

EcoLogo^{CM} Program Criteria Review Certification Discussion Document

CCD-003: Electricity-Renewable Low-Impact
(B) BIOGAS-FUELLED ELECTRICITY



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1 Instructions

EcoLogo^{CM} is inviting stakeholders to participate in the review of CCD-003: Electricity-Renewable Low-Impact. This standard is being revised to assure that the current requirements continue to define environmental leadership for renewable low-impact electricity.

Currently, both the scope and the criteria statements found in CCD-003 determine what the EcoLogo^{CM} Program considers to be environmental leadership amongst all types of electricity production in North America. During this review, the EcoLogo^{CM} Program will re-examine both the scope and the criteria statements. As such, leadership will continue to be defined by first determining what types of electricity can be considered as “renewable low-impact” (i.e. scope), and second what requirements should be established to assure that facilities which produce these types of electricity are following best environmental practices according to the market (i.e. criteria statements).

Stakeholder contributions play a pivotal role in the EcoLogo^{CM} standards development process.

To begin your participation and register for the review process:

- Send a request to forums@ecologo.org and specify your name (first and last name), indicating your affiliation, and your wish to participate in the CCD-003: Electricity-Renewable Low-Impact.

While the EcoLogo^{CM} Standard Development Forum is the main tool for compiling comments, the EcoLogo^{CM} program will also accept comments by e-mail and fax. These comments may also be posted to the online forum and will be viewable by all registered forum participants involved in the discussion.

This stakeholder consultation period will be open for 52 days beginning Nov 18, 2008. Comments must be received by January 9, 2009.

Your time and input in helping us to establish the most stringent environmental standards are very much appreciated. We will send you a reminder as our closing date for comments approaches.

Sincerely,

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1 Introduction

Biogas-powered electricity is currently considered in the EcoLogo^{CM} Certification Criteria Document (CCD-003) for Electricity-Renewable Low-Impact, and five biogas-powered generating facilities amounting to a total capacity of 21 MW have already been third-party certified by the EcoLogo^{CM} Program.

The purpose of this CDD is to present broad market information for biogas-powered electricity in Canada and the U.S., and to solicit comments regarding several specific issues that need to be resolved.

The EcoLogo^{CM} Program is designed to support a continuing effort to improve and/or maintain environmental quality by reducing energy and materials consumption and by minimizing significant life cycle environmental impacts. Life cycle review is an ongoing process and as such, EcoLogo^{CM} CCDs are regularly updated. Products are also re-audited regularly to ensure certified products continue to offer significant environmental benefits.

2 Description

The EcoLogo^{CM} Program currently defines biogas as “gaseous products (primarily methane and carbon dioxide) produced by the anaerobic decomposition of organic wastes.”

Currently, the biogas electricity products included in CCD-003 include *inter alia* those derived from

- landfill sites
- sewage treatment plants
- anaerobic digestion organic waste processing facilities

3 Market Overview

3.1 Canadian Market

In 2005, there were 13 landfill gas-fuelled facilities amounting to a total capacity of 67MW (Environment Canada’s Greenhouse Gas Division, 2007). In 2007, there were 25 wastewater treatment facilities, 1 municipal solid waste plant and approximately 10 farms, and 1 plant in the pulp and paper industry producing biogas in Canada (Natural Resources Canada, 2007).

3.2 American Market

In general, according to the Energy Information Administration (EIA), the biomass market from which biogas is derived has been declining by approximately 2% between 2002 and 2006. Between those years, however, the biogas sector for landfill gas products has grown by approximately 17%. Nearly 400 landfills in the United States recover and combust landfill gas to generate heat or electricity (Biodiesel and Ethanol Circle Corporation, 2008).

4 Other Eco-label Standards

To meet the requirements of the Naturemade Swiss label (2008):

- Biomass from genetically modified organisms cannot be used.
- Energy Crops and other sources of biomass must be grown using renewable sources of power.
- Plants using untreated wood must meet a standard guided by the FSC label.
- Electricity generating facilities using wood fuel and old wood must have an overall efficiency of at least 60 percent.
- The operator of the plant for generating electricity from wood fuel and old wood must declare the origin of the wood fuels, on its own responsibility.

5 Life Cycle Research Findings

5.1 Life Cycle Definition

Our initial research indicates the life cycle stages of biogas-fuelled electricity sources from which most significant environmental stressors and impacts occur is the use stage. At this point, the EcoLogo^{CM} Program leaves the scope and boundaries of the life cycle analysis open for discussion since as stakeholders, you might know of other stressors and impacts not currently addressed in this CDD.

