribution network used for petroleum products will be addressed in Chapter 4).

There are now 19 Canadian refineries with 324,373 m³ per day capacity, as illustrated in Figure 6. Refineries in the West mainly process crude from the Western Canada oil patch; whereas, farther East in Québec and the Atlantic Provinces, most oil is imported and a lesser quantity is extracted offshore of Newfoundland. Ontario has a middle position and benefits from both markets: Western crude and oil imported from the East. Table 4 shows that all provinces except Manitoba and Prince Edward Island have at least one refinery.

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11. The information in this section is drawn largely from Overview of the Canadian Downstream Petroleum Industry, Ottawa, Natural Resources Canada, July 2005.

12. Distillates comprise products such as domestic heating oil, low and high sulphur diesel fuel, aviation fuel and kerosene.
<table>
<thead>
<tr>
<th>Refinery Plant</th>
<th>Primary Terminal</th>
<th>Rack</th>
<th>Secondary Terminal</th>
<th>Rack</th>
<th>Card Locks</th>
<th>Gas Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home &amp; Commercial Heating (Bioheat)</td>
<td>Small Power Generation Installations</td>
<td>Transport Off-Road Clients with their own installation</td>
<td>Transport On-Road Clients with their own installation</td>
<td>Transport On-Road Retail Customers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* May use the same four transportation modes as shown above.

**Figure 7 – Actual Distribution Infrastructure for Distillate Products in Canada**
Primary terminals (also called “product terminals”) are in greater number (about 70) and more evenly distributed geographically than Canadian refineries (see Table 5). They are generally located near major markets and transportation modes. Twenty Canadian cities have primary terminals posting rack prices for wholesalers. Some terminals are located at a refinery while others are separate tank farms that receive products by pipeline, rail or marine. Products at some primary terminals are either wholesalers or suppliers to trading partners or both.

Some regions have a single primary terminal supplying all distributors. Product exchange agreements between competitors are driven by distribution efficiency. Also, product quality is justified by lowering tankage diversity.

Each region of Canada has its particularities. The choice of transportation mode and infrastructure largely depends on geographic factors. In regions with ample waterways, petroleum products are transported to primary terminals mainly by marine tankers. This is especially true for Québec and the Atlantic provinces. Transportation in Québec is also by unit train. Western provinces except British Columbia are essentially land-locked and products are transported from refineries to terminals mainly by pipeline. In Ontario, products are transported largely by pipeline, but also by unit train or by marine tanker through the St. Lawrence Seaway.

### Table 4 – Refineries in Canada – 2005

<table>
<thead>
<tr>
<th>Region</th>
<th>City</th>
<th>Refinery Name</th>
<th>Production Capacity (Thousands of cubic metres per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic</td>
<td>Dartmouth, NS</td>
<td>Imperial Oil</td>
<td>13,992</td>
</tr>
<tr>
<td></td>
<td>St-John’s, NB</td>
<td>Irving Oil</td>
<td>44,517</td>
</tr>
<tr>
<td></td>
<td>Come-By-Chance, NF</td>
<td>North Atlantic Refining</td>
<td>16,700</td>
</tr>
<tr>
<td>Quebec</td>
<td>Montréal, QC</td>
<td>Montreal</td>
<td>26,635</td>
</tr>
<tr>
<td></td>
<td>Sarnia, ON</td>
<td>Shell</td>
<td>11,100</td>
</tr>
<tr>
<td></td>
<td>St-Romuald, QC</td>
<td>Ultramar</td>
<td>33,000</td>
</tr>
<tr>
<td>Ontario</td>
<td>Nanticoke, ON</td>
<td>Imperial Oil</td>
<td>17,800</td>
</tr>
<tr>
<td></td>
<td>Sarnia, ON</td>
<td>Imperial Oil</td>
<td>19,200</td>
</tr>
<tr>
<td></td>
<td>Sarnia, ON</td>
<td>Suncor</td>
<td>13,500</td>
</tr>
<tr>
<td></td>
<td>Sarnia, ON</td>
<td>Nova Chemicals</td>
<td>12,700</td>
</tr>
<tr>
<td>Prairies</td>
<td>Regina, SK</td>
<td>Co-op Newgrade</td>
<td>13,500</td>
</tr>
<tr>
<td></td>
<td>Lloydminster, AB</td>
<td>Husky</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>Edmonton, AB</td>
<td>Imperial Oil</td>
<td>28,800</td>
</tr>
<tr>
<td></td>
<td>Edmonton, AB</td>
<td>Petro-Canada</td>
<td>21,929</td>
</tr>
<tr>
<td></td>
<td>Moose Jaw, SK</td>
<td>Moose-Jaw Asphalt</td>
<td>2,400</td>
</tr>
<tr>
<td></td>
<td>Sarnia, ON</td>
<td>Shell</td>
<td>20,000</td>
</tr>
<tr>
<td>British Columbia</td>
<td>Burnaby, BC</td>
<td>Chevron</td>
<td>8,300</td>
</tr>
<tr>
<td></td>
<td>Prince George, BC</td>
<td>Husky</td>
<td>1,800</td>
</tr>
<tr>
<td></td>
<td>Total BC</td>
<td></td>
<td>10,100</td>
</tr>
<tr>
<td>Total Canada</td>
<td></td>
<td></td>
<td>324,373</td>
</tr>
</tbody>
</table>

### Table 5 – Primary Terminals in Canada that Post Rack Prices for Diesel – 2006

<table>
<thead>
<tr>
<th>City</th>
<th>Rack Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saint John (NB)</td>
<td>Esso, Petro-Canada</td>
</tr>
<tr>
<td>St. John’s (NFL)</td>
<td>Ultramar</td>
</tr>
<tr>
<td>Halifax (NS)</td>
<td>Esso, Ultramar, Petro-Canada</td>
</tr>
<tr>
<td>Québec (QC)</td>
<td>Esso, Ultramar, Shell, Petro-Canada, Olco</td>
</tr>
<tr>
<td>Montréal (QC)</td>
<td>Esso, Ultramar, Shell, Petro-Canada, Olco</td>
</tr>
<tr>
<td>Ottawa (ON)</td>
<td>Esso, Ultramar, Shell, Sunoco, Petro-Canada, Olco, Coastal</td>
</tr>
<tr>
<td>Toronto (ON)</td>
<td>Esso, Ultramar, Shell, Sunoco, Petro-Canada, Olco</td>
</tr>
<tr>
<td>Hamilton (ON)</td>
<td>Oilo, Sunoco</td>
</tr>
<tr>
<td>London (ON)</td>
<td>Esso, Ultramar, Shell, Sunoco, Petro-Canada, Olco</td>
</tr>
<tr>
<td>Sarnia (ON)</td>
<td>Esso, Ultramar, Shell, Sunoco, Petro-Canada, Olco</td>
</tr>
<tr>
<td>Thunder Bay (ON)</td>
<td>Petro-Canada</td>
</tr>
<tr>
<td>Winnipeg (MB)</td>
<td>Esso, Shell</td>
</tr>
<tr>
<td>Regina (SK)</td>
<td>Esso, Shell</td>
</tr>
<tr>
<td>Calgary (AB)</td>
<td>Esso, Shell, Petro-Canada</td>
</tr>
<tr>
<td>Edmonton (AB)</td>
<td>Esso, Shell, Petro-Canada</td>
</tr>
<tr>
<td>Kamloops (BC)</td>
<td>Esso, Shell, Petro-Canada</td>
</tr>
<tr>
<td>Vancouver (BC)</td>
<td>Esso, Shell, Petro-Canada</td>
</tr>
<tr>
<td>Nanaimo (BC)</td>
<td>Petro-Canada</td>
</tr>
<tr>
<td>Victoria (BC)</td>
<td>Esso</td>
</tr>
<tr>
<td>Barepoint (BC)</td>
<td>Shell</td>
</tr>
</tbody>
</table>

*Source: Bloomberg*
There are three main companies in Canada that distribute distillates by pipeline. These companies and networks are primarily located in the West and in the Sarnia – Montréal corridor in the East: (see Figure 8).

- **Alberta Products Pipeline (APP)** is owned by Imperial Oil (Esso), Shell and Petro-Canada, and operated by Esso. It supplies gasoline and diesel fuel to Calgary terminals and Jet A-1 to Calgary Airport Terminal (owned by APPL and operated by Esso).

- **Enbridge Pipe Lines (EPL)** – ships gasoline and diesel fuels from Edmonton refineries across the prairies to Milden (for Saskatoon), Regina and Gretna (for Winnipeg). Jet A-1 is carried to the Esso terminal in Regina and Esso and Shell Terminals in Winnipeg (via Gretna). Syncrude and downgraded interface continues to eastern (Sarnia) refineries. Petro-Canada operates a transfer pipeline from Milden, on EPL, to bring product up to Saskatoon. Esso and Shell operate transfer pipelines from Gretna, on EPL, to bring product to Winnipeg.

- **Trans Mountain Pipe Line (TMPL)** – (recently Terasen and now owned by Kinder Morgan Canada) – ships crude oil and refined products via Kamloops terminals (gasoline and diesel fuel) to Vancouver area (crude oil to Chevron refinery; gasoline, diesel fuel and Jet A-1 base to Petro-Canada’s Burrard terminal (and crude oil to Puget Sound refineries).

Distillates are generally stored in large aboveground tanks in primary terminals. Although most of the terminals have the necessary capacity and equipment to heat certain products, the storage of distillates does not generally require those facilities.

Primary terminals are equipped with product delivery and loading racks that vary from one terminal to another. For example, some terminals linked via pipeline will not necessarily have racks that are adapted for other modes of transportation (train or truck). The effect of this practice on the distribution of biodiesel will be addressed in Chapter 5.

Finally, given that primary terminals are designed to provide downstream distribution of finished products, they all have loading facilities for truck, pipeline or rail. Some may have high performance injection equipment already installed at the loading rack. However, in most cases injection equipment presently installed will be on a smaller scale for additives. Some primary terminals may have product blending capability. For others this would need to be added for biodiesel blending (in-line blending, see Section 4.3.1).
3.3 DOWNSTREAM DISTRIBUTION

In downstream distribution, product moves from primary terminal by pipeline, rail, tanker truck or marine tanker to secondary terminals. Sometimes, the finished products could be delivered, by trucks, directly from primary terminals to retail facilities or end-users without going through a secondary terminal.

A secondary terminal and depot may represent a modest facility with a few aboveground tanks which offer only a small range of light products. Larger facilities could have both small and large tanks (underground or aboveground) and offer a full range of light products. A terminal may be operated under single ownership or, in some cases; the terminal is jointly operated by several petroleum companies. There are hundreds of secondary terminals in Canada. On average, there is one for every segment of the population with over 25,000 inhabitants.

Finished products in secondary terminals do not require heated equipment. Secondary terminals are equipped with product delivery and loading racks with occasional additive injection for private brands. If blends are necessary at this step, techniques such as splash blending and in-tank blending (for definition, see Section 4.3.1) can be used.

From secondary terminal (or depot), product is moved mainly by tanker truck to retail outlets and direct delivery to end-users. Retail outlets include gas stations and card locks. Typically, a gas station has three underground non-heated tanks (two for gasoline, one for diesel fuel) and offers a small variety of products through service islands, and convenience stores.

3.4 PETROLEUM INDUSTRY INTEREST IN BIODIESEL

Within the Canadian petroleum industry there are currently varying degrees of interest regarding biodiesel. Many independent marketers have demonstrated an interest in the biofuel and are assuming a lead role in biodiesel distribution. Several independents have actively participated in recent projects demonstrating and testing biodiesel for the public transit sector in a number of Canadian cities. Several independents have implemented and continue to operate adapted distribution systems to meet the demand for specific projects or programs.

The major petroleum companies have not yet shown a commitment to participate in the biodiesel distribution infrastructure. This will change as we move closer to the implementation of the Federal Renewable Fuel Standard (RFS). The implementation of the RFS for biodiesel is no later than 2012, but a defined date has not yet been set. Although the details are not yet worked out, it is expected that refining companies will be required to meet the 2% content in renewable fuels on the overall diesel pool (including both on-road and off-road) based on the company’s national distribution volumes in Canada, but be given the flexibility as to the regions in which this will be blended.

