

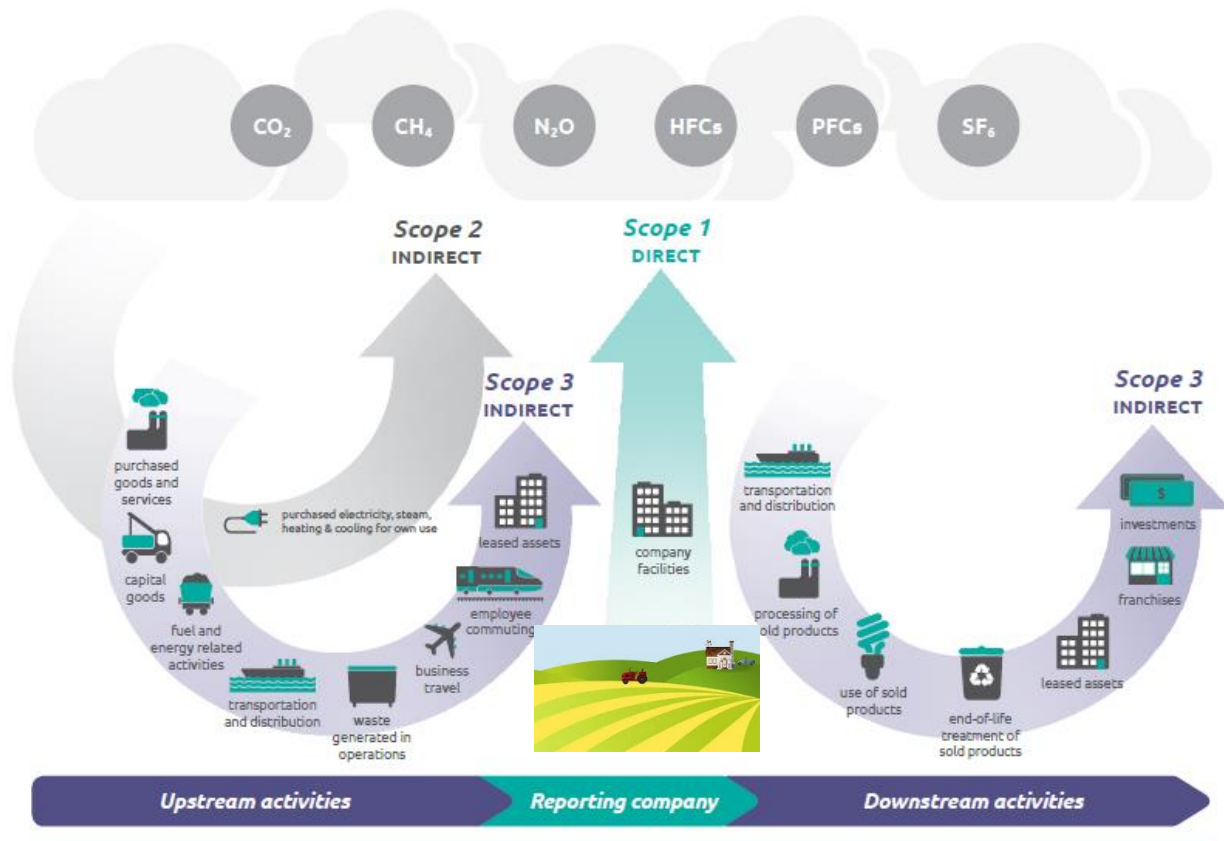


BIOLOGICAL
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A Guide to Calculate a Canadian Farm and Ranch Emissions Footprint



August 15, 2024



Scope One Emissions

Scope 1 emissions are direct greenhouse (GHG) emissions from sources controlled or owned by the farm.

Scope Two Emissions

Scope 2 emissions are indirect GHG emissions associated with purchasing electricity, steam, heat, or cooling. Scope 2 emissions physically occur at the facility. The emissions are accounted for in the farm's GHG inventory due to the farm's energy consumption.

Scope Three Emissions

Scope 3 emissions result from activities from assets not owned or controlled by the farm, but the farm indirectly affects the value chain from purchases to the farm and purchased services on farm exports post-change of ownership.

Farm Scope Manual Calculator

Instructions

The calculator below asks for total numbers. To begin the process, locate all the following records from your on-farm data.

