2019 GREENHOUSE GAS INVENTORY

Annual Assessment of Municipal and Community Emissions

CITY OF DENTON

sustainable DENTON

(Left Blank Intentionally)

Welcome to the Inventory

The City of Denton is committed to improving quality of life, protecting the environment, and creating economic opportunity.

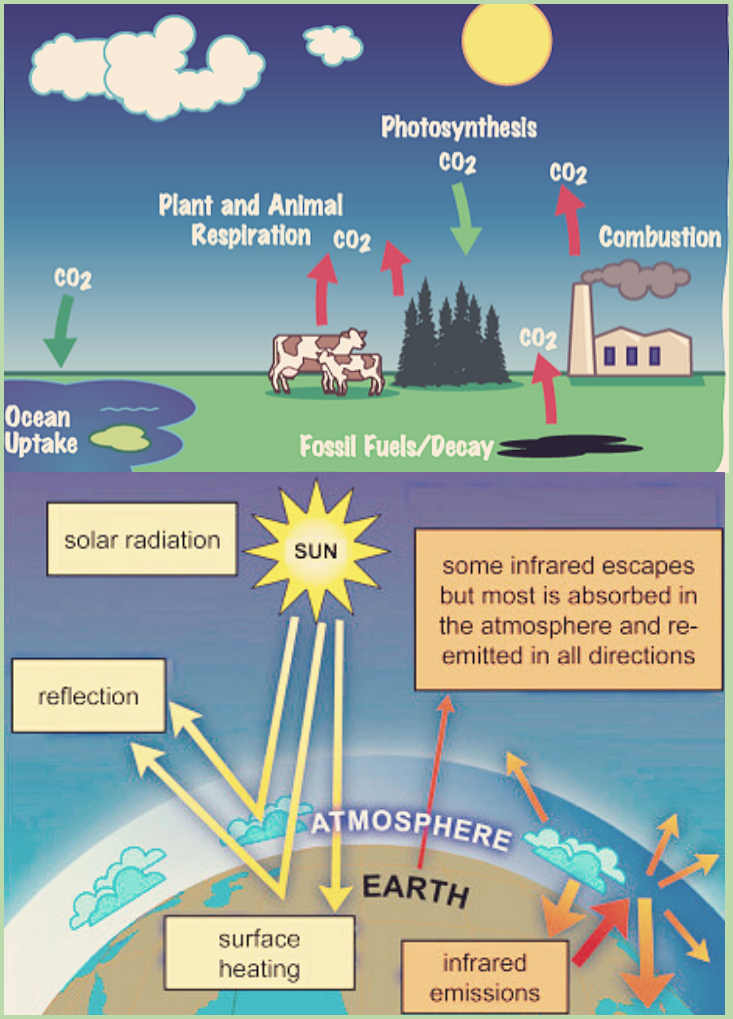
Air Quality and Greenhouse Gas Management are key focus areas of Denton's Sustainability Framework "Simply Sustainable".

The City of Denton collects data, and takes actions to both identify and reduce Greenhouse Gas (GHG) emissions.

GREENHOUSE GASES THE BASICS

Naturally occuring gases, called greenhouse gases (GHGs), help regulate the temperature of our planet in a phenomenon referred to as the greenhouse effect. Modern human activities including the burning of fossil fuels, use of aerosols, clearing of land, and generation of solid waste, have increased greenhouse gases in the atmosphere.

Climate science is highly complex and the state of knowledge about climate change is constantly evolving. The most widely cited source on the science of climate change is the Intergovernmental Panel on Climate Change (IPCC). This international body is now on its 6th assessment released in 2018.



Climate Change refers to any significant change in measure of climate (such as temperature, precipitation, or wind) lasting for an extended period.

Global Warming, an average increase in the temperature of the atmosphere near Earth's surface, which can contribute to changes in global climate patterns.

ABOUT THIS REPORT

REPORTING AREAS

The GHG Inventory will include emissions from municipal operations as well as the Denton community as a whole

EMISSION SCOPES

Scope 1- Direct emissions from combustion or organic material decomposition in city boundries
Scope 2- Indirect emissions over which an entity has direct control such as electricity consumption
Scope 3- Outside of boundary and outside of direct control

INVENTORY YEARS

The City of Denton is committed to producing a GHG inventory each year to increase data, accurately track GHG changes, and address areas of concern year to year.