5.2 Summary of Major Environmental Impact Categories and Related Stressors

Below you will find some of the major environmental stressors and impacts potentially associated to biogas-fuelled electricity as well as specific ones potentially associated with biogas-fuelled electricity from landfill gas, sewage treatment plants and anaerobic digestion organic waste processing facilities.

Stage of the life cycle	Environmental Stressors and Impacts (numbers in the table refer to specific sections in the document) according to various Life Cycle Stages and Impact Categories					
	Energy	Resources	Emissions to			Other
	Renewable/ Nonrenewable	Renewable/ Nonrenewable	Water	Air	Soil	
Resource Extraction			6.3.2.1			
Production	6.3.5		6.3.2.1	6.3.5	6.3.5	
Distribution			6.3.2.1,6.3.4	6.3.4		
Use	6.3.3.1	6.3.3.1, 6.3.3.5, 6.3.5	6.3.2.1, 6.3.3.1, 6.3.3.3?, 6.3.5, 6.3.6	6.3.1.1, 6.3.2.2, 6.3.3.1 6.3.3.2, 6.3.3.3?, 6.3.3.4, 6.3.5, 6.3.6	6.3.3.3?, 6.3.6	6.3.5, 6.3.6
Disposal			6.3.4, 6.3.6			

5.3 Discussion Points on Major Environmental Impact Categories and Related Stressors

This section draws attention to the major environmental impact categories and stressors the EcoLogo^{CM} Program intends to address in its revision of CCD-003 for biogas-fuelled electricity. Each section below contains questions pertaining to the environmental impact categories and stressors under investigation.

5.3.1 Current Broad Environmental Impact Categories and Related Stressors under Review for Biogas-Fuelled Electricity

5.3.1.1 Carbon Monoxide (CO), Particulate Matter (PM), Nitrogen Oxides (NOx), and Sulfur Oxides (SOx) Emissions

Currently, CCD-003 stipulates that to meet the criteria, the biogas-fuelled electricity must be generated in such a manner that the total of load points assessed for operational air emissions of CO, PM, NOx (measured as NO₂) and SOx measured as (SO₂) does not exceed 6:

Compound	Load Points					Assigned Load Points
	0	1	2	3	8	
CO	< 2.15 kg/MWh	2.151 - 3.22 kg/MWh	3.221 - 4.30 kg/MWh	4.301 - 5.37 kg/MWh	> 5.371 kg/MWh	
PM	< 0.228 kg/MWh	0.2281 - 0.387	0.3871 - 0.516	0.5161 - 0.645	> 0.6451 kg/MWh	
NOx (as NO ₂)	< 0.77 kg/MWh	0.771 - 1.15 kg/MWh	1.151 - 1.52 kg/MWh	1.521 - 1.90 kg/MWh	> 1.901 kg/MWh	
SOx (as SO ₂)	< 0.141 kg/MWh	0.1411 - 0.212	0.2121 - 0.282	0.2821 - 0.352	> 0.3521 kg/MWh	
TOTAL LOAD POINTS						

1.Q) Do you think that these load points still represent environmental leadership? If so, how and why? If not, why not?

5.3.2 New Broad Environmental Impact Categories and Related Stressors for Biogas-Fuelled Electricity

5.3.2.1 Greenhouse Gas Emissions (GHG)

According to Zah et al. (2007), the greenhouse gases produced through the life cycle of biogas power production are negligible compared to other conventional forms of power and certain biomass power sources.

In fact, in the case of landfill gas, according to Environment Canada (2002), even though CO₂ emissions increase by 188% during the combustion of landfill gas from *inter alia* gas boilers, internal combustion engines and gas turbines, “the combustion of one standard cubic meter of methane in landfill gas reduces GHG emissions by 13.7 kg of CO₂ eq, a virtual elimination of GHG emissions.” The EPA (2007) concurs on this point by stating that by using landfill gas to produce energy, landfills can significantly reduce their emissions of methane and avoid the need to generate energy from fossil fuels, thus reducing emissions of carbon dioxide from fossil fuel combustion. For example, if a 3 megawatt (MW) landfill gas electricity project starts up at a landfill with previously uncontrolled landfill gas, the project would have a direct methane reduction of approximately 6,000 tons per year (125,000 tons of carbon dioxide equivalents per year).

