DUFFERIN COUNTY

Community Greenhouse Gas Inventory

Dufferin county

Clean Air Partnership

Clean Air Partnership

ABOUT THE CLEAN AIR PARTNERSHIP:

Clean Air Partnership (CAP) is a registered charity that works in partnership to promote and coordinate actions to improve local air quality and reduce greenhouse gases for healthy communities. Our applied research on municipal policies strives to broaden and improve access to public policy debate on air pollution and climate change issues. Clean Air Partnership's mission is to transform cities into more sustainable, resilient, and vibrant communities where resources are used efficiently, the air is clean to breathe and greenhouse gas emissions are minimized.

REPORT AUTHORS:

Allie Ho, Clean Air Partnership

Kevin Behan, Clean Air Partnership

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INTRODUCTION

1.0 | INTRODUCTION

Climate Change is one of the most urgent challenges facing humanity. Dufferin County is developing a Community Climate Action Plan to focus on mitigating the County's greenhouse gas (GHG) emissions while also adopting a climate lens for everyday activities and decisions to increase community climate resiliency.

Canada's Changing Climate Report found that Canada's climate is warming twice as rapidly compared to the rest of the world.[1] Due to human activity, as well as a combination of climate processes and feedback mechanisms, warming in Canada is expected to increase further in the future. This will have major implications for local climate patterns, human and environmental health, and economic development.

The Intergovernmental Panel on Climate Change (IPCC) released a report in the fall of 2018, *Special Report on Global Warming of 1.5°C*, stressing the urgency in limiting global temperature rise to 1.5°C above pre-industrial levels by the end of the century.[2] The report stated that global net anthropogenic CO2 emissions must decline by 45% from 2010 levels by 2030 to reach net zero by 2050 as projected from modelled pathways.

1 Canada's Changing Climate Report, 2019

2 Special Report on Global Warming of 1.5°C, 2018

1.1 | CLIMATE CHANGE AND DUFFERIN COUNTY

In May 2018, Dufferin County joined the Partners for Climate Protection (PCP) program delivered by the Federation of Canadian Municipalities (FCM) and ICLEI-Local Governments for Sustainability. This program supports and guides the municipality in reducing GHG emissions through the Milestone Framework. The five milestones are:

- **Milestone 1:** Creating a baseline emissions inventory and forecast
- **Milestone 2:** Set emissions reduction target
- **Milestone 3:** Develop a local action plan
- **Milestone 4:** Implement the local action plan
- **Milestone 5:** Monitor progress and report results

This report summarizes a baseline inventory of community GHG emissions of within Dufferin's geographical boundaries to fulfill the requirements for Milestone 1 of the PCP program.

1.2 | MILESTONE 1

A greenhouse gas inventory summarizes and tracks the GHG emissions released by corporate and/or community activities. This inventory is focussed on community GHG generation, and uses 2016 as the baseline year.
The following sectors are included in the inventory:

- Residential Buildings
- Institutional and Commercial Buildings
- Industrial Buildings
- Other Buildings
- Transportation
- Community Solid Waste
- Agriculture, Forestry and Other Land Use (AFOLU)

DATA SOURCES

2.0 | DATA SOURCES

In order to compile and complete a thorough community GHG inventory, complete, accurate, and real consumption data were used. In the absence of consumption data, assumptions were made using downscaled provincial data. Table 1 lists the data sources that were used for each sector.

TABLE 1. DATA SOURCES USED FOR COMMUNITY GHG EMISSIONS INVENTORY

SECTOR	DATA SOURCE	DATA TYPE
ELECTRICITY	HYDRO ONE	Electricity consumption for customer type and postal code (residential, commercial, industrial, other) (kwh)
	ORANGEVILLE HYDRO	Electricity consumption for customer type and postal code (residential, commercial, industrial, other) (kwh)
NATURAL GAS	ENBRIDGE INC.	Natural gas consumption for customer type and postal code (residential, commercial, industrial, other) (m^3)
PROPANE AND HEATING OIL	NATURAL RESOURCES CANADA	Provincial estimations of propane and heating oil use
	STATISTICS CANADA	Provincial rural population data

SECTOR	DATA SOURCE	DATA TYPE
TRANSPORTATION	TRANSPORTATION TOMORROW SURVEY, UNIVERSITY OF TORONTO DATA MANAGEMENT GROUP	Vehicle kilometres travelled
	ONTARIO MINISTRY OF TRANSPORTATION	Vehicle registration data (number of passenger vehicles)
	STATISTICS CANADA	Provincial Data on commercial transportation fuel
COMMUNITY SOLID WASTE	DUFFERIN COUNTY WASTE SERVICES	Waste generation amount (tonnes)
AFOLU	ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS (OMAFRA)	Livestock numbers

Once the data were collected, appropriate emission coefficients were applied to each energy source to calculate the GHG emissions (see Table 2). These emission coefficients were obtained primarily from Canada's National Inventory Report Part 2[1] with some emissions calculated using the PCP Milestone Tool.[2] All emissions are converted to carbon dioxide equivalents (CO_2e) to allow for meaningful comparison among different GHGs. GHG emissions generated from electricity usage for residential, commercial, industrial and other buildings were calculated with the corresponding electricity emission intensity value specific to Ontario for 2016.

1 Canada's National Inventory Report Part 2, 2017

2 PCP Milestone Tool

TABLE 2. SUMMARY OF EMISSION COEFFICIENT VALUES

ENERGY SOURCE	EMISSION COEFFICIENT
ELECTRICITY	0.00004 T CO_2E
NATURAL GAS	0.001899 T CO_2E
UNLEADED GAS	2.307 KG / L
DIESEL	2.681 KG / L
PROPANE	1.515 KG / L
CALVES	43.8 $KGCH_4$ / HEAD
STEERS	48.8 $KGCH_4$ / HEAD
BEEF COWS	121.3 $KGCH_4$ / HEAD
DAIRY COWS	137.5 $KGCH_4$ / HEAD
PIGS	1.5 $KGCH_4$ / HEAD
SHEEP AND LAMBS	8 $KGCH_4$ / HEAD
CALVES (MANURE MANAGEMENT)	2.9 $KGCH_4$ / HEAD
STEERS (MANURE MANAGEMENT)	2 $KGCH_4$/HEAD
BEEF COWS	4.5 $KGCH_4$ / HEAD
DAIRY COWS	37 $KGCH_4$/HEAD
PIGS <20 KG (MANURE MANAGEMENT)	2.1 $KGCH_4$ / HEAD*
PIGS 20-60 KG (MANURE MANAGEMENT)	4.3 $KGCH_4$ / HEAD*
PIGS >60 KG (MANURE MANAGEMENT)	9 $KGCH_4$ / HEAD
SHEEP (MANURE MANAGEMENT)	0.33 $KGCH_4$ / HEAD
LAMBS (MANURE MANAGEMENT)	0.22 $KGCH_4$ / HEAD*
CHICKENS (MANURE MANAGEMENT)	0.03 $KGCH_4$ / HEAD
HENS (MANURE MANAGEMENT)	0.12 $KGCH_4$ / HEAD*
TURKEYS (MANURE MANAGEMENT)	0.1 $KGCH_4$ / HEAD

**Emission coefficient not used in calculations due to unavailable data*

3.0 | COMMUNITY GREENHOUSE GAS INVENTORY METHODOLOGY AND RESULTS

In 2016, 438,687 tonnes of CO_2e were emitted by the community of Dufferin County. Table 3 summarizes the total community GHG emissions by sector and Table 4 summarizes the emissions by energy source. The same information is presented graphically in Figure 1 and Figure 2.

TABLE 3. DUFFERIN COUNTY COMMUNITY EMISSIONS BY SECTOR

SECTOR	CO_2E PRODUCED (TONNES)	%
RESIDENTIAL	94,440	22%
COMMERCIAL	20,797	5%
INDUSTRIAL	7,451	2%
OTHER	21,139	5%
TRANSPORTATION	215,499	49%
SOLID WASTE	8,180	2%
AFOLU	70,760	16%
TOTAL	**438,266**	**100%**

TABLE 4. DUFFERIN COUNTY COMMUNITY EMISSIONS BY ENERGY SOURCE

ENERGY SOURCE	CONSUMPTION	CO_2E PRODUCED (TONNES)	%
ELECTRICITY	585,833,011kwh	23,012	5%
NATURAL GAS	53,084,019m^3	100,825	23%
GASOLINE	85,035,238L	202,870	46%
DIESEL	2,953,638L	8,180	2%
PROPANE	7,513,527L	11,531	3%
HEATING OIL	1,662,848L	12,908	3%
SOLID WASTE	7,100T	8,180	2%
LIVESTOCK	2,830kgCH_4	70,760	16%
TOTAL		**438,266**	**100%**

FIGURE 1. DUFFERIN COUNTY COMMUNITY EMISSIONS BY SECTOR

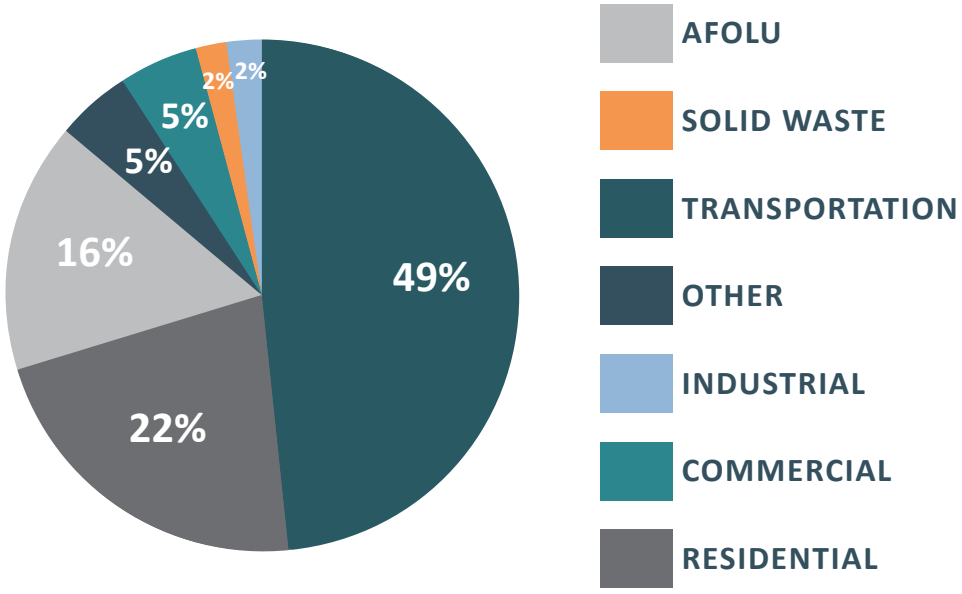
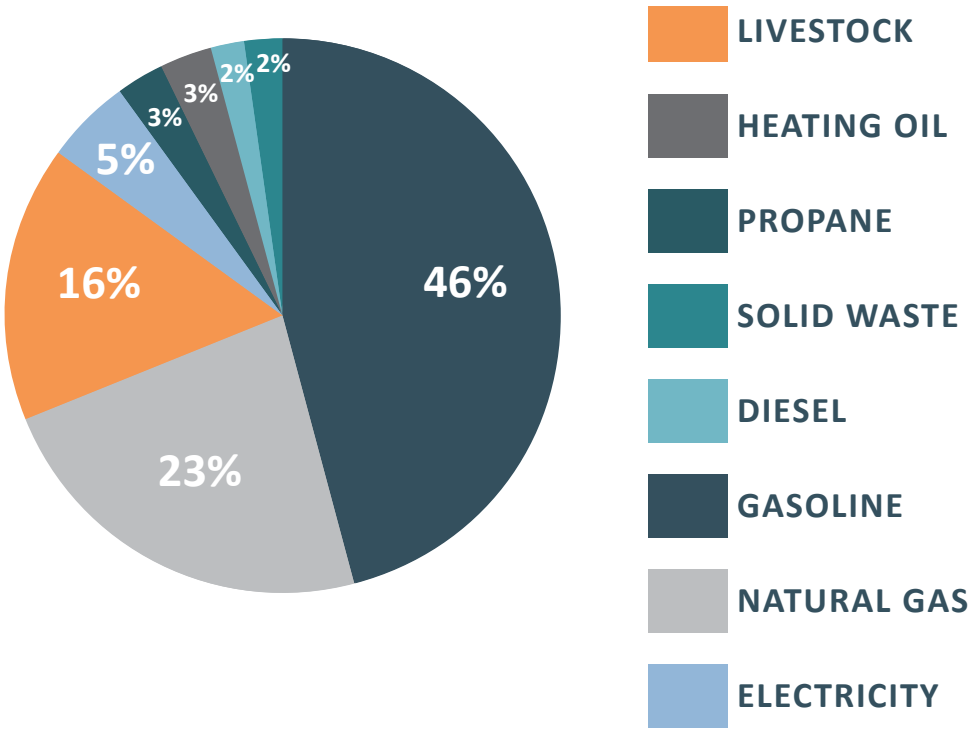


