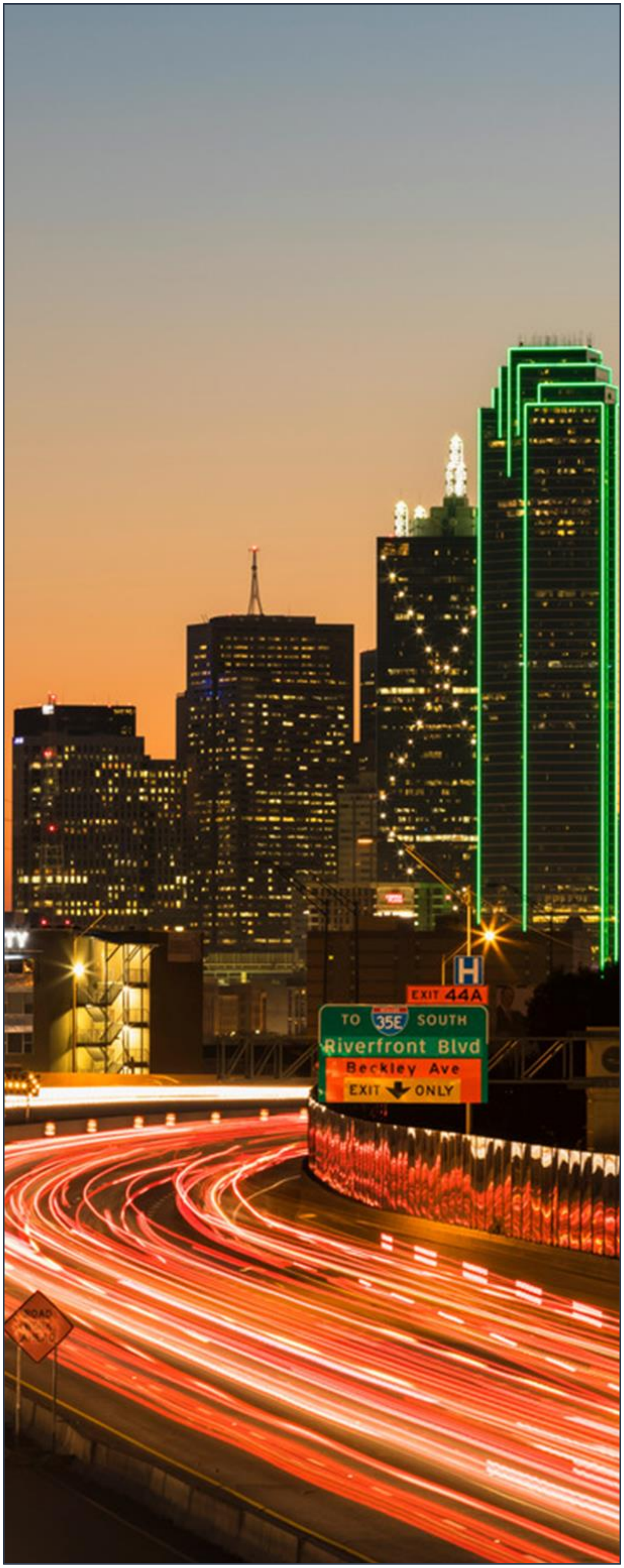

NCTCOG Area 16-County Inventory of Community Greenhouse Gases 2019

Developed by the North Central Texas Council of Governments

with assistance from ICLEI (Local Governments for Sustainability USA) and special thanks to the generous contribution from Burlington Northern Santa Fe (BNSF) Railway

North Central Texas Council of Governments

Credits and Acknowledgements

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City of Carrollton
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Farmers Electric Cooperative
Fort Belknap Electric Cooperative
Grayson-Collin Electric Cooperative
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Oncor
Texas A&M Transportation Institute (TTI)
Texas Commission on Environmental Quality (TCEQ)
Texas Gas Service
Texas Parks and Wildlife (TPW)
Texas New Mexico Power (TNMP)
United Cooperative Services

Table of Contents

Exhibits

Acronyms

AEDT	Federal Aviation Administration's Aviation Environmental Design Tool
AERR	Air Emissions Reporting Requirements
APU	Auxiliary Power Unit
AQIP	Air Quality Improvement Plan
ATR	Automatic Traffic Recorder
BNSF	Burlington Northern Santa Fe Railway
cf	Cubic feet
CFR	Code of Federal Regulations
CH_4	Methane
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CO-OP	Cooperative (in the Electricity sector)
CPRG	Climate Pollution Reduction Grant
DART	Dallas Area Rapid Transit
DFW	Dallas-Fort Worth
DGNO	Dallas, Garland & Northeastern Railroad
ECHO	Enforcement and Compliance History Online (EPA)
EIA	Energy Information Administration
EPA	Environmental Protection Agency
ERG	Eastern Research Group
FHWA	Federal Highway Administration
FLIGHT	Facilities Level Information on Greenhouse gases Tool (EPA)
FWWR	Fort Worth & Western Railroad
GHG	Greenhouse Gas
GHG EI	Greenhouse Gas Emissions Inventory
GHGRP	Greenhouse Gas Reporting Program
GIS	Geographic Information System
GWP	Global Warming Potentials
ICLEI	Local Governments for Sustainability
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt hours
LGO Protocol	Local Government Operations Protocol for Accounting and Reporting Greenhouse Gas Emissions
MMBtu	Metric Million British Thermal Unit
MOU	Municipal Owned Utilities
MOVES	MOtor Vehicle Emission Simulator (EPA)
MPA	Metropolitan Planning Area
MPO	Metropolitan Planning Organization
$MTCO_2e$	Carbon Dioxide Equivalent Emissions in Metric Tons
N_2O	Nitrous Oxide

NAAQS	National Ambient Air Quality Standards
NCTCOG	North Central Texas Council of Governments
NEI	National Emissions Inventory (EPA)
NO_2	Nitrogen Dioxide
NPDES	National Pollutant Discharge Elimination System
O_3	Ozone
Pb	Lead
PM_{10}	Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
ppb	Parts per Billion
ppm	Parts per Million
RFP	Reasonable Further Progress
RISE	Regional Integration of Sustainability Efforts
RRC	Railroad Commission of Texas
SEDS	State Energy Data System
SHEI	Source Hours Extended Idling
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
State DOTs	State Departments of Transportation
TAFT	Transportation Analytical Forecasting Tool
TCEQ	Texas Commission for Environmental Quality
TPW	Texas Parks and Wildlife
TRE	Trinity Rail Express
TTI	Texas A&M Transportation Institute
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
VMT	Vehicle Miles of Travel

Executive Summary

The North Central Texas Council of Governments (NCTCOG) recognizes that changes in climate are occurring, and that global anthropological activities are an attributable factor. NCTCOG works in cooperation with federal, state, and local partners to achieve comprehensive air quality improvements throughout Dallas-Fort Worth across multiple transportation and emission sectors. This includes greenhouse gas emissions and criteria pollutants. Air quality in North Central Texas has long been a concern since the region is classified as being nonattainment under two National Ambient Air Quality Standards (NAAQS) for the pollutant ozone and is likely to be designated as nonattainment under the new (January 2024) fine Particulate Matter Standard ($PM_{2.5}$) in the future. Due to their harmful effects on the health of humans and the environment, ground-level ozone, as well as $PM_{2.5}$ are monitored and targeted for emission reductions.

Development of a statewide air quality plan, known as the State Implementation Plan (SIP), is required for all nonattainment areas to demonstrate how ozone will be reduced to levels compliant with the NAAQS. NCTCOG is dedicated to continuing the pursuit to attain federal compliance for both ozone NAAQS for the Dallas-Fort Worth region and contribute to a better quality of life for all North Texans. NCTCOG's primary goal in air quality is to reach and maintain federal attainment for criteria pollutants, and many air quality efforts reduce particulate matter, greenhouse gas, and ozone precursor emissions though supporting efforts to improve air quality comprehensively. This multipollutant approach is centered around emission reductions within the 16-county region to mitigate regional airshed pollutants that may pose substantial risks to the future health, wellbeing, and prosperity of the Dallas-Fort Worth area, and reduce greenhouse gas emissions and contribute to meeting the Paris Agreement commitment to reduce global emissions by 50 percent by 2023 and reach climate neutrality by 2050 in order to keep warming below 1.5°C globally.

NCTCOG provided cities in the North Central Texas 12-county Metropolitan Planning Area (MPA) access to an emission inventorying software tool through participation in an emission inventory cohort. Participating cohort cities leveraged the emission inventory tool to produce their own citywide greenhouse gas emission inventories, with ICLEI (Local Governments for Sustainability) and NCTCOG support. These reports facilitate city planning and can be used as a baseline to support policy/technical decisions along with allowing a means of benchmarking actions that take place.

In the framework of the Environmental Protection Agency's (EPA) Climate Pollution Reduction Grant Air Quality Improvement Plan (CPRG AQIP), the 12-county MPA greenhouse gas inventory was extended to encompass the entire 16-county NCTCOG area.

The following report provides details on the quantitative estimates of greenhouse gas emissions totaling 102,856,587 MTCO2e resulting from anthropological activities within the North Central Texas 16-county area during calendar year 2019.

1 Key Findings

Exhibit 1 shows communitywide emissions by sector. The largest contributor is the Energy sector, with 53 percent of regional emissions. The next largest contributors are the Transportation and Mobile Sources (43 percent) sector and the Solid Waste (4 percent) sector. The Water and Wastewater sectors, when combined, were responsible for the remaining less than 1 percent of emissions. As a continuation of NCTCOG's dedication to reduce greenhouse gases (GHGs), as well as advancing regional air quality and public health, emission reduction strategies from all sectors are necessary. The largest contributing sectors, of course, will have the largest amount of targeted emission reductions in the ongoing future through subsequent planning, advancements, and developments.

