



Maricopa County 2018 Community Greenhouse Gas Emissions Inventory

Executive Summary

The Maricopa County Air Quality Department prepared this community greenhouse gas emissions inventory to give city, town, and county leaders an understanding of the carbon footprint of their communities. By understanding the sources of greenhouse gas emissions, leaders can make operational decisions and implement voluntary programs to reduce greenhouse gas emissions within their communities. Businesses and individuals can also make personal choices to reduce their carbon footprint.

Voluntary reductions in greenhouse gas emissions benefit everyone. When governments, businesses, and individuals reduce their carbon footprint, they also save money through reduced fuel, water and/or electricity costs. These changes also reduce emissions of volatile organic compounds (VOC) and nitrogen oxides (NO_x), which are precursors to ozone formation. The MCAQD is working to reduce emissions of VOC and NO_x because the U.S. Environmental Protection Agency has determined that there is too much ozone in the air in Maricopa County. Over the last five years, Maricopa County has recorded an average of 34 exceedances of the 2015 ozone standard each year. Voluntary reductions in emissions will benefit the health of Maricopa County residents and help Maricopa County attain the 2015 ozone standard.

To prepare this report the MCAQD estimated greenhouse gas emissions from nine different source categories: electricity use, mobile sources (such as vehicles and airplanes), stationary fuel combustion, wastewater, livestock, solid waste, manufacturing, imported water, and fertilizer use. The MCAQD also estimated carbon dioxide (CO₂) sequestration by the trees in Maricopa County. Based on these estimates, the MCAQD calculated net greenhouse gas emissions (emissions minus tree carbon sequestration) generated by the Maricopa County community. The MCAQD also estimated the amount of greenhouse gas emissions coming from each municipality and from unincorporated portions of Maricopa County.

The dominant greenhouse gases (GHG) generated by the Maricopa County community are CO₂, methane (CH₄), and nitrous oxide (N₂O). In 2018, the Maricopa County community generated approximately 51.27 million metric tons of carbon dioxide equivalents (MTCO_{2e}). Within Maricopa County, trees remove approximately 160,151 MTCO_{2e} from the air each year. In 2018, the net greenhouse gas emissions (total greenhouse gas emissions generated minus the amount of CO₂ sequestered by trees) for the Maricopa County Community was 51.11 million MTCO_{2e}.

The two largest sources of GHG emissions are electricity generation and mobile sources, which each respectively represent 42.6% and 40.7% of the greenhouse gases generated by the Maricopa County community. These findings suggest that projects related to energy and fuel efficiency improvements, as well as projects to encourage the adoption of alternative fuel and electric vehicles would have a

significant impact on community greenhouse gas emissions in Maricopa County. The GHG emissions profile for the Maricopa County community is summarized on the following page.

Table 1. Maricopa County GHG Emissions by Source Category

Source Category	GHG Emissions	
	*MTCO ₂ e	Percent
Electricity Use	21,859,902	42.6
Mobile Sources	20,857,181	40.7
Stationary Fuel Combustion	5,123,377	10
Wastewater	947,506	1.8
Livestock (Cattle)	904,886	1.8
Solid Waste	656,745	1.3
Manufacturing (Fluorinated Gas Use)	565,059	1.1
Imported Water (Electricity Used)	238,101	0.5
Fertilizer Use	123,706	0.2

*Metric tons of carbon dioxide equivalent

Gross GHG Emissions
51,276,462 MTCO₂e
 GHG Reductions (Urban Forestry)
-160,151 MTCO₂e
 Net GHG Emissions
51,116,312 MTCO₂e
 Per Capita Net GHG Emissions
11.9 MTCO₂e

Figure 1. Maricopa County GHG Emissions by Source Category

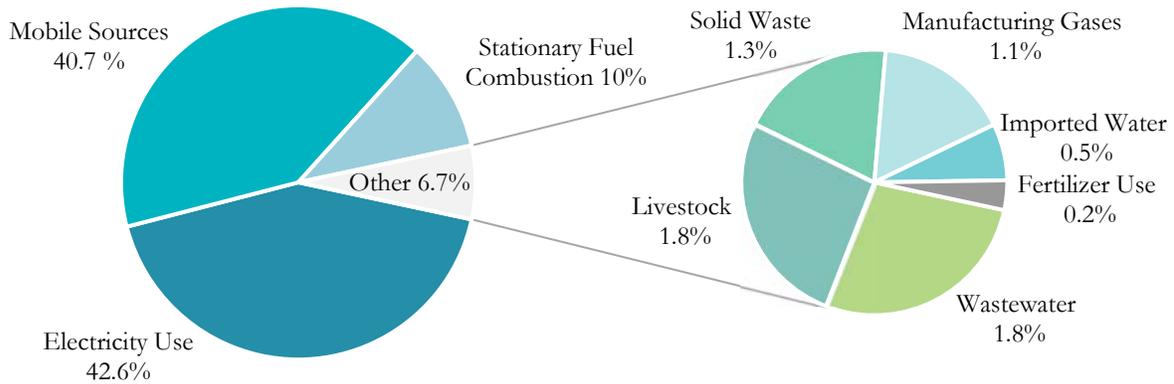


Figure 2. Maricopa County Electricity Use GHG Emissions by Economic Sector

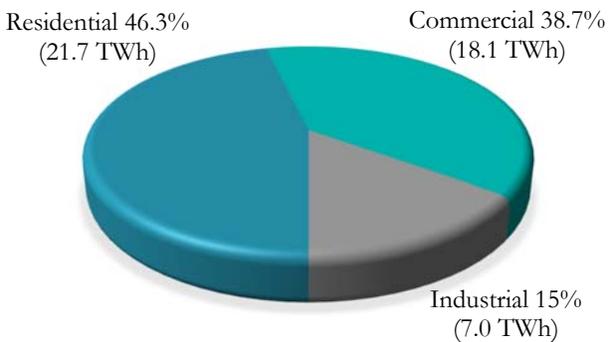
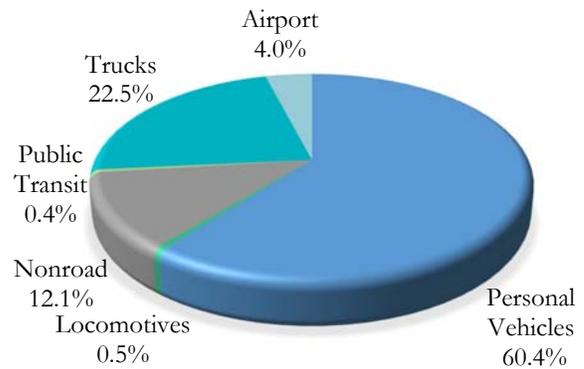


Figure 3. Maricopa County Mobile Source GHG Emissions



Contents

Executive Summary 1

Contents 4

Introduction..... 5

Methodology, Emissions Estimates, and Emissions Allocations 6

 Electricity..... 6

 Mobile Sources 7

 Mobile Source..... 8

 Stationary Fuel Consumption..... 10

 Wastewater 11

 Livestock (Cattle) 11

 Solid Waste..... 12

 Manufacturing Gases 12

 Imported Water Electricity Use 13

 Agriculture and Land Management 13

 Urban Forestry 14

References 17

Greenhouse Gas Emissions Profiles for Municipalities and Unincorporated Maricopa County 18

Introduction

The U.S. Environmental Protection Agency (EPA) sets National Ambient Air Quality Standards (NAAQS) for six criteria air pollutants: ozone, particulate matter, carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO₂), and lead. States are required to meet the NAAQS in order to comply with the Clean Air Act (CAA). Within Maricopa County, the Arizona Department of Environmental Quality has delegated authority for air quality monitoring, permitting, compliance, and planning to the Maricopa County Air Quality Department (MCAQD). As a result, the MCAQD is responsible for meeting the NAAQS. Portions of Maricopa County are currently designated as nonattainment for ozone and particulate matter less than 10 microns in diameter (PM₁₀), because EPA has determined that air quality in portions of Maricopa County has exceeded the NAAQS for these pollutants. As a result, the MCAQD is taking action to reduce emissions of NO_x and volatile organic compounds (VOC), which are precursors to ozone formation, and PM₁₀. The MCAQD is also working to reduce emissions of particulate matter less than 2.5 microns in diameter (PM_{2.5}), to ensure continued attainment of the PM_{2.5} NAAQS.

Greenhouse gases (GHG) are molecules in the earth's atmosphere that trap heat. GHG are emitted when fuels are burned to generate electricity or heat, or to power motor vehicles and equipment. Some GHG are also emitted by chemicals that are used or produced by manufacturing and material processing operations. CO₂ is the dominant GHG emitted in the world. However, CH₄ and N₂O are respectively 25 and 298 time more powerful than CO₂ in terms of their 100-year global warming potential, which are converted to the standard unit of GHG equivalent of metric tons of CO₂ equivalent (MTCO₂e) as the GHG reporting units used in this report. Although Arizona does not have any statutes or regulations that require individuals, businesses, or municipalities to reduce GHG emissions, many entities are choosing to reduce their emissions on a voluntary basis. When individuals, businesses, and municipalities take voluntary action to reduce their GHG emissions, these actions also reduce emissions of criteria air pollutants, which benefits everyone who lives, visits, or works in Maricopa County.

In this report, MCAQD quantifies GHG emissions for Maricopa County during 2018. GHG emissions were calculated using the EPA Community Greenhouse Gas Inventory Tool (EPA, 2018), EPA Facility Level Information on Greenhouse Gases Tool (FLIGHT) (EPA, 2020a), or sector specific methodologies where appropriate. This report also allocates GHG emissions to municipalities and unincorporated Maricopa County, and identifies the portion of GHG emissions from each sector of the economy. This report will help cities and towns better understand their own GHG emissions profile so they can identify opportunities to save energy, save money, and reduce criteria air pollution emissions as a co-benefit of any voluntary GHG reductions that result from municipalities' programs and policies.

The overall Maricopa County community GHG emission profile is shown in the executive summary. Methodologies used to quantify GHG emissions and the methodologies used to allocate GHG emissions to different municipalities and unincorporated Maricopa County are explained in the following section. The greenhouse gas emissions profiles for each municipality and unincorporated Maricopa County are included at the end of this report.

