

Appendix B Greenhouse Gas Emissions

1. Facility Level Greenhouse Gas Emissions

To determine the potential change in greenhouse gas emissions related to the proposed project, a facility level estimate of direct greenhouse gas emissions associated with the existing HyLife Foods facility and the R3 Innovations IWWTF and the proposed alterations at these facilities was completed.

As outlined in the document “Greenhouse Gas Emissions Reporting: Technical Guidance on Reporting Greenhouse Gas Emissions”, greenhouse gas emissions should be estimated using methods consistent with the guidelines adopted by the United Nations Framework Convention on Climate Change (UNFCCC) (Pollutant Inventories and Reporting Division, Environment Canada, 2012). The UNFCCC accepts the Intergovernmental Panel on Climate Change (IPCC) technical documents for estimating greenhouse gas emissions. For the purposes of this assessment, the IPCC technical document titled “2006 IPCC Guidelines for National Greenhouse Gas Inventories” was used to estimate the greenhouse gas emissions (Intergovernmental Panel on Climate Change, 2006). Further guidance on emission factors and methodology was obtained from Canada’s National Inventory Report 1990-2009: Greenhouse Gas Sources and Sinks in Canada (Pollutant Inventories and Reporting Division, Environment Canada, 2011).

Reporting of greenhouse emissions is mandatory in Canada for facilities that emit 50 kilotonnes or more of carbon dioxide (CO₂) equivalent (CO₂e) annually.

Under the facility level reporting guidelines (Pollutant Inventories and Reporting Division, Environment Canada, 2012), when reporting greenhouse gas emissions, the reporter is required to disaggregate the emissions by the following source categories:

- Stationary Fuel Combustion
- Industrial Process
- Venting
- Flaring
- Fugitive
- On-site Transportation
- Waste
- Wastewater

Detailed calculation sheets are attached showing the estimated existing and proposed annual greenhouse gas emissions at the HyLife Foods facility and the IWWTF.

2. HyLife Foods Greenhouse Gas Emissions

The existing HyLife Foods facility and the proposed alterations at this facility will generate direct greenhouse gas emissions under the Industrial Process, Stationary Fuel Combustion and On-Site Transportation source categories.

The following are the greenhouse gas emission sources at the HyLife Foods facility and their related source categories.

- Enteric fermentation of the live hog population at the facility (Industrial Process)
- CO₂ used in the stunning system (Industrial Process)
- CO₂ used to produce dry ice (Industrial Process)
- Diesel fuel combusted in the on-site skid steer (On-Site Transportation)

- Natural gas combusted for building and process heat (Stationary Fuel Combustion)

The proposed alterations at the HyLife Foods facility are not anticipated to change the emission sources at the facility, however are anticipated to increase the amount of greenhouse gas emissions generated at the facility on an annual basis.

Although the HyLife Foods facility contains refrigeration and cooling units, as outlined in the facility level reporting guidelines, emissions of hydrofluorocarbons (HFCs) from refrigeration and air conditioning are not considered industrial process or industrial product use emissions and therefore should not be reported. As such, potential fugitive emissions from refrigeration and cooling units have not been included in this inventory. (Pollutant Inventories and Reporting Division, Environment Canada, 2012)

As wastewater from the hog holding facility is transferred to the IWWTF for treatment and the truck bedding material is stored and applied to land offsite, greenhouse gas emissions associated with the management of manure were not included in this inventory.

2.1 Industrial Process

Enteric fermentation of the live hog population at the HyLife Foods facility will generate methane (CH₄) emissions which is considered a direct greenhouse gas emission. The maximum storage capacity of the holding facility is 4,000 hogs. At the existing processing rate of 27,550 hogs/week, approximately 5,510 hogs pass through the holding facility over a 24 hour period. At the proposed processing rate of 37,500 hogs/week approximately 7,500 hogs will pass through the holding facility over a 24 hour period. Although more hogs will pass through the holding facility over a 24 hour period, the live hog population will never exceed 4,000 hogs as no expansion to the existing holding facility is proposed. To estimate the existing and proposed greenhouse gas emissions associated with the enteric fermentation of the live hog population at the HyLife Foods facility, a total live hog population of 4,000 hogs was assumed to be present within the holding facility for both scenarios.