ClearPath

AN ICLEI USA TOOL

ICLEI Local Governments for Sustainability

A Software for tracking GHGs

Since 2006, the City utilized software developed and endorsed by ICLEI Local Governments for Sustainability and partners including the National Assessment of Clean Air Agencies (NACAA), and the U.S. Environmental Protection Agency (USEPA). The software is updated over time to reflect the most current scientific understanding.

Data pertaining to energy use, fuel consumption, transportation, and waste is gathered from City Departments, community agencies, and service providers and entered into the software to generate GHG inventories for both the municipal operations and community activities.The software translates all data into CO2 equivalents (CO2e). This is the amount of CO2 that would have the same global warming potential as the actual mix of GHGs produced.

2019 INVENTORY HIGHLIGHTS

ELECTRICITY EMISSIONS

In 2019, Denton Municipal Electric (DME) took large steps towards their 100% renewable energy portfolio goal. This resulted in substantial decreases in energy consumption emissions reported in Scope 2.

DENTON ENERGY CENTER (DEC)

The Denton Energy Center is a natural gas power plant owned and operated by DME. The plant went through its first full year of operation in 2019 and emissions are reported as Municipal Scope 1.

LANDFILL EMISSIONS

Landfill gas capture (prior to processing) remained high this year leading to a higher emissions calculation however, further data exploration revealed methane generation in 2019 increased at a lower rate than 2018.

COMMUNITY TRANSPORTATION

Community Transportation Data was updated with most recent Vehicle Miles Traveled (VMT) data for the Denton area. In addition, updated national vehicle efficiency data was updated in 2020 and applied to the 2019 data set.

MUNICIPAL TRANSPORTATION

Fleet Services updated their data reporting method to more accurately reflect fuel use and mileage. This new method has been applied to previous inventories to maintain the accuracy of comparisons and changes are reflected in this inventory.

MUNICIPAL EMISSION CHANGES

↑ 32.44%

2019 COMPARED TO BASELINE (2006)

↑ 14.91%

2019 COMPARED TO 2018

COMMUNITY EMISSION CHANGES

↓ 36.48%

2019 COMPARED TO BASELINE (2006)

↓ 18.32%

2019 COMPARED TO 2018

TOTAL COMBINED CHANGE

↓ 30.14%

2019 COMPARED TO BASELINE (2006)

↓ 14.15%

2019 COMPARED TO 2018

Municipal 16% of total Community 84% of total

MUNICIPAL EMISSIONS

MOVING FORWARD: Municipal GHG Minimization Strategies

- Achieve DME portfolio of 100% renewable electricity
- Continued energy tracking and targeted efficiency projects for municipal buildings and new internal natural resource conservation efforts
- Continued internal recycling and waste reduction efforts including environmentally preferred purchasing
- Improvements through Comprehensive Solid Waste Management Strategy
- Continued improvement of fleet efficiency, including reduced lawn equipment usage, and improved fuel sources

2019 MUNICIPAL HIGHLIGHTS

- The Denton Energy Center had its first full year of operation in the 2019 inventory scope and contributed 104,211 MTCO2e.

- The Denton Landfill saw increased methane reporting in 2019 due to continued high capture of landfill gas (+14.81%). While the amount of gas drawn for utilization remains high, 2019 saw a reduced rate of increase in the amount of modeled methane generation. In addition a decrease in waste generated at municipal facilities was reported (-6.01%).

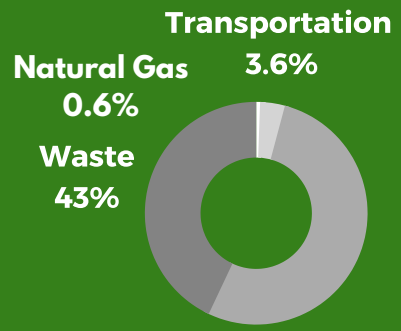
- An increase in renewable energy between 2018 (62%) and 2019 (85%) in the Denton Municipal Electric grid mix has resulted in a large decrease in Scope 2 electricity consumption emissions at the municipal level.

- Fleet Services improved data collection methods and updated national values for vehicle efficiencies were applied to the 2019 data set. Fleet continues to reduce emissions annually (-3.58%) as efficiencies improve and fuel alternatives become increasingly available.

- Natural gas consumption continues to increase as the municipal operation grows. This necessary growth requires an increased focus on efficiency and research into electric options to level and eventually decrease emissions.