Methodology, Emissions Estimates, and Emissions Allocations

Electricity

Consumption of electricity results in emissions of GHG, primarily CO₂, from fuel combustion that occurs when electricity is generated. GHG emissions from electricity consumption were calculated based on 2018 Maricopa County electricity use data provided by Arizona Public Service Company (APS) and Salt River Project (SRP). GHG emissions from electricity consumption were calculated using a GHG emission factor for the U.S. southwest regional electrical grid, 0.466 MTCO₂e/MWh, from the EPA 2018 eGRID summary tables (EPA, 2020b). Apache Junction and Queen Creek both span the border between Maricopa and Pinal Counties. Electricity use from the portions of Apache Junction and Queen Creek that are within Maricopa County were estimated based on the percentage of the population of each respective municipality that resides within Maricopa County.

Distribution of electricity results in emissions of sulfur hexafluoride, a GHG which is used as an electric insulator in high-voltage circuit breakers and other electrical equipment (Wikipedia, 2020). APS and SRP reported a total of 30,493 MTCO₂e of GHG emissions from the release of sulfur hexafluoride (SF₆) for 2018 (EPA, 2020c). GHG emissions from sulfur hexafluoride were allocated to municipalities and unincorporated areas of Maricopa County and by economic sector based on the relative proportion of total electricity consumed. Table 2 shows the electricity emissions by jurisdiction and economic sector. Residential are homes; commercial consists of office space, commercial establishments (i.e. stores, restaurants, hotels), and institutions such as hospitals; industrial is manufacturing and production facilities. Electricity consumption and related SF₆ use generated 42.6% of the total GHG emissions for Maricopa County in 2018.

Table 2. GHG emissions from electricity generation and sulfur hexafluoride use by municipality and economic sector.

	Greenhouse Gas Emissions (MTCO ₂ e)			Emissions by Economic Sector (% of Total)		
	Electricity Generation	SF ₆	Total	Residential	Commercial	Industrial
Apache Junction	1,765	2	1,767	71.4	28.2	0.5
Avondale	290,832	587	291,419	62.6	36.9	0.6
Buckeye	280,243	541	280,784	65.0	29.9	5.0
Carefree	24,784	26	24,811	63.9	36.0	0.1
Cave Creek	141,012	41	141,053	77.4	21.9	0.6
Chandler	2,267,807	1,863	2,269,670	31.6	21.7	46.7
El Mirage	92,736	243	92,979	74.7	20.5	4.8
Fountain Hills	128,804	171	128,974	74.7	25.1	0.2
Gila Bend	52,895	14	52,909	9.3	14.1	76.6
Gilbert	1,084,354	1,797	1,086,151	64.2	32.4	3.3
Glendale	506,458	1,717	508,175	63.5	34.1	2.4
Goodyear	409,083	601	409,684	47.3	45.3	7.4
Guadalupe	11,950	45	11,995	57.1	42.9	0.0
Litchfield Park	116,014	47	116,062	71.0	27.3	1.7
Mesa	2,271,359	3,472	2,274,831	53.2	33.7	13.1

Paradise Valley	182,755	99	182,855	70.3	28.4	1.3
Peoria	729,940	1,251	731,191	65.3	33.7	1.0
Phoenix	7,374,140	11,345	7,385,485	42.9	49.6	7.5
Queen Creek	415,976	307	416,282	78.2	21.6	0.1
Scottsdale	2,081,668	1,743	2,083,410	51.6	46.1	2.3
Surprise	457,323	943	458,266	69.0	28.8	2.1
Tempe	1,407,444	1,316	1,408,759	27.7	53.0	19.3
Tolleson	260,280	50	260,330	4.4	32.9	62.7
Wickenburg	33,326	49	33,375	58.3	40.3	1.5
Youngtown	20,524	47	20,571	64.4	35.4	0.2
Unincorporated Maricopa County	1,185,937	2,177	1,188,114	25.0	13.7	61.2
Total	21,829,409	30,493	21,859,902			

Mobile Sources

MCAQD requested greenhouse gas emissions data for mobile sources from the Maricopa Association of Governments (MAG). MAG estimated 2018 greenhouse gas emissions using the EPA Motor Vehicle Emission Simulator (MOVES) 2014b model for onroad and nonroad transportation GHG emissions, and the Aviation Environmental Design Tool (AEDT) version 2d for airport GHG emissions. Locomotive GHG emissions were calculated based on the most recently available locomotive fuel usage reported in the 2017 Ozone and PM₁₀ Periodic Emissions Inventory Report. The 2017 locomotive fuel use was assumed to be the same as 2018 fuel use for GHG emission calculations. MCAQD used locomotive diesel fuel consumption emission factors for CO₂, N₂O and CH₄ from the Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC, 2007) to estimate greenhouse gas emissions from locomotives. Mobile sources emit about 20.9 million MTCO_{2e}, which is 40.7% of Maricopa County GHG emissions. The county wide mobile source emissions are allocated to municipalities and nonincorporated areas according to the proportion of population those areas.

Table 3 shows the GHG emissions from each mobile source category. Personal vehicles dominate the emissions profile with 12.6 million MTCO_{2e} (60.4%), followed by trucks with 4.7 million MTCO_{2e} (22.5%) and nonroad vehicles with 2.5 million MTCO_{2e} (12.1%). The personal vehicles category includes motorcycles, passenger cars, passenger trucks, and motor homes. The truck category includes light commercial, refuse, single unit short-haul, single unit long-haul, combination short-haul, and combination long-haul trucks. The public transit category is comprised of inter-city, transit, and school busses.

Light commercial means minivans, pickups, SUVs and other trucks with two axles and 4 tires that are used primarily for commercial applications. These vehicles are expected to differ from passenger trucks in terms of annual mileage and operation by time of day.

Single unit means single frame trucks that are not pulling trailers.

Combination means tractor trucks pulling one or more trailers.

Short haul means trucks with the majority of operation within 200 miles of home base.

Long-haul means trucks with the majority of operation more than 200 miles from home base.

Table 4 shows the emissions from onroad sources by vehicle type, with passenger cars dominating the profile at 9.6 million MTCO_{2e} (55.3%), followed respectively by passenger trucks and single unit short-haul trucks at 2.8 and 2.1 million MTCO_{2e}, respectively. Table 5 shows the emissions from nonroad sources by vehicle category, where construction equipment is the dominant source of nonroad emissions at 1.7 million MTCO_{2e} (69.6%). This is followed by Table 6 which shows greenhouse gas emissions for each airport and category. Airport emissions are from the Federal Aviation Administration’s AEDT model for aircraft within the county during take off, landing, and touch and go operations.

Take off means the portion from the start of the ground roll on the runway, through wheels off, and the airborne portion of the ascent up to cutback during which the aircraft operates at maximum thrust.

Landing means the portion of an aircraft’s landing on the runway before the aircraft begins decelerating (for arrival and circuit procedure profiles) or accelerating (for touch-and-go procedure profiles)

Touch and go operations mean a flight operation that begins with a level flight in the terminal control area, descends and lands on an airport runway, and then takes off immediately after landing and returns to level flight.

The AEDT model assumes 3,000 feet of elevation as the cutoff for aircraft airport operations.

Table 6 shows that Sky Harbor Airport is the dominant source of emissions in the airport category with 463,101 MTCO_{2e}, followed by Luke Air Force Base with 106,010 MTCO_{2e}.

Table 3. Maricopa County mobile source category 2018 GHG emissions.

Mobile Source	MTCO_{2e}	%
Airport	840,372	4.0
Locomotives	113,142	0.5
Nonroad Vehicles	2,527,974	12.1
Personal Vehicles	12,603,272	60.4
Public Transit	79,985	0.4
Trucks	4,692,436	22.5
Total:	20,857,181	100.0

Table 4. Maricopa County onroad mobile source 2018 GHG emissions.

Onroad Source	MTCO ₂ e	%
Motorcycle	76,427	0.4
Passenger Car	9,617,356	55.3
Passenger Truck	2,836,272	16.3
Motor Home	73,218	0.4
Light Commercial Truck	725,901	4.2
Refuse Truck	159,038	0.9
Single Unit Short-haul Truck	2,100,533	12.1
Single Unit Long-haul Truck	124,371	0.7
Combination Short-haul Truck	436,182	2.5
Combination Long-haul Truck	1,146,411	6.6
Intercity Bus	13,321	0.1
Transit Bus	22,228	0.1
School Bus	44,437	0.3
Total:	17,375,693	100.0

Table 5. Maricopa County nonroad mobile source 2018 greenhouse gas emissions.

Nonroad Source	MTCO ₂ e	%
Agriculture	41,629	1.6
Commercial	193,788	7.7
Construction	1,759,421	69.6
Industrial	287,798	11.4
Lawn/Garden	213,609	8.4
Pleasure Craft	8,554	0.3
Railroad Maintenance	722	< 0.1
Recreational	22,453	0.9
Total:	2,527,974	100.0

Table 6. Maricopa County airport mobile source 2018 greenhouse gas emissions (MTCO₂e).

Airport	Air Carrier	Air Taxi	General Aviation	Military	Total	%
Chandler	0	734	21,280	39	22,052	2.6
Deer Valley (Phoenix)	3	1,255	56,641	16	57,914	6.9
Falcon Field (Mesa)	0	18,628	25,849	313	44,790	5.3
Glendale	0	69	14,003	16	14,087	1.7
Goodyear	86	1,454	13,600	1,776	16,916	2.0
Williams Gateway (Mesa)	11,233	11,801	24,904	3,174	51,111	6.1
Sky Harbor (Phoenix)	434,984	17,950	5,135	5,031	463,101	55.1
Scottsdale	3	4,453	33,144	150	37,749	4.5
SkyRanch (Carefree)	0	0	386	0	386	< 0.1
Wickenburg	0	101	4,757	287	5,144	0.6
Stellar (Chandler)	0	0	4,118	0	4,118	0.5
Gila Bend	0	288	6,195	59	6,541	0.8
Buckeye	0	55	9,249	123	9,427	1.1
Pleasant Valley (Peoria)	0	0	1,026	0	1,026	0.1
Luke Air Force Base (Glendale)	0	0	0.0	106,010	106,010	12.6
Total:	446,309	56,785	220,287	116,991	840,372	100.0

Stationary Fuel Consumption

Greenhouse gas emissions from stationary fuel combustion at residential, commercial, and industrial sources were estimated based on 2017 fuel use data. The 2017 fuel use data was used as a surrogate for 2018 data, because fuel use data for 2018 was not available. The amount of distillate oil and natural gas used at residential, commercial, and industrial sources was obtained from the EPA Institutional, Commercial, and Industrial (ICI) fuel use tool. The 2017 ICI fuel use tool also indicated the amount of liquid petroleum gas (LPG) used at commercial and industrial sources. However, the 2017 ICI fuel use tool did not include the amount of LPG used at residential sources. Therefore, residential LPG fuel use was estimated by extrapolating 2014 residential LPG fuel use to 2018 using the proportion of increased population in Maricopa County. Likewise, all remaining fuel use in all categories were extrapolated to 2018 levels based on the population increase from 2017 to 2018 in Maricopa County. Stationary fuel combustion totals were allocated to municipalities and nonincorporated areas based on their population proportions. Table 7 gives the 2018 Maricopa County GHG emissions for stationary fuel use by sector. The total stationary fuel GHG emissions are 5.1 million MTCO₂e, or 10.0% of the total Maricopa County GHG total. Table 8 shows the break-out of fuel type used by the different source types in Maricopa County during 2018.