- 2.Q) Do you think that the EcoLogo^{CM} Program should consider greenhouse gas emissions as a significant environmental stressor for biogas-fuelled generating facilities? If so, why and how? If not, why not?

5.3.2.2 H₂S Emissions

According to Smith (2007), biogas contains concentrations of H₂S, one of main components of biogas, in the ranges between 200-5000 ppmv from municipal facilities and 30,000 ppmv from industrial facilities. H₂S can have an odor at concentrations above 50 ppbv and be toxic at concentrations above 100 ppmv. This gas is a health and safety hazard, it can corrode and ruin equipment, as well as kill bacteria needed in anaerobic digesters. However, some methods exist to remove H₂S from landfill gas.

- 3.Q) Do you know if all biogas-fuelled generating facilities are required to recover their H₂S emissions? If not, should they be and why? If not, why not?
- 4.Q) Do you know what represents environmental leadership regarding H₂S emissions for biogas; are there any specific restrictions for these emissions?

5.3.3 Specific Environmental Impact Categories and Related Stressors under Review for Biogas-Fuelled Electricity from Landfill Gas

5.3.3.1 Low-Impact and Renewable

Whether energy from landfill gas is a renewable and low-impact form of electricity remains a controversial question. Some organizations, including the EPA (2007) would argue that landfill gas turned into energy presents many environmental benefits compared to letting the gas be emitted from landfills. For example, they state that:

By volume, landfill gas is about 50 percent methane and 50 percent carbon dioxide and water vapor. It also contains small amounts of nitrogen, oxygen, and hydrogen, less than 1 percent Non Methane Organic Compounds (NMOCs), and trace amounts of inorganic compounds. Some of these compounds have strong, pungent odors (for example, hydrogen sulfide, or H₂S). NMOCs consist of certain Hazardous Air Pollutants (HAPs) and Volatile Organic Compounds (VOCs), which can react with sunlight to form ground-level ozone (smog) if uncontrolled. Nearly 30 organic HAPs have been identified in uncontrolled landfill gas, including benzene, toluene, ethyl benzene, and vinyl chloride. Exposure to these HAPs can lead to adverse health effects. Thermal treatment of NMOC (including HAP and VOC) and methane through flaring or combustion in an engine, turbine, boiler, or other device greatly reduces the emission of these compounds.

Also, Lunghi (2004), has shown that landfill gas energy is more environmentally benign than natural gas, one of the fossil fuel energy sources with the least environmental impacts, because of its lower emissions of CO₂ eq/kWh, NO_x, SO₂ eq/kWh and a much lower result in the Eco Indicator 99 model. However, Ewall (2008) mentions that “a report by the Environmental Protection Agency documents that burning landfill gas releases more pollution per unit of energy produced than burning non-renewable natural gas and by some measures (carbon monoxide, CO₂, NMOCs and methane) is even dirtier than coal.” Some could also argue that encouraging the harvesting of energy from landfills might encourage landfilling over more environmentally benign waste management alternatives such as *inter alia* composting or simply creating energy from organic waste separated at the source. For example, Chen, C. & Greene, N. (2003), have stated that:

A long-term strategy for addressing the LFG issue must emphasize the importance of recycling. From an environmental perspective, recycling, composting, and waste reduction are by far the best strategies for methane reduction. Diverting waste to recycling and composting programs and encouraging waste reduction prevent these materials from ever reaching the landfill. The ultimate solution to the LFG issue is to keep the materials that result in LFG and HAPs from getting there in the first place, and encouraging recycling and composting should be a top priority for federal, state, and local governments.

This is echoed by the Natural Resources Defense Council (2003) who state that:

Because LFG is a by-product of landfills, and landfills are such a poor way to manage our waste, LFG can not be considered renewable. In addition to the global warming impacts of landfills, they are also a source of groundwater pollution. At best, the Environmental Protection Agency's current landfill regulations merely postpone the inevitable damage landfills will cause. Landfills are simply unsustainable, and therefore so is LFG. As with any waste issue, the proactive solution is to look upstream and see what can be done to stop creating waste products. With landfill gas, it's no different. Landfills are the end-point of much of the excesses of our wasteful economy. At the very beginning of the system, we must look at such things as phasing out of halogens in industrial use. This is the only way that we can stop chlorine, fluorine and bromine pollution and the organohalogens (dioxins, furans, etc.) that come with them. We also must consider the technology of landfills. There are communities in the United States which are recycling 80-90% of their waste (some even higher). It is the act of mixing materials together that makes waste. Source separation and recycling prevents this. In landfills themselves, it makes sense to segregate organic wastes from other wastes by placing them in different cells of a landfill. This would concentrate the methane generation in an area where many of the toxic compounds won't be present (which is not to imply that yard waste and such doesn't come laden with pesticides and toxic sludge "fertilizer" applications).