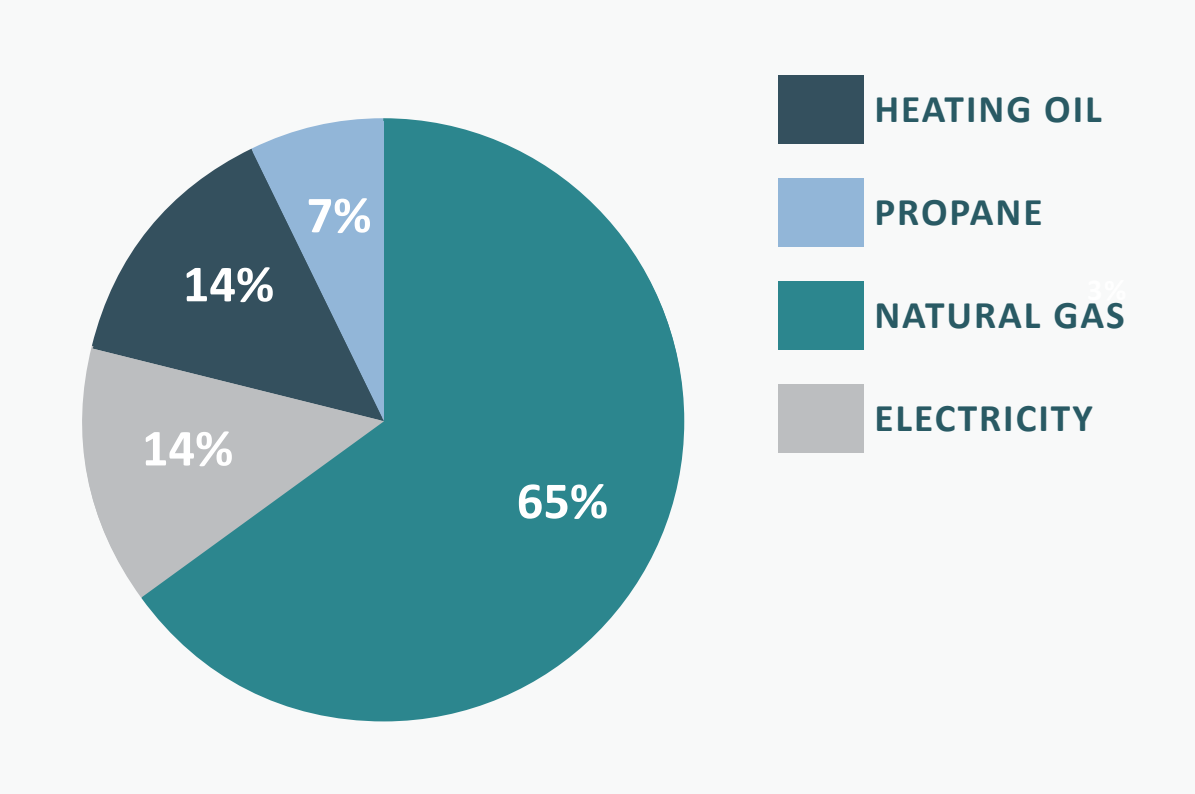
FIGURE 2. DUFFERIN COUNTY COMMUNITY EMISSIONS BY ENERGY SOURCE



3.1 | RESIDENTIAL BUILDINGS

Residential buildings make up 22% of the County's community emissions. There are 4 main energy sources that were included to calculate the greenhouse gas emissions for this sector: electricity, natural gas, propane and heating oil (see Figure 3). Wood burning is recognized as a significant and popular form for heating, however, as there is no data available, its prevalence within Dufferin County is unknown and therefore its emissions were omitted for this inventory. Wood burning is considered carbon neutral in GHG accounting protocols, so this omission is typical.

FIGURE 3. DISTRIBUTION OF RESIDENTIAL EMISSIONS BY ENERGY SOURCE



3.1.1. | ELECTRICITY

There were two main electricity distributors who service Dufferin County; Hydro One and Orangeville Hydro. Orangeville Hydro covers Orangeville and parts of Grand Valley, while Hydro One covers all remaining areas. In 2016, the demand from residential households serviced by Hydro One was 232,924,920 kwh while for Orangeville Hydro, it was 92,676,425 kwh for a total of 325,601,345 kwh (see Table 5).

TABLE 5. ELECTRICITY CONSUMPTION AND GHG EMISSIONS FROM RESIDENTIAL BUILDINGS

SECTOR	TOTAL CONSUMPTION (KWH)	CO_2E (TONNES)
RESIDENTIAL	325,601,345	13,024

3.1.2. | NATURAL GAS

Enbridge Gas supplied natural gas in Dufferin County to areas where there were existing gas lines. In 2016, natural gas consumption from residential households were 32,340,639m^3 (see Table 6).

TABLE 6. NATURAL GAS CONSUMPTION AND GHG EMISSIONS FROM RESIDENTIAL BUILDINGS

SECTOR	TOTAL CONSUMPTION (M^3)	CO_2E (TONNES)
RESIDENTIAL	32,340,639	61,426

3.1.3. | PROPANE

In rural parts of the County, where natural gas lines have not been installed, many households use propane as their main energy source. Residential propane uses include furnaces, hot water heaters, gas stoves and other appliances. For this section, larger municipalities that have access to natural gas lines were excluded. This includes Orangeville, Shelburne and Grand Valley. Results from these assumptions for residential propane use were for the remaining 5 municipalities of Amaranth, East Garafraxa, Melancthon, Mono and Mulmur.

For this inventory, local suppliers were unable to provide quantities of propane used for residential, commercial and industrial purposes so real consumption data was unavailable Therefore, provincial data downscaling was required to calculate estimated residential propane emissions from the municipalities. Commercial and industrial use of propane could not be determined but are assumed to be minimal.

The average house size is around 1,743ft^2. This was acquired through the Municipal Property Assessment Corporation (MPAC) for Dufferin County. For this inventory, it is assumed that a household's annual propane consumption would be 2.5 x 500-gallon tanks.[1] One gallon is equivalent to 3.8 litres.

There are 5,169,174 dwellings in Ontario, of which 714,380 are rural. The total number of households in Ontario using propane as their main heating energy source were 92,458 households calculated through a survey conducted by Natural Resources Canada (NRCan)[2] and data from Statistics Canada.[3]

1 Santa Energy.com, 2019

2 Natural Resources Canada, 2015

3 Statistics Canada, 2016

Assuming only non-urban households use propane, the proportion of rural households using propane is estimated at 12.94%. We apply this same factor to all rural Dufferin County households. The total number of households were acquired through Dufferin County's ArcGIS Esri Community Analytics (see Table 7).

The resulting number of households using propane is summarized in Table 8 and the propane emissions from residential buildings is summarized in Table 9.

TABLE 7. SUMMARY OF TOTAL HOUSEHOLDS

MUNICIPALITY	TOTAL HOUSEHOLDS
AMARANTH	1,340
EAST GARAFRAXA	854
MELANCTHON	1,028
MONO	2,938
MULMUR	1,315
GRAND VALLEY	1,106
ORANGEVILLE	10,527
SHELBURNE	2,787
TOTAL	**21,895**

TABLE 8. TOTAL NUMBER OF HOUSEHOLDS USING PROPANE AND TOTAL PROPANE USAGE

MUNICIPALITY	NUMBER OF HOUSEHOLDS USING PROPANE	PROPANE USAGE BY HOUSEHOLD (L)
AMARANTH	173	820,468
EAST GARAFRAXA	111	522,895
MELANCTHON	133	629,434
MONO	380	1,798,908
MULMUR	170	805,161

TABLE 9. PROPANE GHG EMISSIONS FROM RESIDENTIAL BUILDINGS

MUNICIPALITY	CO_2E (TONNES)
AMARANTH	1,269
EAST GARAFRAXA	809
MELANCTHON	974
MONO	2,784
MULMUR	1,246

3.1.4. | HEATING OIL

Heating oil is another common energy source for heating homes in a rural setting if natural gas lines do not reach their household. Therefore, the results from assumptions for residential fuel oil use was for the same 5 municipalities as propane: Amaranth, East Garafraxa, Melancthon, Mono and Mulmur.

Assumptions for heating oil were calculated from provincial data following the same methodology for calculating propane use. Commercial and industrial use of heating oil could not be determined. The total number of households, in Ontario, using heating oil as their main heating energy source were 122,888 households in 2016 through the same survey conducted by NRCan[1] and same data from Statistics Canada.[2] Assuming only non-urban households use heating oil, the proportion of rural households using heating oil is estimated at 17.20%. We apply this same factor to all rural Dufferin County households.

An assumption that each household would use a 275-gallon tank of heating oil was made for this inventory and that it is in use during the colder months (November to March). Each month is assumed to also have 4 weeks. Shipley Energy stated that during 0°C weather, a 275-gallon tank will last for approximately 56 days while during -6°C weather, it will last for approximately 39 days.[3] Therefore, for 140 days, a household would need 3.5 tanks. This equates to 962.50 gallons or 3643.46 L. Table 10 summarizes the total heating oil GHG emissions from residential buildings.