Table 7. Maricopa County stationary fuel combustion GHG emissions by economic sector.

Category	MTCO ₂ e	%
Industrial:	3,355,458	65.5
Commercial:	1,135,599	22.2
Residential:	632,320	12.3
Total:	5,123,377	

Table 8. Maricopa County stationary fuel combustion GHG emissions by source type.

Category	MTCO ₂ e	%
Industrial Distillate Oil: Boilers	1,679,960	32.8
Industrial Distillate Oil: Engines	1,119,973	21.9
Industrial Natural Gas	11,653	0.2
Industrial Liquefied Petroleum Gas	543,872	10.6
Commercial/institutional distillate oil: Boilers	58,381	1.1
Commercial/institutional distillate oil: Engines	3,073	0.1
Commercial/institutional natural gas	18,808	0.4
Commercial/institutional LPG	1,055,337	20.6
Residential Heating Distillate Oil	3,220	0.1
Residential Heating Natural Gas	14,984	0.3
Residential Heating LPG	614,116	12.0
Total:	5,123,377	

Wastewater

GHG emissions from wastewater were calculated using the EPA GHG Tool (US EPA, 2018). The EPA GHG Tool estimates emissions of CH₄ from incomplete combustion of digester gas, fugitive emissions of CH₄ from process lagoons, N₂O from nitrification and denitrification processes, and N₂O emissions from effluent discharge. Input data for sewer system wastewater treatment model parameters for the EPA GHG Tool were acquired using an online web survey administered by MCAQD. Thirteen wastewater treatment facilities, representing a total of 3,549,825 people in Maricopa County, responded to the survey. The remaining 744,635 residents were assumed to be on septic systems, which represents 17.3% of the population in Maricopa County. This 17.3% of the population on septic is roughly consistent with the most recent US Census survey data from 1990 that showed an 18.7% rate of septic use at that time (US Census Bureau, 2011). The EPA GHG Tool was also used to calculate the GHG emissions from the county population using septic systems. Wastewater treatment yielded 763,987 MTCO₂e for 82.7% of the county population, while septic systems emitted 183,519 MTCO₂e of GHG for 17.3% of the county population. Wastewater GHG emissions were allocated to the municipalities and nonincorporated area according to population proportion and represent 1.8% of the total GHG emitted by Maricopa County in 2018.

Livestock (Cattle)

Methane emissions from cattle livestock in Maricopa County are calculated based on the 2017 population of beef and dairy cattle reported by the National Agricultural Statistics Service (NASS) as a surrogate for 2018 data, because 2018 data was not available. NASS reports that in 2017 there were 3,034 beef cattle, and 121,778 dairy cattle in Maricopa County. The CH₄ emissions from these cattle were calculated using revised emission factors from *Revised methane emission factors and spatially distributed annual carbon fluxes for global livestock* (Wolf, Asrar, & West, 2017) for manure and enteric CH₄ generation. The emission factors used in these calculations are from Wolf, Asrar, & West (2017) Table 3 for the US-Canada region. Beef cattle GHG emissions were 4,642 MTCO₂e and dairy cattle GHG emissions were 900,244 MTCO₂e, which totaled 904,886 MTCO₂e overall. GHG emissions from cattle livestock were allocated to the municipalities and nonincorporated area according to GIS proportion of land

area in those locations used for cattle production. Cattle livestock GHG emissions in 2018 were 1.8% of the total GHG emissions for Maricopa County.

Solid Waste

The EPA Facility Level GHG Emissions Data Tool (FLIGHT) was used to obtain data on landfill GHG emissions for all landfills except the City of Chandler Landfill which had FLIGHT reporting discontinued due to low emission levels. For the City of Chandler Landfill, reported landfill parameters from survey administered by MCAQD were used to calculate GHG emissions using the GHG Tool. All other landfills reported 2018 GHG emissions in the FLIGHT Tool, except for the Salt River Landfill which did not have a value for 2018. For the Salt River Landfill, emissions from the FLIGHT Tool from 2010-2014 were used as an estimate of the 2018 Salt River Landfill GHG emissions. Table 9 shows the landfill GHG emissions for each landfill, totaling 656,745 MTCO_{2e}, or 1.3% of the total 2018 GHG emissions for Maricopa County. Solid waste GHG emissions were allocated to the municipalities and nonincorporated area according to population proportion.

Table 9. Greenhouse gas emissions from landfills serving Maricopa County.

Landfill	MTCO _{2e}
Butterfield Station Facility	35,132
Cave Creek Landfill	21,249
City of Chandler Landfill	519
City of Glendale Landfill	92,465
City of Phoenix - Skunk Creek Landfill	58,017
City of Phoenix 27th Ave Landfill	39,581
Lone Cactus Landfill	68,956
Northwest Regional Landfill	101,475
Queen Creek Landfill	59,386
Salt River Landfill	5,967
Southwest Regional Landfill	35,365
SR 85 Landfill	138,633
Total:	656,745

Manufacturing Gases

Manufacturing often involves the use of specialized gases with GHG emission factors that can be thousands of times more powerful than CO₂. This makes accounting of such gases an important part of a GHG inventory. The FLIGHT Tool was used to gather 2018 reported emissions of these specialized gases, CH₄, and N₂O from semiconductor manufacturing in Maricopa county but not CO₂, because CO₂ emissions are captured in the section in this report for on-site fuel combustion. Specialized gases included in this section of the inventory, in addition to CH₄ and N₂O, include sulfur hexafluoride (SF₆), nitrogen trifluoride (NF₃), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), hydrofluoroethers (HFEs), and other fully fluorinated (OFF) GHG. Table 10 shows the breakdown of emissions of these specialty gases by gas type with a total of 565,059 MTCO_{2e}. The distribution of GHG emissions from manufacturing is allocated to the municipalities and

nonincorporated areas according to population under the assumption that these facilities represent a regional economic resource that extends beyond the municipalities in which the facilities reside. These specialty manufacturing gases represent 1.1% of the total GHG emissions for Maricopa County in 2018.

Table 10. Semiconductor manufacturing GHG emissions.

Gas	MTCO _{2e}
CH ₄	35
N ₂ O	44,646
SF ₆	91,740
NF ₃	59,001
HFCs	59,082
PFCs	251,022
HFES	35
OFF	59,498
Total:	565,059

Imported Water Electricity Use

The electricity consumed outside of Maricopa County for the purpose of pumping Central Arizona Project (CAP) water into the county is a source of GHG emissions. Data on the 2018 CAP imported water and electricity intensity to pump water into Maricopa County was provided by the Decision Center for a Desert City (Ray Quay, PhD, personal communication January 27, 2020). The data shows that the amount of CAP imported water into Maricopa County in 2018 was 335,000 acre-feet (ac-ft), with an electric power intensity of 1,525 kWh/ac-ft resulting in a total of 510,875 MWh of electricity used to import CAP water into Maricopa County in 2018. GHG emissions from electricity used to pump CAP water into Maricopa County were calculated using a GHG emission factor for the U.S. southwest regional electrical grid, 0.4795 MTCO_{2e}/MWh, from the EPA GHG Tool, resulting in a total of 243,129 MTCO_{2e} of GHG emissions in 2018. These GHG emissions were allocated to municipalities and nonincorporated areas based on population proportion and are 0.5% of the total GHG emitted from Maricopa County in 2018.

Agriculture and Land Management

Nitrogen fertilizer is a source of N₂O GHG emissions. There is no central database of farm and non-farm nitrogen fertilizer use in Maricopa County for 2018. However, a study was completed in 2012 by the US Geologic Survey that estimated county level nitrogen fertilizer use from 1987-2006 (USGS, 2012). This data was used to generate a linear regression model for both farm and non-farm nitrogen fertilizer use to estimate 2018 usage. For the nonfarm data, values for 1988, 2005 and 2006 were excluded from the regression as outliers. The resulting regression equation predicting farm fertilizer use (y) in kilograms (kg) as a function of year (x) was $y = 605,748,536.7 - 293391.7x$, and the regression equation for non-farm fertilizer was $y = 2,984,294.9 - 1370.1x$. These equations result in 2018 estimated nitrogen fertilizer use of 13,684,107 kg, or 15,084 tons for farms, and 219,528 kg, or 242 tons for non-farm use. A conservative assumption was made that all the nitrogen fertilizer

used was synthetic. Therefore, the EPA GHG Tool was used to estimate N₂O GHG emissions from nitrogen fertilizer use for the farm and non-farm categories using the estimated totals from the regression equations assuming 100% synthetic fertilizer. This resulted in total GHG emission for farm and non-farm fertilizer use of 123,706 MTCO₂e and 1,953 MTCO₂e, respectively. This results in a total of 123,706 MTCO₂e for both types of fertilizer use within Maricopa County, or 0.2% of all GHG emitted from Maricopa County in 2018.

Farm and non-farm N₂O GHG emissions from nitrogen fertilizer use were allocated to municipalities using GIS land use data for parcels in Maricopa County. Farm GHG emissions from nitrogen fertilizer were allocated based on the relative area of parcels zoned for agriculture in each municipality and in unincorporated areas. Non-farm GHG emissions from nitrogen fertilizer were allocated based on the relative area of parcels zoned for residential use, city parks, and golf. Farm fertilizer use was assumed to be uniform and no distinction was made for different nitrogen fertilizer use rates for different crop types. Residential open land area was determined by subtracting the building area from the land area. For residential parcels, 33% of the open land area was assumed to be vegetated and available for fertilizer application. This approach has the limitation that the reduction in yard area by subtracting the building area is overestimated whenever a property has more than a single floor on the property. City park area was also assumed to be 33% vegetated when calculating the amount of land that was available for fertilizer application. The entire land area of golf courses was assumed to be vegetated and available for fertilizer application. However, golf courses were weighted by an additional factor of 5.4 relative to residential and park areas because golf courses use, on average, 5.4 times as much fertilizer per acre compared to residential application (GCSAA, 2009; USGS, 2012).

