2010 – 2015 ST. LOUIS REGIONAL GREENHOUSE GAS INVENTORY

Photo by Richard Reilly

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EXECUTIVE SUMMARY

The main sources of GHG emissions come from building energy use, transportation, waste management, industrial processes, and agricultural activities. In 2010, the region was responsible for the emissions of 58.4 million metric tons of CO2e (mmtCO$_2$e), and in 2015 emissions went down to 53.1 mmtCO$_2$e. This represents an 9.2% reduction (-5.3 mmtCO$_2$e).

The earth's average temperature has continued to rise over the last century resulting in continuous changes in our climate. These changes, mostly due to human activities and burning of fossil fuels, pose challenges to human health, food production, biodiversity and more.

The St. Louis region is not immune to these challenges. To avoid the most serious impacts of climate change, local and global reductions in greenhouse gas (GHG) emissions are necessary. This report provides a community wide, regional GHG emissions inventory, establishing 2010 as the baseline year for the St. Louis bi-state region, and includes five counties in Missouri (Franklin, Jefferson, St. Charles, City of St. Louis, and St. Louis County) and three counties in Illinois (Madison, Monroe, and St. Clair).

The inventory includes emission estimates associated with the built environment (stationary energy generation and use), transportation, waste and wastewater, industrial processes, and agriculture. An update for 2015 is included to track the St. Louis region's progress towards reducing GHG pollutants that contribute to climate change. This executive summary of the report provides a data-driven narrative, which aims to spark action amongst residents, community groups, utility companies, businesses, and government agencies.

1.1. Key Findings & Emission Trends

- In 2010 and 2015, the residents, businesses, employees, and visitors of the St. Louis eight-county region produced 58.4 mmtCO_2e and 53.1 mmtCO_2e, respectively. This equates to 22.7 metric tons of CO_2e (mt CO_2e) and 20.7 mt CO_2e per capita in 2010 and 2015, respectively.

- Total greenhouse gas (GHG) emissions in 2015 decreased by 9.2% (-5.3 mmtCO_2e) between 2010 and 2015. Per capita emissions decreased 8.8%.

- The largest GHG emissions sources in the St. Louis region continue to be from energy use by the built environment (stationary energy), which produced 40,562,850 mt CO_2e, or nearly 69.4% of all emissions in the region in 2010.

- In 2015, building energy use accounted for 64.2% of the region's total emissions at 34,052,579 mtCO_2e, a 16% reduction in emissions from 2010.

- Electricity demand by the built environment carves out the largest portion of those emissions, with 47.7% and 43.8% of total regional emissions from electricity. Natural gas is much lower at 10.4% and 11.3% in 2010 and 2015, respectively, however, demand for natural gas did increase between the two years.

- Transportation emissions equal 17.1% and 19.5% of total emissions in 2010 and 2015, respectively; nearly 90% of the transportation emissions belong to on-road transportation (burning of gasoline and diesel fuels) in 2010 and 2015.

- Emissions from Industrial Processes and Refrigerant use is responsible for the third largest percentage of regional emissions at 9%, or 5.4 mmtCO_2e in 2010, and nearly 6 mmtCO_2e, or 11%, of regional emissions in 2015, an increase of 10% between the two years.

- Sectors that experienced a decrease during the five-year period include: building energy use, waste and wastewater emissions, agriculture emissions.

II. INTRODUCTION

Photo by Richard Reilly

This GHG inventory was conducted under the collaborative regional effort of OneSTL. OneSTL began in 2010, with a grant awarded from the Partnership for Sustainable Communities, an interagency partnership between the U.S. Environmental Protection Agency, the Department of Transportation and the Department of Housing and Urban Development. The grant required completing a regional plan for sustainable development.

East-West Gateway Council of Governments completed the grant and developed the plan in collaboration with various local government entities including St. Louis City, St. Louis County, Heartlands Conservancy, Trailnet, Metropolitan St. Louis Equal Housing Opportunity Council, Great Rivers Greenway, Citizens for Modern Transit, Metro St. Louis, Focus St. Louis, and the Applied Research Collaborative.

2.1. The History of the Inventory

The plan, titled OneSTL, documented the current and planned activities of many agencies working on issues of sustainability across the St. Louis Region. One of the recommendations in the plan was to complete a regional greenhouse gas inventory.

Jump to 2017 and several organizations came together to host a regional sustainability summit to discuss ways in which we could more actively work to implement recommendations in the OneSTL plan and make the St. Louis Region more sustainable. More than 300 people attended the two-day event. As a result of the summit, six working groups formed to address different areas of expertise and focus.

One group, the Energy and Emissions Working Group, embarked upon the effort to track and reduce the region's greenhouse gas emissions.

There are several reasons why it is important to have a region-wide inventory of GHG emissions, as opposed to inventories for each individual municipality. First, the area surveyed for this inventory includes 196 municipalities. For many of the smaller local governments, resources are too limited to allow them to complete their own GHG emissions inventory. Second, greenhouse gas emissions from cars, transit, and other sources do not stay within political boundaries.

Regional cooperation is necessary for reducing the metropolitan area's GHG emissions. In addition, some municipalities may find that they have a much bigger carbon footprint than their neighbors, due to the presence of industrial facilities. A regional inventory helps put these differences into context.

2.2. Defining the Region

The St. Louis Regional Greenhouse Gas Emissions Inventory includes eight of the 14 counties within the greater St. Louis Metropolitan Statistical Area (MSA). These eight counties make up the membership of the East-West Gateway Council of Governments (EWG), serving an area that spans more than 4,400 square miles in the bi-state St. Louis region.

Included are the City of St. Louis and Franklin, Jefferson, St. Charles, and St. Louis counties in Missouri, and Madison, Monroe, and St. Clair counties in Illinois.

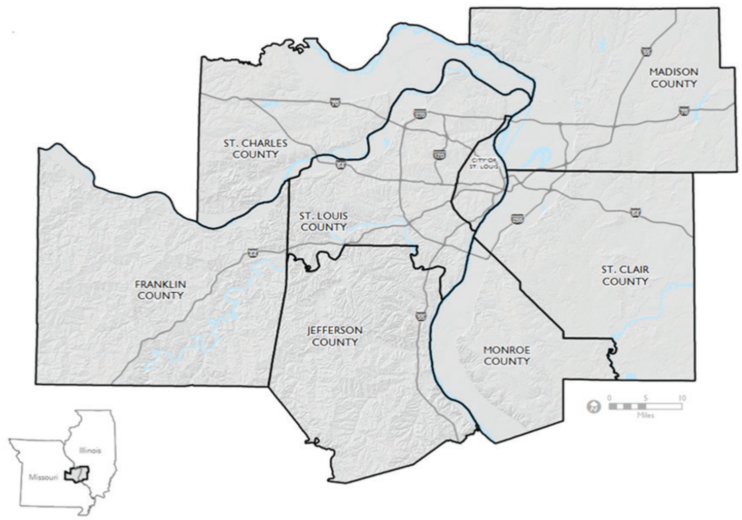


Figure 1. This map represents the geographic area of the GHG Inventory.

2.3. Population & GDP

The table below lists population estimates from the U.S. Census Bureau, square miles, and gross domestic product (GDP) reported by the U.S. Bureau of Economic Analysis[12]. Figures for the region and the eight counties are included for the baseline inventory year 2010 and 2015. 2015 saw a small decline in population and an increase in GDP for the region.

COUNTY	POPULATION		AREA (sq. mi)	Gross Domestic Production	
	2010	**2015**		**2010**	**2015**
Franklin County	101,424	102,265	923	$3,865,981	$4,419,757
Jefferson County	219,130	223,185	657	$4,421,760	$4,987,570
Madison County	269,315	266,112	716	$9,475,330	$14,338,662
Monroe County	33,051	33,811	385	$821,289	$925,790
St. Charles County	361,808	358,108	560	$12,074,326	$15,661,721
St. Clair County	270,368	265,008	658	$9,743,031	$11,122,764
St. Louis City	319,294	316,268	62	$29,930,606	$28,734,733
St. Louis County	999,454	1,001,327	508	$67,357,725	$74,395.692
Total	**2,573,844**	**2,566,084**	**4,469**	**$137,690,048**	**$154,586,689**

Tale 1.This table compares the population estimates from the U.S. Census Bureau, square miles, and gross domestic product (GDP) reported by the U.S. Bureau of Economic Analysis in eight counties in Illinois and Missouri between 2010 and 2015.

2.4. Inventory Framework

The inventory for the St. Louis Region follows the guidelines provided by the Global Protocol for Community-Scale Greenhouse Gas Inventories, v1.1 (GPC). This widely-used protocol provides two reporting options: BASIC and BASIC+. In this report, the "BASIC+" level is used and covers all BASIC level sectors of stationary energy, in-boundary transportation, and in- boundary generated waste. BASIC+ also covers the additional sectors of industrial process and refrigerant use (IPR), and agriculture, forestry, and other land use (AFOLU).

2.5. Categorizing Emission

According to the GPC, inventory data is reported by scope and geography. Scope refers to the source of the emissions and specifies where the emissions actually occur. Emissions sources are listed by sector in Figure 2. Within each sector, the greenhouse gases are produced by combustion within the boundary of the study area (i.e. the St. Louis region), or are emitted somewhere else as a result of an activity within the region. The location of the actual emissions of the gases are explained as Scope 1, 2 and 3. Scope 1 emissions occur within the St. Louis region, such as driving a car, manufacturing a product, or using power produced by a generator. Scope 2 includes using electricity that was produced at a central location such as a power plant. Scope 3 refers to emissions that occur somewhere else because of activity in the region such as garbage sent to landfills outside of the region, products that are made in the region but shipped to other places, or products that were used in the region but were made somewhere else, and electricity line loss.

The geographic aspect of the inventory is referred to in the GPC as the "region-induced framework". This involves estimating emissions from Scope 1, 2, and 3 sources and attributing them to the St. Louis Region.

Scope	Definition
Scope 1	GHG emissions from sources located within the city boundary
Scope 2	GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the city boundary
Scope 3	All other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary

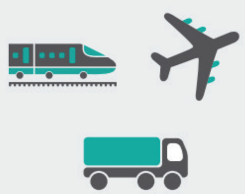
Table 2. Scope definitions used in the inventory.

2.6. Sectors in the Inventory

Stationary Energy

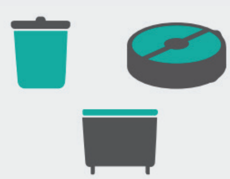
Stationary energy sources are the largest contributors to a city's GHG emissions. These emissions come from the combustion of fuel in residential, commercial, and institutional buildings and facilities and manufacturing industries and construction, as well as power plants to generate grid-supplied energy. This sector also includes fugitive emissions which occur during the distribution of natural gas and loss of electricity during transmission.

Transportation



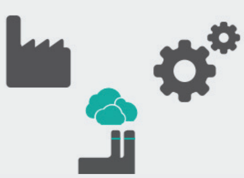
Transportation covers all journeys by road, rail, water and air, including inter-city. GHG emissions are produced directly by the combustion of fuel or indirectly by the use of grid-supplied electricity. Collecting accurate data for transportation activities, calculating emissions and allocating these emissions to cities can be a particularly challenging process.

Waste Emissions



Waste disposal and treatment produces GHG emissions through aerobic or anaerobic decomposition, or incineration. GHG emissions from solid waste is calculated by landfill, biological treatment and incineration and open burning. If methane is recovered from solid waste or wastewater treatment facilities as an energy source, it is reported under Stationary Energy.

Industrial Process & Refrigerants (IP&R)



GHG emissions are produced from a wide variety of non-energy related industrial activities. The main sources of emissions are from industrial processes that chemically or physically transform materials (e.g., the blast furnace in the iron and steel industry, and ammonia and other chemical products manufactured from fossil fuels and used as chemical feedstock). During these processes, many different GHGs are produced.

Agriculture, Forestry, and Other Land Use (AFOLU)

AFOLU sector produces emissions and removals through various pathways. These include emissions from livestock, resulting from processes such as enteric fermentation and manure management. Additionally, land use and land use change activities, such as deforestation for agriculture or human settlements, also play a role. Other sources of emissions in this sector arise from activities on land, such as fertilizer application.