1 Natural Resources Canada, 2015

2 Statistics Canada, 2016

3 Shipley Energy, 2020

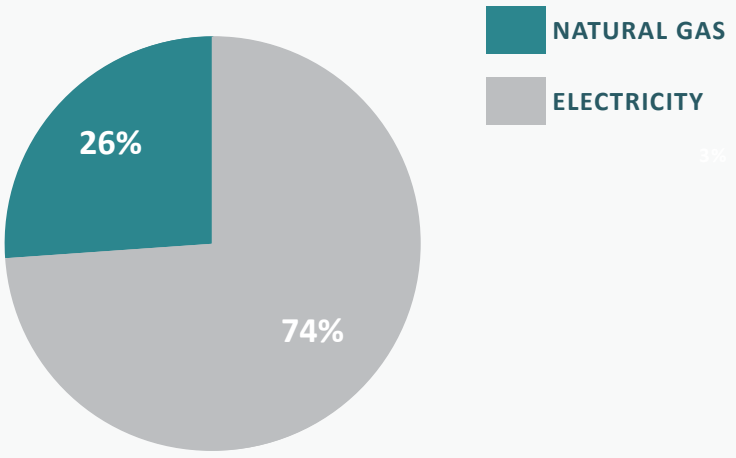
TABLE 10. HEATING OIL CONSUMPTION AND GHG EMISSIONS FROM RESIDENTIAL BUILDINGS

MUNICIPALITY	NUMBER OF HOUSEHOLDS USING HEATING OIL	HEATING OIL USAGE BY HOUSEHOLD (L)	CO_2E (TONNES)
AMARANTH	230	839,744	2,314
EAST GARAFRAXA	147	535,180	1,475
MELANCTHON	177	644,222	1,775
MONO	505	1,841,171	5,073
MULMUR	226	824,077	2,271

3.2 | COMMERCIAL BUILDINGS

Commercial buildings make up 5% of Dufferin County's community emissions. There were 2 main energy sources that were included to calculate the greenhouse gas emissions for this section: electricity and natural gas (see Figure 4).

FIGURE 4. DISTRIBUTION OF COMMERCIAL EMISSIONS BY ENERGY SOURCE



3.2.1 | ELECTRICITY

The two main hydro companies who provided residential service to Dufferin County, Hydro One and Orangeville Hydro also supplied electricity to commercial buildings. In 2016, the demand from commercial buildings serviced by Hydro One was 72,855,280 kwh while for Orangeville Hydro it was 64,423,691 kwh for a grand total of 137,278,971 kwh (see Table 11).

TABLE 11. ELECTRICITY CONSUMPTION AND GHG EMISSIONS FROM COMMERCIAL BUILDINGS

SECTOR	TOTAL CONSUMPTION (KWH)	CO_2E (TONNES)
COMMERCIAL	137,278,971	5,491.16

3.2.2. | NATURAL GAS

Enbridge Gas supplied natural gas in Dufferin County to areas where there are existing gas lines as mentioned in the residential sector. However, please note that Enbridge Gas groups apartment buildings with commercial buildings for the commercial sector. Therefore, for this inventory, these two categories of buildings were combined into this commercial sector. In 2016, natural gas consumption from commercial buildings were 8,058,549 m^3 (see Table 12).

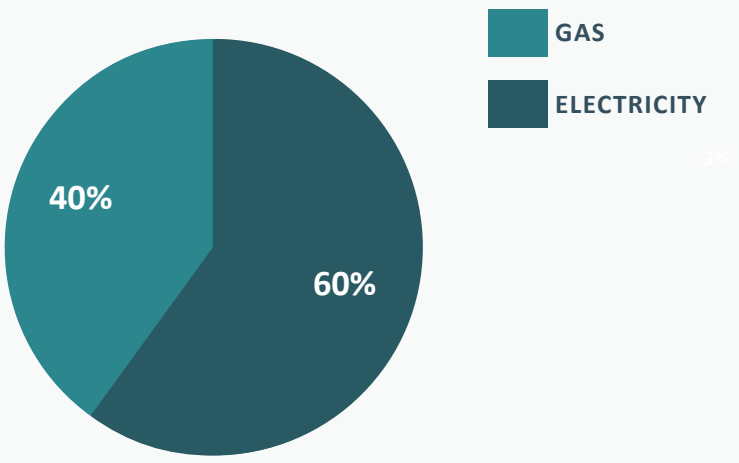
TABLE 12. NATURAL GAS CONSUMPTION AND GHG EMISSIONS FROM COMMERCIAL BUILDINGS

SECTOR	TOTAL CONSUMPTION (M^3)	CO_2E (TONNES)
COMMERCIAL	8,058,549	15,306.09

3.3 | INDUSTRIAL BUILDINGS

Industrial buildings make up 2% of Dufferin County's community emissions. There were 2 main energy sources that were included to calculate the greenhouse gas emissions for this section: electricity and natural gas (see Figure 5).

FIGURE 5. DISTRIBUTION OF INDUSTRIAL EMISSIONS BY ENERGY SOURCE



3.3.1. | ELECTRICITY

Hydro also supplied electricity to industrial buildings. In 2016, the demand from industrial buildings serviced by Hydro One was 30,089,963 kwh while for Orangeville Hydro it was 91,933,547 kwh for a grand total of 122,023,510 kwh (see Table 13).

TABLE 13. ELECTRICITY CONSUMPTION AND GHG EMISSIONS FROM INDUSTRIAL BUILDINGS

SECTOR	TOTAL CONSUMPTION (KWH)	CO_2E (TONNES)
INDUSTRIAL	122,023,510	4,460

3.3.2. | NATURAL GAS

Enbridge Gas supplied natural gas in Dufferin County to areas where there are existing gas lines. In 2016, natural gas consumption from industrial buildings were 1,574,655 m^3 (see Table 14).

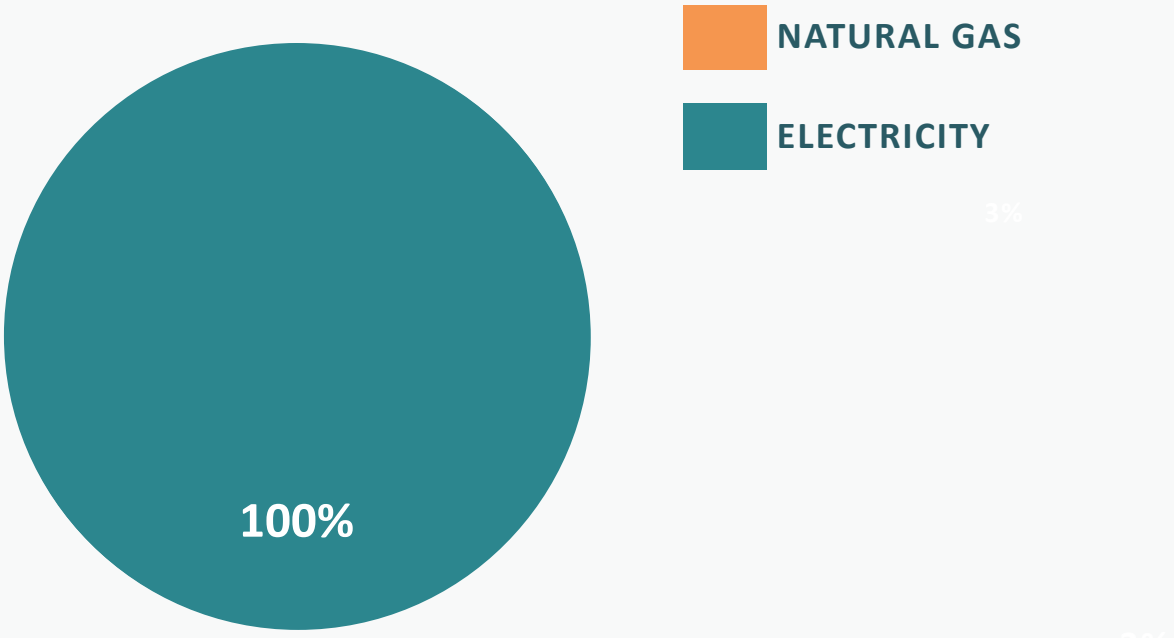
TABLE 14. NATURAL GAS CONSUMPTION AND GHG EMISSIONS FROM INDUSTRIAL BUILDINGS

SECTOR	TOTAL CONSUMPTION (M^3)	CO_2E (TONNES)
INDUSTRIAL	1,574,655	2,991

3.4 | OTHER BUILDINGS

Other buildings make up 5% of Dufferin County's community emissions. There were 2 main energy sources that were included to calculate the greenhouse gas emissions for this section: electricity and natural gas (see Figure 6). The buildings in this section were either large buildings that consumed more than 25% of the total consumption of a certain postal code or buildings that had incorrect postal codes that do not belong to Dufferin County. However, from Enbridge Gas' analysis, a negligent percentage have incorrect postal codes in their system.

FIGURE 6. DISTRIBUTION OF OTHER BUILDING EMISSIONS BY ENERGY SOURCE



3.4.1. | ELECTRICITY

The two main hydro companies who provided service to Dufferin County, Hydro One and Orangeville Hydro also supplied electricity to other buildings. In 2016, the demand from other buildings serviced by Hydro One was 510,127 kwh while for Orangeville Hydro it was 419,058 kwh for a grand total of 929,185 kwh (see Table 15).

TABLE 15. ELECTRICITY CONSUMPTION AND GHG EMISSIONS FROM OTHER BUILDINGS

SECTOR	TOTAL CONSUMPTION (KWH)	CO_2E (TONNES)
OTHER	929,185	37

3.4.2. | NATURAL GAS

Enbridge Gas supplied natural gas in Dufferin County to areas where there are existing gas lines. In 2016, natural gas consumption from other buildings were 11,110,176 m^3 (see Table 16).

TABLE 16. NATURAL GAS CONSUMPTION AND GHG EMISSIONS FROM OTHER BUILDINGS

SECTOR	TOTAL CONSUMPTION (M^3)	CO_2E (TONNES)
OTHER	11,110,176	21,102

3.5 | TRANSPORTATION

Transportation emissions make up 49% of Dufferin County's community emissions. Transportation greenhouse gas emission estimates were based on the Transportation Tomorrow survey conducted by the University of Toronto Data Management Group. Daily vehicle kilometers travelled (VKT) were calculated based on residential surveys on distance travelled in Dufferin County. From this study, total VKT for residential use in 2016 was 772,060,045 km.

Based on 2016 vehicle registration data from the Ontario Ministry of Transportation, the number of total passenger vehicles registered were 37,093 with 22,298 light duty vehicles and 14,795 light duty trucks. Light duty vehicles (passenger cars) and light duty trucks (LDTs) (pickup, minivans and SUVs) are vehicles with a gross vehicle weight rating (GVWR) of less than or equal to 3,900 kg as defined in the PCP protocol. For the calculation of the emissions emitted by both gasoline and diesel, assumptions were made. For this sector, we are using the default fuel type for cars and LDT in the PCP Milestone Tool. 97% of cars use gasoline while 3% use diesel. The same percentage was applied for the LDT and applied to the VKT. The default fuel efficiency for cars using gasoline was 9 L/100 km while the default fuel efficiency for cars using diesel was 7.7 L/100 km. The default fuel efficiency for LDT using gasoline was 14.7 L/100 km while the default fuel efficiency for LDT using diesel was 12.5 L/100 km. The total residential transportation emissions are summarized in Table 17.

