SUSTAINABILITY
DOUGLAS COUNTY
KANSAS

DOUGLAS COUNTY, KANSAS

2021 Inventory of Community-Wide Greenhouse Gas Emissions

Prepared For:

Douglas County, Kansas

Produced By:

ICLEI – Local Governments for Sustainability USA
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ICLEI – Local Governments for Sustainability USA

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Executive Summary

Douglas County, Kansas recognizes that greenhouse gas (GHG) emissions from human activity are catalyzing profound climate change, the consequences of which pose substantial risks to the future health, wellbeing, and prosperity of our community.

In late 2019, Douglas County adopted PLAN 2040, A Comprehensive Plan for Unincorporated Douglas County & The City of Lawrence, which lays out a vision for the future. PLAN 2040 specifically calls for our community to:

1. Adopt a climate change adaptation and mitigation plan incorporating potential climate change scenarios and identifying specific actions to reduce greenhouse gases, risk, and exposure to hazards.
2. Manage air quality in the community to limit outdoor air pollution, excessive greenhouse gases, and indoor air pollution.

Douglas County and the City of Lawrence were invited to join a ten-county collaboration in the development of a Kansas City Regional Climate Action Plan. The regional plan, adopted by Mid-America Regional Council in March 2021, provides high-level regional guidance to reduce greenhouse gas emissions while mitigating the many risks climate change poses. Douglas County's participation in the regional plan fosters a systems approach to shared regional challenges and the area plan provides a wide foundation for the development of our locally-specific climate action and adaptation plan.

In late 2021, Douglas County launched the development of its own county-wide climate action and adaptation plan (CAAP); a plan that is tailored to our community's priorities, which will account for our assets and vulnerabilities and recommend short and long-term policy and program development. An important element of the forthcoming plan is a baseline year of greenhouse gas emissions.

The following report serves this purpose by providing estimates of greenhouse gas emissions resulting from activities in Douglas County, Kansas in 2021.

Key Findings

Figure 1 shows community-wide emissions by sector. The largest contributors are Residential Energy (28%), Transportation & Mobile Sources (27%), and Commercial Energy (26%). Industrial Energy, Agriculture, Solid Waste, Water & Wastewater, and Process & Fugitive emissions were responsible for the remaining (less than 20%) emissions.

The Inventory Results section of this report provides a detailed profile of emissions sources within Douglas County; information that is key to guiding local reduction efforts. The inventory data provides a baseline against which the county will be able to compare future performance and demonstrate progress toward reducing emissions.

EMISSIONS AT A GLANCE

1 Residential Energy
28%

2 Transportation & Mobile Sources
27%

3 Commercial Energy
26%

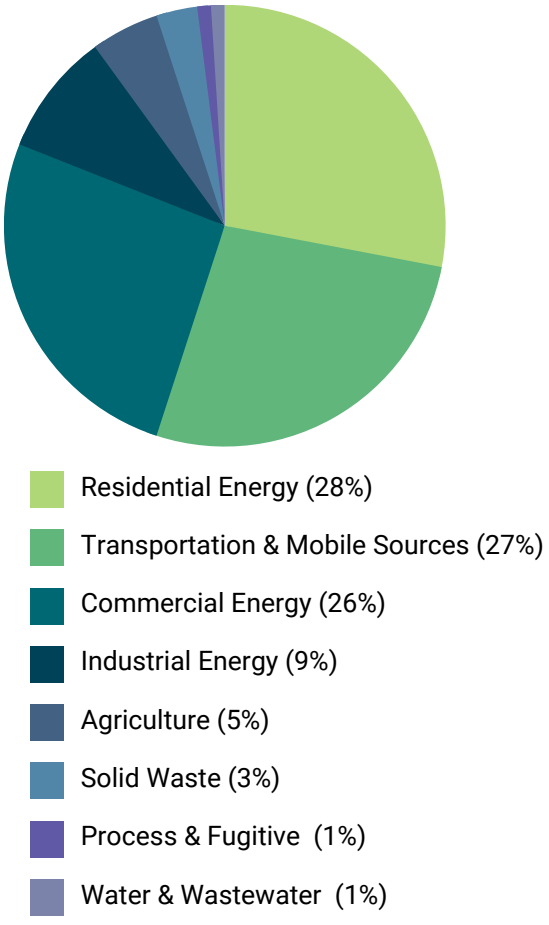

Figure 1: Community-Wide Emissions by Sector

Introduction to Climate Change

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is burning fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere.