Exhibit 1: Communitywide Dallas-Fort Worth 16-County 2019 Annual CO_2e Emissions by Sector

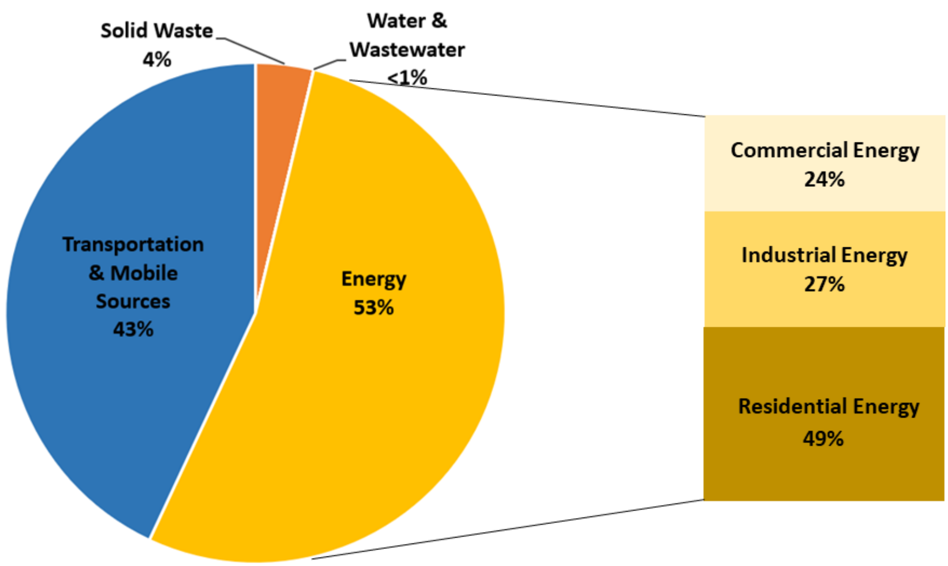
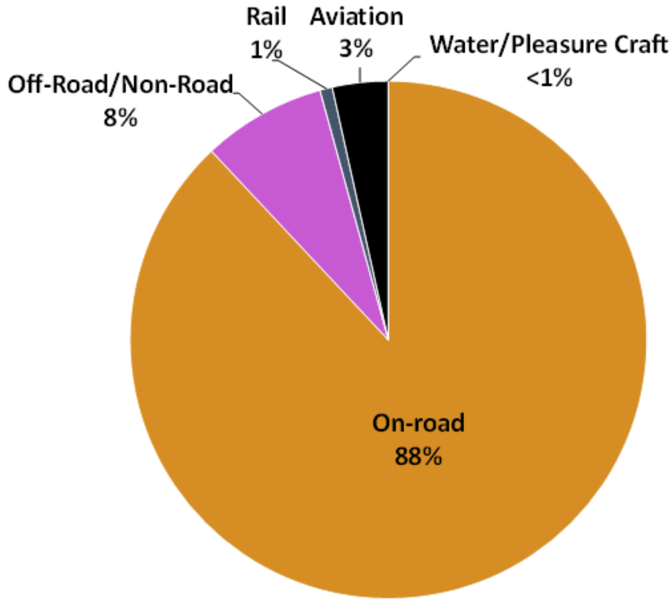


Exhibit 2 shows the emissions apportionment of the Transportation sector. NCTCOG works closely with local, state, and federal partners to plan and recommend transportation projects that will improve the Transportation sector and encourage more efficient land use, all while minimizing the overall impact on the region's air quality. As the second largest contributing sector, emission reduction strategies in the Transportation sector will be an integral part in any climate action plans developed by NCTCOG in the future.

The inventory results section of this report provides a detailed profile of emissions sources within the North Central Texas 16-county region. These results are not only pivotal as key information to guiding emission reduction efforts, but also provide a baseline against which the region will be able to compare future performance and demonstrate emission reduction progress.

Exhibit 2: Communitywide Dallas-Fort Worth 16-County 2019 Annual CO_2e Transportation and Mobile Sources Emissions



2 Regional Context

The geographic scope of the GHG inventory includes all 16 counties served by NCTCOG. This includes Collin, Dallas, Denton, Ellis, Erath, Hood, Hunt, Johnson, Kaufman, Navarro, Palo Pinto, Parker, Rockwall, Somervell, Tarrant, and Wise counties, as can be seen in Exhibit 3.

In partnership with the Regional Integration of Sustainability Efforts (RISE) Coalition, and with the generous contribution from Burlington Northern Santa Fe (BNSF) Railway, NCTCOG developed a 12-county inventory that focused on the Metropolitan Planning Organization (MPO) area. This inventory was expanded to encompass all 16 counties that NCTCOG represents.

Exhibit 3: NCTCOG 16-County Area Map

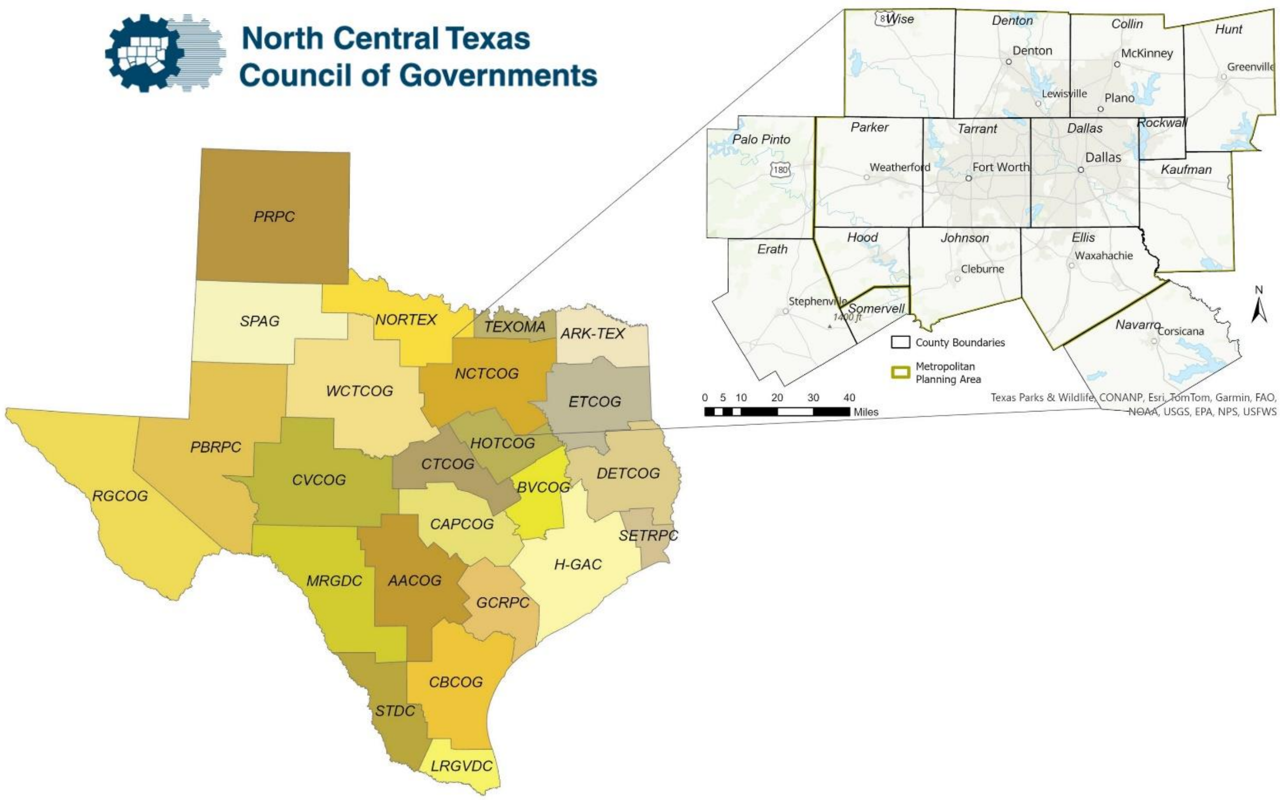


Exhibit 4 provides the 2023 estimated population of each county within the NCTCOG region, as well as the total regional population.[1]

The NCTCOG Transportation Department, the Regional Transportation Council (RTC), and the NCTCOG Executive Board together serve as the MPO for 12 counties in the Dallas-Fort Worth region (Collin, Dallas, Denton, Ellis, Hood, Hunt, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise). Ten of these counties (Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise) have been designated by the EPA as nonattainment for the pollutant ozone. As the MPO in an ozone nonattainment area, NCTCOG has responsibility for incorporating air quality planning into transportation planning efforts at the regional level, specifically via Transportation Conformity and the Metropolitan

[1] https://data-nctcoggis.opendata.arcgis.com/documents/2023-nctcog-population-estimates-publication/explore

Transportation Plan, which are two of the core functions of the MPO. The MPO works closely with regional, state, and federal partners to plan and recommend transportation projects that will improve mobility and encourage more efficient land use, all while minimizing the impact on the region's air quality.

Exhibit 4: Population by County

County	2023 Population Estimate
Collin	1,175,974
Dallas	2,675,009
Denton	1,006,492
Ellis	218,125
Erath	43,287
Hood	62,511
Hunt	109,127
Johnson	201,427
Kaufman	158,672
Navarro	55,639
Palo Pinto	29,277
Parker	155,607
Rockwall	124,734
Somervell	9,899
Tarrant	2,188,951
Wise	70,159
16-County Total NCTCOG Population	**8,284,890**

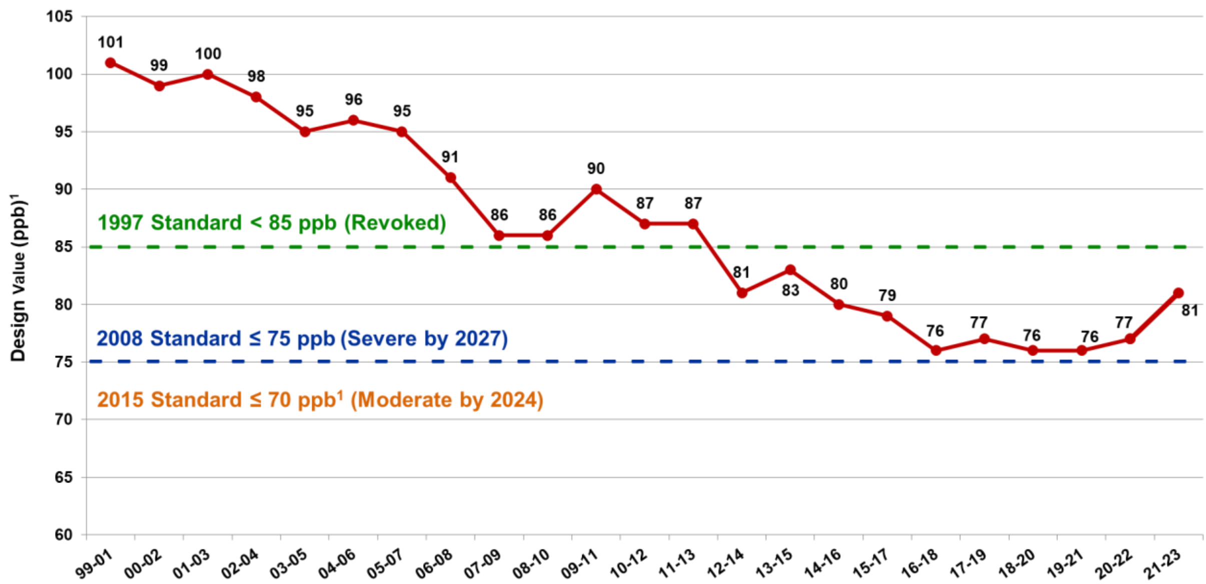
As noted, NCTCOG has a long history of working collaboratively with local governments (cities, counties, transit agencies, special districts, and school districts), and other local, state, and federal partners across the region on air quality issues. This collaboration was borne from long-standing ozone nonattainment issues but is expanding as other air quality concerns are becoming more urgent.