Assumptions regarding commercial emissions were made through downscaled provincial data from Statistics Canada[1,2].

1 Statistics Canada, 2020

2 Statistics Canada, 2020

Commercial diesel, unleaded (gas) and propane were assumed to be solely used for transportation fuel. The total commercial transportation emissions are summarized in Table 18 and the total transportation emissions are summarized in Table 19 and graphically in Figure 7.

TABLE 17. RESIDENTIAL TRANSPORTATION GHG EMISSIONS IN DUFFERIN COUNTY

	PASSENGER CARS		LIGHT DUTY TRUCKS	
	UNLEADED (GAS)	DIESEL	UNLEADED (GAS)	DIESEL
LITRES OF FUEL	40,440,505	1,070,075	44,035,217	1,158,090
CO_2E PRODUCED (TONNES)	120,947	3,741	80,631	2,494

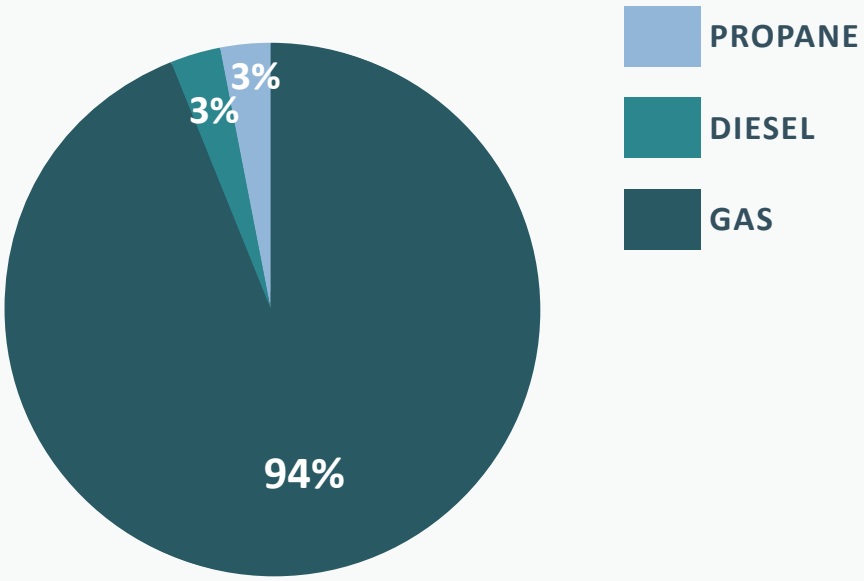
TABLE 18. COMMERCIAL TRANSPORTATION GHG EMISSIONS IN DUFFERIN COUNTY

	UNLEADED (GAS)	DIESEL	PROPANE
LITRES OF FUEL	559,516	725,473	2,936,658
CO_2E (TONNES)	1,291	1,946	4,449

TABLE 19. TOTAL TRANSPORTATION GHG EMISSIONS IN DUFFERIN COUNTY BY FUEL SOURCE

FUEL	CONSUMPTION (L)	CO_2E (TONNES)
UNLEADED (GAS)	85,035,238	202,870
DIESEL	2,953,638	8,180
PROPANE	2,936,658	4,449

FIGURE 7. DISTRIBUTION OF TRANSPORTATION EMISSIONS BY ENERGY SOURCE



3.6 | SOLID WASTE

Community solid waste emissions make up 2% of Dufferin County's community emissions. Dufferin County Waste Services collected county wide waste data which includes residential, institutional, industrial, commercial and corporate solid waste. Since corporate waste is included in the community inventory, corporate solid waste is not included in the corporate inventory to avoid a double count of emissions. The waste is delivered to Pine Tree Acres in Lenox, Michigan, where the landfill gas is captured through a landfill gas system. However, due to unavailable data regarding the amount of annual landfill gas captured, the comprehensive method listed in the PCP Milestone Tool was not used and the methane commitment method was used instead. As the solid waste facility is not located within the County's geographical borders, only solid waste generation emissions were reported for this inventory.

To determine solid waste emissions for each municipality, solid waste emissions were calculated on a per capita basis. The amount of carbon dioxide equivalent emissions and methane emissions were calculated through the PCP Milestone Tool. Dufferin County conducted a waste composition study in 2015 and the composition results were used to calculate the amount of total GHG emissions (see Table 20). The total solid waste emissions are summarized in Table 21.

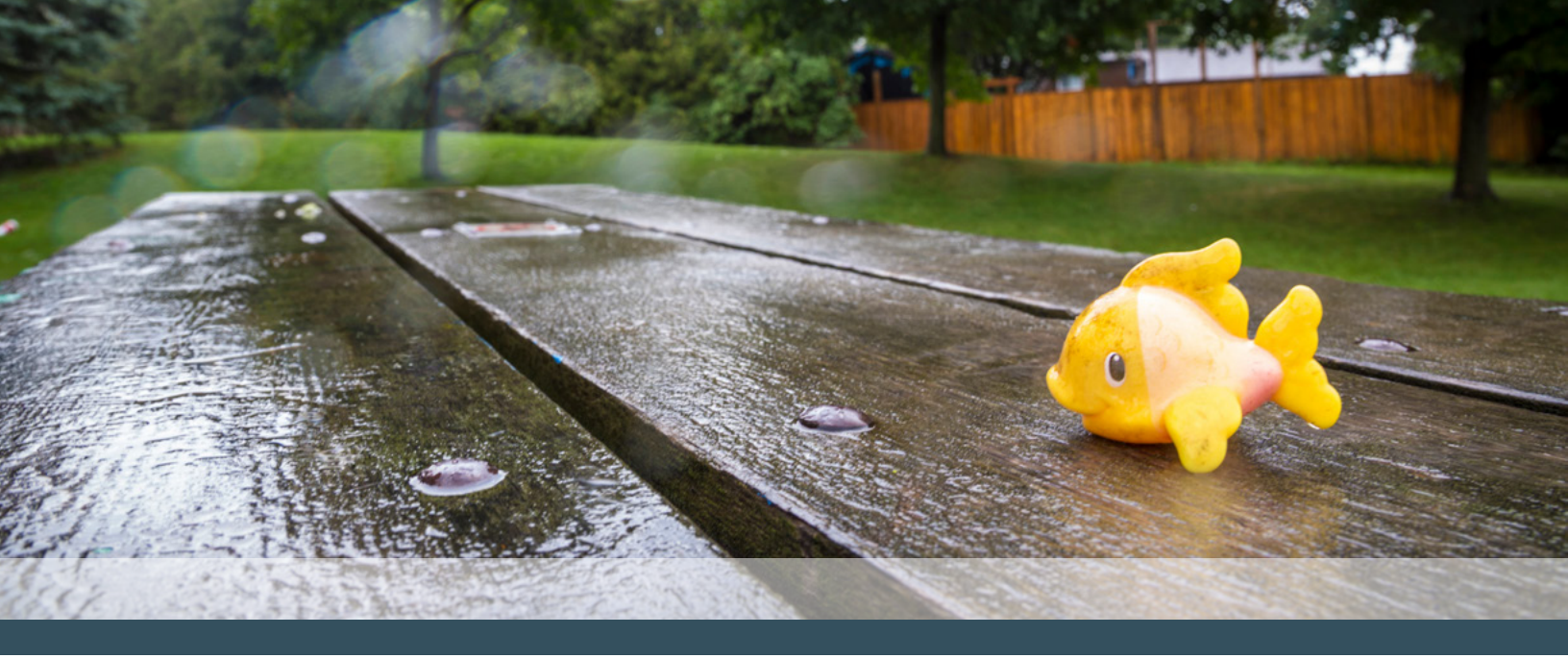


TABLE 20. WASTE COMPOSITION IN DUFFERIN COUNTY IN 2015

COMPOSITION	COMPOSITION AMOUNT (%)
GARBAGE	41
GREEN BIN ORGANICS	32
BLUE BOX RECYCLABLES	19
YARD WASTE	2
ELECTRONICS	2
HAZARDOUS WASTE	1
TEXTILES	1
SCRAP METAL	1

TABLE 21. SOLID WASTE CONSUMPTION AND GHG EMISSIONS IN DUFFERIN COUNTY

SECTOR	CONSUMPTION (TONNES)	CO_2E (TONNES)
SOLID WASTE	7,100.58	8,179.87

3.7 | AGRICULTURE, FORESTRY AND OTHER LAND USE (AFOLU)

Agriculture plays a significant role in Dufferin County's community greenhouse gas emissions as these emissions make up 16% of the community GHG inventory with 70.76 Mt CO_2e produced. Livestock data were collected from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)'s agricultural profile. Emissions from this sector were calculated for emissions from enteric fermentation as well as manure management. Data was unavailable for other sources of emissions within the agriculture sector. Carbon dioxide equivalent emissions produced from methane were calculated through the PCP Milestone Tool. Table 22 summarizes the number of livestock and its resulting emissions through enteric fermentation and is graphically represented in Figure 8. Table 23 summarizes the number of livestock and its resulting emissions through manure management and is graphically represented in Figure 9.

TABLE 22. ENTERIC FERMENTATION EMISSIONS IN DUFFERIN COUNTY IN 2016

LIVESTOCK	NUMBER OF LIVESTOCK	CH_4 PRODUCED (KG)	CO_2E (TONNES)
CATTLE AND CALVES	23,704	1,038,235	25,956
STEERS	6,750	329,400	8,235
BEEF COWS	4,093	496,480.9	12,412
DAIRY COWS	2,568	353,100	8,828
PIGS	27,007	40,510.5	1,013
SHEEP AND LAMBS	12,429	99,432	2,486
HENS AND CHICKENS	248,750	N/A	N/A
TURKEYS	5,883	N/A	N/A