- The land is private and owned. Lease, Crown lease, and rented lands are the responsibility of their owner and not part of these calculations.
- Wetlands and riparian zones to the historic high-water mark are also part of the Crown lease category.
- Livestock should include all animals owned over the 12-month period. If an animal is owned for less than 12 months, pro-rate the period.
- Record fertilizers as the actual nitrogen applied.
- Burning requires an estimate of the total dry matter consumed. Extension papers have used the bushel weight x yield (bu/ac) to approximate stover.
- Fuels required a record of all fuels (liters and gigajoules) consumed.
- Soil sequestration requires hectares under management, new croplands added, and lands sold for development in the year assessed.
- The calculator uses coefficients from Canada's GHG National Inventory Report and Agriculture and Agri-Food Canada.
- There is a new section from older versions addressing a farm's scope 3 emissions.
- Farm data should be a yearly total.
- Private easements on grassland conversion rights are additional but may not create an offset or credit.

Multiply the amount by the emission factor. Once done, add all the emissions together at the bottom.

Dairy Operations

Greenhouse Gas Net Emissions Report				
For the Year Ending (Month, Day, Year)				
Source	(A) Amounts	(B) Months Owned (max 12)	(C) kg/head/mo nth	(A x B x C) Estimated Emissions per year
Dairy				
Dairy Livestock Ch4 Enteric				
Dairy Cows			12.1500	=
Dairy Bulls			10.2667	=
Dairy Heifers			6.3917	=
Dairy Slaughter Heifers			4.5500	=
Dairy Slaughter Steers			4.1583	=
Dairy Calves			3.6583	=
Total CH4 (Enteric) Emissions from Livestock			Sum	=
Total CO2e (CH4 Enteric) Emissions from Livestock	CH4 x 28 = A			=

Dairy Livestock Ch4 Manure				
Dairy Cows	(Same as above)		3.3333	=
Dairy Bulls			0.3917	=
Dairy Heifers			0.2667	=
Dairy Slaughter Heifers			0.1833	=
Dairy Slaughter Steers			0.1667	=
Dairy Calves			0.2417	=
Total CH4 Emissions (Manure) from Livestock			Sum	=
Total CO2e (CH4 Manure) Emissions from Livestock	CH4 x 28 = B			=
Dairy Livestock N2O Manure				
Dairy Cows	(Same as above)		0.0953	=
Dairy Bulls			0.1425	=
Dairy Heifers			0.0761	=
Dairy Slaughter Heifers			0.0437	=
Dairy Slaughter Steers			0.0458	=
Dairy Calves			0.0353	=
Total N2O Emissions (Manure) from Livestock			Sum	=
Total CO2e (N2O Manure) Emissions from Livestock	N2O x 265 = C			=

Cattle Operations

Greenhouse Gas Net Emissions Report				
For the Year Ending (Month, Day, Year)				
Source	(A) Amounts	(B) Months Owned (max 12)	(C) kg/head/month	(A x B x C) Estimated Emissions per year
Beef				
Beef Livestock Ch4 Enteric				
Beef Cows			10.0583	=
Beef Bulls			10.2667	=
Beef Heifers			7.6167	=
Beef Slaughter Heifers			4.5500	=
Beef Slaughter Steers			4.1583	=
Beef Calves			3.6583	=
Total CH4 (Enteric) Emissions from Livestock			Sum	=
Total CO2e (CH4 Enteric) Emissions from Livestock	CH4 x 28 = D			=

Beef Livestock Ch4 Manure				
Beef Cows	(Same as above)		0.3750	=
Beef Bulls			0.3917	=
Beef Heifers			0.2667	=
Beef Slaughter Heifers			0.1833	=
Beef Slaughter Steers			0.1667	=
Beef Calves			0.0319	=
Total CH4 Emissions (Manure) from Livestock			Sum	=
Total CO2e (CH4 Manure) Emissions from Livestock	CH4 x 28 = E			=
Beef Livestock N2O Manure				
Beef Cows	(Same as Above)		0.5680	=
Beef Bulls			0.6092	=
Beef Heifers			0.5444	=
Beef Slaughter Heifers			0.0437	=
Beef Slaughter Steers			0.0458	=
Beef Calves			0.0353	=
Total N2O Emissions (Manure) from Livestock			Sum	=
Total CO2e (N2O Manure) Emissions from Livestock	N2O x 265 = F			=

