SUSTAINABILITY OF BIOMASS UTILIZATION

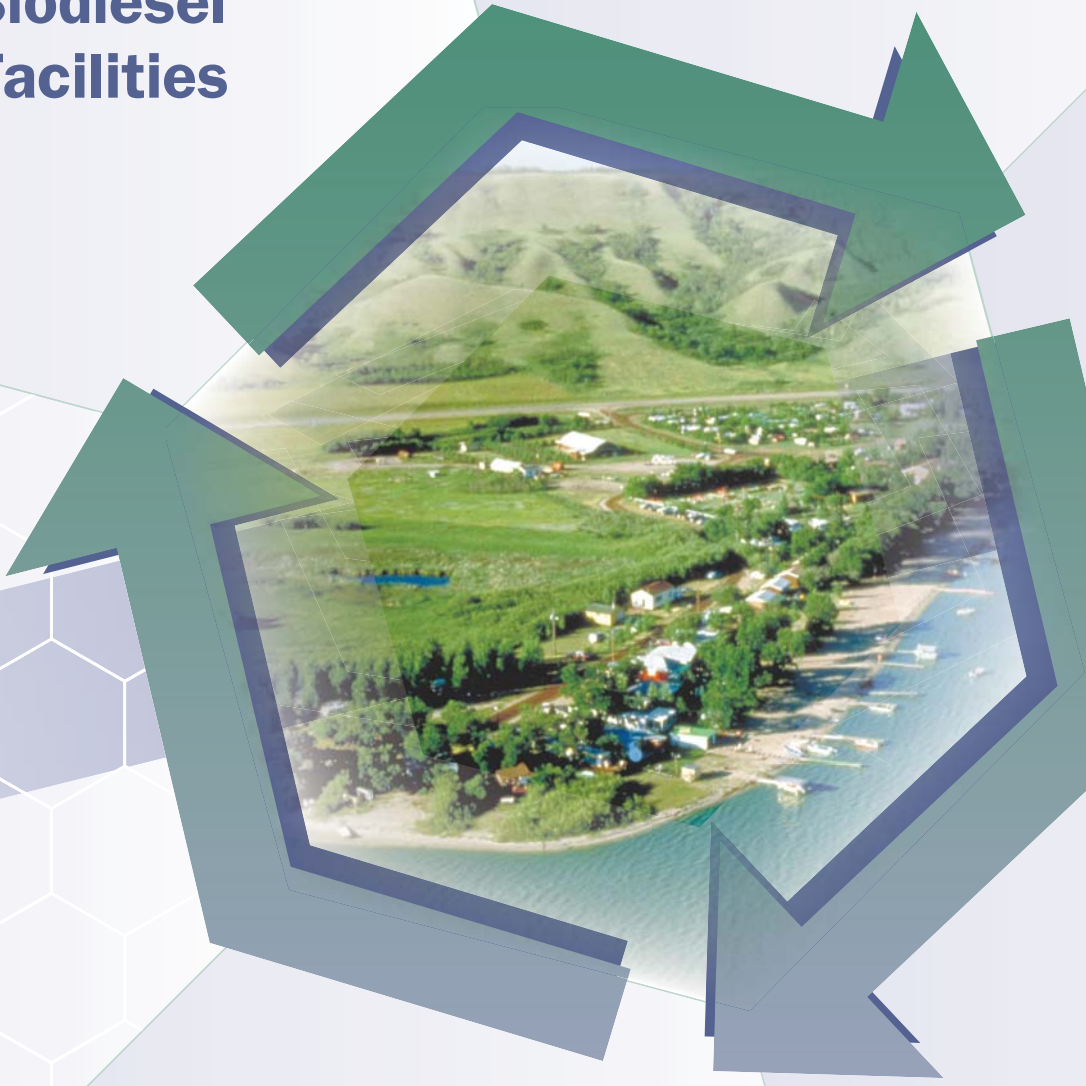
DRAFT SUMMARIES:

Anticipated Environmental Effects of Bioethanol Production from Lignocellulosic Waste Material

and

Criteria for Biodiesel Production Facilities

November 2005



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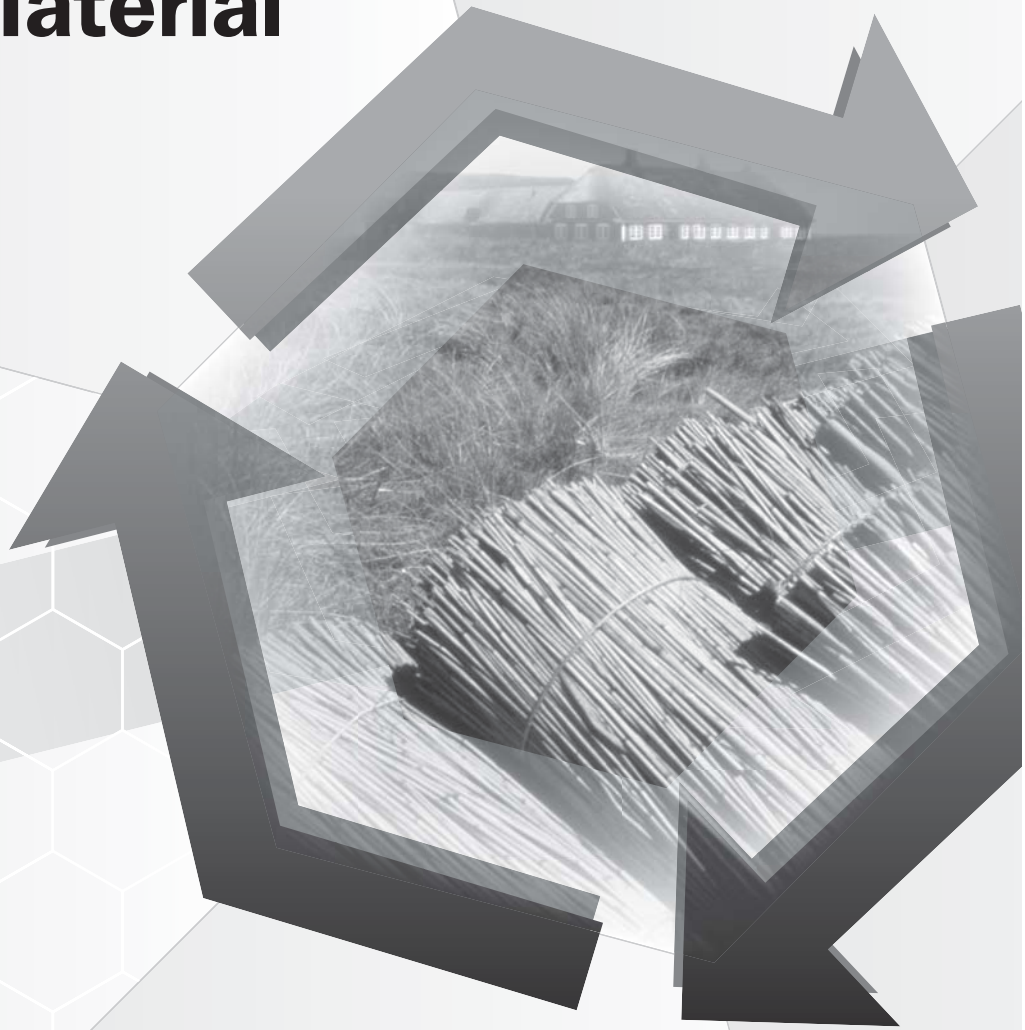

