

| Municipal Scale - MTCO2e By Scope and Sector | | | | | | |
|---|--|----------------|----------------|----------------|----------------|----------------|
| Scope | Category | 2006 | 2011 | 2015 | 2016 | 2017 |
| Scope 1 | Buildings and Facilities - Natural Gas | 725 | 1,100 | 1,149 | 1,008 | 943 |
| | Water - Natural Gas | 9 | 17 | 7 | 4 | 7 |
| | Wastewater - Natural Gas | 89 | 199 | 85 | 135 | 125 |
| | Wastewater - Digester Methane | 136 | 137 | 122 | 100 | 117 |
| | Solid Waste - Landfill Methane | 64,732 | 47,684 | 50,881 | 69,519 | 64,880 |
| | Vehicle Fleet | 12,515 | 6,318 | 6,997 | 7,842 | 8,360 |
| Scope 2 | Buildings and Facilities - Electricity | 12,018 | 7,260 | 6,827 | 6,373 | 6,603 |
| | Water - Electricity | 10,761 | 7,931 | 7,734 | 6,753 | 6,670 |
| | Wastewater - Electricity | 6,182 | 8,921 | 5,315 | 5,322 | 5,159 |
| | Solid Waste - Electricity | - | - | 289 | 247 | 251 |
| | Street Lights | 3,291 | 2,212 | 1,949 | 1,771 | 1,890 |
| | Traffic Signals | 152 | 46 | 43 | 42 | 42 |
| | Electric Power Production - T&D Losses | 43,011 | 36,670 | 31,638 | 28,821 | 30,270 |
| Total (Scopes 1 & 2) | | 153,621 | 118,494 | 113,036 | 127,938 | 125,316 |
| Scope 3 | Solid Waste | 2,291 | 2,470 | 2,388 | 2,290 | 2,363 |
| | Employee Commute | 3,528 | 3,705 | 3,515 | 4,697 | 3,756 |
| Total (Scopes 3) | | 5,818 | 6,174 | 5,903 | 6,988 | 6,119 |
| Total (Scopes 1, 2, & 3) | | 159,439 | 124,669 | 118,939 | 134,926 | 131,436 |

Municipal Electric Summary

Katherine Barnett, Sustainability and Customer Initiatives Manager, City of Denton

Richard Sorell, Director of Consumer Affairs, Oncor

Paul Virag, Key Accounts Manager, CoServ

All electricity consumption pertaining to facilities and operations for Solid Waste, Water Supply, Wastewater Treatment, or Streetlights, are reported under these categories; all other municipal electric consumption is reported under Buildings and Facilities. The summary table below is the result of a comprehensive data collection from each of our three utility providers, including individual department analysis of electric meter location and function. Electricity for most City facilities is provided by **DME**. The City tracks all **DME** consumption, except for some unmetered Street Lights and Traffic Signals, through the Northstar System. **CoServ** provides electricity to some Buildings and Facilities, Water Supply and Wastewater. **Oncor** provides electricity to some Buildings, Streetlights and Wastewater. Unmetered Streetlights and Traffic Signals are reported separately.

| Municipal Electricity (in kWh's) | | | | |
|----------------------------------|---------------|--------------|------------|---------------|
| Category | DME | CoServ | Oncor | Total |
| Buildings & Facilities | 14,999,178.85 | 1,207.00 | 7,196.00 | 15,007,581.85 |
| Streetlights | 11,523.00 | - | 8,488.00 | 20,011.00 |
| Water Supply | 7,863,215.00 | 6,164,447.00 | - | 14,027,662.00 |
| Wastewater | 10,767,783.00 | 547,818.00 | 262,414.00 | 11,578,015.00 |
| Solid Waste | 571,648.00 | - | - | 571,648.00 |
| Total | 34,213,347.85 | 6,713,472.00 | 278,098.00 | 41,204,917.85 |

Municipal Streetlights (Unmetered) Summary

Rich Selmi, System and Operations Administrator, DME

Most City Streetlights are unmetered and therefore billed by the utility based on an estimated kWh/yr. consumption factor. City staff has provided streetlight counts by bulb wattage. Estimated kWh/yr. is calculated as follows: (((# of Lights * Wattage of Light) * 12 hours) * 365 day) / 1,000

| DME | | | |
|-----------------|-----------------|-------------------|---------------------|
| Source | # of Lights | Wattage of Lights | Estimated kWh/yr |
| DME Streetlight | 5,890.00 | 100.00 | 2,579,820.00 |
| DME Streetlight | 1,486.00 | 250.00 | 1,627,170.00 |
| DME Streetlight | 38.00 | 400.00 | 66,576.00 |
| Total | 7,414.00 | | 4,273,566.00 |