Figure 2. This figure defines the sectors measured in the Greenhouse Gas Inventory.[3]

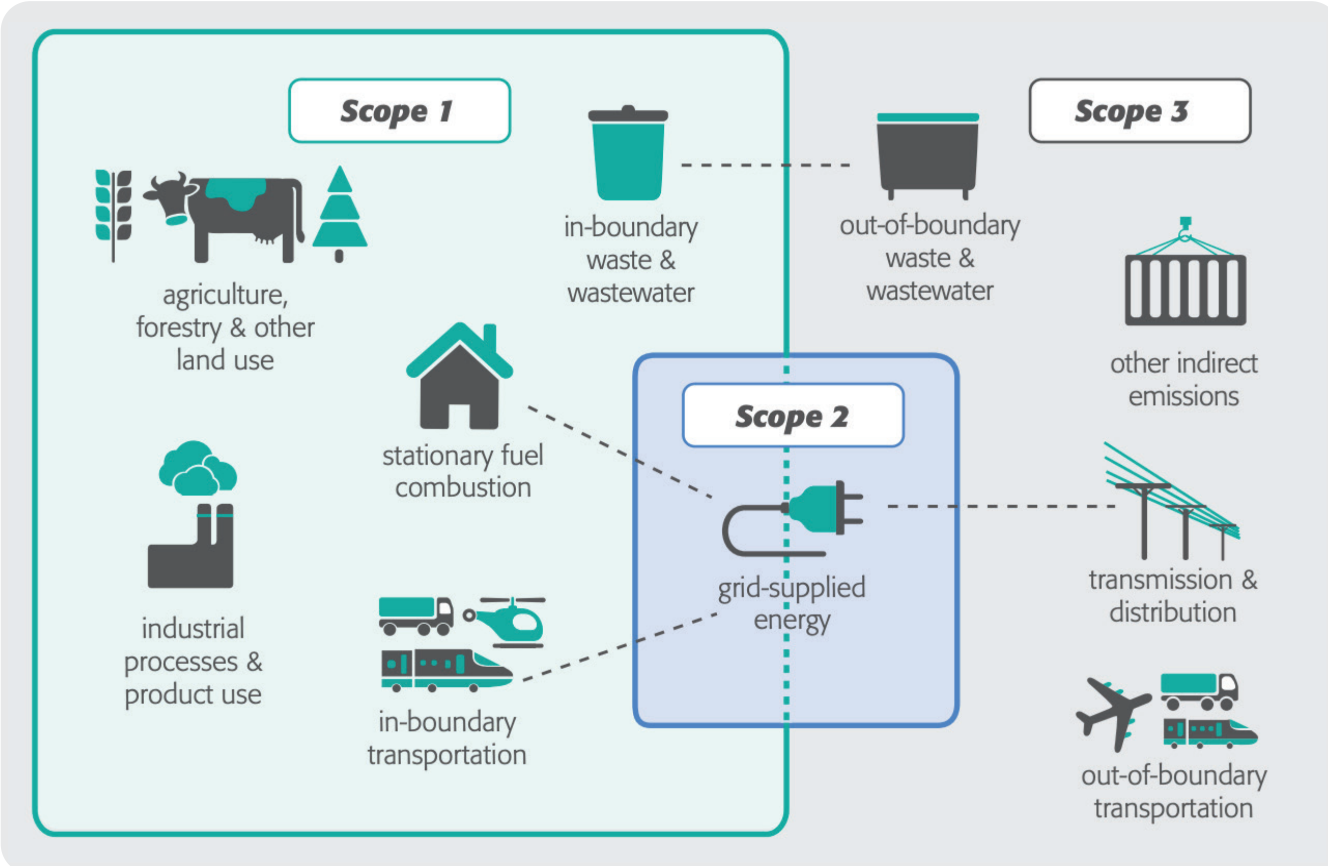


Figure 3. Sources and boundaries of GHG emissions.[4]

2.7. Types of Emissions

Emissions sources in this inventory are quantified using calculation-based methodologies. Activity data refers to the relevant measurement of energy use or other processes that generate greenhouse gasses.

These include fuel consumption by fuel type, metered annual electricity consumption by sector (residential, commercial, or industrial), and annual vehicle miles traveled (VMT). Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. metric tons CO2/kWh of electricity).

The following gasses or family of gasses are considered greenhouse gasses by the IPCC and required to be considered in measurements:

IPCC Greenhouse Gases
Carbon Dioxide - CO_2
Methane - CH_4
Nitrous Oxide - NO_2
Hydrofluorocarbons - HFCs
Perfluorocarbons - PFCs
Sulfur Hexafluoride - SF6
Nitrogen Trifluoride - NF3
Carbon Dioxide Equivalent - CO_2e*

**CO_2e is determined by multiplying each gas by its respective global warming potential (GWP). The 100-year GWP from the IPCC Fifth Assessment Report, 2014 (AR5) CARBON DIOXIDE equivalent (CO_2e)*[5]

Table 3. List of IPCC Greenhouse Gases

2.8. The Inventory by the Numbers

This section provides a summary of the results for the 2010 Baseline Year GHG Emissions Inventory and the 2015 Update. This section is followed by details of each sector: Stationary Energy, Transportation, Waste, Industrial Process & Refrigerants, and Agriculture, Forestry and Other Land Use.

In 2010, the eight-county St. Louis region was responsible for 58.4 million metric tons of carbon dioxide equivalent (mmtCO_2e) compared to 53.1 mmtCO_2e in 2015. This represents a 9.2% reduction (-5.3 mmtCO_2e) from the 2010 baseline year for measuring GHG emissions reductions.

2010 & 2015 GHG Emissions by Sector

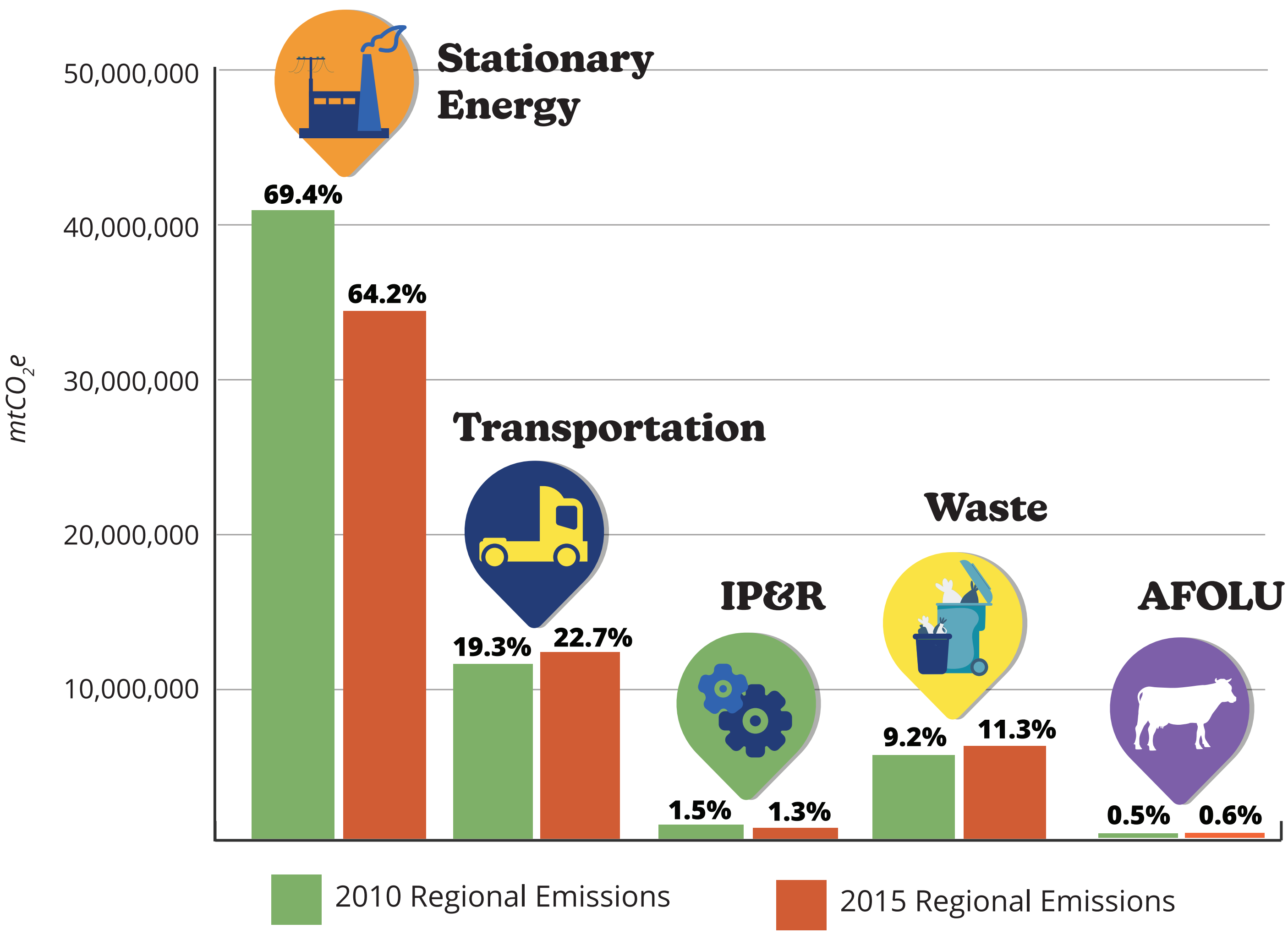


Figure 4. Bar chart comparing 2010 and 2015 St. Louis regional emissions by sector. AFOLU stands for Agriculture, Forestry, and Other Land Use. IP&R stands for Industrial Process & Refrigerants. The percentages included are the percentage of total emissions for the respective year measured in metric tons of carbon dioxide.

2.9. TABLE OF 2010 EMISSIONS BY SECTOR

SECTOR	SCOPE 1	SCOPE 2	SCOPE 3	
Residential Buildings	3,505,035.70	11,149,162.80	689,018.26	
Commercial & Institutional Buildings	1,944,499.33	12,001,967.66	756,767.22	
Manufacturing Industries	5,299,192.83	4,728,450.36	293,010.11	
Fugitive Emissions from Oil & Natural Gas Systems	195,746.07	NA	NA	
STATIONARY ENERGY TOTAL	**10,944,473.93**	**27,879,580.82**	**1,738,795.59**	**40,562,850.34**
On-Road Transportation & Metro Bus/Vans	10,015,727.14	NE	NE	
Railways	433,579.35	NE	NE	
Waterborne Navigation	52,428.58	NO	564,378.21	
Aviation	NE	NO	202,171.44	
Off-Road Transportation	NE	NE	NA	
TRANSPORTATION TOTAL	**10,501,735.07**		**766,549.65**	**11,268,284.72**
Solid Waste Disposal	811,159.49	NA	NE	
Incineration & Open Burning	13,506.75	NA	NE	
Wastewater	65,994.71	NA	NO	
WASTE TOTAL	**890,660.95**			**890,660.95**
Industrial Process	4,292,859.84	NA	NE	
Refrigerant Use	1,105,251.40	NA	NE	
INDUSTRIAL PROCESS TOTAL	**5,398,111.24**			**5,398,111.24**
Livestock	174,073.66	NA	NE	
Other Land Use	121,598.68	NA	NE	
AGRICULTURE AND OTHER LAND USE TOTAL	**295,672.34**			**295,672.34**
TOTAL mtCO_2e EMISSIONS BY SCOPE	**28,030,653.52**	**27,879,580.82**	**2,505,345.24**	**58,415,579.59**

Table 4. This table is the 2010 greenhouse gas emissions by sector, measured in metric tons of carbon dioxide.
NA = Not Applicable, NE = Not Estimated, NO = Not Occurring

2.10. TABLE OF 2015 EMISSIONS BY SECTOR

SECTOR	SCOPE 1	SCOPE 2	SCOPE 3	
Residential Buildings	3,324,768.76	8,859,768.22	397,803.59	
Commercial & Institutional Buildings	1,964,245.27	10,334,620.82	479,761.81	
Manufacturing Industries	4,281,439.09	4,038,571.51	182,160.14	
Fugitive Emissions from Oil & Natural Gas Systems	189,439.82	NA	NA	
STATIONARY ENERGY TOTAL	**9,759,892.93**	**23,232,960.54**	**1,059,725.54**	**34,052,579.02**
On-Road Transportation & Metro Bus/Vans	10,343,733.39	NE	NE	
Railways	859,664.51	NE	NE	
Waterborne Navigation	56,300.79	NO	606,061.50	
Aviation	NE	NO	191,556.06	
Off-Road Transportation	NE	NE	NA	
TRANSPORTATION TOTAL	**11,259,698.70**		**797,617.56**	**12,057,316.26**
Solid Waste Disposal	612,819.48	NA	NE	
Incineration & Open Burning	14,511.96	NA	NE	
Wastewater	58,237.89	NA	NO	
WASTE TOTAL	**685,569.33**			**685,569.33**
Industrial Process	5,072,421.39	NA	NE	
Refrigerant Use	902,841.10	NA	NE	
INDUSTRIAL PROCESS TOTAL	**5,975,262.49**			**5,975,262.49**
Livestock	150,298.00	NA	NE	
Other Land Use	144,473.98	NA	NE	
AGRICULTURE AND OTHER LAND USE TOTAL	**294,771.97**			**294,771.97**
TOTAL mt CO_2e EMISSIONS BY SCOPE	**27,975,195.42**	**23,232,960.54**	**1,857,343.10**	**53,065,499.07**

Table 5. This table is the 2015 greenhouse gas emissions by sector, measured in metric tons of carbon dioxide.
NA = Not Applicable, NE = Not Estimated, NO = Not Occurring

III. GHG EMISSIONS INVENTORY

2010 Baseline Year & 2015 Update

Photo by Richard Reilly

Stationary Energy Sector

3.1. THE BUILT ENVIRONMENT

In the St. Louis region, the largest contributor of GHG emissions is stationary energy use, which is the energy consumed by our built environment. In 2010, stationary energy accounted for 40,562,850 $mtCO_2e$, or nearly 69% of the GHG emissions for the region. Similarly, in 2015 this sector remained the primary source of emissions with 34,052,579 $mtCO_2e$, or 64% of the region's total emissions.