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Executive Summary

This Guideline Report examines the potential environmental, social, and economic effects of possible future bioethanol production in Canada. It is intended to assist government agencies in the review of future project proposals. Bioethanol is generally understood to be ethanol (fuel-grade alcohol) that is produced from lignocellulosic biomass material. Potential sources of biomass or feedstocks include agricultural residue (e.g. corn stover, wheat straw), forestry residue (e.g. wood chips), and municipal solid waste and energy crops (e.g. switchgrass). The focus of this report is on the use of agro-forestry waste materials. The cellulose and hemicellulose components of these materials contain sugars that can be converted to bioethanol.

Relatively large quantities of ethanol from starch-based feedstocks such as corn and sugarcane are currently produced in the world. However, at the time of this report preparation, there were no full-scale commercial operating bioethanol production facilities in the world, although several are planned.

The use of bioethanol as a blend with gasoline for vehicle use is considered to have several environmental benefits as described in this report, the key one being that bioethanol is cleaner burning (lower ground-level ozone-forming pollutants and reduced greenhouse gas emissions).

Canada has a considerable supply of potential biomass feedstocks for bioethanol production, the key ones being forestry waste, corn stover, and cereal grain straw. Although the estimated quantities of these materials vary, the amount of bioethanol that could be produced from these feedstocks has been estimated in previous studies to be in the range of 1000–2000 million litres per year for corn stover, 1700–6000 million litres per year for wheat straw, and 6300 million litres per year for forestry residues. Provinces with the greatest supplies of feedstock include Quebec (forestry residue and corn stover), Ontario (forestry residue, corn stover, and wheat straw), Manitoba and Saskatchewan (wheat straw), Alberta (forestry residue and wheat straw), and British Columbia (forestry residue).

As background information to understanding the potential effects from bioethanol production, this report provides an overview of the various technological processes that either are available or are being researched to convert biomass to bioethanol. The two key platforms include "biological/chemical" and "thermochemical." The former has received the most attention to date, and its key steps include pretreatment (through physical/chemical means to make the sugars more accessible), hydrolysis (the solubilization and conversion of the cellulose into sugars through the use of acid or enzymes), fermentation, and distillation.

Despite the fact that there are no full-scale commercial plants operating in the world today, bioethanol production has been researched for well over 100 years, with numerous pilot/demonstration-scale facilities in operation for various lengths of time. The report describes the activities and progress of various companies that are developing bioethanol production technologies/processes throughout the world. In preparing this report, attempts were made to contact all of these companies to receive updates on their progress. There are several companies that indicated that they have plans for full-scale production facilities in the near term.

The development and operation of bioethanol production facilities have the potential to result in environmental, social, and economic effects at all phases of the production processes, including:

- *Feedstock harvesting*: The collection of forestry and agricultural residue can affect soil nutrient levels, increase erosion rates, and affect wildlife habitat. There exists some debate as to how much residue can be collected without resulting in substantial adverse effects.
- *Feedstock transportation*: A production facility will require the delivery of a steady stream of feedstock to the site, likely by truck. A modest-sized facility (190 million litres per year) is estimated to require up to 148 trucks per day. Effects from truck traffic could be of concern to the local community.
- *Facility construction*: Construction effects would be similar to those for other industrial facilities, including footprint effects and noise/air quality disturbance effects to nearby receptors. For a modest-sized facility (190 million litres per year), about 3 ha of land would be required. More land might be required for long-term feedstock storage. Careful plant siting and the implementation of standard construction mitigation measures (e.g. for stormwater runoff) should reduce most of these effects.
- *Facility operation*: Key concerns related to the production phase include noise, air emissions (particulate matter, volatile organic compounds, nitrogen oxides, sulphur oxides, methane, carbon dioxide, and hydrogen sulphide), odours, visual effects, water supply consumption, solid waste generation, and wastewater discharge. There is also the potential for some health risks (largely air related) from production activities, as described in this report. The literature suggests that all of these potential effects can be managed with the proper controls in place.

The development of bioethanol production facilities has the potential to result in fairly significant economic benefits, particularly if the facility is developed in communities with small or depressed economies.

Finally, an impact assessment framework has been developed, which includes facility siting criteria and criteria to guide the assessment of proposed production facilities.

