



2020 Greenhouse Gas Inventory Update

January 2023





Background

Johnson County has a deep history of commitment to maximizing the economic, environmental and societal benefits of its operations within the community and has undertaken a comprehensive sustainability program that addresses topics ranging from air quality and energy efficiency to recycling and water resources.

As part of its commitment to operating more sustainably, the County adopted greenhouse gas (GHG) emissions reduction targets in 2007 setting the following goals:

- Reduce county government operation GHG emissions by at least 33% by 2020, below a 2005 baseline
- Reduce GHG emissions associated with energy use in new and substantially renovated buildings occupied and used by Johnson County Government to zero by 2030
- Reduce community-wide GHG emissions by 80% by the year 2050, below a 2005 baseline

Since the establishment of these goals, in 2021, the Johnson County Board of County Commissioners endorsed the KC Regional Climate Action Plan calling for net zero regional greenhouse gas emissions by 2050. It contains strategies to build stronger, healthier, more vibrant and economically vital communities.

As Johnson County considers emission reduction strategies and works to align with the KC Regional Climate Action Plan, it should identify and quantify the emission reduction benefits and strategies in the following areas: energy efficiency, renewable energy, vehicle fuel efficiency, alternative transportation, vehicle trip reduction, land use and transit planning, waste reduction and other strategies. Through these efforts and others, Johnson County can achieve additional benefits beyond reducing emissions, including saving money and improving economic vitality, health and quality of life.

This greenhouse gas inventory report provides results of previous inventories to identify the progress made since 2005.

Climate Change and Greenhouse Gases

As communities burn fossil fuels like oil, coal and gas to power our buildings, schools, homes and transportation, gasses like carbon dioxide, methane, nitrous oxide and ozone are released. Most of that gas stays trapped in the atmosphere, where it absorbs heat from the sun and traps heat from the earth's surface. Because of higher concentrations of these “greenhouse” gasses (GHG), the planet continues to warm. Climate change affects sea levels, weather patterns and temperature locally and globally.

Research also suggests that climate change is likely to have negative impacts on human health. For example, rates of cardiovascular and respiratory diseases and other chronic conditions are likely to increase under projected climate change scenarios. For the already disadvantaged and vulnerable residents of our community - the elderly, very young, people with certain medical conditions, urban residents and outdoor laborers – climate change has a compounding effect on their ability to thrive. Also, people with dementia, mental illness and disabilities are more vulnerable during extreme weather events such as heat waves, floods and tornadoes. These neighbors will be impacted first and most by our changing climate.

However, responses to these challenges present opportunities to create more livable, equitable and economically vibrant communities. By using energy more efficiently, harnessing renewable energy to power our buildings, enhancing access to sustainable transportation and recycling our waste, communities can keep dollars within the local economy, spark the creation of new green jobs, reduce costs and improve the quality of life for all.

Beyond these benefits, the impacts associated with climate change make action at all levels an urgent necessity. Without targeted actions, the rise in temperatures has profound implications for the reduced availability of the natural resources that drive economic prosperity and human development. It also has potentially severe economic, health, social and environmental consequences for us. The first step is to quantify and understand the data around current sources of emissions, and any historical progress made within the community.

Below are the summaries of the 2020 Johnson County community and operational greenhouse gas emissions, in relation to the 2013 emissions inventory.

Table 1: **Community Emissions**

Community Emissions Sources	Scope	2013	% of 2013 Total	2020	% of 2020 Total	Change from 2013
Built Environment		8,158,479	72%	4,658,705	59%	-43%
Electricity	2	5,517,645	48%	2,080,082	26%	-62%
Natural Gas	1	1,185,362	10%	1,084,414	14%	-9%
Other Fuels	1	782,759	7%	756,078	10%	-3%
Industrial Processes	1	454,482	4%	410,567	5%	-10%
Fugitive and refrigerants	1	218,231	2%	327,564	4%	50%
Transportation & Mobile		2,961,076	26%	3,007,467	38%	2%
On-road Transportation	1	2,423,057	21%	2,413,320	30%	0%
Off-road vehicles	3	278,969	2%	478,852	6%	72%
Airline Travel	1	255,614	2%	112,028	1%	-56%
Transit	1	3,436	0%	3,267	0%	-5%
Other emission sources		257,845	2%	280,510	4%	9%
Solid Waste	1	231,762	2%	250,530	3%	8%
Wastewater and Water	1	26,083	0%	29,980	0%	15%
Total annual emissions (MT CO₂e)		11,377,400		7,946,682		-30%

Table 1: Community-wide Greenhouse Gas Emissions (MT CO₂e) showing total emissions in 2013 and 2020, broken down by major sources, the inventory scopes (defined below in the report discussion) as well as each sector's share of the respective year. The percentage change from 2013 to 2020 is shown in the last column.