Ozone nonattainment issues have plagued the NCTCOG region for over three decades, starting in the mid-1990s when only four counties were designated nonattainment. While there has been substantial improvement in ground-level ozone concentrations, reflected by the decreasing design value[2] illustrated in Exhibit 5, the EPA has continued to lower the ozone NAAQS to reflect the latest data on ground-level ozone concentrations that are protective of human and environmental health. As these standards have become more stringent over time, the geographic scope of the nonattainment area has increased to now encompass 10 counties. Moreover, as multiple deadlines to meet the ozone standards have come and gone, the EPA has reclassified the region multiple times and now, for the first time, 10 counties

[2] A design value is a statistic that describes the air quality status of a given location relative to the level of the National Ambient Air Quality Standards. For Ozone, the United States Environmental Protection Agency defines the Design Value as the 4th highest daily maximum 8-hour average concentration, averaged over a 3-year period (Source and more information: EPA - Ozone Designations).

have reached the “severe” nonattainment designation, which is the worst designation that has been applied across the region to date.

Exhibit 5: Ozone Design Values Trendline 1999 - 2023



[1] Attainment Goal - According to the U.S. Environmental Protection Agency National Ambient Air Quality Standards, attainment is reached when, at each monitor, the *Design Value* (3-year average of the annual 4th highest daily maximum 8-hour average ozone concentration) is equal to or less than 70 parts per billion.

Exhibit 5 also illustrates that the progress in reducing ozone concentrations has stalled. Until the last few years, the region was benefiting from improvements (that is, reductions) in ground-level ozone even though population, vehicle miles traveled, and levels of economic activity were increasing. However, in the past few years, ozone levels have started to worsen again, with the design value creeping back up. The reasons for this are not yet understood, but the pervasiveness of the region’s ozone nonattainment issues underscore the compelling need for widespread actions across all emissions sectors to achieve improvements.

Several other air quality developments have arisen recently that began extending NCTCOG’s air quality activities beyond ozone-related MPO obligations. As discussed in Section 3.4 , the revised NAAQS for fine particulate matter will likely trigger new nonattainment designations for the two most populous counties in the NCTCOG region - Dallas and Tarrant. This means that approximately 4.9 million residents will be living in areas designated as nonattainment for two different air pollutants – ozone and fine particulate matter – both of which cause respiratory issues and put this population at greater risk of health issues and other negative impacts. Local air quality has already been one of the most pressing local concerns, and new nonattainment designations under a second pollutant will greatly exacerbate existing worries among residents.

In addition, new Federal Performance Measures requirements related to GHGs attributable to the transportation system will require that State Departments of Transportation (State DOTs; for the State of Texas, TxDOT) and MPOs establish declining carbon dioxide emissions targets for the GHG measure and report on progress toward achievement of those targets.

State DOTs will establish two- and four-year statewide emissions reduction targets, and MPOs will establish four-year emissions reduction targets for their metropolitan planning areas. In addition, the rule requires certain MPOs utilizing urbanized areas with populations of 50,000 or more to establish additional joint targets. State DOTs and MPOs have the flexibility to set targets that work for their respective climate change policies and other policy priorities, so long as they are declining. State DOTs and MPOs are also required to report on their progress in meeting the targets. State DOTs established targets February 1, 2024. Subsequent targets will be established and reported no later than October 1, 2026.

While these air quality issues continue to pose challenges, the NCTCOG region faces constant population and economic growth. According to the 2010 and 2020 Decennial Censuses and the Mobility 2045 Update demographic forecast, in recent years, the region has continued to add roughly 125,000 residents per year and is on track to exceed a population of 11 million by 2045. The population growth parallels an increase in economic activity, especially in the Freight sector. The Federal Highway Administration (FHWA) estimates freight shipment tonnage will increase between 2015 and 2045 by 40 percent nationally[3,] and the value of freight shipments to and from the Dallas-Fort Worth area is estimated to increase by 67 percent in a low-growth scenario, according to the FHWA Freight Analysis Framework.[4] The NCTCOG Freight North Texas report details the extensive network of freight assets and impact of freight in the NCTCOG region.[5,6] Increases in population and economic activity lead to more activity in nearly every emissions sector for multiple pollutants: increased vehicle miles of travel (VMT), greater demand for electricity generation, more need for waste management resources, additional pressure on water and wastewater treatment facilities, and more land development that decreases the amount of available green space that absorbs or mitigates air pollutants.

The resulting Greenhouse Gas Emissions Inventory (GHG EI) has been developed to establish a baseline and to be able to reliably track developments primarily in greenhouse gas, while also paying attention to ozone precursors, and fine particulate matter emissions and drawing a comprehensive air quality picture.

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[3] https://www.transportation.gov/briefing-room/dot-releases-30-year-freight-projections
[4] https://faf.ornl.gov/faf5/dtt_total.aspx
[5] https://www.transportation.gov/briefing-room/dot-releases-30-year-freight-projections
[6] https://nctcog.org/getmedia/a3642652-f78b-4bbc-b33f-85fd13e599c3/Freight-North-Texas-2022-A-FREIGHT-Mobility-Plan.pdf

3 Greenhouse Gas Inventory

The first step toward achieving tangible emission reductions requires identifying baseline emissions levels in relation to sources and activities generating emissions in the region. This report presents an assessment of anthropological emissions from the 16-county NCTCOG area, including local government operations. The government operations inventory is mostly a subset of the community inventory, as shown in Exhibit 6. The emissions from local government operations are included in the community emissions to create a wholistic report within a larger area, whereas a government operations inventory is the subset of emissions attributed to any local government from their operations. For example, data on commercial energy use by the community includes energy consumed by municipal buildings, and community vehicle-miles-traveled estimates include miles driven by municipal fleet vehicles.

Exhibit 6: Relationship of Community and Government Operations Inventories

As local governments continue to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. This inventory uses the approach and methods provided by the U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions (Community Protocol)[7] and the Local Government Operations Protocol for Accounting and Reporting Greenhouse Gas Emissions (LGO Protocol)[8] to quantify regional emission estimates, both of which are described below.

3.1 Scope and Base Year

Communities contribute to greenhouse gas emissions in many ways. Two central categorizations of emissions are used in the community inventory:

1) GHG emissions that are produced by "sources" located within the community boundary, and

2) GHG emissions produced as a consequence of community "activities".

[7] https://icleiusa.org/us-community-protocol/

[8] https://icleiusa.org/ghg-protocols/: https://s3.amazonaws.com/icleiusaresources/lgo_protocol_v1_1_2010-05-03.pdf

By reporting on both GHG emissions sources and activities, local governments can develop and promote a deeper understanding of GHG emissions associated with their communities. A purely source-based emissions inventory could be summed up to estimate total emissions released within the community's jurisdictional boundary. In contrast, a purely activity-based emissions inventory could provide perspective on the efficiency of the community, even when the associated emissions occur outside the jurisdictional boundary.

Exhibit 7: Source and Activity – Definition

Source	Activity
Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere.	The use of energy, materials, and/or services by members of the community that result in the creation of GHG emissions.

This inventory utilizes 2019 as its baseline year, because it is the most recent year for which the necessary data was available and best represents normative regional operations for the 16-county NCTCOG region before COVID-19 prevention measures lead to long term disruptions.

Three greenhouse gases included in this inventory are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Most charts in this report represent emissions in "carbon dioxide equivalent" (CO_2e) values, calculated using the Global Warming Potentials (GWP) from the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report.[9] The GWP is an indicator describing the radiation impact of one unit of a greenhouse gas to one unit of CO_2. It indicates the degree of harm to the atmosphere.

Exhibit 8: Global Warming Potentials as Published by the IPCC (2014)

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous Oxide (N_2O)	265

3.2 Inventory Methodology

The ICLEI Community Emissions Protocol

Version 1.2 of the U.S. Community Protocol for Accounting and Reporting GHG Emissions was released by ICLEI in 2019 as a nationally recognized standard in guidance to help U.S. local governments develop

[9] https://www.ipcc.ch/assessment-report/ar5/

effective community GHG emission inventories by establishing reporting requirements for all community GHG emissions inventories.

The community inventory in this report includes emissions from the five Basic Emissions Generating Activities required by the Community Protocol:

- Use of electricity by the community
- Use of fuel in residential and commercial stationary combustion equipment
- On-road passenger and freight motor vehicle travel
- Use of energy in potable water and wastewater treatment and distribution
- Generation of solid waste by the community

The 2019 regional inventory also includes the following activities to be more comprehensive:

- Wastewater processing
- Off-Road and Non-Road sectors
- Airport and aviation emissions
- Water/pleasure craft emissions

The ICLEI Local Government Operations Protocol

In 2010, ICLEI, the California Air Resources Board (CARB), and the California Climate Action Registry (CCAR) released Version 1.1 of the Local Government Operations (LGO) Protocol. The LGO Protocol serves as the national standard for quantifying and reporting greenhouse emissions from local government operations. The purpose of the LGO Protocol is to provide the principles, approach, methodology, and procedures needed to develop a local government greenhouse gas emissions inventory.

The following activities are included in the LGO inventory:

- Energy and natural gas consumption from buildings and facilities
- Wastewater treatment processes
- On-road transportation from employee commute and vehicle fleet

Emissions Quantification Methods

Greenhouse gas emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.
- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used:

Activity Data x Emission Factor = Emissions

Most emissions sources in this inventory are quantified using calculation-based methodologies. Activity data refers to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, annual vehicle miles traveled, etc.

Emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g., lbs. CO_2/kWh of electricity). For this inventory, calculation results are given in Carbon Dioxide Equivalent Emissions in Metric Tons ($MTCO_2e$).

3.3 Community Emissions Inventory Results

Total communitywide $MTCO_2e$ for the regional 2019 inventory are shown in Exhibit 9, Exhibit 10, Exhibit 11, and Exhibit 12. Exhibit 13 shows an overview of the relative distribution of communitywide emissions by sector. The Energy sector (comprised of residential, commercial, and industrial subsectors) makes up the largest portion of the regional inventory at 53 percent. Transportation and Mobile Sources is the second largest sector contributing to regional emissions at 43 percent, with the Waste and Wastewater sector making up the remaining emissions. Note that emissions from the Water Supply sector have been included in the energy sector.