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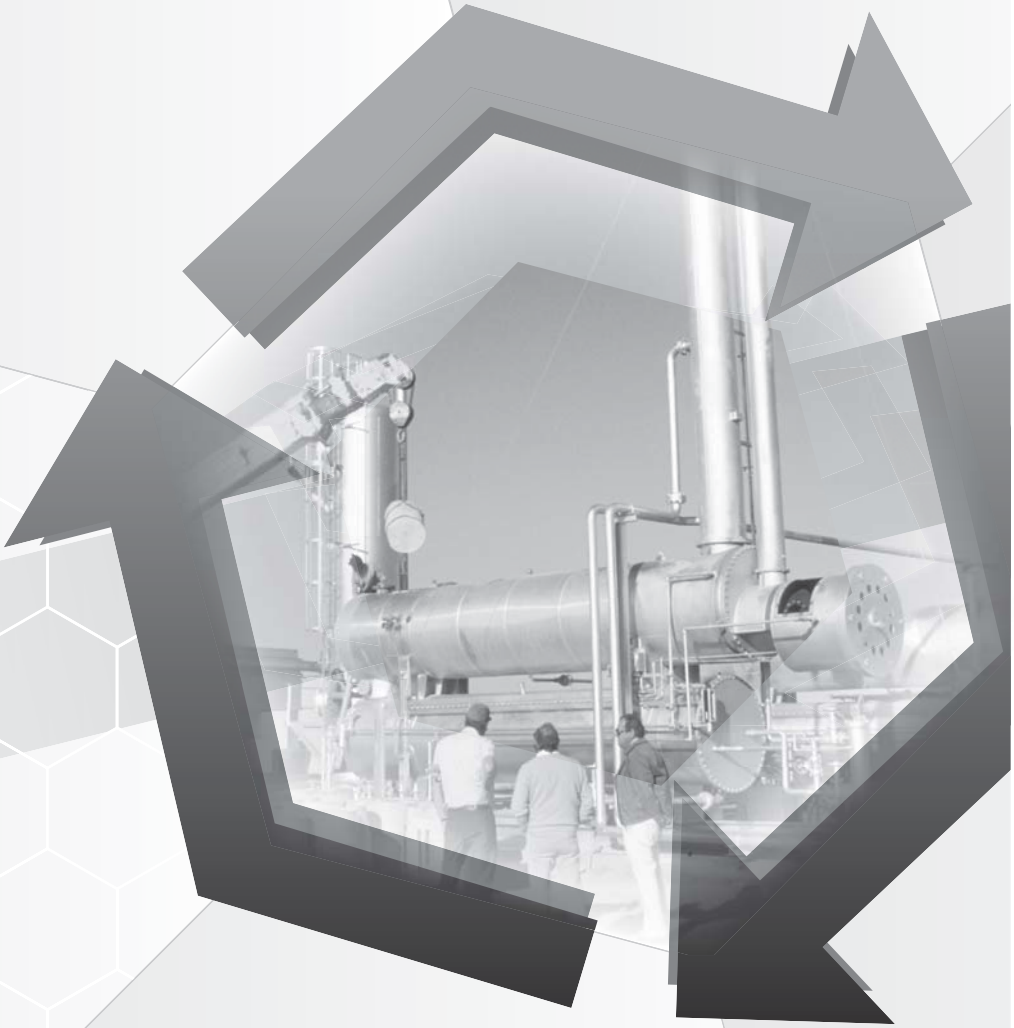

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LIST OF ACRONYMS

ASTM	American Society for Testing and Materials (now called ASTM International)
B20	20% biodiesel
B100	pure (100%) biodiesel
BSE	bovine spongiform encephalopathy
Btu	British thermal unit
CGSB	Canadian General Standards Board
COD	chemical oxygen demand
DNA	deoxyribonucleic acid
EPA	Environmental Protection Agency
FFA	free fatty acid
GHG	greenhouse gas
GTL	gas to liquid
HAZ-OP	hazard and operability
IEA	International Energy Agency
ISO	International Organization for Standardization
MIU	moisture content, impurities, and unsaponifiables
MSDS	Material Safety Data Sheet
MTBE	methyl tertiary-butyl ether
NIOSH	National Institute for Occupational Safety and Health
NOx	nitrogen oxides
OSHA	Occupational Safety and Health Administration
PM_{10}	particulate matter <10 microns in diameter
ppm	parts per million
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
R&D	research and development
SRM	specific risk material
TSCA	Toxic Substances Control Act
TSE	transmissible spongiform encephalopathy
VOC	volatile organic compound

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Part One: Summary and Criteria

Summary

This report has been prepared for the Technology & Industry Branch of Environment Canada as a draft criteria document addressing environmental and sustainability criteria for facilities producing biodiesel from biomass sources. It provides an overview of those aspects of biodiesel that would affect decisions about planning, design, and operation of biodiesel facilities in Canada. The scope covers farm gate to the pump, although some aspects of feedstock production must inevitably be considered when planning for biodiesel production. This report does not include biodiesel fuel quality criteria, as these are the subject of an ongoing standards development process led by the Canadian General Standards Board (CGSB).

The report is intended to address the needs of advisors, regulators, producers and aspiring producers, municipalities, and biodiesel plant neighbours and potential neighbours. It provides preliminary guidance on the key environmental, economic, and social aspects that may be appropriate for consideration by biodiesel producers and by all other organizations and individuals who have an interest in or a responsibility for aspects of biodiesel production. It provides a perspective on the risks and opportunities associated with developing biodiesel production facilities in Canada to help meet sustainable development goals.

The report finds that biodiesel production facilities present no significant challenges different from those presented by long-established facilities in the chemical industry. A modern biodiesel plant located in an industrial location with appropriate management systems in place and modern technology with high energy efficiency and low emissions should have little odour and noise and pose relatively lower risk compared with some industrial

facilities. Issues such as tanker trucks delivering feedstocks and hazardous chemicals for the manufacturing process are worrisome to neighbours. The risks of traffic accidents or other spills or a fire at the plant need to be identified and addressed. The most significant environmental challenges arise from feedstock processing, use of flammable liquids and solvents, spills, and waste management, but these are not unusual in industrial plants in Canada today.