Swine Operations

Greenhouse Gas Net Emissions Report				
For the Year Ending (Month, Day, Year)				
Source	(A)	(B)	(C)	(A x B x C)
	Amounts	Months Owned (max 12)	kg/head/month	Estimated Emissions per year
Swine				
Swine Ch4 Enteric				
Boars			0.1250	=
Sows			0.1250	=
Pigs < 20kg			0.1250	=
Pigs 20-60 kg			0.1250	=
Pigs > 60 kg			0.1250	=
Total CH4 (Enteric) Emissions from Livestock			Sum	=
Total CO2e (CH4 Enteric) Emissions from Livestock	CH4 x 28 = G			=
Swine Ch4 Manure				
Boars	(Same as Above)		0.5833	=
Sows			0.5833	=
Pigs < 20kg			0.1833	=
Pigs 20-60 kg			0.3500	=
Pigs > 60 kg			0.7833	=
Total CH4 Emissions (Manure) from Livestock			Sum	=
Total CO2e (CH4 Manure) Emissions from Livestock	CH4 x 28 = H			=

Swine N2O Manure				
Boars	(Same as Above)		8.3417	=
Sows			6.4000	=
Pigs < 20kg			0.6417	=
Pigs 20-60 kg			2.4833	=
Pigs > 60 kg			6.4667	=
Total N2O Emissions (Manure) from Livestock			Sum	=
Total CO2e (N2O Manure) Emissions from Livestock	N2O x 265 = I			=

Poultry Operations

Greenhouse Gas Net Emissions Report				
For the Year Ending (Month, Day, Year)				
Source	(A)	(B)	(C)	(A x B x C)
	Amounts	Months Owned (max 12)	kg/head/month	Estimated Emissions per year
Poultry				
Poultry Livestock CH4 Enteric				
Total CO2e (CH4 Enteric) Emissions from Livestock	CH4 x 28 = J			= 0
Poultry Livestock NH3 Manure				
Turkeys			0.0833	=
Chicken Hens			0.0250	=
Pullets			0.0083	=
Broilers			0.0167	=
Total CH4 Emissions (Manure) from Livestock			Sum	=
Total CO2e (NH3 Manure) Emissions from Livestock	NH3 x 3.6 = K			=
Poultry Livestock N2O Manure				
Turkeys	(Same as Above)		0.0058	=
Chicken Hens			0.0014	=
Pullets			0.0007	=
Broilers			0.0012	=
Total N2O Emissions (Manure) from Livestock			Sum	=
Total CO2e (N2O Manure) Emissions from Livestock	N2O x 265 = L			=

Poultry Livestock CH4 Manure				
Turkeys	(Same as Above)		0.0083	=
Chicken Hens			0.0092	=
Pullets			0.0025	=
Broilers			0.0025	=
Total N2O Emissions (Manure) from Livestock			Sum	=
Total CO2e (N2O Manure) Emissions from Livestock	N2O x 28 = M			=

Livestock Summary

LIVESTOCK SUMMARY		CO2e from Animals (N)	CO2e from Manures (CH4) (O)	Manures CO2e (N2O + NH3) (P)	Total kg CO2e
	A				
	B				
	C				
	D				
	E				
	F				
	G				
	H				
	I				
	J				
	K				
	L				
	M				
		Sum	Sum	Sum	
Totals		=	=	=	=

Ag Operations

Yearly Farm Operations			
Source	(A) Amounts	(B) Emission Factor ¹	(A x B) Estimated Emissions per year
Operations	As Applied		
Inorganic Fertilizer (kg of nitrogen)	kg of N	0.01 kg of N ₂ O	= kg
Organic Fertilizer (kg of nitrogen)	kg of N	0.01 kg of N ₂ O	= kg
Animal Manure Applied (kg of nitrogen)	kg of N	0.01 kg of N ₂ O	= kg
Organic Fertilizer (kg of nitrogen)	kg of N	0.01 kg of N ₂ O	= kg
Burning of Annual Crops	Tonnes of Dry Matter	0.06 kg per 1000 tonnes of N ₂ O	= kg
Total N₂O		(a)	= kg
Burning of Annual Crops	Tonnes of Dry Matter	2.5 kg per 1000 tonnes of CH ₄	= kg
Total CH₄		(b)	= kg
Limestone	kg	0.000125 kg of CO ₂	= kg
Urea	kg	0.0002 kg of CO ₂	= kg
Total CO₂		(c)	= kg
(a)		(a) x 265	= kg
(b)		(b) x 28	= kg
(c)		(c) x 1	= kg
Total CO₂e Emissions from Fertilizers and Other Sources			= (a+b+c) kg
			(Q) kg