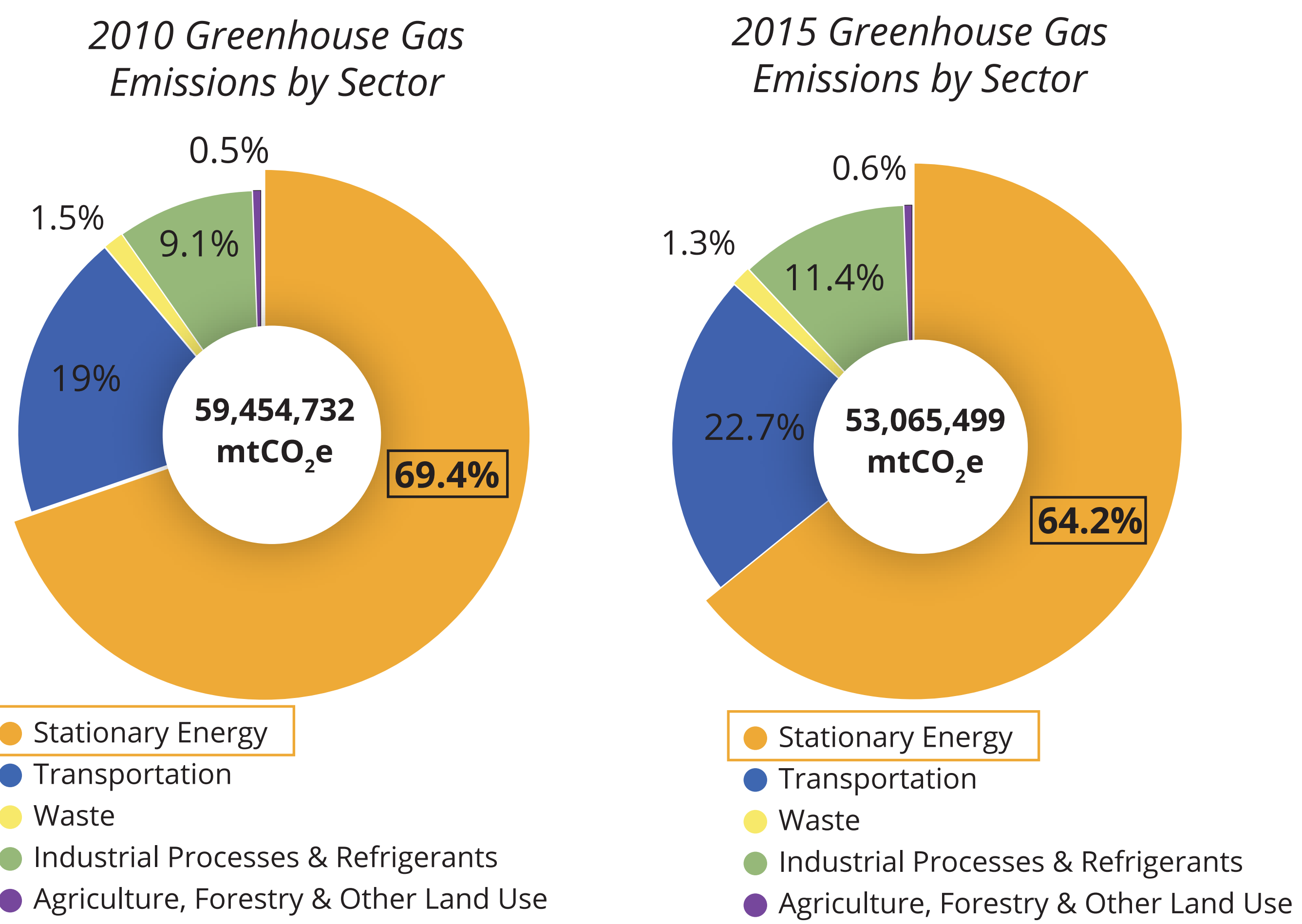


Figure 5. These two pie charts represent the GHG emissions by sector for 2010 & 2015. This chart highlights the Stationary Energy Sector.

3.1.a. Electricity Emissions

The majority of emissions in the built environment can be attributed to electricity and natural gas. Specifically, the GHG emissions from electricity demand, known as Scope 2 emissions, were significant, accounting for 67% and 68% of the total emissions in 2010 and 2015, respectively. However, emissions were reduced by 17% between 2010 and 2015. It is important to note that Ameren, an electricity generation and distribution company, plays a critical role in Missouri's electricity generation and distribution, as well as electricity distribution in Illinois.

Ameren reported total emissions for its six power plants within the St. Louis region at 39,655,187 mtCO_2e and 39,708,179 mtCO_2e in 2010 and 2015, respectively. Ameren's service territory extends beyond the St. Louis eight-county region and this inventory only includes the energy demanded and consumed within the eight counties in order to calculate the emission totals.

Ameren generates electricity in a variety of ways to meet regional power demand, with their primary method relying on coal-fired power plants. Burning coal generates approximately 80% higher CO_2 emissions per MMBTU than burning natural gas. Ameren is increasing the use of natural gas in its generation processes. Natural gas emissions are composed mostly of methane, a potent GHG with a global warming potential of nearly 30 times that of CO_2.

2010 & 2015 Electricity Emissions by Source - CO_2e

	Residential Buildings	Commercial & Institutional Buildings	Manufacturing Industries
2010 Electricity	11,149,162.80	12,001,967.66	4,728,450.36
2015 Electricity	8,859,768.22	10,334,620.82	4,038,571.51

Table 6. This table shows the carbon dioxide emissions produced by electricity in different sources between 2010 and 2015.

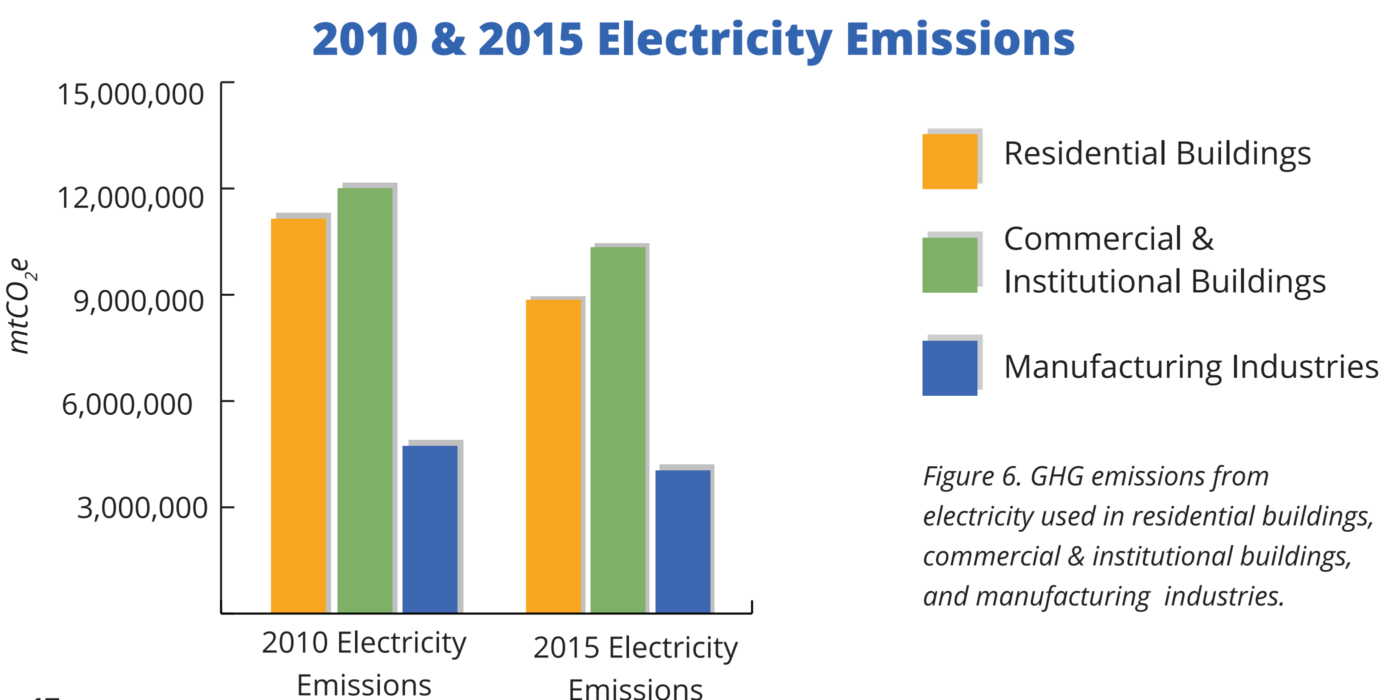


Figure 6. GHG emissions from electricity used in residential buildings, commercial & institutional buildings, and manufacturing industries.

3.1.b. Natural Gas

Emissions resulting from the use of natural gas and other fuels, categorized as Scope 1 emissions, accounted for 19% of the total emissions in 2010, decreasing to 18% in 2015. Over the period of 2010 to 2015, Scope 1 emissions experienced a reduction of 5%. Among the directly combusted fuels, natural gas plays a more significant role, particularly in residential and commercial buildings, where it is widely used for heating air and water, as well as for cooking.

Spire, formerly Laclede Gas, is the primary natural gas provider to the 5 Missouri counties. In comparison, Ameren provides a small amount of natural gas in Missouri but is the primary provider of natural gas in Illinois for the St. Louis region.

2010 & 2015 Natural Gas Emissions by Source - CO_2e

	Residential Buildings	Commercial & Institutional Buildings	Manufacturing Industries
2010 Natural Gas	3,230,541.39	1,944,499.39	921,029.85
2015 Natural Gas	3,129,981.14	1,964,24545.27	899,823.90

Table 7. This table shows the carbon dioxide emissions from natural gas by sector for 2010 and 2015. Units are $mtCO_2e$.

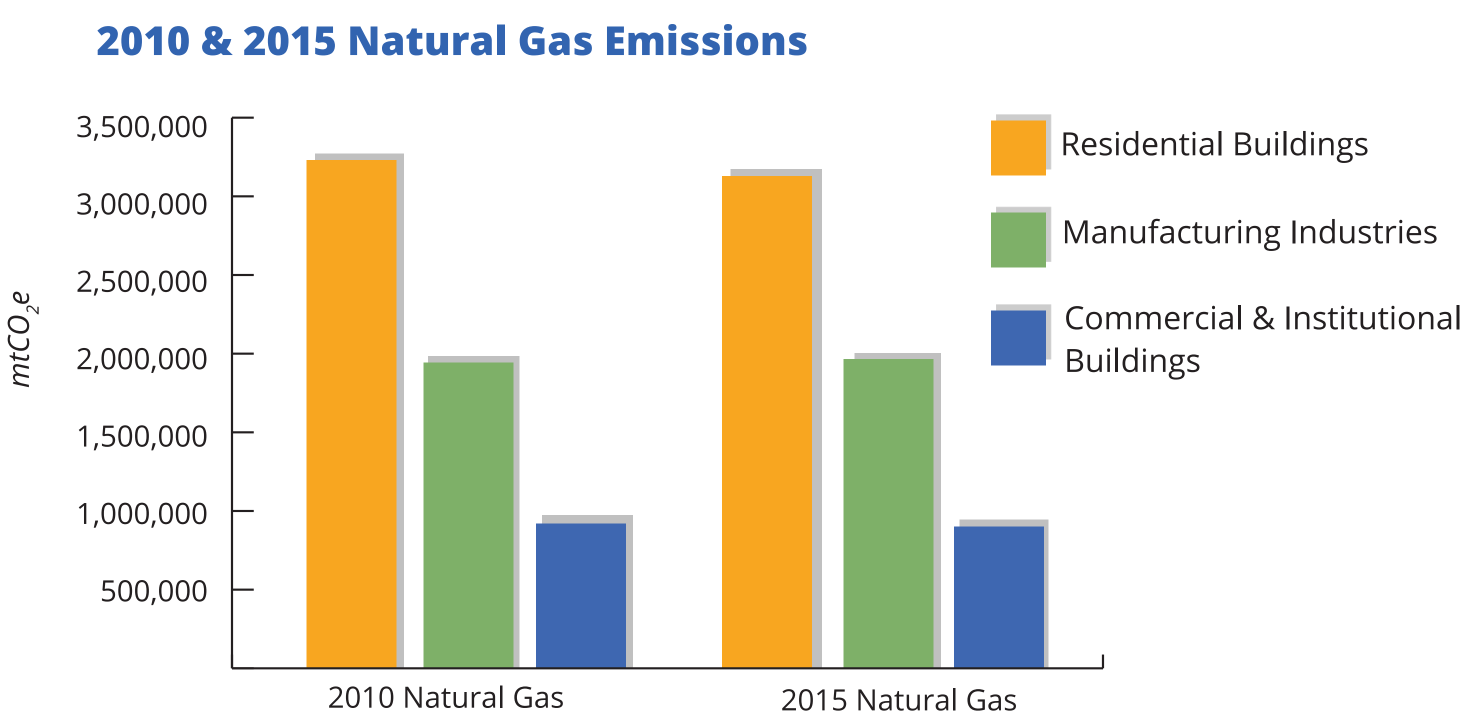


Figure 7. GHG emissions from natural gas used in residential buildings, commercial & institutional buildings, and manufacturing industries. This figure compares the metric tons of carbon dioxide produced by natural gas emissions in different sources between 2010 and 2015.

3.1.c. Other Fuels

It is important to acknowledge the significance of other fuels in the overall GHG emissions of the region. In 2010, these fuels accounted for 8% of total emissions, which fell to 7% in 2015. Large corporations in the St. Louis region involved in manufacturing report high emissions using other fuels, such as fuel gas in oil refining operations, blast furnace gas in steel manufacturing, and subbituminous coal and bituminous coal for manufacturing operations. However, this report does not capture emissions from smaller companies using other directly combusted fuels.

In commercial buildings, the use of other fuels include an estimated amount of distillate fuel oil, primarily for heating purposes. Residential buildings also contribute to the use of other fuels, including the burning of propane, distillate fuel oil, and wood. Notably, a significant decrease in fuel combustion in the manufacturing industry contributed towards a 21% reduction in emissions in this subcategory between 2010 and 2015.

3.1.d. Fugitive Emissions

Fugitive emissions, or Scope 3 emissions, represent the energy lost in transmission and distribution of electricity to consumers in the region. According to EPA Emissions and Generation Resource Integrated Database (Egrid), the energy loss rate is estimated to be 6.18% in 2010 and 4.49% in 2015. These losses account for approximately 2% of total GHG emissions.