Economic benefits of biodiesel plants include jobs for operational and administrative personnel at the biodiesel facility. If feedstock is sourced locally, then additional economic benefits may accrue to the community. All communities benefit to the extent to which biodiesel is able to reduce Canada's greenhouse gas (GHG) emissions. Biodiesel plants that are operated with high standards of energy efficiency, pollution prevention, and material reuse and recycling can help communities meet goals for developing sustainable economic sectors (1).

Commitment by biodiesel facility owners/operators to construct, operate, and maintain the facility to meet or exceed environmental requirements and standards, including an environmental management system, to maintain open communications with neighbouring residents and businesses, and to listen and respond to complaints about adverse effects will improve the attractiveness of this type of industrial activity and may reduce local concerns and even succeed in gaining the support of local communities (1).

Economic issues are still being defined by this very young industry; at this time, however, biodiesel is unlikely to be directly competitive with conventional diesel in transportation and stationary diesel engines. This could change if conventional fuel prices continue to increase and if government programs to favour biodiesel are put in place. The social impacts of biodiesel production appear equivalent to the social impacts of other energy and chemical industry activities, although biodiesel could provide some benefit to agricultural communities if use of Canadian oilseeds becomes widespread. However, the economic aspects of increased demand for agricultural products in Canada are not well understood due to the global commodity nature of vegetable oils.

In Part One, draft environment and sustainable development criteria for biodiesel production facilities that are seen as potentially appropriate for new and existing biodiesel facilities in Canada are presented. These criteria are generally similar to those that would be applied to any type of chemical processing facility employing Good Manufacturing Practices. Following the criteria section, the main body of the report (Part Two) provides a review of key aspects of biodiesel production from farm gate to pump.

Sources of information

This report has been compiled from published information supplemented by a limited number of interviews with experts in the field. All sources are listed in the section headed References at the end of Part Two of the report. The section on draft criteria has been developed by the author team applying their own experience and expertise to information available in the published literature. The list of criteria may not be complete: a recommendation has been made that this draft criteria list be updated as field information from operating biodiesel plants becomes available.

Criteria for biodiesel production facilities

Biodiesel can be produced from a variety of animal, vegetable, and waste animal and vegetable oil feedstocks. It should be noted that some biodiesel production plants are constructed as additions to existing rendering, vegetable oil processing, or other biomass processing plants that produce potential biodiesel feedstocks. In other cases, both the feedstock processing plant and the biodiesel production plant to be built on the same site are new. In these situations, we have considered primarily, but not exclusively, the biodiesel production facility and would refer readers to criteria documents for vegetable oil or biomass processing plants for criteria that relate to the feedstock part of the activity. In other cases, biodiesel production plants may be sited independently of feedstock processing plants. In this situation, these draft criteria are wholly applicable.

Criterion 1: Nomenclature

The term biodiesel should be used to describe only fuels that meet the ASTM[1] or CGSB standards or some other recognized North American biodiesel standards. Other fuels may be described as bio-oils but should not be described as biodiesel. Confusion over terminology has the potential to be harmful to the entire biodiesel industry.

Criterion 2: Testing to standards

Biodiesel sold as fuel should be tested against ASTM and/or CGSB standards by accredited laboratories (2). Biodiesel suppliers should provide documentation to customers confirming that the biodiesel complies with specified standards and should provide information on the properties of the fuel (3).

Criterion 3: Engine manufacturer approvals

Biodiesel marketers should check with engine manufacturers before recommending the use of biodiesel on vehicles with advanced emission control technologies such as treatment systems for future ultra-low emission engines (2). Marketers should monitor and update recommendations based on national experiences with compatibility issues.

Criterion 4: Marketer responsibility for monitoring material compatibility issues

Biodiesel marketers should establish a monitoring and inspection program to identify material incompatibility arising from biodiesel use.

Criterion 5: Marketer responsibility for product quality

Biodiesel marketers should not sell fuels that do not meet appropriate fuel quality standards for mobile or stationary diesel engines. Fuels that do not meet standards may be appropriate for uses other than in diesel engines, but marketers should ensure that purchasers are fully aware of the properties of the material being sold and of the uses for which it is appropriate. Plans for distribution of biodiesel should be developed jointly by the involved parties in order to ensure that the marketed fuel meets the specifications of users under all likely conditions of use — for example, in unusually cold weather conditions (4).

[1] ASTM International used to be called the American Society for Testing and Materials, an organization responsible for developing standards.

Criterion 6: Assessment of sustainability of feedstocks

Biomass to biofuel converters should undertake an assessment of the environmental impact of their actual and planned use of resources based on life cycle and sustainability criteria.

Producer business plans should describe how biodiesel feedstocks are being produced on a sustainable basis and grown, harvested, and produced in an environmentally preferable way. Sustainable biodiesel feedstock issues that should be addressed may include land health, productive capacity, preservation of soil, water, and biodiversity, and carbon and nutrient budgets in setting priorities for use of biomass for biodiesel. Biodiesel producers might consider, for example and where appropriate, giving preference to feedstocks from farms that have implemented an environmental farm plan or equivalent.

Criterion 7: Markets for glycerine byproduct

Business plans for biodiesel production facilities need to consider in their cost analyses that unless new uses for glycerine are found, expansion of the biodiesel market will lead to further lowered prices for glycerine. Until expanded uses for glycerine are found, biodiesel producers should ensure that they have a market for glycerine produced as a byproduct.

Business plans should define to what extent glycerine produced will be refined on site or sold as a commodity. Plans that have explored niche markets for glycerine should be viewed more favourably (3).

Criterion 8: Markets for other byproducts

Business plans should describe plans to expand the market potential of all byproducts derived from the production of biodiesel (2).

Criterion 9: Development of markets for biodiesel

Biodiesel producers should show that they intend to develop education, distribution, and acceptance in the marketplace and should not rely on government to provide market-building activities. Biodiesel producers should also commit to an ongoing effort to educate potential users on the benefits and challenges of renewable fuels.

Criterion 10: Financial risk management

A risk management and risk mitigation strategy for future changes in prices should be part of every biodiesel producer's business plan.