Carbon dioxide (a greenhouse gas) is used at the HyLife Foods facility in the stunning system and to produce dry ice for product shipments. The proposed increase in processing will increase the CO₂ used in both of these systems.

2.2 On-Site Transportation

A diesel fueled skid steer is used on-site to move materials. The combustion of diesel fuel generates CO₂, CH₄ and nitrous oxide (N₂O) all of which are considered greenhouse gases. The proposed increase in processing is anticipated to increase the amount of diesel fuel used and therefore the associated greenhouse gas emissions.

2.3 Stationary Fuel Combustion

Carbon dioxide, CH₄ and N₂O are generated during the combustion process. The use of natural gas for building and process heat produces carbon dioxide, methane and nitrous oxide emissions. The current rate of natural gas usage at the facility is not expected to change with the increase in hog processing,

2.4 Change in Greenhouse Gas Emissions – HyLife Foods

The following Table presents the current and proposed emissions in carbon dioxide equivalent at the HyLife Foods facility. Detailed calculations sheets are attached.

Table 1: Current and Proposed Carbon Dioxide Emissions

Current Condition		
Total CO ₂ e	25,385	kg CO ₂ e/day
Total CO ₂ e	9,266	tonne CO ₂ e/year
Proposed Condition		
Total CO ₂ e	26,283	kg CO ₂ e/day
Total CO ₂ e	9,593	tonne CO ₂ e/year

3. IWWTF Greenhouse Gas Emissions

According to the IPCC, reported and counted emissions from wastewater treatment are to include CH₄ and N₂O. Aerobic treatment of wastewater can emit substantial quantities of CO₂; however, these emissions are of biogenic origin. In accordance with IPCC reporting guidelines, special consideration is necessary when reporting carbon dioxide emissions from biomass to ensure that there is no double counting. Carbon dioxide emissions from the aerobic treatment of wastewater are not to be included in inventories as it is assumed that the biomass is produced in a sustainable manner meaning that the carbon dioxide released by the degraded biomass is replaced by growing biomass which in turn reabsorbs the same amount of atmospheric carbon as was given during the aerobic wastewater treatment process. Methane and nitrous oxide emissions must be reported for wastewater treatment as there is no reverse biogenic mechanism by which replacement biomass removes these emissions from the atmosphere. As a result, the IPCC have not developed guidelines to quantify the amount of carbon dioxide generated during aerobic wastewater treatment. (Intergovernmental Panel on Climate Change, 2006)

According to the IPCC, wastewater and its sludge can produce methane if degraded anaerobically. During aerobic wastewater treatment, methane production is assumed to be negligible. Methane production is dependent on the quantity of degradable organic material in the wastewater.

Direct emissions of nitrous oxide are generated during both the nitrification and denitrification process in wastewater treatment. The IPCC has developed a method to estimate the nitrous oxide emissions at municipal treatment plants based on the human population discharging to the plant. No method has been developed to determine the nitrous oxide emissions from industrial wastewater treatment facilities (Intergovernmental Panel on Climate Change, 2006).

As the wastewater treatment and sludge management at the IWWTF does not include anaerobic processes, the greenhouse gas emissions to be considered in the facility's inventory are limited to the following sources:

- Diesel fuel combusted in a site truck for moving sludge bins (On-Site Transportation)
- Natural gas combusted for building heat (Stationary Fuel Combustion)

The proposed alterations at the IWWTF facility are not anticipated to change the emission sources at the facility.

3.1 On-Site Transportation

A diesel fueled truck is used on-site to move sludge bins around the IWWTF site. The combustion of diesel fuel generates CO₂, CH₄ and N₂O all of which are considered greenhouse gases. The proposed increase in sludge generation is anticipated to increase the amount of diesel fuel used and therefore the associated greenhouse gas emissions.

3.2 Stationary Fuel Combustion

Carbon dioxide, CH₄ and N₂O are generated during the combustion process. The use of natural gas for building heat and produces carbon dioxide, methane and nitrous oxide emissions. No increase in natural gas usage is anticipated at the IWWTF as a result of the proposed alterations, therefore no changes to the amount of emissions generated are anticipated.

3.3 Change in Greenhouse Gas Emissions - IWWTF

The following Table presents the current and proposed emissions in carbon dioxide equivalent at the IWWTF. Detailed calculations sheets are attached.