Urban Forestry

The EPA GHG Tool was used to calculate the amount of carbon sequestration that occurs in Maricopa County due to urban tree cover. During photosynthesis, trees take in CO₂ from the atmosphere and convert it to organic carbon as they grow. The EPA EnviroAtlas (EPA, 2020d) was used to acquire the GIS spatial data layers for percent tree cover in Maricopa County. This data provided comprehensive information about tree cover in the urban core, but it did not extend to all portions of the county. Specifically, EnviroAtlas did not contain tree cover data for Gila Bend and Wickenburg, and contained incomplete tree cover data for several areas, which is summarized in Table 11 with areas less than 100% EnviroAtlas coverage. Urban tree cover was not extrapolated beyond the EPA EnviroAtlas data and therefore is a conservative estimate. GIS land use was used to determine the tree coverage percent and extent for residential, commercial, and industrial parcels in each municipality and in unincorporated areas based on GIS land-use codes. Table 12 shows the urban forestry carbon sequestration by sector, with a total of 160,151 MTCO₂e across all sectors. Figure 2 below shows the GIS percent tree coverage from EnviroAtlas.

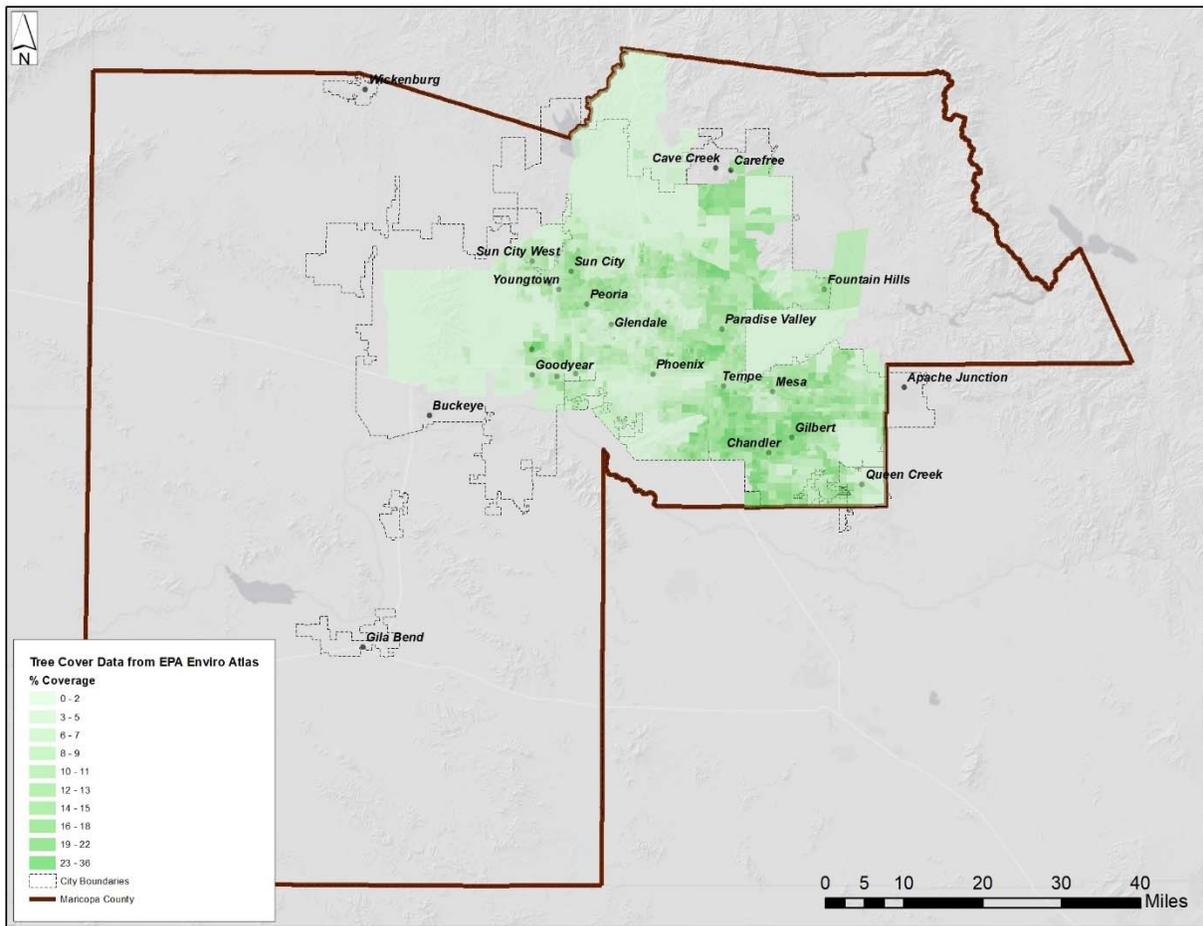
Table 11: Municipalities with less than 100% EnviroAtlas tree coverage data.

Location	Coverage (%)
Apache Junction	0.2
Avondale	46.0
Buckeye	29.9
Carefree	48.2
Cave Creek	5.1
Chandler	97.9
Gila Bend	0.0
Goodyear	31.2
Peoria	44.2
Queen Creek	84.9
Scottsdale	78.3
Surprise	43.8
Wickenburg	0.0
Unincorporated areas	75.9

Table 12. Urban forestry carbon sequestration by sector.

Sector	MTCO ₂ e
Residential	90,794
Commercial	63,140
Industrial	6,217
Total:	160,151

Figure 4. Percent tree cover in Maricopa County from the EPA EnviroAtlas.



References

- Golf Course Superintendents Association of America (GCSAA), 2009. Environmental Institute for Golf: Golf Course Environmental Profile Nutrient Use and Management on U.S. Golf Courses Volume III. <https://www.gcsaa.org/uploadedfiles/Environment/Environmental-Profile/Nutrient/Golf-Course-Environmental-Profile--Nutrient-Management-Report.pdf>
- IPCC (2007). Intergovernmental Panel on Climate Change Fourth Assessment Report, September 2007. <https://www.ipcc.ch/assessment-report/ar4/>
- US Census Bureau (2011). Historical Census of Housing Tables (October, 2011). <https://www.census.gov/hhes/www/housing/census/historic/sewage.html>
- EPA (2012). Locomotive Emission Inventories for the United States from ERTAC Rail, August 2012. <https://www3.epa.gov/ttnchie1/conference/ei20/session8/mbergin.pdf>
- EPA (2018). User's Guide Local Greenhouse Gas Inventory Tool: Community Module (March 2018). <https://www.epa.gov/statelocalenergy/forms/download-local-greenhouse-gas-inventory-tool-and-sign-updates>
- EPA (2020a). Facility Level Greenhouse Gas Tool (FLIGHT). <https://ghgdata.epa.gov/ghgp/main.do>
- EPA (2020b). eGrid Summary Tables 2018. https://www.epa.gov/sites/production/files/2020-01/documents/egrid2018_summary_tables.pdf
- EPA (2020c). GHG Reporting Program Data Sets: 2018 Data Summary Spreadsheets. <https://www.epa.gov/ghgreporting/ghg-reporting-program-data-sets>
- EPA (2020d). EnviroAtlas Tool. <https://www.epa.gov/enviroatlas>
- USGS (2012). National Water-Quality Assessment Program, County-Level Estimates of Nitrogen and Phosphorus from Commercial Fertilizer for the Conterminous United States 1987-2006. Scientific Investigations Report 2012-5207. <https://pubs.er.usgs.gov/publication/sir20125207>
- Wikipedia (2020). Sulfur Hexafluoride. https://en.wikipedia.org/wiki/Sulfur_hexafluoride (accessed April 6, 2020).
- Wolf, J., Asrar, G., and West, T. (2017). Revised methane emission factors and spatially distributed annual carbon fluxes for global livestock. *Carbon Balance and Management*, 12:16. <https://cbmjournals.biomedcentral.com/articles/10.1186/s13021-017-0084-y>

2018 Greenhouse Gas Emissions Profiles for Maricopa County Municipalities and Unincorporated Area

The various jurisdictions in Maricopa County have different GHG emission profiles based on the proportion of activity present from different source categories within those areas. GHG Emissions from the following source categories were equally allocated across jurisdictions based on population proportion: mobile sources, stationary fuel combustion, wastewater, solid waste, manufacturing gases, and imported water from the Central Arizona Project. This allocation method was used because there was insufficient data available for a different allocation approach in these source categories. Other than mobile sources, emissions from categories that were allocated based on population proportion are minor components of the overall GHG emissions profile. As a result of this allocation method, the percentage of mobile source emissions from each mobile source subcategory is the same across all jurisdictions.

GHG emissions from electricity were allocated based on electricity use in each jurisdiction, as reported by the electrical utilities. The emissions profiles vary significantly with regard to the percentage of GHG emissions from electricity, as well as the portion of the electricity used by residential, commercial, and industrial sectors. For example, Avondale, Buckeye, El Mirage, Glendale, Guadalupe, and Youngtown have a smaller electricity GHG emissions contribution relative to transportation when compared to Maricopa County as a whole, which indicates that those jurisdictions have lower per capita electricity use than other jurisdictions.

The per capita net 2018 GHG emission rate is also an indicator of the relative GHG emissions intensity of different jurisdictions, with Maricopa County having an overall per capita net GHG emissions of 11.9 MTCO₂e. Cave Creek, Litchfield Park, and Paradise Valley have respective net per capita GHG emissions of 31.1, 23.9, and 19.5 MTCO₂e that are driven by a much larger share of electricity consumption relative to Maricopa County as a whole which comes mostly from the residential sector. Areas with larger net per capita GHG emission rates often have economic activity and production that benefit all of Maricopa County and should be considered in this context. Gila Bend and Tolleson have respective per capita net GHG emissions of 33.5 and 44.9 MTCO₂e, with a very large proportion of overall emissions coming from electricity, for which the largest sector component of electricity use is industrial.

GHG emissions from livestock and fertilizer use were allocated based on GIS analysis of parcel data from the Maricopa County Assessor's website. Emissions from these categories were also minor components of the overall GHG emissions profile.

The unincorporated area of Maricopa County is more rural than other jurisdictions and as expected has a larger share of livestock and fertilizer use emissions based on land use as compared to Maricopa County as a whole.



