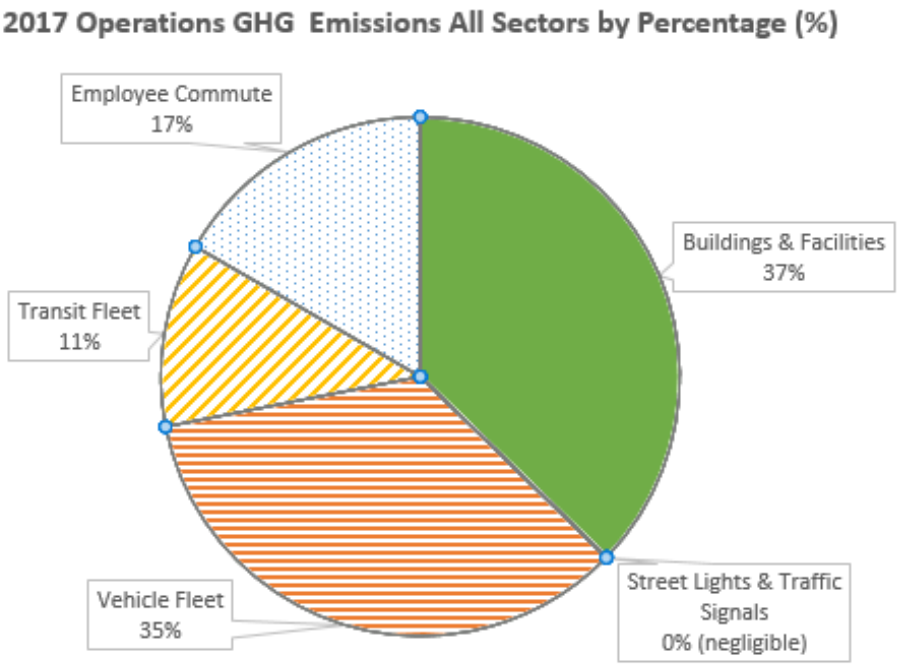
JOHNSON COUNTY IOWA

OPERATIONS GREENHOUSE GAS EMISSIONS INVENTORY UPDATE 2017



JUNE 2019 JOHNSON COUNTY PLANNING, DEVELOPMENT AND SUSTAINABILITY DEPARTMENT

ACKNOWLEDGMENTS

This report was authorized by the Johnson County Board of Supervisors and prepared by the Johnson County Planning, Development and Sustainability Department: Josh Busard, Director; Becky Soglin, Sustainability Coordinator; and Guadalupe Muñoz Rocha, Greenhouse Gas Intern.

The individuals listed below provided data or other assistance for this report. We greatly appreciate their help and thank them for their efforts and time. In addition, we appreciate the participation of the 357 county employees who responded to our commuter survey.

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In addition to previous Johnson County Operations GHG Inventories for 2008 and 2010, the following greenhouse inventories were of particular help as background:

Iowa City Municipal Greenhouse Gas Emissions: August 2017 Inventory Update

City of Kansas City, Missouri, 2017 Greenhouse Gas Inventory Update

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1. INTRODUCTION

Why Greenhouse Gas Emissions Matter

Greenhouse gas (GHG) emissions result from using energy for buildings, transportation, manufacturing, and other uses. These emissions trap heat that would normally leave the Earth's surface and go into space. The result, documented by decades of quality scientific research, is the "Greenhouse Effect."

As GHGs increase, they contribute to temperature increases in the lower atmosphere. Impacts include these global warming and climate changes: rising oceans and lakes, seasonal shifts (e.g. more frost-free days) and more frequent, intense or variable weather events including heavy precipitation, extreme heat, drought, and tornados or hurricanes.

These events contribute to human and other loss of life or suffering as well as flooding, soil loss, crop failures and stored grain degradation, building and infrastructure damage, and pathogens and pests that further stress agriculture, plant and aquatic life, wildlife, and human health. The impacts have financial costs and implications for business and manufacturing, agriculture and food availability, transportation, recreation, and more. GHG effects range from local to state to regional to global.

> "PROJECTED CHANGES IN PRECIPITATION, COUPLED WITH RISING EXTREME TEMPERATURES BEFORE MID-CENTURY, WILL REDUCE MIDWEST AGRICULTURAL PRODUCTIVITY TO LEVELS OF THE 1980S WITHOUT MAJOR TECHNOLOGICAL ADVANCES."[1]
>
> *Fourth National Climate Assessment*, 2018

Reducing GHG emissions can potentially improve future conditions, reduce costs over time, increase livability, attract businesses, and create green jobs. Concurrently, mitigation efforts can minimize effects, and adaptation efforts can reduce existing effects.

What a Greenhouse Gas Inventory Provides

A greenhouse gas inventory helps (1) identify and quantify different emission sources and sectors, (2) track changes in energy use and impacts over time, and (3) provide guidance for policies, programs, and projects that might reduce GHG emissions and their impacts.

This current report focuses on Johnson County ***operations***: the energy and fuel used by the County to provide services and amenities to the people of Johnson County. A *community* inventory would analyze greenhouse gases resulting from all uses in the county by residents, visitors, and workers as well as business and organizational effects. The major sectors assessed

[1] From "Background" in Ch. 21: Midwest, USGCRP 2019: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment: Volume II*, U.S. Global Change Research Program. Retrieved from https://nca2018.globalchange.gov/chapter/21/.

in this operational inventory are buildings and facilities, vehicle fleet and transit fleet, street and traffic (caution) lights, and employee commute, which relates indirectly to County operations.

Greenhouse gas inventories obviously depend on data. However, energy is not always used or tracked in easily accessible ways. We made substantial efforts to gather and analyze data and produce an accurate, informative report; however, the methodology notes limitations. Greenhouse gas inventories are most useful used over time, revealing shifts or trends.

ICLEI—Local Governments for Sustainability and Prior Inventories

Prior Inventories

Johnson County became an ICLEI member around 2008 and maintained a membership through 2011.[2] Using ICLEI protocols, Johnson County completed its first operations GHG inventory for 2008 and provided an update in 2010. Since then, inventory protocols and software changed, and staff focused on energy-reduction efforts rather than completing inventories. Renewing ICLEI membership in 2018, the County gained access to software and protocols to update the greenhouse gas inventory for 2017. The three inventories (2008, 2010, and 2017) together indicate trends and underscore the need to reduce GHG emissions. For comparison purposes, the 2008 and 2010 values were recalculated per ICLEI protocol and are close to, but not exactly the same as, the values originally reported in 2008 and 2010 (see Methodology for details).

ICLEI Milestone Framework

In addition to providing inventory software, ICLEI promotes a Five Milestones Framework for measuring and reducing GHG emissions (Figure 1).

Figure 1: ICLEI Climate Mitigation Milestone Framework

[2] Founded in 1990 as the International Council for Local Environmental Initiatives, ICLEI changed its name in 2003 to Local Governments for Sustainability but retained the acronym, which is pronounced "ick-lee."

2. COUNTY SUSTAINABILITY COMMITMENT

The County Board of Supervisors (Board) made commitments to sustainability in 2008, including authorizing the first GHG inventory. The Board set two ambitious goals: reduce greenhouse gas emissions by 10% by the end of 2010 and by 80% by 2050. While the 10% goal was not met, the Board remained committed to projects that advanced energy efficiency and conservation.

The Board included energy and sustainability goals in the 2010 GHG Reduction and Sustainability Plan for Operations and in strategic two-year plans. The County added a half-time sustainability position in 2010 to help meet goals and aid Physical Plant with energy audits. By 2016, the sustainability position became a full-time coordinator position. Meanwhile, many department heads and elected officials have been finding ways to reduce energy or resource use. Many also directly or indirectly deal with the effects of GHG emissions and climate change.

The County's 2018 Comprehensive Plan includes a sustainability chapter and goals for internal-facing (operations) and external efforts. The plan also integrates sustainability into three other areas: Local Economy, Infrastructure and Amenities, and Land Use.

Primary Operational GHG-Reduction Accomplishments

Many efforts have helped reduce energy or minimize operational GHG emissions. Highlights are described in this section, while Section 6: Recommendations includes a status report on goals from various plans since 2008. External-facing efforts such as the successful 2018 Solarize Johnson County program, which helped residents add discounted solar to their own homes, are not detailed here.

County Facility Projects and Policies

The County has completed multiple energy-efficiency audits and projects, including heating, venting, and air conditioning, LED lighting, and insulation since 2012. Rebates garnered (more than $500,000) flow into the internal Sustainability and Energy Reinvestment Fund created by the Board to support projects that further reduce energy use or address climate change effects.

The Board adopted a Sustainable Capital Project Process and Sustainability Minimum Standards (SMS) in 2014. County projects of 2,000+ conditioned square feet must pursue Leadership in Energy and Environmental Design (LEED) or the County's own SMS in order to include high energy-efficiency and other features. Four buildings are LEED certified (three Gold and one Silver), including the Ambulance Service and Medical Examiner Facility (*pictured*), which was completed in 2017 and earned LEED Gold in early 2019.

In behavioral-related practices, the Information Technology (IT) Department helped ensure computers were set for energy saving, and other staff checked other equipment to reduce energy draws. Physical Plant added sensors to keep lights off when no one occupies a room. The Green Team raised awareness about keeping lights and equipment off when not in use, including over long holiday weekends.

Since 2014, the County has added 400 kW of on-site photovoltaic solar (five arrays) to serve multiple buildings and sites, and purchased off-site shares from Farmers' Electric Cooperative. Online portals linked to real-time solar energy generation are available at www.johnson-county.com/solar. On-site solar energy generation helped the County earn a SolSmart Gold designation in 2017. Three of the five on-site solar arrays serving County buildings are at the downtown campus in Iowa City (*above*).

County Vehicles and Fleet

Since 2016, hybrid and other highly fuel-efficient vehicles have been added to the general fleet and Johnson County SEATS (paratransit), whose drivers are trained on driving practices to reduce gas use. Two shared bicycles are available for employees to use for meetings near the downtown campus.

Employee Programs and Education

Since 2010, the County has encouraged employees to reduce their commute of vehicle-miles-traveled (VMT) through several programs: the discounted bus pass program, the annual "One Less Car" and Bike-to-Work encouragement and competition, and regular bicycle education. In spring 2017, the Administration Building, Health and Human Services Building, and Ambulance Service and Medical Examiner Facility earned gold designation from the League of American Bicyclists for the bicycle education options, accessible bicycle racks, shower facilities for bicycle commuters, and other amenities and programs that support bicycling.

Resource use reduction may minimize GHGs; however, this inventory report does not measure consumption-based efforts such as the County's green office supply purchasing policy and its internal surplus supply store, which allows staff to share items among departments and offices (virtual store 2012–2018; in-person store since 2018).

3. METHODOLOGY

This section describes the inventory protocol, sectors and scopes, carbon dioxide equivalents, and data sources used for this report. As an ICLEI member, Johnson County used ICLEI's ClearPath greenhouse gas inventory software, which provides access to the Local Governments Operations Protocol (LGOP). This protocol was developed by the California Air Resources Board, the California Climate Action Registry, ICLEI, and The Climate Registry in order to provide U.S. local governments a consistent methodology for GHG emissions accounting and reporting.

Local Government Operations Protocol: Sectors and Scopes

The protocol reports emissions by **sector**, and Johnson County reported emissions for the following sectors: **buildings and facilities, vehicle fleet and transit fleet, street and traffic lights, and employee commute**.[3] The protocol also requires reporting emissions by **scope**, to avoid double counting and to clarify sources. This inventory reports Scope 1, 2, and 3 emissions.

- Scope 1 includes emissions generated directly from stationary and mobile combustion sources owned and/or operated by a local government. Examples include a portion of building energy use (e.g. furnace) and vehicle fleet and transit fleet tailpipe emissions.
- Scope 2 includes indirect emissions resulting from local government operations where the energy generation is purchased or acquired (e.g. power plant emissions).
- Scope 3 emissions result from operations, but the organization has no direct financial or operational control over them (e.g. employee commute, contracted services, and emissions associated with waste disposal). While Scope 3 emissions are not frequently included in local government inventories, Johnson County included employee commute in the current inventory.

Carbon Dioxide Equivalents

This inventory calculates the following greenhouse gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The protocol can assess other GHGs; however, their amounts are considered negligible, so this analysis does not include them. Methane (CH_4) and nitrous oxide (N_2O) emissions are converted to **carbon dioxide equivalents (CO_2e)** using the Global Warming Potentials (GWPs) developed by the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment 100-Year GWP values (Appendix A). GWPs quantify different emissions effects on Earth over the next 100 years, using carbon dioxide as the basis. Methane has a GWP of 28, or 28 times the heat capturing of carbon dioxide. Nitrous oxide has 265 times the capacity of carbon dioxide. We report GHG emissions in **metric tons CO_2e** (equivalent to 2,205 U.S. pounds).