MUNICIPAL DATA SUMMARY

Figure 1: Breakdown of Municipal Emissions by Sector



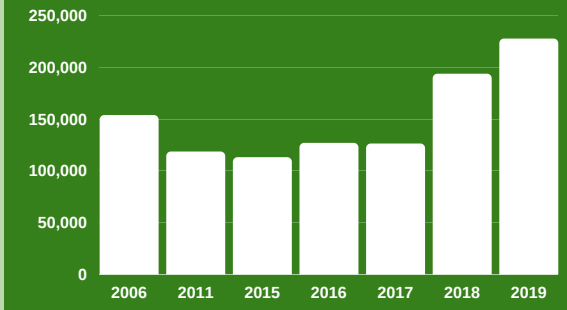
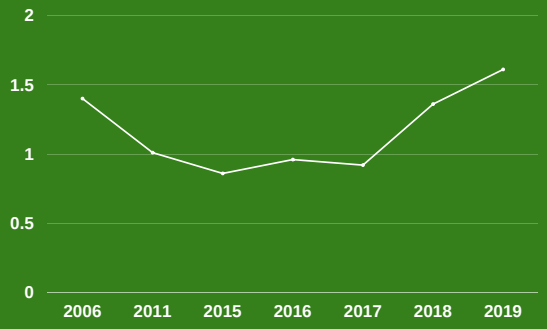


Figure 2: Municipal Emissions by Year in Metric Tons of CO2e

Figure 3: Municipal Emissions by Population in Metric Tons of CO2e per Capita



2019 TO 2018 COMPARISON

WASTE EMISSIONS +14.81

TRANSPORTATION EMISSIONS -3.58%

ELECTRICITY EMISSIONS +21.81%

NATURAL GAS EMISSIONS +6.29%

2019 BASELINE COMPARISON

WASTE EMISSIONS +50.73%

TRANSPORTATION EMISSIONS -38.84%

ELECTRICITY EMISSIONS +59.43%

NATURAL GAS EMISSIONS +54.27%

COMMUNITY EMISSIONS

MOVING FORWARD: Community GHG Minimization Strategies

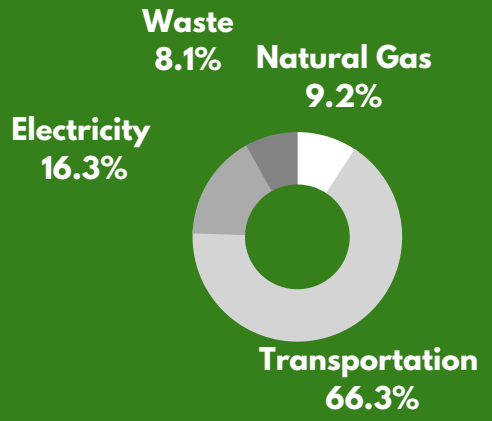
- Continued community education about ways to conserve energy, reduce waste, increase recycling, and choose efficient transportation options
- Achieve DME portfolio of 100% renewable electricity
- Continued support of energy audit and rebate program
- Continued development of alternative transportation options
- Continued support of alternative fuel vehicle deployment
- Continued participation with state and regional partners

2019 COMMUNITY HIGHLIGHTS

- Overall community emissions decreased 18.32% from 2018 to 2019 and decreased in 36.48% from the 2006 base year.
- Electricity consumption emissions reached their lowest point with a 56.51% decrease from 2018 and an overall decrease of 80.82% since base year. This is attributed to an increase in renewable energy through DME. Other factors will be determined upon completion of the Contribution Analysis.
- Waste emissions increased 14.81% from 2018 to 2019, due to an increase over the last two years in landfill gas utilization.
- Natural gas emissions increased 11.22% from 2018 to 2019. Natural gas consumption will be influenced by population growth and year to year temperature variations.
- Transportation emissions decreased 4.55% from 2018 to 2019. A newly released data set for fuel efficiency contributes to this decrease, as population numbers rose again in 2019.