Table 2: Current and Proposed Carbon Dioxide Emissions

Current Condition		
Total CO ₂ e	179	kg CO ₂ e/day
Total CO ₂ e	65	tonne CO ₂ e/year
Proposed Condition		
Total CO ₂ e	182	kg CO ₂ e/day
Total CO ₂ e	66	tonne CO ₂ e/year

4. References

Pollutant Inventories and Reporting Division, Environment Canada. (2012). *Greenhouse Gas Emissions Reporting: Technical Guidance on Reporting Greenhouse Gas Emissions*. Gatineau QC: Government of Canada.

Intergovernmental Panel on Climate Change. (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Hayama, Japan: Institute for Global Environmental Strategies.

Pollutant Inventories and Reporting Division, Environment Canada. (2011). *National Inventory Report 1990-2009: Greenhouse Gas Sources and Sinks in Canada*. Available at <http://www.ec.gc.ca/ges-ghg/>

Calculations based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Current Condition - HyLife Foods			
Stationary Fuel Combustion			Notes
Natural Gas Usage - building and process heat	4,500,000	m ³ /year	Provided by HyLife Foods
Emissions GHG = Fuel Consumption x Emission Factor			
CO ₂ Emission Factor	1,877	g CO ₂ /m ³	Canada - National Inventory Report 1990-2009 Table A8-1 CO ₂ Emission Factors for Natural Gas, Manitoba, Marketable
CH ₄ Emission Factor	0.037	g CH ₄ /m ³	Canada - National Inventory Report 1990-2009 Table A8-2 CH ₄ and N ₂ O Emission Factors for Natural Gas, Industrial
N ₂ O Emission Factor	0.033	g N ₂ O/m ³	Canada - National Inventory Report 1990-2009 Table A8-2 CH ₄ and N ₂ O Emission Factors for Natural Gas, Industrial
CO ₂ emissions	8446500000.00	g CO ₂ /year	
CO₂ emissions	23141.10	kg CO₂/day	
CH ₄ emissions	166500.00	g CH ₄ /year	
CH₄ emissions	0.46	kg CH₄/day	
N ₂ O emissions	148500.00	g N ₂ O/year	
N₂O emissions	0.41	kg N₂O/day	
Industrial Process			
Live hog population	4,000	hogs	Maximum capacity of the holding facility is 4,000 hogs - barn is emptied and filled throughout the day but live hog population never exceeds this. As wastewater from holding facility is transferred to IWWTF for treatment, manure management emissions are anticipated to be negligible
Emissions GHG = Live hog population x Emission Factor			
CH ₄ Emission Factor	1.5	kg CH ₄ /head/year	Canada - National Inventory Report 1990-2009 Table A8-22 Methane Emission Factors for Enteric Fermentation for Non-cattle Animals, Pigs >60 kg emission factor
CH ₄ emissions	6000.00	kg CH ₄ /year	No emission factors are available for CO ₂ and N ₂ O emissions from enteric fermentation
CH₄ emissions	16.44	kg CH₄/day	
CO ₂ Use (Dry Ice and Stunning)	620384.00	kg CO ₂ /year	Provided by HyLife Foods
CO₂ emissions	1699.68	kg CO₂/day	