[3] "Street and Traffic Lights" is the official category in the protocol. Johnson County does not operate any traffic signals (e.g. three-light signals: red, amber, green) but it does have several streetlights and caution lights.

Data Sources

The data sources were from calendar year 2017 unless otherwise noted. The County typically uses fiscal (FY) year reporting (i.e. July 1 to June 30); however, ICLEI prefers calendar year reporting. The data account for energy and fuel used by the following County departments and offices (exceptions and limitations noted in data source descriptions):

DEPARTMENTS AND OFFICES

Ambulance Service
Auditor
Board of Supervisors
Conservation
County Assessor
County Attorney
Emergency Management Agency
Finance
Human Resources
Information Technology
Medical Examiner
Mental Health and Disability Services
Physical Plant
Planning, Development and Sustainability
Public Health
Recorder
SEATS
Secondary Roads
Sheriff
Social Services
Treasurer
Veterans Affairs

Building and Facilities Sector data and Street and Traffic Light Sector data were obtained from utility company online accounts and/or paper bills from MidAmerican Energy, Linn County Rural Electric Cooperative, Alliant Energy, and Eastern Iowa Light and Power (EILP) Rural Electric Cooperative. The County has more than 40 energy meters for electrical and natural gas usage. County Sustainability staff enter utility data for most buildings into Excel sheets and into the online Iowa Public Buildings Benchmarking program, also known as B3 Benchmarking Program. Data for Conservation facilities, streetlights, and a few other facilities are currently maintained only by paper copy. In addition to the offices and departments listed above, several other agencies are located in County buildings: Iowa City Assessor in the Administration Building; Clerk of Court in the Courthouse; Department of Human Services and Juvenile Court System in the Health and Human Services Building. Their building energy use is part of overall use. However, excepting Iowa City Assessor, their fleet and commuter data are not included in this GHG report.

Vehicle/Equipment and Transit Fleet Sector data are from the County's Innoprise systems: Work Management and Financials (including Accounts Payable). **Fuelmaster Reporting** (managed by IT and Fleet) tracks operations expenditures, fuel and/or mileage usage of official County government fleet vehicles (including off-road machinery) and SEATS transit vehicles. Data for each assessor's office are included in this report, although their vehicles are technically not part of the County fleet. Reporting includes fuel obtained at metered pumps at the County's Secondary Roads/SEATS campus and at the Iowa City Public Works Facility. Some official County vehicle mileage is not electronically tracked; these miles were calculated using fuel quantity purchased and the average fuel economy of similar vehicles or from specifications. **Accounts Payable** (Auditor's Office) provides data for off-site fuel purchases for official government vehicles (intercounty or interstate travel) and for mileage reimbursements when County employees use their personal vehicles for official county business. Some staff do not seek

mileage reimbursement, so some mileage is undercounted. Because some data were available only in dollars ($), we made reasonable assumptions to convert these values to gallons. Non-uniform descriptions of some charges made it difficult to determine whether they reflected mileage paid, fuel costs or non-fuel costs (e.g. parking). Additional assumptions were made or data excluded, leading to potential undercounting. Conservation provided clarifications on their fuel used. Fuel used through employee air travel is not included. Fuel used for contractor projects (e.g. bridges) would be Scope 3 emissions and are not tabulated in County databases.

Employee Commute data for all employees (589), including temporary and seasonal, were based on survey results from 327 of 357 respondents (some responses were not usable). Data included an assumed averaged daily single-car commute for non-respondents and the unusable responses.[4] Employees responded to a survey (Appendix B) made available online and on paper from June to July 2018, so the data are from the year *after* the building and fleet data. The survey included questions about mode, time, distance, and frequency for travel to and from work. The survey response format contributed to some unusable responses and did not allow for some needed specificity. Details for the assumed average commute are provided in Results.

Emission factors for the energy data for electric and natural gas usage were provided by the utility companies and the U.S. Environmental Protection Agency's (EPA) Emission Factors for Greenhouse Gas Inventories. Vehicle emission factors were sourced from the U.S. Bureau of Transportation Statistics and the EPA. Other default EPA emission factors integrated into the software were used. Appendix A shows the sources and values used for the emission factors.

On-site solar PV data originated from bills or online solar tracking data (www.johnson-county.com/solar) which staff enter into Excel sheets and the B3 system. In 2017, four arrays were operating on County sites through Power Purchase Agreements. Solar produces no GHGs.

Inventory Compatibility

Because the 2008 and 2010 inventories involved older ICLEI software, they were not comparable "as is" to the 2017 inventory. To make them comparable, we accounted for differences in two ways: converted year 2008 and 2010 values from pounds or tons into *metric* tons and updated year 2008 and 2010 values using current Global Warming Potential (GWP) 100-year values. As a result, the GHG values used for 2008 and 2010 in this report are not the same as those originally reported (Appendix A).[5] The 2008 inventory is believed to be a calendar year, and the 2010 inventory spans November 2009 through October 2010.

[4] Of the 357 responses, 30 could not be used due incomplete or conflicting responses. Changes in future surveys may make it easier for respondents to answer the questions.

[5] The former Planning and Zoning Department reported the 2008 and 2010 data and provided analysis in a memo prepared Dec. 17, 2010, by Josh Busard for the Board of Supervisors.

4. MAJOR RESULTS AND IMPLICATIONS

Greenhouse gas emissions reporting protocol uses sectors and scopes. This inventory reports year 2017 operations emissions for the following sectors: buildings and facilities, vehicle fleet and transit fleet, street and traffic lights, and employee commute. Scopes are further explained on pages 7 and 15 and in the methodology. [6]

Big Picture: Operational GHG emissions in 2017 were slightly below 2008 levels and substantially below 2010 levels even though building energy use has actually increased by at least 50% since 2008 and by 14% since 2010. However, the County still has work to do to reduce emissions by 80% by 2050.

Operations GHG Goals and Trends

GHG History: 2008 to 2010

From 2008 to 2010, the County did not meet its initial goal to reduce GHGs by 10%, as overall emissions increased by nearly 26% from 5,690 to 7,150 MT CO_2e (Table 1).[7] In 2009, the construction and occupancy of the Health and Human Services Building, although LEED-designed, added emissions since it is a large building. Building sector GHGs increased by 67% in that two-year period. Vehicle and transit fleet GHGs decreased slightly (1%) during that time, and employee commute increased by 20%.

Overall GHG Changes through 2017

County policies and energy-efficiency and renewable energy projects, along with increased renewable energy provided by utilties and technological advances, have helped bring operational GHGs down from 2010 levels. Including the employee commute, from 2008 to 2017, emissions overall decreased slightly by 2% from 5,690 to 5,570 MT CO_2e. **From 2010 to 2017, emissions overall decreased substantially by 22%** (Table 1). This change is encouraging since building square footage increased from 2010 to 2017.

CO_2E = CARBON DIOXIDE EQUIVALENTS

Because some greenhouse gases (GHGs) are more powerful than others, CO_2e equivalents quantify the major GHGs under one measurement, making calculations and comparisons easier.

CO_2E METRIC TONS

CO_2e are measured in metric tons (MT). One metric ton equals 2,205 pounds. The average U.S. resident annually generates 16 MT CO_2e through energy and fuel uses. The County's 2017 GHG emissions for buildings and fleet (excluding employee commute) equal the energy use of nearly 290 such individuals.

[6] "Street and Traffic Lights" is the official protocol category. The County does not operate any traffic signals but it has several street and caution lights. Their GHG emissions (3 MT CO_2e) are included in the building sector unless noted.
[7] Year 2008 and 2010 emissions were adjusted to make them comparable to year 2017. See Methodology for details.

Year 2008 was the original base year for the County operations GHG emissions inventories. This current inventory proposes using 2010 as the base year going forward, given the substantial building footage increase that occurred in 2009.

Table 1: Operational GHG Emissions by Quantity and Percent over Time

Sector	GHG Emissions (MT CO_2e) Year			Percent Changes		
	2008	2010	2017	2008 to 2010	2008 to 2017	2010 to 2017
Buildings and Facilities	1,994	3,336	2,077	67%	4%	-38%
Vehicle and Transit Fleets	2,968	2,939	2,565	-1%	-14%	-13%
Employee Commute	728	875	928	20%	27%	6%
TOTALS ***MT CO_2e only*** *(Percentages are not totaled.)*	**5,690**	**7,150**	**5,570**	26%	-2%	-22%

Excluding the employee commute reveals a somewhat improved GHG picture. Considering only buildings and fleet, from 2008 to 2017 operational GHGs decreased 6.4% from 4,962 to 4,642 MT CO_2e. Building and fleet emissions decreased 26% since 2010 from 6,275 to 4,642 MT CO_2e. (Additional analysis excluding the employee commute appears later in this report.)

Sector Overview through 2017

Of the three sectors, the GHG data for the buildings (including street/caution lights) are the most reliable. Data for fleet and commute are less accurate due to less complete or less precise data sets and associated assumptions or extrapolation (see Methodology).

A comparison of 2008 and 2017 shows building emissions increased only by 4% (1,994 to 2,077 MT CO_2e), while vehicle and transit fleet decreased by 14% (2,968 to 2,565 MT CO_2e), and the employee commute increased by 27% (728 to 928 MT CO_2e) as shown in Table 1 and Figure 2.

A comparison of 2010 and 2017 shows building emissions decreased significantly by 38% even with new buildings added. Meanwhile, fleet emissions decreased by 13%, and employee commute emissions crept up 6%.

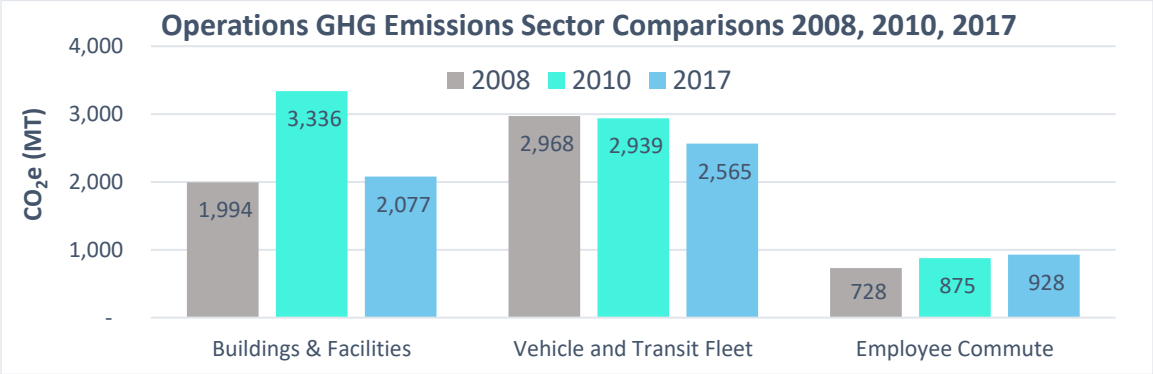


Figure 2: Operations GHG Emissions Sector Comparisons over Time

Buildings and Facilities

The construction of the Secondary Roads Shop (2015) and the Ambulance Service and Medical Examiner Facility (2017) increased overall building square footage from 255,394 sq ft in 2010 to 316,404 sq ft by the end of 2017. Three primary changes underlie the 38% decrease in building GHG emissions from 3,336 to 2,077 MT CO_2e despite the increased square footage:

(1) The County's primary utility provider, MidAmerican Energy, added wind generation and reduced coal burning, resulting in 50.8% of electricity being generated from renewable (non-GHG-emitting) sources in 2017.
(2) The County added 330 kW of onsite solar from 2014 to 2017, which is as if the entire Administration Building's electrical use has no GHG emissions.[8]
(3) Building efficiency projects such as LED light installations reduced emissions. However, efficiencies were sometimes part of new, larger buildings, so there may be no net-effects on emissions for some projects. (Building-by-building energy analysis is not part of this GHG inventory but is key to reducing emissions.)

Vehicle and Transit Fleet

Fleet GHG emissions roughly held steady from 2008 to 2010 and show an overall decrease of 14% from 2008 to 2017, likely due to improved vehicle mileage per gallon (i.e. less fuel used overall), increased use of ethanol, increased vehicle maintenance, and addition of a hybrid SEATS vehicle. In addition, training by the SEATS program helps transit drivers use the most fuel-efficient acceleration and deceleration techniques, thereby reducing GHGs.