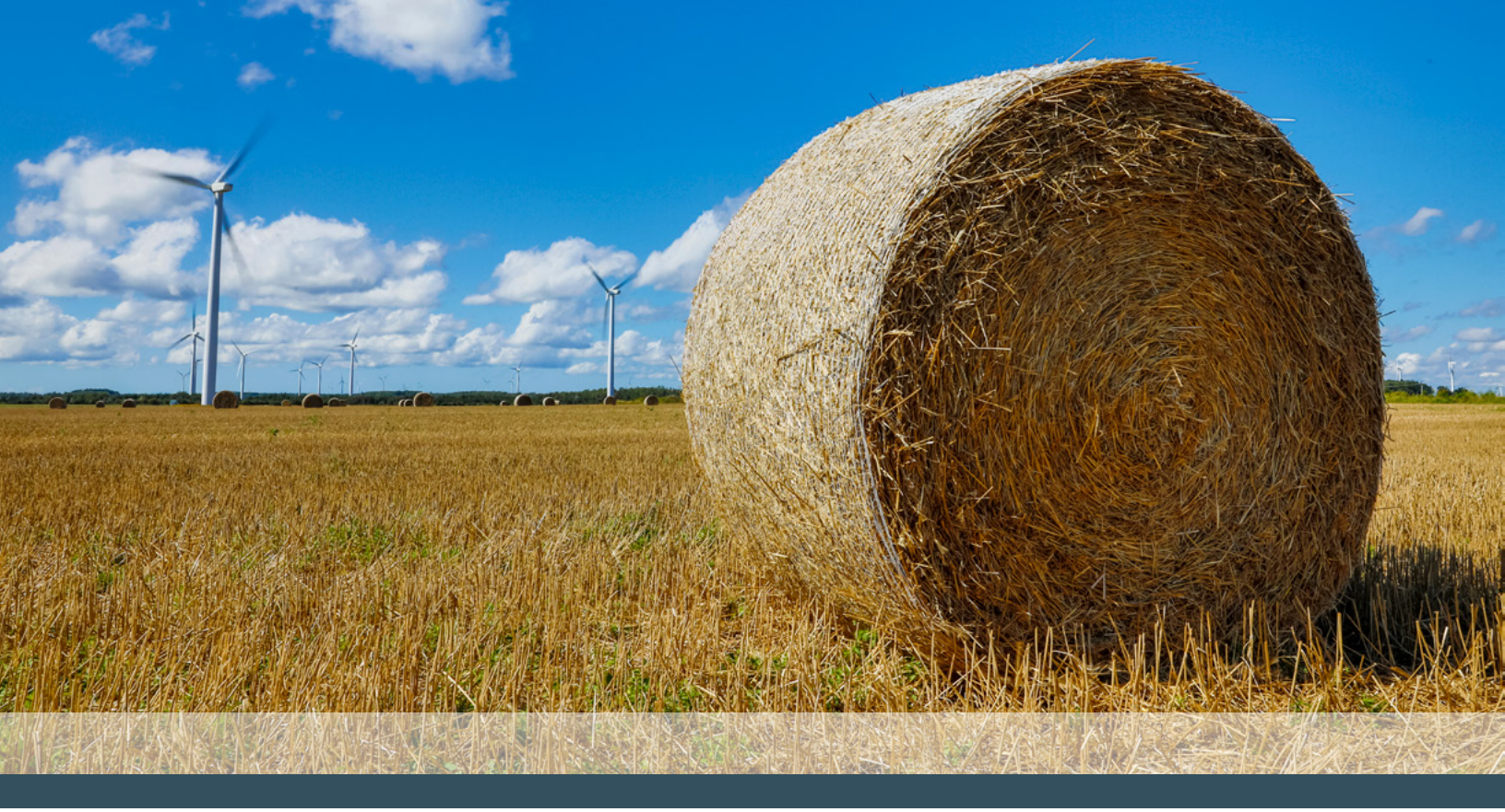


FIGURE 8. VISUAL REPRESENTATION OF THE NUMBER OF LIVESTOCK COMPARED WITH TCO_2E PRODUCED BY ENTERIC FERMENTATION

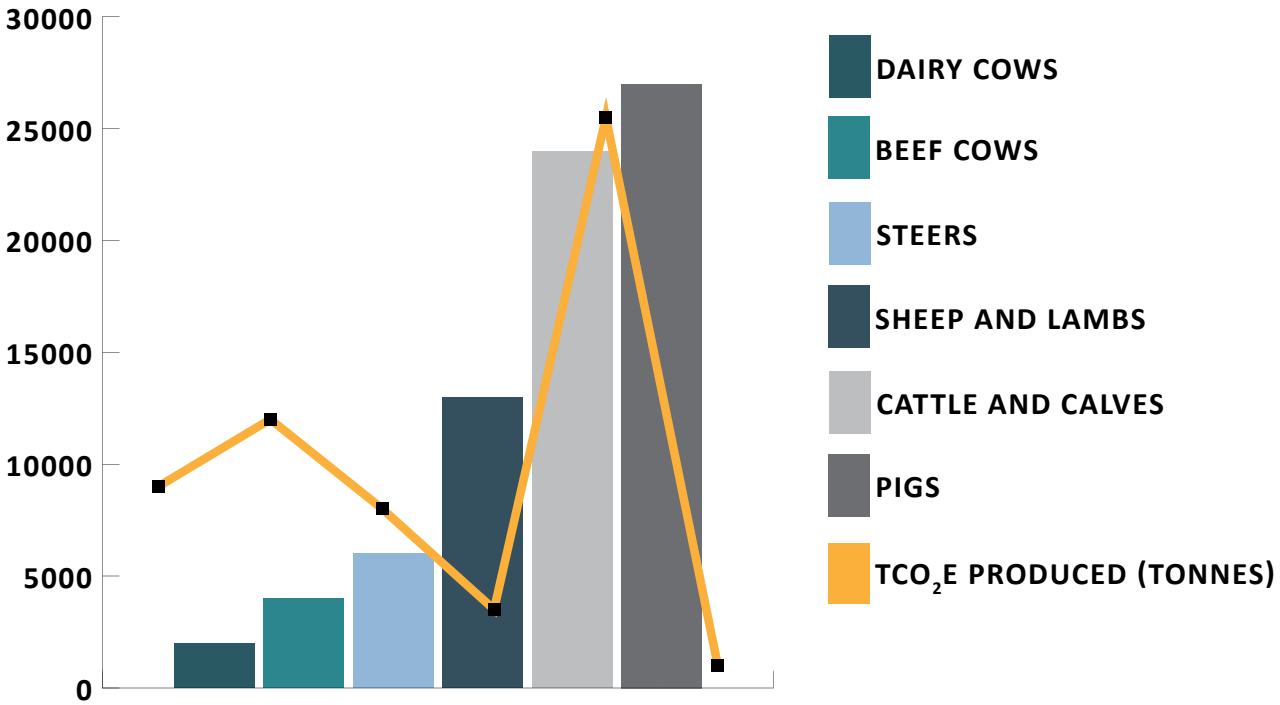
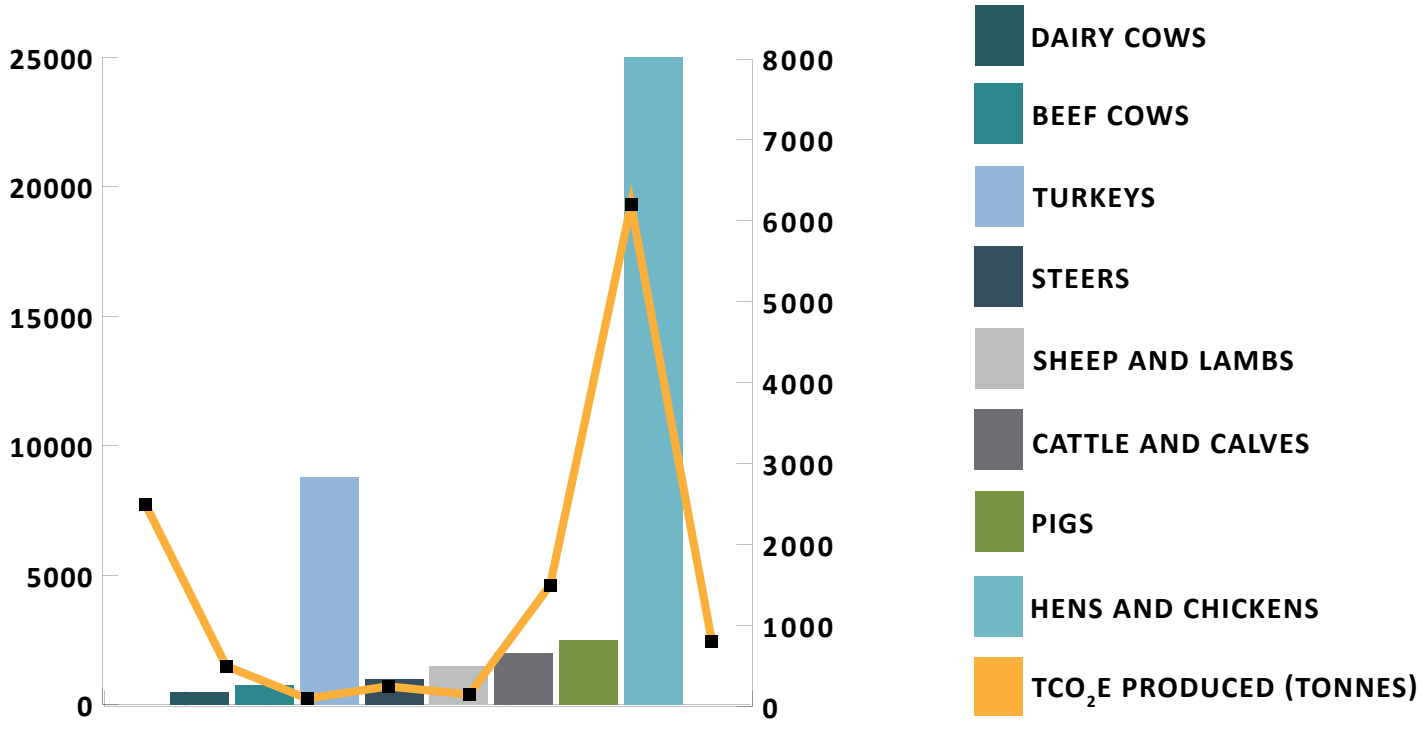


TABLE 23. MANURE MANAGEMENT EMISSIONS IN DUFFERIN COUNTY IN 2016

LIVESTOCK	NUMBER OF LIVESTOCK	CH_4 PRODUCED (KG)	CO_2E (TONNES)
CATTLE AND CALVES	23,704	68,741.6	1,719
STEERS	6,750	13,500	338
BEEF COWS	4,093	18,418.5	460
DAIRY COWS	2,568	95,016	2,375
PIGS	27,007	243,063	6,077
SHEEP AND LAMBS	12,429	4,101.57	103
HENS AND CHICKENS	248,750	29,850	746
TURKEYS	5,883	588.3	15

These emissions produced may be overestimated from actual released emissions due to unavailable data from OMAFRA's Dufferin County agriculture profile. For manure management, the NRI has a separate emission coefficient for pigs of different weight, sheep, lambs, chickens and hens. In the agriculture profile dataset, the pigs were not categorized into a separate weight class as the OMAFRA's agriculture data groups them all together. Similarly, the sheep, lambs, hens and chickens were also grouped in 2 groups (sheep and lambs, hens and chickens) therefore two emission coefficients were used instead of four (refer to Table 2).

FIGURE 9. VISUAL REPRESENTATION OF THE NUMBER OF LIVESTOCK COMPARED WITH TCO_2E PRODUCED THROUGH MANURE MANAGEMENT



LOCAL MUNICIPALITIES

4.0 | LOCAL MUNICIPALITIES WITHIN DUFFERIN COUNTY

Community emissions, except for AFOLU emissions and natural gas emissions, were then separated for the respective municipalities in Dufferin County (see Appendix A). These municipalities are Amaranth, East Garafraxa, Grand Valley, Melancthon, Mono, Mulmur, Orangeville and Shelburne.

In order to accurately separate both electricity and natural gas consumption data to the respective municipalities, only postal codes with 6 digits were used. Due to privacy concerns, some postal codes only consist of 3 or 4 digits. The corresponding data were omitted in the analysis. Therefore, the consumption data for each municipality will be slightly lower but more accurate location-wise.

The data were separated for each municipality to allow for tailored climate plans to be made and while the total consumption data from each municipality will not equal the overall county-wide consumption data, it is important to track the emissions for the overall picture for the county.