- 5.Q) Countries like Sweden have already put a ban on the landfilling of organic matter yet landfill gas energy is currently included in CCD-003 as a “low-impact renewable “ electricity

source. Despite some of the environmental benefits of landfill gas, do you think that it can really be considered a low-impact renewable source of electricity? If so, how and why? If not, why not?

5.3.3.2 Dioxins and Furans

According to the EPA (2007):

The EPA's review of the available data indicates that dioxins and furans can be released in small amounts when landfill gas is combusted by flare or for recovering energy. Based on national and international source tests, the concentration of dioxins from landfill gas combustion ranges from non-detectable to 0.1 nanograms (10^{-9} grams) of toxic equivalents (TEQ) per dry standard cubic meter of exhaust, at 7 percent oxygen. Because of the health threat from uncontrolled emissions of other organic compounds in landfill gas, EPA found, in developing emissions standards, that landfill gas destruction in a proper control device (e.g., flare or energy recovery unit) with minimal by-product generation of dioxins/furans is preferable to the release of uncontrolled landfill gas. In summary, EPA believes that the potential for dioxin emissions from the combustion of landfill gas is small.

According to Chen & Greene (2003),

Data on the benefits of collection and combustion of landfill are very clear. While a small amount of dioxins are formed, the reduction in other HAPs makes collection and combustion an essential public health strategy.

The stringent regulations in Germany restrict the release to 100pg TEQ/m³ (Environment Canada, 1999).

CCD-003 currently does not address dioxins and furans for biogas-powered electricity. However, it addresses furans and dioxins emissions in point 7. c) for biomass-fuelled electricity when it states that:

(c) if generated from clean biomass fuel sources containing salt-laden wood, de-inking sludge or spent pulping liquors from mills using elemental chlorine bleaching, the facility must not emit polychlorinated dioxins and/or furans in excess of one of the following, whichever may be lower:

i. 100 pg I-TEQ/m³

6.Q) Do you think that the EcoLogo^{CM} Program should establish a maximum threshold emission level for dioxins and furans for landfill gas energy?

5.3.3.3 Mercury Emissions

According to Chen, C. & Greene, N. (2003), the addition of an energy system to a landfill generally reduces mercury emissions. Moreover, according to EPA's 1997 Mercury Study Report to Congress, landfills contributed less than 0.1 percent of the total mercury released from all man-made sources in the United States in 1994. When compared on an annual basis, mercury emissions from landfill gas are significantly less than mercury emissions generated by small oil-fired boilers used in homes and apartments.

5.3.3.4 Non-methane Organic Compounds Emissions

According to the EPA (2007),

Concentrations of NMOC in uncontrolled landfill gas can vary depending on several factors, including the type of waste discarded in the landfill, the climate surrounding the landfill, and the physical properties of the individual organic compound. A default concentration of 595 parts per million by volume (ppmv) of NMOC is presented in EPA's Compilation of Air Pollutant Emission Factors (AP-42). Of this total NMOC, 110 ppmv are considered HAP compounds, according to default concentrations in AP-42. Therefore, total uncontrolled concentrations of organic HAP at landfills are typically less than 0.02 percent of the total landfill gas. The Standards of Performance for New Stationary Sources (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations require combustion of NMOC, a surrogate for organic HAP, at a destruction efficiency of 98 percent, or to an outlet concentration of 20 ppmv NMOC. The process of combustion destroys organic compounds, including methane and NMOC. During combustion, these organic compounds chemically react with oxygen in the presence of heat, breaking apart to form water vapor, carbon dioxide, and other less volatile compounds. Combusting the gas in a reciprocating engine, gas turbine, or boiler to generate energy also reduces pollution associated with the extraction and use of fossil fuels to produce the same amount of energy.

5.3.3.5 Re-Usability of Equipment

According to Haile (2007), some landfill gas equipment can be relocated once the resource has been depleted.