The 2017 GHG fleet emissions total includes GHG emissions from employees using their own vehicles for County business. The 2008 and 2010 inventories did not include these emissions. As a result, the 2017 decrease in fleet GHGs can be seen even more positively since it is actually accounting for an additional category of travel for County business that was not included in previous inventories. At the same time, anecdotal reports indicate that not all employees ask for mileage reimbursement for County business travels, and so, some emissions are underreported.

Because we do not have vehicle versus transit fleet data separated out for 2008 and 2010, we cannot make meaningful comparisons for each sub-sector. However, going forward such comparisons may be possible. Fuel use and cost changes are discussed beginning on p. 13.

Employee Commute

Employee commute includes single-driver, carpool or vanpool, motorcycle, public transit (bus), car+bicycle, bicycle, and walking. Not surprisingly, most employees who responded to the commuter survey said they drive alone to work at least part of the time for their County

[8] The Ambulance Service and Medical Examiner array began operating in August 2018, adding another 69 kW in renewable energy and reducing GHGs.

employment (Table 2). Only a small percentage of County employees use other modes. (Section 5: Result Details explores why this is the case and what might help people change modes.) Commute GHG emissions appear to have steadily increased since 2008 from 728 to 875 to 928 MT CO_2e. At the same time, the employee count used for caulcations increased from 433 to 492 to 587 individuals. The GHG emissions increase can be explained by several possible factors:

- An increase in the number of employees and an increase in how we are accounting for all employees (temporary as well as permanent).
- The average round-trip commute increased by at least .5 mile and possibly up to about 4.5 miles per employee. With population increases, more people may be traveling from outlying cities within or beyond the county to County workplaces. In addition, loss of jobs in outlying counties may increase intercounty travel.
- Vehicle fuel-efficiency improved since 2008–2010, but SUVs and other larger vehicles are more common, given the economic recovery and automobile industry changes.

The employee commute in 2010 averaged 17.8 miles per employee (it is not clear whether this was weighted for full-time versus part-time). Based on survey responses of the 327 employees in 2018, the employee commute in 2018 averaged 23.6 miles round-trip for all modes of tranpsortation per full-time equivalent employee, and 23.4 miles for those driving alone in a vehicle. (This 2017 inventory uses the 2018 commute values since there was no 2017 survey.) Extrapolating for the remaining employees, the overall average daily commute was 18.3 miles round-trip for all modes, while the single-driver average daily commute per day was 18 miles per trip. These values are closer to the 17.8 miles average seen in 2008. The commuter calculation is further explained in Section 3: Methodology and in Section 5: Result Details. Section 5 also details the County's discounted bus pass program for employees and why employees drive alone to work and their interest in trying other modes.

Table 2: Employee Commute Modes (2018 Survey Results)

Mode	Employees Using Mode (#)	Percent of Respondents (%)**
Driving Alone	319	98
Carpool/Vanpool	22	7
Bike	18	6
Motorcycle	9	3
Walk	7	2
Public Transit*	3	1
Bike + Drive	3	1

*More than three employees bought transit passes from the County in 2018. However, not all employees responded to the survey.

**Some employees use different commute modes on different days, and so the total here is more than 100%.

Energy and Fuel Use and Costs

While 2017 operational GHG emissions modestly decreased compared to 2008, overall energy and fuel use has actually increased since 2008. The measure one million British Thermal Unit (MMBTu) allows different types of energy and fuels to be quantified and compared under the same measurement. Total energy and fuel use steadily increased from 63,838 MMBtu in 2008 to 71,391 in 2010 to 73,765 in 2017 (Table 3, column 7). Excluding the employee commute over which the County has less control, total building and fleet energy use has declined since 2010 (Table 3, column 8); however, the decrease can be attributed to a decrease in fleet fuel use. As seen in column 4 of Table 3, Vehicle and transit fleet fuel use slightly decreased from 2008 to 2010, and more significantly decreased by 2017, likely thanks to higher fuel-efficiency vehicles.

Table 3: Fuel and Energy Use and Costs All Sectors: 2008, 2010, and 2017

(1) Year	(2) Building Energy* MMBtu	(3) Building Energy Cost ($)	(4) Fleet MMBtu	(5) Fleet Fuel Cost ($)	(6) Employee Commute MMBtu	(7) All Sectors MMBtu	(8) Buildings + Fleet MMBtu	(9) Costs Buildings + Fleet ($)
2008	12,793	198,014	40,816	714,256	10,229	63,838	53,609	912,270
2010	18,693	290,956	40,413	691,357	12,284	71,391	59,106	982,313
2017	21,230	297,941	36,631	521,338	15,904	73,765	57,861	819,280

*Building energy use and costs include solar energy uses and costs. Solar energy does not produce GHGs.

Building energy use (Table 3, column 2) increased by 50% from 12,793 MMBtu in 2008 to 21,230 MMBtu in 2017. (Some buildings existing in 2008 were included in the 2017 inventory but not in the earlier inventories.) Building energy costs (Table 3, column 3) increased from 2008 to 2010 by nearly $93,000, but only by $7,000 from 2010 to 2017, due partly to efficiencies. In 2017, energy cost per square foot (excluding most Conservation buildings and Secondary Roads sheds) was tied for lowest in the past nine years at $1.00 per square foot (Table 4). Energy use in 2017 at 62 kBtu/SF was the lowest per square foot, due to efficiencies and the new Ambulance Service and Medical Examiner Facility being occupied only by mid-year 2017.

Table 4: Building Energy Use and Cost per Square Foot (B3 Energy Benchmarking)

Period	Days	Complete	SF	Actual kBtu/SF	Total Cost $/SF	Cost Rate $/kBtu
Jan 2010-Dec 2010	365	86%	255,394	73.44	$1.11	$0.015
Jan 2011-Dec 2011	365	100%	261,469	75.79	$1.12	$0.015
Jan 2012-Dec 2012	366	100%	261,469	66.87	$1.05	$0.016
Jan 2013-Dec 2013	365	100%	261,469	74.30	$1.16	$0.016
Jan 2014-Dec 2014	365	100%	251,848	77.34	$1.25	$0.016
Jan 2015-Dec 2015	365	100%	281,684	66.12	$1.00	$0.015
Jan 2016-Dec 2016	366	100%	283,538	65.67	$1.04	$0.016
Jan 2017-Dec 2017	365	100%	298,728	62.00	$1.00	$0.016
Jan 2018-Dec 2018	365	100%	316,404	70.75	$1.08	$0.015

Vehicle and Transit Fleet Fuel Costs for 2017, including mileage reimbursements, were $521,338 (Table 5). Compared to 2008 and 2010, when costs were $714,256 and $691,356, fleet fuel costs have decreased by about 25%. Lower fuel costs and reduced fuel use together explain the decrease. There is more discussion on fuel use in the Section 5: Result Details.

Table 5: Fleet Fuel Usage and Costs: 2008, 2010, and 2017

	Gallons			Cost ($)			Cost
Year	**Gasohol**	**Diesel**	**Total**	**Gasohol ($)**	**Diesel ($)**	**Total ($)**	**Per gallon**
2008	100,509	204,367	304,876	$ 231,056	$ 483,200	$ 714,256	$2.34
2010	99,091	202,730	301,821	$ 212,881	$ 478,475	$ 691,356	$2.29
2017	156,885	127,500	284,385	$ 282,953	$ 236,606	$ 521,338	$1.83

Scope Overview Through 2017

GHG emissions can also be assessed by scope (Figure 3). While sectors relate primarily to how energy is used (e.g. for buildings), *scopes* relate primarily to how cleanly energy is made and delivered in the first place and how much direct control the County has over these processes.

- Scope 1 = Emissions from energy directly used and controlled by County (fleets and a smaller portion of buildings). Together, these have remained fairly constant over time.
- Scope 2 = Emissions from energy used by but indirectly controlled by the County (most of the building energy). Scope 2 fluctuated greatly due to increased energy use by the County in 2010, followed by cleaner energy generation by the primary utility company.
- Scope 3 = Emissions from energy use related to County operations but not directly controlled by the County (employee commute). These emissions have gradually increased.

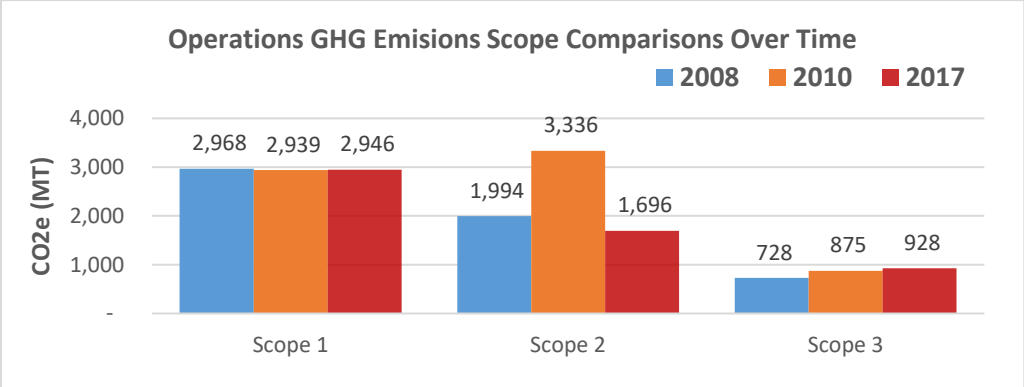


Figure 3: Operations GHG Emissions Scope Comparisons over Time

Implications of This Inventory

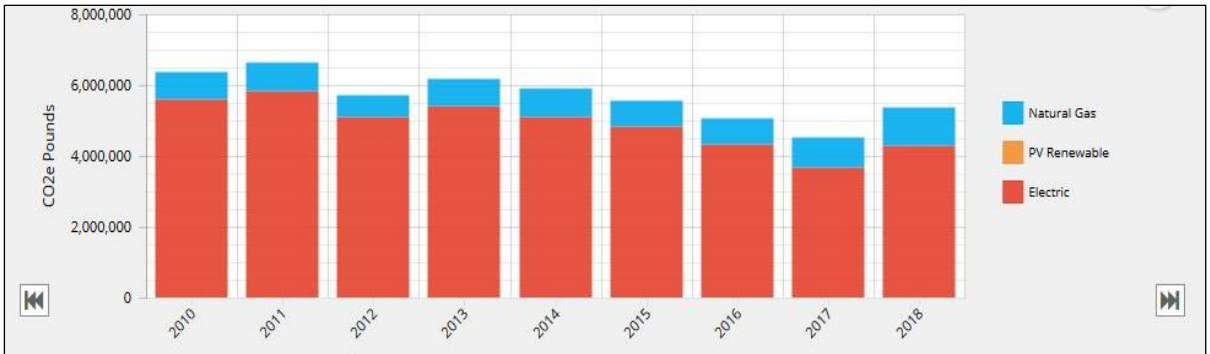
The fact that emissions in 2017 were overall about the same as in 2008 is a status to be proud of, especially in view of the increased amount of building square footage. However, given the 2008 to 2050 GHG emissions reduction goal of 80%, and the imperative to combat climate change, we must promote fuel-efficiency and renewable even as the utility companies begin to generate even cleaner energy.

Building energy use is again increasing (Table 6), and so are GHGs (Figure 4). Weather differences from year to year may explain some of the increases. The more days that require heating or cooling in any given year, the more energy needed. Calendar year 2018 had more "heating and cooling days" total (7,778) than did year 2017 (6,431). Heating and cooling degree days are misnomers and are not actual days; they relate to temperature, not time. The basic concept is the more "degree days" of either type, the more energy is being used to heat or cool a building. (See Appendix C for details on heating and cooling degree days.)

Table 6: County Building Energy Use: 2017 to 2018 Increase

Year	**Building Square Feet**	**Natural Gas** (Therm)	**Electric** (kWh)	**On-Site Solar PV Electric** (kWh)
2010	255,394	64,142	3,626,013	0
2017	298,728	70,647	2,947,866	401,580
2018	316,404	91,782	3,462,178	408,964

County Building GHG Emissions Increasing 2017 to 2018



Consumption Summary By Year

Period	Days	Complete	SF	Actual CO2e Pounds	Total Cost	Cost Rate $/CO2e Pounds
Jan 2010-Dec 2010	365	86%	255,394	6,351,428	$284,210.29	$0.045
Jan 2011-Dec 2011	365	100%	261,469	6,650,141	$293,171.97	$0.044
Jan 2012-Dec 2012	366	100%	261,469	5,727,154	$273,682.63	$0.048
Jan 2013-Dec 2013	365	100%	261,469	6,181,704	$302,335.90	$0.049
Jan 2014-Dec 2014	365	100%	251,848	5,914,383	$314,172.18	$0.053
Jan 2015-Dec 2015	365	100%	281,684	5,586,630	$282,143.53	$0.051
Jan 2016-Dec 2016	366	100%	283,538	5,077,561	$295,674.87	$0.058
Jan 2017-Dec 2017	365	100%	298,728	4,503,373	$297,911.43	$0.066
Jan 2018-Dec 2018	365	100%	316,404	5,392,226	$342,226.63	$0.063

Figure 4: County Building GHG Emissions Increasing 2017 to 2018 (B3 Energy Benchmarking)

Next Steps

The County Board of Supervisors, other elected and appointed leadership, and staff can use this report for short- and long-term planning, including to meet the County's 2018 Comprehensive Plan sustainability goal #6: *Remain a leader in green facilities, operations and infrastructure*.