Given that the principal point of entry to the fuel distribution network is through their terminals, it is important to examine prevailing concerns and conditions under which the Canadian refining community would consider greater participation or even partnership with the biodiesel industry as part of an overall energy strategy (as is happening in the ethanol industry). To this end, the Assessment study aims to address the following challenges presented by the petroleum industry during the regional workshops:

- Consistent product quality and cold weather use.
- Consistent product supply.
- Capital investment at the terminal level. Primary terminals are operating at full capacity. Lack of biodiesel critical mass does not justify additional infrastructure investment. There is also reluctance to invest given that biodiesel, by petroleum industry standards, is available in limited quantity. The return on investment must consider blending costs, necessary terminal modifications, handling and compatibility considerations throughout the distribution chain, as well as the economics of any streams which were displaced in order to accommodate biodiesel.
- Impact of heating costs for the storage of B100.
- Lack of competitive pricing and uncertainty regarding tax incentives and public policy. These are perceived as determining factors in building critical mass.
- There is some concern about the warranties by the engine manufacturers of biodiesel blends with ULSD, above B5.
- Biodiesel does not “fit” within the petroleum industry’s standardized and large-scale approach to production and distribution.
- Fungibility issue and inability to treat biodiesel or biodiesel blends like any other petroleum product in the pipeline system.

Most of these concerns will be addressed in the following chapters. Nevertheless, given the uncertainty around many developments that will shape the future of the Canadian biodiesel industry (government policy, participation of the refining community, etc.), the Assessment study does not address the prevailing challenges relating to biodiesel supply and demand. The focus of the Assessment study is on infrastructure challenges and barriers related to logistics – specifically, the distribution, storage of B100 and the blending and distribution of biodiesel blends. These challenges and barriers and their relation with current and future industry practices are discussed in detail in Chapters 4 and 5.

13. A card lock can be located right on the site of a secondary terminal
14. Except for Suncor following their agreement with the Toronto Transit Commission (ITC).
3.5 HIGHLIGHTS REGARDING THE EXISTING CANADIAN INFRASTRUCTURE FOR DISTILLATE PRODUCTS DISTRIBUTION

The following provide a brief overview of the key contents of Chapter 3.

- Biodiesel could penetrate the same markets and be handled by the same distribution system as petroleum products.
- In Canada, three major corporations (Imperial Oil, Petro-Canada and Shell) have activities from coast to coast. Eight regional refiner-marketers represent the remaining larger distributors. There are also approximately 120 independent marketers offering petroleum products under their own brand. The market share of independents varies greatly from region to region. Independents are rare in the West and more common in Eastern Canada.
- In Canada, there are now 19 Canadian refineries producing distillates and about 70 primary terminals (also called “product terminals”) generally located near major markets and transportation modes. Some regions have a single primary terminal supplying all distributors; product exchange agreements are a common practice. Products and procedures are standardized all over the country.
- In upstream distribution, the choice of transportation mode (pipeline, rail car, tanker truck or marine tanker) largely depends on volume and geographic factors and varies region to region. Infrastructure and equipment also varies according to the regional needs and constraints.
- The mode of transportation between primary terminal and secondary terminals is mostly truck or rail.
- There are many hundreds of secondary terminals in Canada. A secondary terminal may represent a modest facility with a few small tanks or larger facilities could have both small and large tanks.
- Blending is generally done by in-line injection at the primary terminals; in-tank and splash blending are the blending techniques used at the secondary terminals.
- Distillates do not require heated equipment (for storage or blending) at any terminal level.
- From secondary terminal, product is generally moved by tanker truck to retail outlets and direct delivery to end-users.
- Within the Canadian petroleum industry there are currently varying degrees of interest regarding biodiesel. Many independent marketers have demonstrated an interest in the biofuel and has assumed up to now a lead role in biodiesel distribution.
- With some exceptions, the major petroleum companies have not yet shown a commitment to participate in the biodiesel distribution infrastructure.
To ensure that the biodiesel distribution infrastructure is sustainable and effective, it must be built on a solid foundation by offering a high-quality product and by taking all necessary measures to guarantee that quality is maintained. It must also take into account the features that biodiesel shares with distillates while adapting to the differences between the two products, primarily with respect to its solvent features and its conditions for use in cold weather. Chapter 4 presents the standards in effect, outlines the biodiesel characteristics that affect quality and recommends best practices for ensuring that quality is maintained at all stages of the distribution process. The impact biodiesel has on the choice of a mode of transportation is also studied in detail.

4.1 QUALITY STANDARDS FOR DIESEL FUELS AND BIODIESEL

To introduce biodiesel effectively into the distribution infrastructure in place, we must be able to offer the same quality guarantees as those that exist in the petroleum industry. Quality is a petroleum industry-wide issue and is part of doing business. In fact, industry players have agreed to adopt strict standards enacted by recognized standardization bodies and they voluntarily apply them throughout the country. It is due to this practice of self-regulation adopted by petroleum companies that, regardless of where they are in Canada and regardless of the season, consumers are guaranteed a standard, high-quality oil product. It is understandable that the petroleum industry is hesitant about introducing any new products that could potentially compromise its credibility with respect to quality standards. As a result, the main standardizing bodies have developed specific standards for biodiesel.

Drafted to ensure that the use of biodiesel would not affect engines and ignition systems designed to run with diesel fuel, these standards are essential for improving confidence in this new product and for increasing its credibility as a viable renewable fuel alternative.

At the moment, standards in effect in Canada with respect to its solvent features and its conditions for use in cold weather. Chapter 4 presents the standards in effect, outlines the biodiesel characteristics that affect quality and recommends best practices for ensuring that quality is maintained at all stages of the distribution process. The impact biodiesel has on the choice of a mode of transportation is also studied in detail.

For its part, ASTM D6751 is the standard specification for biodiesel. It applies to pure biodiesel (B100) as a blend stock designed for blends. Although ASTM D6751 does not specify a blend percentage level, only blends of up to 20% in volume with diesel fuel (B20) have been considered by Original Engine Manufacturers (OEM’s) and Fuel Injection Equipment (FIE) manufacturers.

**CANADIAN GENERAL STANDARD BOARD (CGSB)** is a fuel standardization body who addresses the needs of Canadian refiners, engine manufacturers and Canadian consumers. The goal is to design fuel standards which meet the best compromise between competing interests, providing fuels that satisfy customers’ applications, comply with environmental regulations, and can be produced in sufficient volume at a reasonable cost.

- The CAN/CGSB 3.517 standard for Automotive Low Sulphur Diesel (LSD) Fuel is similar to ASTM D975 in many respects, differing primarily in lubricity requirements due to in part a different refinery crude diet relative to the USA and different cold flow specifications due to different seasonal conditions in Canada. CAN/CGSB 3.6 is the standard for Regular Sulphur Diesel (RSD) Fuel.
- The CGSB made a conscious decision to not develop a separate B100 biodiesel standard for Canada. The decision was rather to reference the ASTM D6751 within the CGSB biodiesel blend standard CAN/CGSB 3.520, for Automotive Low Sulphur Diesel Fuel Containing Low Levels of Biodiesel (B1-B5) Fuels. This standard sets the same technical specifications as CAN/CGSB 3.517 with the addition that the biodiesel component must comply with ASTM D6751 or European EN 14214 standard. This approach was taken because at the time when the CGSB CAN/CGSB 3.520 standard was developed there was not yet a specification for oxidation stability in ASTM D6751. The inclusion of EN 14214 was left in CAN/CGSB 3.520 as an alternate specification for the biodiesel component of the blend for commercial reasons.
- A proposed CAN/CGSB 3.522 for B6-B20 biodiesel fuels standard has been developed but not yet balloted successfully. Fuel to this proposed standard would be restricted to “knowledgeable buyers” such as fleets and not offered for sale to the general public. The proposed standard has been deferred until the incorporation of a specification at ASTM D6751 has been addressed.
Current, there are no specific CGSB standards for biodiesel used in home heating oil. It is possible that the high demand in Eastern Canada (Quebec and Atlantic Canada), could create the demand for biodiesel blends in this field. This could lead the way for the need for a B1 to B5 biodiesel blends in heating oil.

In the past few years, reports of quality problems have damaged the credibility of biodiesel. In all cases, the product did not comply with quality standards. Therefore, these problems could have been avoided. This is why a general consensus is emerging in the industry to ensure that all biodiesel in Canada meets ASTM D6751 for pure biodiesel (B100) and CAN/CGSB 3.520 for low biodiesel blends (B1-B5). But it is not the role of standardization bodies to enforce the standards, simply to set them. There is no federal or legislative body that can prevent biodiesel which does not meet these standards from being sold into the marketplace in Canada. Given this context, what can be done to ensure that, in the future, the market will demand products that meet these specifications and accept nothing less? The means to accomplish this is through some of the specific avenues of the Assessment study shown below in Section 4.5 – Compliance Issues.

4.2 IMPACT OF LOW TEMPERATURE / COLD WEATHER HANDLING PROPERTIES ON BIODIESEL QUALITY

Certain temperature conditions can have an effect on the quality and integrity of a fuel at every stage of the distribution process (storage, blending and transportation). This is certainly true for diesel and even more so for biodiesel. In fact, given the properties of biodiesel, careful attention must be paid when dealing with the product in cold weather climates. It is extremely important that users be familiar with the cold weather properties of both biodiesel and the generic diesel intended for blending before handling the fuels.

Cloud point is the temperature, during cooling, at which wax crystals first form in the fuel. Wax crystals create a visible haze. These crystals can plug fuel filters in diesel engines. Without heating aids on the fuel filter and fuel lines, the cloud point limits the low temperature operability of a diesel fuel.

Diesel Fuel

To ensure that wax crystals do not form in the diesel fuel during cold weather, petroleum companies adjust diesel features throughout the year. In the winter, Canadian petroleum refiners supply seasonally adjusted blends of diesel fuel to various regions of Canada. These adjustments are based on historical temperature data and on data concerning the region in which the fuel is to be sold (Winter Design Temperature [WDT]). The cloud point of the material must be known and must meet the requirements for the region in which it will be used, based on the 2.5% mean low temperatures for particular months and regions in Canada. CAN/CGSB standards 3.517, 3.520 and 3.6 contain seasonal specifications for cold-flow properties such as cloud point.

Biodiesel

The same precautions taken with diesel fuel can be used to ensure trouble-free operations with biodiesel. Traditional cold weather solutions for diesel work well with biodiesel with the exception of commercial cold-flow additives. Although some additive suppliers claim to have products that work with biodiesel, it is more likely that these products impact the generic diesel or heating oil cold-flow characteristics and not the neat biodiesel.

A key issue for cold weather performance in Canada is that B1-B5 biodiesel blends sold for on-road use within Canada must meet all of the specifications for CAN/CGSB 3.520, including cloud point. These low temperature requirements mean that diesel fuels and low blends of biodiesel must be suitable for low temperature operations under virtually all normal winter conditions.

B100 solidifies/freezes at higher temperatures than conventional diesel fuels. Operators must take this into account if they are handling, using or storing B100. Most B100 begins to cloud between -3 and 15°C. This clouding will lead to sedimentation that could plug lines and filters. Heated, insulated tanks, lines, and pumps may be needed even in moderate climates for storage of B100. The viscosity of B100 begins to rise dramatically as it begins to gel. Viscosity rises to levels much higher than most diesel fuel. This can cause increased stress on pumping equipment.

How can these problems be anticipated and how can the “mixability” of the two products and the quality of the result once the blend is made be verified quickly and in advance?

In general, it has been found that cloud point or LTFT (Low Temperature Flow Test) are better indicators of operability limits. The LTFT is a test which takes 24 hours, and is therefore impractical. In many cases, the CFPP (Cold Filter Plugging Point) tends to overestimate the operability of B100 and B20 blend. The cloud point is therefore the most widely accepted measure of cold weather operability limits.