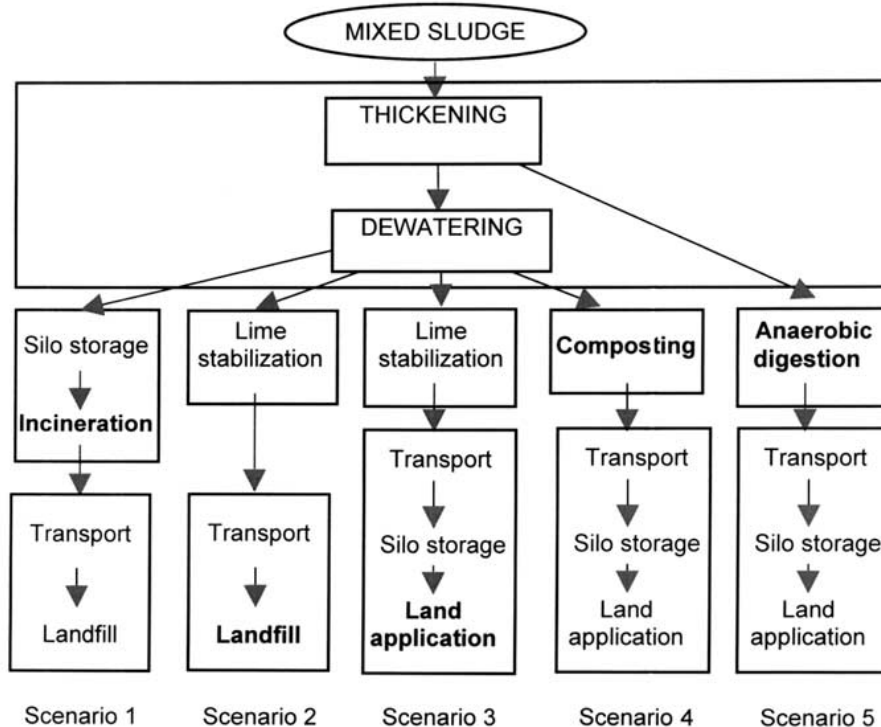
7.Q) What percentage of technologies can be relocated to other projects in the Canada and the U.S?

8.Q) Can these technologies be used for other power generation and if so, which type(s)?

5.3.4 Current Specific Environmental Impact Categories and Related Stressors under Review for Biogas-Fuelled Electricity from Sewage Treatment Plants

5.3.4.1 Low-Impact

Suh and Rousseaux (2002) conducted a Life Cycle Assessment to compare the five scenarios of alternative treatments of sewage sludge. These scenarios are summarized in the figure below:



(Suh and Rousseaux, 2002)

They found that the most sustainable strategy, in the French context, for the management of sewage sludge was scenario 5, when anaerobic digestion is combined with agricultural application. Even though this scenario was the approach with the least environmental impacts, it still had quite a high potential for water aquatic ecotoxicity due to the release of heavy metals. According to them “in all processes, VOC and nitric acids resulting from the diesel combustion of transport vehicles and mobile machines, were the main contributors to resources depletion and to oxidant formation.”

- 9.Q) The energy derived from sewage treatment plants is currently considered as a renewable low-impact form of electricity within CCD-003 provided that it meets all of the criteria including those for biogas-fuelled electricity. Do you think that the EcoLogo^{CM} Program should continue to include this type of electricity within CCD-003?
- 10.Q) If you think that this type of electricity should remain within CCD-003, should the EcoLogo^{CM} Program put further restrictions on the types of electricity from sewage treatment plants that it accepts within CCD-003? If so, what should these restrictions be and why? If not, why not?
- 11.Q) Do you know of methods to reduce or remove heavy metals from sewage sludge that could be used to avoid the release of these on fields? If not, is the use of sewage sludge on fields too big of a direct risk to human health compared to the other methods? Should the EcoLogo^{CM} Program establish criteria for what to do with the waste from biogas-fueled electricity derived from sewage? If so, what should these be and why? If not, why not?