Criterion 11: Stakeholder consultations

Each biodiesel producer should commit to a dialogue and communication with the various stakeholders — for example, petrodiesel producers and marketers, regulators, feedstock producers, neighbouring communities, etc. — so as to avoid problems that might set back the entire fledgling industry. Producer policies should be based on sound economics leading to both environmental and social good (5).

Criterion 12: Siting of biodiesel production plants

Siting should avoid or mitigate environmental impacts on sensitive lands or waters and address issues such as agricultural land protection, protection of habitat, community access to recreation and other community lands and services, cultural heritage, and Aboriginal interests.

Communities should consider to what extent the proponents have applied good to high standards of environmental management in other projects and have the experience necessary to construct and operate the facility to such standards.

Proponents should ensure that the facility is adequately described in terms of infrastructure, responsibilities, movement of material, fuel being produced, inputs and outputs, and operational parameters (3). Descriptions should include the infrastructure of the project: buildings and construction (e.g. processing plant, small tank farm, administration, control and maintenance buildings) (3).

As biodiesel production facilities may sometimes be located in rural or waterfront areas so as to be near feedstocks or feedstock transportation routes, siting should consider visual impacts, such as height of facility, positioning so as not to block views of key natural vistas or landmarks, etc.

Biodiesel producers should consider that brownfield sites and secondarily established industrial sites provide excellent siting opportunities. To support rural development, communities should be encouraged to use already developed sites rather than rezoning agricultural land (3).

Impact on the community should be addressed, including both environmental impacts and economic impacts (employment, infrastructure, quality of life, tourism, etc.).

Proponents should review tenure, zoning, and ownership of the site and facility, past history of the site, such as previous environmental assessment reports, neighbouring development, and nearest residential, commercial, and institutional areas.

Criterion 13: Environmental management plans and systems

A construction environmental management plan should be developed and implemented before undertaking earthworks or construction on site.

Biodiesel producers should develop an environmental management plan prior to commencing production operations. Under best practices, the environmental management plan should be verified by an independent third party (3).

The environmental management plan should clarify who is responsible for the various operational functions to ensure good environmental management. It should ensure that transportation and movement of materials to different properties or within the facility are handled in an environmentally safe manner.

In addition, the plant operator should have a proper environmental management system in place and in operation, similar to any responsible chemical or petrochemical manufacturing facility — examples include Responsible Care®, ISO 14001, etc.

Criterion 14: HAZ-OP procedure

Hazard and operability (HAZ-OP) procedure should be followed. Design, construction, and operation of many industrial facilities utilize accredited engineers to ensure that the facilities meet all government regulations, industry best practices, and appropriate codes. During the design stage, a HAZ-OP study should be completed to ensure that the design and operation of the facility utilize adequate engineering and/or administrative controls to mitigate process upsets that could result in impacts to the environment or create unsafe working conditions.

A HAZ-OP report should be generated and signed off by all parties before the facility is commissioned to make certain that design features do not cause unsafe work conditions or practices to be developed. As-built drawings and a final operating procedure manual should also be provided for the facility.

Criterion 15: Compliance and notification

Approvals to construct and operate must be obtained from the relevant municipal, provincial/territorial, and federal authorities. All relevant approvals, such as permits and licences, must be obtained before commencing construction or operation.

Full compliance with codes and regulations, such as local zoning, permitting, building codes, electrical, air quality, occupational health and safety, fire, transportation of dangerous goods, tank and piping standards, and stormwater system design, is required.

Compliance with permit or licence conditions is required.

If a permit amendment is needed due to changes in operating conditions, such as increase in throughput, change in feedstock, etc., approvals should be obtained in advance of instituting the change (6).

Government authorities may require periodic reports such as annual emission inventories. All required reports should be prepared and submitted by stipulated deadlines.

Before approval of construction, an overview or brief description of the source, including the types of feedstocks to be processed, nominal operating capacity, and chemicals to be used, should be prepared and made available to all authorities and stakeholders (6).

Criterion 16: Traffic

Traffic to and from a biodiesel production plant will be similar to traffic associated with any liquid fuel production plant of a similar size. Parties should assess traffic access and traffic loading (1).

Deliveries should be planned to reduce congestion of delivery vehicles with negative impacts associated with safe handling and air quality. If it is necessary to reduce the impact of truck traffic, such measures as limiting shipments/deliveries to specified hours — for example, 7 a.m. to 5 p.m. Monday to Friday — could be considered. Reaching agreements with suppliers and customers to keep truck traffic to certain routes with least negative impact on neighbours could also be considered (1).

Criterion 17: Plant design

The processing plant and infrastructure should be constructed according to applicable standards. Best practices include energy efficiency, low embedded energy materials, least toxic materials, etc.(3).

Plants should be designed, built, and operated in accordance with a plan for environmentally sound management. Design and construction should also be appropriate to possible climatic and weather conditions, wind loading, and earthquake potential.

All operations, including loading and unloading bays and processing areas, should take place within contained areas so that spills can be prevented from being released to the environment without appropriate treatment.

Pipelines should be designed to protect against damage from vehicles or other plant operations. Pipelines and plant infrastructure should be designed to industry best standards. Tanks should be designed with gauges to measure fill level and with alarms to prevent overfilling.

Criterion 18: Site landscaping

As biodiesel is often considered a “green” fuel, plant designers and operators should consider making the plant site as green as possible, including use of naturalized and xeriscaped (irrigation-free) landscaping and tree planting.

Criterion 19: Energy use in the plant

Biodiesel plant designers/operators should consider using biodiesel in combination with or separately from natural gas in on-site energy-consuming production systems (1).

Criterion 20: Monitoring and control systems

Appropriate monitoring and control systems should be installed to monitor and warn of process upsets; for example, sump pumps should be equipped with continuous monitors and automatic shutoff valves to avoid discharges to storm drains, in case of problems.