These are the ***primary recommendations*** based on this inventory (more information and details are provided in Section 6: Recommendation and Next Steps):

Buildings

- Manage facilities for optimal energy efficiency (including hiring experts).
- Continue to add solar PV installations where possible.

Fleets

- Finalize and carry out GHG aspects of the Fleet Strategic Plan Fiscal Year 2020 and beyond, including improved and standardized fleet data tracking.
- Purchase high-efficient and/or green vehicles when possible.

Employee Commute

- Renew efforts to encourage non single-driver commuting by employees.

Overall

- Identify any additional department-specific ways to reduce GHGs.
- Help departments self-review to identify threats from GHGs (global warming and climate change) and find ways to develop resiliency.

5. RESULT DETAILS

The Major Results summary highlighted trends based on the 2008, 2010, and 2017 inventories. This section presents only 2017 findings by sector and scope, and adds a GHG trend analysis.

Sectors: 2017

Considering all sectors, including employee commute, buildings produced the most emissions: 2,074 MT CO_2e (Figure 5) or 37% of all operational emissions in 2017 (Figure 6). Vehicle fleet and transit fleet together produced 2,566 MT CO_2e in emissions, which is more than the buildings did; however, the two fleets can also be seen as distinct sectors at 35% and 11%, respectively, of total emissions. Employee commute accounted for 17% of all emissions. Streetlights and traffic (caution) signal emissions are negligible since the County operates very few of these.

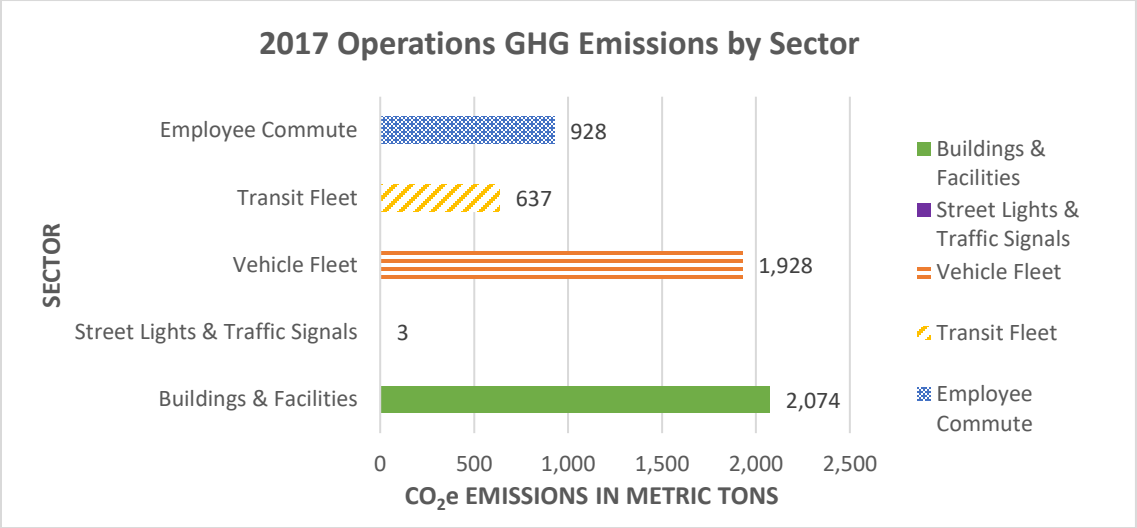


Figure 5: 2017 Operations GHG Emissions by Sector

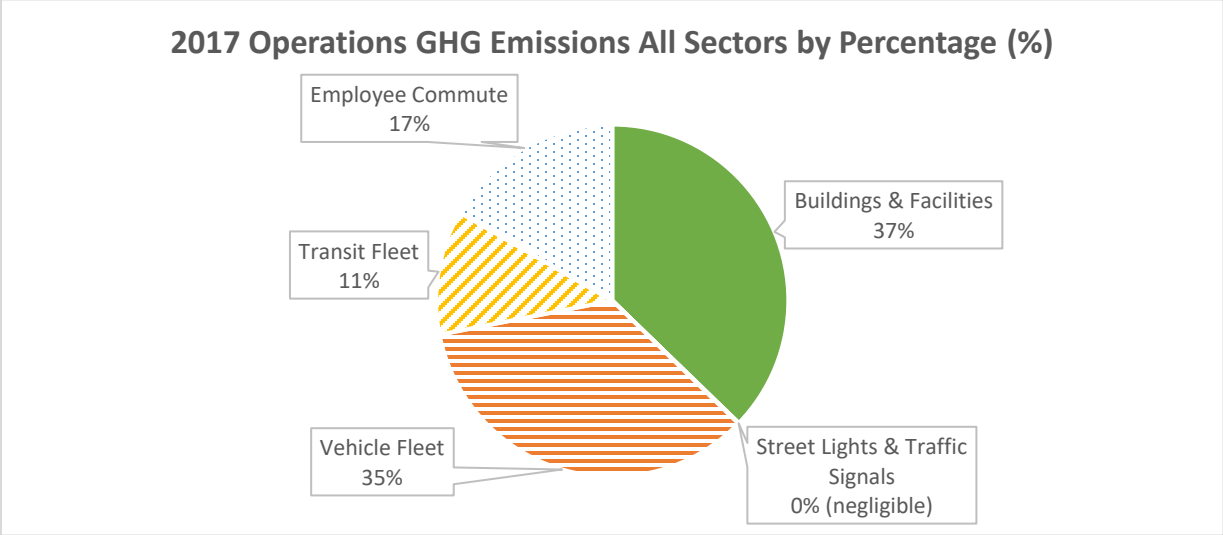


Figure 6: 2017 Operations GHG Emissions by Sector Percentages

As previously mentioned, counties and cities rarely calculate employee commute emissions since the commute is within Scope 3. Excluding the commute and comparing only the four remaining sectors, buildings still constitute most of the emissions at 45% (Figure 7). Vehicle fleet is 41% and transit fleet is 14%. Streetlights are negligible and appear as 0%.

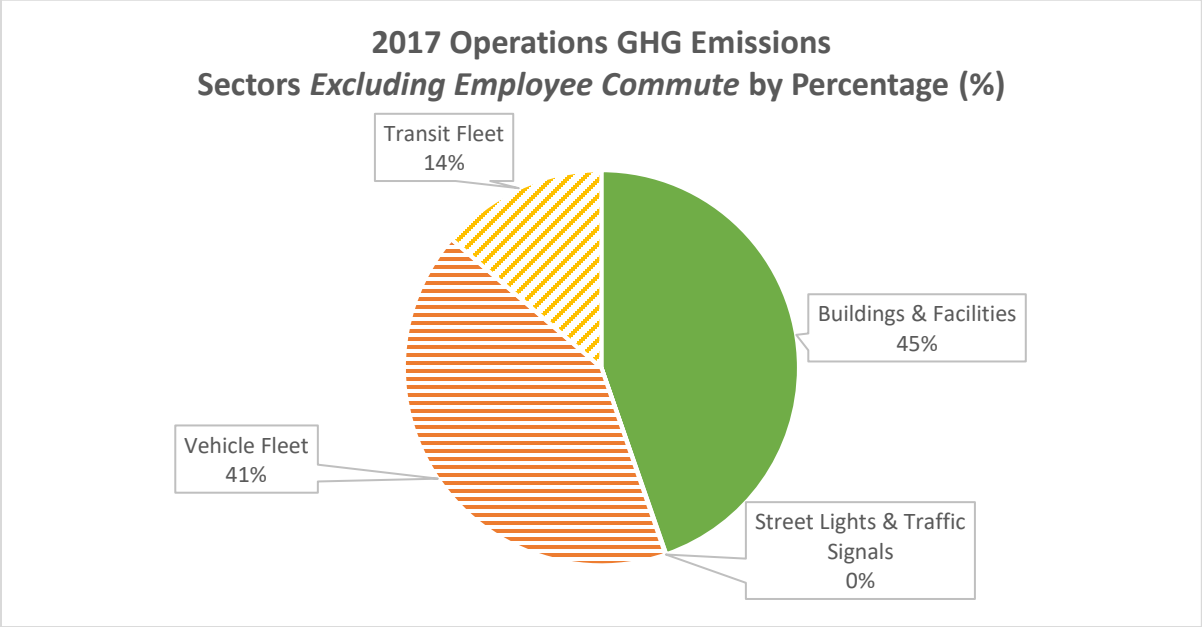


Figure 7: 2017 Operations GHG Emissions by Sector Percentages (No Employee Commute)

Scopes: 2017

This inventory included three scopes (1, 2, and 3), which relate to the amount of direct control an organization has over the emissions (Figure 8).

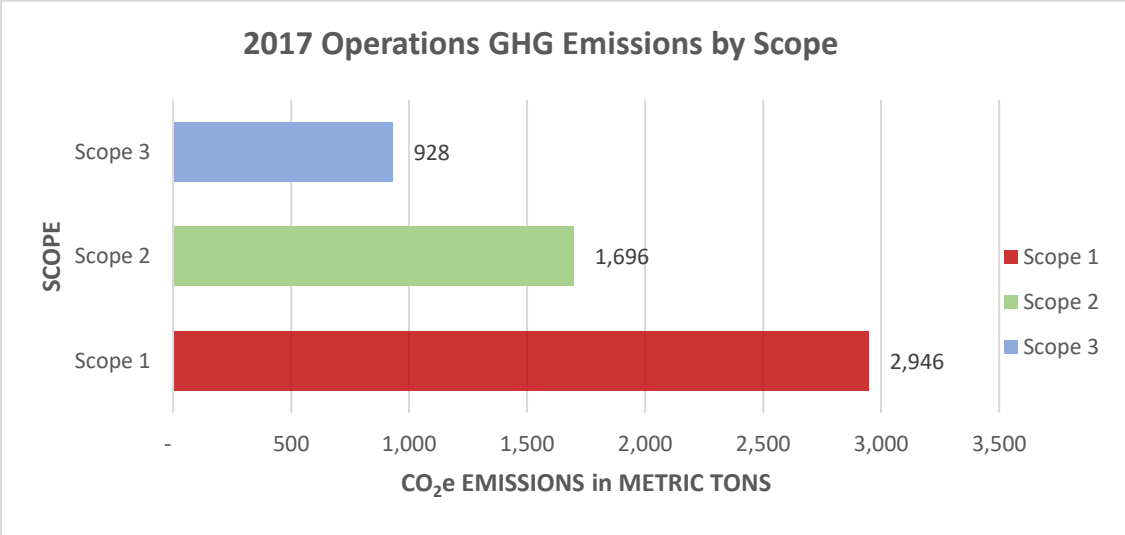


Figure 8: 2017 Operations GHG Emissions by Scope

As detailed in Figure 9, which shows both scopes *and* sectors, Scope 1 equals 2,946 MT CO_2e total and includes a portion (about 18%) of the building emissions plus all of the vehicle and transit fleet emissions. Scope 2 equals 1,696 MT CO_2e total and includes indirect emissions from the bulk of the building emissions (1,693 MT CO_2e) plus the nearly negligible emissions of 3 MT CO_2e from street and caution lights. Scope 3 is solely the employee commute of 928 MT CO_2e.