Exhibit 9: Communitywide NCTCOG Area 16-County 2019 Annual CO_2e Emissions – Energy

Sector	Fuel or Source	2019 Usage	Usage Unit	2019 Emissions ($MTCO_2e$)
Residential Energy				
	Electricity	56,878,355	MWh*	22,506,452
	Natural Gas (Utility Fuel Combustion)	82,432,173	MMBtu*	4,384,279
	Kerosene and Distillate Fuel Oil (Non-Utility Fuel Combustion)	1,276	MMBtu	95
	Propane (Non-Utility Fuel Combustion)	3,774,980	MMBtu	234,271
	Wood (Non-Utility Fuel Combustion)	375,569	MMBtu	3,741
Residential Energy Total				**27,128,838**
Commercial Energy				
	Electricity	26,005,061	MWh	10,290,060
	Natural Gas	48,384,406	MMBtu	2,573,397
	Kerosene and Distillate Fuel Oil (Non-Utility Fuel Combustion)	4,245,660	MMBtu	316,130
	Propane (Non-Utility Fuel Combustion)	2,977,516	MMBtu	184,781
	Wood (Non-Utility Fuel Combustion)	119,052	MMBtu	239
Commercial Energy Total				**13,364,607**

Sector	Fuel or Source	2019 Usage	Usage Unit	2019 Emissions ($MTCO_2e$)
Industrial Energy				
	Electricity	17,419,413	MWh	6,892,766
	Natural Gas	1,672,497	MMBtu	88,767
	Distillate Fuel Oil (Non-Utility Fuel Combustion)	55,453,329	MMBtu	4,116,477
	Propane (Non-Utility Fuel Combustion)	66,350,347	MMBtu	4,103,339
Industrial Energy Total				**15,201,349**
Energy Total				**55,694,794**

** Units: MMBtu - Metric Million British Thermal Unit; MWh - Megawatt Hour*

Exhibit 10: Communitywide NCTCOG Area 16-County 2019 Annual CO_2e Emissions – Transportation

Sector	Fuel or Source	2019 Emissions ($MTCO_2e$)
Transportation		
On-Road	Gasoline	31,426,078
	Diesel	9,038,873
Aviation	Total Jet A (Jet Kerosene) and Aviation Gasoline	1,405,499
Off-Road/Non-Road	Total Off-Road/Non-Road Fuel Types	3,521,275
Pleasure Craft	Diesel	95
	Gasoline	1,760
Rail	Freight Diesel and Passenger Diesel	378,586
Transportation Total		**45,772,166**

Exhibit 11: Communitywide NCTCOG Area 16-County 2019 Annual CO_2e Emissions – Solid Waste, Water and Wastewater

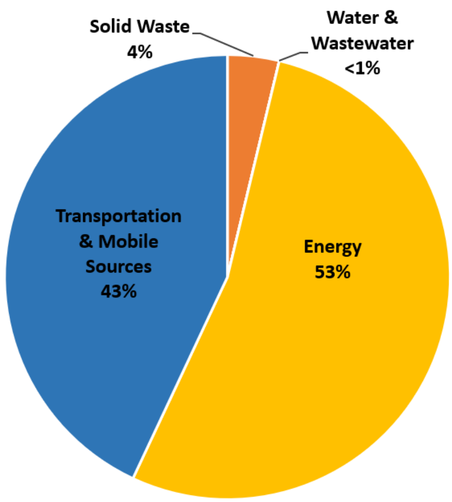
Sector	Fuel or Source	2019 Usage	Usage Unit	2019 Emissions ($MTCO_2e$)
Solid Waste				
Solid Waste	Waste Generation	10,486,236	MT*	3,911,496
	Flaring	20,505,666,550	cf/y*	56,010
Solid Waste Total				**3,967,505**
Water and Wastewater				
Water and Wastewater	Effluent Nitrogen Load	1,439	kg N/day*	1,093
Water and Wastewater Total				**1,093**

** Units: MT – Metric Tons; cf/y - Cubic Feet/Year; kg N/day Kilogram of Nitrogen Load/Day*

Exhibit 12: Communitywide NCTCOG Area 16-County 2019 Annual CO_2e Emissions – Total

Sector	2019 Emissions ($MTCO_2e$)
Energy Total	55,694,794
Transportation Total	45,772,166
Solid Waste Total	3,967,505
Water and Wastewater Total	1,093
Total Communitywide NCTCOG Area 16 Counties [$MTCO_2e$]	**105,435,559**

Exhibit 13: Communitywide NCTCOG Area 16-County 2019 Annual CO_2e Emissions – Total



3.3.1 Electricity

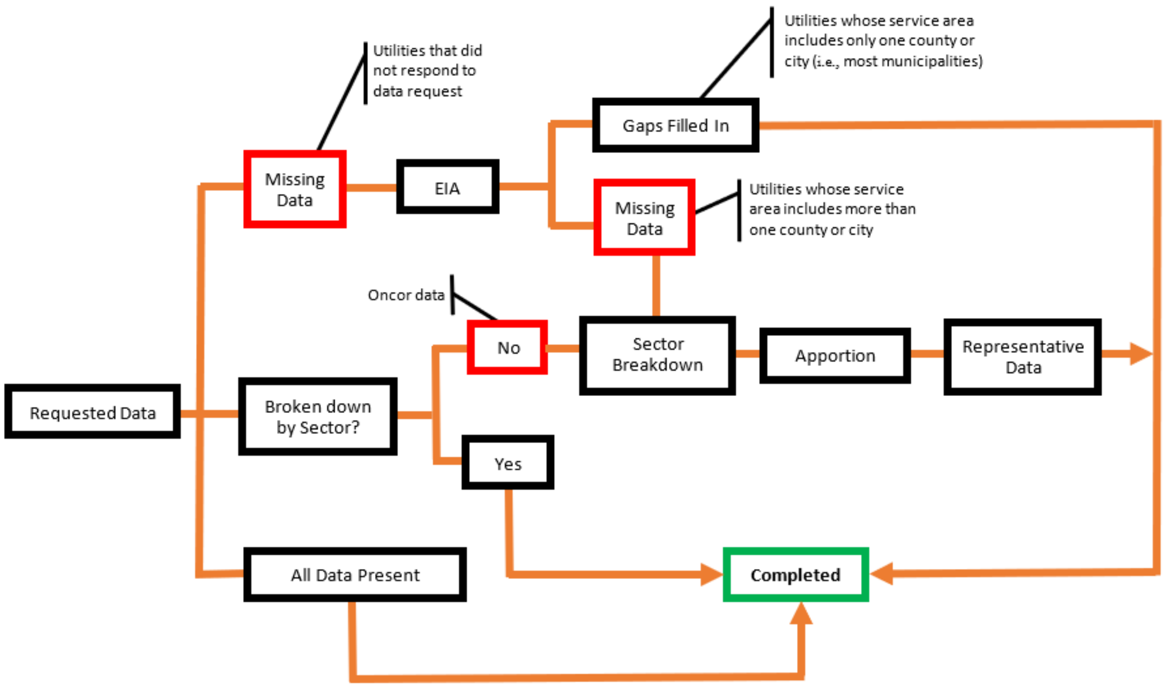
Electricity Data GHG Emissions Methodology

Electricity data activity was estimated using a combination of Energy Information Administration data (EIA-861).[10] NCTCOG GIS data, the National Land Cover Database[11] GIS data, and electricity usage data from municipal owned utilities (MOU), cooperatives (CO-OP), and electric transmission providers data requests. The data was categorized by Residential, Commercial, and Industrial sectors for each county within the 16-county region.

Electricity usage for each county contained the summation of electricity usage from each electricity utility provider that served the county. Depicted below in Exhibit 14 is a process flow diagram describing the data gathering and representative data apportioning process for county electricity data.

[10] https://www.eia.gov/electricity/data.php
[11] https://www.usgs.gov/centers/eros/science/national-land-cover-database

Exhibit 14: County Electricity Data Methodology



Limitations

Limitations for this sector's emission inventory primarily relate to data constraints due to data availability and the level of data granularity. Some data requests were not fulfilled by electricity utility providers. Therefore, EIA-861 data apportioned with GIS was used to supplement. Oncor data was aggregated regardless of energy sector and EIA data was not at a county level, which lead to data apportionment processing.

Assumptions

The following are assumptions made to complete the emissions inventory for the Electricity sector.

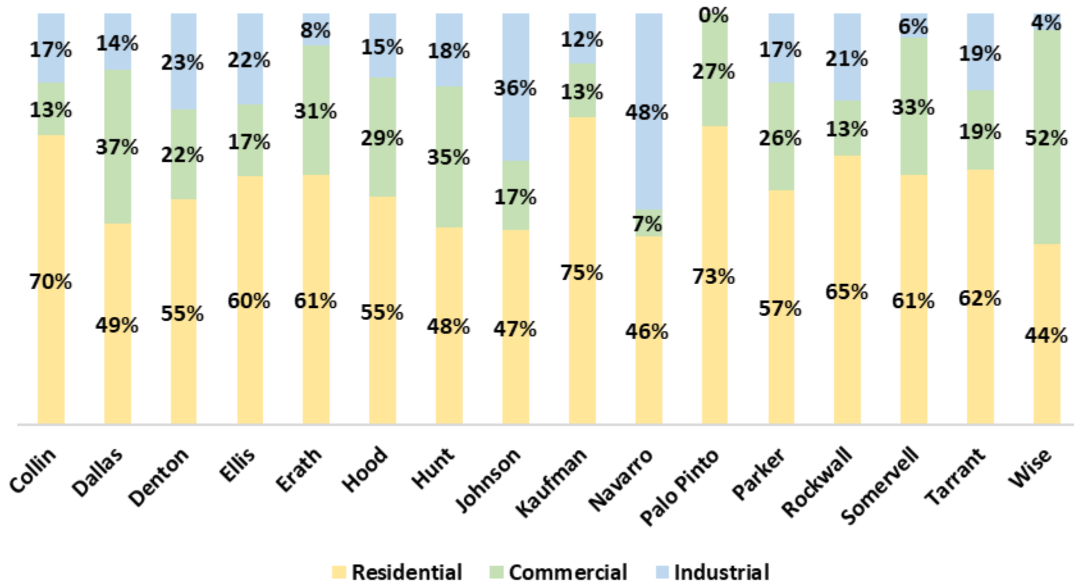
- There is no overlap between CO-OPs and MOUs in coverage and those in an MOU area are subject to using the MOU.
- Land-Use data incorporation assumes that negligible electricity consumption occurred in areas that are not urbanized/incorporated.
- Apportioned data assumes equal amount of usage per area - counties with more urban developments, Industrial, or Commercial sectors are likely to have fluctuating electricity usages.

Electricity Data GHG Emissions Results

The Energy sector is the largest contributor to CO_2e across the inventory, at 53 percent of regional emissions in 2019, with electricity being the bulk of the Energy sector emissions – electricity from the residential, commercial, and industrial energy subsectors combined account for almost 38 percent of the regional inventory's CO_2e. Total electricity emissions for 2019 in the 16-county region were 39,689,277 metric tons of CO_2e, of which 57 percent (22,506,452 $MTCO_2e$) were residential, 26 percent

(10,290,060 $MTCO_2e$) were commercial, and 17 percent (6,892,766 $MTCO_2e$) were industrial. The sector percentage breakdown of the electricity consumption for each county can be seen in Exhibit 14.