Apache Junction[†] 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	1,767	45.8
Mobile Sources	1,540	39.9
Stationary Fuel Combustion	378	9.8
Wastewater	70	1.8
Solid Waste	48	1.3
Manufacturing (Fluorinated Gas Use)	42	1.1
Imported Water (Electricity Used)	18	0.5
Livestock (Cattle)	0	0
Fertilizer Use	0	0

Gross GHG Emissions
3,863 MTCO₂e

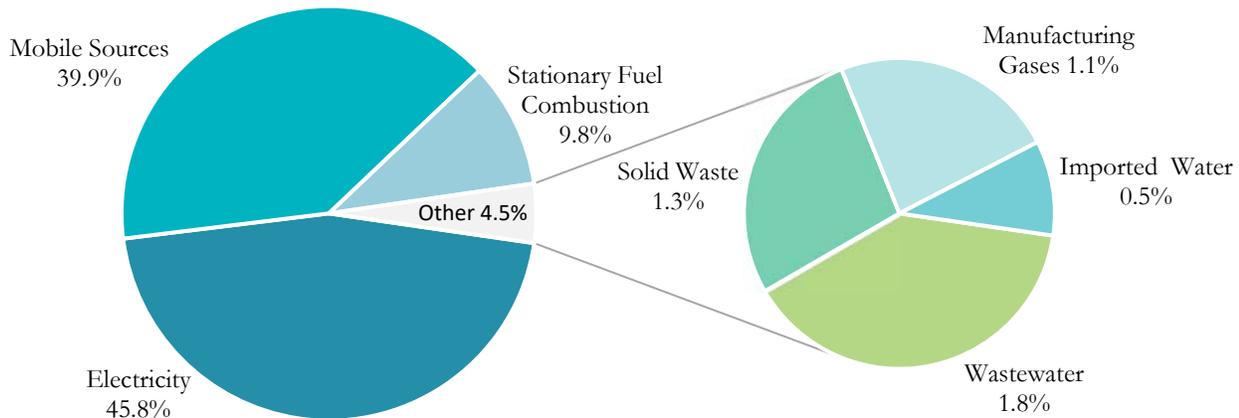
GHG Reductions (Urban Forestry)
-8 MTCO₂e

Net GHG Emissions
3,855 MTCO₂e

Per Capita Net GHG Emissions
12.2 MTCO₂e

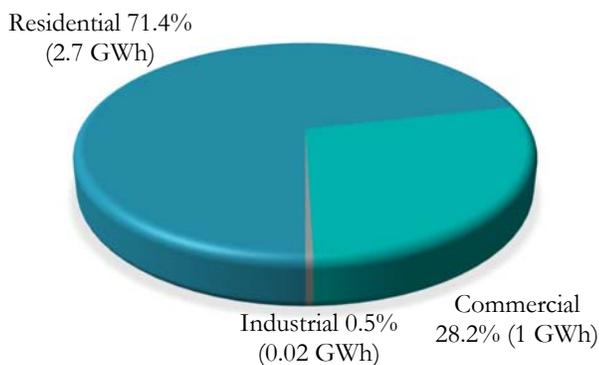
*Metric tons of carbon dioxide equivalent; [†]Emissions from Maricopa County portion of Apache Junction

Apache Junction Greenhouse Gas Emissions by Source Category**

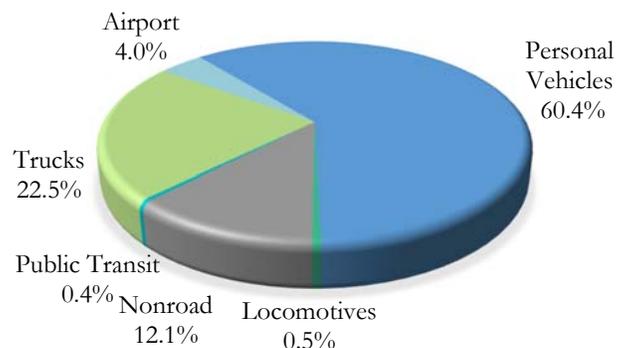


**Fertilizer use and livestock not included

Apache Junction Electricity Use GHG Emissions by Economic Sector



Apache Junction Mobile Source GHG Emissions





Avondale 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	291,419	34.8
Mobile Sources	401,193	47.9
Stationary Fuel Combustion	98,549	11.8
Wastewater	18,226	2.2
Solid Waste	12,633	1.5
Manufacturing (Fluorinated Gas Use)	10,869	1.3
Imported Water (Electricity Used)	4,580	0.5
Livestock (Cattle)	0	0
Fertilizer Use	766	0.1

*Metric tons of carbon dioxide equivalent

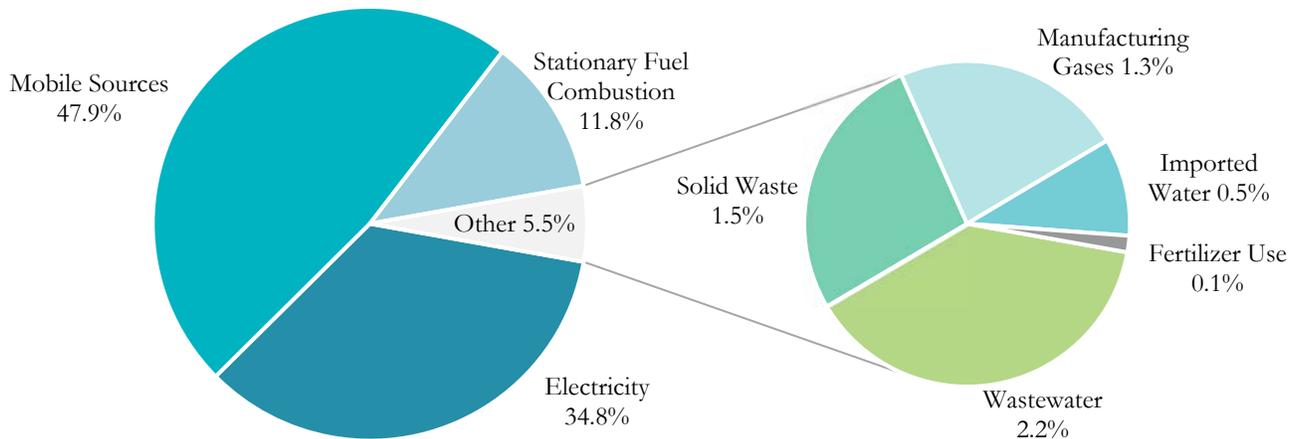
Gross GHG Emissions
838,234 MTCO₂e

GHG Reductions (Urban Forestry)
-2,255 MTCO₂e

Net GHG Emissions
835,979 MTCO₂e

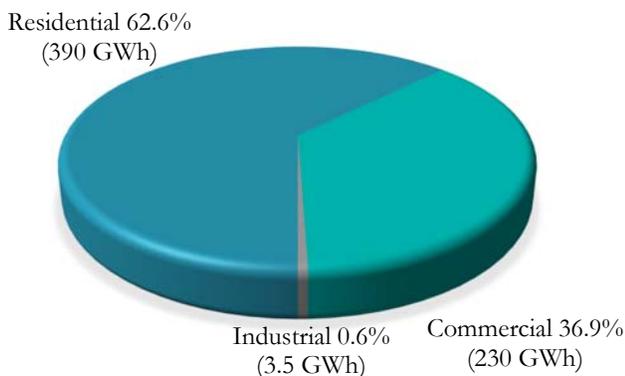
Per Capita Net GHG Emissions
10.1 MTCO₂e

Avondale Greenhouse Gas Emissions by Source Category**

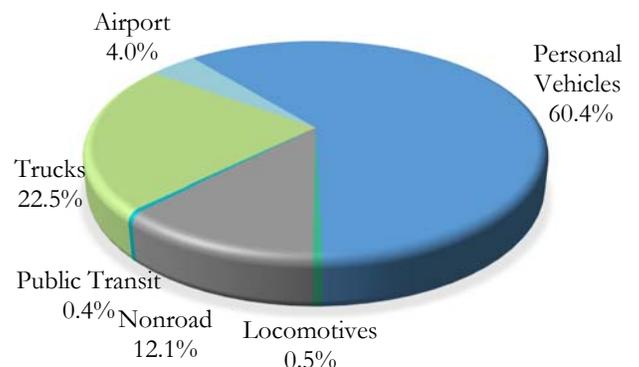


**Livestock not included

Avondale Electricity Use GHG Emissions
by Economic Sector



Avondale Mobile Source GHG
Emissions





Buckeye 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	280,784	34.8
Mobile Sources	369,818	45.8
Stationary Fuel Combustion	90,843	11.3
Wastewater	16,800	2.1
Solid Waste	11,645	1.4
Manufacturing (Fluorinated Gas Use)	10,019	1.2
Imported Water (Electricity Used)	4,222	0.5
Livestock (Cattle)	15,074	1.9
Fertilizer Use	7,407	0.9