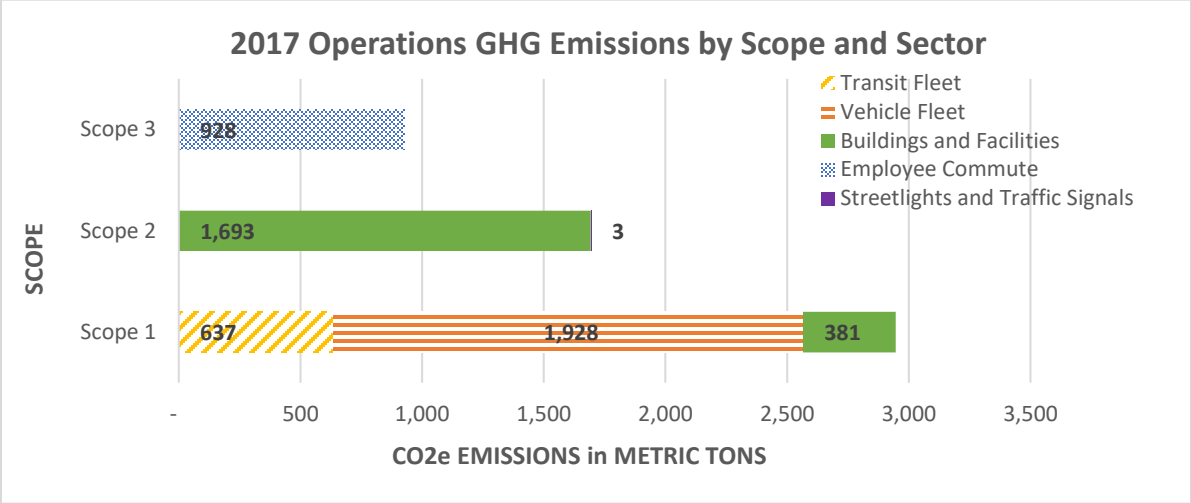


Figure 9: 2017 Operations GHG Emissions by Scope and Sector

Comparisons Excluding Employee Commute

It is useful, but challenging, to measure employee commute GHG emissions. Since the County has less direct influence on the commute, comparisons excluding it are helpful. Excluding the commute, the operations GHG picture improves from 2010 to 2017. In that time, **operational GHGs decreased 26%** from 6,275 to 4,642 MT CO_2e (Figure 10). In 2008, the County set a long-range goal of reducing emissions by 80% by 2050. Now using 2010 as the base year, the dotted lines show operational GHGs compared to 10%, 25%, and 80% reduction targets.

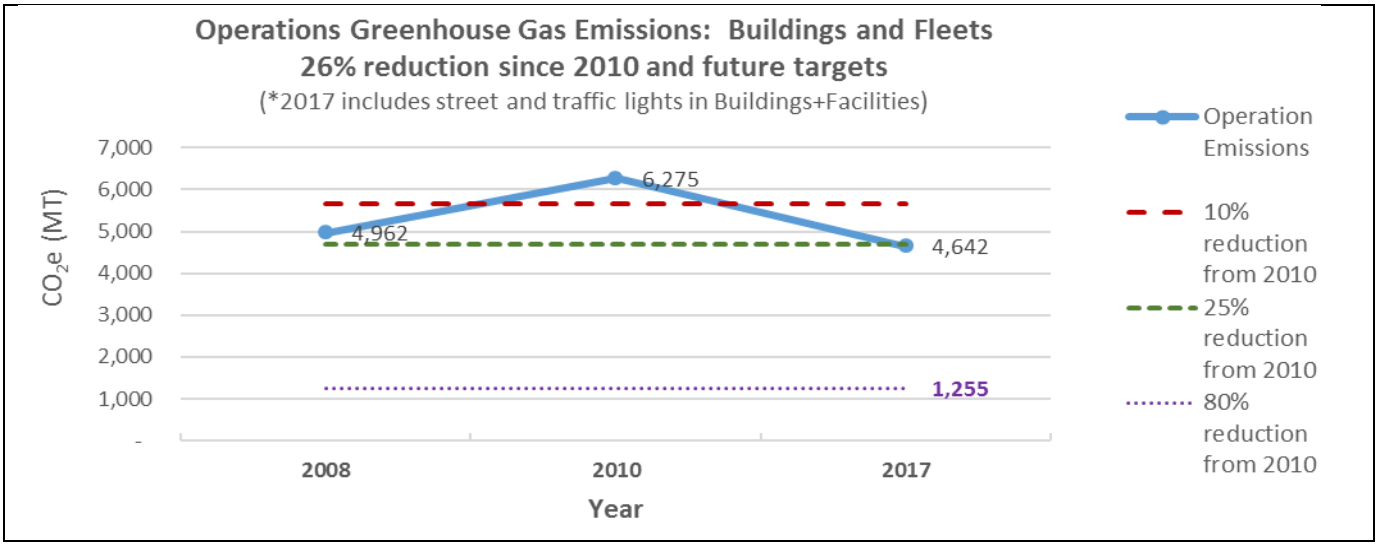


Figure 10: Operations GHG Emissions Buildings and Fleets: 2010 to 2017 Comparison

Building Energy Use

The buildings that used the most GHG-related energy in 2017 are shown in Table 7. Because the Ambulance Service and Medical Examiner Facility began operation mid-year 2017, it may rise in percentage of GHG-generating energy use and GHG emissions in the future, or this may be offset by its onsite solar. In general, the amount of non-clean energy used relates to the amount of GHGs produced. However, the Administration Building used less potentially GHG-causing energy than the Secondary Roads/SEATS campus did but actually contributed more emissions (303 MT CO_2e compared to 280 MT CO_2e). This could be related to the amount of solar-generated energy offsetting emissions and/or to the non-renewable fuels used for building comfort in an office building (Administration Building), where more individuals are present eight hours daily than in Secondary Roads / SEATS facilities.

Table 7: GHG-Related Energy Use and GHG Emissions of Top 10 Buildings

	TOTAL ENERGY ASSOCIATED WITH GHG EMISSIONS BY BUILDING/SITE		TOTAL CO_2e Buildings	
BUILDING/SITES	MMBtu (GHG-related only)	% of all GHG-related building energy MMBtu	MT	% of all building CO_2e
HHS	4,275	21.5%	552	26.6%
Admin Building	2,778	14.0%	303	14.6%
Sec Rds/SEATS Campus	3,826	19.3%	280	13.5%
Jail/Sheriff's Office	2,491	12.5%	245	11.8%
Courthouse Site 2017	2,221	11.2%	216	10.4%
JECC	1,595	8.0%	212	10.2%
Conservation Kent Park-2048 Hwy 6 NW	659	3.3%	88	4.3%
Ambulance Building	635	3.2%	53	2.5%
Blue Building	487	2.4%	38	1.8%
Former CQ Clinton	298	1.5%	19	0.9%

Note: Some buildings use solar-generated (no GHG) energy, which is not included in the totals above.

Vehicle and Transit Fleet Fuel Use

2017 Fleet Fuel Used

Johnson County vehicle and transit fleets use both gasohol (ethanol-based) and diesel fuels sources. In 2017, vehicle fleet emitted 1,928 MT CO_2e, while transit fleet emitted 637 MT CO_2e. The combined County vehicle fleet and transit fleet fuel usage was 127,500 gallons of diesel, and 156,885 gallons of gasohol (E10), which is 10% ethanol and 90% gasoline (Figure 11). These quantities include fuel purchases made at the County Secondary Roads and City of Iowa City metered pumps for on- and off-road vehicles that the County owns or leases. The above values also include the calculated gallons used by County employees who traveled in their personal vehicle for official county business and sought allowable reimbursements. Total emissions for

gasohol and diesel powered vehicles and equipment were 1,345 MT CO_2e and 1,306 MT CO_2e, respectively (Figure 12).

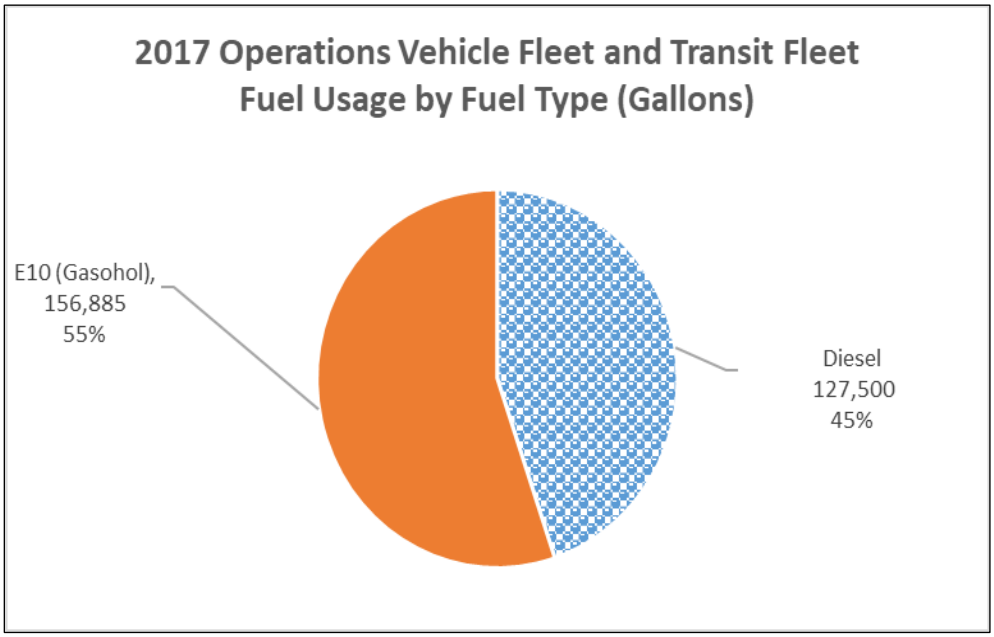


Figure 11.Operations Vehicle and Transit Fleet Fuel Usage by Fuel Type

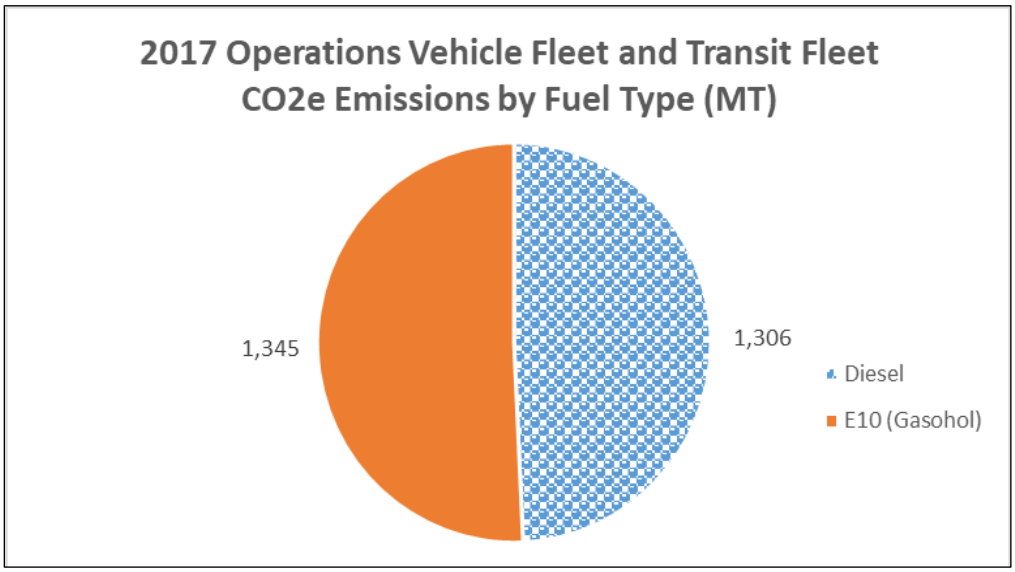


Figure 12. Operations Vehicle Fleet and Transit Fleet GHG Emissions by Fuel Type

Vehicle and transit fleets combined include approximately 225 vehicles, including buses, heavy-duty equipment, and dump trucks. The County's off-road vehicles include mules, mowers, loaders, excavators, graders, tractors, and boats. Off-road vehicles powered by diesel produced 212 MT CO_2e and those powered by gasohol produced 6 Mt CO_2e (Table 8). The emissions produced from these vehicles make up 8.2% of the total fleet emissions produced but

contribute 7.3% of the total gallons of fuel used. The total fuel usage to power off-road vehicles and equipment was 21,412 gallons (20,637 gallons of diesel and 775 gallons of gasoline).

Table 8. 2017 Fuel Usage by Type and Vehicle for GHGs Emissions and Gallons Used

	Diesel		**Gasoline**		
Vehicle Type	*On-road*	*Off-Road*	*On-Road*	*Off-Road*	*Total*
CO_2e (MT)	1,094	212	1,338	6	2,651
Gallons	106,863	20,637	156,111	775	284,385

Fleet Fuel Use Comparisons

Fuel use and total costs did not change significantly from 2008 to 2010; however, gallons used and total cost declined by 2017. In 2008, the County used a total of 304,876 gallons of fuel: 100,509 gallons of gasoline and 204,367 gallons of diesel. In 2010, the County used a total of 301,821 gallons: 99,091 gallons of gasoline and 202,730 gallons of diesel. In 2017, 20,491 gallons fewer total were used than in 2008, and 71,504 fewer gallons than in 2010.