Exhibit 15: NCTCOG Area 16-County 2019 Annual Electricity Usage by Sector



3.3.2 Natural Gas

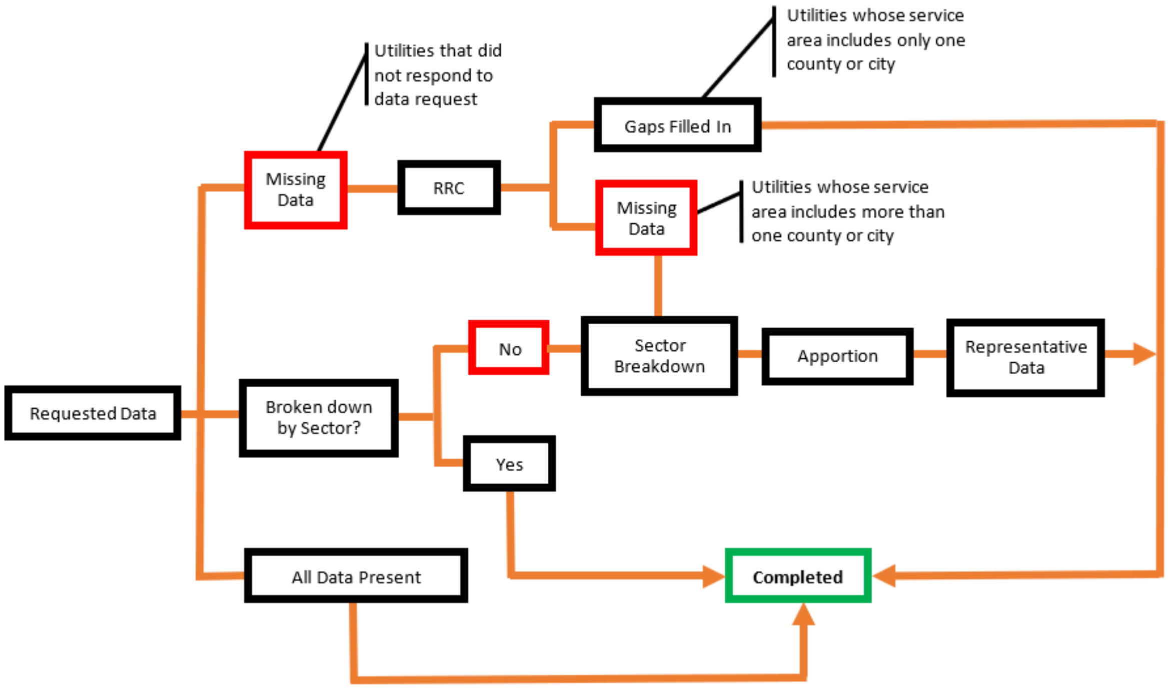
Natural Gas Data GHG Emissions Methodology

Natural gas data was collected either directly from utilities or indirectly as supplemental data from the Railroad Commission of Texas (RRC).[12] Data collected directly from utilities included division of natural gas by Residential, Commercial, and Industrial sectors for each county and cohort city in the NCTCOG region. Data collected indirectly from the RRC included only Residential and a combined mix of Commercial and Industrial sectors, which would then need to be processed and attributed to cohort cities and counties (see Exhibit 16).

Creating the representative data from RRC was accomplished by first identifying if a city within the NCTCOG region was serviced by more than one utility. If a city was serviced by only one utility, it could be added into the data for that county. However, if a city was serviced by more than one utility or that city existed in multiple counties, natural gas consumption data was apportioned based on that city's urban land use from the 2019 National Land Cover Database. The percentage of urban territory for each county within the service areas was then attributed to the individual county.

[12] https://www.rrc.texas.gov/resource-center/

Exhibit 16: County Natural Gas Data Methodology



Limitations

Limitations for this emission inventory primarily come from the use of supplemental data from the RRC. Ideally, data for natural gas consumption would have come directly from each utility that serves the NCTCOG region. The RRC receives natural gas consumption data directly from utilities. However, the structure of RRC data limits the scope of this inventory as RRC data does not include any unincorporated areas within counties and is limited to the city level. Additionally, the RRC data does not differentiate between commercial and industrial.

Assumptions

The following are assumptions that were made to get the most wholistic view of natural gas consumption for the NCTCOG region:

- Commercial and Industrial sector data from the RRC would only be included as commercial in the final product. This was done since data from Atmos Energy supported a more commercial heavy natural gas consumption.
- Data from Texas Gas Service included a “Public Authority” consumption. This sector was included as commercial in the final product since it included entities such as universities and government buildings.
- Most natural gas consumption is assumed to be in urban areas to help apportion data to different counties. However, this is not entirely true as numerous other land use areas consume natural gas.

Electricity Data GHG Emissions Results

Total natural gas consumption for 2019 in the region was 132,489,077 MMBtu, of which 82,432,173 MMBtu was residential, 48,384,406 MMBtu was commercial, and 1,672,497 MMBtu was industrial. A breakdown by natural gas consumption for each county can be seen in Exhibit 17.

Exhibit 17: NCTCOG Area 16-County 2019 Annual Natural Gas Usage by County, per Sector (MMBtu)

County	Residential	Commercial	Industrial
Collin	17,069,925	5,026,766	97,509
Dallas	28,237,312	22,366,973	278,197
Denton	11,976,048	3,947,603	20,518
Ellis	849,596	608,677	82,046
Erath	137,039	146,443	4,192
Hood	95,415	118,542	0
Hunt	484,158	452,233	151,925
Johnson	648,447	501,344	165,429
Kaufman	814,352	404,970	29,478
Navarro	306,134	258,106	13,622
Palo Pinto	171,300	198,130	5,759
Parker	384,276	440,237	6,869
Rockwall	1,404,920	449,868	0
Somervell	12,353	49,748	0
Tarrant	19,691,689	13,174,683	816,954
Wise	149,210	240,084	0

3.3.3 Stationary Non-Utility Fuel Combustion

Stationary Non-Utility Fuel Combustion GHG Emissions Methodology

Stationary Non-Utility Fuel Combustion is reported by each source to the U.S. EPA under 40 CFR Part 98 Subpart C (Greenhouse Gas Reporting Program (GHGRP), Title 40, Code of Federal Regulations)13 – General Stationary Fuel Combustion Sources and is also collected by the U.S. Energy Information Administration for usage in their State Energy Data System (SEDS)14. Reported data was extracted for statewide usage and downscaled for each sector, with the region's Industrial sector data also gathered via the EPA's Facilities Level Information on Greenhouse Gases Tool (FLIGHT)15 for regional guidance and comparative purposes. Data was then input into ICLEI's ClearPath tool to convert total consumption into metric tons of CO_2e using an emissions factor conversion for the corresponding fuel combusted.

Limitations

Limitations for this emission inventory primarily relate to data availability for accuracy and precision. Ideally, data for stationary non-utility fuel consumption would have come directly from each utility that

[13] ghgfactsheet.pdf (epa.gov)
[14] https://www.eia.gov/state/seds/
[15] https://ghgdata.epa.gov/ghgp/main.do?site_preference=normal

serves the NCTCOG region. As the threshold for the federal GHG reporting program is 25,000 MT CO_2e for any facility to appear in reporting, many smaller emitters are left out and may cumulatively be a significant number of emissions that are unaccounted. Additionally, EIA SEDS aggregates consumption of all types of distillate fuel oil into one number for the Residential and Commercial sectors. Therefore, custom emissions factors appropriate for general distillate fuel oil consumption of all types were used for ClearPath entry by using CO_2 emission factors from the EIA, and CH_4 and N_2O emission factors from EPA's emission factors in Appendix C of the U.S. Community Protocol.

Assumptions

The following are assumptions that were made to get the most wholistic view of stationary non-utility fuel consumption for the NCTCOG region:

- FLIGHT data was used to highlight what large industrial facilities exist in the region and what fuel types were consumed in 2019. This information was used as an indicator for what are likely the only fuels with widespread use throughout the region's Industrial sector and therefore what fuels would also be unlikely to be used at smaller facilities in a nonnegligible amount.
- Assumed electricity, natural gas, and district heating/cooling be delivered by utilities and included in other sectors of this emission inventory.
- Commercial and Industrial sectors are involved in downscaling non-local (i.e., statewide) data on fuel consumption to a local level using Census job counts.
- EIA assumes statewide residential coal consumption in 2008 and beyond to be zero/negligible.

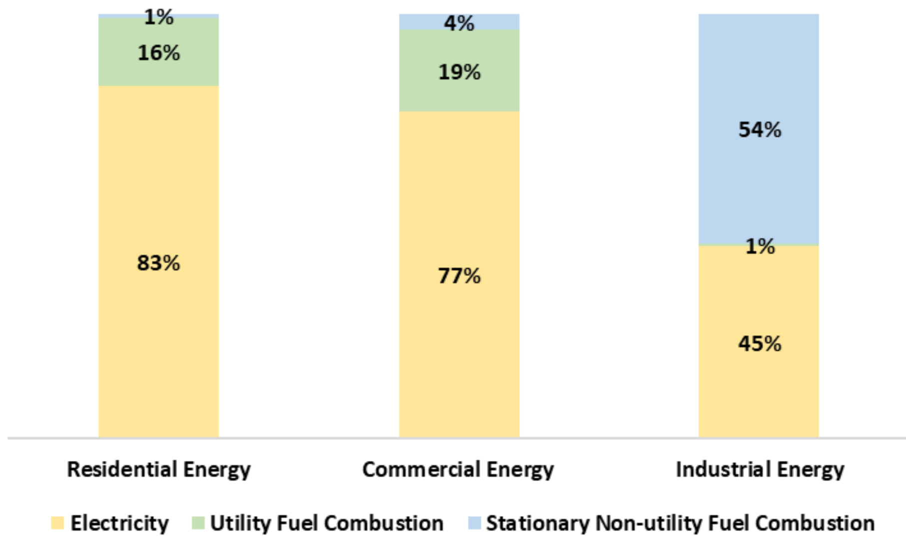
Stationary Non-Utility Fuel Combustion GHG Emissions Results

Total stationary non-utility gas consumption for 2019 in the region resulted in 8,959,074 $MTCO_2$e of emissions of which 238,107 $MTCO_2$e were residential, 501,150 $MTCO_2$e were commercial, and 8,219,816 $MTCO_2$e were industrial.

A sector-wide percentage comparison of the regional emission total is shown in

Exhibit 18.

Exhibit 18: NCTCOG Area 16-County 2019 Annual Energy Emissions



3.3.4 Transportation: On-Road

On-Road GHG Emissions Methodology for the NCTCOG 12-County Metropolitan Planning Area

Estimation of Vehicle Activity

The Dallas-Fort Worth Travel Model, the Transportation Analytical Forecasting Tool (TAFT), serves as the source for forecasting VMT and other travel characteristics for the North Central Texas nonattainment area. The network-based TAFT is executed in the TransCAD environment, which is a Geographic Information System-based commercial travel demand software package for transportation planning. The NCTCOG Transportation Department is responsible for executing TAFT and conducting various planning studies for the region. The forecasting technique of TAFT is based on a four-step sequential process designed to model travel behavior and predict the level of travel demand at regional, sub-area, or small area levels. These four steps are: Trip Generation, Trip Distribution, Mode Choice, and Roadway Assignment.