¹ Based on 2021 ECCC IPCC Background Tables

Yearly Farm Energy and Fuels

Source	(A) Amounts	(B) Emission Factor	(A x B) Estimated Emissions per year
Farm Diesel		2.89 kg per liter	= kg
Farm Gasoline		2.23 kg per liter	= kg
Farm Natural Gas		52.6 kg per Gj	= kg
Farm Propane		1.565 kg per liter	= kg
Farm Electricity		Per Kwh (see Table)	= kg
Total CO2e Emissions from Energy Consumption			= (R) kg

Land and Sinks

Land and Soil Sinks			
Source	(A) Amounts	(B) Emission Factor	(A x B) Estimated Emissions per year
Private Owned Lands	# Hectares		
Annual Owned Cropland		See Ecozone Table	= kg
Additional Cropping Management	AA	See Table Below	= kg
Management of Owned Native Grasslands		-26 kg	= kg <small>This number will be negative.</small>
Management of Owned Tame Forage		-110 kg	= kg <small>This number will be negative.</small>
Management of Owned Intensive Grazing		-804 kg	= kg <small>This number will be negative.</small>
Conversion of Forrest to Cropland	New Hectares Added in the crop year.	See Ecozone Table	= kg
Conversion of Grassland to Cropland	New Hectares Added in the crop year.	3,696 kg	= kg
Conversion of Cropland to Urban	New Hectares Added in the crop year.	10,256 kg	= kg
Conversion of Grassland to Urban	New Hectares Added in the crop year.	21,400 kg	= kg
Total CO2e Net Emissions from Land Sources			Sum = (S) kg

Emission Summary

Summary of Emissions				
Total CH4 Enteric Emissions	(N)	↻		kg CO2e
Total CH4 Manure Emissions	(O)	↻		kg CO2e
Total N2O Manure Emissions	(P)	↻		kg CO2e
Total CO2e Fertilizer Emissions and Other Sources	(Q)	↻		kg CO2e
Total CO2e Energy Emissions	(R)	↻		kg CO2e
Total CO2e Net Land Emissions	(S)	↻		kg CO2e
Scope 3 emissions	(T)	↻		kg CO2e
Total GHG Footprint CO2e	Sum			kg CO2e

Ecozone Sink Tables

Ecozone	Cropland remaining cropland kg/ha	Forest converted to cropland kg/ha
Boreal Plains	-108.103	33.73003
Subhumid prairies	-669.682	-37.0625
Semiarid prairies	-862.807	0
Taiga Plain	1126.667	0
Montane Cordillera	235.6604	66.10711
Pacific Maritime	944.125	-302.449
Boreal Shield East	295.8199	-143.588
Atlantic Maritime	213.5527	234.2269
Mixed-wood Plains	332.8179	-164.632
Boreal Shield West	-85.551	-10.8379

Electricity Table

Province	Factor per kwh	Province	Factor per kwh
BC	0.001 kg	PQ	0.001 kg
AB	0.590 kg	NB	0.280 kg
SK	0.580 kg	PEI	0.001 kg
MB	0.001 kg	NS	0.680 kg
ON	0.025 kg	NL	0.028 kg
YK	0.1 kg	NT	0.280 kg