2010 & 2015 Other Fuels Emissions by Source - CO_2e

	Residential Buildings	Commercial & Institutional Buildings	Manufacturing Industries
2010 Other Fuels	274,494.31	97,239.70	4,378,161.02
2015 Other Fuels	194,787.62	175,255.48	3,381,609.90

Table 8. This table shows the metric tons of carbon dioxide emissions produced by other fuels by different sources between 2010 and 2015.

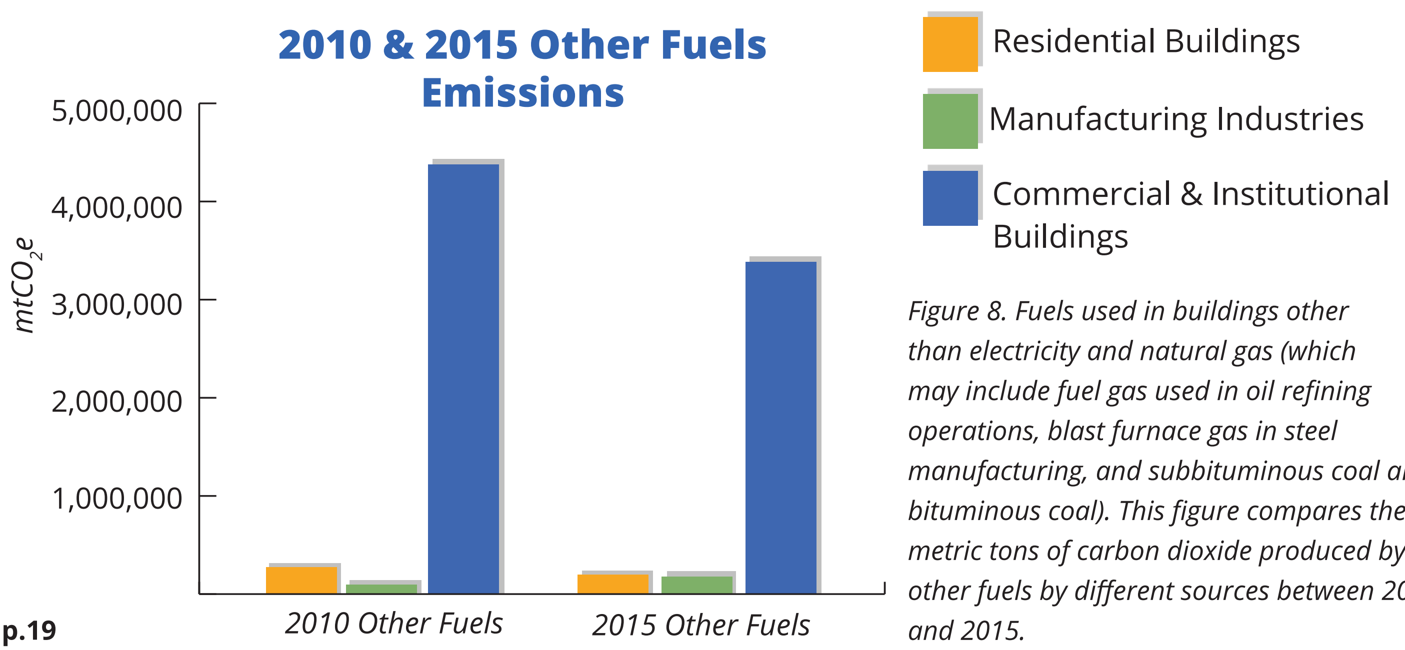


Figure 8. Fuels used in buildings other than electricity and natural gas (which may include fuel gas used in oil refining operations, blast furnace gas in steel manufacturing, and subbituminous coal and bituminous coal). This figure compares the metric tons of carbon dioxide produced by other fuels by different sources between 2010 and 2015.

Transportation Emissions

3.2. TRANSPORTATION

The Transportation sector accounts for 11,268,285 mtCO_2e, or 19% of the total GHG emissions in 2010 and increased by 6% in 2015 to 11,987,647 mtCO_2e representing 23% of total emissions. The majority of emissions produced by the Transportation sector come from on-road transportation, equaling 95% of this sector's Scope 1 emissions in 2010, and 91% in 2015.

The Transportation sector also includes emissions for railways, waterborne navigation, and aviation. No Scope 2 emissions are included due to lack of data for electric vehicle charging in 2010 and 2015. Off- road emissions are also not included. Both are recommended for inclusion in future reports.

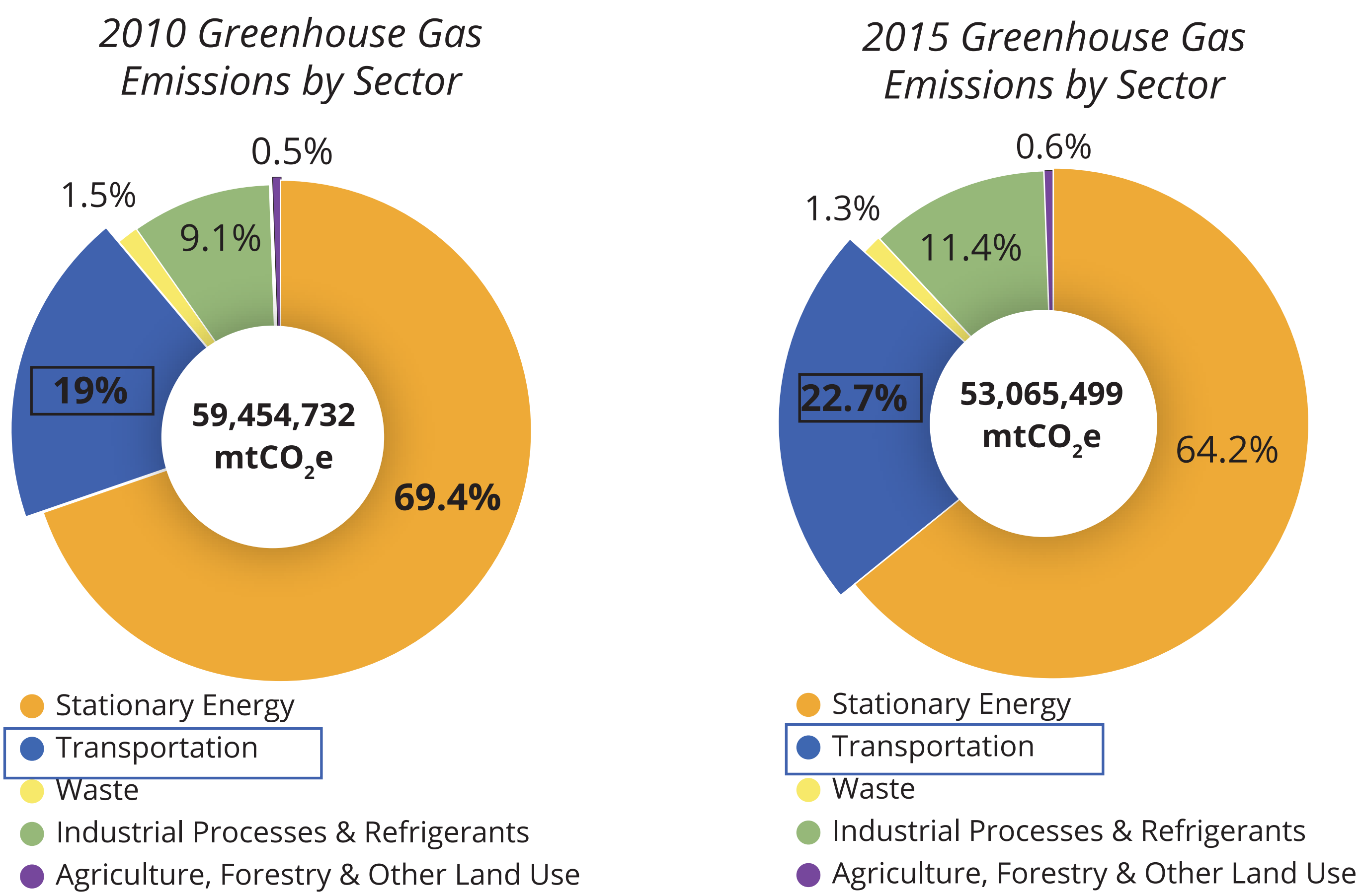


Figure 9. These two pie charts represent the GHG emissions by sector for 2010 & 2015. This chart highlights the Transportation Sector.

2010 & 2015 Transportation Emissions by Source - CO_2e

	On-Road Transportation	Railways	Waterborne Navigation	Aviation
2010 Transportation	10,015,727.14	433,579.35	616,806.79	202,171.44
2015 Transportation	10,343,733.39	859,665.51	662,362.29	191,556.06

Table 9. This figure shows the metric tons of carbon dioxide produced by transportation emissions by difference sources between 2010 and 2015.

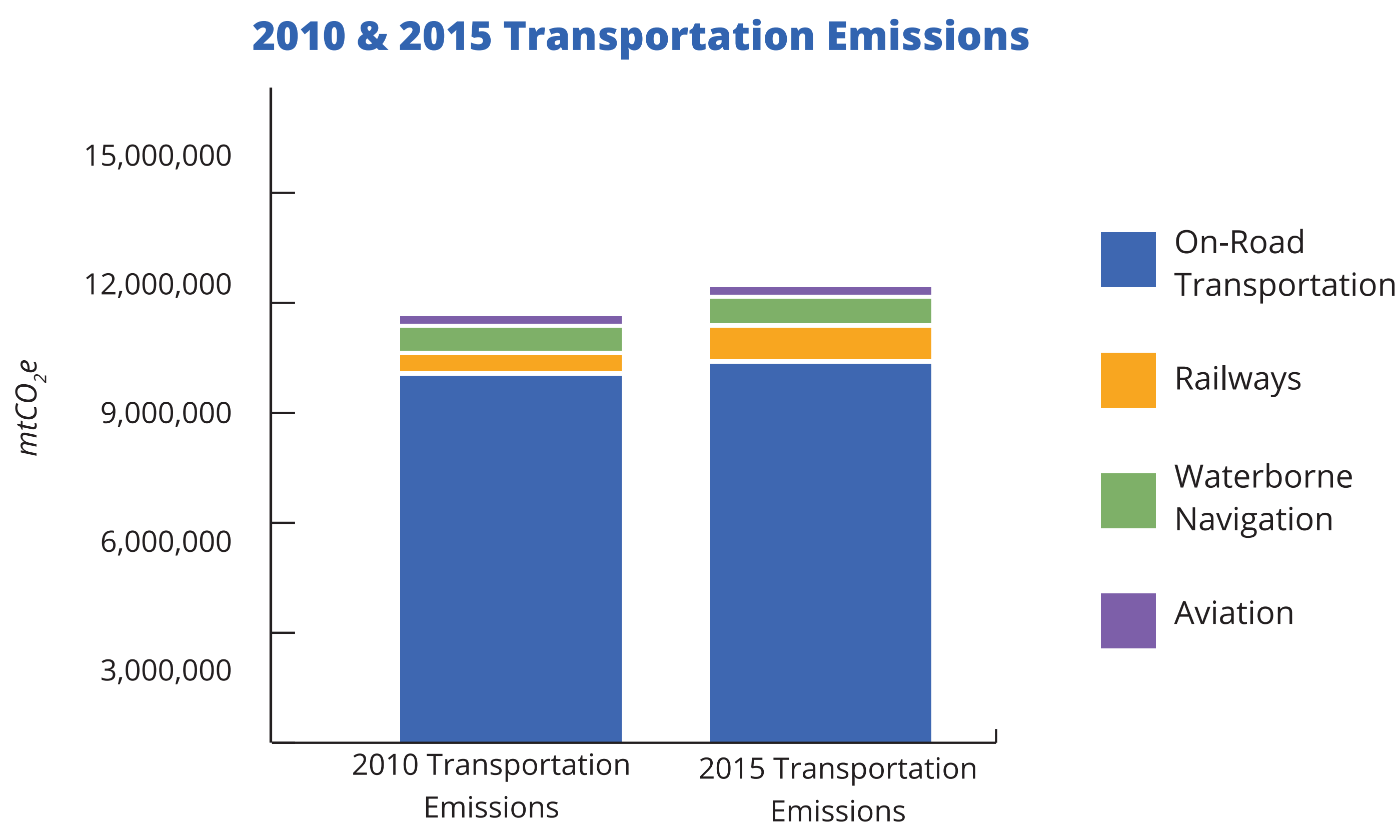


Figure 10. GHG emissions from on-road transportation, railways, waterborne navigation, and aviation. This graph compares the metric tons of carbon dioxide emissions produced by different transportation sources between 2010 and 2015.

3.2.a. On-Road Transportation

In 2010, on-road transportation and public transportation using gasoline, diesel, and biodiesel were estimated at 10,015,727 mtCO_2e, which increased by 3.2% to 10,343,733 mtCO_2e in 2015. Estimates for vehicle-miles-traveled (VMT) for the public roadways, which include interstate, freeway, principal arterial, minor arterial, collector, and local roads, were provided by the Missouri Department of Transportation for the five Missouri counties and by the Illinois Department of Transportation for the three Illinois counties included in the St. Louis region.

Trips occurring within the boundary of the eight-county region fall under Scope 1 emissions. Although the roadways mentioned above are not "all-inclusive", they still provide a fair estimate of the amount of vehicular travel throughout the region.

To estimate the fuel types and fuel efficiencies of the vehicle mix, national averages for the percentages of passenger vehicle type were applied to the VMT figures . For future reports, it is recommended to utilize transportation planning software available to metropolitan planning agencies for more precise emissions estimates for the region.