17 For this section, most of the information comes from the A Fleet Managers Guide for the Handling, Receipt and Storage of Biodiesel Fuel – Version 1, 2005 available on the CRFA (greenfuels.ca) web site.
More typical cloud point ranges are found in the following Figure 9. Typical cloud points for biodiesel will vary based on the feedstock from which they were derived:

<table>
<thead>
<tr>
<th>B100 Biodiesel Fuel</th>
<th>Cloud Point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soy Methyl Ester</td>
<td>-3 to 2</td>
</tr>
<tr>
<td>Canola Methyl Ester</td>
<td>-5 to 0</td>
</tr>
<tr>
<td>Tallow Methyl Ester</td>
<td>10 to 20</td>
</tr>
<tr>
<td>Yellow Grease Methyl Ester</td>
<td>5 to 15</td>
</tr>
</tbody>
</table>

On average, a B5 biodiesel blend will warm the cloud point by 3 to 5°C19. In general, a B20 blend will impact the finished fuel’s cold weather operational temperatures by 7 to 12°C. The actual warming of the cloud point is dependent upon the cloud point of the biodiesel fuel and that of the diesel fuel. B20 has enjoyed a successful track record when these basic instructions are adhered to.

**Pour Point** is the lowest temperature at which a diesel fuel will flow, and is usually a few degrees below the cloud point. This can be relevant to the minimum delivery temperature for a diesel fuel, especially a biodiesel fuel blend.

**Impact of Cold Weather Biodiesel Properties in Storage and Transport of B100**20

B100 must be stored in underground tanks or in insulated heated tanks, pipes and pumping equipment during the winter months. It should be stored at temperatures at least 6°C higher than the cloud point. Generally, storage temperatures of 10 to 13°C are acceptable for most B100 fuels, although some B100 fuels may require higher storage temperatures. These temperature requirements make most underground storage facilities adequate, but above-ground fuel systems, depending on the climate, should be protected with insulation, agitation, heating systems and other methods. These precautions should also be taken with piping, tanks, pumping equipment, vehicles or any other equipment used for the storage of the fuel.

B100 must be transported in insulated heated tanks during the winter months. In some cases, the product can be heated only once it has reached its destination, as in the case of terminals equipped with vapour heating systems.

### 4.3 IMPACT OF BLENDING TECHNIQUES ON BIODIESEL QUALITY

As noted at the beginning of this chapter, compliance with quality standards is essential for the successful integration of biodiesel in the petroleum product distribution channel. The properties of this biofuel (in particular its cloud point) make it sensitive to Canada’s winter climate. As a result, particular care must be taken at every step of the distribution of the product and in particular during fuel blending operations.

In certain conditions, the blending technique chosen can significantly influence quality. Therefore, whereas some techniques may guarantee that product quality is maintained, others will depend more on the prevailing conditions during the blending phase and on compliance by operators with industry-recommended procedures and best practices.

#### 4.3.1 Blending Techniques

The market has grown for biodiesel and biodiesel blends. This has increased the need for information on options and associated cost for biodiesel blending. Due to a lack of infrastructure for biodiesel blending in Canada, much of the blending has been in the form of less favourable blending techniques such as on-site or splash blending. The precursor to deciding a blending strategy is to determine the distribution market for the biodiesel blends. The market volume will at least in part determine the economic viability of the various blending options. It is also important to note that the blends should now be prepared further up the distribution chain and no longer on the site of the end-user.
However, other factors in addition to the distribution volume which will determine the most viable blending options include blend level, tankage, space availability, and overall equipment costs.

There are three main options for biodiesel blending at a terminal location:

1. **Splash Blending (Figure 10)**

   Splash blending is an operation where the biodiesel and diesel fuel are loaded into a vessel separately with relatively little mixing occurring as the fuels are placed in the vessel. The vessel is usually an individual vehicle fuel tank or a fuel delivery truck. Blending fuel in a drum or a tote is not recommended and is not splash blending. In some cases the approach is taken that because biodiesel is heavier than diesel, biodiesel should be introduced first (1), followed by diesel (2). Given the volumes, this practice allows for an initial product blending. This is not recommended. In the case of splash blending of gasoline and ethanol, the ethanol is blended on top of the gasoline. Ethanol is lighter in density than gasoline. The reason for adding in this order is not density related, but to maximize fuel contact and improve mixing through agitation. The other issue with adding the biodiesel into the vessel first is of particular concern in the winter months. Biodiesel has a higher cloud point than petroleum diesel. Therefore introducing biodiesel into a cold steel or aluminium vessel could result in solidification of the biodiesel, making the proper mixing and homogeneous mixture more difficult to attain. Therefore, the recommended practice is to add the biodiesel on top of the diesel fuel. Once the fuels are in the vessel, driving down the road is regarded as sufficient agitation to allow the biodiesel and diesel fuel to become thoroughly mixed. Usually this approach is successful, but on occasion difficulties in mixing can be encountered if the biodiesel is loaded into the vessel first under very cold temperature conditions. The blend level being mixed also has a bearing on the success of splash blending. At higher blend levels such as B20 splash blending will have a lower chance of successful mixing and attaining a homogeneous fuel mixture unless the delivery is a long route with frequent stops or sufficient movements to cause sufficient agitation. The other issue with high blends such as B20 using splash blending is of concern during the winter months. The cold petroleum diesel can act as a “cold sink” and if it is at or colder than the cloud point of the B100, the biodiesel must be warmed sufficiently to overcome that and ensure proper mixing and a resulting homogeneous mixture. **Sequential blending** is really just splash blending with accurately metered pumps, and may include some additional block valves. Splash blending or sequential blending is the least intrusive and least expensive to add to an existing terminal infrastructure. It is basically a matter of adding a new product to a loading lane at the truck terminal facility. The ultimate result enables a terminal operator to load multiple products at one loading position or at different rack positions through different loading arms.

   *Note:* Currently, splash blending is the most common blending technique in Canada (particularly by distributors and end-users that make their own blends). It is a simple and flexible technique that can be used with any type of terminal. However, splash blending can potentially be problematic in cold temperatures. In addition, the homogeneity of the blend is not ideal in certain conditions. Due to its limitations, this technique is therefore the least recommended in the context of developing a wide distribution infrastructure that is integrated into the normal petroleum product distribution network.

2. **In-Tank Blending (Figure 11)**

   In-tank blending is where the biodiesel and diesel fuel are loaded separately where agitation is involved, or, at the same time through different incoming sources, but at a high enough fill rate that the fuels are sufficiently mixed without the need for additional mixing, recirculation, or agitation. In some cases this is similar to splash blending but without the need to drive up and down the road. In other cases, the tank may need to be recirculated or further mixed in order to get the two fuels thoroughly blended. Since biodiesel and diesel fuel mix easily and completely, in-tank blending is sufficient to get a homogeneous blend in many cases, depending on the exact means of adding the fuel, the tank geometry, etc. However, it is rare for terminal distillate storage tanks to have mixers. Unless it is known for certain that the tank contains mixers and that they are of sufficient velocity to obtain a homogeneous mixture, the practice of filling both products into the tank at the same time should be employed. The other issue with large blends such as B20 using in-tank blending is of concern during the winter months. The cold petroleum diesel can act as a “cold sink” and if it is at or colder than the cloud point of the B100, the biodiesel must be warmed sufficiently to overcome that and ensure proper mixing and a resulting homogeneous mixture.

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21. 2004 – Biodiesel Handling and Use Guidelines, USDOE.
3. In-Line Blending (Figure 12)

In-line blending is where the biodiesel is added to a stream of diesel fuel as it travels through a pipe or hose in such a way that the biodiesel and diesel fuel become thoroughly mixed by the turbulent movement through the pipe—or by the mixing that occurs once the fuel is loaded into its receiving vessel. The biodiesel is added slowly and continuously into the moving stream of diesel fuel via a smaller line inserted or “Y” in a larger pipe, or the biodiesel can be added in small slug or pulsed quantities spread evenly throughout the time the fuel is being loaded. This is similar to the way most additives are blended into diesel fuel today and is most commonly used at pipeline terminals and racks. In some cases, distributors who carry B100 and diesel fuel in separate compartments and blend the two as they are loading into a customer’s tank also use this method.

Note: Even in cold temperatures, this blend technique is the safest way of producing a biodiesel blend on the transport truck loading rack. It also allows for maximum blend homogeneity. In-line blends are typically carried out at injection blending facilities, i.e. more often than not in primary terminals. This type of equipment is not found in most secondary terminals given that they generally distribute only finished and pre-blended products. It is the most recommended technique in the context of developing a wide distribution infrastructure that is integrated into the normal petroleum product distribution network.

Each method of blending and its required blending infrastructure has many positives and negatives. The choice of strategy must be based on the needs of the terminal operator or the distributor, the goals of the operation, and the constraints of the budget.

4.3.2 Cold Weather Biodiesel Properties Regarding Blending Techniques

Cold weather Biodiesel properties are critical to the blending regardless which blending option is employed. Biodiesel has a pour point of from -4 to 13°C—depending on the biodiesel fuel—and it therefore may require heating to ensure flow prior to being introduced into the generic distillate portion of biodiesel blend. Once the biodiesel is blended into the generic distillate, the cold-flow performance of the finished product may be impacted between 2 to 3°C for a B2 blend, and 3 to 5°C for a B5 biodiesel blend. This cloud-point warming is dependent upon the diesel fuel’s characteristics and its cloud point, and the cloud point of the biodiesel fuel. The warming of the cloud point will be more pronounced with a B20 blend, and again will be dependent upon the cloud points of the diesel fuel and the biodiesel. The lower the winter operability temperatures for the generic distillate that is intend to blend the biodiesel with, the more reliable the blended fuel will be for winter operability.

Based on “Biodiesel Cold Weather Blending Study”, it was determined that the recommended temperature for the biodiesel that is to be blended with cold diesel is a minimum of 6°C above the actual cloud point of the biodiesel being used for in-line blending. Since soy methyl ester, yellow grease and tallow each have different cloud points this target temperature will need to be determined on an individual basis (see Table 6, p. 21). It will be important for blenders to request the Certificate of Analysis (COA) from suppliers for cold weather considerations.

For splash blending the rule of thumb for B100 blending temperature is 21°C. This is because there is more surface contact with the colder diesel fuel relative to the smaller point of contact with in-line blending. There has not been a study to determine the optimum temperature for splash blending. This is one of the recommendations from the consultations sessions that such a study be done. It is also important to know the optimum temperature or temperature differential between the biodiesel and the diesel fuel in order to ensure effective mixing in splash blending. This will be dependent upon the cloud point temperatures of the two fuels and also on the blend level of the biodiesel blend.

As mentioned the desulphurization process reduces the aromatics content in ULSD relative to LSD. Aromatic components have favourable cloud point properties. Consequently, refiners are more constrained for favourable cloud point materials (particularly in Western Canada in January and February) and thus will be blending closer to the limit for the seasonal cloud point specifications for the relative regions in Canada.

Note: This blending technique is more often used for storing blends in tanks in order to supply the loading racks with finished products (B2, B5 or B20). It can also be used to directly fill a transport truck or other types of transportation tanks. In general, tanks with a product recirculation system are not found in secondary terminals. In addition, this technique should be limited to primary terminals interested in storing biodiesel blends rather than B100.

**Table 6**
What that means for biodiesel blending is that it will potentially leave less “cloud point room” to accommodate biodiesel blends for some diesel fuels for some regions. This can be overcome by oil refiners blending the diesel fuel to accommodate the warmer biodiesel cloud point. The other option is for the refiners to seek a biodiesel produced from a feedstock which as a more favourable cloud point. In either case, this is a decision which will be made by the refiners based on the economics and the specific variables involved. If it is secondary blenders or independent petroleum distributors involved, the variables will be different (as they will have no control over the refinery cloud point specifications). However, it will still be determined by the economics of those variables.