Municipal Traffic Signals (Unmetered) Summary

Cynthia Williams, Business Information Analyst, City of Denton

Traffic Signals are billed by historical average kWh's at each intersection per year. We were provided the total annual charges for Traffic Signals, as well as the DME kWh rate for traffic signals. Consumption was estimated by the following equation: (DME Total Charges / DME kWh Rate)

| Energy Consumed (in kWh's) | | |
|----------------------------|-----------|-------------------|
| Total Cost | kWh Rate | Estimated kWh/yr. |
| \$ 6,302.69 | \$ 0.0662 | 95,149.31 |

Municipal Natural Gas Summary

Melanie Beard, Accounts Payable Supervisor, City of Denton

Natural Gas is the primary source of space and water heating for City facilities. Since 2005, Atmos Energy has been the provider of natural gas to the City. Original data is from paper billings, calculated in a spreadsheet, and summarized by departmental category in the chart below. Two units of measure (MCF and MMBtu) are provided to effectively quantify all affiliated GHG emissions based on the amount of energy consumed at each meter. According to EIA in 2017, the average heat content of Natural Gas was 1.037 (the factor we used to convert MCF to MMBtu below).

| Atmos Energy | | |
|--------------|-----------|-----------|
| Category | MCF | MMBtu |
| Buildings | 17,101.90 | 17,734.67 |
| Wastewater | 2,259.40 | 2,343.00 |
| Water Supply | 120.20 | 124.65 |
| Total | 19,481.50 | 20,202.32 |

Wastewater Fugitive Emissions

Rusty Willard, Water Reclamation Superintendent, City of Denton

The City tracks daily digester gas produced. Water Reclamation provided data for total daily digester gas collected, as well as gas used for heating digesters and open flared (waste gas). A review of City data shows that approximately 32 percent of the digester gas is used to heat the digesters and 68 percent is flared as waste gas. Based on current protocols (in ClearPath), Equation 10.1 for Incomplete digestion (LGOP 2010) was applied to 68 percent of the gas totals. ClearPath applies equation WW.1 a or WW.2.a. of Community Protocol to the remaining 32 percent. Annual CH₄ emissions (metric tonnes CO₂e)=(Digester gas in ft³/day x FCH₄ x p(ch₄) x (1-DE) x .0283 x 356.25 x 10⁻⁶) x GWP

| Digester Gas Summary | | | |
|----------------------------|-----------|---------------------|----------------------|
| Unit of Measure | MCF/yr | ft ³ /yr | ft ³ /day |
| Total Gas Collected | 48,921.49 | - | - |
| Waste Gas Combustion | - | 33,624,721.70 | 92,059.47 |
| Heat Exchanger Utilization | - | 15,296,770.00 | 41,880.27 |

Municipal Waste

Erin Clark, Administration Manager, City of Denton

The refuse number is an estimate and is are based on quantity, size and frequency of waste pickup at City facilities (x12 for the year). ICLEI provided a conversion factor based on the typical weight per cubic yard of un-compacted commercial and industrial waste, to convert cubic yards to pounds. National averages for local government waste stream shares were applied to the weight collected.

| 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: | 19,416.96 |
| Converted to lbs = cubic yards x 600 | 11,650,176.00 |
| Converted to metric tons = lbs x 0.00045359 | 5,284.40 |

Landfill Gas

Ami Reeder, Regulatory Compliance Manager, City of Denton

The Local Government Operations Protocol recommends that Community's which own and manage their own landfill (like Denton), and report annually to the USEPA's Mandatory GHG Reporting Program, use the same methods here. The City of Denton's Landfill has reported annually to the USEPA's Mandatory GHG program since 2010. Weaver Consultants Group has produced the data for us to conduct these reports. Per protocol recommendations, we used HH-8 for this year's GHG Inventory (previously used HH-6) because it was the greater of the two sums.