2010 & 2015 On-Road Transit by Fuel Type - CO_2e

	Gasoline	Diesel	Ethanol
2010 On-Road Transit Fuel Type	6,855,068	1,766,396	434,452
2015 On-Road Transit Fuel Type	7,044,676	1,844,946	1,454.111

Table 10. This table shows the metric tons of carbon dioxide produced by on-road transit by fuel type for 2010 & 2015.

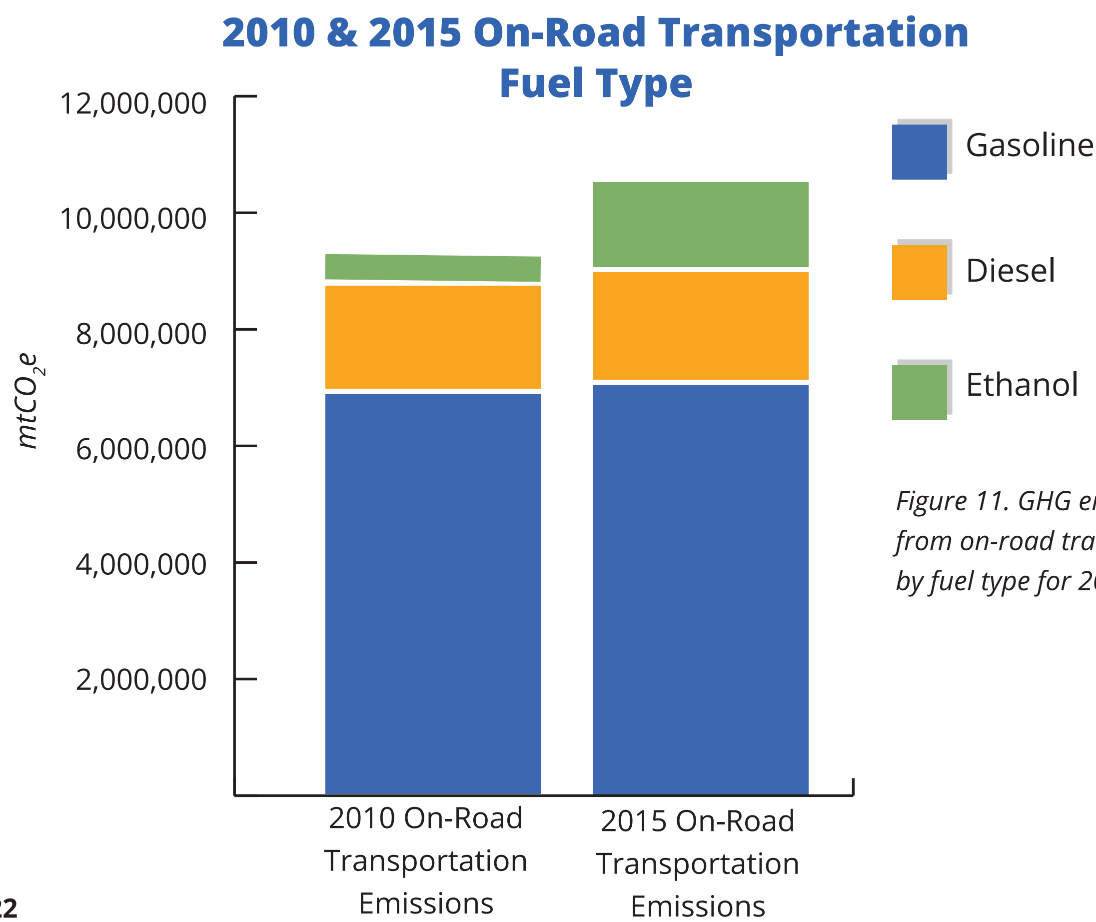


Figure 11. GHG emissions from on-road transportation by fuel type for 2010 & 2015.

3.2.b. Railway

Freight rail includes GHG emissions associated with freight-ton-miles within the eight-county region and are categorized as Scope 1 emissions. In 2010 and 2015, the St. Louis region was served by six Class I Railroads. In 2017, the Association of American Railroads ranked Illinois 2nd in the nation for total rail miles and 3rd for total railroads, while Missouri followed closely, ranking 11th in the nation for total rail miles and 20th for number of railroads[6]. For 2010, emissions from freight were estimated at 433,579 mtCO_2e. This substantially increased by 98% in 2015 to 859,665 mtCO_2e. This is due to both a large increase in distillate fuel sales for rail in Illinois and the amount of freight tons moved by rail in Illinois. Missouri saw a smaller increase in comparison. Unfortunately, the availability of data did not allow for estimating Scope 3 transboundary emissions, but it is recommended for future inventories.

While rail is not an appropriate mode for all types of freight transportation, it boasts high efficiency; one train can carry the freight equivalent of hundreds of trucks, traveling 479 miles on 1 gallon of fuel, making it a far more efficient mode of transport compared to truck transportation.

2010 & 2015 Railway Emissions - CO_2e

Table 11. This table shows the metric tons of carbon dioxide emissions produced by railways between 2010 and 2015.

	Emissions
2010 Railway Emissions	433,579.35
2015 Railway Emissions	859,664.51

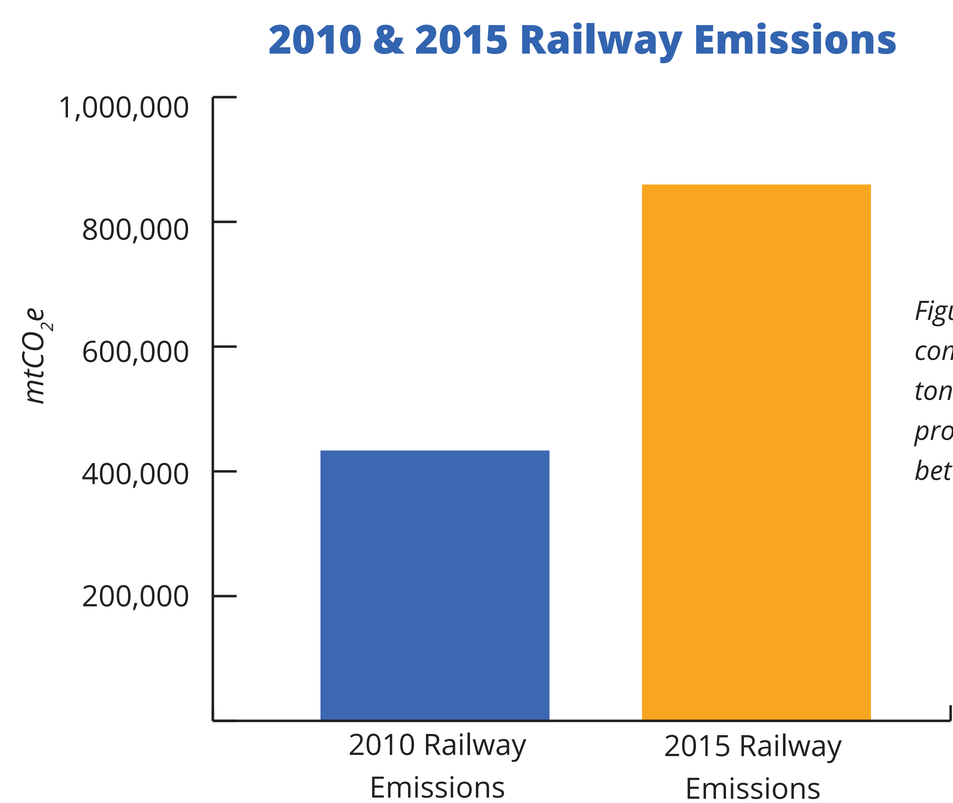


Figure 12. This figure compares the metric tons of carbon dioxide produced by railways between 2010 and 2015

3.2.c. Waterborne Navigation

In 2010, GHG emissions for Waterborne Navigation totaled 616,807 mtCO_2e. This number increased by 7.4% to 662,362 mtCO_2e in 2015. These emissions are focused on freight movement and do not include emissions generated by recreational boating.

The primary mode of freight transportation via waterways in the region is through barge tows on the Mississippi River. A small percentage of emissions within the region is counted as in-boundary and categorized as Scope 1 emissions. This accounts for 52,429 mtCO_2e in 2010 and increased to 56,301 mtCO_2e in 2015.

Freight transported on the Mississippi River between the port of New Orleans and the St. Louis region accounts for the bulk of these emissions. These transboundary trips are reported as Scope 3 emissions and were estimated at 564,378 mtCO_2e in 2010, increasing to 606,062 mtCO2e in 2015.

According to a report commissioned by the U.S. National Waterways Foundation, inland river barge transportation has demonstrated enhanced fuel efficiency in cargo transport when compared to road and rail. The study shows that with a single gallon of fuel, barges can move a ton of cargo 647 miles. It should be noted that increased drought in the summer may have a negative impact on river levels and barge traffic in the future.

2010 & 2015 Waterborne Emissions by Scope - CO_2e

	Scope 1	Scope 3	Total
2010 Waterborne Navigation	52,428.58	564,378.21	616,806.79
2015 Waterborne Navigation	56,300.79	606,061.50	662,362.29

Table 12- This table shows the metric tons of carbon dioxide emissions produced by waterborne navigation in different scopes between 2010 and 2015.

3.3.d. Aviation

In 2010, the emissions from aviation totaled 202,171 mtCO_2e. In 2015 emissions decreased by 5.3% to 191,556 mtCO_2e. These calculations are based on the number of departing flights from major and regional airports in the region as reported by the Federal Aviation Administration (FAA), taking into account fuel efficiencies estimated for different aircraft types. Calculations are only for landings and take-offs (LTOs) for all transboundary flights. The International Civil Aviation Organization (ICAO) defines a LTO cycle as those activities occurring up to 3,000 ft (914.4 m) above ground level.[7] These emissions are classified as Scope 3.

However, emissions for intra-regional flights were not estimated due to lack of available data, and these emissions were expected to be relatively small. If included in the future, they would be categorized as Scope 1 emissions.

The ICAO recommends that aviation emissions inventories include fuel use for every departing flight, and only to the first stop, in order to avoid double-counting. Obtaining data at this level proved challenging as airlines were not able to easily provide this level of detail for this report.

2010 & 2015 Aviation Emissions - CO_2e

	Emissions
2010 Aviation Emissions	202,171.44
2015 Aviation Emissions	191,556.06

Table 13. This table shows the metric tons of carbon dioxide emissions produced by aviation emissions between 2010 and 2015.

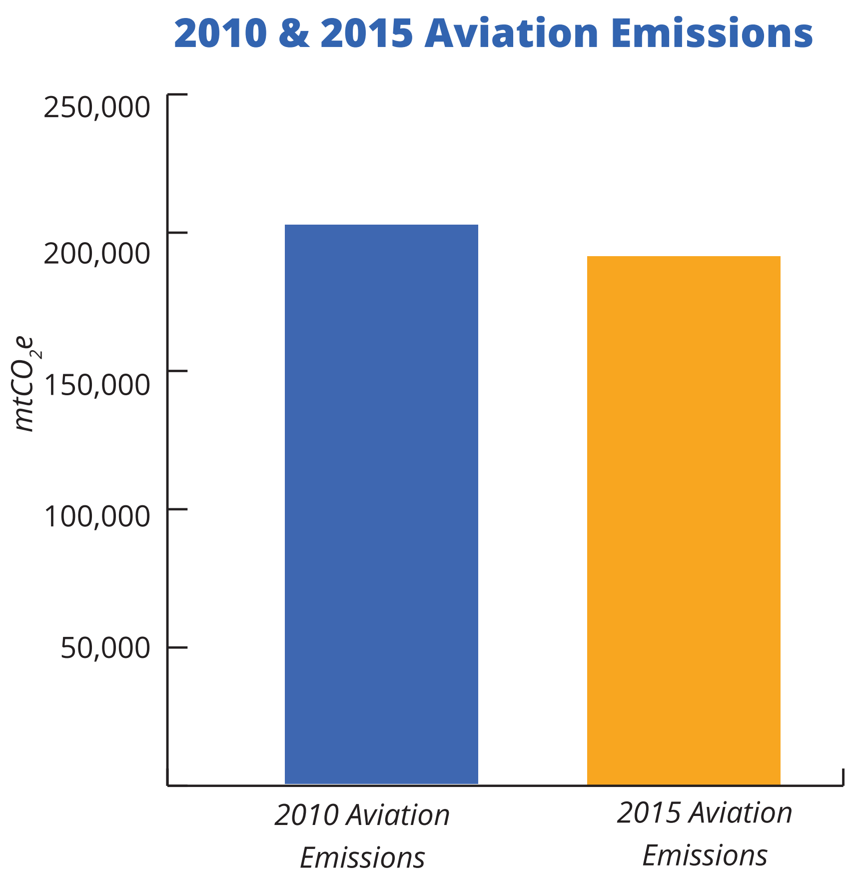


Figure 13. This figure compares the metric tons of carbon dioxide produced by aviation emissions between 2010 and 2015. GHG emissions from aviation, based on the number of departing flights from major and regional airports in the region. Calculations are for landings and take-offs for all trans-boundary flights.

Waste Emissions

3.4. WASTE

Waste emissions include solid waste disposal, incineration, and wastewater treatment. In 2010, waste emissions equaled 890,660.95 mtCO_2e, or just under 2% of total emissions for the region. Waste emissions fell by 23% in 2015 to 685,569.33 mt CO_2e, only 1% of the year's total emissions.

All solid waste emissions reported to the EPA are classified as Scope 1. The Metropolitan Sewer District (MSD) of St. Louis provided actual data for the City and St. Louis County. For other counties, estimates for wastewater emissions are based on population data, including an estimation for septic systems.