Criterion 21: Plant construction

Plant construction should follow good practices, such as the following:

- Separate construction wastes for reuse, recycling, and disposal. For example, separate clean rock and rubble after excavation so that these can be reused elsewhere (3). Use only licensed waste management companies to take solid waste to landfill.
- Collect waste oil and lubricants in drums. Use only a licensed waste company to dispose of or recycle waste oils and lubricants.
- Use measures to reduce fine particulate matter, energy, noise, and waste and minimize landform disturbance as appropriate. Control dust levels through visual monitoring and control and suppression techniques (3).
- Consider using cleaner fuels such as biodiesel to reduce air emissions, especially fine particulates from construction machinery.
- Comply with noise control standards. Earthworks and construction should take place during specified hours (e.g. daylight) to reduce noise impact.
- Comply with other construction site requirements (e.g. availability of portable toilets, etc.) (3).
- Develop a construction erosion and sedimentation management plan.
- Install sediment control fencing if required, and use other measures as appropriate to protect water quality (3).

Criterion 22: Disposal of contaminated materials

Disposal of contaminated materials, including soils, during construction and operation should be according to industry best practices.

Criterion 23: Plant security

Plants should have security personnel on duty 24 hours a day, 7 days a week, to reduce risks of leaks and fire. There should be security fencing with secure access to the plant for personnel — for example, identity cards for visitors. Security should conduct routine documented inspection of the site.

Fire detection and fire suppression systems must be installed, particularly on all tanks that contain flammable material. All equipment used should be flameproof and sparkproof. Groundings on tanks and pads and internal floating covers for chemicals such as methanol and hydrochloric acid are necessary (3).

Smoking and drinking of alcoholic beverages should be prohibited over the entire plant site at all times.

The site should be kept free of litter and other material that may create a fire risk.

Local fire departments should be consulted for help in developing a fire protection

plan. Design, construction, operations, and maintenance should be in compliance with all fire regulations and standards.

Notification should be made to the appropriate authority of any deviations from permit conditions that could endanger human health or the environment, including required information such as cause, exact dates, reason for deviation, and whether the deviation has been corrected or when it is expected to be corrected, as well as steps taken or planned to reduce, eliminate, and prevent recurrence of the deviation (6).

Criterion 24: Emergency equipment

Equipment may include emergency generators and fire-fighting equipment. Limits for air emissions, operating hours, fuel type, training of personnel, recordkeeping, and conditions for operation should be met. For example, other than for limited testing/training purposes, the emergency generator may be permitted to operate only for providing power to the compressed air system, the cooling water pumps, and the emergency lighting in the event of a power outage.

Criterion 25: Environmental audits

Environmental audits should be conducted regularly and should consider potential effects, significance of effects, and elimination or mitigation measures to address effects. Public consultation and involvement should also be part of the environmental audit process (1).

Criterion 26: Biosecurity

Rendering and subsequent use of rendered fats and oils to produce biodiesel are considered one of several methods of making use of dead animals and animal parts. Whether the rendering or the biodiesel is the best method depends on factors that affect the spread of disease and the environment in any particular situation. Biosecurity plans should be in place for all plants handling dead animals (7).

Assessment of risk due to bovine spongiform encephalopathy (BSE) and other pathogens should be modified if new scientific evidence provides reasons for concern (8). It should be ensured that there is no cross-contamination with the food or feed supply or threat to human and animal health. Risks include transmission of microorganisms, parasites, protozoal diseases, and prions (9).

Criterion 27: Fuel usage

Fuel usage should be specified — for example, pipeline natural gas and low-sulphur distillate oil. As a good practice, records of fuel combusted each month should be maintained (6).

Criterion 28: Methanol emissions

Methanol is a volatile organic compound (VOC) and a hazardous substance. As such, measures to prevent emissions of methanol to air are essential. Scrubbers or other means of capturing methanol should be in place in vents with potential for methanol release to the atmosphere. For example, water scrubbers capture methanol, which can be recovered by returning the water to the system. All vents with the potential to release methanol should be labelled.

Emergency protocols should be in place with the ability to shut the plant down in case of unacceptably high levels of methanol venting.

Criterion 29: Air emissions control

Emissions, such as particulate matter and VOCs, should be controlled. These can arise from various aspects of operations.

Minimal emissions of air pollutants should be ensured. Scrubbers should be used to minimize air pollutants if necessary. Fugitive emissions should be prevented by appropriate procedures and protocols. Emergency protocols must be in place for controlling unplanned air emission events.

An operation and maintenance plan for all air pollution control equipment should be developed and applied at the stationary source.

All pollution control equipment should be operated whenever the corresponding process equipment and emission units are operated. Air pollution control equipment should be maintained in proper operating condition, and the air pollution control systems should be utilized as designed (6).

Criterion 30: Fugitive emissions

The handling, use, transporting, or storage of any material in a manner that may allow avoidable amounts of particulate matter to become airborne must not be caused or permitted. All other requirements of regulatory authorities regarding fugitive emissions must be complied with (6).

A fugitive emissions control plan must be in place. The plan may include installing and operating particulate matter ambient monitors (6).

Dust must be controlled — for example, from trucks and unloading operations (6).

In any shutdown, breakdown, or deviation, all practical steps to modify operations to reduce the emission of any regulated air pollutant must be taken immediately. Feasible and practical modifications in the operation to reduce emissions of air pollutants should be implemented. No emission units that have an unreasonable frequency of process or control equipment shutdown or breakdown should be operated (6).

Appropriate authorities should be notified as required of a planned shutdown of any control equipment or process equipment if the shutdown would cause any increase in the emissions of any regulated air pollutant. If the owner or operator does not have advance knowledge of the shutdown, notification should be made as soon as possible as required by law. Information conveyed would include the cause of the shutdown and when the shutdown is over (6).

Criterion 31: Fugitive biodiesel production emissions

There should be monitoring for leaks on all systems, whether they contain gas, liquid, or solid phases. Monitoring systems and a repair plan should be in place to address leaks from any type of system or equipment in a timely manner.

Compressors should be equipped with a seal system that includes a barrier fluid system and that prevents leakage of VOCs to the atmosphere and systems to purge into a process stream with zero VOC emissions to the atmosphere. Sensors to detect failures of the seal system, barrier fluid system, or both should be installed.