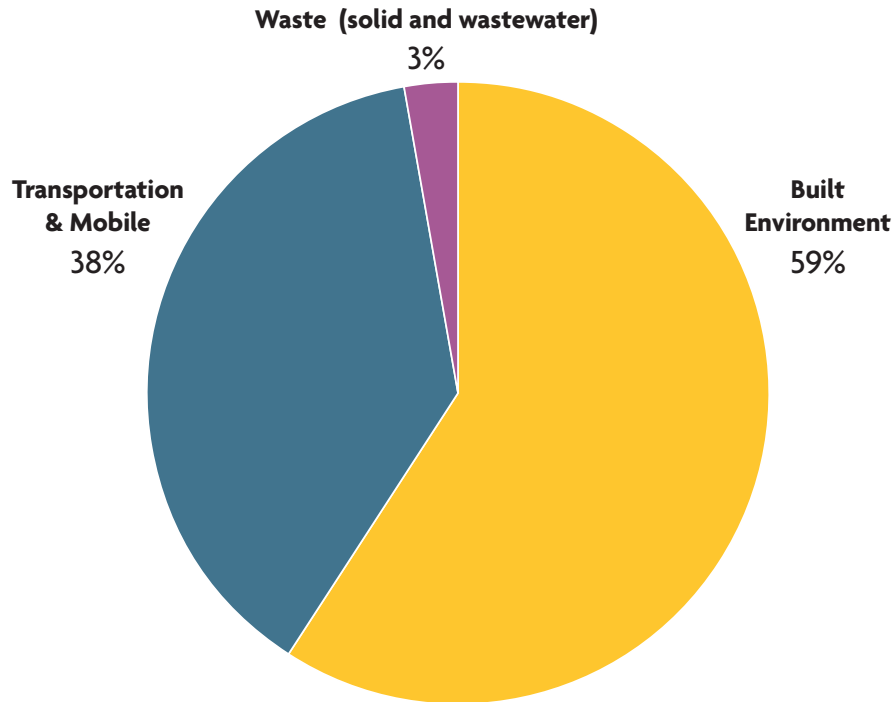
Source: Dynamhex

Community-wide Emissions

Emissions from the **built environment**, including stationary combustion and purchased electricity, as well as various industrial processes, account for 59% of total community emissions, down 43% from 2013 built environment emissions. **Transportation** accounted for 38% in 2020, an increase of 2% from 2013 transportation emissions. **Other** sources of emissions accounted for 4% of 2020 emissions, which was a 9% increase from 2013.

Figure 1:

Total Community Emissions, 2020



GHG emissions from electricity use are Scope 2 indirect emissions; they occur at the source of electricity generation, but are attributed to the consumer's use of the electricity. These Scope 2 emissions primarily come from combusting coal, natural gas and oil to generate electricity which are then transported by distribution lines to the buildings and facilities for consumption.

Figure 2:

Emissions from Built Environment

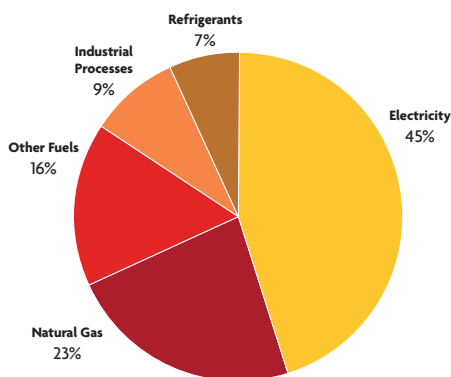


Figure 3:

Emissions from Transportation

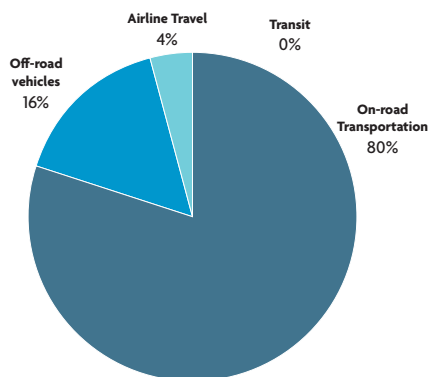
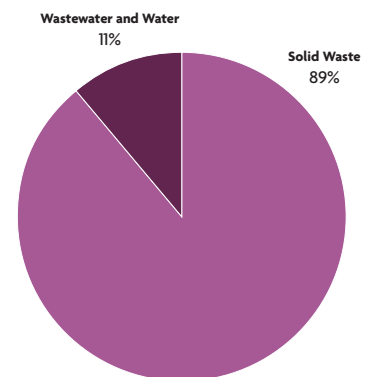


Figure 4:

Emissions from Solid Waste and Wastewater



Built Environment: For electricity delivery to county-owned facilities, emissions calculations were conducted for the county's operational footprint; whereas, all other buildings and facilities within the county boundaries, including residential, commercial or industrial, were attributed to the community inventory. Emissions from these usage data were calculated using the emission factors of the Southwest Power Pool (SPP) North region according to the U.S. Environmental Protection Agency (EPA) methodology¹.