Collectively, these gases intensify the natural greenhouse effect, causing global average surface and temperatures in the lower atmosphere to rise, threatening the safety, quality of life, and economic prosperity of global communities. Although the natural greenhouse effect is needed to keep Earth warm, a human-enhanced greenhouse effect with the rapid accumulation of GHGs in the atmosphere leads to too much heat and radiation being trapped. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report confirms that human activities have unequivocally caused an increase in carbon emissions [1]. Many regions are already experiencing the consequences of global climate change, and Douglas County is no exception.

[1] IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [MassonDelmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

According to the 2019 National Climate Assessment, the Great Plains region of the U.S. will experience potentially devastating impacts from seasonal changes and hazards occurring at unprecedented magnitudes [2]. Northeast Kansas, including Douglas County, is at particular risk for more frequent and more intense droughts, heavy downpours, and heat waves. While this region is accustomed to variable weather and hazards including floods, droughts, severe storms, tornadoes, and winter storms, these conditions and events are likely to increase in frequency and intensity as a result of climate change. Agricultural production is a significant contributor to this region's economy, which is at extreme risk from potential shifts to the growing season. In addition to impacts on the local economy, climate change will continue to produce warmer seasons and extreme temperatures that threaten many sectors within Douglas County including natural systems and regional biodiversity, public health, and mobility.

Many communities in the United States have started to take responsibility for addressing climate change at the local level. Reducing fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions. More efficient use of energy decreases utility and transportation costs for residents and businesses. Retrofitting homes and businesses to be more efficient creates local jobs. In addition, when residents save on energy costs, they are more likely to spend at local businesses and add to the local economy. Reducing fossil fuel use improves air quality, and increasing opportunities for walking and bicycling improves residents' health.

[2] U.S. Global Change Research Program. 2019. National Climate Assessment – Ch 19: Southeast. Retrieved from https://nca2019.globalchange.gov/chapter/19/ .

Greenhouse Gas Inventory as a Step Toward Carbon Neutrality

To complete this inventory, Douglas County utilized resources from ICLEI - Local Governments for Sustainability (ICLEI), which provides authoritative direction for greenhouse gas emissions accounting. ICLEI defines climate neutrality as follows:

> The targeted reduction of greenhouse gas (GHG) emissions and GHG avoidance in government operations and across the community in all sectors to an absolute net-zero emission level at the latest by 2050. In parallel to this, it is critical to adapt to climate change and enhance climate resilience across all sectors, in all systems and processes.

To achieve ambitious emissions reduction, Douglas County will need to set a clear goal and act rapidly following a holistic and integrated approach. Climate action is an opportunity for our community to experience a wide range of co-benefits, such as creating socio-economic opportunities, reducing poverty and inequality, and improving the health of people and nature.

Douglas County recognizes the essential role of our community in establishing both targets and identifying co-benefits, and supplements ICLEI's guidance with experience derived directly from the community through robust public engagement and community input.