In 2008, the County spent $231,056 on gasoline and $483,200 on diesel, while in 2010 costs were $212,881 for gasoline and $478,475 for diesel (Figure 13). In 2017, the County spent $282,953 on gasohol and $236,606 on diesel, spending considerably less on diesel than in years prior. The average price per gallon of fuel was $2.34 in 2008, $2.29 in 2010, and $1.83 in 2017.

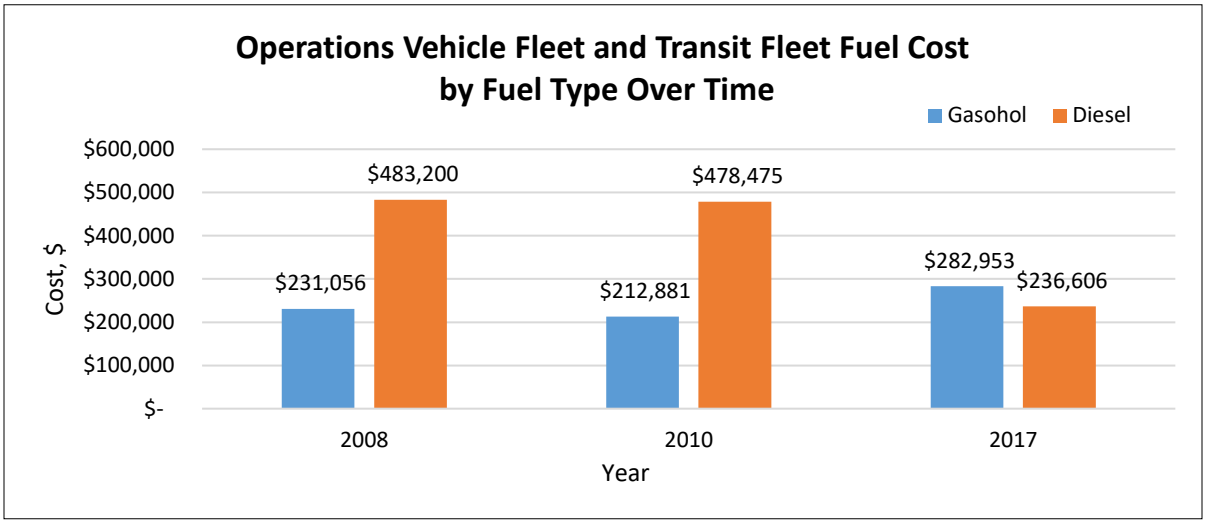


Figure 13: Fleet Fuel Cost by Fuel Type over Time

Employee Commute Details

The average daily commute was calculated using overall miles traveled and the miles traveled by a single-driver. Based only on the survey results, the average daily commute including all modes of transportation was 23.6 miles, while the single-driver average daily commute per day was

23.4 miles. To account for those who did not respond (232 employees) and the incomplete responses (30 employees), we assumed that these other 262 employees (weighted for full-time equivalencies) traveled to work every day in a gasohol-fueled passenger car. Using these assumptions, the overall average daily commute was calculated to be 18.3 miles round-trip, while the single-driver average daily commute per day was 18 miles trip.

Employee commute modes include single-driver, carpool or vanpool, motorcycle, public transit as well as biking, walking, and driving plus biking. Not surprisingly, as previously noted, most employees, 98% of 327 respondents, said they drive alone to work all of the time or at some point (Table 2). However, 20% of all respondents used modes of transportation other than driving alone at some point during the year. Only 8% of those who responded use modes of transportation that are non-GHG emitting: biking and walking.

Discounted bus pass program

Employees' use of the County's discounted bus pass program has fluctuated greatly since inception (Figure 14). High annual use depends on whether any single employee uses the bus as their primary means of commute. Employee participation in the discount program doubled from fiscal years 2012 to 2014 from 520 to 1,180 rides. Use then decreased by more than half by fiscal year 2016 to 680 rides, then averaged 365 rides in fiscal years 2017 and 2018. However, the current fiscal year 2019 indicates an increase, with rides purchased already at 360 rides.

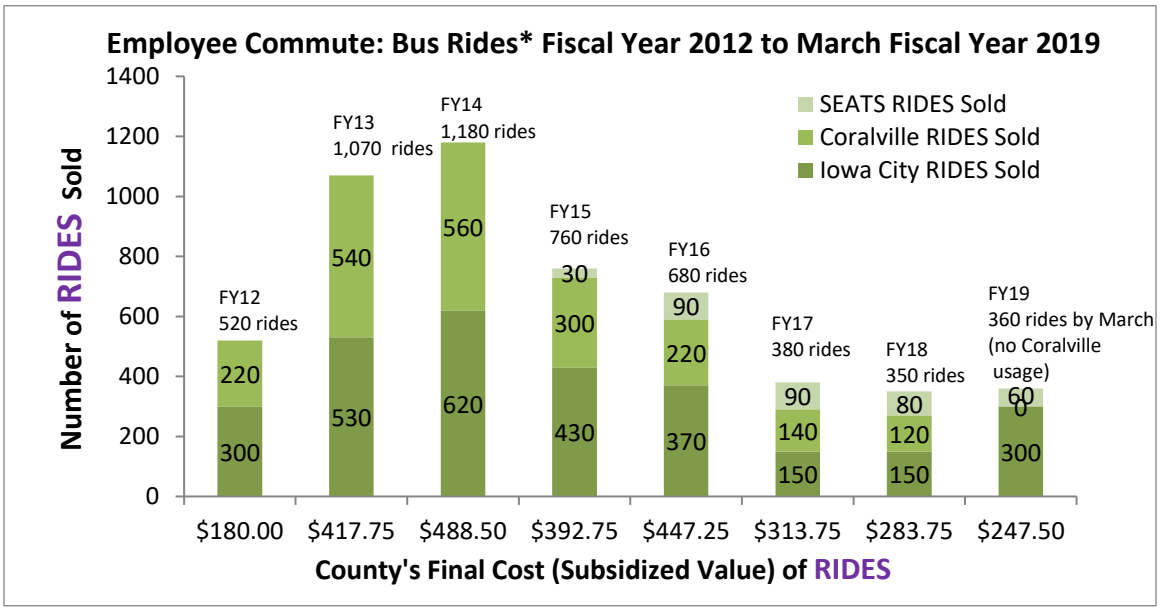


Figure 14: Employee Commute: Bus Rides Purchased Since Program Inception

**Passes are sold as pre-loaded 10-ride and 20-ride tickets for Iowa City Transit and Coralville Transit, respectively, and are sold at half the County's cost to employees. The SEATS 10-ride pass is provided through a "Buy three passes, get one pass free" charge structure. For these reasons, it is more accurate to count rides rather than passes sold.*

Reducing single-driver commuting

Three questions on the County employee commuter survey were designed to provide insight into what affects employees' choice of commute mode and what might influence them to commute to work other than by driving alone in a vehicle. The responses can help the County support alternative modes.

The four most important factors affecting employees commute mode are convenience and flexibility (217), reliability (155), the ability to make stops or run errands on the way to home (143), and short commute time (133) (Table 9). Reliability relates to why people may hesitate to take public transit if the perception or reality is that they may be late more often. The third most common response, being able to run errands or make stops, involves bundling trips which could have some GHG emissions savings. Interestingly, nearly half of respondents (162) said they drive their own car during the workday for work-related needs that are separate from commuting (Table 10). The County fleet and sustainability staff should explore this need.

Table 9: Factors Affecting County Employees' Choice of Commute Mode

What is most important to you when choosing how you get to work? Select up to 3.	**Responses**
Convenience/Flexibility	217
Reliability	155
Ability to make stops or run errands on the way to home or work	143
Short(est) commute time	133
Comfort/Safety	94
Financial Savings	64
Flexible/Fixed schedule	50
Reducing pollution/Conserving energy	32
Commute stress savings	22

Table 10: County Employees' Use of Personal Vehicle during the Work Day

If you drive your personal vehicle during the workday (i.e. not just for commuting to/from work), please indicate why.	**Responses**
Work-related	162
Personal business (e.g. errands, lunch)	161

The survey's final question asked what might help employees use a commute mode other than driving alone in a vehicle (Table 11). The most popular response (43 responses) was help finding a ride match for carpooling. The County may be able to do more to help employees coordinate

with one another for carpooling. A related, and the fourth most popular response (36 responses), was interest in free or discounted vanpool parking.

The second most common response (41 responses) was increased availability of non-motorized vehicle infrastructure such as bicycle lanes and paths. Fortunately, the County and metro areas continually work to improve and add this type of infrastructure, make bicycling an easier and safer mode of transportation. As more bicycle-friendly routes become available, the County can help publicize them and encourage use.

Financial incentives were the third most popular choice (37 responses) for encouraging alternative mode commutes. However, the survey did not provide detail on type. The current bus discount program is substantial at 50% of typical fares, so it is unclear whether an additional discount (putting aside the question of fiscal feasibility) would make a difference and attract more riders. Nearly 10% of respondents showed interest in a shuttle service between a transit station and workplace. This is another service County fleet and sustainability staff should further explore.

Table 11: Potential Influences to Choose an Alternative Commute Mode

If you usually drive alone to work, what would encourage you to use a different way to get to work (i.e. carpooling, transit, biking, or walking)? Select up to 3.	**Responses**
Assistance finding a ride match	43
Availability of infrastructure for non-motorized vehicles (e.g. bike lanes, protected paths, etc.)	41
Financial incentives	37
Free or discounted parking for carpool/vanpool vehicles	36
Shuttle between transit station and work place	34
Availability of nearby public transit	19
Help with transit information	3
Bike routes/maps and safety information/seminars	2

6. RECOMMENDATIONS AND NEXT STEPS

Use of *less* energy and *cleaner* energy in County operations will lead to fewer GHG emissions. It will be an uphill climb to reduce *energy use*, given the need for more buildings (e.g. behavioral health access center) and increasing overall temperatures and other climate challenges. GHG emissions per building square foot may decrease as MidAmerican Energy delivers a great percentage of clean energy. However, it is still imperative to reduce the amount of energy used and to consider the resourcefulness of energy independence through solar arrays.

Looking ahead, these are some of the factors we need to consider:

- How operations may expand or contract based on changes in population, technology, or need;
- Energy source changes;
- Other technology changes; and
- Climate change impacts.

In particular, MidAmerican Energy's goal to produce even more renewable energy will help the County keep GHG emissions lower than they otherwise would be. MidAmerican's wind production commitment is commendable and important. However, the utility's 100% renewable goal (primarily wind) does not mean the utility will actually deliver 100% clean energy to the County 100% of the time. It can be surmised that MidAmerican Energy is communicating they have installed enough wind turbines to generate the electricity needed for its Iowa customers. Yet their 100% renewable claim can be misleading because the utility will still operate coal, natural gas, and nuclear plants to meet customer demand in Iowa and other states when the wind is not blowing. The coal-based production is especially large.[9] Thus, onsite solar energy generation still is important for Johnson County.

Currently, electric and other alternative vehicles are not an available option for heavy-duty vehicles such as ambulances and dump trucks or for vehicles used for many hours each day such as patrol vehicles. Technological changes may provide more options in the future. The SEATS Department / Fleet is writing an extensive strategic plan that includes GHG strategies and goals and intends to form a fleet committee. Sustainability and other staff should be part of this collaboration, provide input on the plan and help carry out its goals.

[9] "Groups Question MidAmerican's 100% Renewable Energy Plan, Given Coal Reliance," *Des Moines Register*, Aug. 8, 2018. https://www.desmoinesregister.com/story/money/business/2018/08/07/midamerican-renewable-energy-plan-coal-reliance-environmental-groups-wind-energy/913170002/.

Future Inventories

Compiling a formal GHG inventory is important but time-consuming. We recommend limiting staff to compiling formal GHG inventories to no more than every five years. Sharing the detailed monthly building data in **B3 Benchmarking program** provides a helpful annual snapshot for most buildings. In addition, at this time we do not recommend doing a formal community-level GHG inventory. If protocols and software become uniform, we would recommend it at that time.

Tools needed to improve tracking and analysis ability

Tools that may help with GHG-related tracking and understanding are generally described in Table 12. Additional notes based on the inventory process are also available.

Actions

The following table updates the status of actions found in the 2010 GHG plan, the 2011–2013 Strategic Plan of the Johnson County Board of Supervisors, the 2014–2016 Strategic Plan of the Johnson County Board of Supervisors, and the 2017–2018 Strategic Plan of the Johnson County Board of Supervisors. The table also includes suggested new actions. An official plan for the next stage needs to be prepared.