COMMUNITY DATA SUMMARY

Figure 4: Breakdown of Community Emissions by Sector



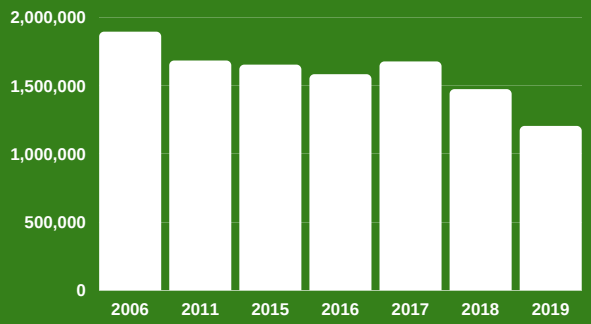
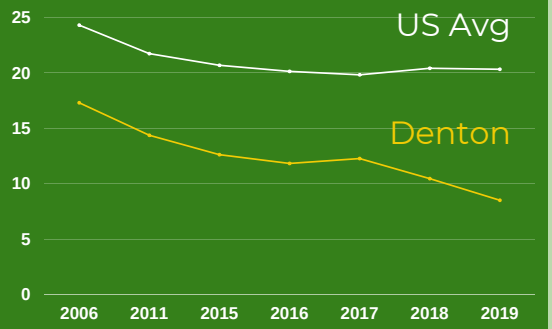


Figure 5: Community Emissions by Year in Metric Tons of CO2e

Figure 6: Community Emissions by Population in Metric Tons of CO2e per Capita



2019 TO 2018 COMPARISON

WASTE EMISSIONS +14.81%

TRANSPORTATION EMISSIONS -4.55%

ELECTRICITY EMISSIONS -56.51%

NATURAL GAS EMISSIONS +11.22%

2019 BASELINE COMPARISON

WASTE EMISSIONS +50.73%

TRANSPORTATION EMISSIONS +12.70

ELECTRICITY EMISSIONS -80.82%

NATURAL GAS EMISSIONS +15.40%

REFERENCES

ANDERSON, THOMAS R., ED HAWKINS, AND PHILIP D. JONES. "CO2, THE GREENHOUSE EFFECT AND GLOBAL WARMING: FROM THE PIONEERING WORK OF ARRHENIUS AND CALLENDAR TO TODAY'S EARTH SYSTEM MODELS." ENDEAVOUR 40.3 (2016): 178-187.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC). (2015). FIFTH ASSESSMENT (AR5). CLIMATE CHANGE 2014: SYNTHESIS REPORT. SUMMARY FOR POLICYMAKERS (SR SP). HTTP://WWW.IPCC.CH/.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC). (2015). FIFTH ASSESSMENT (AR5). CLIMATE CHANGE 2014: SYNTHESIS REPORT (SR). HTTP://WWW.IPCC.CH/.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC). (2007). FOURTH ASSESSMENT (AR4). CLIMATE CHANGE 2007: SYNTHESIS REPORT. SUMMARY FOR POLICYMAKERS (SR SP). HTTP://WWW.IPCC.CH/.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA). (2019). EARTH SCIENCE COMMUNICATION TEAM CALIFORNIA INSTITUTE OF TECHNOLOGY. GREENHOUSE EFFECT: KEEPING THE BALANCE. HTTPS://CLIMATEKIDS.NASA.GOV/GREENHOUSE-EFFECT-AND-CARBON-CYCLE/.

NATIONAL RESEARCH COUNCIL OF THE NATIONAL ACADEMIES. 2010. ADVANCING THE SCIENCE OF CLIMATE CHANGE, IN BRIEF REPORT. CLIMATE CHANGE AND THE NATIONAL ACADEMIES WEBSITE: HTTP://NAS-SITES.ORG/AMERICASCLIMATECHOICES/. ACCESSED AUG. 20, 2013.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA- 1. HUMAN HEALTH IMPACTS & ADAPTATION. HTTP://WWW.EPA.GOV/CLIMATECHANGE/IMPACTS-ADAPTATION/HEALTH.HTML. ACCESSED AUG. 19, 2013.

USEPA-2.CLIMATE CHANGE WEBSITE. HTTP://WWW.EPA.GOV/CLIMATECHANGE. ACCESSED OCTOBER 2013.

USEPA-3.CLIMATE CHANGE WEBSITE. HTTP://WWW.EPA.GOV/CLIMATECHANGE. ACCESSED AUGUST 2013.

USEPA-4.CLIMATE CHANGE WEBSITE. HTTP://WWW.EPA.GOV/CLIMATECHANGE. ACCESSED JUNE 2009.

USEPA-5. APRIL 2009. FREQUENTLY ASKED QUESTIONS ABOUT GLOBAL CLIMATE CHANGE: BACK TO BASICS.