Except for pressure relief, each pressure relief device in gas/vapour service should be operated with no detectable emissions, as measured by an instrument.

Standards for delay of repair may be acceptable if technically infeasible without a process shutdown. Conditions for allowing delays should be defined: for example, if emissions from immediate repairs are greater than fugitive emissions from the leak until the repair is made or if at the time of repair the purged

material is collected and destroyed or recovered by a control device, then delay in repair may be appropriate.

Criterion 32: Odours

Good housekeeping is necessary to avoid odours. Raw materials and unprocessed oils and fats can generate odours. Condensing units should be used to address odour in sequence with either chemical scrubbers or afterburners as well as biofilters if required for non-condensable odours. Deodorization of storage and processing units may be necessary — for example, by chemical means such as acid and alkali scrubbing or by steam cleaning. Monitoring and recordkeeping for odour control equipment are required (7). Use of closed systems to offload and load feedstock, chemicals, and biodiesel product can assist in odour reduction.

Criterion 33: Noise

Noise reduction and control strategies for both inside and outside the plant should be developed.

Criterion 34: Receiving and shipping

Emissions and spills, such as particulate matter, fugitive emissions, etc., at unloading and shipping stations should be controlled.

For trucks and railcars:

- Containers should be made of aluminum, steel, fluorinated polyethylene, fluorinated polypropylene, Teflon®, or most fibreglass (4).
- Washout certificates should show proper washing out of the vehicle and that inspection has been done.
- Previous load carried and residues should be checked. Only diesel is acceptable as a residue. Unacceptable residues are food, gasoline, lubricants, and water (4).
- Hoses and seals should be clean and compatible with B100 (pure biodiesel).

In cold weather:

- Ensure that the temperature of the biodiesel does not fall below the cloud point. Factors to be considered include the cloud point of the biodiesel, the ambient temperature, the temperature of the biodiesel, and the length of time needed to ship the biodiesel (4).
- Check whether insulation or heating is needed.
- Options for shipping immediate delivery of hot or warmed biodiesel: hot in railcars delivered within a week, frozen in railcars equipped with external steam coils that are used to melt the fuel on arrival; blended with winter diesel, kerosene, or other low cloud fuel in railcars or trucks (4).

Criterion 35: Spills

A plan should be in place to control and clean up spills.

Emergency protocols should cover potential spills during delivery and shipping, including compliance with port or harbour requirements if applicable. Offloading and delivery acceptance should be handled by experienced personnel only.

For ships, ship-to-shore communication should be in place to ensure that pumps can be turned off quickly if a problem occurs.

Inspections should be conducted regularly — for example, hourly.

Good practices include pumping in a closed system directly from truck, railcar, or ship to tanks with vapour balances back to the delivery

container. Connections, hose drainers, nitrogen purge, and other practices should be in place to eliminate spillage and emissions (1).

All spilt material, including materials used in cleanup, should be removed by a licensed waste collector (3). Spills should be notified as required by law.

Criterion 36: Hazardous materials

Hazardous materials should be controlled to ensure that the risks of handling them are minimized (3).

Emission limits should be met for specified hazardous materials. A written plan for demonstrating compliance on hazardous materials should include:

- procedures for minimizing material loss, including during shutdown, malfunction, startup, and non-operation conditions;
- quality assurance for methods of measurement, frequency of measurement, and control plan;
- recordkeeping and reporting, including process modifications that affect material inventories and use (6); and
- compliance with specific standards, such as use of control technology for specified materials.

Criterion 37: Sourcing and utilization of water

Biodiesel production requires significant volumes of water. Depending on the process, much of this water can be recovered and reused. Plant design should seek to minimize consumption of water. Where consumption of water is unavoidable, proponents should make all necessary arrangements and acquire approvals to access sufficient water supply in advance of committing to plant construction.

Criterion 38: Generation and treatment of wastewater

Wastewater should be separated into streams based on specifications such as chemical oxygen demand (COD) content. The relevant authority should be consulted about such options as use of local sewers, discharge into watercourse with water discharge licence, wastewater treatment facility, or other licensed facility. Licences for disposal or discharge must be obtained as required (3).

Underground and aboveground stormwater management systems should be designed, constructed, and maintained.

It must be ensured that stormwater is clean and directed to stormwater drains as required.

Water from all containment areas should be drained into a wastewater buffer tank. If required, wastewater should be removed by a licensed waste company.

Routine inspections should be conducted (e.g. hourly) on the site to ensure that the pipeline or other infrastructure is not leaking.

If the plant is making claims of zero discharge of wastewater, it must be ensured that these claims can be substantiated (3).

Domestic water and sewage should be treated with an on-site septic system, wastewater treatment system, or, if permitted, discharge to the municipal or local sewage system (3).

Criterion 39: Waste management

Process waste materials should be stored in dedicated containers for recycling or disposal by a licensed waste company.

All waste should be removed by a licensed waste contractor as required and hazardous

waste by a licensed hazardous waste contractor for disposal at licensed facilities (3).

Domestic waste should be separated for recycling or disposal and carried by a licensed waste company for recycling or disposal (3).

Criterion 40: Boilers

Boiler systems should be equipped with a relief safety valve subject to an annual test. Standards relating to emissions, such as use of natural gas or other fuels in boilers, must be complied with.

Government requirements for nitrogen oxides (NOx), VOCs, total particulate matter, particulate matter <10 microns in diameter (PM_{10}), sulphur dioxide, etc., must be met or exceeded.

Criterion 41: Stacks

Stack emissions are to meet requirements. Emissions from all sources, such as cooling water system, heater systems, process, compressed air, etc., should be reduced through best practices. Best practices include design for emission reduction, maintenance, filters, purge control systems, low NOx burners on combustion equipment, and solvent recovery (1).

Criterion 42: Air emissions control equipment

The objective is to ensure that, as soon as possible, based on the operation and maintenance plan, actions are taken to eliminate any visible emissions and/or any pressure drops outside the permitted range specified for any equipment such as filters.

The control equipment should be operated, monitored, and maintained any time that the process equipment that it controls is in operation.