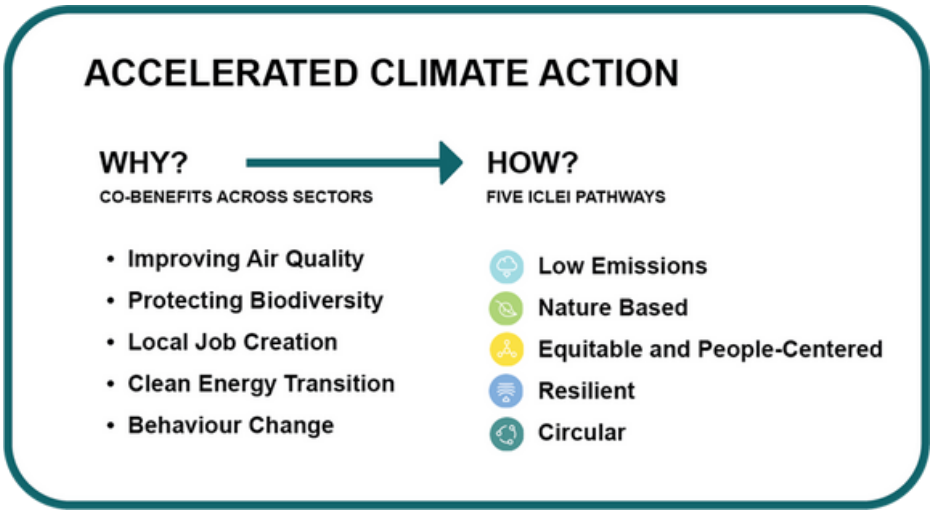

Figure 2: Co-Benefits and ICLEI Pathways to Accelerated Climate Action

Douglas County, Kansas Interactive Planning Process

In response to the climate emergency, many communities in the United States are taking responsibility for addressing emissions at the local level. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, waste diversion, and more, local governments can dramatically reduce emissions within their boundaries and influence regional emissions through partnerships and advocacy. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts.

ICLEI works with local governments to identify sources of greenhouse gas emissions and set targets for reduction. Douglas County utilized ICLEI's services to inventory greenhouse gas emissions in concert with a community-led climate planning process. These are the interacting components of the development process:

Figure 3. Douglas County's Interactive Planning Process

This report represents the completion of a baseline inventory of emissions, and provides a foundation for future work to reduce greenhouse gas emissions in Douglas County.

Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

A significant step toward achieving tangible greenhouse gas (GHG) emission reductions requires identifying baseline emissions levels, and sources and activities generating emissions in the community. This report presents emissions from the Douglas County community as a whole.

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).

Three greenhouse gases are included in this inventory: carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). Many of the charts in this report represent emissions in "carbon dioxide equivalent" (CO2e) values, calculated using the Global Warming Potentials (GWP) for methane and nitrous oxide from the IPCC 5th Assessment Report. Global Warming Potential (GWP) refers to the heat-trapping ability of each GHG relative to that of CO2. For example, the GWP of methane is 28 and the GWP of carbon dioxide is 1. This means that methane is 28 times more potent than carbon dioxide in terms of its heat-trapping ability.

Table 1: Global Warming Potential Values (IPCC, 2014)

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO2)	1
Methane (CH4)	28
Nitrous Oxide (N2O)	265

Completion of another GHG inventory in two to five years is recommended to assess progress resulting from any actions implemented. The detailed methodology section of this report, as well as notes and attached data files in the ClearPath Climate Planner tool and a master data Excel file provided to Douglas County, will be helpful to complete a future inventory consistent with this one.

Community Emissions Protocol

Version 1.2 of the Community Protocol [3] was released by ICLEI in 2019, and represents a national standard in guidance to help U.S. local governments develop effective community GHG emissions inventories. It establishes reporting requirements for all community GHG emissions inventories, provides detailed accounting guidance for quantifying GHG emissions associated with a range of emission sources and community activities, and provides a number of optional reporting frameworks to help local governments customize their community GHG emissions inventory reports based on their local goals and capacities.

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

- 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 community inventory also includes the following activities:

- Wastewater treatment processes
- Process and fugitive emissions from industrial processes and natural gas distribution
- Agriculture, forestry, and other land use

Quantifying Greenhouse Gas Emissions

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Douglas County's community GHG emissions inventory utilizes 2021 as its baseline year because it is the most recent year for which the necessary data are available.

[3] ICLEI. 2019. U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions. Retrieved from https://icleiusa.org/us-community-protocol/

Quantification Methods

GHG emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of GHG 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 GHG-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please see the appendices for a detailed listing of the activity data used in composing this inventory.