Estimation of Off-Network Activity

The non-roadway-based inventory estimates (e.g., from vehicle starts, parked vehicle evaporative processes, non-roadway-based vehicle idling, hoteling activity) were calculated as the product of the amount of associated activity and the mass per unit of activity. To estimate the source hours parked (SHP) and vehicle starts activity, vehicle population estimates were needed. Hoteling activity estimates (composed largely of the emissions-producing source hours extended idling (SHEI) and diesel auxiliary power unit (APU) hours) were based on county-specific actual estimates.

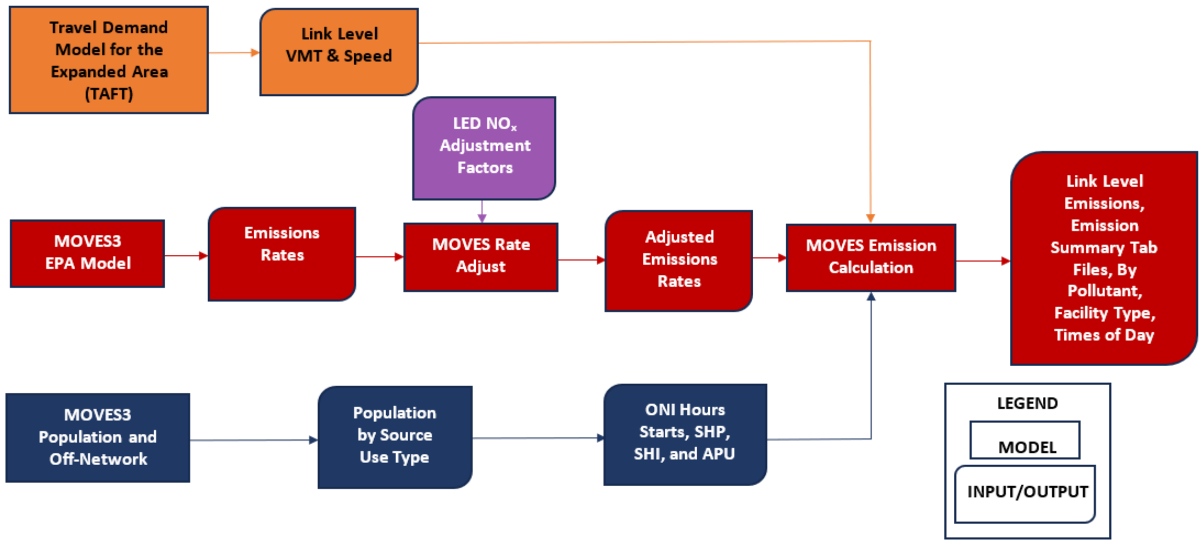
The methodology provided by the Texas A&M Transportation Institute (TTI), similar to the region's Transportation Conformity, was used to calculate the vehicle population and off-network activity estimates.

Emissions Estimation

Emissions were calculated using the EPA's MOtor Vehicle Emission Simulator (MOVES) 3 model and the utilities developed by TTI. The utilities combine vehicle and off-network activity and emission rates to create emission estimates.

Exhibit 19 below outlines the emission calculation modeling process used to calculate the Dallas-Fort Worth Metropolitan Planning Area emissions estimates.

Exhibit 19: Emissions Modeling Process



On-Road GHG Emissions Methodology for the NCTCOG Additional Four Counties (Erath, Navarro, Palo Pinto, and Somervell)

The emission estimates for the four counties of Erath, Navarro, Palo Pinto, and Somervell were calculated using the EPA's MOVES 3 model in the inventory mode, utilizing the EPA's default activities.

On-Road GHG Emissions Results

The emissions for Collin, Dallas, Denton, Ellis, Erath, Hood, Hunt, Johnson, Kaufman, Navarro, Palo Pinto, Parker, Rockwall, Somervell, Tarrant, and Wise counties were produced at a summer weekday level, and a conversion factor from TxDOT's Automatic Traffic Recorder (ATR) Data was used to annualize the estimates. The on-road annual CO_2e emissions for the analysis year 2019 are listed in

Exhibit 20.

Exhibit 20: NCTCOG Area 16-County 2019 Annual On-road CO_2e Emissions

County	$MTCO_2e$	County	$MTCO_2e$
Collin	4,386,731	Kaufman	1,214,645
Dallas	14,642,389	Navarro	689,279
Denton	3,476,454	Palo Pinto	341,823
Ellis	1,384,734	Parker	1,010,439
Erath	347,899	Rockwall	441,550
Hood	346,761	Somervell	79,864
Hunt	958,525	Tarrant	9,479,378
Johnson	965,320	Wise	699,160
		Total	**40,464,951**

3.3.5 Transportation: Off-Road/Non-Road

Off-Road/Non-Road GHG Emissions Methodology

The off-road/non-road emissions include emissions from various equipment such as agricultural, airport, commercial, construction and mining, industrial, lawn and garden, logging, railroad, and recreational. The emissions estimates were developed using the TexN model, a tool for estimating Texas-specific emissions from off-road/non-road sources. The Texas Commission of Environmental Quality (TCEQ) contracted with Eastern Research Group (ERG) to develop the model. The TexN model uses EPA's Non-Road model to calculate emissions, as previously required by the EPA for developing emissions estimates for State Implementation Plan revisions, national emissions inventories, and reasonable further progress (RFP) analyses. Since TexN was developed, TCEQ has frequently updated the Texas-specific data within the tool and enhanced the tool's functionality. The recent version available, TexN 2.2, was utilized for this inventory.

Off-Road/Non-Road GHG Emissions Results

The TexN 2.2 model was set to the scenario year of 2019, an annual period, and was run for all the 16 counties (Collin, Dallas, Denton, Ellis, Erath, Hood, Hunt, Johnson, Kaufman, Navarro, Palo Pinto, Parker, Rockwall, Somervell, Tarrant, and Wise). The off-road/non-road annual CO_2e emissions for the analysis year 2019 are listed in

Exhibit 21.

Exhibit 21: NCTCOG Area 16-County 2019 Annual Off-Road/Non-Road CO2e Emissions

County	$MTCO_2e$			
Collin	397,742		Kaufman	82,530
Dallas	1,418,388		Navarro	34,333
Denton	290,817		Palo Pinto	20,748
Ellis	138,050		Parker	65,856
Erath	24,414		Rockwall	51,097
Hood	36,107		Somervell	16,351
Hunt	38,465		Tarrant	778,049
Johnson	75,241		Wise	53,089
			Total	**3,521,275**

3.3.6 Rail

Rail Data GHG Emissions Methodology

Rail data was collected from a combination of fuel usage data from regional rail agencies' data requests, total rail track miles and annual fuel use from rail agencies' sustainability/annual reports, representative rail data (for rail entities that had no data available), and single rail track miles operated by rail agencies within the NCTCOG region from the NCTCOG GIS database (see

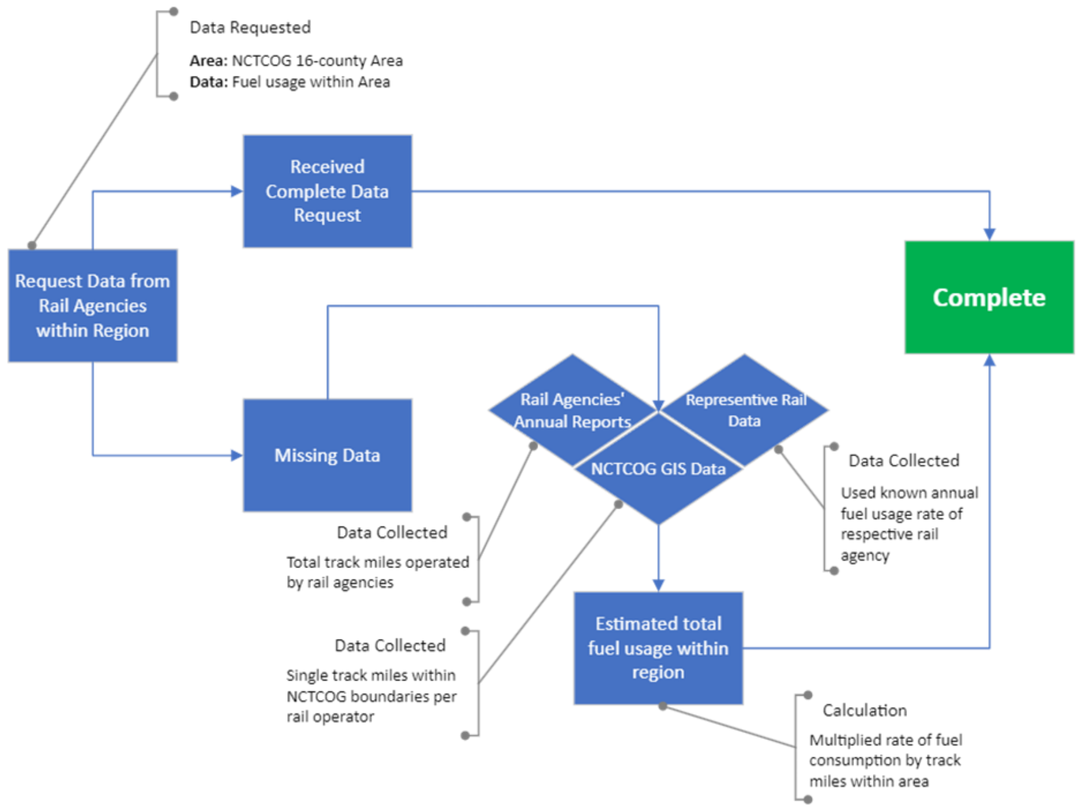
Exhibit 22). The data was categorized as freight diesel, passenger diesel, and passenger electric.

Rail emissions were estimated by calculating the rate of fuel consumption per single track mile for each rail agency and applying that rate to the number of single-track miles within the NCTCOG region.

$$Fuel\ Consumption_{Regional} = \frac{Fuel\ Consumption_{Total}}{Single\ Track\ Mile_{Total}} \times Single\ Track\ Mile_{Regional}$$

$$Emissions_{Regional} = Fuel\ Consumption_{Regional} \times ERCOT\ eGRID\ emission\ factor$$

Exhibit 22: County Rail Data Methodology



Limitations

For this emissions inventory, the assumption that each track mile had the same emission rate was used to calculate emissions. Unless the rail agency solely operated within the NCTCOG region and provided their total fuel usage, this assumption did not account for the number of trips or number of locomotives for each track which would invariably over or underestimate the emissions per track mile. Additionally, ICLEI's ClearPath tool used only the Emissions & Generation Resource Integrated Database (eGRID) for the rail transportation factor set. "The eGRID is a comprehensive source of data from EPA's Clean Air Markets Division on the environmental characteristics of almost all electric power generated in the United States."[16] However, eGRID may not accurately estimate the emissions from rail diesel as its focus is related to electricity generation and those associated emissions. This would work for electric rail transportation but may not as accurately calculate emissions for diesel rail transportation.