Each piece of control equipment should be operated and maintained such that it achieves a removal efficiency to the specified standard (6).

Equipment should have audible and visible alarms and be tested regularly for performance.

Inspection should be performed at specified times or as required by specifications and/or the manufacturer. Also, regular inspection should be conducted of all components that are not subject to wear or plugging, including structural components, housing, ducts, and hoods. A written record of inspections and any corrective actions resulting from inspections should be maintained (6).

Criterion 43: Dust

Dust suppression strategies should be included in plant management plans. Visual monitoring of dust levels and use of dust suppression should be provided for as needed. Dust complaints should be investigated and dust suppressed as needed (3).

Criterion 44: Wastewater

Wastewater emissions should be reduced, including from the cooling water system. All wastewater should be disposed of in an environmentally sound manner, including removal by a licensed contractor for wastewater destined for disposal or on-site treatment as required — for example, passing through oil-water and oil-grit separators to meet requirements (1).

All rainwater collection and stormwater system requirements for controlling runoff to specified time periods and limits on requirements such as total suspended solids should be complied with.

Criterion 45: Storage, cleaning, and grinding of materials

Emissions such as particulate matter should be controlled. Spills should be cleaned up.

Air control equipment should be used and maintained. It should be ensured that the handling, use, transporting, and storage of any material prevent avoidable amounts of particulate matter from becoming airborne.

Criterion 46: Storage tanks

Records on dimensions of individual storage vessels and the capacity of each one should be maintained. Construction of all tanks, bunds, and pipelines should be to industry best practice and regulations and standards. Spill response and emergency protocols for all chemicals on site should be based on Material Safety Data Sheets (MSDS) and consultation with relevant authorities.

Criterion 47: Methanol storage tanks and sodium methylate tanks

Records showing the dimensions of each tank and tank capacity should be maintained. Authorities should be notified as appropriate of maximum true vapour pressure (6).

Criterion 48: Biodiesel reactor tanks

Compliance with regulations must be demonstrated. Any venting should be maintained below regulatory or permitted thresholds. The effect of changes in equipment or process on emissions should be documented (6).

Criterion 49: Loading and unloading equipment

Regulated and permitted requirements for equipment such as pumps, hoppers, and feeders used to load and move materials should be met or exceeded.

Criterion 50: Transportation

Transport of dangerous goods requirements should be complied with. When offloading and uploading feedstock, methanol, and products, relevant protocols, such as spill procedures, precautionary measures, and requirements with marine safety, should be complied with (3).

Criterion 51: Switching from blends to B100 in shipping containers

When switching fuels, time and costs associated with cleaning the fuel system when first using B100 should be planned and budgeted for, so as to avoid dissolving sediments from conventional diesel or B20 (20% biodiesel), which may clog fuel lines (4).

Criterion 52: In-plant climatic conditions

Employees should be informed about the climatic conditions in the plant at its extreme and how to reduce the effects of these on the work environment.

Criterion 53: Recordkeeping and equipment list

A written list of all units on site that are not insignificant should be maintained. The list should include the type of equipment; identifying number; date of installation, modification, and/or reconstruction; and identification of any applicable performance standards, including records of emissions resulting from any changes (6).

All records should be retained for a specified period (e.g. five years from the date of monitoring, sampling, measurement, or report). Records to be retained include all calibration and maintenance records, all original recordings for continuous monitoring instrumentation, and copies of all reports required by the permit. Records must conform to the requirements (6).

Criterion 54: Performance testing

All performance tests should be conducted according to approved methodologies at specified intervals and frequencies (6).

Criterion 55: Startup, shutdown, and malfunction plan

A plan, including procedures for minimizing emissions during startup, shutdown, and malfunctions, a program for corrective action in regard to malfunctioning process and air pollution control equipment, and specified procedures for estimating solvent loss during each of these events, should be developed and implemented. After one of these events, a report should be submitted within a specified period of time (6).

Criterion 56: Employee training

Personnel should be trained in response to emergencies such as fire and to understand and perform their responsibilities in the environmental management system. Drills should be held as required or at least annually (3). Emergency drills should be conducted to test emergency response to releases of hazardous materials (3).

Training of personnel in transport, storage, and handling of all chemicals should be put in place on site.

Criterion 57: Risk management

A risk assessment should be undertaken to determine the risks associated with the particular facility, location, design, technology, operation, personnel skill level, and so on. The level of risk (e.g. low, high, rare, frequent, and so on) should be identified. Controls to address risks should be identified.

An environmental management system and associated monitoring and reporting help to address the risks. Regular inspections by an independent third party to verify that the project is consistent with the environmental management system would help to address community concerns.

Criterion 58: Site maintenance

All paved roads and areas should be cleaned to minimize the discharge of fugitive particulate emissions to the atmosphere. Such cleaning should be accomplished in a manner that minimizes the resuspension of particulate matter (6).

Criterion 59: Handling and transportation of product

The producer should consider the most energy-efficient transport options. Producers may wish to supply to local distributors to reduce transport energy requirements (3).

Criterion 60: Emergency planning and preparedness

Emergency protocols should be developed in relation to the environmental management system, including response in regard to hazardous materials and natural disasters and events (3).

Risks to the natural environment and human health and safety should be assessed.

It should be ensured that the risk to the natural environment is kept as low as possible by preventing threats to the marine environment and groundwater (e.g. siting away from areas where spills would pose threats, operating procedures to prevent and control spills and leaks).

Criterion 61: Community impacts

The site should have a 24-hour 7-day contact for community complaints and facility to

investigate the complaint. Valid complaints are to be addressed by reasonable and appropriate mitigation measures. Records of all complaints, investigation findings, and mitigation measures taken should be kept. A continued pattern of certain complaints may trigger new analysis (e.g. for dust or odour) (6).

Criterion 62: Animal, avian, and insect pests

Biodiesel plants may be attractive to pests. A pest control system should be implemented to address public concerns.

Criterion 63: Certifications

The owner and/or operator of the facility should have sufficient knowledge of the facility to certify its compliance with applicable requirements (6).

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