On-Site Transportation			
Diesel used in Skid Steer	165	L/week	Provided by HyLife Foods
Emissions GHG = Fuel Consumption x Emission Factor			
CO ₂ Emission Factor	2,663	g CO ₂ /L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
CH ₄ Emission Factor	0.140	g CH ₄ /L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
N ₂ O Emission Factor	0.082	g N ₂ O/L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
CO ₂ emissions	439395.00	g CO ₂ /week	
CO₂ emissions	62.60	kg CO₂/day	
CH ₄ emissions	23.10	g CH ₄ /week	
CH₄ emissions	0.0033	kg CH₄/day	
N ₂ O emissions	13.53	g N ₂ O/week	
N₂O emissions	0.0019	kg N₂O/day	
TOTAL EMISSIONS HYLIFE FOODS AS CO ₂ EQUIVALENT			
Total CO ₂	24903.38	kg CO ₂ /day	
Total CH ₄	16.90	kg CH ₄ /day	
Total N ₂ O	0.4088	kg N ₂ O/day	
GWP CH ₄	21		IPCC values
GWP N ₂ O	310		IPCC values
Total CO₂e	25,385	kg CO₂e/day	
	9,266	tonnes CO₂e/year	
Current Condition - IWWTF			
Stationary Fuel Combustion			Notes
Natural Gas Usage	33,467	m ³ /year	Provided by HyLife Foods
Emissions GHG = Fuel Consumption x Emission Factor			
CO ₂ Emission Factor	1,877	g CO ₂ /m ³	Canada - National Inventory Report 1990-2009 Table A8-1 CO ₂ Emission Factors for Natural Gas, Manitoba, Marketable
CH ₄ Emission Factor	0.037	g CH ₄ /m ³	Canada - National Inventory Report 1990-2009 Table A8-2 CH ₄ and N ₂ O Emission Factors for Natural Gas, Industrial
N ₂ O Emission Factor	0.033	g N ₂ O/m ³	Canada - National Inventory Report 1990-2009 Table A8-2 CH ₄ and N ₂ O Emission Factors for Natural Gas, Industrial
CO ₂ emissions	62817559.00	g CO ₂ /year	
CO₂ emissions	172.10	kg CO₂/day	
CH ₄ emissions	1238.28	g CH ₄ /year	
CH₄ emissions	0.0034	kg CH₄/day	
N ₂ O emissions	1104.41	g N ₂ O/year	
N₂O emissions	0.0030	kg N₂O/day	
On-Site Transportation			
Diesel used in onsite truck for sludge bin movement	852	L/year	Provided by HyLife Foods
Emissions GHG = Fuel Consumption x Emission Factor			
CO ₂ Emission Factor	2,663	g CO ₂ /L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
CH ₄ Emission Factor	0.140	g CH ₄ /L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
N ₂ O Emission Factor	0.082	g N ₂ O/L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
CO ₂ emissions	2268876.00	g CO ₂ /year	
CO₂ emissions	6.22	kg CO₂/day	
CH ₄ emissions	119.28	g CH ₄ /year	
CH₄ emissions	0.0003	kg CH₄/day	
N ₂ O emissions	69.86	g N ₂ O/year	
N₂O emissions	0.0002	kg N₂O/day	
TOTAL EMISSIONS IWWTF AS CO ₂ EQUIVALENT			
Total CO ₂	178.32	kg CO ₂ /day	
Total CH ₄	0.004	kg CH ₄ /day	
Total N ₂ O	0.0032	kg N ₂ O/day	
GWP CH ₄	21		IPCC values
GWP N ₂ O	310		IPCC values
Total CO₂e	179	kg CO₂e/day	
	65	tonnes CO₂e/year	