Assumptions

The following are some assumptions that were made to complete the emissions inventory for the Rail sector:

- Each track mile was assumed to have the same emission rate for all rail agencies.
- Fuel consumption from the Trinity Rail Express (TRE) was estimated using fuel consumption rates from Dallas Area Rapid Transit (DART) and Trinity Metro because both operate part of the TRE.
- There was no fuel consumption attributed to the Northeast Texas Rural Rail Transportation District because no trains were likely to run on the tracks located within our region.

[16] www.epa.gov/egrid

- The rate of fuel consumption for the Dallas, Garland & Northeastern Railroad (DGNO) was used to estimate Fort Worth & Western Railroad (FWWR) fuel consumption because no fuel data was available for FWWR and DGNO was a known representative data source.
- DART Light Rail electricity consumption is already accounted for in the electricity emissions inventory.

Rail Data GHG Emissions Results

The total CO_2e region associated with the Rail sector in the region for 2019 was 378,586 metric tons. Tarrant County freight rail is shown to have contributed the highest amount of carbon dioxide equivalent (CO_2e) with 68,507 metric tons, followed by Dallas County freight rail with 54,697 metric tons of CO_2e. The electricity use associated to the Rail sector is accounted for in the Electricity sector.

Exhibit 23: NCTCOG Area 16-County 2019 Annual Rail Sector (Passenger and Freight) CO_2e Emissions

County	$MTCO_2e$		County	$MTCO_2e$
Collin	20,383		Kaufman	5,808
Dallas	69,179		Navarro	25,839
Denton	42,902		Palo Pinto	6,916
Ellis	38,111		Parker	6,597
Erath	2,021		Rockwall	667
Hood	1,492		Somervell	0
Hunt	10,212		Tarrant	86,880
Johnson	32,728		Wise	28,851
			Total	**378,586**

3.3.7 Pleasure Craft

Pleasure Craft Data GHG Emissions Methodology

Pleasure craft data was provided as a regional annual estimate based on data from the Texas Parks and Wildlife (TPW) Boat Registration inventory.[17] The pleasure craft inventory was filtered down to the boats in the 16-county region that were built by 2019 and fuel description was processed to count all pleasure craft that may use diesel or gasoline. Pleasure craft emissions were estimated by establishing hours of pleasure craft operation and applying the number of boats in each speciated category against a conservative estimate for annual hours of boating per pleasure craft, then applying the hours against the corresponding emission factors from EPA's MOVES 3 model.

The EPA's MOVES 3 emission factors were used for the scenario year of 2019 and for the 16 counties (Collin, Dallas, Denton, Ellis, Erath, Hood, Hunt, Johnson, Kaufman, Navarro, Palo Pinto, Parker, Rockwall, Somervell, Tarrant, and Wise).

[17] https://tpwd.texas.gov/

Limitations

Limitations for this section of the emission inventory include having to rely on TPW boat registration data accuracy. Fuel description was a vital column for being able to fully speciate pleasure craft emissions, and inconsistencies generally required manual edits for dataset manipulation. An additional limitation pertains to the location of pleasure craft usage and the number of hours operated, which were estimated using data on registered boats in Texas from the 2012 National Recreational Boating Survey and the corresponding exposure hours. There are also limitations on emission quantification due to the usage of summer weekday averages for each class of craft for emission rates.

Assumptions

The following are some assumptions that were made to complete the emissions inventory for regional pleasure craft emissions:

- Pleasure craft registered within the 16-county region that also had a year built of 2019 or earlier were included in estimates.
- All pleasure craft were assumed to operate, and to operate an equal amount within the region.
- TPW data post-processing occurred to superimpose corresponding fuel descriptions and emission factors. The following occurred:
  - Boats registered as sail propulsion that did not have an engine or fuel description were superimposed as "NONE/NA" fuel description.
  - Boats registered as sail propulsion that did not have an engine but were listed with a diesel fuel description were assumed to be inboard/sterndrive as a conservative estimate.
  - Fuel description "NONE/NA" was not included for emission estimates.
  - Fuel description as electric were not included for emission estimates to avoid potential double counting.
  - Fuel description "OTHER" that also had no engine were not included for emission estimates.
  - Pleasure craft with a blank fuel description and no engine were not included for emission estimates.
  - Combined engine types of NONE/NA, OTHER, (Blanks), and POD DRIVE were assumed to use the most conservative gasoline emission factor.
  - Summer weekday activity is consistent across the region and representative of activity levels.

Pleasure Craft Data GHG Emissions Results

The estimated regional pleasure craft $MTCO_2e$ emissions for the analysis year 2019 are listed in

Exhibit 24.

Exhibit 24: NCTCOG Area 16-County 2019 Annual Pleasure Craft CO_2e Emissions

County	$MTCO_2e$		County	$MTCO_2e$
Collin	229		Kaufman	52
Dallas	360		Navarro	25
Denton	296		Palo Pinto	25
Ellis	65		Parker	95
Erath	12		Rockwall	49
Hood	87		Somervell	3
Hunt	30		Tarrant	419
Johnson	67		Wise	41
			Total	**1,855**

3.3.8 Aviation

Aviation Data GHG Emissions Methodology

To maintain consistency with the state, regional aviation data emissions were sourced from the 2019 and 2020 data used in development of the SIP through a recent airport emission inventory ("2020 Texas Statewide Airport Emissions Inventory and 2011 through 2050 Trend Inventories")[18] provided by TTI for TCEQ. The report is required every three years by the EPA to fulfill Air Emissions Reporting Requirements (AERR) for usage in the EPA's National Emissions Inventory (NEI).[19]

The emissions estimates were modeled using average summer weekday emissions from airport – auxiliary power unit and ground support equipment – and aircraft emissions through the Federal Aviation Administration's Aviation Environmental Design Tool (AEDT). The most recent version of AEDT, AEDT 3d, was used for modeling and emission estimates listed in Exhibit 25. As noted within the study, aircraft emissions were based on calculations for taxi-in, taxi-out, climb, and landing.

Limitations

Limitations for this emission inventory primarily come from the use of an external report. As the report is only required every three years by the AERR, there may be times that data may be unavailable or that required years may not align with desired/horizon years. Additionally, the COVID-19 pandemic may have had some impact on this study.

Assumptions

The following assumptions were made:

- All commercial, military, and turbine engines use Jet A (Jet Kerosene), are domestic passenger flights, and are between jurisdictions (Scope 3).
- All piston engines use Aviation Gasoline, are domestic passenger flights, and are within jurisdictions (Scope 1).

[18] https://www.tceq.texas.gov/downloads/air-quality/research/reports/emissions-inventory
[19] National Emissions Inventory (NEI)

- The model assumes a maximum mixing height of 3,000 feet for emissions, so emissions at/above cruising altitude are not included in results.

Aviation Data GHG Emissions Results

Exhibit 25: NCTCOG Area 16-County 2019 Annual Aviation CO_2e Emissions

County	$MTCO_2e$		County	$MTCO_2e$
Collin	47,474		Kaufman	3,786
Dallas	213,161		Navarro	2,349
Denton	24,020		Palo Pinto	137
Ellis	8,748		Parker	5,799
Erath	941		Rockwall	1,656
Hood	1,994		Somervell	23
Hunt	7,529		Tarrant	1,081,707
Johnson	3,902		Wise	2,273
			Total	**1,405,499**

3.3.9 Solid Waste

Solid Waste GHG Emissions Methodology

Greenhouse gas emissions from the Solid Waste sector were calculated using methane generation and flaring data from federal regulatory reporting for the 26 registered landfills within the inventory area for the year 2019. Methane is generated from the breakdown of organic material within landfills and may either be released directly into the atmosphere, captured for flaring, or converted into compressed natural gas (CNG). Flaring is the process of combusting landfill gas to reduce methane and other harmful compounds emitted.

Landfill methane generation is reported by landfills to the U.S. EPA under 40 CFR Part 98 Subpart HH – Municipal Solid Waste Landfills. This data was extracted for each landfill in the inventory area via the FLIGHT Tool and totaled for the entire region. Data was input into ICLEI's ClearPath tool to convert total methane generated into metric tons of CO_2e.

Landfill gas flaring emissions data was extracted using the EPA's FLIGHT tool. Landfills are required to report the amount of landfill gas flared, the fraction of methane in the landfill gas, and the equipment destruction efficiency. The amount of gas flared was totaled for the inventory area, and averages were calculated for the fraction of methane and equipment destruction efficiency. Data was entered into ICLEI's ClearPath tool to convert the total amount flared into metric tons of CO_2e.

The waste characterization factor set used was from the 2019 North Central Texas Waste Characterization Study.

Limitations

Since landfill methane is a Scope 1 emission, all methane emissions from each landfill are attributed to the county in which the landfill is located. All generation and disposal data are assumed to be from within the same county for ease of attribution. Hood, Kaufman, Rockwall, and Wise counties have no landfills reporting through EPA FLIGHT or TCEQ.

Data on emissions associated with compost facilities is not included in the Solid Waste sector as these facilities are not currently reporting emissions to EPA or TCEQ. Emissions from the collection and transportation of solid waste are included in the On-Road Transportation sector.

Solid Waste GHG Emissions Results

As to be expected, compared to the vast emissions from the Energy and Transportation sectors in the area, emissions generated from solid waste are comparingly small. The results of the solid waste emission calculation are shown in Exhibit 26 below.

Exhibit 26: NCTCOG Area 16-County 2019 Annual Solid Waste CO_2e Emissions

Solid Waste Sector Emissions (MT CO_2e)	
Waste Generation Emissions	3,911,496
Landfill Gas Flaring Emissions	56,010
Total	3,967,505

3.3.10 Wastewater and Water Treatment

Wastewater and Water Treatment GHG Emissions Methodology

Greenhouse gas emissions from the Water Supply sector were calculated based on the total volume of water intake for water providers within the inventory area. Water intake data is reported by water providers to the Texas Water Development Board (TWDB) and published in TWDB's Water Use Survey.[20] Total intake volume was converted to kWh of electricity usage using the ICLEI U.S. Community Protocol, Appendix F, Method WW.14: Calculation of Upstream Emissions Associated with Water Supply, Conveyance, Treatment and Delivery.[21] The data was then entered into ICLEI's ClearPath tool to convert total electricity usage into metric tons of CO_2e.

Emissions from wastewater effluent discharge were calculated based on data available through the EPA's Enforcement and Compliance History Online (ECHO).[22] Daily nitrogen load was estimated via monthly averages reported to the EPA's National Pollutant Discharge Elimination System (NPDES)[23] by wastewater facilities, based on nitrogen readings taken at effluent discharge sites. Daily averages are reported by facilities in lbs/day, so they were converted to kg/day. County data was calculated and entered into ICLEI's ClearPath tool to convert daily nitrogen load to annual metric tons CO_2e. For ease of calculation and to properly assign Scope 1 emissions at the point of source, all wastewater effluent is assumed to be generated and treated in-boundary.