4.3.3 Biodiesel Blending Infrastructure Considerations

At the loading rack, there will not be a good, single method to select for blending the complete range from B2 to B100. It is a combination of utilizing current assets and building additional infrastructure which will both fit the needs and the budget of the distribution facility. To begin, it is important to select the blending option that meets the needs and is supported by the existing equipment. In many cases, new or modified equipment will need to be added at the terminal. This will need to be taken into account when assessing infrastructure needs and costs.

Blending Flow Rates

To accommodate B2 to B5 biodiesel blends with product flow rates of 2,000 litres per minute (LPM) it is important to ensure that the pump and supply line will handle the demand of the total volume for all load arms with sufficient pressure. Blend ratios in this range will require a larger injection point typically a 2-inch opening. Consideration must also be given to the power requirements for the larger motors needed for this blending ratio.

To distribute B2 to B5 biodiesel blends with a product flow of 2,000 LPM, it requires a meter and valve rated for 45 LPM minimum, while B5 will require a 110 LPM system. These ranges are achievable with the current high capacity meter based injectors found in many terminals nationwide. High capacity meter based injectors will allow accurate control and metering of up to 5% blending.

Blending biodiesel in ratios of 10% and above requires a higher level of biodiesel blending infrastructure. B10 and above will be more invasive as it pertains to the physical space required by this equipment, but this blend percentage will be achieved by using sequential blending, with or without automation, or preset ratio blending using automation only.

In sequential blending, products are basically loaded one product at a time and can use the same meter for both products—biodiesel and diesel fuel. Both products can also use one common control valve but a block valve for each product will be necessary.

4.4 OTHER BIODIESEL TECHNICAL CONSIDERATIONS

To support rising market demand, biodiesel must be distributed on a larger scale, more efficiently and at a lower cost — ideally through the same infrastructure that exists for petroleum products. However, successful integration of this biofuel requires that the unique specifications and properties of biodiesel be taken into account in relation to storage, blending and transportation. These unique qualities are associated with specific infrastructure requirements or practices — especially for B100. This will be addressed below.

4.4.1 Materials Compatibility

Pure biodiesel (B100) is not compatible with certain materials. This crucial information must be taken into account at every step of the distribution process. The configuration of the tanks, pipes and pumps is in fact critical for maintaining the integrity of the product. It is therefore important to ensure that all equipment used for storing, blending and transporting the product is compatible. An assessment of the nature of the materials must be carried out before any B100 is introduced.

B100 may degrade some hoses, gaskets, seals, elastomers, glues and plastics with prolonged exposure. Natural or nitrile rubber compounds, polypropylene, polyvinyl, and Tygon materials are particularly vulnerable. B100 permeates some plastics typically used in petroleum applications. More testing is being done to extend this list of vulnerable materials.

B100 is also not compatible with certain metals (copper, brass, bronze, zinc, lead, tin). Prolonged contact with these metals may catalyze the oxidation process of biodiesel, creating fuel sediments or gels and salts. Lead solders and zinc linings should be avoided, as should copper pipes, brass regulators, and copper fittings.

In general, the most recent equipment (after 1993) is already equipped with biodiesel resistant material such as Viton, Teflon and Nylon. Acceptable storage tank materials include aluminium, steel, fluorinated polyethylene, fluorinated polypropylene, Teflon, and most fibreglass materials. These materials have very little reaction to biodiesel and are among the materials that can be used to update incompatible equipment.

23 For this section, most of the information comes from the A Fleet Managers Guide for the Handling, Receipt and Storage of Biodiesel Fuel – Version 1, 2005 and from the 2004 – Biodiesel Handling and Use Guidelines, USDOE. Both documents are available on the CRFA (greenfuels.ca) web site.
Biodiesel blends of 20% or less have shown a much smaller effect on materials. The effects are virtually non-existent in low-level blends such as B2. When handling blends of B20 or less, normal monitoring of hoses and gaskets for leaks is sufficient. Blends of B20 and lower also reduce the impact of metal compatibility issues.

4.4.2 Solvency / Cleaning Effect

Biodiesel is comprised of methyl esters. Methyl esters are mild solvents and have been used as low volatile organic-compound cleaners for years. Thus, B100 has a stronger solvent effect than petroleum products. This is another feature of biodiesel fuel that must be taken into account at every step of the distribution process. Biodiesel will remove water, rust, gums, and other contaminants in many systems. Therefore, B100 may dissolve or dislodge the accumulated sediments in diesel storage tanks, pipes, fuelling systems and engine fuel tanks. Dissolved or dislodged sediments left over time by hydrocarbon fuels and base oils can plug fuel filters and cause fuel injector failure. It is highly recommended that existing tanks, transfer and fuel systems should be cleaned, dried, and inspected prior to introducing B100 into the tank. If this recommendation is impractical or impossible, it is important to expect the possibility of some filter clogging and more frequent filter changes until the system has been cleaned of old sediments. Once the system is cleaned, the filter change interval should return to normal intervals.

These effects are greatly reduced or eliminated in blends of 20% or less (B5 and B2). Additional unscheduled filter changes have been reported in less than 2% of the cases when biodiesel blends less than 20% are first introduced. There have been no reports of additional filter changes with the use of B2. Tank maintenance and storage is crucial in all cases. However, this issue is vital for those organizations planning on using diesel fuel or heating oil tanks with years of accumulated sediment (tank bottoms).

In some cases, the cleaning effect or solvency of B100 has been confused with gums and sediments that could form over time in storage as fuel ages. It should also be noted that this solvent effect should diminish after the second load. Tests of the acid number and the viscosity should be performed to determine the cause of the sediment. If these numbers are within ASTM specifications, the sediment is most likely the result of the solvency of B100.

4.4.3 Excess Air

One aspect that should be monitored, particularly during the storage of biodiesel, is the presence of air. As a fuel tank is emptied, air will enter through the vent pipes to displace the fuel in the tank. The excess air in the tank may lead to increased oxidation, particulate contamination, and increased water levels. These contaminants affect both the stability and quality of the fuel. In order to limit the effects of air in the tanks, it is recommended that fuel handlers do not store fuels for long periods of time in partially empty tanks without stabilizers. Additionally, one may consider desiccant filters on vents to reduce moisture and particulate contamination (dirt).

4.4.4 Product Contamination

Proper storage and transport practices may significantly reduce the possibility of biodiesel contamination.

Water

It is important to store biodiesel (especially B100) in an environment, free from water to avoid the possibility of contamination or oxidation. Biodiesel is susceptible to water-related problems. Desiccant filters on breathing vents will greatly reduce condensation in the tank and are highly recommended. Sump drains are recommended where practical.

Both free and entrained water accelerate corrosion and fuel degradation. Free water may enter bulk fuel tanks via condensation, carry-over from the fuel distribution system or leakage through the fill cap, spill containment valve or piping. In addition to accelerated breakdown of the fuel product, water also creates a fertile growing environment for microbial contamination. Microbial activity, surfactants, alcohols, particulates, and poorly designed additives may be the cause of entrained water problems. Poor tank design can make complete removal of water nearly impossible, and therefore, it is important to take steps to prevent water entrance.

Microbial Contamination

Biocides are recommended for conventional and biodiesel fuels wherever biological growth in the fuel has been a problem. If biological contamination is a problem, water and sediment contamination must be controlled. The preferred approach, however, is simply a good tank cleanliness program.

4.4.5 Stability (Long Term Storage)

Thermal stability presents no more of a concern to biodiesel distributors and users. Oxidative stability, however, does pose some additional concerns relative to petroleum diesel. Biodiesel distributors should be aware of the oxidation stability of the B100 used to make the blended fuel. In biodiesel, poor stability can lead to high acid numbers, high viscosity, and the formation of gums and sediments that clog filters. If these numbers exceed the limits in ASTM D6751, the biodiesel is degraded beyond specification and should not be used. Comparing B100’s acid number and viscosity over time can provide insight on the oxidation of the fuel in storage. Sampling should be done upon receipt of the fuel, and periodically during storage, to ensure that the fuel meets specifications. Storage life and the stability of biodiesel are contingent on the biodiesel being stored properly.
4.4.6 Personal, Safety, and Operating Procedures

Biodiesel is still a widely unknown product. To promote its introduction into the petroleum product distribution network, it is important to familiarize the personnel involved (terminal, transport, blending operations) with this fuel and with any new equipment and its operation. This information will be company-, terminal-, and equipment-specific. Additionally, any new or modified company procedure such as accounting changes should be addressed. Safety and firefighting information should be covered and Material Safety Data Sheets (MSDS) should be posted or issued to each employee.

Information on the proper procedures for receiving biodiesel should be thoroughly covered, including instructions for properly unloading rail cars and tanker trucks of biodiesel. Procedures for receiving marine shipments should be covered if applicable.

4.5 COMPLIANCE ISSUES

Whether pure or blended, biodiesel must meet specific quality standards established by competent authorities to ensure optimal and safe use. The distribution infrastructure set up for biodiesel must take these standards into account and take adequate measures to comply with them at all steps in the process.

4.5.1 Testing and Laboratory Accreditation

The biodiesel that enters the distribution system must comply with the quality standards in place. One way of ensuring this is to conduct regular laboratory trials (tests) on biodiesel samples. However, some laboratories that are equipped to carry out tests on traditional fuels do not always have the necessary experience to conduct tests on methyl esters. For this reason, it is important to confirm that the performance of testing facilities and instruments used by these laboratories meets accepted standards for biodiesel. It is also important to verify that their testing activities, procedures and test results are complete, reproducible and verifiable. To do so, efforts for the near future could be to provide accreditation to testing laboratories by a respected accreditation body.

There is no lab proficiency qualification per se in the petroleum industry. The Canadian refineries use the Alberta Research Council (ARC) monthly cross check program as a measure of proficiency. This is self-regulated program for the industry, but can be customer-driven, and in some cases incorporated into refinery lab ISO programs. The most practical means of attaining proficiency for biodiesel testing labs is to be part of the ARC or ASTM biodiesel testing cross check programs. It is the responsibility of the testing labs to demonstrate proficiency. It is recommended that those seeking a biodiesel testing lab inquire about the performance of that lab in either the ARC or ASTM biodiesel testing cross check programs and where they score relative to other labs.

It is the responsibility of the individual labs to perform the training necessary to be proficient in all test methods in ASTM D6751 if they test biodiesel fuel.

4.5.2 BQ-9000 Accreditation Program

Quality assurance for biodiesel in all concentrations is essential at all industry levels. Biodiesel which is introduced into the petroleum distribution system in Canada must meet the same high standards of quality presently employed by the petroleum producers in Canada. That means that quality of B100 and the blended fuel must be ensured. To do so, it is important to provide a mechanism to track biodiesel in the distribution system, identify biodiesel which meets industry standards, and provide a means to reduce the probability of product reaching the marketplace which does not meet ASTM D6751. The expectation of the Canadian petroleum companies is that Certificate of Analysis (COA) will accompany each batch of biodiesel produced and that it will in all cases meet ASTM D6751 specification. It is also important to find a way to avoid redundant testing throughout the production and distribution system. One such means of ensuring this is the BQ-9000 quality program developed by the National Biodiesel Accreditation Commission (NBAC), a distinct entity, but is under the auspices of the National Biodiesel Board (NBB).

BQ-9000 does consist of a cooperative and voluntary program for the accreditation of producers and marketers of biodiesel. The purpose of this program is to maintain quality throughout the marketing and distribution chain. It was born out of desire to instil consumer and engine manufacturer confidence in the production and distribution of biodiesel and biodiesel blends. Standards and quality assurance programs will facilitate acceptance of biodiesel use by OEM’s (safe and optimal performance of engines). For that reason, many OEM’s have endorsed the BQ-9000 Program. Major OEM’s and Fuel Injection Equipment (FIE) manufacturers have made positive B5 warranty statements, but only few of them for B20. Many (most) OEM’s are currently testing B20 blends. BQ-9000 is a unique combination of the ASTM standard for biodiesel, ASTM D6751, and a quality systems program that includes storage, sampling, testing, blending, shipping, distribution, and
4.6 TRANSPORTATION MODE REQUIREMENTS OR ADAPTATIONS AND LOGISTICS

There are several basic modes of transportation that could be used for successfully transporting biodiesel (B100) or blends to destination markets. These include truck, rail, barge, tanker, and pipeline, and in some cases, a combination of two or more modes. In addition, as the market expands, product exchanges and marketing agreements will be used to minimize unnecessary biodiesel transportation and associated costs. Also, the preferred transportation mode depends on a number of variables including the size of the shipment, the shipping plants capability, the receipt capabilities and storage capacity at the destination terminal, and other operational factors. However as a general rule, larger quantities are generally moved by the mode that requires the least number of individual movements. Depending of the transportation mode utilized, it may also be necessary to make terminal modifications to accommodate receipt of biodiesel product (e.g. rail spur, tanker truck unloading). These are discussed briefly below.