LIMITATIONS

5.0 | LIMITATIONS AND AREAS FOR IMPROVEMENT

5.1 | OTHER SOURCES OF ENERGY FOR RESIDENTIAL USE

Due to the limitations of the data given, the estimations done in this inventory that were made regarding propane and heating oil greenhouse gas emissions, are assumptions and may not capture the full extent of what has been released in each municipality. An accurate comparison cannot be made unless real consumption data are collected from local propane suppliers, a conduction of a survey for residential consumption data, or other means of comparing rural data when doing assumptions.

5.2 | TRANSPORTATION

For the transportation sector, real emissions were captured and presented for residential activity. Assumptions from downscaled provincial data were made for commercial activity, but emissions from off-road transportation activity were unavailable. For future inventories, if VKT can be captured and recorded for commercial transportation or fuel sales from local fuel distributors, it will create a clearer picture regarding community emissions in the transportation sector.

5.3 | SOLID WASTE

For the solid waste sector, due to unavailable data regarding the annual landfill gas captured for Pine Tree Acres, the emissions may be overestimated. For future inventories, if this value is available, the emissions from the solid waste sector will be drastically reduced due to the appropriate calculation method.

5.4 | AGRICULTURE, FORESTRY AND OTHER LAND USE (AFOLU)

For the AFOLU sector, as stated in section 3.7, the emissions emitted reflect only emissions from enteric fermentation as well as manure management. However, these emissions are not inclusive of all emissions from this sector in Dufferin County. This inventory does not include propane or other fuel use emissions from high energy farm vehicles and equipment (i.e. grain dryers). The lack of data along with its limitations and uncertainty surrounding this area hinders Dufferin's ability to identify their emission sources and meet the County's climate targets. In order to develop informed decisions and analysis regarding climate solutions and climate adaptation, complete and real data are required. For future inventories, the inclusion of local fuel data from farm vehicles and equipment will form a deeper understanding of how the community's GHG emissions are distributed.

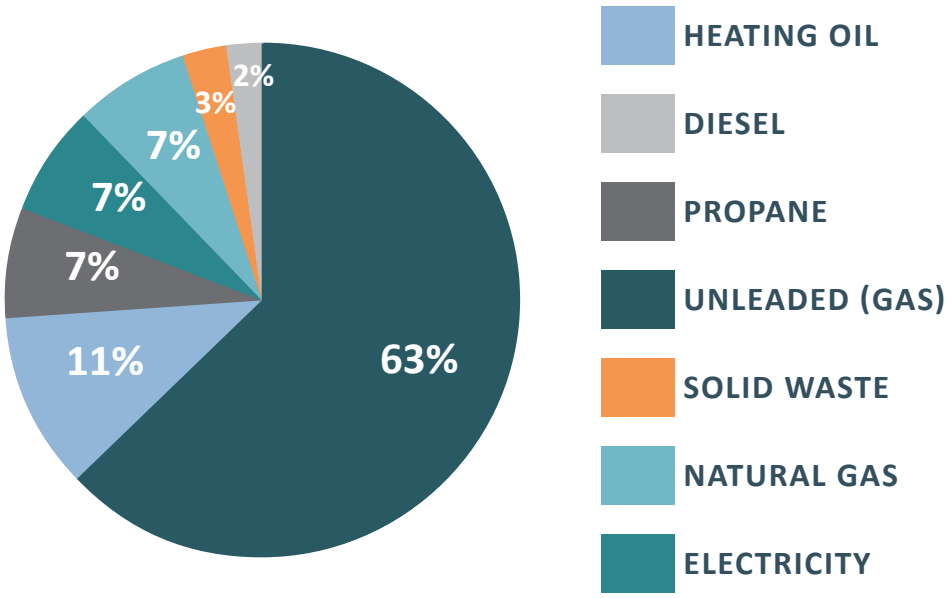
APPENDIX A

APPENDIX A | GREENHOUSE GAS EMISSIONS FOR EACH LOCAL MUNICIPALITY

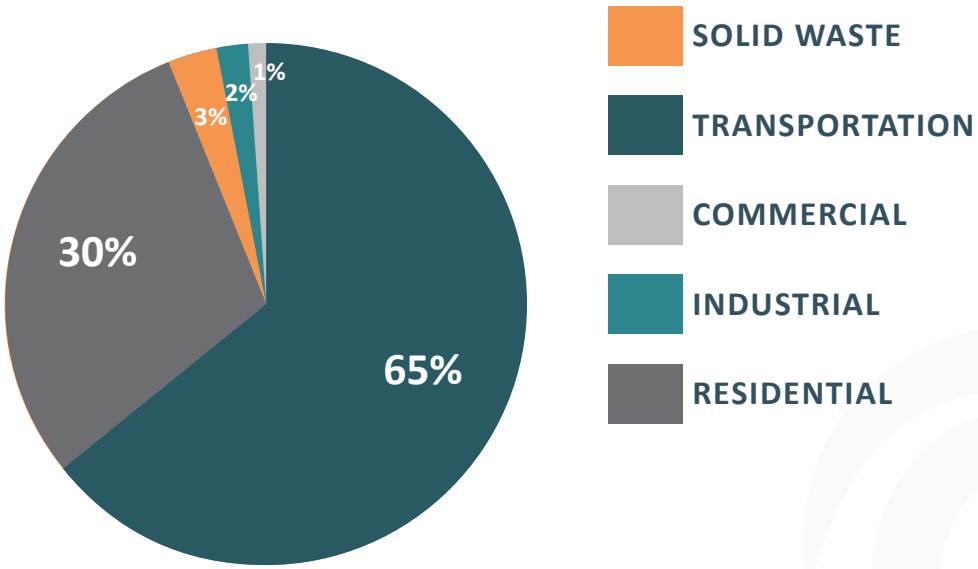
Notes on local emissions apportioning. For the 'AFOLU' and 'Other' sector, emissions were unable to be apportioned by municipality. As such, totals in this section do not perfectly match the total County emissions.