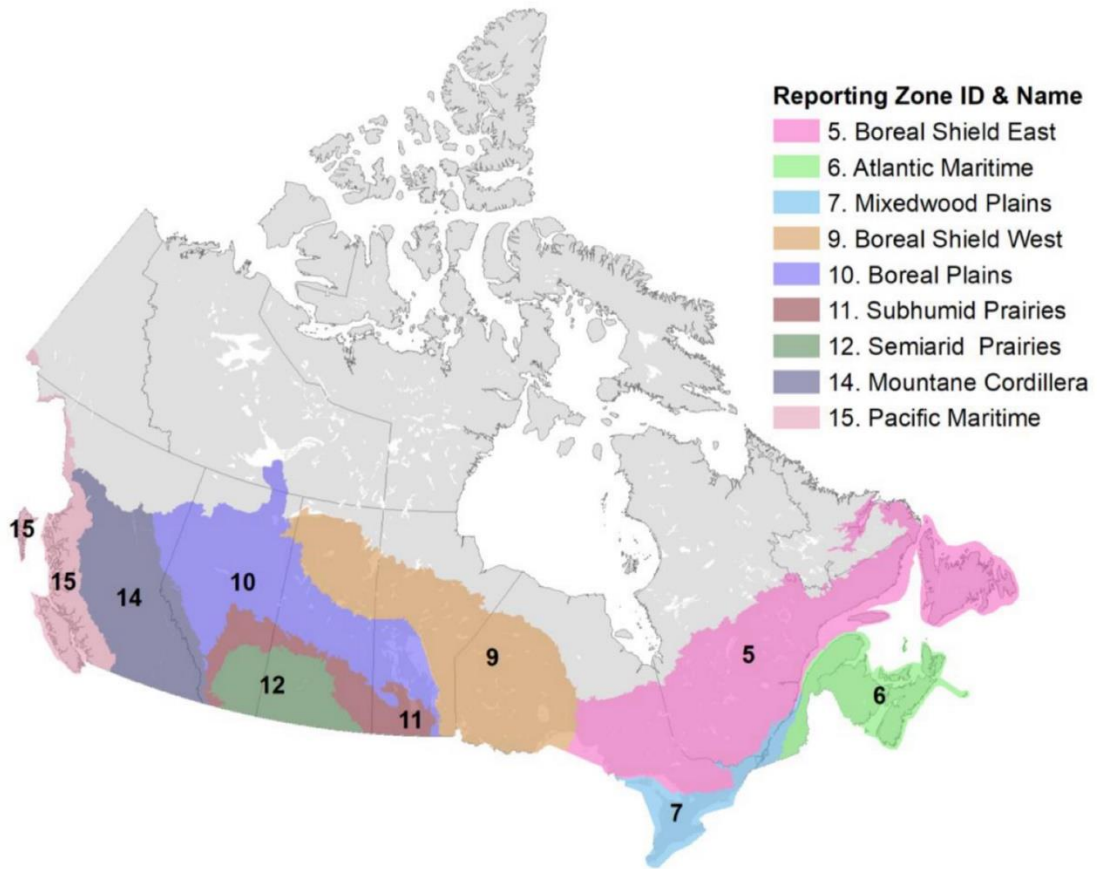
Scope 3 Emissions

Item Purchased	CO2e per Unit	Yearly Quantity Purchased	CO2e total
Example 2x4 8 ft board	8 kg	100	= 800 kg
Example Baler Twine	4.77 kg/kg	100 units or 1120 kg/unit	= 5,342 kg
		Totals	= (T)

Additional Crop Management

AAFC Additional Management For Cropping Year	Additional CO ₂ e cropland kg/ha (a)	# Hectares using (b)	Total kg = a x b
Winter Cover Crop	-180	x	= kg
Intercropping	-290	x	= kg
Fertilizer Inhibitors	-120	x	= kg
Split Fertilizer Application	-60	x	= kg
Organic Amendments	-440	x	= kg
Legume in Rotation	-81	x	= kg
Fertilizer Spring Application	-37	x	= kg
Fertilizer Fall Application	37	x	= kg
Fall Tillage	20	x	= kg
Tame pastures with Legumes	-40	x	= kg
Other Known Coefficients			
Easement to Prevent Conversion on Private Native Grasslands	-500	x	= kg
Emission savings from the application of fertilizer delivered with individual boot sectional controls on the implement.	3% of the total GHG from purchased fertilizers.	deduct	= kg
Sale of Offsets or Credits			
Sale 1 _____ kg	Yearly total kg sold.	Add back	= kg
Sale 2 _____ kg	Yearly total kg sold.	Add back	= kg
TOTALS	(AA)		= kg

Ecozone Maps



Factors and Coefficients

BCC knows of many good discussions and debates on the coefficients used to identify and measure greenhouse gas emissions and sinks. Therefore, this worksheet uses the ECCC and AAFC coefficients. For the grasslands and forage, we recognize better soil and grazing management does leave an increase in net energy, increasing soil carbon over time. The coefficients used are conservative.

As other coefficients become better known and our scientific community expands their on-farm coefficient work, BCC commits to revising our calculator.

For Membership and Other Extension Information

Biological Carbon Canada

www.biologicalcarbon.ca