| Annual Waste Collected | |
|------------------------|-------------|
| Year | Metric Tons |
| 2016 | 243,076 |

| HH-R Equation Summary | |
|--|--|
| Methane Emissions= $[(R/f_{Rec} * CE)) * (1-OX) + R * [1-(DE * f_{Dest})]$ | |
| R= | Quantity of recovered CH ₄ |
| f_{Rec} = | 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= $[(R/f_{Rec} * CE)) * (1-OX) + R * [1-(DE * f_{Dest})]$ | |
| 2,317.15 | Metric Tonnes CH ₄ |

Municipal Vehicle Fleet Summary

Brad Holland, Fuel Specialist, City of Denton

Fleet Services tracks the quantity of fuel used by each vehicle and fuel type. Working within the category framework of the ClearPath software, Fleet Services summarized the total consumption of fuel (in gallons) by each of the following categories. Although the city has begun to record miles driven per vehicle, due to an assumed likelihood of human input error this data set was not considered reliable. As done previously, we estimated an average MPG per category to calculate total miles driven with the provided gallons consumed.

| Total Fuel Consumption (in Gallons) | | | | | | |
|-------------------------------------|------------|------------|-----------|------------|------------|--------------|
| Category | Diesel | Biodiesel | Ethanol | Gasoline | CNG | TOTAL |
| Heavy Duty | 38,596.49 | 85.95 | - | 2,053.10 | - | 40,735.54 |
| Heavy Truck | 142,929.99 | 183,792.53 | - | 8,645.25 | 61,039.55 | 396,407.32 |
| Light Duty | - | - | 7,621.65 | 135,450.45 | - | 143,072.10 |
| Light Truck | 23,807.53 | 8,422.68 | 5,076.58 | 126,231.64 | 91,559.33 | 255,097.76 |
| Motorcycle | - | - | - | 1,452.20 | - | 1,452.20 |
| Off Road Agriculture | 5,776.64 | 5,645.19 | - | - | - | 11,421.83 |
| Off Road Construction | 7,664.24 | 146,449.16 | - | 5.90 | - | 154,119.30 |
| Off Road Small Utility | 11.60 | - | - | 126.50 | - | 138.10 |
| Off Road Utility | - | 151.36 | - | - | - | 151.36 |
| Total | 218,786.49 | 344,546.87 | 12,698.23 | 273,965.04 | 152,598.88 | 1,002,595.51 |

| Total Vehicle Miles Driven | | | | | | |
|----------------------------|--------------|--------------|------------|--------------|--------------|---------------|
| Category | Diesel | Biodiesel | Ethanol | Gasoline | CNG | TOTAL |
| Heavy Duty | 223,859.64 | 498.51 | - | 10,881.43 | - | 235,239.58 |
| Heavy Truck | 828,993.94 | 1,065,996.67 | - | 50,142.45 | 354,029.40 | 2,299,162.47 |
| Light Duty | - | - | 182,157.44 | 2,925,729.72 | - | 3,107,887.16 |
| Light Truck | 452,343.07 | 160,030.92 | 96,455.02 | 2,171,184.21 | 1,739,627.23 | 4,619,640.45 |
| Motorcycle | - | - | 7 - | 63,170.70 | - | 63,170.70 |
| Total | 1,505,196.65 | 1,226,526.10 | 278,612.46 | 5,157,937.81 | 2,093,656.63 | 10,325,100.35 |

Municipal Employee Commute Summary

Lisa Manning, Human Resources, City of Denton

The City maintains a list of all employees and their residential zip code. The total # of employees residing per zip code was multiplied by the daily round trip distance from the residential zip code to city center (76201-where most City offices are located). Employees driving a distance > 70 miles one way were assumed to not be regular commuters and were excluded from the final calculations. The daily employee trip distances were summed for each zip code, and multiplied x 260 working days/year. We also assumed all passenger vehicles consumed unleaded gasoline.