- **Electricity** accounted for 26% of total community emissions, down by 62% since 2013. In 2020, the community consumed 4.8 TWh of grid-based electricity (over 99% delivered by Eversource and less than 1% by the City of Gardner's municipal utility). While the total consumption decreased 32% between 2013 and 2020, from 7.06 TWh of total consumption in 2013, Eversource representatives felt that the 2013 data likely had some double counting with three overlapping utilities reporting the data across zip codes (Westar, KCP&L and Gardner). Two separate analyses were conducted on the community-wide electricity consumption values from Eversource to verify 2020 values.
- **Natural gas** accounted for 13.6% of total community-wide emissions, reducing 9% from 2013: In 2020, the community used 204,335,447 therms of natural gas, 39% delivered by Atmos Energy and 61% by Kansas Gas. Regarding the distribution across three rate classes, residential accounted for 82.26%, commercial accounted for 17.63% and industrial was 0.11% of total natural gas consumption.
- **Other stationary combustion of fuels** accounted for 9.4% of total community emissions, down by 3% since 2013, likely due to higher levels of electrification over the last seven years. This inventory considers the county population-adjusted state totals on direct fuel usage, primarily coal, asphalt or road oil, distillate and residual fuel oil, LPG and wood for different applications, from heating sources to industrial feedstock.
- **Industrial processes** accounted for 5.2% of total community emissions, down by 10% since 2013. Emissions from industrial processes from large emitters are direct emissions (Scope 1) at the community level and are reported to the EPA each year as part of its 2020 Greenhouse Gas Reporting Rule. In 2020, emissions from a glass manufacturing plant (AGC in Spring Hill), a waste landfill center (Waste Management), a natural gas distribution system (Kansas Gas) as well as a power plant (West Gardner Generation Station) were recorded as industrial emissions. Certain portions of the total emissions have been removed from consideration, as already counted in stationary emissions, solid waste category or electricity and gas consumption elsewhere.
- **Fugitive and refrigerant emissions** are direct sources of GHG emissions released to the atmosphere from various equipment and processes, such as refrigeration and air conditioning systems, fire suppression systems and consumption and release of industrial gasses. Hydrofluorocarbons (HFCs) and, to a lesser extent, perfluorocarbons (PFCs) are used as substitutes for the regulated Ozone Depleting Substances (ODSs) which have been phased out. Emissions from the refrigeration and air conditioning sector result from the manufacturing process, from leakage and service over the operational life of the equipment, and disposal at the end of the useful life of the equipment. These included all equipment in the Johnson County boundary, including household refrigeration, domestic air conditioning (AC) and heat pumps, mobile air conditioning, chillers, retail food refrigeration, cold storage warehouses, refrigerated transport, industrial process refrigeration and commercial AC systems. Also included in activities and equipment are fixed and portable fire suppression systems, as well as emissions from purchased industrial gasses, such as manufacturing and lab testing applications, etc. 4% of community emissions were attributable to fugitive emissions, up 50% from 2013 levels, based on the prorated share of the county's share of Kansas's total refrigerant emissions, according to the EPA.



¹US EPA (2022): Power Profiler: Environmental Protection Agency EGRID summary tables. <https://www.epa.gov/system/files/documents/2021-09/power-profiler-terms-calculations-and-data-sources-9-21-2021.pdf>

Transportation and other mobile sources accounted for 38% of emissions. GHG emissions from on-road transportation are direct emissions, Scope 1. They occur at the tailpipes of vehicles due to the combustion of fossil fuels like motor gasoline and diesel in the engines of automotive vehicles. The community inventory includes any personal or commercial vehicles as well other transportation options, like transit services, operating within the county limits as well as trips that cross the county's boundary.

- **On-road transportation** accounted for over 30% of total community emissions, decreasing by less than 1% from 2013. Although vehicle miles traveled (VMT) for the county increased by 2.7% from 2013, the mode share moved to more passenger vehicles (with higher mpg vehicles), for a net 0.4% reduction in emission from tailpipes.
- **Off-road transportation** emissions, which accounted for 6% of total community emissions, increased by 72% since 2013. Construction and mining equipment's energy usage is counted in off-road transportation, which consumed 49,794 gallons of gasoline and 967,901 gallons of diesel. On the other hand, agriculture consumed 95,740 gallons of gasoline and 1,891,580 gallons of diesel. Other off-road transportation sectors, such as agriculture, accounted for 749,723 gallons of gasoline and 512,930 gallons of diesel.
- **Airline travel**, which accounted for 1.4% of emissions, reduced by 56% from 2013. Passenger enplanement went from 4.9M to 2.24M between 2013 and 2020 leading to 56% emission reductions. However, these reductions were likely due to restrictions to travel due to COVID-19, and are likely to return to normal levels in future years.
- **Transit emissions** decreased by 5% from 2013 and accounted for less than 1% of total emissions. Gasoline consumption of 43,325 gallons (380 MT CO₂e), compared to diesel consumption of 231,453 gallons (2363 MT CO₂e) and 75,921 gallon-equivalent of CNG (523 MT CO₂e) were consumed in 2020. This reduction is likely due to reduced activity during COVID.