4.6.1 By Pipeline

Because of operational considerations and specific challenges, B100 and biodiesel blends are not currently transported via pipeline in Canada. However, the pipeline is considered to be the most economical mode of transportation for petroleum products and as a result, it is widely used in Canada for long-distance shipments between refineries and primary and secondary terminals, particularly in Western Canada.

Shipment of biodiesel by pipeline in the future remains a remote possibility. In view of the superior solvent properties of biodiesel, there are concerns that shipments of B100 or high blends (B20) would pick up contaminants in the pipeline resulting in contaminated biodiesel at the end shipment. As well, lubricity additives/products can disarm the coalescers in jet-fuel filters which is a concern to the aviation fuel community. A possible solution would require that pipeline segments undergo some form of preparatory cleaning to effectively remove the build up of lacquers, gums and other deposits in the lines. However, even with this cleaning, access to pipelines is limited to certain regions and volumes transported by pipeline relative to other petroleum shipments would likely remain small.

Until satisfactory solutions can be found for the potential cross-contamination problems, biodiesel, even in its weakest concentrations (B1 to B5 blends), cannot be transported via pipeline. This situation could limit access to biodiesel in certain regions in the country (primarily for the Western provinces).

In some cases, pipeline transportation could be used – with dedicated and heated equipment – to ship B100 between a biodiesel production plant and a nearby primary terminal.

Pipeline adaptation or installation costs related to the transportation of biodiesel have yet to be assessed based on the options selected.

4.6.2 By Rail Car

Biodiesel (B100) could move by rail from the biodiesel production plant to destination terminals (mainly primary terminals or, in some cases, secondary terminals equipped with rail spurs). Rail shipment is generally the most cost effective delivery method for medium and longer range distance destinations, incapable of receiving product by barge or marine tanker (i.e. 500 to 5,000 km). In certain regions of Canada, the rail lines are limited and access varies from province to province. In addition, several terminals, in particular those supplied by pipeline in Western Canada, do not have rail receipt capability.

As a result, biodiesel is limited to truck transportation in certain regions given that the product cannot be transported via pipeline.

24. For more details about this program, please refer to their web site: bq-9000.org.
25. When biodiesel (or renewable diesel) can be produced through the refining process (2nd or 3rd generation processes) used by petroleum companies, it will have the same properties as fossil fuels and should therefore be able to be easily transported via pipeline.
This is a key point. In general, rail is more extensive in Alberta and Saskatchewan compared with other provinces. Manitoba and Ontario have rail lines in mostly the southern part of the province. In British Columbia, the rail lines are concentrated in the eastern and southern part of the province. In the Atlantic Provinces rail lines are limited. As mentioned, the fact that existing petroleum distribution terminals do not have rail access is a distribution and infrastructure problem. Existing petroleum distribution facilities were designed with pipeline distribution as the primary product receipt. In more remote or smaller petroleum distribution terminals product receipts were designed around truck receipt and delivery. This in many cases makes rail ineffective as a transportation mode for receipt of B100 or distribution of the blended product.

Actually, shipments in Canada are typically as small as one rail car\(^26\) or two at a time but with the development of the industry, this volume could increase significantly. The properties of B100 require dedicated rail cars or wash certificates between loads. In cold weather, the transportation of B100 also requires heated rail cars or a vapour heating system at terminal level.

Because of the number of units and smaller volume per unit as well as the labour-intensive efforts for cargo unloading and inspection, rail shipments do require more effort compared with tankers for example. The transportation of biodiesel via train also requires more complex logistics (availability of heated or dedicated rail cars, delays due to cleaning rail cars in the case of non-dedicated rail cars or heating rail cars at the terminal, etc.). In some cases, installing heating systems or rail spurs adds to the terminal adaptation costs.

There are different types of rail cars in use in Canada. Rail cars in current use have a capacity of approximately 100,000 litres or 70,000 litres (for a smaller size version).

<table>
<thead>
<tr>
<th>Table 9 – Equipment and Cost Considerations – For Rail Car</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail car: 500 barrels (79,500 litres)</td>
</tr>
<tr>
<td>A 2,000,000 litres tank will accommodate 23 to 24 rail cars.</td>
</tr>
<tr>
<td>Cleaning cost per rail car: $500</td>
</tr>
<tr>
<td>Terminal – Rail receipt capabilities:</td>
</tr>
<tr>
<td>– Cost of rail spurs: $100 to $150 per track foot</td>
</tr>
<tr>
<td>– Total cost for rail spur per terminal: $400,000 to $600,000</td>
</tr>
</tbody>
</table>

**4.6.3 By Marine Tanker**

Shipping large volumes of B100 may be done via small or large tankers for longer range distance marine destinations (i.e. up to 500 km). The shipments could be as small as one compartment of a small Canadian tanker (~10 M litre capacity) or as large as an entire oceanic tanker (30 to 40 M litre capacity). For the same reasons as for rail, pipeline or truck shipments, the equipment used must be dedicated (or previously cleaned) and adequately heated. In Canada, this mode of transportation is utilized mostly in the St. Lawrence Seaway Corridor. However, with an increase in biodiesel production in the country, this mode of transportation could become a feasible option in some regions, particularly in Québec, the Atlantic Provinces and Ontario, where biodiesel could be shipped via the St. Lawrence Seaway.

The cost of moving biodiesel by tanker does not present major economic incentives over rail. The main benefit of marine cargoes is for the destination terminal which in many cases prefers single shipments of large quantities as opposed to the more time consuming task of spotting, inspecting, testing product quality and unloading numerous rail cars. Additionally, this reduces strain on the biodiesel producers rail car fleets.

<table>
<thead>
<tr>
<th>Table 10 – Equipment and Cost Considerations – For Marine Tanker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barge: 27,000 to 50,000 barrels (5.5 to 10.5 M litres)</td>
</tr>
<tr>
<td>Small Tanker (Canadian Fleet): 60,000 barrels (8.54 M litres)</td>
</tr>
<tr>
<td>Ocean Tanker: from 187,000 to 250,000 barrels (30 to 40 M litres) –</td>
</tr>
<tr>
<td>1 compartment 50,000 barrels (8 M litres)</td>
</tr>
<tr>
<td>Cleaning cost of one compartment: $25,000</td>
</tr>
</tbody>
</table>

| 4.6.4 By Tanker Truck |

For short term distances (i.e. under 500 km) tanker truck is usually the most efficient and cost effective delivery mode. Tanker trucks are the same ones seen delivering gasoline or diesel to the local service station. They haul typically 29,500 to 31,000 litres (average ~30,000 litres) of product. Some delivery trucks (for heating oil) are smaller with a capacity of ~18,000 litres.

In some cases, a tanker truck picks up B100 directly from the production plant to near terminals. In distant markets, tanker trucks may also pick up B100 or blends at primary terminals that have received biodiesel by tanker) or rail, and deliver to secondary terminals that either cannot take product other than by truck or that have insufficient tankage for larger quantity delivery. The redistribution of biodiesel blends to retails outlets and end-users is also made by trucks.

Tanker trucks used to deliver B100 must be totally or partially dedicated to biodiesel (separate compartments). Otherwise, they must be cleaned between each product change. In cold weather, heated equipment must be used when shipping B100. Truck shipments of blends up to B5 do not require specific conditions.

<table>
<thead>
<tr>
<th>Table 11 – Equipment and Cost Considerations – For Tanker Truck</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanker Truck: 45,000 litres</td>
</tr>
<tr>
<td>Delivery Truck: 18,000 litres</td>
</tr>
<tr>
<td>Cost for a heating system for transport truck: $4,000</td>
</tr>
<tr>
<td>Cleaning cost for a transport truck: $300</td>
</tr>
</tbody>
</table>

26. Rail cars in current use have a capacity of approximately 100,000 litres or 70,000 litres (for a smaller size version).
4.6.5 Operational and Logistic Considerations

**Dedicated Equipment**

Transport of B100 should preferably use dedicated equipment (rail car, truck, barge or compartment). In the case where it is not possible equipment should be cleaned or washed (providing a wash certificate) each time prior to being used. Transport of blends does not necessitate the use of dedicated equipment, but deliveries should be accompanied with a wash certificate in order to avoid cross contamination of products.

**Shipping and Operating Costs**

Biodiesel (B100) has been up to now priced on a destination market basis (local or regional rack price + premium) or FOB at the producer’s plant, for that reason most of the time the cost of the shipment is paid by the biodiesel marketers. Even if the shipping logistic is managed by biodiesel producers or biofuels marketers, they will try to utilize the lowest cost shipping method available within the confines of shipping capabilities and customer preferences. A cost comparison of the various modes of transportation is presented as a guide in Table 12.

<table>
<thead>
<tr>
<th>Transportation Mode</th>
<th>Shipping Distance</th>
<th>Quantity Ship</th>
<th>Price per litre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanker Truck</td>
<td>&lt; 100 km</td>
<td>45,000 litres</td>
<td>0.3 to 0.6 ¢</td>
</tr>
<tr>
<td>Tanker Truck</td>
<td>100 &lt; 250 km</td>
<td>45,000 litres</td>
<td>1.2 to 1.5 ¢</td>
</tr>
<tr>
<td>Tanker Truck</td>
<td>250 &lt; 500 km</td>
<td>45,000 litres</td>
<td>3.0 to 3.8 ¢</td>
</tr>
<tr>
<td>Rail car</td>
<td>500 &lt; 5,000 km</td>
<td>80,000 litres</td>
<td>3.0 to 5.0 ¢</td>
</tr>
<tr>
<td>Barge</td>
<td>No Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small tanker (Canadian) On the St-Lawrence River</td>
<td>250 &lt; 500 km</td>
<td>60,000 barrels (~10 M litres)</td>
<td>0.8 to 1.2 ¢</td>
</tr>
<tr>
<td>Small tanker (Canadian) On the St-Lawrence Seaway</td>
<td>500 &lt; 1,300 km</td>
<td>60,000 barrels (~10 M litres)</td>
<td>2.2 to 2.7 ¢</td>
</tr>
<tr>
<td>Small Oceanic Tanker</td>
<td>5,000 &lt; 10,000 km</td>
<td>80,000 barrels (~10 M litres)</td>
<td>2.5 to 2.9 ¢</td>
</tr>
<tr>
<td>Pipeline</td>
<td>No Data</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.7 HIGHLIGHTS REGARDING QUALITY ASSURANCE, TECHNICAL CONSIDERATIONS AND TRANSPORTATION MODES

The following provide a brief overview of the key contents of Chapter 4:

**Quality Assurance**

- There is consensus throughout the industry that all biodiesel in Canada must meet ASTM D6751 for pure biodiesel (B100) and CAN/CGSB 3.520 for low blends (B1-85).
- CAN/CGSB B6-B20 standard is on hold waiting for ASTM standard.
- There are no specific CGSB standards for biodiesel used in home heating oil.
- Given the properties of biodiesel, careful attention must be paid when dealing with the product in cold weather climates. These properties can have an effect on maintaining quality at every step of the distribution process (storage, blending, and transportation).
- The blending technique chosen (in-line blending, in-tank blending, splash blending and sequential blending) can also have a significant impact on whether quality is maintained at every step of the distribution process. Cold weather biodiesel properties are critical to the blending regardless of which blending option is employed. The technique of in-line injection blending is more recommended than other techniques in cold weather.
- Blending should not occur at end-users’ locations.