Calculations based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Proposed Condition - HyLife Foods			
Stationary Fuel Combustion			Notes
Natural Gas Usage - building and process heat	4,500,000	m ³ /year	Provided by HyLife Foods
Emissions GHG = Fuel Consumption x Emission Factor			
CO ₂ Emission Factor	1,877	g CO ₂ /m ³	Canada - National Inventory Report 1990-2009 Table A8-1 CO ₂ Emission Factors for Natural Gas, Manitoba, Marketable
CH ₄ Emission Factor	0.037	g CH ₄ /m ³	Canada - National Inventory Report 1990-2009 Table A8-2 CH ₄ and N ₂ O Emission Factors for Natural Gas, Industrial
N ₂ O Emission Factor	0.033	g N ₂ O/m ³	Canada - National Inventory Report 1990-2009 Table A8-2 CH ₄ and N ₂ O Emission Factors for Natural Gas, Industrial
CO ₂ emissions	8446500000.00	g CO ₂ /year	
CO₂ emissions	23141.10	kg CO₂/day	
CH ₄ emissions	166500.00	g CH ₄ /year	
CH₄ emissions	0.46	kg CH₄/day	
N ₂ O emissions	148500.00	g N ₂ O/year	
N₂O emissions	0.41	kg N₂O/day	
Industrial Process			
Live hog population	4,000	hogs	Maximum capacity of the holding facility is 4,000 hogs - barn is emptied and filled throughout the day but live hog population never exceeds this. As wastewater from holding facility is transferred to IWWTF for treatment, manure management emissions are anticipated to be negligible
Emissions GHG = Live hog population x Emission Factor			
CH ₄ Emission Factor	1.5	kg CH ₄ /head/year	Canada - National Inventory Report 1990-2009 Table A8-22 Methane Emission Factors for Enteric Fermentation for Non-cattle Animals, Pigs >60 kg emission factor
CH ₄ emissions	6000.00	kg CH ₄ /year	No emission factors are available for CO ₂ and N ₂ O emissions from enteric fermentation
CH₄ emissions	16.44	kg CH₄/day	
CO ₂ Use (Dry Ice and Stunning)	946800.00	kg CO ₂ /year	Provided by HyLife Foods
CO₂ emissions	2593.97	kg CO₂/day	
On-Site Transportation			
Diesel used in Skid Steer	175	L/week	Provided by HyLife Foods
Emissions GHG = Fuel Consumption x Emission Factor			
CO ₂ Emission Factor	2,663	g CO ₂ /L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
CH ₄ Emission Factor	0.140	g CH ₄ /L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
N ₂ O Emission Factor	0.082	g N ₂ O/L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
CO ₂ emissions	466025.00	g CO ₂ /week	
CO₂ emissions	66.39	kg CO₂/day	
CH ₄ emissions	24.50	g CH ₄ /week	
CH₄ emissions	0.0035	kg CH₄/day	
N ₂ O emissions	14.35	g N ₂ O/week	
N₂O emissions	0.0020	kg N₂O/day	
TOTAL EMISSIONS HYLIFE FOODS AS CO ₂ EQUIVALENT			
Total CO ₂	25801.46	kg CO ₂ /day	
Total CH ₄	16.90	kg CH ₄ /day	
Total N ₂ O	0.4089	kg N ₂ O/day	
GWP CH ₄	21		IPCC values
GWP N ₂ O	310		IPCC values
Total CO₂ e	26,283	kg CO₂ e/day	
	9,593	tonnes CO₂ e/year	
Proposed Condition - IWWTF			
Stationary Fuel Combustion			Notes
Natural Gas Usage	33,467	m ³ /year	Provided by HyLife Foods - no change in annual consumption anticipated
Emissions GHG = Fuel Consumption x Emission Factor			
CO ₂ Emission Factor	1,877	g CO ₂ /m ³	Canada - National Inventory Report 1990-2009 Table A8-1 CO ₂ Emission Factors for Natural Gas, Manitoba, Marketable
CH ₄ Emission Factor	0.037	g CH ₄ /m ³	Canada - National Inventory Report 1990-2009 Table A8-2 CH ₄ and N ₂ O Emission Factors for Natural Gas, Industrial
N ₂ O Emission Factor	0.033	g N ₂ O/m ³	Canada - National Inventory Report 1990-2009 Table A8-2 CH ₄ and N ₂ O Emission Factors for Natural Gas, Industrial
CO ₂ emissions	62817559.00	g CO ₂ /year	
CO₂ emissions	172.10	kg CO₂/day	
CH ₄ emissions	1238.28	g CH ₄ /year	
CH₄ emissions	0.0034	kg CH₄/day	
N ₂ O emissions	1104.41	g N ₂ O/year	
N₂O emissions	0.0030	kg N₂O/day	
On-Site Transportation			
Diesel used in onsite truck for sludge bin movement	1,150	L/year	Provided by HyLife Foods
Emissions GHG = Fuel Consumption x Emission Factor			
CO ₂ Emission Factor	2,663	g CO ₂ /L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
CH ₄ Emission Factor	0.140	g CH ₄ /L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
N ₂ O Emission Factor	0.082	g N ₂ O/L	Canada - National Inventory Report 1990-2009 Table A8-11 Emission Factors for Energy Mobile Combustion Sources, Heavy-duty Diesel Vehicles moderate control emission factor
CO ₂ emissions	3062450.00	g CO ₂ /year	
CO₂ emissions	8.39	kg CO₂/day	
CH ₄ emissions	161.00	g CH ₄ /year	
CH₄ emissions	0.0004	kg CH₄/day	
N ₂ O emissions	94.30	g N ₂ O/year	
N₂O emissions	0.0003	kg N₂O/day	
TOTAL EMISSIONS IWWTF AS CO ₂ EQUIVALENT			
Total CO ₂	180.49	kg CO ₂ /day	
Total CH ₄	0.004	kg CH ₄ /day	
Total N ₂ O	0.0033	kg N ₂ O/day	
GWP CH ₄	21		IPCC values
GWP N ₂ O	310		IPCC values
Total CO₂ e	182	kg CO₂ e/day	
	66	tonnes CO₂ e/year	