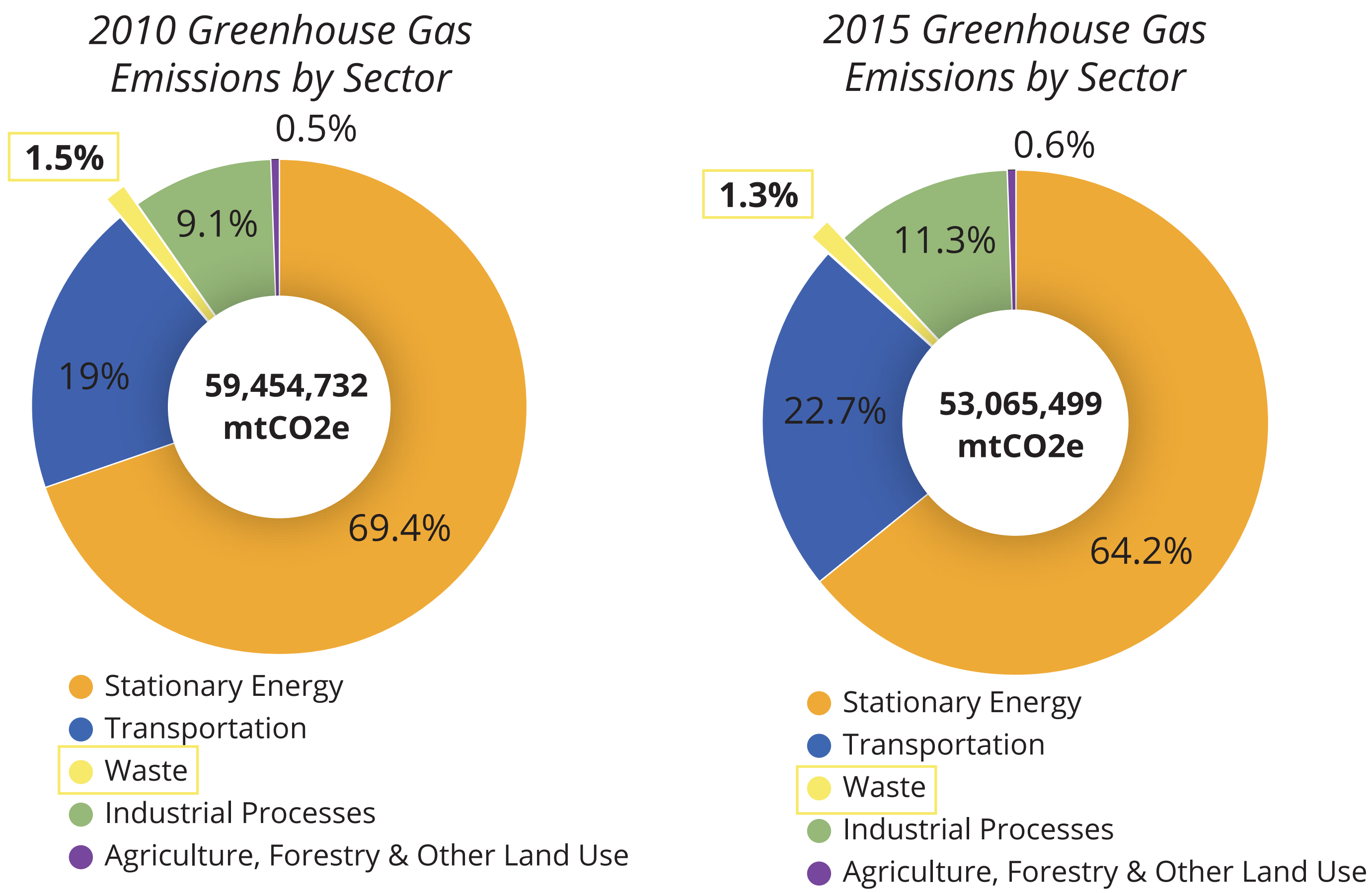


Figure 14. 2010 & 2015 GHG Emissions by Sector - These two pie charts represent the GHG emissions by sector for 2010 & 2015. This chart highlights the Waste Sector.

2010 & 201 Waste Emissions by Source - CO_2e

	Solid Waste	Incineration & Open Burning	Wastewater	Total
2010 Waste Emissions	811,159.49	13,506.75	65,994.71	890,660.95
2015 Waste Emissions	612,819.48	14,511.96	58,237.89	685,569.33

Figure 14. This table shows the metric tons of carbon dioxide emissions produced from waste emissions by different sources between 2010 and 2015.

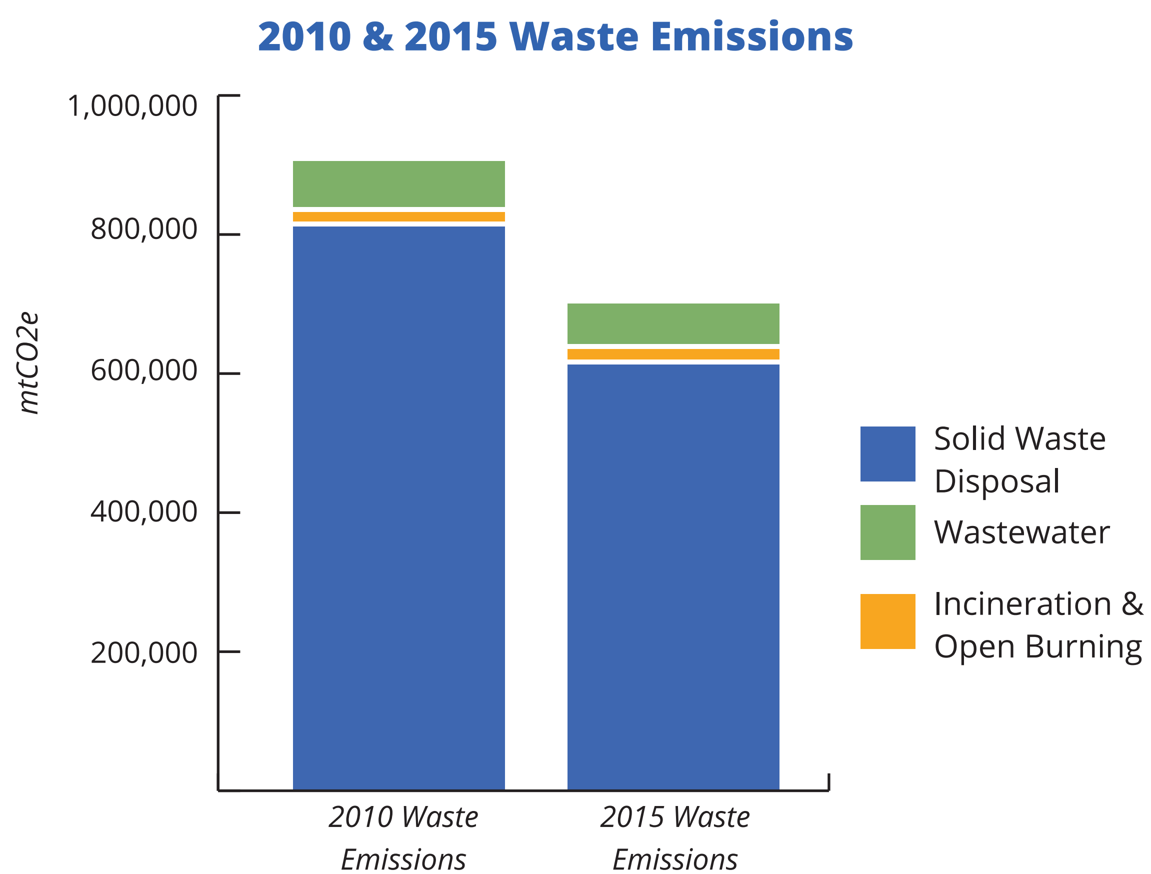


Figure 15. This figure shows the metric tons of carbon dioxide emissions produced from waste emissions by different sources in 2010 and 2015. Theses sources include solid waste disposal, wastewater, and incinerations and open burnings.

3.4.a. Solid Waste Disposal

The majority emissions within this sector are attributed to solid waste disposal, accounting for 91% in 2010 and 89% in 2015. These emissions are primarily generated from the disposal of new solid waste, which amounted to 3.4 wet tons in 2010 and 3.2 wet tons in 2015, and from the decay of waste in existing landfills over time. Composting emissions were not included in this inventory as they are relatively small in comparison to landfilled waste emissions.

3.4.b. Wastewater

Wastewater is the second largest contributor to emissions within this sector, accounting for 7% of emissions in 2010 and 8% of emissions in 2015. The remaining 2% in 2010 and 3% in 2015 belonged to waste incineration associated with certain wastewater applications.

GHG emissions from the wastewater sector stem from the biological processing of organic wastewater products in both wastewater treatment plants and septic systems.

Additionally, wastewater treatment plants indirectly produce GHG emissions through energy used to power their treatment processes. Those emissions are included in the Stationary emissions for the commercial and institutional buildings sub-sector.

3.4.c. Industrial Process & Refrigerants (IP&R)

Industrial Processes chemically or physically transform materials and release GHG emissions. The St. Louis region is home to industries that contribute to these emissions including steel production, oil refining, glass production, cement production, and lead smelting.

Industrial process emissions increased from 2010 to 2015 from 4,292,860 mtCO_2e to 5,072,421 mtCO_2e, accounting for 11% of the region's emissions in 2015. Emissions were as reported to the EPA. Smaller companies with industrial process emissions are not included in this report.

Refrigerant emissions stem primarily from the release of hydrofluorocarbons (HFCs), which are a substitute for ozone depleting substances (ODSs). HFCs are greenhouse gasses, and mainly used for air conditioning and refrigeration equipment. In 2010 and 2015, refrigerant use decreased by only a negligible amount, still accounting for just under 2% of the region's emissions in both years. The refrigerant emissions in this inventory are estimated by downscaling national level refrigerant emission data to the local level based on population. Therefore, trends in this source are a product of both national-level refrigerant trends and local population growth rates.

2010 & 2015 Industrial Processes & Refrigerant Emissions

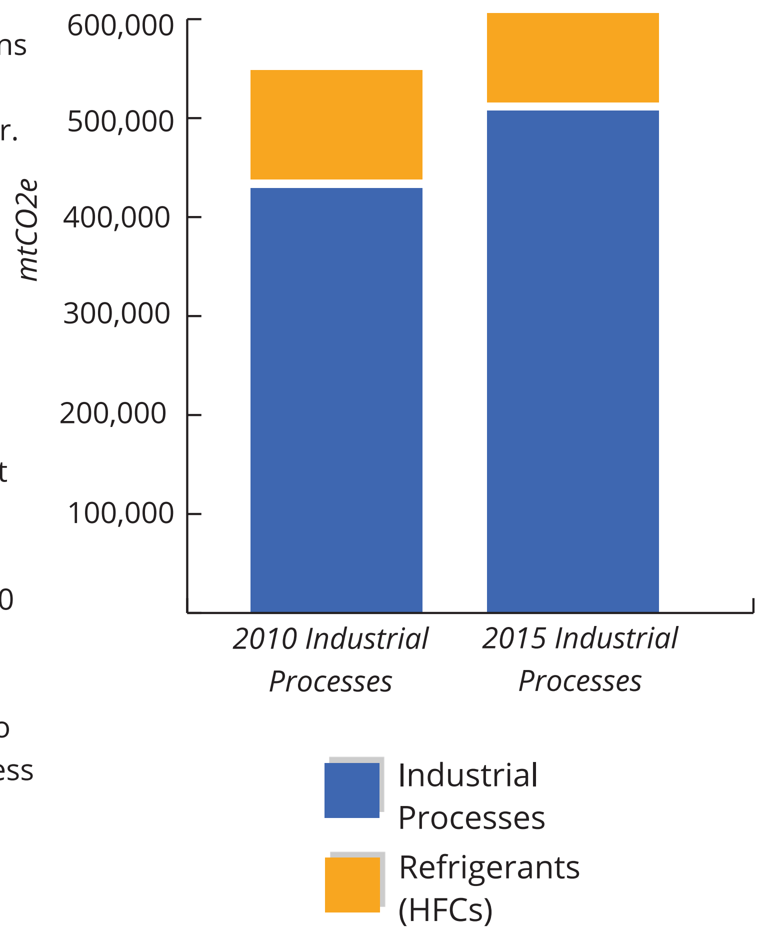


Figure 16. This figure compares the metric tons of carbon dioxide emissions produced by industrial processes and refrigerants between 2010 and 2015.

Agriculture, Forestry and Other Land Use

3.5. AFOLU

Agricultural and Other Land Use involves crop and livestock production for food and non-food use. Direct emissions include N_2O from cropped soils (fertilizer application), CH_4 from enteric fermentation, and N_2O and CH_4 from managed livestock manure. Total emissions equal 295,672 mtCO_2e in 2010 and 294,772 mtCO_2e in 2015, less than 1% of the total emissions for the region. On-farm energy use, including buildings and equipment, are included in the Stationary emissions sector, and not included in this sector.