Table 12: Past and Proposed GHG Reduction Actions

MEASURES: Yellow highlight indicates a new suggested measure. (The other measures are from previous plans, as indicated.)	**Status**	**Notes**
REPORTING and PLANNING		
Update the GHG **Inventory** biannually – *recommend revise to every five years (see below)*.	Not done	No inventories from 2011 to 2016 due to focus on projects instead.
Update the 2008 GHG **Plan** (2011–2013 Strategic Plan goal).	Periodic	Goals were set within the strategic plans versus having a stand-alone GHG plan.
Update Operations GHG Inventory.	*Count from 2017*	Do a formal inventory every five years.
Analyze and share building GHG emissions data annually using B3 Benchmarking.	*Begin for 2018*	
Calculate and share fleet data every year.	*Begin 2019*	
Streamline fleet reporting (see Fleet).	*Begin FY2020*	
RESILIENCY		
Review departments for resiliency to GHG effects and departmental-specific ways to reduce GHG.	*Begin in fall 2019*	

BUILDING		
Hire an expert to review certain buildings. Our detailed B3 data shows that after years of steady GHG emissions in the Administration building, 2018.	*By fall 2019*	Some of this may be attributed to weather differences but should be checked.
Encourage LEED certification (2010 GHG Plan)	Exceeded	See Capital Project Standards below
Encourage LEED certification for major renovations (2010)	In place	
Set Sustainable Capital Project Standards to include LEED or internal minimum standards for new builds and major renovations (proposed in 2011-13 strategic plan; re-proposed in 2014-16 Strategic Plan)	Met	Adopted July 2014 along with Sustainability Minimum Standards. Both sets of standards should be reviewed for changes.
Computers set for energy saving (2010)	Ongoing	
Educate and encourage employees about energy efficiency (2010)	Ongoing	
Reduce electric draw of office and non-office equipment (2014 Strategic Plan)	Met	Review completed in 2015.
Complete energy-efficiency upgrades (2014 Strategic Plan)	Met	
Create an internal fund for energy efficiency and renewable energy projects (2014 Strategic Plan)	Met	Fund created in July 2014 and used annually.
Reduce energy usage (2017-18 Strategic Plan goal) Renew for future strategic plans.	Ongoing	
Provide at least 20% of the electricity through renewable sources (2010 GHG Plan)	Met	Through utility and onsite solar.
Prepare a feasibility report on a renewable energy project and begin a project (2014 strategic plan)	Met	First on-site solar began in 2014; installed in 2015. Two more arrays added in 2016.
Increase energy coming from renewables (2017-18 strategic plan)	Met	Additional array added in 2018. More planned.
FLEET		
Investigate and adopt a policy stating certain MPGs (2010 GHG Plan; 2017-18 Strategic Plan) / Establish a baseline for passenger vehicles (2017-18 Strategic Plan)	Not formally met.	No formal policy but in practice this is done.

Educate employees on ways to reduce VMT	Partially met	Some departments have active programs; some general education.
Increase biofuel usage (2010 GHG Plan)	Met	
Maintain vehicles for best fuel efficiency (2010 GHG Plan)	Ongoing	Effort made. In addition, Fleet manager hired in 2017.
Minimize A/C usage in vehicles (2010 GHG Plan)	Ongoing	Drivers encouraged to do this but customer comfort also considered.
Monitor efficiency of fleet vehicles (2017-18 Strategic Plan)	Ongoing	
Collaborate on the Fleet Strategic Plan including but not limited to the suggestions listed below		
Further improve fleet tracking methods	Ongoing	Innoprise; involved IT, Fleet, Sustainability, others.
Promote reduced idling (recognizing limitations emergency, law enforcement and other vehicles)	Planned	Fleet will investigate.
Purchase only alternative fueled vehicles by 2020 (2014 GHG Plan)	Partial	Electric vehicles not sufficient for heavier fleet needs.
EMPLOYEE COMMUTE		
Facilitate car and van pool efforts (2010 GHG Plan)	Met	Met but only a small effect. Few users. Could renew.
Sponsor programs encouraging employees to use public transit efforts (2010 GHG Plan)	Met and ongoing	Bus pass discount programs; education.
Encourage employees to walk or bike to work efforts (2010 GHG Plan)	Met and ongoing	Bike to Work month; One Less Car Competition; quarterly education.
Promote telecommuting when possible (by 2017 goal)	Not realized	Largely not feasible.
Reduce work week to four days by 2010	Not realized	Explored but found not feasible due to customer service needs.
Education efforts (2014 Strategic Plan)	Ongoing	The County has hosted electric vehicles talk, promoted bus passes.

7. APPENDICES

A: Emission Factors, Global Warming Potentials, and Prior Inventory Adjustments

Emission Factors Used

Unit	Emission Factors				Description	Source
	CO_2	CH_4*	N_2O*	Total CO_2		
lbs/kWh	0.998	0.000	0.000	1.004	Average emission factor for the statewide electricity grid (2016)	U.S. EPA eGRID 2016 State Specific
lbs/kWh	0.996	0.000	0.000	1.002	Average emission factor for MidAmerican customers in Iowa (2017)	MidAmerican Energy
lbs/kWh	1.227	0.000	0.000	1.234	Average emission factor for IPL customers (Alliant Energy's Iowa subsidiary) for electricity (2017)	IPL (Alliant Energy)
lbs/kWh	1.004	0.000	0.000	1.010	Average emission factor for CIPCO (EILP) customers for electricity provided (2017)	CIPCO (Eastern Iowa Light and Power)
g/therm	5302.000	0.500	0.010	5302.510	Average emission factor for natural gas (based on ICLEI protocol)	ICLEI and EPA
g/mile	367.900	0.019	0.011	367.930	Average emission factor for emissions caused by **gasoline passenger** vehicles (8.78 kg CO_2/gallon)	U.S. EPA Emission Factors for Greenhouse Gas Inventories 2015 to 2018
g/mile	367.900	0.020	0.017	367.937	Average emission factor for emissions caused by **gasoline light truck** vehicles (8.78 kg CO_2/gallon)	U.S. EPA Emission Factors for Greenhouse Gas Inventories 2015 to 2018
g/mile	1637.600	0.033	0.134	1637.767	Average emission factor for emissions caused by **gasoline heavy truck/paratransit** vehicles (8.78 kg CO_2/gallon)	U.S. EPA Emission Factors for Greenhouse Gas Inventories 2015 to 2018
g/mile	367.900	0.672	0.069	368.641	Average emission factor for emissions caused by **gasoline motorcycle** vehicles (8.78 kg CO_2/gallon)	U.S. EPA Emission Factors for Greenhouse Gas Inventories 2015 to 2018
g/mile	426.770	0.000	0.001	426.776	Average emission factor for emissions caused by **diesel passenge**r vehicles(10.2 kg/gallon)	U.S. EPA Emission Factors for Greenhouse Gas Inventories 2015 to 2018
g/mile	426.770	0.001	0.002	426.773	Average emission factor for emissions caused by **diesel light truck** vehicles (10.2 kg/gallon)	U.S. EPA Emission Factors for Greenhouse Gas Inventories 2015 to 2018
g/mile	1658.650	0.005	0.005	1658.660	Average emission factor for emissions caused by **diesel heavy truck/paratransit** vehicles (10.2 kg/gallon)	U.S. EPA Emission Factors for Greenhouse Gas Inventories 2015 to 2018

*Factor derived using a ratio of the CO_2 emission factor. Ratios are from the electric company and eGRID 2016 State Specific.

Global Warming Potentials (GWPs)

Common Name	Chemical Formula	Global Warming Potential (100-year)
Carbon Dioxide	CO_2	1
Methane	CH_4	28
Nitrous Oxide	N_20	265
Sulfur hexafluoride*	SF_6	23,500
Hydrofluorocarbons*	Various	Varies
Perfluorocarbons*	Various	Varies
Source: Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2014). * *Not taken into account in this inventory*		

2008 and 2010 Original and Adjusted CO_2e (MT) Values

MAIN SECTORS	2008 Original	2008 Adjusted for Comparison	2010 Original	2010 Adjusted for Comparison	2017
Buildings and Facilities	2,184	1,994	3,678	3,336	2,077
Vehicle and Transit Fleet	3,272	2,968	3,240	2,939	2,565
Employee Commute	804	728	966	1,936	928
TOTALS	6,260	5,690	7,884	8,211	5,570

B: Employee Commute Survey

Employee Commute Survey 2018

This survey is being used to help sustainability staff complete a Greenhouse Gas Inventory for Johnson County Operations. At a recent work session, the Board of Supervisors approved use of this survey. The results will help staff calculate emissions generated by employees' commutes and understand commuting needs. The following questions will ask about your commute. The survey takes about two or three minutes to complete. We need to know your name only so we can be sure your commute info is counted -- your name will not appear publicly in the data shown for the report nor will it be used for any other purposes. Please answer all questions as best as you can by JULY 6, 2018. Completing the survey by this date allows you to be eligible for a prize drawing! THANK YOU FOR YOUR TIME! If you have any questions about the survey, contact greenteam@co.johnson.ia.us or call 356-6083.

* Required

1. Please provide your first and last names. (Your name will not appear publicly in the data shown for the report. All data will be aggregated.) *

_____

2. What year did you start working at Johnson County? *

3. What is your department? *

Mark only one oval.

- ◯ Ambulance
- ◯ Auditor/Elections
- ◯ Board of Supervisors
- ◯ Conservation
- ◯ County Assessor
- ◯ County Attorney
- ◯ Emergency Management
- ◯ Finance
- ◯ Human Resources
- ◯ Information Technology
- ◯ Medical Examiner
- ◯ Mental Health /Disability Services
- ◯ Physical Plant
- ◯ Planning, Development and Sustainability
- ◯ Public Health
- ◯ Recorder
- ◯ SEATS/Fleet
- ◯ Secondary Roads
- ◯ Sheriff
- ◯ Social Services
- ◯ Treasurer
- ◯ Veteran Affairs
- ◯ Other: _____

4. Please provide the following information regarding your employment. Check all that apply. *

Check all that apply.

- [ ] Full-time
- [ ] Part-time
- [ ] Temporary

5. On average, how many days a week do you commute to your County job? *

Mark only one oval.

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7

6.What is your daily commute distance round-trip (i.e. both ways combined) in miles? Please write this as a numeral only, e.g. 10. You do not need to add the word "miles." *

_____

7. What is your daily commute time round-trip in minutes for your primary mode of travel? (e.g. you usually drive by car and each way is 35 minutes. Round-trip = 70 minutes) *

8. Check how many times per week ON AVERAGE you use the following modes to commute to work DURING COLDER MONTHS SEPTEMBER TO APRIL. For example, if you answered in question 5 that you commute to work three days a week, you might drive alone 1 time, bicycle 1 time and do a bike/car combo 1 time. Whatever your mode(s), the number of modes you mark below should add up to your number of commuting days listed in question 5. *

Mark only one oval per row.

	0	1	2	3	4	5	6	7
Drive alone (car)	◯	◯	◯	◯	◯	◯	◯	◯
Drive alone (motorcycle/moped)	◯	◯	◯	◯	◯	◯	◯	◯
Carpool (2-6 Commuters)	◯	◯	◯	◯	◯	◯	◯	◯
Vanpool (7 or more commuters)	◯	◯	◯	◯	◯	◯	◯	◯
Public Transit	◯	◯	◯	◯	◯	◯	◯	◯
Bicycle + Drive combo	◯	◯	◯	◯	◯	◯	◯	◯
Bicycle only	◯	◯	◯	◯	◯	◯	◯	◯
Walk	◯	◯	◯	◯	◯	◯	◯	◯

9. Check how many times per week ON AVERAGE you use the following modes to commute to work DURING THE WARMER MONTHS MAY THROUGH AUGUST. Whatever your mode(s), the number of modes you mark below should add up to your number of commuting days listed in question 5 unless you're seasonal and don't work these months. *

Mark only one oval per row.

	0	1	2	3	4	5	6	7
Drive alone (car)	◯	◯	◯	◯	◯	◯	◯	◯
Driver alone (motorcycle/moped)	◯	◯	◯	◯	◯	◯	◯	◯
Carpool (2-6 Commuters)	◯	◯	◯	◯	◯	◯	◯	◯
Vanpool (7 or more commuters)	◯	◯	◯	◯	◯	◯	◯	◯
Public Transit	◯	◯	◯	◯	◯	◯	◯	◯
Bicycle + Drive	◯	◯	◯	◯	◯	◯	◯	◯
Bicycle	◯	◯	◯	◯	◯	◯	◯	◯
Walk	◯	◯	◯	◯	◯	◯	◯	◯

10.If you drive your own car to work, please select the TYPE OF VEHICLE you drive most of the time? (The question after this will ask about fuel type.)