Figure 5:

Community-wide Emissions Trend

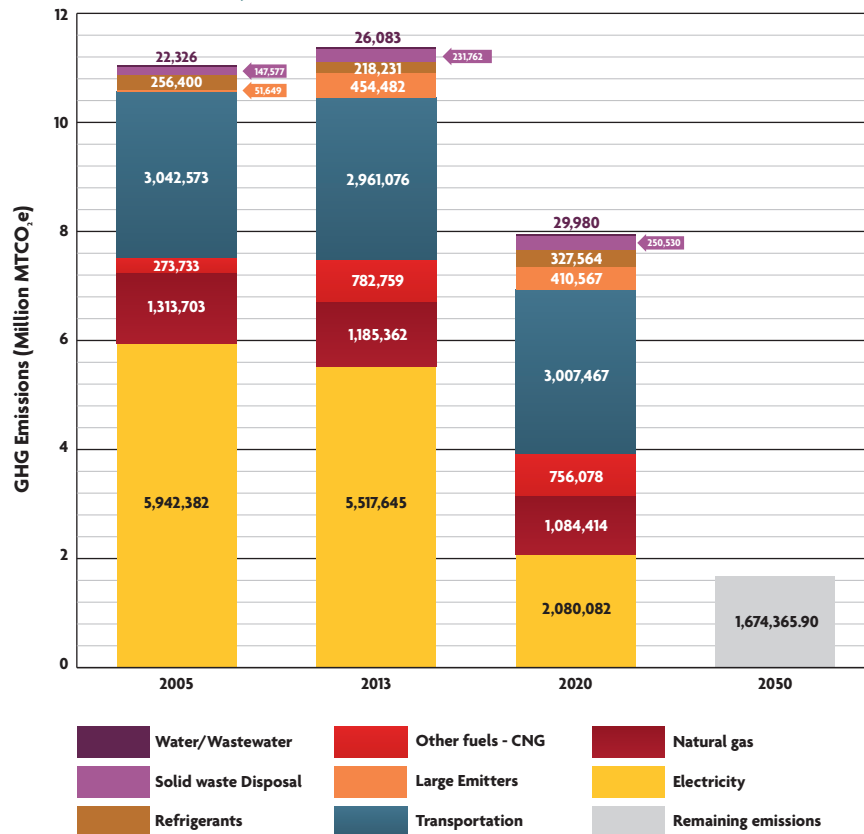


Figure: Annual progress on GHG mitigation across inventory years. The 2050 “remaining emissions” have been linearly projected based on the reduction percentage per year from the 2013 level to the 2020 level. Note: The Regional Net-zero by 2050 plan was recently endorsed by Johnson County, implying that any remaining sources of emissions in 2050, should be offset with emission sinks, such as the roadmap suggested by the KC Regional Climate Action Plan. See details at kcmetroclimateplan.org.

Other sources of emissions include solid waste disposal, wastewater treatment and water delivery. At the community level, the GHG emissions from solid waste disposed at landfills are direct (Scope 1) and result from decomposing organic materials and waste management processes in landfills for all community waste. Wastewater treatment is also a direct source of GHG emissions, in terms of CH₄ and N₂O emitted due to various treatment processes located within the county. Finally, water treatment and distribution are Scope 1 direct emissions, emanating from the usage of electricity to both treat and distribute water in the community. Five utilities provided gallons delivered data by zip code or region, year and rate class for 2020, which included WaterOne and Water 7, as well as the cities of Olathe, Spring Hill, De Soto and Gardner.

- **Solid waste emissions** increased by 8% from 2013 and accounted for approximately 3% of total community-wide emissions. There was a 32% increase in the volume of solid waste generated in 2020 from 2013 values, from 835,205 tons to 1,105,700 tons. In 2020, commercial solid waste generation was highest at 45% of all waste generated in the county, followed by construction at 32% and finally residential at 23%. Commercial recycling rates were down from 29% in 2013 to 20% in 2020, with higher landfill (at 79% compared to 70% in 2013) and lower composting rates (from 1.3% in 2013 to 0.4% in 2020). While almost all construction waste went to landfill in 2013, a minute amount did go to recycling in 2020. In 2020, 35% of residential municipal solid waste was recycled and 14% composted - while the rest, more than 50%, was landfilled. This was an improvement from 2013, when 71% of residential waste was landfilled, and only 16% recycled and 14% composted.
- **Water and wastewater emissions** accounted for less than 1 percent of total community-wide GHG emissions. Water consumption decreased by less than 1% from 2013 in total gallons consumed. 15 billion gallons of wastewater were treated in the six water treatment facilities in Johnson County in 2020.

Johnson County has changed significantly since the previous greenhouse gas emissions inventory of the community, seeing 8% increase in population. Per capita emissions in 2013 were 21 metric tons per resident. Despite the population increase since 2013, emissions decreased by 30% - amounting to a 35% reduction in per capita emissions to 13 metric tons of emissions per resident. With a growing population, a community incurs some economies-of-scale in being more efficient with both energy consumption and travel, but with the absolute emissions increasing. However, this was not the case for the increase in population and decrease in emissions between 2013 and 2020.



Table 2: **Operational Emissions**

Operational Emissions	Scope	2013	% of 2013 Total	2020	% of 2020 Total	Change from 2013
Stationary		86,979	67%	100,141	70%	15%
Electricity	2	76,287	58.4%	87,733	61.2%	15%
Natural gas	1	10,692	8.2%	12,408	8.7%	16%
Transportation		16,981	13%	12,899	9%	-24%
Commuting	3	6,798	5.2%	8,248	5.8%	21%
Fleet vehicles	1	9,620	7.4%	4,393	3.1%	-54%
Gasoline		3,334	2.6%	3,262	2.3%	-2%
Diesel		6,286	4.8%	1,455	1.0%	-77%
Operational Financed Travel	3	563	0.4%	258	0.2%	-54%
Air travel		76	0.1%	28	0.0%	-63%
Reimbursement miles		487	0.4%	230	0.2%	-53%
Other		26,678	20%	30,197	21%	13%
Solid Waste	3	705	0.5%	1,182	0.8%	68%
Wastewater Process	1	25,973	19.9%	29,015	20.3%	10%
Total emissions (MT CO2e)		130,638		143,237		9%

Table 2: Table shows County’s operational Greenhouse Gas Emissions (MT CO2e) in 2013 and 2020, broken down by major sources, the inventory scopes as well as relative influence of each of the sectors to the totals across those two years, shows as percentage of total 2013 and 2020 emissions, respectively. The percentage change from 2013 to 2020 is also shown in the last column.