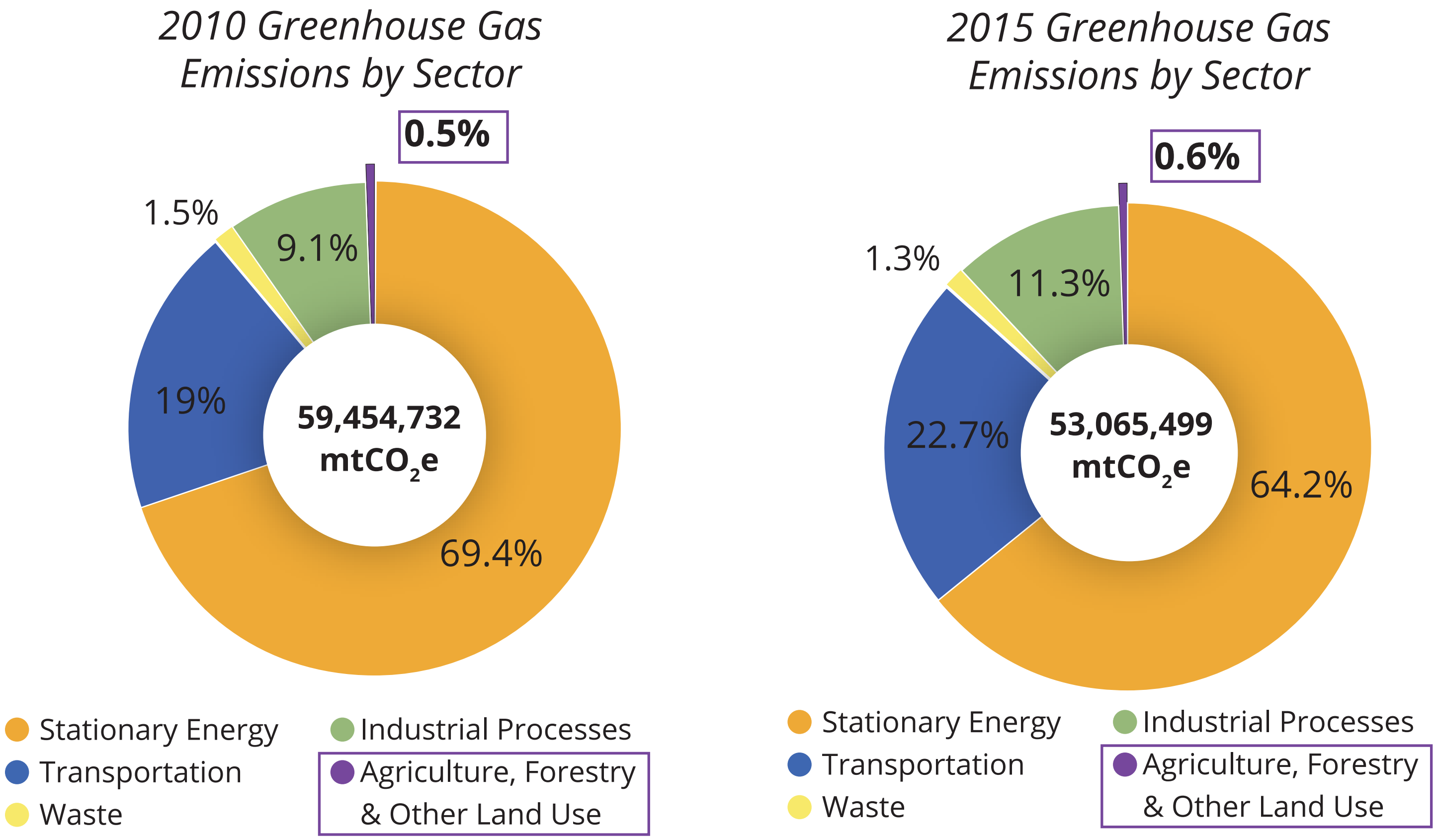


Figure 17. These two pie charts represent the GHG emissions by sector for 2010 & 2015. This chart highlights the AFOLU Sector.

Further research and reporting in this sector are recommended, as land use conversions between forest land, cropland, grassland, wetlands, and built environment were not included in this inventory. Land use changes influence emissions either as carbon "sinks", for example, by carbon sequestration through forests and wetlands, or act as "sources", for example, when forests and wetlands are removed for development.

2010 & 201 AFOLU Emissions by Source - CO_2e

	Livestock	Land Use	Other AFOLU	Total
2010 AFOLU	174,073.7	NE	121,598.7	295,672.3
2015 AFOLU	150,298.00	NE	144,473.98	294,771.97

Table 15. This table shows the metric tons of carbon dioxide emissions produced by agriculture, forestry, and other land uses by different sources between 2010 and 2015.

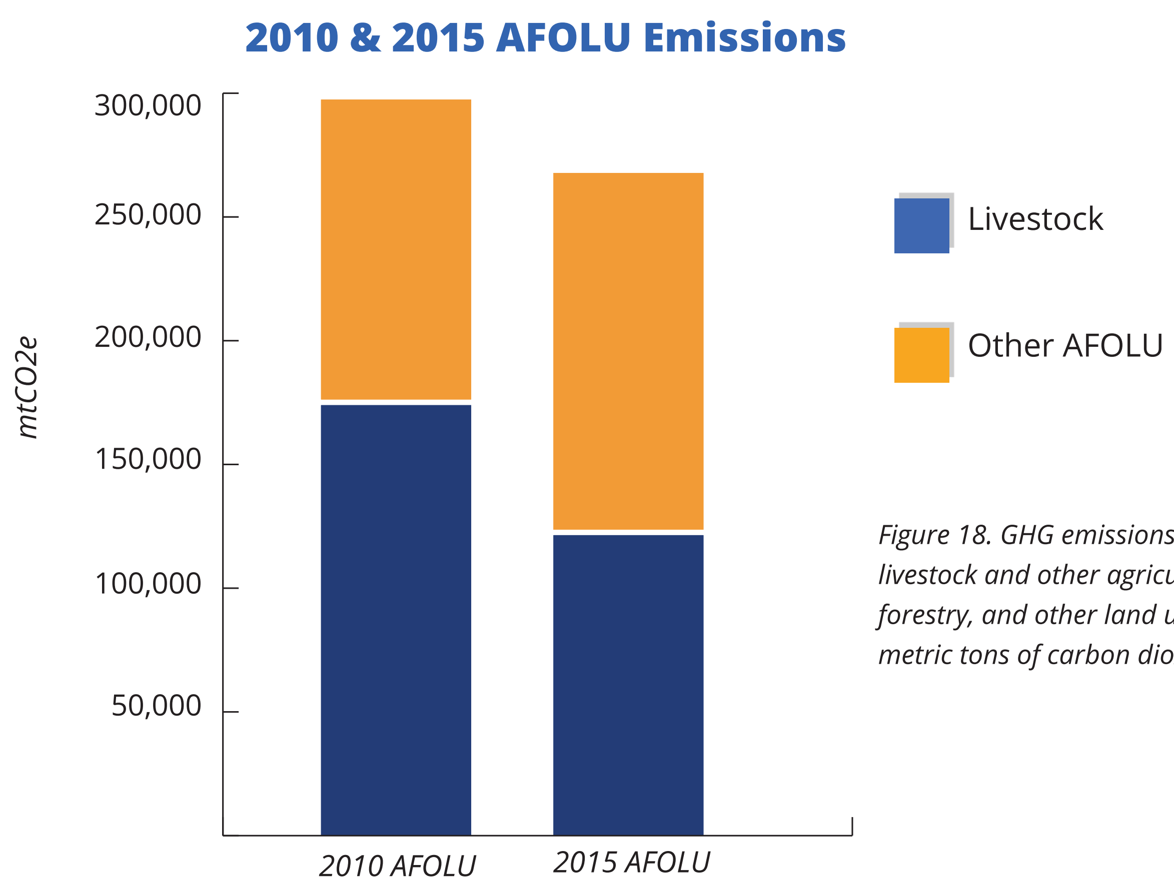
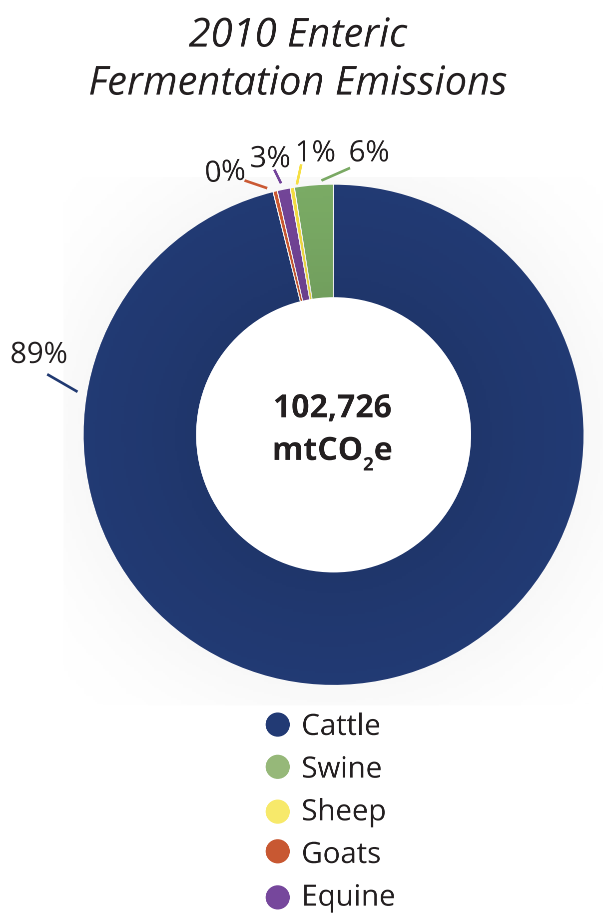


Figure 18. GHG emissions from livestock and other agriculture, forestry, and other land uses in metric tons of carbon dioxide.

3.5.a. Enteric Fermentation

Enteric fermentation is responsible for 35% of total emissions in the agricultural sector in 2010, which decreased to 32% in 2015. Cattle are the primary contributors to GHG emissions from enteric fermentation, followed by swine, equine, sheep, and goats. Enteric fermentation occurs when anaerobic microbes decompose and ferment food in the digestive tract of animals, leading to the production of compounds that are absorbed by the animal host. As a result of this process, methane (CH_4) emissions are released through the animal's "burps".



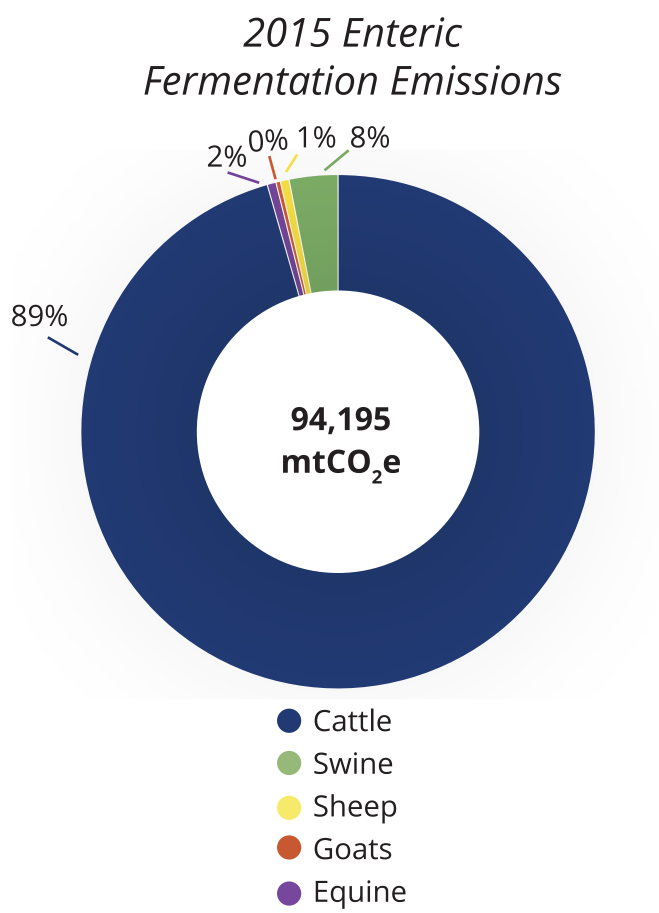


Figure 19. This figure compares the metric tons of carbon dioxide emissions produced by enteric fermentation emissions from varying types of livestock between 2010 and 2015. The 0% source is due to the percentage being extremely low and rounding down.

3.5.b. Managed Livestock Manure

Manure Management accounted for 24% and 19% of this sector's emissions in 2010 and 2015 respectively. Swine manure is the largest contributor of GHG emissions, followed by cattle, equine, sheep, poultry, and goats. Manure management is the process in which animal excretion is captured, stored, treated, and used. The climate impact of manure depends on how it is processed. Emissions occur during manure storage due to the decomposition of organic matter in the manure under anaerobic conditions.

2010 & 201 Manure Management Emissions by Source - CO_2e

	Cattle	Equine	Goats	Poultry	Sheep	Swine
2010 Manure Management	18,988.30	559.45	32.86	144.80	288.55	51,293.31
2015 Manure Management	18,767.98	444.89	24.55	154.44	228.65	36,482.66

Table 16. This table shows the metric tons of carbon dioxide emissions produced from manure management by different livestock between 2010 and 2015.