*Metric tons of carbon dioxide equivalent

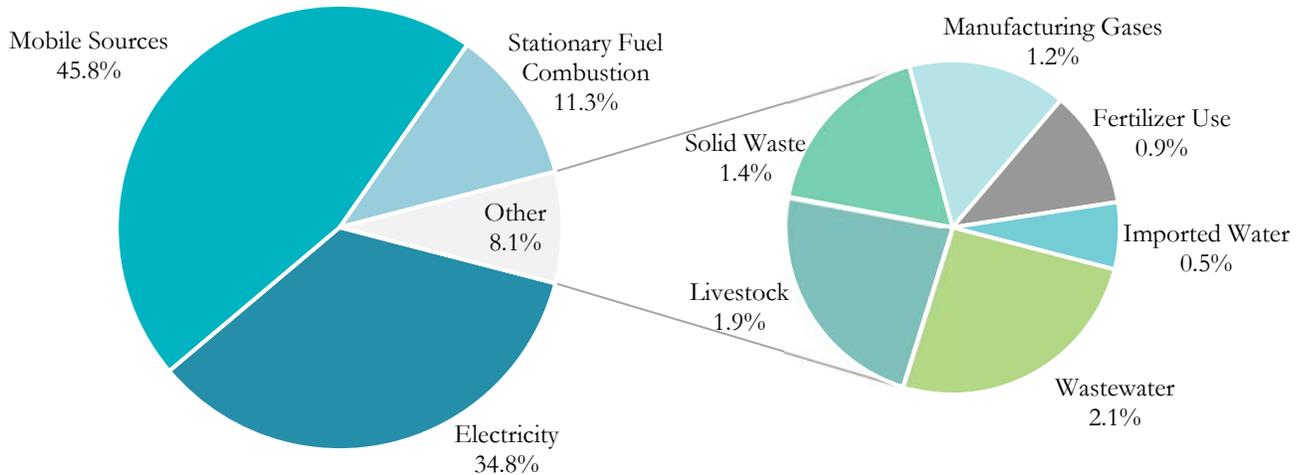
Gross GHG Emissions
806,613 MTCO₂e

GHG Reductions (Urban Forestry)
-1,425 MTCO₂e

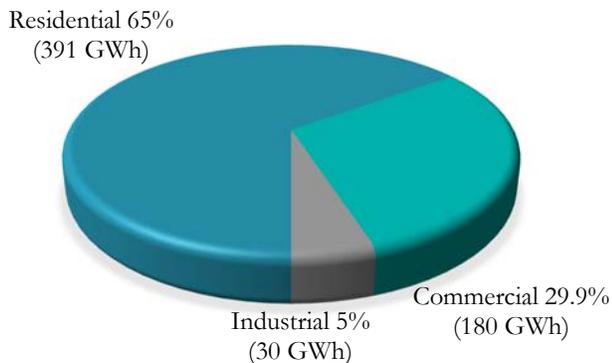
Net GHG Emissions
805,187 MTCO₂e

Per Capita Net GHG Emissions
10.6 MTCO₂e

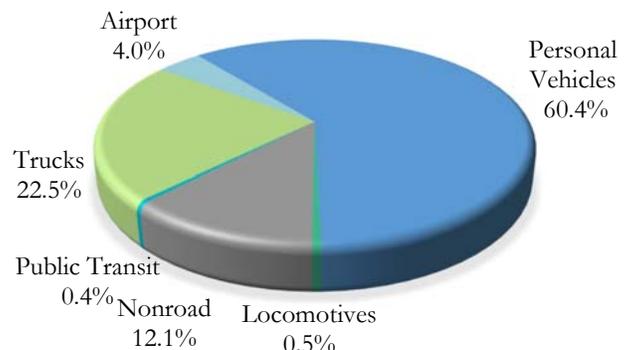
Buckeye Greenhouse Gas Emissions by Source Category



Buckeye Electricity Use GHG Emissions
by Economic Sector



Buckeye Mobile Source GHG
Emissions





Carefree 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	24,811	47.8
Mobile Sources	18,077	34.9
Stationary Fuel Combustion	6,872	13.3
Wastewater	821	1.6
Solid Waste	569	1.1
Manufacturing (Fluorinated Gas Use)	490	0.9
Imported Water (Electricity Used)	206	0.4
Livestock (Cattle)	0	0
Fertilizer Use	13	0

*Metric tons of carbon dioxide equivalent

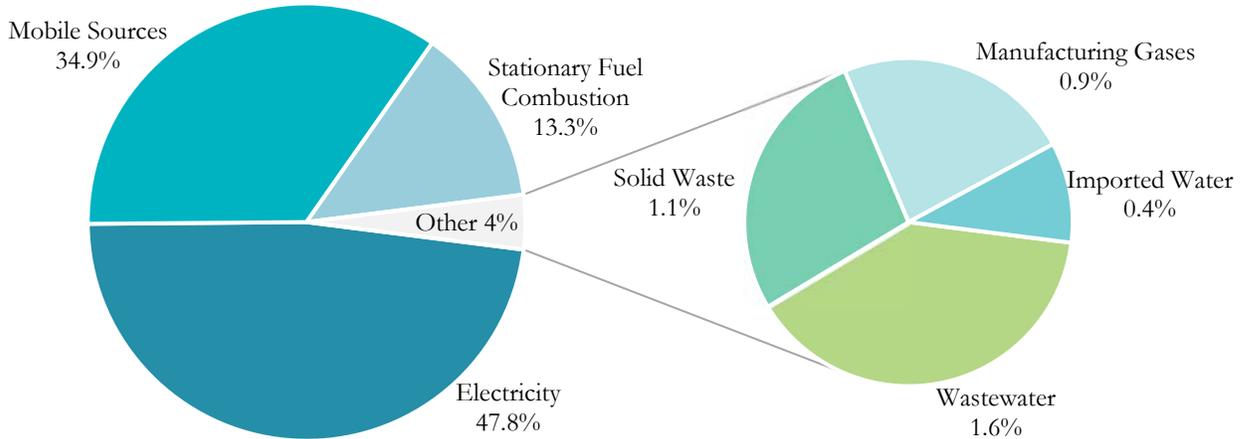
Gross GHG Emissions
51,859 MTCO₂e

GHG Reductions (Urban Forestry)
-168 MTCO₂e

Net GHG Emissions
51,692 MTCO₂e

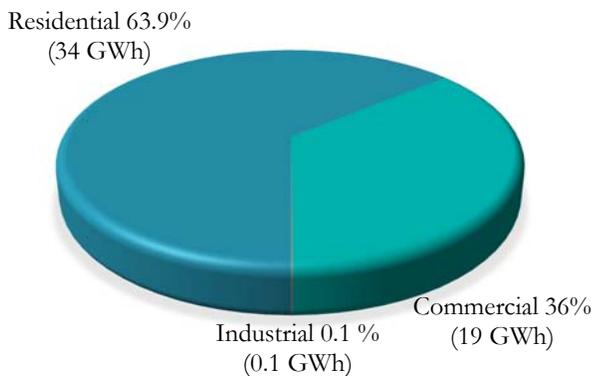
Per Capita Net GHG Emissions
13.9 MTCO₂e

Carefree Greenhouse Gas Emissions by Source Category**

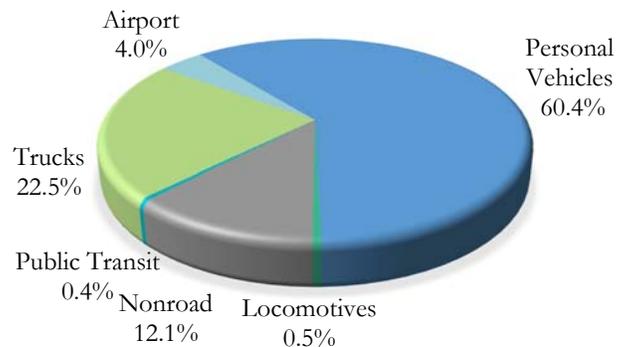


**Fertilizer use and livestock not included

Carefree Electricity Use GHG Emissions by Economic Sector



Carefree Mobile Source GHG Emissions





Cave Creek 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	141,053	78.7
Mobile Sources	27,975	15.6
Stationary Fuel Combustion	6,872	3.8
Wastewater	1,271	0.7
Solid Waste	881	0.5
Manufacturing (Fluorinated Gas Use)	758	0.4
Imported Water (Electricity Used)	319	0.2
Livestock (Cattle)	0	0
Fertilizer Use	19	0

*Metric tons of carbon dioxide equivalent

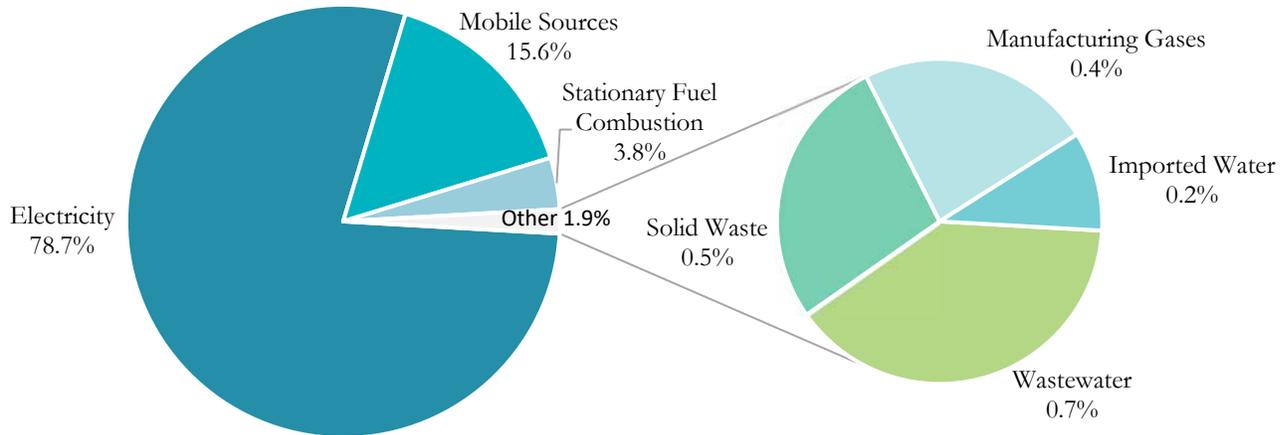
Gross GHG Emissions
179,148 MTCO₂e

GHG Reductions (Urban Forestry)
-168 MTCO₂e

Net GHG Emissions
178,980 MTCO₂e

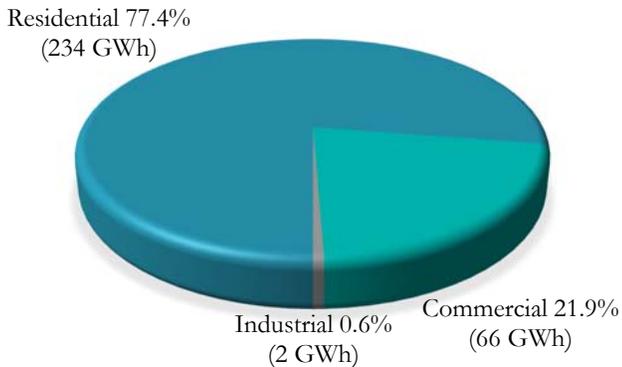
Per Capita Net GHG Emissions
31.1 MTCO₂e

Cave Creek Greenhouse Gas Emissions by Source Category**

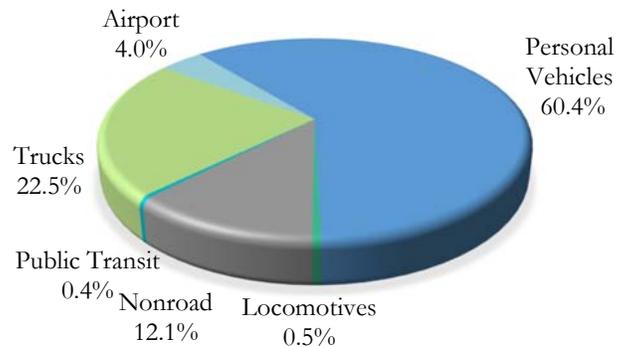


**Fertilizer use and livestock not included

Cave Creek Electricity Use GHG Emissions by Economic Sector



Cave Creek Mobile Source GHG Emissions





Chandler 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	GHG Emissions Percent
Electricity Use	2,269,670	56.6
Mobile Sources	1,274,036	31.8
Stationary Fuel Combustion	312,955	7.8
Wastewater	57,877	1.4
Solid Waste	40,116	1
Manufacturing (Fluorinated Gas Use)	34,516	0.9
Imported Water (Electricity Used)	14,544	0.4
Livestock (Cattle)	2,158	0.1
Fertilizer Use	831	0