**Compliance Issues**

- The biodiesel that enters the distribution system must comply with the quality standards in place. One way of ensuring this is to conduct regular laboratory trials (tests) on biodiesel samples.
- Another way of ensuring that quality standards are respected is to adopt the BQ-9000, a cooperative and voluntary program for the accreditation of producers and marketers of biodiesel. The purpose of this program is to maintain quality throughout the marketing and distribution chain.

**Technical Considerations**

- Storage, blending and transport of B100 or blends, whether in primary or secondary terminals or between the different locations, require compliance with specific conditions:
Storage of Pure Biodiesel (B100)
- B100 is typically stored separately in a clean and dry environment, free from water and light to avoid the possibility of contamination or oxidation.
- The composition of storage tanks, pipes, pumping equipment and blending systems are critical in maintaining the integrity of the biodiesel. Certain materials are not compatible.
- B100 should not be stored for a period beyond six months. Longer-term storage is feasible with the use of appropriate fuel additives.
- B100 must be stored in underground tanks or in insulated and heated tanks, pipes and pumping equipment during the winter months (based on the regional temperature and the cloud point of the biodiesel produced). B100 should be stored at temperatures at least 6°C higher than the cloud point. Generally, storage temperatures of 10 to 13°C are acceptable for most B100 fuels, although some B100 fuels may require higher storage temperatures.
- Dedicated storage tanks will be needed for storage of B100. In many cases this will necessitate the addition of new storage tanks as in most cases existing tanks will be fully utilized.
- If an existing tank is changed to accommodate B100 storage, it must be cleaned and flushed prior to use.
- Storage of B100 in the winter months in Canada will require heat tracing on the tanks.
- The tank design and infrastructure costs will need to include electrical tracing as in most cases steam tracing will not be a readily accessible utility.
- Storage tank peripheral equipment such as seals will need to be made of compatible materials.

Biodiesel Blending
- Blending activities should now be prepared further up the distribution chain and no longer on the site of the end-user.
- The market volume as well as blend level, tankage, space availability, and overall equipment costs will determine the economic viability of the various blending options.
- Currently, splash blending is the most common blending technique in Canada. However, splash blending can potentially be problematic in cold temperatures.
- In-tank blending should be limited to primary terminals interested in storing biodiesel blends rather than B100.
- Even in cold temperatures, in-line blending is the safest way of producing a biodiesel blend on the transport truck loading rack.
- The recommended temperature for the biodiesel that is to be blended with cold diesel is a minimum of 6°C above the actual cloud point of the biodiesel being used for in-line blending.
- For splash blending the rule of thumb for B100 blending temperature is 21°C. There has not been a study to determine the optimum temperature for that technique.

Transport of Pure Biodiesel (B100)
- There are several basic modes of transportation that could be used for transporting biodiesel (B100) or blends to destination markets. These include tanker truck, rail car and marine tanker. B100 and biodiesel blends are not currently transported via pipeline in Canada.
- The tanks in the vehicles used to transport B100 must be made of compatible materials (aluminium, carbon steel, or stainless steel). Hoses and seals must also be compatible.
- Tanks used to deliver B100 must be totally or partially dedicated (separate compartments). Otherwise, proper inspection and washout of transport are needed. Hoses and seals must also be properly cleaned.
- To avoid any contamination of the biodiesel, there must be no residual water present during transportation.
- It is important to check previous load carried and residual. Food products or raw vegetable oil, gasoline, and lubricants are not acceptable residuals for the transportation of B100.
- During winter months, isolated and heated equipment must be used when shipping B100. In some cases, a vapour heating system could be used at the terminal level.
The biodiesel industry is still at the infancy stage and must work actively to create the demand needed to generate sufficient critical mass and ensure its development. It is not within the scope of this Assessment study to make recommendations about how to increase demand or about the government measures that should be taken to support and promote the industry during this transitional phase. That is up to government and industry. However, it is clear that the development of the biodiesel distribution infrastructure depends heavily on these crucial factors. The federal RFS plan to include a minimum biofuel content requirement (ethanol and biodiesel) for all fuel sold in Canada for on-road applications by 2010 for ethanol and no later than 2012 for renewable diesel will impact the development of the distribution infrastructure differently than if the market evolves solely based on growing demand.

In addition, it is difficult to determine how Canadian petroleum companies will manage the introduction of a new product such as biodiesel in the context of increased pressure on terminals once transition to 500 ppm diesel for off-road is introduced in 2007 and then to 15 ppm in 2010 commences. It is also too early to predict the geographic scope of the biodiesel market in Canada or to understand which niche markets (on-road or off-road applications) will be favoured in the country.

Therefore, it is unknown at the moment how and at what rate the industry will develop in the coming years. There are too many factors involved. Only one thing is certain—the industry will need to be supported by a distribution infrastructure. As we have seen, introducing biodiesel in the petroleum product distribution infrastructure will mean adapting the infrastructure that is currently in place. Depending on the biodiesel volumes involved, the industry will most likely require assistance in carrying out the adaptation. The use of certain incentives designed specifically for distribution, based on the U.S. models of the Blender’s Credit or a tax credit for infrastructure development (15 to 25%), is an option that could possibly be assessed in the near future in Canada.

5.1 TWO SIMPLE SCENARIOS FOR CHARTING THE COURSE

Given that it is impossible to generalize about the required adaptations and overall costs for the entire country, the Assessment study has developed two scenarios (see Figure 13 on next page) that provide an idea regarding the route that biodiesel could—or should—take in the current distribution infrastructure.

These scenarios would therefore replace the temporary, costly and non-adapted solutions, especially for storing and transporting B100. Providing indications and a cost estimate for the facilities at a typical Canadian terminal (whether primary or secondary) will enable petroleum companies and distributors throughout Canada to determine the gap between their current infrastructure and the adaptations required for biodiesel. All players will therefore be able to choose the scenario that best meets their needs while reflecting the realities of their region and target market. They will also be able to make the investment decisions needed to meet their requirements.

The scenarios can be described as follows:

**Scenario 1** – The best practice in a mature market would involve storing B100 in primary terminals with all the necessary equipment (dedicated, insulated and heated tanks, fuel in-line injection blending systems). This is the best way of ensuring maximum quality control of the product. The entire downstream distribution process, including secondary terminals, would only be concerned with biodiesel.

**Scenario 2** – In regions where access to primary terminals is limited or even impossible, B100 could be stored in secondary terminals, which would require all necessary equipment (dedicated, insulated and heated tanks and, if possible, the addition of fuel in-line injection blending systems). In this scenario, biodiesel blends would be prepared at the secondary terminal rack before being transported to retail outlets.

These scenarios are based on the following claims:

- That B5 biodiesel will likely become the basic blend in Canada throughout the year and for all types of usage;
- That B20 will remain a specialty blend, available on a seasonal basis only and for knowledgeable users (vehicle fleet managers, etc.) who own their own storage facilities;
- That biodiesel sold in Canada must comply with quality standards (ASTM and CGSB) during the entire distribution process;
- That the in-line blending technique is the best technique for guaranteeing product quality;
- That all infrastructure designed for B100 (transport, storage and blending) must be dedicated, insulated and heated.
Figure 13 – Proposed Distribution Infrastructure for Biodiesel and Biodiesel Blends in Canada

Biodiesel Production

Biodiesel Imports

Biodiesel Plant

Upstream Distribution

Refinery Plant

Primary Terminal

Rack

Secondary Terminal

Rack

Or

End-Users

Home & Commercial Heating (Bioheat)

Small Power Generation Installations

Transport Off-Road Clients with their own installation

Transport On-Road Clients with their own installation

Transport On-Road Retail Customers

Retail Customers

Gas Stations

Card Locks

* May use the same four transportation modes as shown above.
5.1.1 Description of Scenario 1 – B100 at Primary Terminals

In this scenario, the route taken by pure biodiesel (B100) from the production plant to the primary terminals can potentially be carried out by all modes of transportation available in the industry (truck, ship, rail car and even pipeline in some cases) as long as the equipment used (transportation tanks, loading racks, pipes and pumping equipment) is dedicated, insulated and heated. If access to heated transportation tanks is impossible, a system will be needed to heat the shipment at destination.

If the B100 must be transported between a primary terminal located near a refinery and another primary terminal, the same modes of transportation and conditions will apply although it is unlikely that a pipeline would be used or built for that purpose.

As is the case for petroleum products, choosing a mode of transportation always depends on the distance between the production plant and the primary terminals, the volumes transported and the type of infrastructure available at the destination (delivery rack, delivery frequency, tank size, etc.).

Once in the primary terminals, the B100 must be stored in tanks that are dedicated, insulated and heated. Tanks must be of sufficient size to meet not only necessary demand but to receive the minimum tender size while still having an adequate working inventory. Sizing storage tanks and controlling the cold weather handling characteristics of biodiesel represent the majority of the installation costs.

Several terminals already have tanks, in-line blending systems for preparing blends at the rack and equipment that can be reassigned for biodiesel. However, in some cases, the equipment must be adapted. Costs for converting currently existing tankage and equipment was estimated to cost 25-30% of the cost of installing new tanks. This number would include a heating system, filter changes, tank insulation, proper cleaning and preparation, etc.

Some primary terminals that are already functioning at full capacity must build new biodiesel-adapted tanks and equipment.

In this scenario, the B100 is blended with the diesel by injection before being transported in its blended form (B5 or B20) to secondary terminals or retail outlets (service stations, card locks, users with their own storage facilities). At this stage, the modes of transportation used no longer have to be insulated and heated. However, it is strongly recommended that the tanks or compartments used for transportation be cleaned and reserved solely for biodiesel. Transportation via pipeline could eventually be possible between primary and secondary terminals, but only for very weak concentrations of biodiesel (B1 or B2). Most biodiesel blends would be transported to retail outlets by truck.

Storing blends at secondary terminals does not require specific conditions in cold weather. However, petroleum companies may not have enough tanks for the new product, particularly if they wish to offer it in several concentrations (B5 and B20). As a result, their only option will be to build new tanks.

In both scenarios, the costs related to possible modifications to be made to the biodiesel delivery infrastructure (product delivery rack by tanker truck, marine tanker, rail car and pipeline) should be also assessed. Petroleum companies or secondary distribution companies will choose the mode of transportation for transporting biodiesel to the terminals based on the existing delivery infrastructure at each terminal.

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27. Given adequate volume, there is no reason why a dedicated, heated and insulated pipeline could not be installed between a production plant and a primary terminal located nearby.
5.1.2 Description of Scenario 2 – B100 at Secondary Terminals

In this scenario (see Figure 13), pure biodiesel (B100) is transported directly from the production plant to the secondary terminals without first passing through a primary terminal. B100 must always be transported using dedicated, insulated and heated equipment, regardless of the mode of transportation used (truck, ship, train and pipeline in some cases\(^{28}\)). Storing B100 at the secondary level is subject to the same requirements (dedicated, heated and insulated equipment) as those that apply for primary terminals, with the possible exception of the size of the tanks, which could be smaller based on the volumes and markets involved. As is the case for scenario 1, investments can be made at the secondary level to convert the existing tanks to B100 (25-30% of the cost of installing new tanks, including a heating system, filter changes, tank insulation, proper cleaning and preparation, etc.).

In this scenario, B100 is blended at the rack and then delivered in various concentrations (B5-B20) to the retail outlets (service stations and users with their own storage tanks). At this stage, the modes of transportation used no longer need to be insulated and heated. However, it is strongly recommended that the tanks or compartments used for transportation be cleaned and reserved solely for biodiesel. Most biodiesel blends will be transported to retail outlets by truck.

5.2 ASSESSMENT STUDY RECOMMENDATIONS

The comments and concerns expressed during the regional workshops provided the opportunity to further examine the main challenges associated with biodiesel distribution in Canada, as well as to develop a strategy and options within the framework of a distribution infrastructure Assessment study. While the workshops touched on issues ranging from feedstock supply to the end-user, the Assessment study focuses on recommendations that impact distribution directly. Consequently, considerations regarding biodiesel production, tax measures and other forms of incentives (discussed earlier in the document) are not addressed.