AMARANTH

TCO_2E AMARANTH BY ENERGY SOURCE

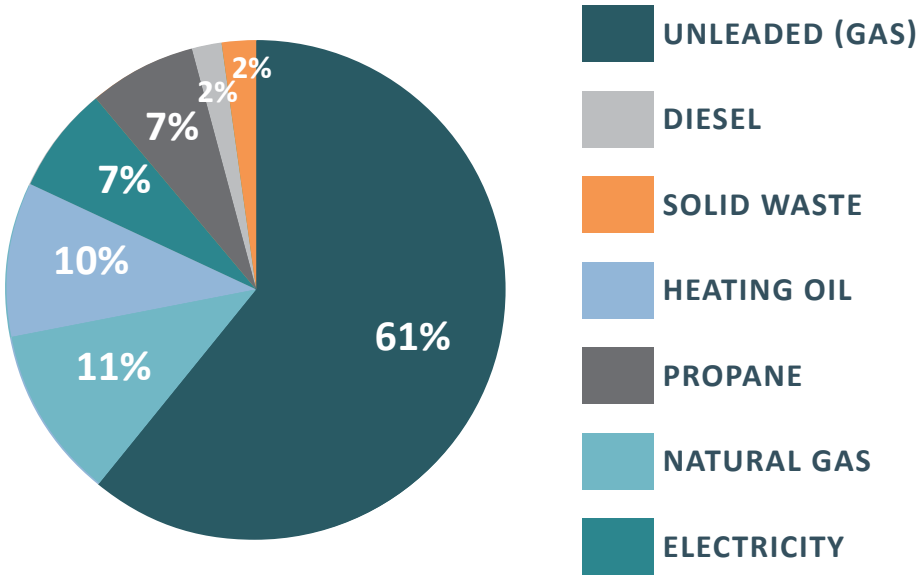


TCO_2E AMARANTH BY SECTOR

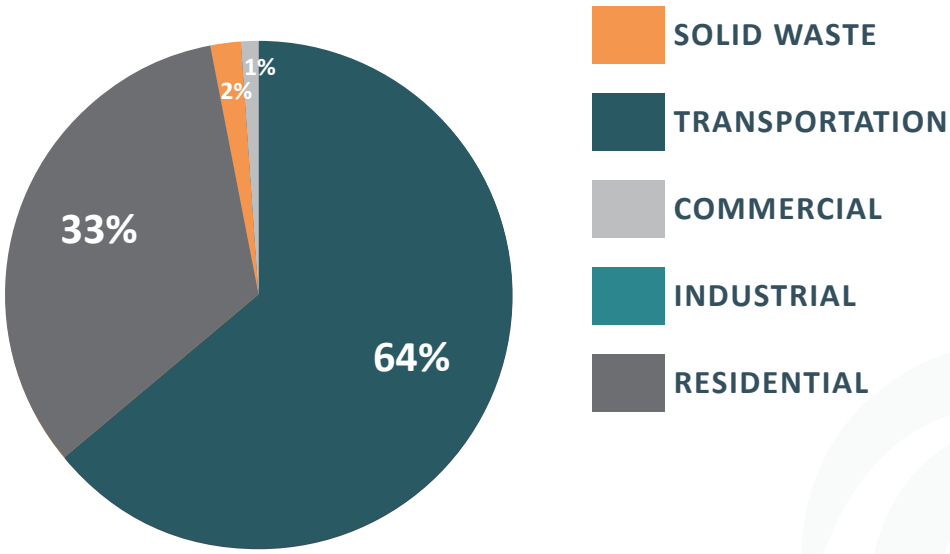


EAST GARAFRAXA

TCO_2E EAST GARAFRAXA BY ENERGY SOURCE

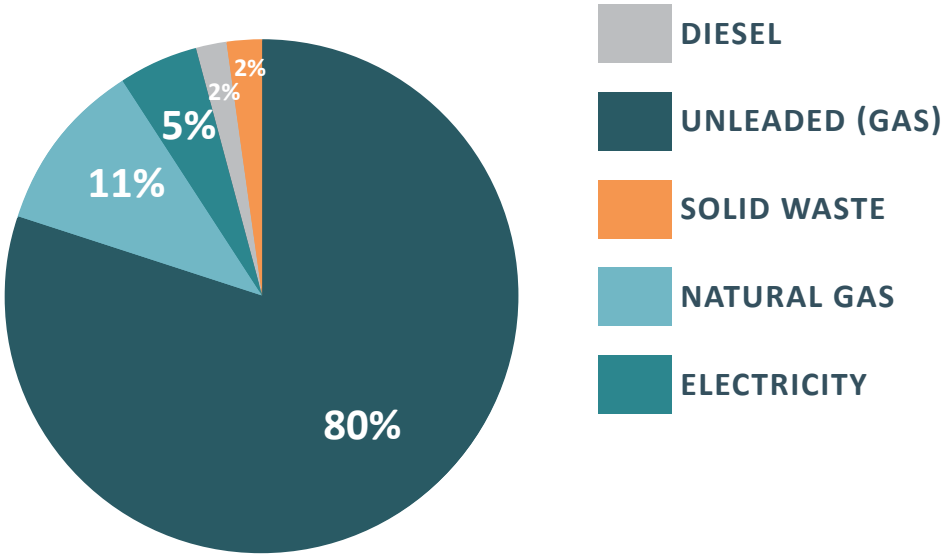


TCO_2E EAST GARAFRAXA BY SECTOR

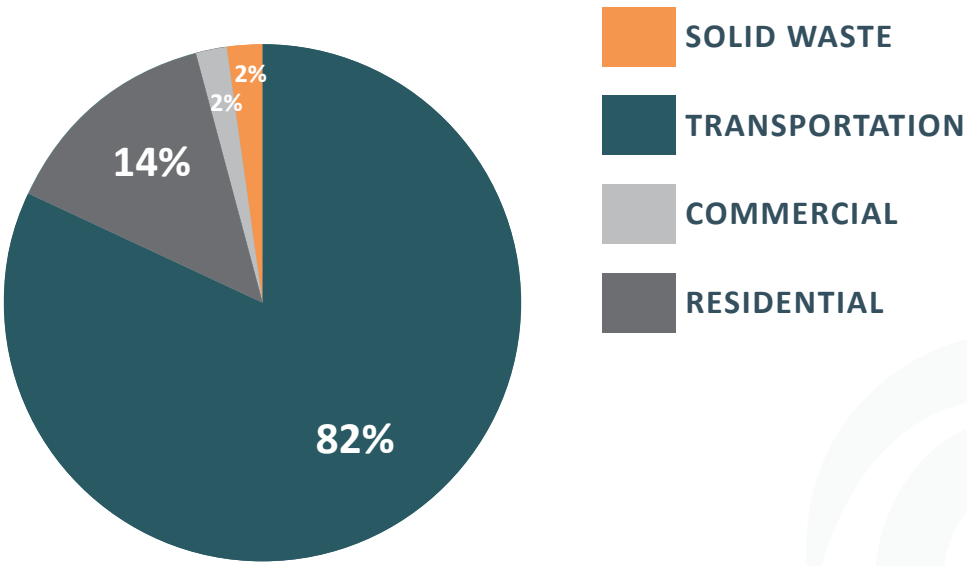


GRAND VALLEY

TCO_2E GRAND VALLEY BY ENERGY SOURCE

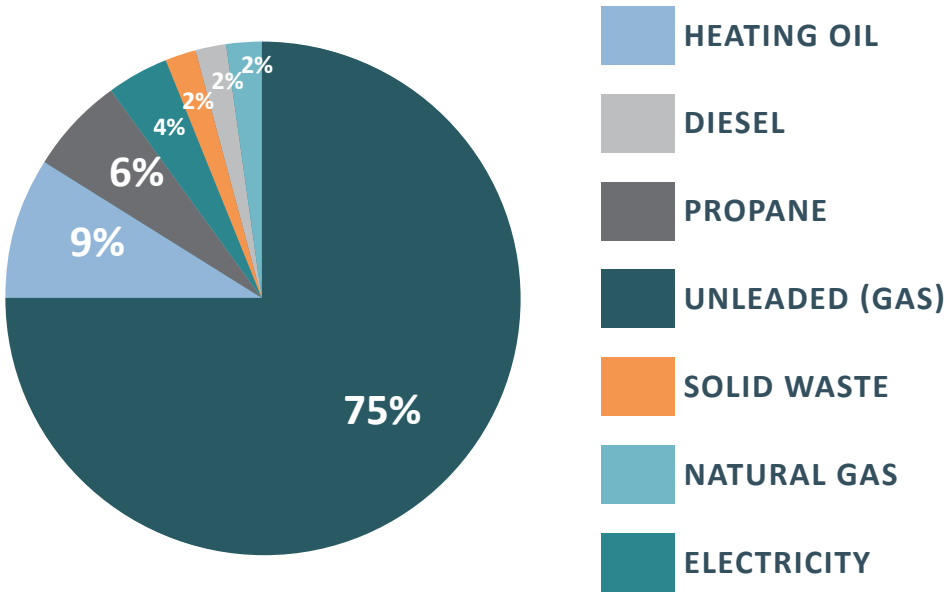


TCO_2E GRAND VALLEY BY SECTOR

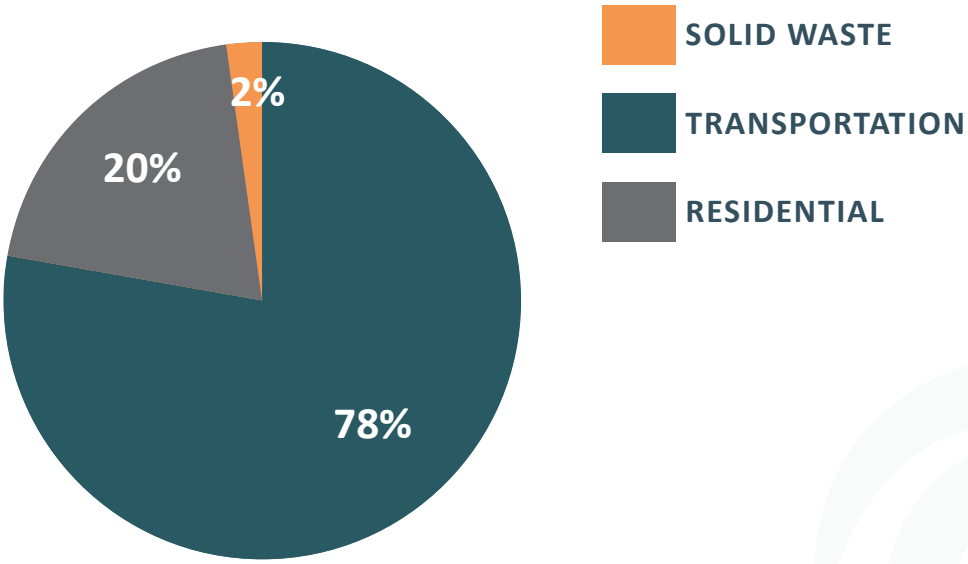


MELANCTHON

TCO_2E MELANCTHON BY ENERGY SOURCE

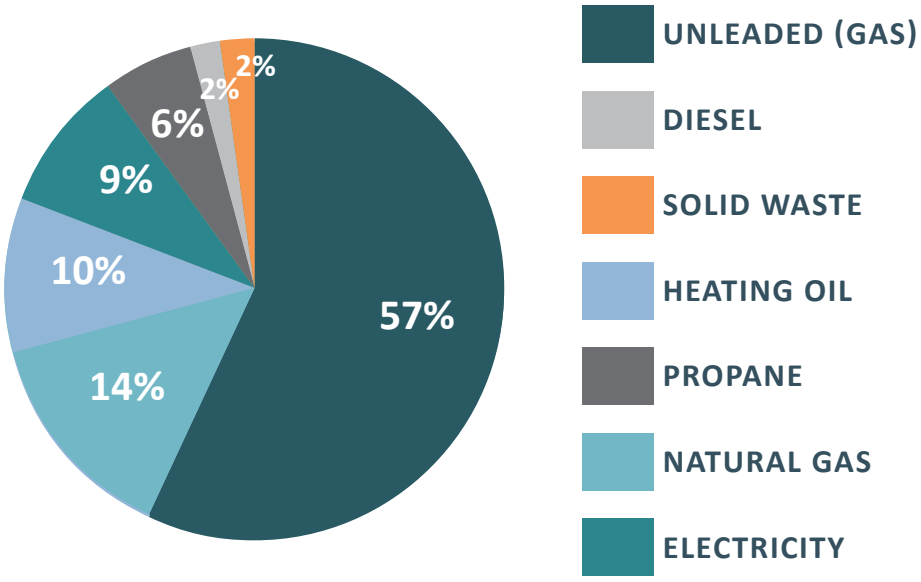


TCO_2E MELANCTHON BY SECTOR

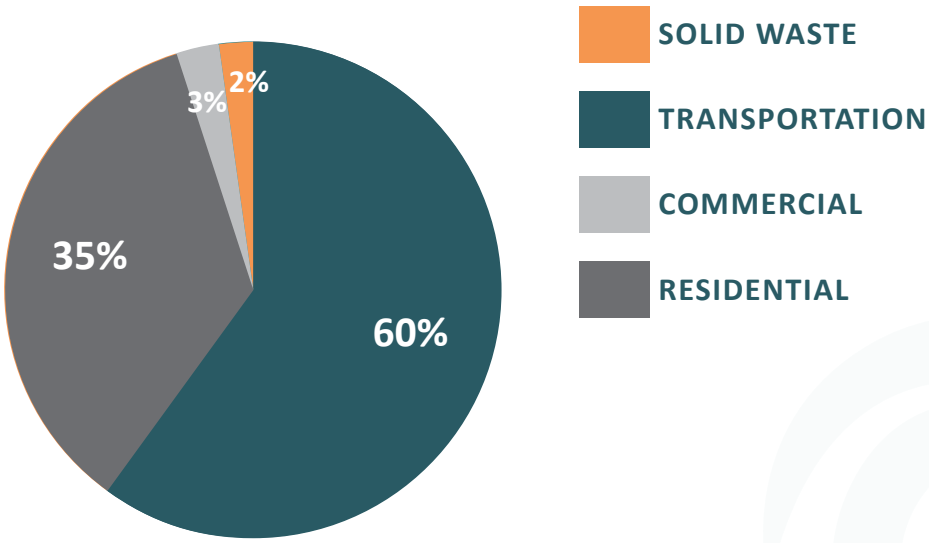


MONO

TCO_2E MONO BY ENERGY SOURCE

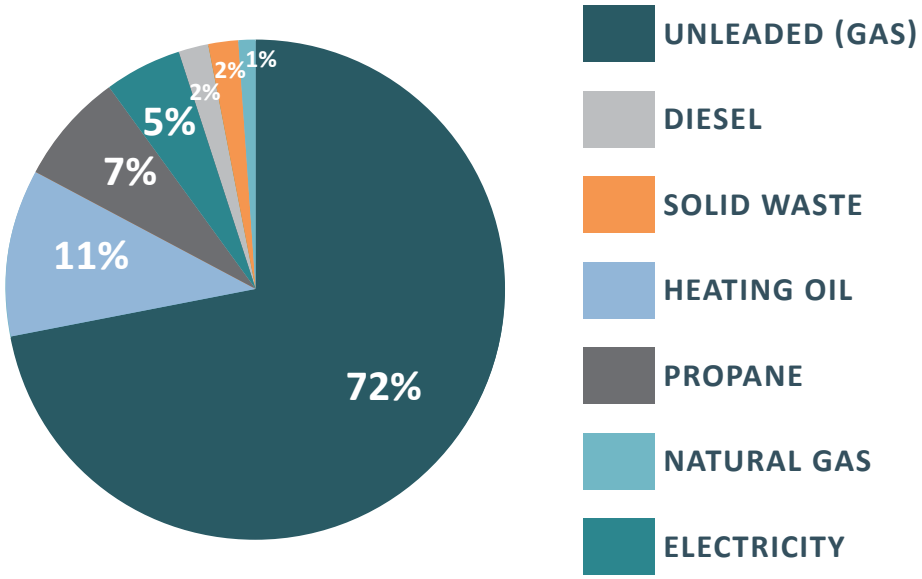


TCO_2E MONO BY SECTOR

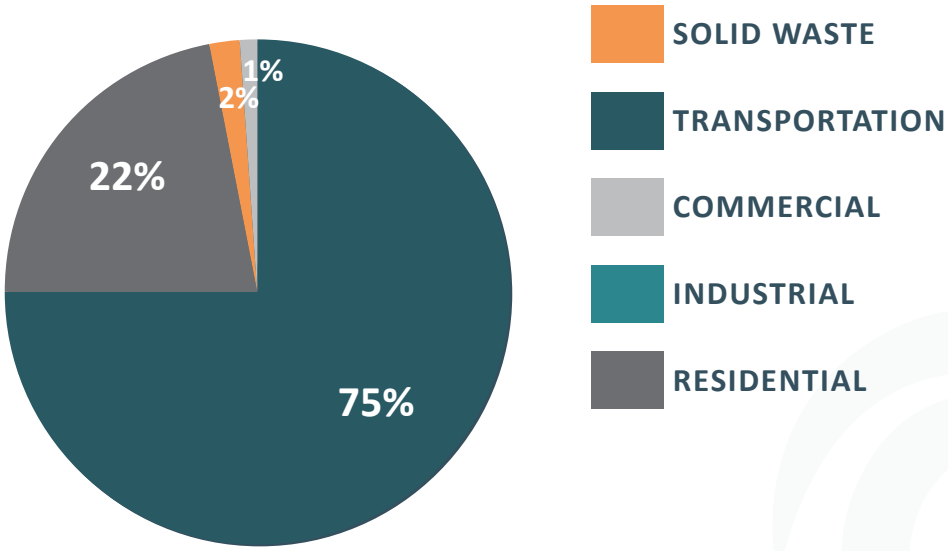


MULMUR

TCO_2E MULMUR BY ENERGY SOURCE

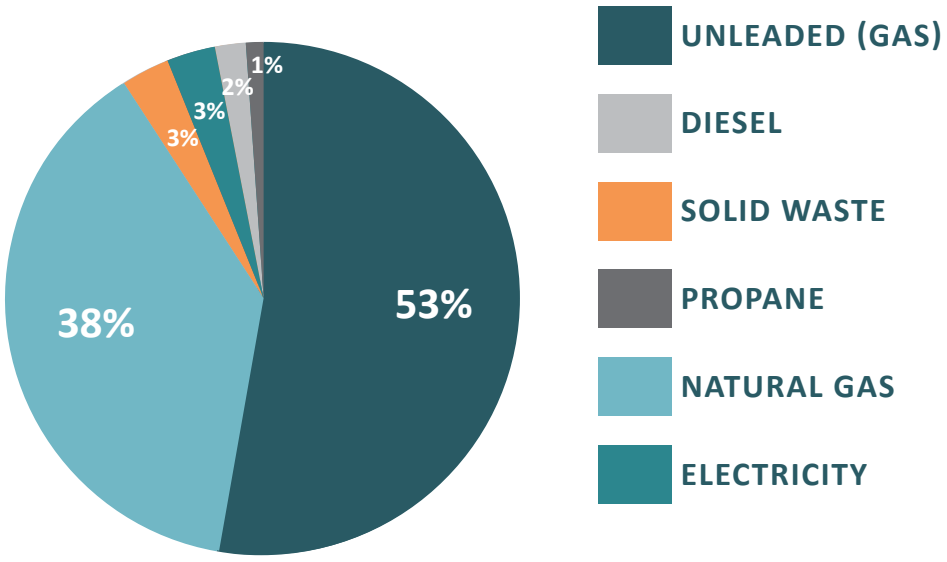


MULMUR GHG EMISSIONS BY SECTOR

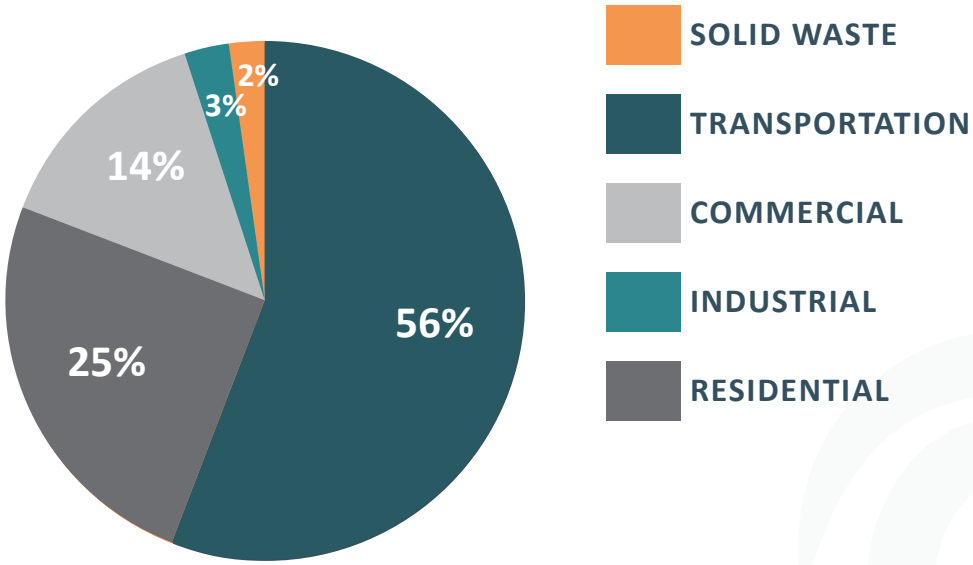


ORANGEVILLE

TCO_2E ORANGEVILLE BY ENERGY SOURCE

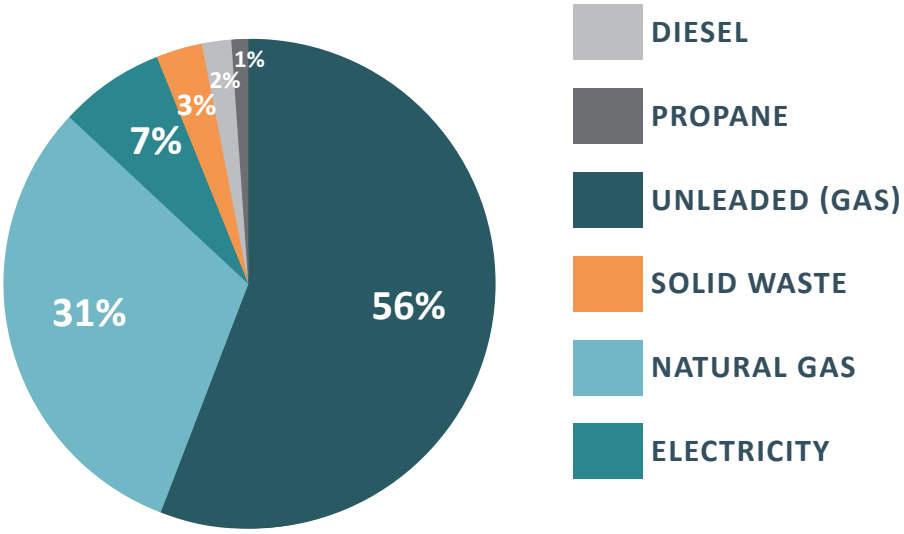


TCO_2E ORANGEVILLE BY SECTOR



SHELBURNE

TCO_2E SHELBURNE BY ENERGY SOURCE



TCO_2E SHELBURNE BY SECTOR

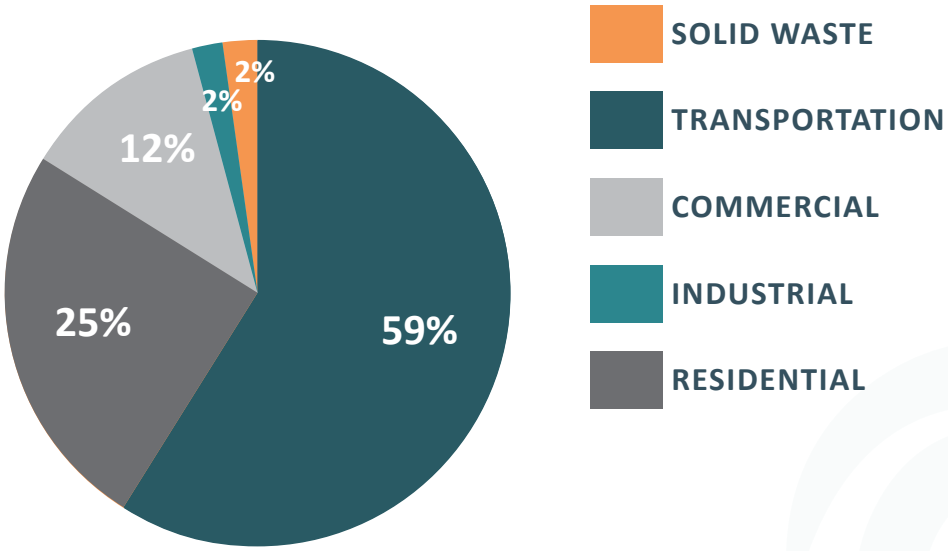


TABLE 24. SUMMARY OF LOCAL MUNICIPALITIES COMMUNITY GREENHOUSE GAS EMISSIONS IN TCO_2E BY SECTOR