Known 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 CO2/kWh of electricity). For this inventory, calculations were made using ICLEI's ClearPath Climate Planner tool.

Community Emissions Inventory Results

The total community-wide emissions for the 2021 inventory are shown in Table 3 and Figure 4.

Table 2: Community-Wide Emissions Inventory

Sector	Fuel or Source	2021 Usage	Usage Unit	2021 Emissions (Mt CO2e)
Residential Energy	Electricity	501,967,770	kWh	254,593
	Propane	262,288	MMBtu	16,277
	Natural Gas	22,945,073	Therms	122,037
Residential Energy Total				**392,907**
Commercial Energy	Electricity	546,905,708	kWh	259,509
	Natural Gas	18,436,795	Therms	98,059
Commercial Energy Total				**357,568**
Industrial Energy	Electricity	255,145,356	kWh	131,020
	Natural Gas	193,309	Therms	1,026
Industrial Energy Total				**132,046**
Transportation & Mobile Sources	Diesel	71,515,579	VMT	102,860
	Gasoline	670,347,276	VMT	267,086
	Public Transit			1,971
Transportation & Mobile Sources Total				**371,917**
Solid Waste	Waste Sent to Landfill	74,188	Tons	48,458
	Yard Waste for Compost	14,759	Tons	1,028
	Methane Flaring			131
Solid Waste Total				**49,617**
Water & Wastewater	Septic Systems			1,527
	Combustion of Digester Gas			6
	Flaring of Digester Gas			34
	N2O			862
Water & Wastewater Total				**2,430**

*Blank cells are a result of variability in the format of available data by sector and fuel or source type.

Table 2: Community-Wide Emissions Inventory (continued)

Sector	Fuel or Source	2021 Usage	Usage Unit	2021 Emissions (Mt CO2e)
Process & Fugitive Emissions	Natural Gas Distribution	4,157,500	MMBtu	7,213
	Fugitive Emissions from Oil Wells			237
	Industrial Process Emissions			12,326
Process & Fugitive Emissions Total				**19,776**
Agriculture	Enteric Fermentation			30,632
	Manure Management			2,436
	Crop Residues			40,545
Agriculture Total				**73,613**
Total Gross Emissions				**1,399,873**
Forests and Trees	Forests and Trees			-121,888
	Trees Outside of Forests			-29,374
Forests & Trees Total				**-151,262**
Total Emissions with Sequestration				**1,248,611**

*Blank cells are a result of variability in the format of available data by sector and fuel or source type.

Figure 4 shows the distribution of community-wide emissions by sector. Residential Energy is the largest contributor, followed by Transportation & Mobile Sources and Commercial Energy.

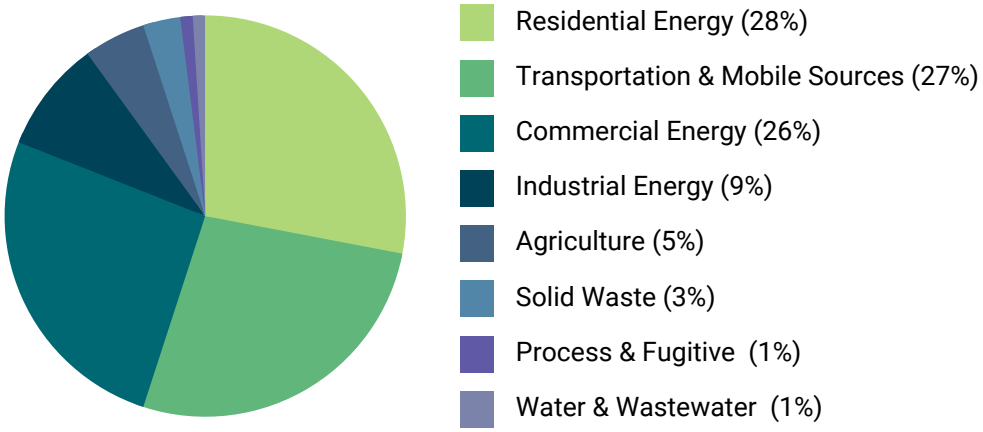

Figure 4: Community-Wide Emissions by Sector

Conclusion

With this inventory, Douglas County can forecast emissions, set an emissions-reduction target, and complete a robust climate action and adaptation plan that identifies specific quantified strategies that can cumulatively meet that target.