The Assessment study presents a series of basic recommendations which can be applied in a general sense — regardless of region or end-use market. These recommendations are based on the fundamental principal that in order to ensure successful development of the industry, biodiesel must meet quality standards and product integrity must be maintained throughout the distribution chain — from the biodiesel producer to the final user.

It is critical that equipment used for storage, blending and transport (whether upstream or downstream) is adapted to the unique product characteristics of biodiesel. The various players involved in the distribution process must have access to reliable technical information and guidelines as well as adequate training.

The Assessment study recommendations, as well as supporting activities designed to ensure effective results, are presented below.

5.2.1 Quality Assurance and Compliance Issues

- **All biodiesel in Canada must meet ASTM D6751 for pure biodiesel (B100)**
  It is incumbent upon biodiesel producers to join ASTM and know the latest specifications for meeting ASTM D6751. This will be expected and demanded by Canadian refiners who blend biodiesel with their petrodiesel.

- **Promote understanding and use of the ASTM D6751 standard at all levels of distribution**
  It needs to be understood the reason behind the testing requirements for the ASTM D6751 testing parameters so that its importance will drive the need for meeting this standard. The specification was driven and developed by OEM’s and FIe manufacturers. Education needs to be done to drive home this importance, so that the end result is that the market will demand product which meets the D6751 specification and will accept nothing less. The CRFA is in full support of this and will be a conduit for getting this message out.

- **Develop relevant laboratory training programs**
  NRCan has already initiated a Biodiesel Proficiency Program for laboratory training. The National Biodiesel Board (NBB) has initiated some laboratory training workshops in different parts of the USA. This may be something which either through the NBB or NRCan can be further expanded into Canada.

\(^{28}\) Given adequate volume, there is no reason why a dedicated, heated and insulated pipeline could not be installed between a production plant and a secondary terminal located nearby.
Develop proficiency testing programs for labs. Encourage labs to participate in these programs.

The Alberta Research Council (ARC) through NRCan has initiated a biodiesel testing proficiency program. ASTM has also a Biodiesel Cross Check Program for biodiesel lab testing proficiency. This is presently being run twice per year. The frequency will be increased to quarterly. The BO-9000 program is in the process of bringing BO-9000 Accredited Labs into the program. The details and mechanism of that are still under development by the National Biodiesel Accreditation Commission (NBAC).

Testing of biodiesel blends

Testing of biodiesel blends needs to be done at some frequency especially for cloud point. This is more critical for blends higher than B5, as the cloud point impacts will be greater at higher blends.

Educate terminal managers and fuel marketers to demand that a Certificate of Analysis (COA) is provided for every finished batch of B100.

In petroleum refining a COA is issued before the product leaves the terminal gates. This same mindset and expectation needs to be adopted and transferred in biodiesel produced. The CRFA is in full support of this and will be a conduit for getting this message out.

Promote understanding and use of standards at all levels of distribution for biodiesel blends using CGSB standards

Ethanol blends are tested on bench blends by refineries for ethanol gasoline blends. This same mindset must be transferred to biodiesel blends, in particular to ensure that the seasonal cloud point specifications are met. The B1–B5 blends must be ensured to meet the CAN/CGSB 3.520 specification. The education of this need is the first step. CRFA is in full support of this and will be a conduit for getting this message out.

Develop CGSB specifications for the heating oil market

Although this was raised at the Assessment study regional workshops, there is no industry demand to move this forward in CGSB at this time. There was a ballot in the spring of 2007 in ASTM to bring B5 biodiesel blend into ASTM D396, which is the home heating oil specification. Once this is successfully balloted and incorporated, it should expedite the formation of a CGSB B1–B5 specification for home heating oil.

BO-9000 needs to be applied consistently throughout the industry

This will need to be a multifaceted approach. To promote understanding and use of BO-9000 at all levels of distribution. This will involve promotion of the merits of the BO-9000 quality program, and the fact that a quality program to ensure product quality through the marketing chain will save money and maximize uptime. The CRFA is in full support of this and will be a conduit for getting this message out.

Educate the end-users to include the BO-9000 requirement in RFP documents. The other way to drive product quality is through the customer. One of the ways of accomplishing this is to include BO-9000 as a requirement in RFP (Request for Proposal) documents and tenders.

5.2.2 Storage of Biodiesel

Dedicated tanks should be used for the storage of B100

Dedicated storage tanks will be needed for storage of B100. In many cases this will necessitate the addition of new storage tanks as in most cases existing tanks will be utilized. If an existing tank is changed to accommodate B100 storage, it must be cleaned and flushed prior to use.

Storage of B100 in the winter months in Canada will require heat tracing off the line

The tank design and infrastructure costs will need to include electrical tracing as in most cases steam tracing will not be a readily accessible utility.

Storage tank peripheral equipment such as seals will need to be made of compatible materials

The sample handling guide will provide guidance on materials compatibility for seals.

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5.2.3 Biodiesel Blending

- **The preferred means of biodiesel blending is conducted at primary terminals using in-line injection blending equipment**
  The most efficient blending technique is in-line blending using injection equipment set up at primary distribution terminals. However, it is also the most costly in terms of infrastructure costs.

- **Splash blending at primary or secondary terminals is less costly option for biodiesel blends but puts the product integrity at risk**
  Splash blending may be done at terminals if done properly. Accurate metering is important. Also, information on proper splash blending practices is needed. There is much misinformation about proper splash blending techniques.

- **Provide access to testing tools to determine on-site blending ratios**
  There is a proposed test method under development in ASTM for blend level testing in both lab and field test instruments. The NBB is also looking into other field test kits which thus far have not shown promise.

- **Conduct further research regarding cold weather blending practices**
  The cold weather blending best practices study done to date was for in-line blending. There is a need to do a study on splash-blending to determine best practices. Biodiesel temperature for splash blending needs to be included, as part of this study. The guidance provided in the study referenced above was for in-line blending whereby the contact of cold diesel is small and the effects on blending are minimized. However, in the case of splash blending there is a large “cold sink” of diesel fuel during winter blending. A study needs to be conducted to provide guidance for the differential temperatures in the biodiesel and diesel fuel for splash blending to ensure a homogeneous mixture, and also not burden utility costs in tank heating unduly.

5.2.4 Transportation of Biodiesel

- **Further examine pipeline transportation issues (research)**
  The expectation is that pipeline delivery of B100 will not be an option. In terms of pipeline delivery of low blends, the expectation is that pipeline delivery is at best a long term proposition in Canada.

- **Dedicated equipment should be used for the transportation of B100**
  Where possible, dedicated tanker trucks and rail cars should be used to transport B100. If that is not possible or practical, wash certificates should accompany the B100 delivery.

- **Refer to B100 transportation guidelines**
  The Fleet Managers Guide and Biodiesel Handling and Use Guidelines already referenced in this document are good resources and should be referenced by those transporting B100. The BQ-9000 quality program provides guidance and checks and balances for helping to ensure that the quality is maintained in the delivery of the B100 product.

5.2.5 Technical Considerations

- **Build a knowledge infrastructure and create a common (neutral) repository for needed technical information**
  There is a need to create or consolidate a knowledge infrastructure of research and best practices for biodiesel. This exists in the NBB web site. However, it is vast accumulation of information. There is a desire to have an information storehouse which will be both easy to access, address key issues of biodiesel and be pertinent to the Canadian market and climate. This repository would become a single source of guidelines for handling, blending, converting infrastructure, retrofitting, etc. Investigate the best location (or locations) for this repository. This will need to be investigated. The logical choices are NRCan, CRFA or Biofleet groups’ web sites.

- **Document and disseminate case studies, promote best practices for handling and storage all the way through the distribution chain and provide end-user biodiesel information**
  Some of the information gathering and research such as case studies on handling and storage, and end-users handling use which is pertinent for inclusion in the information storehouse has been done and simply needs to be placed on the web sites.

- **Develop a series of fleet manager workshops on a national basis**
  This was also a recommendation at the infrastructure regional sessions. This could be Biofleet groups or associations promoting biodiesel use in fleets.

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30. Biodiesel Cold Weather Blending Study. A copy of this report is available on the NBB (nbb.org) web site.
5.3 TIPS FOR DEVELOPING A DISTRIBUTION INFRASTRUCTURE

The success of the biodiesel industry in Canada — and consequently, the development of the distribution infrastructure — depends largely on external factors, such as the government measures in place and the way in which the governments and industry create demand or build product awareness. Although this is beyond the scope of the Assessment study and formal recommendations cannot be made, we felt it would be useful to conclude this report with a few general tips regarding these key issues.

5.3.1 Government Measures: Incentives and By-laws

Incentives provided to support the development of the infrastructure are immensely helpful and necessary for the industry but they must not become a crutch. By-laws can be effective in creating significant volume, which will promote the development of the biodiesel production industry, but they do not necessarily help in creating demand, especially if the distribution infrastructure is not in place and the price of the product is higher.

Given this context, it is essential that incentives and tax measures help generate sufficient critical mass with respect to the production, distribution and use of biodiesel before thinking of imposing minimum quantities.

• Tip: Support the development of the biodiesel distribution infrastructure through government measures (incentives and by-laws) that are harmonized between the various provinces.

• Tip: Find a balance between the measures that will have an impact on increasing demand (e.g. tax rebates), those that will help boost product volume (e.g. a by-law defining a minimum content requirement) and those that support the development of the industry, both for biodiesel production (e.g. a tax credit for the producer, plant construction financing, etc.) and for developing the product distribution infrastructure throughout the entire country (e.g.: Blender’s Credit, a tax credit or accelerated depreciation for the construction of facilities, etc.).

• Tip: Eliminate or at least reduce complications in the regulation or authorization procedures that could interfere with (or even delay) the development of the distribution infrastructure.

5.3.2 The Need to Inform the Public and Educate Industry Players

Biodiesel is still quite new to the market and information going around about it, especially amongst the general public, is often contradictory. Biodiesel is often mistakenly equated with the use of pure cooking or vegetable oil as alternative fuels. Only a fuel meeting ASTM D6751 or EN 14214 specifications can be called “biodiesel”. In this context, information and education are crucial to promoting the development of the biodiesel industry in Canada.

• Tip: Reassure users and encourage them to buy the product. This is crucial given the intrinsic features of biodiesel (particularly with respect to the cloud point). Consumers must not be left wondering whether the product will work in their vehicle—they must be confident that it will. Once they have been reassured, the “green” aspect of biofuel and its positive impact on the environment and on climate change may appeal to consumers.

• Tip: The same work must be done with industry players. However, they must also be made aware of all the technical aspects of biodiesel (B100 and blends) and their impact on storage equipment, the production of blends, as well as on aspects related to transporting biodiesel and its use.

• Tip: Promote biodiesel as a high-performance, safe and responsible solution for encouraging sustainable development and reducing pollutant emissions and greenhouse gases.

5.3.3 Helping to Create Demand

The best way of contributing to the development of the biodiesel distribution infrastructure in Canada is by creating a demand for the product. To do so, the asking price must be competitive and users must be convinced of the product’s quality, effectiveness and safety… And if the price is appropriate (competitive), users will ask suppliers to provide the fuel. Standards will therefore be set by market conditions.

Until now, the burden of gaining access to biodiesel has tended to be placed on the users.

If the demand is created, the petroleum companies will follow!

• Tip: Provide an example by using biodiesel (from BQ-9000 accredited distributors) for all federal and provincial government departments and agencies.
The Assessment study proposes the most effective pathway to address the inherent challenges and obstacles in building a biodiesel distribution infrastructure in Canada. In particular, the Assessment study emphasizes the pivotal role of quality assurance and product integrity, as well as the importance of appropriate equipment and process. The next few years will prove to be a determining period for the Canadian industry as production capacity and end-markets continue to develop. However, regardless of the extent to which demand and industry will expand, the distribution infrastructure in place must respect the recommendations proposed by the Assessment study.