USEPA-6. GREENHOUSE GAS INVENTORY DATA EXPLORER HTTPS://CFPUB.EPA.GOV/GHGDATA/INVENTORYEXPLORER/INDEX.HTML#ALLSECTORS/ALLGAS/GAS/ALL. ACCESSED MARCH 2019.

UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM (USGCRP). 2009. USGCRP. GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES. CAMBRIDGE UNIVERSITY PRESS: NEW YORK, NEW YORK. ISBN 978-0-521-14407-0. HTTP://WWW.GLOBALCHANGE.GOV/PUBLICATIONS/REPORTS/SCIENTIFIC-ASSESSMENTS/US-IMPACTS.

APPENDIX

Municipal Summary

Municipal Scale - MTCO2e By Scope and Sector

Scope	Category	2006	2011	2015	2016	2017	2018	2019
Scope 1	Buildings and Facilities - Natural Gas	725	1,100	1,149	1,008	943	1,031	1,037
	Denton Energy Center						60,717	104,210
	Water - Natural Gas	9	17	7	4	7	7	6
	Wastewater - Natural Gas	89	199	85	135	125	157	227
	Wastewater - Digester Methane	136	137	122	100	117	126	141
	Solid Waste - Landfill Methane	64,732	47,684	50,881	69,519	64,880	85,036	97,633
	Vehicle Fleet	12,571	6,318	6,997	6,738	9,264	8,495	8,191
Scope 2	Buildings and Facilities - Electricity	12,018	7,260	6,827	6,373	6,603	3,978	1,353
	Water - Electricity	10,761	7,931	7,734	6,753	6,670	5,503	3,309
	Wastewater - Electricity	6,182	8,921	5,315	5,322	5,159	3,084	1,557
	Solid Waste - Electricity	-	-	289	247	251	158	50
	Street Lights	3,291	2,212	1,949	1,771	1,890	1,187	365
	Traffic Signals	152	46	43	42	42	27	12
	Electric Power Production - T&D Losses	43,011	36,670	31,638	28,821	30,270	24,051	9,381
Total (Scopes 1 & 2)		**153,677**	**118,494**	**113,036**	**126,834**	**126,220**	**193,557**	**227,472**
TOTAL Minus DEC		**153,677**	**118,494**	**113,036**	**126,834**	**126,220**	**132,840**	**123,262**
Scope 3	Solid Waste	2,291	2,470	2,388	2,290	2,363	2,894	2,720
	Employee Commute	3,528	3,705	3,515	4,697	3,756	4,048	5,213
Total (Scopes 3)		**5,818**	**6,174**	**5,903**	**6,988**	**6,119**	**6,942**	**7,933**
Total (Scopes 1, 2, & 3)		**159,496**	**124,669**	**118,939**	**133,822**	**132,340**	**200,499**	**235,405**

APPENDIX

Municipal Electric Summary

Municipal Electricity (in kWh's)				
Category	DME	CoServ	Oncor	Total
Buildings & Facilities	15,633,563.00	1,169.00	29,344.00	15,664,076.00
Streetlights	11,298.00		7,920.00	19,218.00
Water Supply	11,295,344.00	5,515,430.00		16,810,774.00
Wastewater	12,900,803.00	693,648.00	369,049.00	13,963,500.00
Solid Waste	581,787.00			581,787.00
Total	40,422,795.00	6,210,247.00	406,313.00	47,039,355.00

Municipal Streetlight (Unmetered) Summary

DME			
Source	# of Lights	Wattage of Lights	Estimated kWh/yr
DME Streetlight (HPS)	5,976.00	100.00	2,617,488.00
DME Streetlight (HPS)	1,430.00	250.00	1,565,850.00
DME Streetlight (HPS)	32.00	400.00	56,064.00
DME Streetlight (LED)	83.00	85.00	30,900.90
DME Streetlight (LED)	32.00	160.00	22,425.60
DME Streetlight (LED)	30.00	241.00	31,667.40
Total	7,583.00		4,215,005.40

APPENDIX

Municipal Traffic Signals (Unmetered) Summary

Energy Consumed (in kWh's)		
Total Cost	kWh Rate	Estimated kWh/yr.
$ 1,904.87	$ 0.0664	28,687.80