*Metric tons of carbon dioxide equivalent

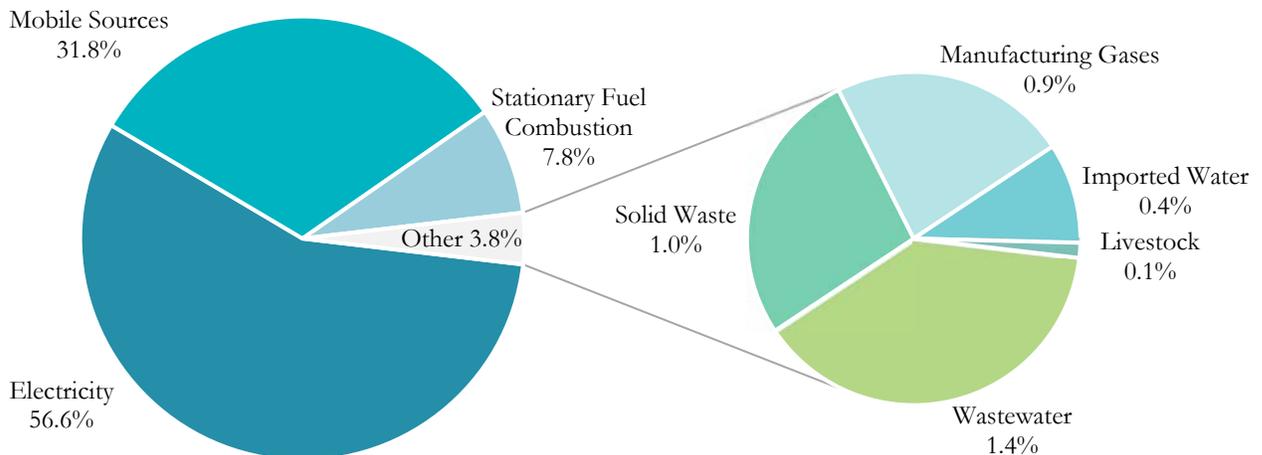
Gross GHG Emissions
4,006,704 MTCO₂e

GHG Reductions (Urban Forestry)
-12,230 MTCO₂e

Net GHG Emissions
3,994,474 MTCO₂e

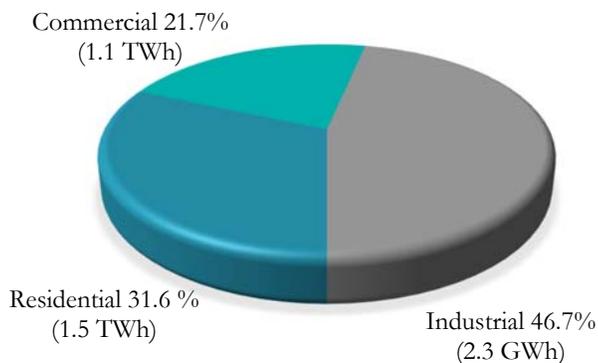
Per Capita Net GHG Emissions
15.2 MTCO₂e

Chandler Greenhouse Gas Emissions by Source Category**

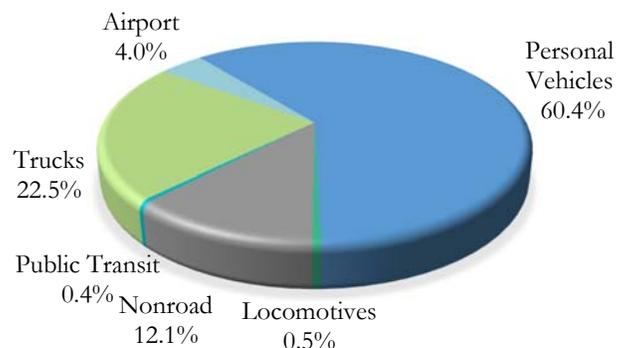


**Fertilizer use not included

Chandler Electricity Use GHG Emissions by Economic Sector



Chandler Mobile Source GHG Emissions





El Mirage 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	*MTCO ₂ e	Percent
Electricity Use	92,979	29
Mobile Sources	166,548	52
Stationary Fuel Combustion	40,911	12.8
Wastewater	7,566	2.4
Solid Waste	5,244	1.6
Manufacturing (Fluorinated Gas Use)	4,512	1.4
Imported Water (Electricity Used)	1,901	0.6
Livestock (Cattle)	0	0
Fertilizer Use	567	0.2

*Metric tons of carbon dioxide equivalent

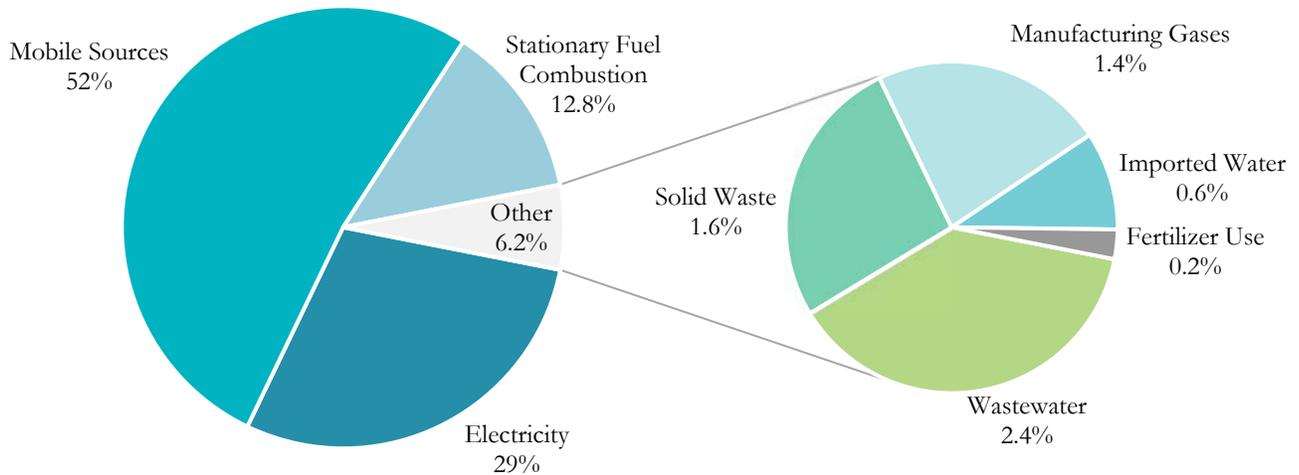
Gross GHG Emissions
320,229 MTCO₂e

GHG Reductions (Urban Forestry)
-801 MTCO₂e

Net GHG Emissions
319,428 MTCO₂e

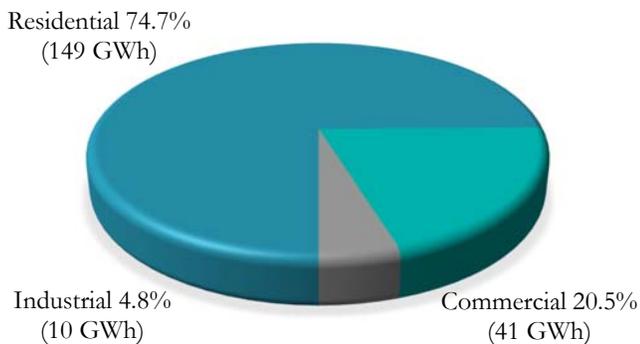
Per Capita Net GHG Emissions
9.3 MTCO₂e

El Mirage Greenhouse Gas Emissions by Source Category**

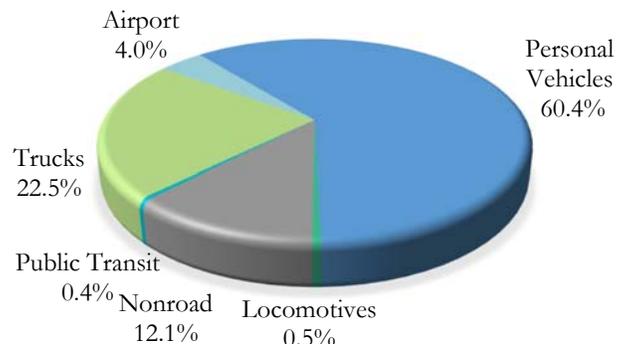


**Livestock not included

El Mirage Electricity Use GHG Emissions by Economic Sector



El Mirage Mobile Source GHG Emissions





Fountain Hills 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	*MTCO ₂ e	Percent
Electricity Use	128,974	44.8
Mobile Sources	116,703	40.5
Stationary Fuel Combustion	28,667	10
Wastewater	5,302	1.8
Solid Waste	3,675	1.3
Manufacturing (Fluorinated Gas Use)	3,162	1.1
Imported Water (Electricity Used)	1,332	0.5
Livestock (Cattle)	0	0
Fertilizer Use	31	0