Mark only one oval.

- ◯ SUV
- ◯ Sedan
- ◯ Wagon
- ◯ Coupe
- ◯ Crossover
- ◯ Hatchback
- ◯ Light Duty Truck
- ◯ Heavy Duty Truck
- ◯ Van
- ◯ Other: _____

11. If you drive your own vehicle (car or motorcycle) to work, what one TYPE OF FUEL do you typically use? (If you use a hybrid vehicle, check off electric and one of the gas types.)

Check all that apply.

- ☐ Gasoline (non-ethanol)
- ☐ Ethanol (E85) aka High-Level Ethanol-Gasoline Blend
- ☐ Ethanol (E15)
- ☐ Ethanol (E10)
- ☐ Diesel
- ☐ Biodiesel
- ☐ Electric

12. FOR CARPOOLERS ONLY: If you carpool or vanpool please, list how many people are in the carpool (including yourself), whether they work for the county or not. If they do, write their names as well. (Note: Names will not be shared publicly.)

_____

_____

_____

_____

_____

13. FOR CARPOOLERS ONLY, if you carpool and ARE NOT THE DRIVER, please select the TYPE OF VEHICLE typically used in the carpool? If the type varies, just list what is the primary type you ride in. (The question after this will ask about fuel type.)

Mark only one oval.

- ◯ SUV
- ◯ Sedan
- ◯ Wagon
- ◯ Coupe
- ◯ Crossover
- ◯ Hatchback
- ◯ Light Duty Truck
- ◯ Heavy Duty Truck
- ◯ Van
- ◯ Motorcycle/moped
- ◯ Other: _____

14. FOR CARPOOLERS ONLY: If you CARPOOL to work and are NOT THE DRIVER, what type of fuel, if known, is used? (If it's a hybrid, you will want to check off electric and one of the gas types.)

Check all that apply.

- ☐ Gasoline (non-ethanol)
- ☐ Ethanol (E85) aka High-Level Ethanol-Gasoline Blend
- ☐ Ethanol (E15)
- ☐ Ethanol (E10)
- ☐ Diesel
- ☐ Biodiesel
- ☐ Electric

15. What is the most important to you when you choose how you get to work? Select up to 3. *

Check all that apply.

- [ ] Financial savings
- [ ] Convenience/Flexibility
- [ ] Reliability
- [ ] Comfort/Safety
- [ ] Reducing pollution/Conserving energy
- [ ] Ability to make stops/run errands on the way to home or work
- [ ] Commute stress savings
- [ ] Flexible/Fixed schedule
- [ ] Short(est) commute time

16. *IF* you drive your personal vehicle *during* the work day (i.e. not just for commuting to/from work), please indicate the reasons for doing so.

Check all that apply.

- [ ] Work-related travel
- [ ] Personal business (e.g. errands, lunch, etc.)
- [ ] Other: _____

17. *IF* you usually drive alone to work, what would encourage you to use a different way to get to work (i.e. carpooling, transit, biking or walking)? Select up to 3.

Check all that apply.

- [ ] Financial incentives
- [ ] Help with transit information
- [ ] Shuttle between transit station and work place
- [ ] Assistance finding a ride match
- [ ] Free or discounted parking for carpool/vanpool vehicles
- [ ] Bike routes/maps and safety information/seminars
- [ ] Availability of nearby public transit
- [ ] Availability of infrastructure for non-motorized vehicles (e.g. bike lanes, protected paths, etc.)
- [ ] Other: _____

C: Heating and Cooling Degree Days

A cooling degree day is the number of degrees that a single day's average daily outdoor temperature is above 65°F, and cooling may be needed to keep a building cool. The "cooling degree days" total for the year is all the degrees of difference added up for the entire year. Conversely, a heating degree day is the number of degrees that a single day's average daily outdoor temperature is below 65°F, and heating may be needed to keep a building's indoor air comfortable. The "heating degree days" and "cooling degree days" subtotals are added to create total degree days (https://www.weather.gov/key/climate_heat_cool).

Heating and Cooling Degree Days for Johnson County 2008 to 2018

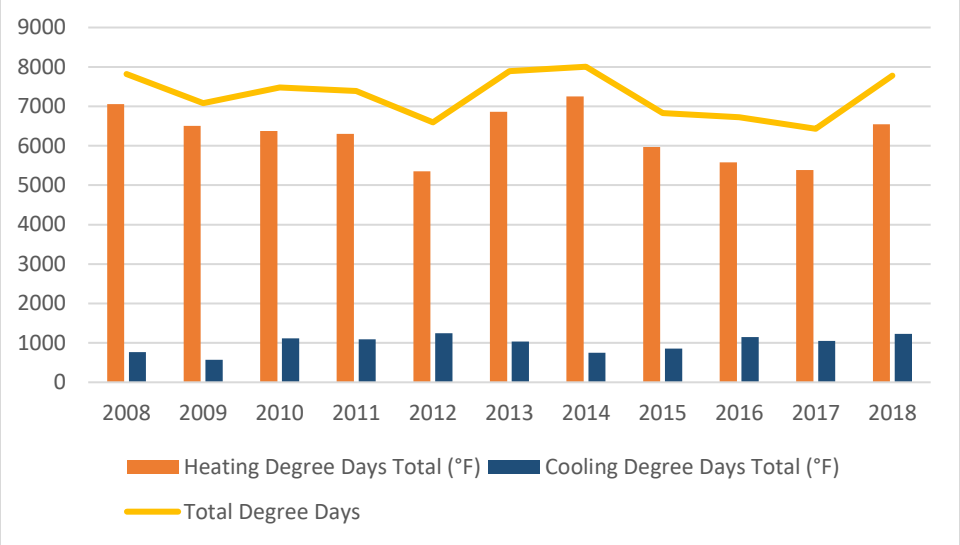


Figure 15: Heating and Cooling Degree Days for Johnson County: 2008 to 2018

Year	Heating Degree Days Total (°F)	Cooling Degree Days Total (°F)	Total Degree Days (°F)
2008	7058	763	7821
2009	6508	574	7082
2010	6371	1111	7482
2011	6302	1088	7390
2012	5356	1241	6597
2013	6861	1034	7895
2014	7254	751	8005
2015	5971	859	6830
2016	5576	1148	6724
2017	5384	1047	6431
2018	6548	1230	7778

Compiled Using Energy Star Portfolio Manager Degree Days Calculator

https://portfoliomanager.energystar.gov/pm/degreeDaysCalculator

Weather Station ID: 725462 (Iowa City Muni Airport)

D: Definitions: Abbreviations and Glossary

Abbreviations

CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
GHG	Greenhouse Gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
ICLEI	Local Governments for Sustainability
kWh	Kilowatt hour, unit of electrical use
LED	Light-emitting diode
LGOP	Local Government Operations Protocol
N_2O	Nitrous Oxide
PFCs	Perfluorocarbons
SF_6	Sulfur Hexafluoride
VMT	Vehicle Miles Traveled

GLOSSARY

Carbon dioxide (CO_2)

A natural occurring gas and also a byproduct of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal human-caused greenhouse gas that affects the Earth. It is also the reference gas against which other greenhouse gases are measured and therefore has a global warming potential (GWP) equal to 1.

Carbon dioxide equivalent (CO_2e)

A measure of the global warming potential of greenhouse gases emitted. It uses carbon dioxide (CO_2) as a standard for reference.

Climate Change

A change in the state of the climate that can be identified by changes in the mean or the variability of its properties and that persists for an extended period, typically decades or longer.

Consumption-based Inventory

An emissions inventory that accounts for the traditional emissions created within an organization or a jurisdiction and evaluates emissions associated with all consumption regardless of where it is produced. Local governments may pursue this type of inventory to better understand how materials, including food, are purchased and consumed by an organization or a community and then have an impact on the environment and the economy.

Emission

The release of a substance into the atmosphere. The substance is typically gas when referring to the climate change.

Emission Factor

A unique value for scaling emissions to activity data in terms of a standard rate of emissions per unit of activity (e.g. grams of carbon dioxide per gallon of gasoline consumer or per kilowatt-hour of electricity used).

Fossil Fuel

A general term for organic materials originally formed from decayed plants and animals that have been converted into crude oil, coal, natural gas, or heavy oils by exposure to heat and pressure in the earth's crust over hundreds of millions of years. Use of fossil fuels is known to contribute to GHG effects.

Global Warming Potential (GWP)

An index that measures the combined effects of substances' emissions on the Earth's energy balance as they accumulate over a period of time (e.g. 100 years). Typically, all measured in terms of carbon dioxide, i.e. carbon dioxide equivalents.

Greenhouse Effect

The trapping and build-up of heat in the atmosphere (troposphere) near the Earth's surface. Some of the heat flowing back toward space from the Earth's surface is absorbed by water vapor, carbon dioxide, ozone, and several other gases in the atmosphere and then radiated back toward the Earth's surface. If the atmospheric concentrations of these greenhouse gases rise, the average temperature of the lower atmosphere gradually increases.

Greenhouse Gas (GHG)

A gas that absorbs and emits thermal radiation into the atmosphere and contributes to the greenhouse effect. GHGs include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), and many others. Only CO_2, CH_4, and N_2O are reported (as CO_2e) in this inventory.

Intergovernmental Panel on Climate Change (IPCC)

The leading body for the assessment of climate change. The panel was established by the United Nations Environment Programme and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the state of the environment and potential environmental and socio-economic consequences. www.ipc.ch/

Kilowatt Hour (kWh)

The electrical energy unit equal to one thousand (1,000) watts of power supplied to or taken from an electric circuit steadily for one hour. (A watt is the unit of electrical power equal to one ampere under a pressure of one volt.)

Light-Emitting Diode (LED)

A high-efficiency lighting technology that reduces energy consumption by as much as 80% compared to traditional incandescent lighting. The County has used this technology in many of its facilities through retrofits and new construction, reducing fossil-fuel derived energy use.

Local Governments for Sustainability (ICLEI)

An international non-profit organization that provides software and assistance to local governments and communities to calculate their GHG emissions. Previously known as the International Council for Local Environmental Initiative, it still goes by the acronym ICLEI.

Local Governments Operations Protocol (LGOP)

Developed by the California Air Resources Board (ARB), the California Climate Action Registry (CCAR), ICLEI, and the Climate Registry in an effort to provide a consistent methodology for GHG accounting and reporting applicable to U.S. Local Governments.

Methane (CH_4)

A hydrocarbon that is a greenhouse. It has a global warming potential 28 times that of carbon dioxide (CO_2). Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, the treatment of wastewater, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion.

Metric Tonne (also written as Metric Ton)

One thousand kilograms, or approximately 2,205 pounds (U.S.).

Natural Gas

Gases consisting of 50 to 90 percent methane (CH_4) and small amounts of heavier gaseous hydrocarbon compounds such as propane (C_3H_3) and butane (C_4H_{10}). It is a common heating fuel for County buildings, although replaced in some instances by electric-based heating. Some natural gas in the U.S. is obtained from underground through a process known as fracking.

Nitrous Oxide (N_2O)

A powerful GHG with a 100-year global warming potential 265 times that of carbon dioxide (CO_2). Sources of nitrous oxide include soil cultivation practices (especially the use of commercial and organic fertilizers), wastewater treatment, fossil fuel combustion, nitric acid production, and biomass burning.

Perfluorocarbons (PFCs)

A category of human-made chemicals composed only of carbon and fluorine. These chemicals were introduced as alternatives, along with hydrofluorocarbons, to the use of ozone-depleting substances. PFCs are also byproducts of industrial processes and used in manufacturing. While they do not harm the stratospheric ozone layer, PFCs are powerful greenhouse gases with global warming potentials ranging from 5,700 to 11,900 times that of carbon dioxide.

Renewables or **Renewable Energy**

Typically refers to a group of clean energy sources that have low to no direct GHG emissions and are generated from renewable resources such as solar, wind, and biomass. These sources, being "clean," generally exclude nuclear, carbon capture and storage, and geothermal energy sources, which also are forms of renewable energy.

Sulfur Hexafluoride (SF_6)

A very powerful greenhouse gas used primarily in electrical transmission and distribution systems and in electronics. The 100-year global warming potential is roughly 23,500 times that of carbon.

Therm

A measure of one hundred thousand Btu.

Vehicle Miles Traveled (VMT)

A measurement of distance covered by vehicles, including passenger vehicles, trucks, vans, and motorcycles. Each mile traveled is counted as miles traveled by one vehicle.