SECTOR	MULMUR	MONO	EAST GARAFRAXA	ORANGEVILLE	SHELBURNE	MELANCTHON	AMARANTH	GRAND VALLEY	TOTAL
RESIDENTIAL	4,486	18,386	4,840	35,874	11,247	3,856	6,216	2,574	**87,479**
COMMERCIAL	190	1,562	118	20,014	5,468	81	297	275	**28,005**
INDUSTRIAL	38	171	33	4,036	702	74	132	84	**5,271**
TRANSPORT	16,129	32,333	9,888	84,511	27,347	15,812	14,232	15,202	**21,5454**
WASTE	461	1,141	342	3,829	1,077	399	632	344	**8,224**
TOTAL	**21,305**	**53,592**	**15,221**	**148,264**	**45,841**	**20,222**	**21,509**	**18,479**	**34,4433**

TABLE 25. SUMMARY OF LOCAL MUNICIPALITIES COMMUNITY GREENHOUSE GAS EMISSIONS BY ENERGY SOURCE

ENERGY SOURCE	MULMUR	MONO	EAST GARAFRAXA	ORANGEVILLE	SHELBURNE	MELANCTHON	AMARANTH	GRAND VALLEY	TOTAL
ELECTRICITY	1,111	4,642	1,095	4,091	3,233	891	1,567	866	**17,496**
NATURAL GAS	88	7,623	1,613	55,833	14,187	373	1,499	2,072	**83,288**
GASOLINE	15,298	30,503	9,334	79,090	25,715	15,038	13,398	14,487	**202,862**
DIESEL	580	1,209	368	3,338	1,046	558	540	528	**8,169**
WASTE	461	1,141	342	3,829	1,077	399	632	344	**8,224**
PROPANE	1,497	3,405	995	2,083	586	1,191	1,564	187	**11,507**
HEATING OIL	2,271	5,073	1,475			1,775	2,314		**12,908**
TOTAL	**21,306**	**53,596**	**15,222**	**148,264**	**45,843**	**20,225**	**21,513**	**18,484**	**344,453**