5.3.5 Specific Environmental Impact Categories and Related Stressors for Biogas-Fuelled Electricity from Anaerobic Digestion of Waste Processing Facilities

5.3.5.1 Specific Environmental Impact Categories and Related Stressors for Biogas-Fuelled Electricity from the Anaerobic Digestion of Animal Renderings

It remains controversial whether or not animal-based products should be considered for environmental leadership simply because, by their inherent nature, they could be considered unsustainable. Some stipulate that meat production and all of the meat industry derived environmental impacts are unnecessary when populations could be fed on vegetable-based diets which have a much lower environmental footprint. Here is a list of environmental impacts generally associated to the meat and dairy industry outlined in Vasil (2007):

- *Meat production is 10 to 20 times more energy intensive per edible ton than grain production.*
- *One-fifth of the planet's land surface is used for grazing animals, double what goes to growing crops.*
- *An area larger than New York State is estimated to be destroyed every year for grazing land.*
- *If no controls are in place, meat production can lead to ammonia, particulate matter, sulfur oxide, hydrogen sulfide or reduced sulfide air emissions.*
- *If untreated, dissolved solids and nitrate might contaminate waterways.*
- *Animal abuse.*
- *An increase in greenhouse gas emissions. Gassy livestock accounts for 18% of the world's greenhouse gases.*
- *Animal protein swallows 8 times more fossil fuels than beans or vegetable protein.*
- *Release of antibiotics (if not grown organically).*
- *Release of hormones.*
- *Over 90% of our exposure to dioxins comes from food, especially animal fats.*
- *Aesthetic impacts due to odors and suspended solids.*
- *Oil and grease discharges may cause problems to infrastructure like sewers.*

12.Q) Knowing the inherent environmental impacts associated to the meat industry and considering its alternatives, do you think that the EcoLogo^{CM} Program should allow the use of animal renderings products for energy? If so, how and why? If not, why not?

5.3.5.2 Specific Environmental Impact Categories and Related Stressors for Biogas-Fuelled Electricity from the Anaerobic Digestion of Manure

According to the literature, there are several environmental benefits associated to the production of electricity from biogas derived from manure. Some of these benefits include:

- A reduction in methane emitted to the atmosphere compared to when manure is held in anaerobic lagoons. This is somewhat significant because methane released from decomposition of livestock and poultry manure generates about 9 percent of all human-caused methane emissions in the United States (ODEO, 2007).
- Colliform bacteria, other pathogens, insect eggs and internal parasites also are destroyed or reduced to acceptable levels by anaerobic treatment (Engler, Jordan, Marshall, McFarland & Lacewell, n.d.; Edelmann, W., Baier, U., Engeli, H., & SchleissLife, K., 2004).
- Lower odors (Engler, Jordan, Marshall, McFarland & Lacewell, n.d.).

It should be noted however, “that total nitrogen, phosphorus and other minerals remain largely unchanged due to their anaerobic digestions and; therefore, effluent from a digester must be retained in a holding pond and used either as recycled flush water or for irrigation (Engler, Jordan, Marshall, McFarland & Lacewell, n.d.)”. Both phosphorus and ammonia can lead to the eutrophication of our waterways. Ammonia emissions can also lead to the acidification of soils due to the production of ammonium cations. To diminish ammonia emissions, Naturemade, recommends that to certify agricultural biogas digesters, “ammonia emissions must be reduced, either by covering the manure pit or conveying it through a drag hose.” Using digested manure as a fertilizer instead of using chemical fertilizers can help reduce acidification and eutrophication problems when growing certain crops. However, growing certain crops as opposed to others can lead to different levels of eutrophication and acidification. For example, wheat has a higher eutrophication and acidification impact than petrol (Auer, S., Haulio, M., Lekawska, L., Sonnleitner, M., 2006).

5.3.5.3 Low-Impact

- 13.Q) Do you think that using manure for energy that is derived from animals inherently demonstrates a lack of environmental leadership due the high environmental impacts related to the meat and dairy industry outlined above? If so, how and why? If not, why not?

5.3.5.4 Reducing Acidification and Eutrophication

- 14.Q) To what levels do you think ammonia and phosphorus emissions should be reduced from methane digesters to demonstrate environmental leadership? What are the best practices currently used to reduce ammonia and phosphorus emissions?
- 15.Q) Do you think that digesters should only use products derived from crops that demonstrate lower eutrophication and acidification potential than petrol?
- 16.Q) Should the EcoLogo^{CM} Program require that all digested manure and other fertilizer waste products created by anaerobic digesters be returned to the land? If so, why? If not, why not?

5.4 General Considerations

17.Q) Do you think that all of the potential significant environmental impact categories and related stressors for biogas-powered electricity have been properly addressed in this Certification Discussion Document? If not, which impact and/or stressor do you think is missing and why?

6 Performance Testing

18.Q) Do you know of performance tests the EcoLogo^{CM} Program should be aware of for biogas-powered generating facilities?

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