Source: Dynamhex

Growth-adjusted reduction: County facilities have grown both in terms of quantity and size since 2013 - with 21% growth in the number of total buildings and 57% increase in total square footage. Despite such increases, while the total consumption of electricity and natural gas have increased by 15% and 16% respectively, the normalized efficiency, as measured by kWh of electricity consumed per square footage, and natural gas MCF consumed per square footage across all county facilities, has decreased. Electricity usage per square foot has decreased 69% and natural gas usage has decreased by 26% per square foot. Water use per square footage also decreased by 23%. This suggests that despite growth in total facilities, resource consumption with respect to that growth has been efficient. Site energy, instead of source energy, was used to conduct the normalization analyses using 2013 data as a benchmark¹.

¹Site energy is the combination of primary and secondary energy that customers buy directly for use at buildings and facilities. On the other hand, source energy is the total Site Energy, in addition to all the delivery and production losses that it incurred in getting each unit of energy from the generation source to the location of the buildings and facilities. As a result, source energy is the sum of primary (fuels) and secondary (electricity or steam) purchased directly, and the losses incurred when the primary energy was converted into the secondary energy, and when both primary and secondary energy were delivered to the consumption location. As a result, source energy is a factor higher than site energy.

In 2013, the county's operational energy data included only site energy, whereas 2020 data included both site and source energy. Source energy was used to estimate emissions for the 2020 inventory, but site energy was used to benchmark normalized changes in emissions per fuel type between 2013 and 2020.

The **stationary and “other” components** accounted for a majority of the county’s operational emissions. More than 90% of the county’s operational emissions came from on-site consumption of electricity and natural gas (70%) and generation of solid waste, which included the energy required for wastewater treatment facilities (21%).

- **Electricity** accounted for 61.2% of total operational emissions, increasing 15% from 2013: In 2020, the county buildings used 153,444 MWh of electricity which was up 53% from the 100,485 MWh consumed in 2013. The emission factor of each MWh of electricity has decreased since 2013 with Evergy’s improvements in its energy generation mix. Facilities (55%) and Wastewater (24%) consumed the highest amounts of electricity among all county departments (20%).
 - It is important to note, that starting in mid-2021, a retail wind contract through Evergy was procured for the county’s operational electricity, which would reduce purchased electricity emissions by 56% for the duration of the 20 year contract. In other words, 34% of the county’s operational emissions in 2021, assuming they were similar to 2020, would be reduced due to the consumption of wind-generated electricity. In future years, as the power grid becomes cleaner with higher adoption of renewable energy than was present in 2020, the relative impact of wind-related emissions reduction would go down.
- **Natural gas** accounted for 8.7% of total community emissions, increasing by 16%. This is likely due to additional buildings and square footage since 2013.

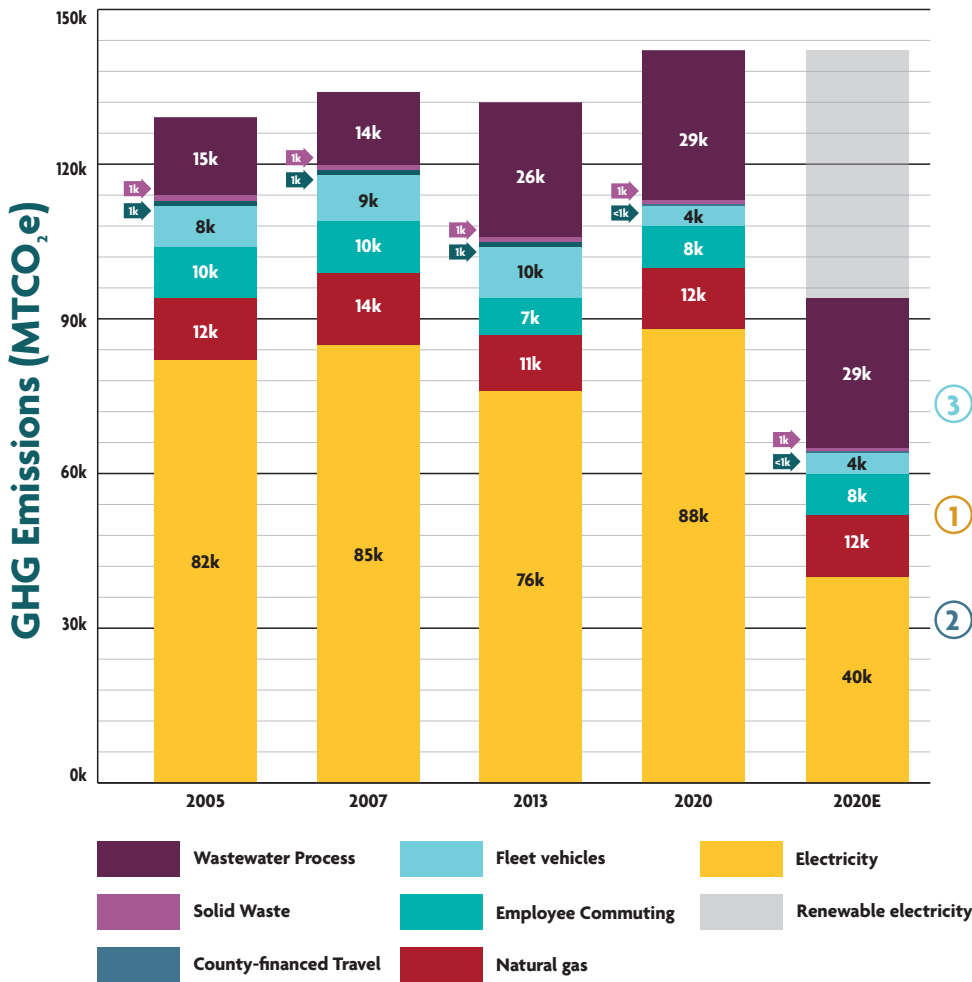
The **transportation component** of the county’s operation emissions accounts for the second largest portion of the footprint. Almost 10% of the total operational emissions were related to fuel combusted in owned fleet vehicles, or for travel – both commuting to and from work for county employees, as well as any county-financed air and land travel. Overall, likely due to COVID-19, the emissions related to transportation decreased by 24% in 2020 since 2013.