The Intergovernmental Panel on Climate Change (IPCC) states that to meet the Paris Agreement commitment of keeping warming below 1.5°C we must reduce global emissions by 50% by 2030 and reach climate neutrality by 2050. Equitably reducing global emissions by 50% requires that high-emitting, wealthy nations reduce their emissions by more than 50%. 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 (SBTs) 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 [4]. Community education, involvement, and partnerships will be instrumental to achieve a science-based target.

Using this inventory, ICLEI calculated Douglas County's SBT at 60.4%. In other words, this is how much Douglas County must reduce community emissions by 2030 in order to play its part in meeting this global commitment.

With fast-approaching and bold targets, every effort at local emissions reduction matters. For more on Douglas County's forthcoming climate action and adaptation plan, visit: douglascountyks.org/climate.

[4] "Science Based Climate Targets: A Guide for Cities." Science Based Targets Network, November 4, 2021. https://sciencebasedtargetsnetwork.org/.

Appendix: Methodology Details

Energy

Table 3: Energy Data Sources

Activity	Data Source	Data Gaps/Assumptions
Residential, Commercial, & Industrial Electricity Consumption	Evergy	Electricity usage including the cities of Lawrence, Baldwin City, Lecompton, and Unincorporated Douglas County.
Residential, Commercial, & Industrial Electricity Consumption	Eudora	No data gaps or assumptions identified.
Residential, Commercial, & Industrial Electricity Consumption	Baldwin Electric	No data gaps or assumptions identified.
Residential, Commercial, & Industrial Electricity Consumption	FreeState	Data provided as a total for commercial and residential. FreeState estimated that 6,500,000 kWh of this was attributed to commercial and the remaining to residential.
Residential Propane Consumption	U.S. Energy Information Administration	Estimations from 2021 EIA and U.S. Census data.
Residential, Commercial, & Industrial Natural Gas Consumption	Black Hills	Industrial natural gas consumption was included with commercial natural gas consumption.
Residential, Commercial, & Industrial Natural Gas Consumption	Atmos Energy	No data gaps or assumptions identified.
Residential, Commercial, & Industrial Natural Gas Consumption	Kansas Gas Service	No data gaps or assumptions identified.

Table 4: Emissions Factors for Electricity Consumption

Emissions Factor	CO2 (lbs./MWh)	CH4 (lbs./GWh)	N2O (lbs./GWh)	Data Gaps and Assumptions
2021 Evergy	1,134.5			Evergy does not provide CH4 and N2O independently from CO2.
SPP North (SPNO) eGRID 2021	991.7	108	16	No data gaps or assumptions identified.

Table 4: Emissions Factors for Electricity Consumption (continued)

Emissions Factor	CO2 (lbs./MWh)	CH4 (lbs./GWh)	N2O (lbs./GWh)	Data Gaps and Assumptions
Baldwin City 2021	723.2	108	16	CO2 lbs/MWh calculated based on Baldwin mix of generation and purchased electricity. CH4 and N2O from eGrid.

Transportation

Table 5: Transportation Data Sources

Activity	Data Source	Data Gaps/Assumptions
On-Road Gasoline and Diesel Consumption	Google Environmental Insights Explorer	No data gaps or assumptions identified.
Public Transit Gasoline and Diesel Consumption	Lawrence Transit	CH4 and N2O (g/mile) assumptions from 2021 National Defaults updated in 2023.

For vehicle transportation, it is necessary to apply average miles per gallon and emissions factors for CH4 and N2O to each vehicle type. The factors used are shown in Table 8.