The success of the Assessment study will ultimately depend on the level of engagement of the various industry stakeholders (producers, distributors, government and users) and the extent to which they recognize and respect the Assessment study parameters.

**Next steps**

Despite the concern that a biodiesel distribution infrastructure is “premature” given the lack of critical mass in the Canadian market, the consultations held across the country clearly support the timeliness and need for the Assessment study. The consultation exercise enabled a more in-depth look at the current situation, but perhaps even more importantly, it brought together the different stakeholder groups – often for the first time. These individuals were given the opportunity to share their concerns and perspectives towards the common purpose of building a vision and strategy to develop a Canadian biodiesel industry.

The synergy and momentum generated by the Assessment study initiative should be maintained and further supported through ongoing opportunity for interaction while the industry continues to develop. The Assessment study represents a starting point. Immediate follow up is critical if the ultimate goal of developing a sustainable industry is to be achieved.
Appendices

Appendix A – Regional Workshop Participants
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Appendix C — Summary of the Consultation with Canadian Biodiesel Stakeholders

The summary of the concerns and issues raised by the participants are presented in the following table.

### 1 – Production of Biodiesel

**Key Questions**
- What type of distribution infrastructure is required to support the existing and expanded biodiesel production?
- How will scale of production impact distribution?
- How will the location of existing and new biodiesel producers impact the distribution infrastructure?
- How will the distribution infrastructure support biodiesel imports – exports?
- How will the biodiesel industry work with the petroleum industry?

**Stakeholders’ Comments and Concerns**
- Competitiveness and reliable access to quality supply are required pre-conditions for building a domestic biodiesel distribution industry.
- The petroleum companies must be on board in order to build a sustainable biodiesel distribution infrastructure. It is likely they will not embark in the short-term given their concerns with ULSD and in the medium-term given insufficient critical mass, especially for large integrated companies.
- There is no obvious conclusion regarding the scale at which a biodiesel plant becomes economically viable. Small scale plants will face the challenge of consistently meeting quality standards and bearing the cost of testing. There is no room for improvisation.

### 2 – Fuel Standards and Quality Assurance

**Key Questions**
- What issues can affect product quality?
- What are the key product quality parameters?
- What other things can affect product quality?
- What issues are there in the blending process that can affect quality?
- What issues are there in downstream distribution that can affect product quality?

**Stakeholders’ Comments and Concerns**
- BQ–9000 needs to be included in the tender process (RFP or RFQ) as part of a pull strategy (push strategy through standards).
- Critical mass will make testing more economically viable. Until then these costs can be prohibitive.
- There is a lack of data regarding ULSD and biodiesel (stability). However, this issue should be resolved by the end of the year.
- Currently there are no specific standards for biodiesel used in heating oil. This is particularly a potential issue in Eastern Canada (Quebec and Atlantic Canada).
- BQ–9000 needs to be included in the tender process (RFP or RFQ) as part of a pull strategy (push strategy through standards).

### 3 – Blending and Storage

**Key Questions**
- Is the current storage and blending infrastructure adequate to accommodate biodiesel?
- What storage requirements are there for biodiesel B100?
- Are there any material compatibility issues?
- What are the blending options for biodiesel blending?
- What are the infrastructure implications for various blending options?
- What are the additional storage requirements for biodiesel blends if any?
- What are the best practices regarding storage and blending at the end-user level?
- Are there any material compatibility issues to consider for downstream distribution and storage?

**Stakeholders’ Comments and Concerns**
- The current practice is splash blending by the distributor. Best practices need to be disseminated and adopted.
- The lack of support by the oil companies will largely influence the industry’s willingness to use biodiesel. If oil companies come on board, the infrastructure will likely consist of in-line injection blending at primary terminals. If the infrastructure is put in place by independents, although there may be some in-line injection blending, the market will likely be splash blending.
- The lack of incentive parity with the USA (i.e. U.S. Blender’s Credit) presents a major roadblock for blending practices in Canada – regardless of the type of blending technology used.
- Distributors are facing the challenge of educating and training their customers (end-users) who are not ready to accept biodiesel (handling and storage guidelines, tank maintenance, OEM’s warranties).
- There is general agreement that blending should not occur at the end-user and that blending will move further upstream (primary terminal) as the industry evolves.
- Investment costs become less significant further downstream when fuel marketers handle lower blends.
- Cold weather blending practices are critical. More understanding is required regarding the temperature at which biodiesel should be heated in order to splash blend for a proper mix. This is important to not increase utility cost unnecessarily.
- While a low-level blend (B2-B5) may be sold all year round, higher blends may meet a seasonal demand (e.g. B20 used in the agriculture sector or captive fleets).
## 4 – Transportation modes

**Key Questions**
- How will biodiesel tap into the existing diesel fuel transportation infrastructure (equipment)?
- What adjustments are required?
- Will biodiesel require dedicated equipment?

**Stakeholders’ Comments and Concerns**
- A dedicated system delivery is required for B100 to avoid contamination. There are material compatibility issues.
- To what extent is a dedicated transport system required for B20? This issue is not presently addressed by BQ–9000. What system needs to be in place to address this? Wash certificates?
- Solvency and possible cross-contamination with other products (i.e., jet-fuel) is a barrier to the longer-term opportunity of transporting biodiesel through pipelines.
- Heating coils in rail cars and trucks may be required, depending on the delivery circumstances (cold weather conditions over longer distance, extended waiting times, etc.)
- Not all primary terminal locations have rail spurs.

## 5 – Financial incentives, legislation, tax measures

**Key Questions**
- What role do financial incentives and legislation play in the distribution infrastructure?
- What is the potential impact of financial and legislative measures on the distribution infrastructure?
- Which measures have the most impact on distribution infrastructure?

**Stakeholders’ Comments and Concerns**
- “We need a ramp-up strategy for financial incentives to bridge the business challenge.”
- It will be important to seek a certain level of harmonization across Canada. This will only be accomplished with federal government leadership.
- The Canadian industry must become competitive. We need to seek parity with the USA.
- The objectives of Government are not clear: Do they want to develop a domestic production or reduce emissions?
- Incentive programs should be aimed at building critical mass in the short-term and need to be in place prior to considering introducing a mandate. Incentives should be reviewed on a regular basis.
- Necessary support measures may be needed to ensure a mandate is successful.

## 6 – Information and training

**Key Questions**
- What information and training programs need to be in-place to support the distribution infrastructure?
- What is needed for upstream distribution?
- What is needed for downstream distribution?
- What support is required for market development (end-users programs)?

**Stakeholders’ Comments and Concerns**
- Information and training programs are needed all the way through the distribution chain in terms of handling and storing biodiesel – best practices.
- Biodiesel knowledge exists. There is an already a solid base of learning and experience. However, information is fragmented and not always consistent. A single source is key to disseminating a consistent message. Messages (technical information) can sometimes be conflicting.
- There is an immediate need to address the ULSD issue (inform).
- Product understanding needs to be promoted. What is biodiesel?
- Basic level information needs to be disseminated on a national level. Education at end-use level (environmental concerns) could drive markets and government policy.
- Promote biodiesel to end-user markets. Build the demand.
- What is the information role of the existing organizations – Fleet Challenge Canada, Canadian Renewable Fuels Association (CRFA) and federal/provincial government departments, and agencies?
- “In order to be treated as an industry, we need to start acting as an industry.”
REFERENCES


Dr. Albert Chan, Assessment of the Environmental Performance and Sustainability of Biodiesel in Canada, Ottawa, National Research Council Canada, 2004, 414 p.


Levelton Engineering Ltd, Alternatives and Future Fuels and Energy Sources for Road Vehicles, Ottawa, Transportation Climate Change Table, 1999, 202 p.


Sine Nomine Group, BIOBUS – Biodiesel Demonstration and Assessment with the Société de transport de Montréal (STM), Montréal, Canadian Renewable Fuels Association, 2003, 62 p.


GUIDES AND HANDBOOKS


Appendix E – Acronyms and Glossary

ACRONYMS

¢/L Cent per litre
ARC Alberta Research Council
AST Above Storage Tank
ASTM American Society for Testing and Materials
B100 100% biodiesel
B2 2% biodiesel, 98% diesel fuel
B5 5% biodiesel, 95% diesel fuel
B20 20% biodiesel, 80% diesel fuel
CFPP Cold Filter Plugging Point
CGSB Canadian General Standard Board
COA Certificate of Analysis
CPPI Canadian Petroleum Products Institute
CRFA Canadian Renewable Fuels Association
FAME Fatty Acid Methyl Ester
FIE Fuel Injection Equipment
FOB Freight on Board
HC Hydrocarbon
ISO International Standard Organization
LTFT Low Temperature Flow Test
LPM Litre per Minute
LSD Low Sulphur Diesel
ME Methyl Esther
mg/kg Milligrams per kilogram
MSDS Material Safety Data Sheet
NBAC National Biodiesel Accreditation Commission
NBB National Biodiesel Board
NRCan Natural Resources Canada
NREL National Renewable Energy Laboratory
OEM Original Equipment Manufacturer
ppm Parts per million
RFP Request for Proposals
RFQ Request for Quotes
RSD Regular Sulphur Diesel
ULSD Ultra Low Sulphur Diesel
USEPA U.S. Environmental Protection Agency
USDOE U.S. Department of Energy
WDT Winter Design Temperature
GLOSSARY

**ASTM D6751**
It is the standard specification for biodiesel (B100) blend stock for distillate fuels developed by the ASTM International. ASTM D6751 was approved in 2001. It applies to biodiesel (B100) as a blend stock designed for blends.

**BQ-9000**
BQ-9000 is a quality program developed by the National Biodiesel Accreditation Commission (NBAC). It consists of a cooperative and voluntary program for the accreditation of producers and marketers of biodiesel. The purpose of this program is to maintain quality throughout the marketing and distribution chain. The program is a unique combination of the ASTM standard for biodiesel, ASTM D6751, and a quality systems program that includes storage, sampling, testing, blending, shipping, distribution, and fuel management practices. BQ-9000 has two levels of accreditation: **Accredited Producers** and **Certified Marketers**. The Canadian Renewable Fuels Association (CRFA) promotes the BQ-9000 program in Canada.

**Biodiesel**
For the purpose of this document refers to a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated B100, and meeting the requirements of ASTM D6751.

**CAN/CGSB 3.520**
It is the Canadian standard for low-sulphur diesel fuel with weak biodiesel blends (1 to 5% – B1 to B5) developed by the Canadian General Standard Board (CGSB). This standard sets the same technical specifications as CAN/CGSB 3.517 for low-sulphur diesel fuel in addition to those from the U.S. standard for pure biodiesel (ASTM D6751). A CGSB standard for blends up to B20 is being delayed until an oxidation stability specification has been included in ASTM D6751.

**Downstream Distribution**
In downstream distribution product is moved by pipeline, train, tanker or barge to secondary terminals or storage finished product terminals before it is moved to retail outlets and direct delivery to end-users. Retail outlets include gas and card lock stations.

**Infrastructure**
For the purpose of this document refers to the tools which are needed to take the pure biodiesel (B100) from the producer into the marketplace for distribution to the public. This includes the physical infrastructure for storage of the B100, the blending of the B100 into biodiesel blends (BXX) and the quality assurance and education infrastructure necessary to provide the marketplace with a quality fuel.

**Primary Terminal**
A primary terminal may be located at a refinery or as separate tank farms that receive products by pipeline, rail, marine tanker or tanker truck. It is generally equipped with storage and blending (primary injection blending) equipment, and with transport loading racks.

**Secondary Terminal**
A secondary or regional terminal is located close to the end-user market. Generally, only finish products are stored at that facility. It is used for storage and blending (primarily splash blending) of products to service retail outlets and end-users.

**Upstream Distribution**
By petroleum industry definition the upstream distribution includes crude oil gathering at the well head (for import in the East), crude oil storage, refinery processing, and the storage at the primary terminal.
ASSESSMENT OF THE BIODIESEL DISTRIBUTION INFRASTRUCTURE IN CANADA

August 2007