Municipal Natural Gas Summary

Atmos Energy		
Category	MCF	MMBtu
Buildings	18,817.50	19,513.75
Wastewater	4,124.00	4,276.59
Water Supply	104.40	108.26
Total	23,045.90	23,898.60

Municipal Wastewater Emissions Summary

Digester Gas Summary			
Unit of Measure	MCF/yr	ft3/yr	ft3/day
Total Gas Collected	58,806.57	58,806,570.00	161,003.61
Waste Gas Combustion	41,497.65	41,497,650.00	113,614.37
Heat Exchanger Utilization	17,308.92	17,308,920.00	47,389.24

APPENDIX

Municipal Waste Summary

Breakdown of Waste		
Type	%	Source
Percentage Newspaper	5.5%	CIWMB
Percentage Office Paper	22.0%	CIWMB-cons
Percentage Corrugated Cardboard	4.6%	CIWMB
Percentage Magazines / Third Class Mail	6.0%	CIWMB-cons
Percentage Food Scraps	13.0%	original 2003
Percentage Grass	3.0%	2003 divided
Percentage Leaves	4.0%	""
Percentage Branches	3.0%	""
Percentage Dimensional Lumber	4.0%	Original 2003
Other	35.0%	

Summary of Waste	
Metric	Total
Cubic Yards Collected/yr:	21,944.00
Converted to lbs = cubic yards x 600	13,166,400.00
Converted to metric tons = lbs x 0.00045359	5,972.15

APPENDIX

Landfill Gas Summary

Annual Waste Collected	
Year	**Metric Tons**
2019	265,016

HH-R Equation Summary	
Methane Emissions=[(R/fRec * CE))*(1-OX) + R * [1-(DE * fDest)]	
R=	Quantity of recovered CH4
fR_{ec}=	fraction of hours collection system operated
CE=	area weighted, average collection efficient
OX=	Oxidation fraction, .10 (10% methane oxidation in cover soils)
DE=	Destruction efficiency
f_{Dest}=	Fraction of hours the destruction device operated

HH-8 Equation Results	
Methane Emissions=[(R/fRec * CE))*(1-OX) + R * [1-(DE * fDest)]	
3,486.90	Metric Tonnes CH_4

Employee Commute

Miles Driven				
# of Employees	**Total Daily**	**Total Annual**	**Average Daily**	**Average Annual**
1,821.00	**46,951.80**	**12,207,468.00**	**25.78**	**6,703.72**

APPENDIX

Municipal Fleet Summary

Total Fuel Consumption (in Gallons)						
Category	Diesel	Biodiesel	Ethanol	Gasoline	CNG	TOTAL
Heavy Duty	98,726.00	178,730.00	-	287.00	155,978.00	433,721.00
Medium Duty	67,640.00	12,578.00		8,874.00		89,092.00
Light Duty	35,655.00	3,228.00	10,250.00	286,217.00	10.00	335,360.00
Motorcycle				1,478.00		1,478.00
Off Road Agriculture	4,749.00	611.00		5.00		5,365.00
Off Road Construction	14,248.00	164,557.00		8.00		178,813.00
Off Road Small Utility	29.00	306.00		147.00		482.00
Misc.	21,763.00	10,440.00		4,993.00	631.00	
Trailer	1,015.00	333.00		777.00		2,125.00
Total	243,825.00	370,783.00	10,250.00	302,786.00	156,619.00	1,046,436.00

Total Vehicle Miles Driven	
Category	TOTAL
Heavy Duty	1,075,409.00
Medium Duty	522,608.00
Light Duty	3,410,514.00
Misc	355.00
Off Road Ag	9,166.00
Off Road Construction	47,400.00
Off Road Small Utility	2,232.00
Trailer	4,311.00
Motorcycle	36,794.00
Total	5,108,789.00

APPENDIX

Electricity Emission Factors

Emission Factors Summary				
Source	Year	CO2 lbs/MWh	CH4 lbs/GWh	N2O lbs/GWh
ERCOT	2018	931.700	0.066	0.009
DME	2019	189.000	0.013	0.002

Denton Energy Center Summary

DEC Emissions Summary 2019 (Metric Tons)			
CO2	CH4	N2O	CO2e
104,103	1.96	0.20	104,211