Table 6: MPG and Emissions Factors by Vehicle Type

Fuel	Vehicle Type	MPG	CH4 (g/mile)	N2O (g/mile)
Gasoline	Passenger car	25.30	0.0084	0.0069
Gasoline	Light Truck	18.20	0.012	0.0087
Gasoline	Heavy Truck	5.38	0.072	0.061
Gasoline	Transit Bus	6.42	0.012	0.009
Gasoline	Para Transit	5.86	0.012	0.009
Gasoline	Motorcycle	44.00	0.0084	0.0069
Diesel	Passenger Car	25.30	0.00050	0.0010
Diesel	Light Truck	18.20	0.00100	0.0015
Diesel	Heavy Truck	6.56	0.00510	0.0048
Diesel	Transit Bus	4.95	0.00100	0.0015
Diesel	Para Transit	18.20	0.00100	0.0015
Diesel	Motorcycle	44.00	0.00050	0.0010
Diesel Hybrid	Transit Bus	4.47	0.00100	0.0015

Wastewater

Table 7: Wastewater Data Sources

Activity	Data Source	Data Gaps/Assumptions
Combustion and Flaring of Digester Gas	City of Lawrence	No data gaps or assumptions identified.
N2O Effluent Discharge & Process N2O	City of Lawrence	No data gaps or assumptions identified.
N2O Effluent Discharge & Process N2O	Eudora	No data gaps or assumptions identified.
Combustion of Digester Gas	Eudora	No data gaps or assumptions identified.
N2O Effluent Discharge & Process N2O	City of Baldwin	No data gaps or assumptions identified.
Septic Systems	Zoning & Codes and U.S. Census Data	No data gaps or assumptions identified.

Solid Waste

Table 8: Solid Waste Data Sources

Activity	Data Source	Data Gaps/Assumptions
Waste Sent to Landfill	Ottawa Sanitation	Data provided as estimates based off of average route weights that primarily run in Douglas County.
Waste Sent to Landfill	City of Lawrence	No data gaps or assumptions identified.
Waste Sent to Landfill	Honey Creek Disposal	Total tonnage was esimated by Honey Creek.
Yard Waste for Compost	City of Lawrence	No data gaps or assumptions identified.
Methane Flaring	HAMM Landfill	No data gaps or assumptions identified.

Fugitive Emissions

Fugitive Emissions: Fugitive emissions are those that are not physically controlled but result from the intentional or unintentional release of GHGs. They commonly arise from the production, processing, transmission, storage and use of fuels or other substances, often through joints, seals, packing, gaskets, etc. Examples include HFCs from refrigeration leaks, SF6 from electrical power distributors, and CH4 from solid waste landfills.

Table 9: Fugitive Emissions Data Sources

Activity	Data Source	Data Gaps/Assumptions
Natural Gas Distribution	Black Hills	No data gaps or assumptions identified.
Natural Gas Distribution	Atmos	No data gaps or assumptions identified.
Natural Gas Distribution	Kansas Gas Service	No data gaps or assumptions identified.
Fugitive Emissions from Oil Wells	Kansas Geological Survey	No data gaps or assumptions identified.
Industrial Process Emissions	EPA FLIGHT	No data gaps or assumptions identified.

Agriculture, Forestry, and Other Land Use

Table 10: Agriculture, Forestry, and Other Land Use Data Sources

Activity	Data Source	Data Gaps/Assumptions
Forests & Trees	LEARN Tool	LEARN combines methods outlined in the ICLEI Greenhouse Gas Protocol's Appendix J with national data sources to derive a first-order approximation of annual GHG impacts over a given time period
Agriculture	Douglas County and U.S. Department of Agriculture (USDA)	2017 is the most recent available data from USDA.

Inventory Calculations

The 2021 inventory was calculated following the Community Protocol and ICLEI's ClearPath Climate Planner software. As discussed in Inventory Methodology, the IPCC 5th Assessment was used for global warming potential (GWP) values to convert methane and nitrous oxide to CO2 equivalent units. ClearPath Climate Planner's inventory calculators allow for input of the sector activity (i.e. kWh or VMT) and emission factor to calculate the final carbon dioxide equivalent (CO2e) emissions.