[20] https://www.twdb.texas.gov/waterplanning/waterusesurvey/index.asp
[21] https://icleiusa.org/us-community-protocol/
[22] https://echo.epa.gov/
[23] https://www.epa.gov/npdes

Limitations

Not all wastewater treatment facilities in the region have reported their nitrogen emission in the NPDES database. Facilities that were not present were omitted in this inventory.

Data on emissions associated with the supply of potable water is included in this report as information only. All emissions associated with water supply are related to the electricity used in water conveyance, treatment, and distribution, which is captured by the Commercial and Industrial Energy sectors.

In the absence of site-specific data, the energy intensities used in the calculations of electricity usage for each stage in the water supply process come from national averages and may have varying degrees of reliability.

Data on emissions associated with anaerobic digestion of wastewater biosolids is not included as this data is not currently reported to EPA or TCEQ. Only 6 of the 130 wastewater treatment facilities in the inventory area currently have on-site anaerobic digesters. There are no emissions associated with the combustion of wastewater biosolids as no wastewater treatment facilities in the inventory area engage in biosolid combustion. Process methane and nitrous oxide emissions from wastewater treatment lagoons and nitrification/denitrification are not included as this data is not currently reported to EPA or TCEQ. Emissions from septic systems are not included as there is no regional database for on-site sewage systems, so the total number of septic systems in the inventory area is unknown.

Wastewater and Water Treatment GHG Emissions Results

Compared to the emissions from the Energy and Transportation sectors in the area, emissions generated from wastewater are small. The results of the wastewater effluent discharge emission calculation are shown in Exhibit 27 below. Note that water supply emissions are displayed for information only; these emissions are included in the inventory of the Energy sector.

Exhibit 27: NCTCOG Area 16-Counties 2019 Annual Water and Wastewater CO_2e Emissions

Water and Wastewater Sector Emissions [MT CO_2e]	
Water Supply Emissions*	500,669*
Wastewater Effluent Discharge Emissions	1,090
Total (Emissions from Water and Wastewater, Including the Emissions Part of Energy Sector)	**501,759**

* Water Supply Emissions data is included in this section for information only. These emissions are included within the Commercial and Industrial Energy sector emissions.

3.4 Criteria Pollutants of Regional Concern

Many air quality efforts addressing GHGs also reduce ozone precursors and particulate matter pollution, thus improving air quality comprehensively in the increasingly populous and economically growing North Texas region. The guidelines are provided by EPA's NAAQS designed to protect human and environmental health and establish regulations for six criteria pollutants. For air quality to be considered "good" or in compliance with NAAQS, air pollutant concentrations need to be measured at levels below the NAAQS – levels that are higher than the NAAQS are considered to "violate" or "exceed" the standard. Exhibit 28 illustrates the current status of attainment designations in the NCTCOG area (meaning the designated area meets or is in compliance with NAAQS) versus nonattainment designations (meaning the designated area violates or exceeds the NAAQS).

Exhibit 28: NAAQS Criteria Pollutants

Air Pollutant	Abbreviation	Dallas-Fort Worth Region Status
Carbon Monoxide	CO	In attainment
Lead	Pb	In attainment
Nitrogen Dioxide	NO_2	In attainment
Particulate Matter	PM_{10}	In attainment
Ground-Level Ozone	O_3	10 counties (Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise) designated nonattainment for the 2008 standard 9 counties (Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Tarrant, and Wise) designated nonattainment for the 2015 standard
Particulate Matter	$PM_{2.5}$	2 counties (Dallas and Tarrant) likely to be designated nonattainment under NAAQS rules finalized February 7, 2024
Sulfur Dioxide	SO_2	Partial nonattainment in Navarro County due to an aggregate plant

Ozone

Portions of the NCTCOG area continue to exceed NAAQS for ground-level ozone. Ten counties in North Texas (Dallas, Denton, Collin, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant and Wise) violate federal standards for having high concentration of ground-level ozone under the 2008 8-hour ozone standard of 0.075 ppm and nine counties are in nonattainment for the 2015 8-hour ozone standard of 0.07 ppm. Since ozone is not emitted directly, efforts to improve air quality and reduce ozone focus on sources of ozone precursor pollutants nitrogen oxides (NO_X) and volatile organic compounds (VOC). There are many more VOCs in the atmosphere than NO_X. The large ratio of VOCs to NO_X means that North Central Texas is "NO_X limited," which results in ozone formation being much more sensitive to changes in NO_X than VOCs. As North Central Texas is NO_X limited, primary efforts to address ozone in the region focus on NO_X reduction.

Significance of Ground-Level Ozone

Clinical studies indicate prolonged exposure to elevated concentrations of ground level ozone may reduce lung function, increase the frequency of asthma episodes, and reduce the body's ability to resist respiratory infections. In addition to threatening human health, high ground-level ozone concentrations pose a risk to the environment, wildlife, and agriculture. Although ground-level ozone is monitored year-round, the EPA designated ozone season for the Dallas-Fort Worth region is from March 1 through November 30, when high ozone concentrations are most common.

Economic Impact of Ozone Pollution

Failure to meet federal standards for air quality could result in additional emission-control requirements or fee-based penalties that can unfavorably affect local businesses and also result in a freeze on federal transportation funding. This would ultimately affect jobs in the region and cost money in lost productivity due to traffic congestion delays.

Emissions Inventory

With ozone being a secondary pollutant, emissions estimates of ozone precursors NO_X and VOCs are part of TCEQ's State Implementation Plan revisions available at the Texas SIP Revisions.

Particulate Matter

On February 7, 2024, the EPA strengthened the NAAQS for $PM_{2.5}$. Specifically, the annual $PM_{2.5}$ standard has been lowered from 12.0 micrograms per cubic meter to 9.0 micrograms per cubic meter. The two most populous counties in the NCTCOG region – Dallas and Tarrant – could be designated as nonattainment under this revised standard[24] due to having a $PM_{2.5}$ monitor in each county with an annual reading above the 9.0 micrograms per cubic meter limit.

Significance of Particulate Matter

Lung and heart diseases are associated with particulate matter exposure, including premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms. Besides people with heart or lung diseases, children and older adults will be most likely affected by particle pollution exposure.

Environmental effects consist of haze, which is often a result of particle pollution, and environmental and material damage. Since particles can be carried over long distances, the source and deposition region can vary significantly. When settling, the effects depend on the chemical composition of the particles but may make lakes and streams acidic, change the nutrient composition in coastal waters and river basins, as well as in soil which can lead to damage to forests and farm crops, contribute to acid rain, and affect the diversity of ecosystems.

Economic Impact of Particulate Matter p\Pollution

The impacts on the environment and existing ecosystems also have an impact on agriculture, including the food industry, and the local price and job landscape. In addition, they can affect seemingly unrelated industries such as the condition of construction materials and tourism, leading to widespread effects on local health conditions and the economy.

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[24] https://www.epa.gov/pm-pollution/national-ambient-air-quality-standards-naaqs-pm

Emissions Inventory

Particulate matter emissions estimates are available on the EPA's comprehensive and detailed estimate of air emissions of criteria pollutants, criteria precursors, and hazardous air pollutants from various air emissions sources, National Emissions Inventory.[25]

[25] National Emissions Inventory (NEI)

4 Next Steps

This inventory is actively being utilized to focus and prioritize regional emission reduction strategies through project and policy planning and will serve as a baseline for future inventories: as a reference to gauge the effectiveness of subsequent actions targeted to reduce harmful emissions within the overall regional airshed, as well as a basis to improve upon for future inventorying efforts.

Based on 2019 emission inventory results, the following areas have the greatest potential for sector-wide emissions reductions:

- Energy
- Transportation and Mobile Sources
- Solid Waste

In the future, NCTCOG plans to utilize the EPA's MOVES model and ICLEI's ClearPath software to conduct an updated comprehensive 16-county regional GHG inventory. This updated inventory would include all GHG emissions and sinks by emission source. The inventory is expected to utilize 2022/2023 data, unless this data is not available, in which case, NCTCOG will use the latest available data. NCTCOG will ensure consistency in the development of this updated GHG EI.

NCTCOG also intends to concurrently develop comprehensive sector-based (industry, electricity consumption, transportation, commercial and residential buildings, agriculture, natural and working lands, and waste and materials management) emission projections for near- and long-term years, 2030/2035 and 2050, respectively.

The updated GHG EI and comprehensive sector-based emission projections would be used by NCTCOG and coordinating entities to establish quantitative GHG emissions reduction targets for the near-term (2030/2035) and long-term (2050) years. These reduction targets would be consistent with the U.S. commitments to reduce emissions by 50 to 52 percent relative to 2005 levels by 2030 and reach net zero by 2050.[26]

The detailed methodology section of this report, as well as notes and attached data files in the ClearPath tool, will be helpful to complete future inventories while maintaining consistency and making improvements for regional accuracy.

[26] https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/

5 Conclusion

This inventory marks the completion of the first regional inventory for the NCTCOG 16-county area.

The Intergovernmental Panel on Climate Change states that to meet the Paris Agreement commitment of keeping warming below 1.5°C, we must reduce global emissions by 50 percent by 2030 and reach climate neutrality by 2050. Equitably reducing global emissions by 50 percent requires that high-emitting, wealthy nations reduce their emissions by more than 50 percent. More than ever, it is imperative that countries, regions, and local governments set targets that are ambitious enough to slash carbon emissions between now and mid-century.

Science-based targets are calculated climate goals, in line with the latest climate science, that represent a community's fair share of the global ambition necessary to meet the Paris Agreement commitment. To achieve a science-based target, community education, involvement, and partnerships will be instrumental. NCTCOG recognizes the need to adopt and implement achievable science-based targets that are guided by quantitative analysis and that will generate the largest emission reductions overall and in the immediate future. Strategies that net large emission reductions across high emitting sectors will be pivotal, especially with ambitious aims to reduce overall emissions at least 50 percent from 2005 levels. This 16-county NCTCOG area inventory will be vital to emission reduction goals by further investigating priority emission reduction strategies and project assessments to guide the regional adoption of science-based targets. NCTCOG will formally adopt science-based targets by the completion of the next full inventory that is planned to be completed during the summer of 2025.

In addition, NCTCOG will continue to track key energy use and emissions indicators on an ongoing basis. It is recommended that communities update their inventories on a regular basis, especially as plans are implemented to ensure measurement and verification of impacts. Regular inventories also allow for "rolling averages" to provide insight into sustained changes and can help reduce the change of an anomalous year being incorrectly interpreted. This inventory shows that the Energy and Transportation sectors, as well as communitywide transportation patterns, will be particularly important to focus on. Through these efforts and others, the region can achieve environmental, economic, and social benefits beyond reducing emissions and attaining federal air quality standards.

For any additional information or access to datasets used for the comprisal of this regional Dallas-Fort Worth GHG emission inventory, please contact NCTCOG staff listed on the website.