- Each year, the county’s **fleet vehicles** consume different types of liquid fuels, such as gasoline and diesel, which were collected in terms of gallons for both vehicles and equipment. The Climate Registry’s CO₂ factors were used, and CH₄ or N₂O use as well as minimal use of propane in equipment such as forklifts were ignored due to being negligible. Fleets accounted for 3.1% of total operational emissions (2.3% from gasoline and almost 1% from diesel), down 54% from 2013 - likely due to work-from-home impacts of county personnel. This reduction was mostly due to a reduction in the consumption of diesel (77%) while gasoline stayed fairly stable (2% reduction) in 2020 from 2013 levels.
- **Employee commute:** All employees, both full-time and part-time, who travel to and from their work site, burn fuels in their personal vehicles (single-passenger vehicles were assumed for all employees) or modes of transportation. In 2020, COVID-based adjustments were made due to travel patterns being affected since March. Despite the pandemic, growth in the workforce impacted a 21% increase in commuting emissions since 2013, which accounted for 5.8% of total 2020 operational emissions.
- All **business travel** data by county employees, such as through county-financed airline flights as well as ground transportation in personal vehicles or rentals for work purposes for the 2020 year were collected. Both financed air travel trips included origin and destinations, as well as costs per mile. On-road financed travel data were captured in reimbursed miles per employee for the calendar year and assumed average passenger car fuel economy (MPG) for motor gasoline to arrive at a total fuel consumed number for the year. CO₂, CH₄ and N₂O factors were used for both modes of travel from TCR, which amounted to 0.2% of the total operational footprint. Air travel was negligible due to COVID travel restrictions, and most of the business travel was through reimbursed mileage, meaning on-road travel. Overall, business travel was reduced by 54% in 2020 compared to 2013 levels. Air travel was reduced by 63%, while financed mileage was reduced by 53%, from the 2013 levels.

Other components, namely solid waste generation at the county facilities as well as the emissions from the six wastewater treatment facilities, collectively accounted for 21% of the total operational footprint, increasing by 13% from 2013. Solid waste generation increased by 68% from 2013, partly due to the 57% increase in total square footage from 2013, as well as improved data gathering on waste pickup and volumes since 2013.

Figure 6:

Annual Operational GHG Emissions



1. Energy efficiency:

- Fund and implement the Facilities Energy Management Plan, including current Capital Improvement Projects
- Achieve 50% average Energy Star ratings for Johnson County Government Facilities from a 2021 baseline of 36%

2. Renewable energy:

- Continue participation in Evergy's Renewables Direct program and evaluate any opportunities to enroll more accounts.
- Evaluate the efficacy of installing on-site renewable energy on new, substantially renovated, and existing county facilities.

3. Electrification and low-carbon fuels:

- Increase the percentage of miles driven by alternative fuel vehicles (electric vehicles, CNG-based or biofuel-based fuels) for Johnson County Government operational fleet to:
 - - 25% of total fleet miles by 2025
 - - 40% of total fleet miles by 2030

Figure: Chart shows annual operational greenhouse gas emissions for the county, based on available inventory year data. Note the line representing the 2020 target (33% from the 2005 baseline)



Next Steps

While Johnson County has made great strides in both community and operational emissions, current adaptation and planning efforts are inadequate to respond to the expected changes as a result of climate change and additional action will be required.

The benefits of carbon reduction in increasing the health and wealth of communities demonstrate that energy and climate leadership is an economically sound proposition and should be incorporated as a common thread in future programs and priorities.

Some of the notable programs and activities that have been undertaken to reduce emissions are listed below.