| Miles Driven | | | | |
|----------------|-------------|--------------|---------------|----------------|
| # of Employees | Total Daily | Total Annual | Average Daily | Average Annual |
| 1,639.00 | 35,340.80 | 9,188,608.00 | 21.56 | 5,606.23 |

| Community Scale - MTCO ₂ e By Scope and Sector | | | | | | |
|---|--|-----------|-----------|-----------|-----------|-----------|
| Scope | Category | 2006 | 2011 | 2015 | 2016 | 2017 |
| Scope 1 | Residential Energy - Natural Gas | 52,214 | 56,737 | 53,944 | 44,243 | 40,872 |
| | Commercial & Industrial Energy - Natural Gas | 44,045 | 45,977 | 51,034 | 46,362 | 47,533 |
| | Solid Waste - Landfill Methane | 64,732 | 47,684 | 50,881 | 69,519 | 64,880 |
| | Transportation - Community VMT | 708,137 | 793,266 | 742,701 | 742,798 | 815,402 |
| | Wastewater- Digester Methane | 136 | 130 | 122 | 99 | 117 |
| Scope 2 | Residential Energy - Electricity | 393,232 | 306,139 | 304,677 | 268,158 | 277,557 |
| | Commercial Energy - Electricity | 226,622 | 156,417 | 167,519 | 150,751 | 155,947 |
| | Industrial Energy - Electricity | 405,928 | 277,074 | 282,420 | 261,191 | 274,376 |
| Total (Scopes 1 & 2) | | 1,895,046 | 1,683,425 | 1,653,297 | 1,583,121 | 1,676,684 |
| Scope 3 | Electric Power Production - T&D Losses | 43,011 | 36,670 | 28,009 | 28,821 | 30,270 |
| Total (Scopes 3) | | 43,011 | 36,670 | 28,009 | 28,821 | 30,270 |
| Total (Scopes 1, 2, & 3) | | 1,938,058 | 1,720,095 | 1,681,306 | 1,611,942 | 1,706,954 |

Community Electric Summary

Elizabeth Ruiz, Energy Programs Coordinator, DME

Paul Virag, Key Accounts Manager, CoServ

Richard Sorell, Director of Consumer Affairs, Oncor

The summary table below is the result of a comprehensive data collection from each of our three utility providers. Electricity for most of the City is provided by **DME**. **CoServ** and **Oncor** provide electricity to some customers as indicated below.

| Community Electricity (in MWh's) | | | | |
|----------------------------------|--------------|------------|-----------|--------------|
| Category | DME | CoServ | Oncor | Total |
| Residential | 555,350.00 | 47,807.55 | 15,987.72 | 619,145.27 |
| Commercial | 311,565.00 | 33,031.62 | 3,202.96 | 347,799.59 |
| Industrial | 582,670.00 | 34,606.45 | - | 617,276.45 |
| Total | 1,449,585.00 | 115,445.62 | 19,190.68 | 1,584,221.30 |

Community Natural Gas Summary

Stacey Medford, Atmos Energy

Atmos Energy provided community-wide natural gas sales data by two sectors: Residential and Commercial & Industrial. To calculate total Community Commercial & Industrial consumption we subtracted the Municipal natural gas consumption figures (summarized under the Municipal section of this report). According to EIA, in 2015 the average heat content of Natural Gas was 1.032.

| Atmos Energy | | | |
|-------------------------|--------------|------------------|------------|
| Category | MCF | MMBtu Equivalent | % of Total |
| Residential | 744,645.00 | 768,473.64 | 46% |
| Commercial & Industrial | 865,996.00 | 893,707.87 | 54% |
| Total | 1,610,641.00 | 1,662,181.51 | 100% |

Community Vehicle Miles Traveled (VMT)

Transportation Department, NCTCOG

Community transportation emissions estimates are based on community vehicle miles traveled and transportation emissions factors. The emissions factors are based on: percentage of vehicle type on road, by fuel for inventory year, and fuel efficiency. This information originated from USEPA data. We have used this methodology for each of our inventoried years. Daily VMT was provided by NCTCOG. This data is based on the Mobility 2040: Metropolitan Transportation Plan for North Central Texas. It was generated from NCTCOG's regional travel demand model and reflects forecasted data, not observed data. Also, this information applies to an approximate area of the City of Denton, as the model's traffic survey zone structure does not precisely match city limits. NCTCOG planners have estimated that 23% of freeway traffic is pass-through traffic in Denton.