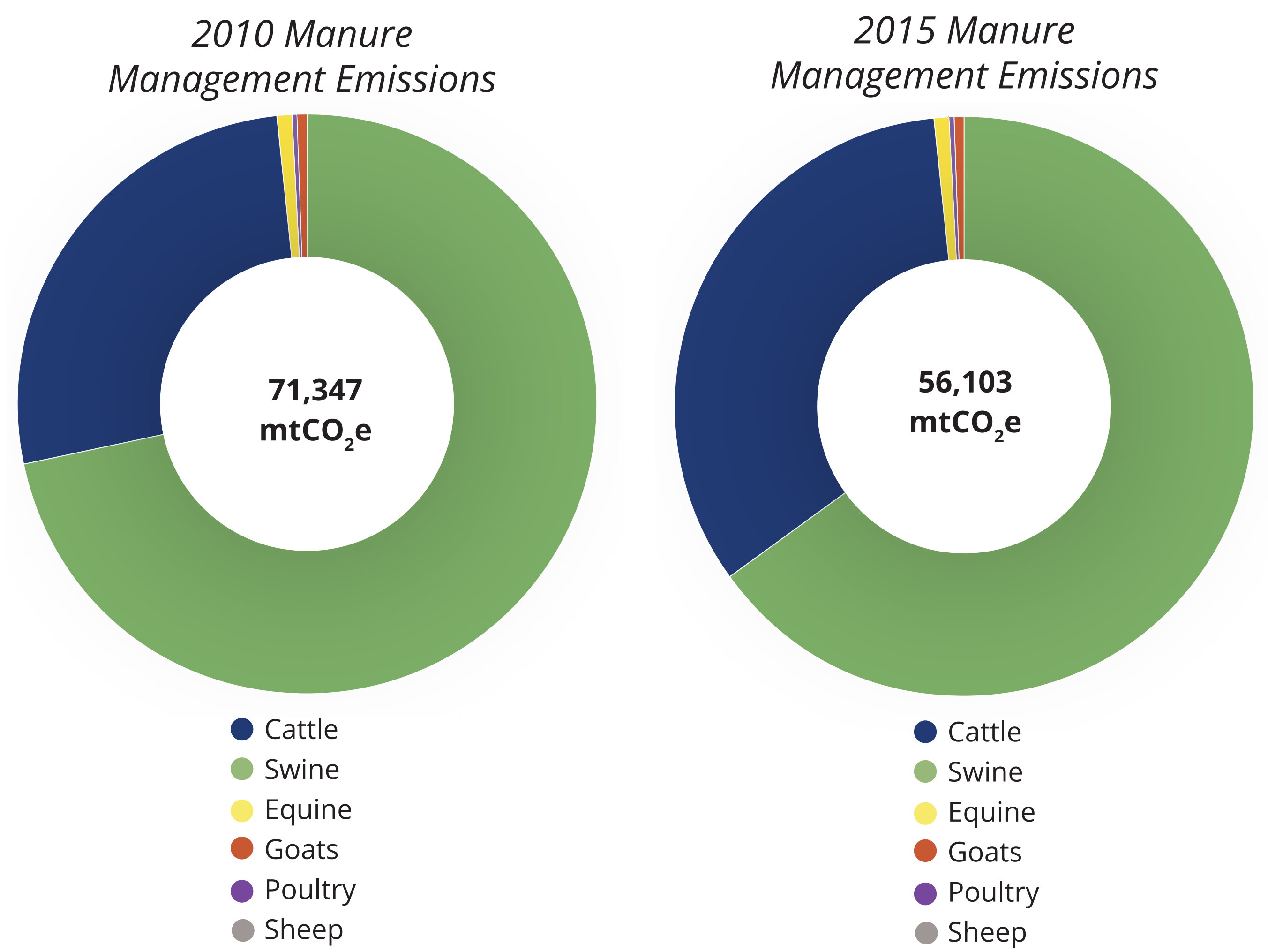


Figure 20. This figure compares the metric tons of carbon dioxide emissions produced by manure management emissions from varying types of livestock between 2010 and 2015. The 0% source is due to the percentage being extremely low and rounding down.

3.5.c. Fertilizer Application

Fertilizer application represents 41% of emissions in the agricultural sector in 2010, which increased to 49% in 2015. The primary source of emissions in fertilizer application is the addition of nitrogen-based fertilizer used for managing nutrient levels in agricultural soils. The main nitrogen sources include synthetic fertilizers, organic matter amendments, and biological nitrogen fixation.

Nitrogen fixation is the process of converting molecular nitrogen (N_2) into forms that can be utilized by plants and animals, such as ammonia (NH_3). When nitrogen is applied in excess of the plant's needs, it can result in the release of excess nitrous oxide (N_2O) emissions, which is a potent greenhouse gas.

2010 Plant Fertilizer Emissions - CO_2e

	CH_4 (mt)	N_2O (mt)	CO_2e (mt)
IL Counties	0	335.29	88,852.18
MO Counties	0	123.57	32,746.50
Total		458.86	121.598.68

Table 17. This table shows the metric tons of methane, nitrogen, and carbon dioxide in fertilizer application between Illinois and Missouri counties in 2010.

2015 Plant Fertilizer Emissions - CO_2e

	CH_4 (mt)	N_2O (mt)	CO_2e (mt)
IL Counties	0	414	109,710
MO Counties	0	131.1	34,763.98
Total		545.18	144,473.98

Table 18. This table shows the metric tons of methane, nitrogen, and carbon dioxide in fertilizer application between Illinois and Missouri counties in 2015.

V. SUMMARY OF REGIONAL INITIATIVES

Photo by Richard Reilly

4.1. UTILITY COMPANIES LONG-TERM PLANS

Both Ameren and Spire play an integral part in reducing GHG emissions in the region. Understanding their long-range energy generation plans informs future strategies, goals, and implementation.

4.1.a. Ameren

In 2020, Ameren announced their triennial Integrated Resource Plan (IRP), making a big splash because of their ambitious carbon emission reduction goals. The 2020 IRP intends to address customers' long-term energy needs in a way that is consistent with the objectives of the Paris Agreement: limiting global temperature rise to 1.5 degrees Celsius and doing so at the least cost to customers. In 2022, Ameren revised the IRP with some minor modifications.[8]

The company has established a net zero carbon emissions goal by 2045 across all its operations in Missouri and Illinois. Ameren Missouri is aiming for a reduction in CO_2 emissions of 60% by 2030, 85% by 2040, and a goal of net-zero CO_2 emissions by 2045 based on 2005 levels.

To accomplish these goals Ameren plans to transform their generation portfolio adding 2,800 MW of renewable generation by 2030 and reaching total wind and solar generation of 5,400 MW by 2040 and deploying 800 MW of battery storage. Additionally, Ameren plans to retire 3,500 MW of fossil-fuel generation by 2030.

However, residents and businesses will need to work with Ameren to achieve these goals. According to the IRP, "Economic growth, naturally occurring energy efficiency and customer adoption of distributed energy resources such as solar and efficient electrification of end-uses are key drivers of future growth in our base case forecast. The plan continues to include robust and cost-effective customer energy efficiency and demand response programs to help customers better control consumption and reduce their electric bills. By 2040, these programs are expected to result in nearly 2,000 MW of peak demand savings."

Energy customers can do their part by making their buildings more energy efficient and reducing energy use overall, especially during times of high energy usage (customer demand). Mindful energy usage supports emissions reduction targets during the transition period to low-emission and renewable technologies, as well as supporting more manageable levels of demand while these systems are being rebuilt.

Ameren's Coal Plant Shut-Down Schedule

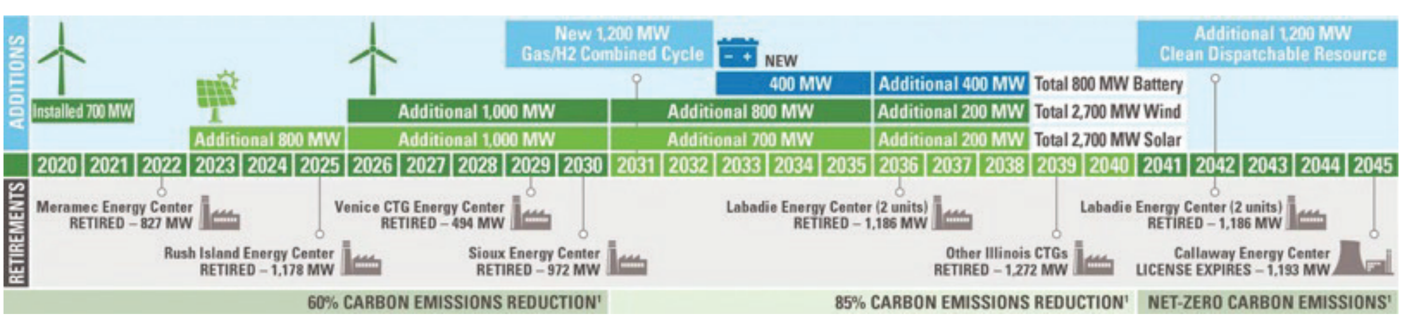


Figure 21. This figure is a timeline from Ameren's Integrated Resource Plan showing planned transition away from coal-fired energy.[10]

4.1.b. Spire

In addition to Ameren serving the St. Louis metro region, Spire serves as the primary natural gas company for the Missouri side of the metro. In 2020, Spire became one of the first natural gas companies to announce their commitment to become a carbon neutral company by mid century. This goal includes only the company's Scope 1 and 2 emissions (primarily methane gas lost in transmission to customers). Spire has taken actionable steps to make a positive environmental impact, with a 46% utility methane emissions reduction, primarily due to infrastructure upgrades and leak detection and repair programs and are on target to reduce methane emissions by 59% by 2025 and 73% by 2035. By 2025, Spire anticipates replacing over 1,000 additional miles of aging infrastructure—ultimately bringing them closer to achieving their emissions reduction goals.[9]

The company is working toward providing renewable natural gas (RNG) offerings to customers who choose this option and are awaiting rulemaking from the Missouri Public Service Commission now that the State of Missouri has legislation around RNG. Spire is in the process of studying hydrogen and its uses in gas distribution system, including the availability of surplus renewable energy, the required investment and commodity cost, technical, safety and equipment issues, and the achievable environmental benefits of blending hydrogen into the natural gas supply.

Spire has been offering energy efficiency programs for well over a decade and plans to continue expanding those efforts. Through weatherization, rebate, and financing programs, customers have access to resources to make more energy-efficient choices for their homes and businesses—ultimately leading to lower GHG emissions.

According to the U.S. Environmental Protection Agency (EPA), "RNG projects capture and recover methane produced at a landfill or anaerobic digestion (AD) facility. Methane has a global warming potential at least 28 times greater than CO2 and a relatively short (12-year) atmospheric life, so reducing these emissions can achieve near-term beneficial impacts in mitigating global climate change."[14] The EPA also notes, "The GHG emissions from projects that convert waste biogas from landfills or anaerobic digester systems to RNG vary greatly based on project-specific details."[15]

4.2. TRANSPORTATION INITIATIVES

Transportation trends such as electrification, increased fuel economy, and expanded public transit could have an effect on reducing the region's GHG emissions. According to an analysis done by the City of St. Louis, EVs are projected to reach about 10% of registered vehicles in St. Louis by 2030.[11] Between 2020 and 2021, registered EVs increased 40.5% in Illinois and 49.1% in Missouri.[12]

In April of 2022, the U.S. Department of Transportation (USDOT) announced new Corporate Average Fuel Economy standards that require an industry-wide fleet average of approximately 49 49 mpg for passenger cars and light trucks in the model year 2026. According to USDOT, this means that new cars in 2026 will get 33% more miles per gallon than in 2021. While St. Louis Metro transit ridership is down, Metro has plans to expand the MetroLink train[13] to the North and South of the city, taking passengers to the new soccer stadium and expanding rail access to new neighborhoods.

4.3. LOCAL INITIATIVES

Local initiatives to reduce greenhouse gas emissions include OneSTL committees, the St. Louis Green Business Challenge, and the Midwest Climate Collaborative, among many others. The OneSTL communications team and working groups provide support to share and replicate successful local strategies to reduce greenhouse gas emissions, such as municipal tree planting projects, EV ready infrastructure ordinances, and transit-oriented development communities.

The Green Business Challenge and Green Cities Challenge also encourage local businesses and municipalities to take action and share their successes, in areas such as supporting green transportation options and getting green certifications for their buildings or operations. Looking beyond the St. Louis region to the entire Midwest, the Midwest Climate Collaborative works to facilitate the development of a coherent Midwest response to the climate crisis through acceleration of climate action, knowledge generation, and leader development. In addition to other projects, the collaborative hosts an annual outcome-driven summit for stakeholders in the Midwest. Numerous other organizations in the St. Louis region work on efforts that reduce GHG emissions, such as home weatherization, policy advocacy, and environmental education.

Municipalities in the region are also taking steps toward emissions reductions. There are at least ten municipalities in the St. Louis region that have climate action plans or sustainability plans that address emissions reductions. These cities include Alton, St. Louis, Brentwood, Collinsville, Creve Coeur, Edwardsville, Maplewood, Richmond Heights, University City, and Webster Groves.

All sustainability plans and climate action plans in the St. Louis region can be accessed through OneSTL's resource library at http://www.onestl.org/resources/reports/sustainability-plans. In addition, some municipalities have taken further action around GHG reduction and climate protection through policy initiatives.

The City of St. Louis passed legislation in 2017 requiring that large commercial, institutional and multi-family buildings report energy and water use annually to the City of St. Louis Building Division. In 2020, the City of St. Louis added energy efficiency requirements for the same buildings, so that 65% of buildings 50,000 square feet and greater will have to make energy efficiency improvements by 2025 to meet the Building Energy Performance Standard.

The City of St. Louis also added solar- ready and Electric Vehicle (EV) charging ready requirements in 2019 and 2021 respectively. Richmond Heights also has EV charging ready requirements for new construction through their building code. A full library of ordinances in the St. Louis region related to sustainability is available at http://www.onestl.org/resources/reports.

The Bipartisan Infrastructure Law (BIL) of 2021 and Inflation Reduction Act (IRA) of 2022 made significant investments in projects to reduce GHG emissions.[16] The BIL establishes a national network of EV chargers and invests in passenger rail, electric school buses, and clean energy transmission and the electric grid. The IRA is estimated to result in a 40% reduction in GHG emissions by 2030, from 2005 levels. It includes tax credits and rebates for home weatherization and electrification projects, as well as rooftop solar and geothermal heating. More information about the credits and rebates can be found at Rewiring America's IRA calculator at [rewiringamerica.org.](rewiringamerica.org)

The IRA also includes other funding opportunities for projects that reduce GHG emissions, including many that are focused on environmental justice. Updates about available funding across all federal departments are available at [https://www.americaisallin.com/.](https://www.americaisallin.com/)

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