Accomplishments since the 2013 GHG inventory:

- Constructed four Leadership in Energy and Environmental Design (LEED) certified Johnson County Government facilities.
- Hired County's first Energy Manager
- Established operational Energy Conservation Policy
- Installed electric vehicle charging stations at eight (8) county buildings and twenty-one (21) stations in Johnson County parks.
- Achieved Gold level certification as a SolSmart Solar Ready Community
- Enrolled in Evergy's Renewables Direct program to procure clean wind energy for over half of County operation's electricity use. Many other local Johnson County governments and institutions have also subscribed.
- Achieved Gold level certification in USGBC's LEED for Cities and Communities rating system
- The governing body endorsed the KC Regional Climate Action Plan

Future operational goals and targets:

Begin analysis of resources required to meet the county endorsed KC Regional Climate Action Plan goals of Net Zero GHG emissions from local government operations by 2030.

Energy efficiency:

- Fund and implement the Facilities Energy Management Plan, including current Capital Improvement Projects
- Achieve 50% average Energy Star ratings for Johnson County Government Facilities from a 2021 baseline of 36%

Renewable energy:

- Continue participation in Evergy's Renewables Direct program and evaluate any opportunities to enroll more accounts.
- Evaluate the efficacy of installing on-site renewable energy on new, substantially renovated and existing county facilities.

Electrification and low-carbon fuels:

- Increase the percentage of miles driven by alternative fuel vehicles (electric vehicles, CNG-based or biofuel-based fuels) for Johnson County Government operational fleet to:
 - -25% of total fleet miles by 2025
 - -40% of total fleet miles by 2030

Future community goals and targets:

Begin analysis of resources required to meet the endorsed KC Regional Climate Action Plan of Net Zero GHG emissions from the community by 2050 (from a 2015 baseline).

Utilize the County's recent Gold level certification in the USGBC LEED for Cities and Communities framework to continue expanding broader sustainability priorities and goals for the entirety of Johnson County.

APPENDIX

Table 3: **GWP of Gases**

GHG Name	GHG Formula	AR4	AR5
Carbon dioxide	CO ₂	1	1
Methane	CH ₄	25	28
Nitrous oxide	N ₂ O	298	265
Nitrogen trifluoride	NF ₃	17,200	16,100
Sulfur hexafluoride	SF ₆	22,800	23,500

Table: Global warming potential (GWP) of different GHG emission sources, across Assessment Report (AR) 4 and 5.

Regional grid mix: Resources used to generate local electricity

- Coal (37.1 %)
- Wind (35.4 %)
- Nuclear (15.1 %)
- Gas (11.7 %)
- Hydro (0.3 %)
- Oil (0.2 %)
- Biomass (0.1 %)
- Solar (0.1 %)
- Geothermal & other (0 %)

Regional power emissions per MWh consumed in a year

- CO₂ 954.0 lbs/MWh
- SO₂ 0.169 lbs/MWh
- NO_x 0.466 lbs/MWh

Glossary:

- **C&D:** Construction and demolition debris
- **CH₄:** Methane, a powerful greenhouse gas
- **CO₂e:** Carbon dioxide equivalent units, converting all emissions to equivalent carbon dioxide units allows for the consideration of different greenhouse gasses on comparable terms
- **GHG:** Greenhouse Gas, the term used for gasses that trap heat in the atmosphere. The principal greenhouse gasses that enter the atmosphere as a result of human activity are carbon dioxide, methane, and nitrous oxide
- **kW:** A kilowatt, equal to 1,000 watts
- **kWh:** A kilowatt hour (1,000 watt-hours), the work performed by one kilowatt of electric power in one hour
- **LED:** Light-emitting diode lights
- **LEED:** Leadership in Energy and Environmental Design, a commonly used green building standard developed by the U.S. Green Building Council
- **MARC:** Mid-America Regional Council
- **MCF:** Thousand cubic feet
- **Metric ton:** 1,000 kilograms (or 2204.6226 lbs.). Also known as a “tonne.”
- **PV:** Photovoltaics, a solar power technology that converts sunlight into electricity
- **Therm:** 100,000 British Thermal Units (BTUs), equivalent to approximately 100 standard cubic feet of natural gas
- **VMT:** Vehicle miles traveled
- **Zero Net Energy Buildings:** A building that achieves maximum energy efficiency so that any remaining energy needs can be met through onsite renewable energy systems, such as solar water and space heating, solar electricity or wind energy
- **Zero Waste:** The milestone to eliminate all waste sent to the landfill, where all of a community or organization’s discarded material are recycled or reused

Johnson County Climate Risks and Vulnerabilities

The following maps help identify where our most vulnerable communities exist in the county and the magnitude of social vulnerability. The maps can help inform planning, equity-focused engagement and relationship building, and identify how and where climate initiatives should be prioritized and targeted. In this assessment, several indicators were used to help pinpoint geographies of overlapping vulnerabilities related to climate change and explore social vulnerability, and vulnerability related to flooding, heat, and tornadoes.