APPENDIX

Community Summary

Community Scale - MTCO2e By Scope and Sector								
Scope	**Category**	**2006**	**2011**	**2015**	**2016**	**2017**	**2018**	**2019**
Scope 1	Residential Energy - Natural Gas	52,214	56,737	53,944	44,243	40,872	53,679	59,462
	Commercial & Industrial Energy - Natural Gas	44,045	45,977	51,034	46,362	47,533	46,287	51,620
	Solid Waste - Landfill Methane	64,732	47,684	50,881	69,519	64,880	85,036	97,633
	Transportation - Community VMT	708,137	793,266	742,701	742,798	815,402	836,100	798,094
	Wastewater- Digester Methane	136	130	122	99	117	126	141
Scope 2	Residential Energy - Electricity	393,232	306,139	304,677	268,158	277,557	199,931	105,162
	Commercial Energy - Electricity	226,622	156,417	167,519	150,751	155,947	97,710	34,655
	Industrial Energy - Electricity	405,928	277,074	282,420	261,191	274,376	154,718	56,930
Total (Scopes 1 & 2)		**1,895,046**	**1,683,425**	**1,653,297**	**1,583,121**	**1,676,684**	**1,473,587**	**1,203,697**
Scope 3	Electric Power Production - T&D Losses	43,011	36,670	28,009	28,821	30,270	34,051	9,380
Total (Scopes 3)		**43,011**	**36,670**	**28,009**	**28,821**	**30,270**	34,051	9,380
Total (Scopes 1, 2, & 3)		**1,938,058**	**1,720,095**	**1,681,306**	**1,611,942**	**1,706,954**	**1,507,638**	**1,213,077**

APPENDIX

Community Vehicle Miles Traveled (VMT)

Breakdown of Community Vehicles		
Vehicle Type	**Fuel Type**	**% of VMT**
Motorcycle Gas	Gasoline	0.1%
Passenger Unleaded	Gasoline	73.7%
Passenger	Diesel	0.7%
Passanger Truck Unleaded	Gasoline	11.3%
Passanger Truck Diesel	Diesel	0.2%
Light Commercial Truck Unleaded	Gasoline	7.0%
Light Commercial Truck Diesel	Diesel	0.4%
Intercity Bus Diesel	Diesel	0.1%
transit Bus Gas	Gasoline	0.0%
Transit Bus Diesel	Diesel	0.0%
School Bus Gas	Gasoline	0.0%
School Bus Diesel	Diesel	0.1%
Refus Truck Gas	Gasoline	0.0%
Refuse Truck Diesel	Diesel	0.1%
Single Unit Short Haul Trucks Gas	Gasoline	0.9%
Single Unit Short Haul Trucks Diesel	Diesel	1.9%
Single Unit Long Haul Trucks Gas	Gasoline	0.1%
Single Unit Long Haul Trucks Diesel	Diesel	0.3%
Motor Home Gas	Gasoline	0.1%
Motor Home Diesel	Diesel	0.1%
Combination Shourt haul Truck Gas	Gasoline	0.0%
Combination Short haul Truck Diesel	Diesel	1.3%
Combination Long Haul Truck Diesel	Diesel	1.8%

Vehicle Miles of Travel (VMT)		
Function	**Daily Miles**	**% of VMT**
Freeways	2,556,225	49%
Principal Arterials	1,089,638	21%
Minor Arterials	867,694	17%
Collectors	462,786	9%
Freeway Ramps	103,858	2%
Frontage Roads	149,853	3%
HOV Lanes	-	0%
Total	5,230,054	100%

APPENDIX

Community Electric Summary

Community Electricity (in MWh's)				
Category	DME	CoServ	Oncor	Total
Residential	611,833.00	66,487.90	57,675.67	735,996.57
Commercial	313,874.00	3,653.64	14,596.02	332,123.66
Industrial	608,164.00	11,289.41	-	619,453.41
Total	1,533,871.00	81,430.94	72,271.70	1,687,573.64

Community Natural Gas Summary

Atmos Energy			
Category	**MCF**	**MMBtu Equivalent**	**% of Total**
Residential	**1,083,336.40**	**1,118,003.16**	**54%**
Commercial & Industrial	**940,456.80**	**970,551.42**	**46%**
Total	**2,023,793.20**	**2,088,554.58**	**100%**

(Page left intentionally blank)

CITY OF DENTON

"http://www.cityofdenton.com" www.cityofdenton.com
ADA/EOE/ADEA TDD: (800) 735-2989
Published by Sustainability 9/2020