| Breakdown of Community Vehicles | | |
|---------------------------------|-----------|----------|
| Vehicle Type | Fuel Type | % of VMT |
| Passenger Unleaded | Gasoline | 60.6% |
| Passenger | Diesel | 0.3% |
| Light Truck Unleaded | Gasoline | 32.4% |
| Light Truck | Diesel | 1.3% |
| Heavy Truck | Diesel | 5.4% |

| Vehicle Miles of Travel (VMT) | | |
|-------------------------------|-------------|----------|
| Function | Daily Miles | % of VMT |
| Freeways | 2,349,763 | 48% |
| Principal Arterials | 1,001,344 | 21% |
| Minor Arterials | 816,420 | 17% |
| Collectors | 444,282 | 9% |
| Freeway Ramps | 111,469 | 2% |
| Frontage Roads | 133,401 | 3% |
| HOV Lanes | - | 0% |
| Total | 4,856,679 | 100% |

Electricity Emission Factors

Clean Air Markets Division, US EPA

Electricity emissions factors are the amount of various pollutants emitted, usually from fuel combustion, per unit of electricity produced. Average emissions factors for a given utility depend on the mix of fuel and power plant types, plant efficiencies, and pollutant control technologies used. The US EPA's eGRID program maintains emissions factors by plant type, utilities and regions in the United States. US EPA staff has worked with City staff to provide DME specific emissions factors. For DME's mix, the emissions factors were proportionally applied to the MWh's purchased from each fuel type. Most of the City's electricity is provided by DME, with some municipal and private accounts being serviced by CoServ or Oncor. Regional emissions factors (for ERCOT) have been applied to Scope 2 emissions (purchased electricity) from CoServ and Oncor.

| Emission Factors Summary | | | | |
|--------------------------|------|-------------|-------------|-------------|
| Source | Year | CO2 lbs/MWh | CH4 lbs/GWh | N2O lbs/GWh |
| ERCOT | 2016 | 1,009.20 | 76.00 | 11.00 |
| DME | 2017 | 964.00 | 89.50 | 13.00 |

Transportation Emission Factors

Transportation Department, NCTCOG

Transportation emissions factors represent the amount of pollutant generated per vehicle mile travelled. Emissions result from fuel combustion, and will vary with vehicle class, model year/efficiency, and pollution control technologies. Average emissions factors for a region reflect the general make-up of on road vehicles by class, age, etc. Two sources of data were used to populate the Transportation Emission Factors set in ClearPath - fuel economy and emissions per mile travelled for the mix of vehicle types estimated to be on the road for North Texas. Fuel economy factors were sourced from a national polling through Alternative Fuels Data Center (AFDC), while the emissions were sourced regionally through NCTCOG via the UP EPA Moves simulator.

| Emission Factors Summary | | | |
|---------------------------------|------------|---------------------|---------------------|
| Classification | MPG | CH4 grams/mi | N20 grams/mi |
| Light Duty - Gasoline | 21.600 | 0.005 | 0.005 |
| Light Truck - Gasoline | 17.200 | 0.008 | 0.009 |
| Heavy Truck - Gasoline | 5.300 | 0.009 | 0.018 |
| Transit Bus - Gasoline | 3.300 | 0.019 | 0.027 |
| Para Transit Bus - Gasoline | 3.300 | 0.019 | 0.027 |
| Motorcycle - Gasoline | 43.500 | 0.054 | 0.006 |
| Light Duty - Diesel | 23.900 | 0.026 | 0.004 |
| Light Truck - Diesel | 19.000 | 0.036 | 0.004 |
| Heavy Truck - Diesel | 5.800 | 0.102 | 0.006 |
| Transit Bus - Diesel | 3.600 | 0.066 | 0.005 |
| Para Transit Bus - Diesel | 3.600 | 0.066 | 0.005 |

T&D Losses

Elizabeth Ruiz, Energy Programs Coordinator, DME

T&D losses were calculated as the difference between electricity purchased and electricity sold by DME.

| DME Electricity Summary | | | |
|-------------------------|-----------|------------|------------|
| MWh Purchased | MWh Sold | T&D Losses | MWh Losses |
| 1,518,387 | 1,449,585 | 4.53% | 68,802 |

Other Inputs

Lisa Manning, Human Resources, City of Denton

US Census Estimate

| City Employees | | |
|----------------|-------|----------------|
| Year | Total | Source |
| 2017 | 1,639 | City of Denton |

| Population | | |
|------------|---------|--------------------|
| Year | Total | Source |
| 2017 | 136,618 | US Census Estimate |