Figure 7: **Flood Hazard Zones**

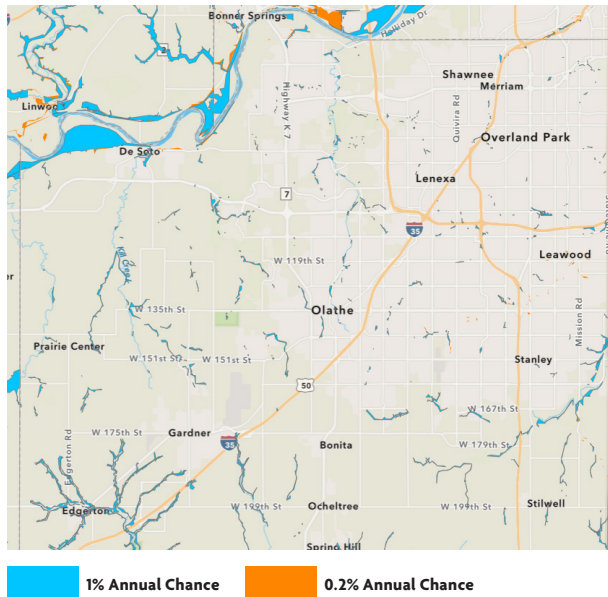


Figure 8: **Regional Socio-economic Stress Index**

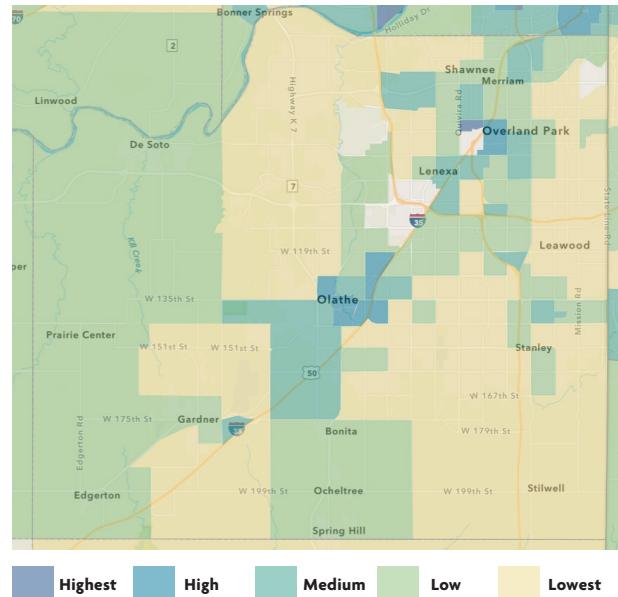


Figure 9: **Heat-Related Socio-economic Stress Index**

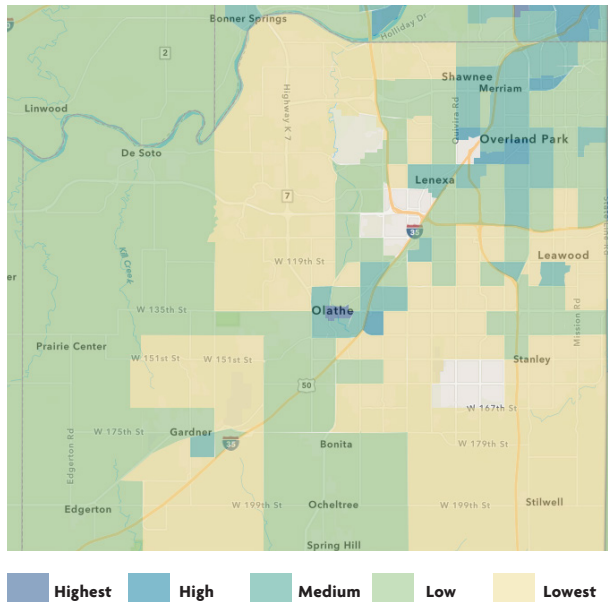


Figure 10: **Tornado-Related Socio-economic Stress Index**

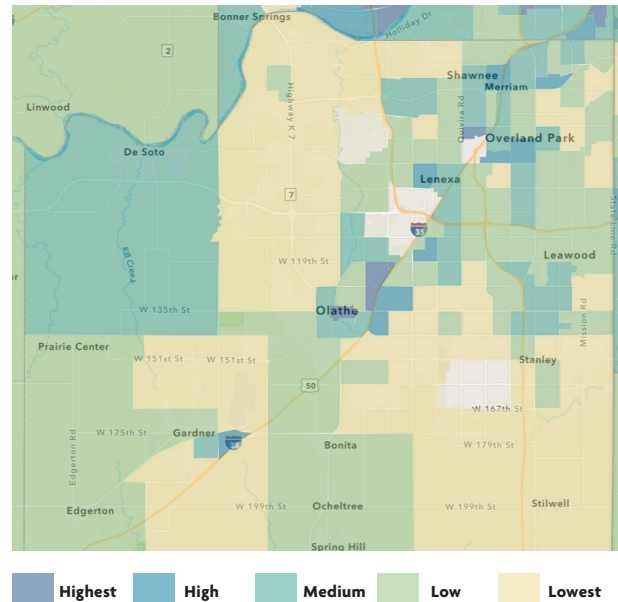


Figure: Distribution across the county across various physical and socioeconomic stresses

Source: MARC Climate Vulnerability Map, last modified June 2021

<https://www.arcgis.com/apps/mapviewer/index.html?webmap=7ab3eb098de04fe4b29b82d570382824>