*Metric tons of carbon dioxide equivalent

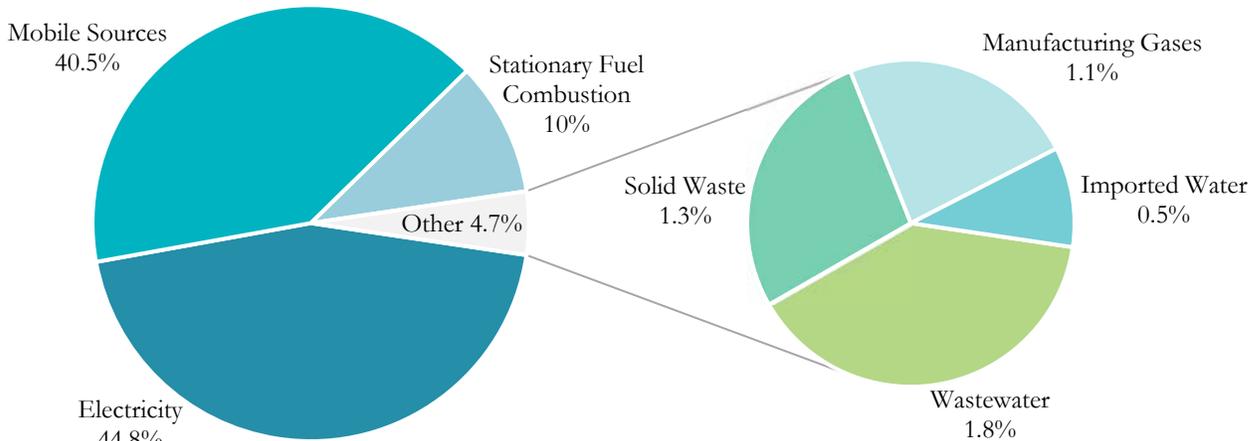
Gross GHG Emissions
287,846 MTCO₂e

GHG Reductions (Urban Forestry)
-2,108 MTCO₂e

Net GHG Emissions
285,737 MTCO₂e

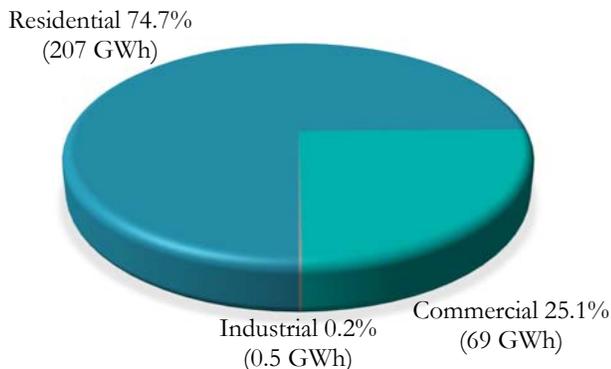
Per Capita Net GHG Emissions
8.3 MTCO₂e

Fountain Hills Greenhouse Gas Emissions by Source Category**

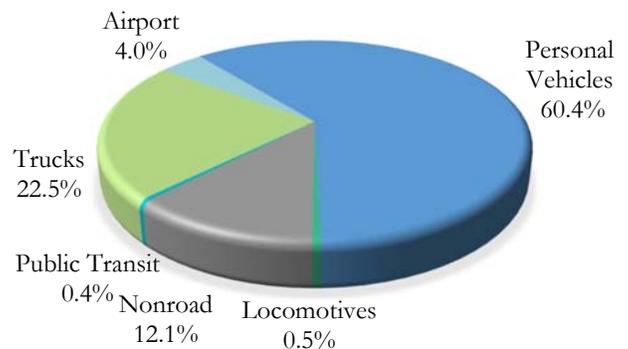


**Fertilizer use and livestock not included

Fountain Hills Electricity Use GHG Emissions by Economic Sector



Fountain Hills Mobile Source GHG Emissions





Gila Bend 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	*MTCO ₂ e	Percent
Electricity Use	52,909	78.5
Mobile Sources	9,782	14.5
Stationary Fuel Combustion	2,403	3.6
Wastewater	444	0.7
Solid Waste	308	0.5
Manufacturing (Fluorinated Gas Use)	265	0.4
Imported Water (Electricity Used)	112	0.2
Livestock (Cattle)	0	0
Fertilizer Use	1,151	1.7

*Metric tons of carbon dioxide equivalent

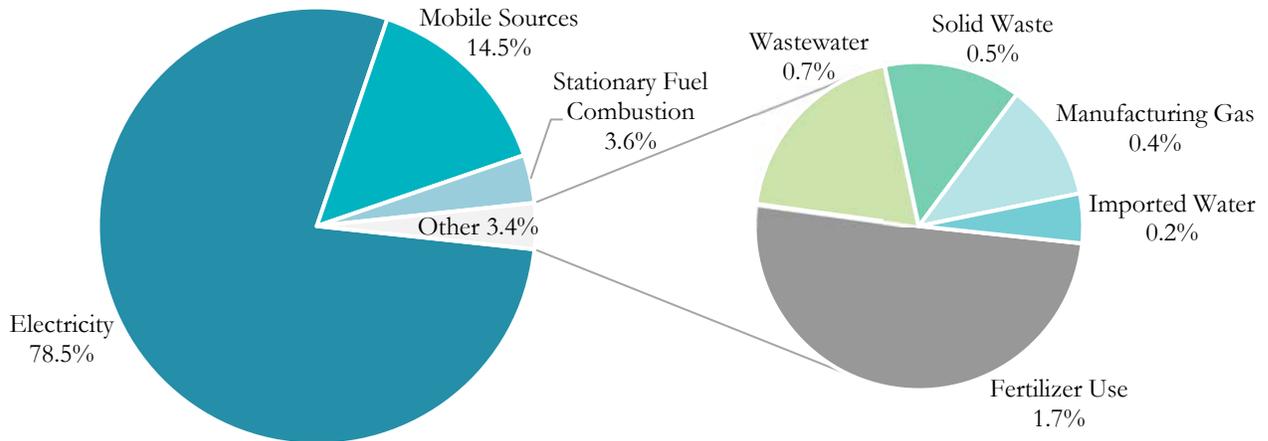
Gross GHG Emissions
67,373 MTCO₂e

GHG Reductions (Urban Forestry)
-0 MTCO₂e

Net GHG Emissions
67,373 MTCO₂e

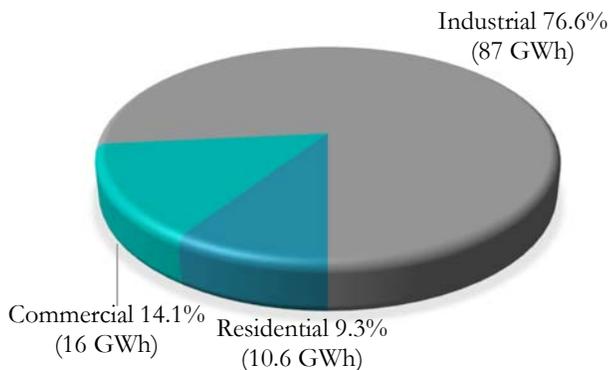
Per Capita Net GHG Emissions
33.5 MTCO₂e

Gila Bend Greenhouse Gas Emissions by Source Category**

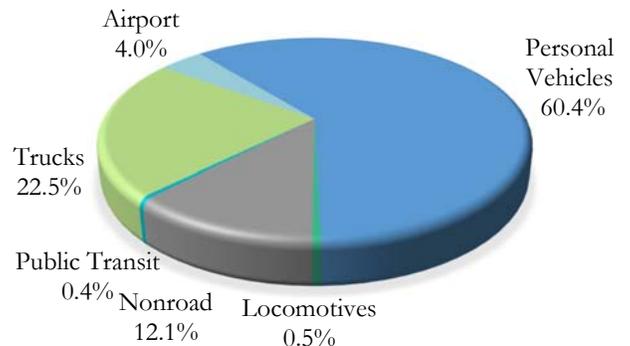


**Livestock not included

Gila Bend Electricity Use GHG Emissions by Economic Sector



Gila Bend Mobile Source GHG Emissions





Gilbert 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	*MTCO ₂ e	Percent
Electricity Use	1,086,151	39.3
Mobile Sources	1,228,936	44.5
Stationary Fuel Combustion	301,878	10.9
Wastewater	55,828	2
Solid Waste	38,696	1.4
Manufacturing (Fluorinated Gas Use)	33,294	1.2
Imported Water (Electricity Used)	14,029	0.5
Livestock (Cattle)	3,766	0.1
Fertilizer Use	1,309	0

*Metric tons of carbon dioxide equivalent

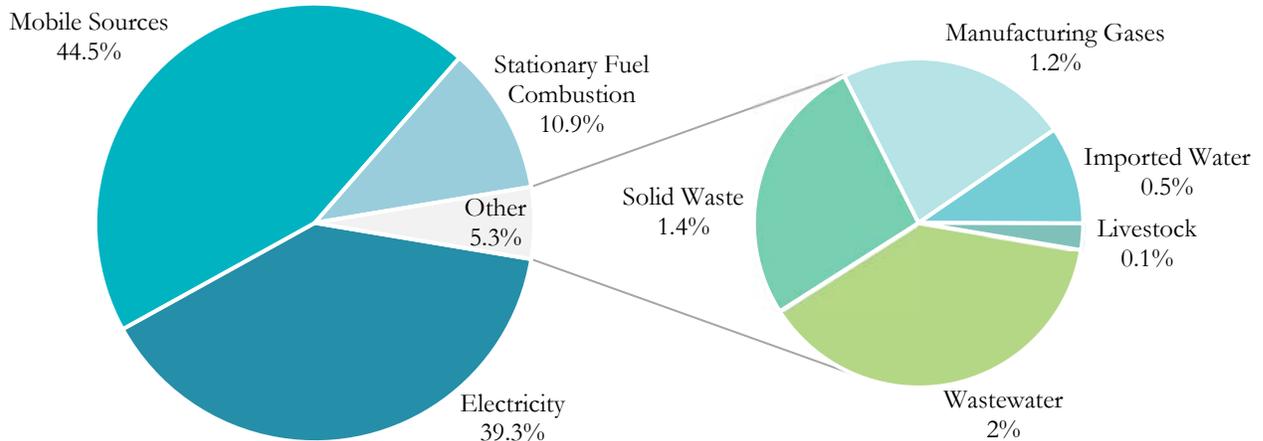
Gross GHG Emissions
2,763,888 MTCO₂e

GHG Reductions (Urban Forestry)
-9,589 MTCO₂e

Net GHG Emissions
2,754,299 MTCO₂e

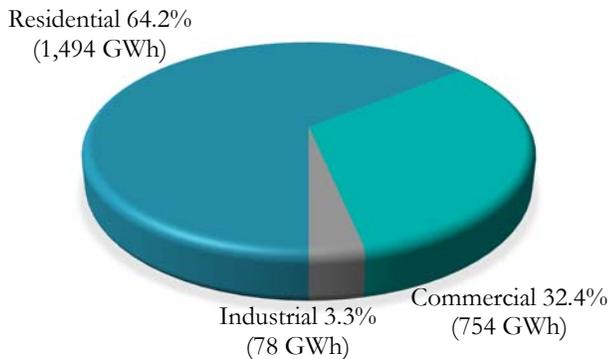
Per Capita Net GHG Emissions
10.9 MTCO₂e

Gilbert Greenhouse Gas Emissions by Source Category**

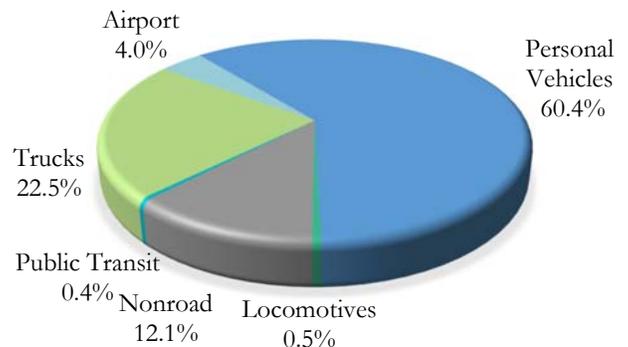


**Fertilizer use not included

Gilbert Electricity Use GHG
Emissions by Economic Sector



Gilbert Mobile Source GHG
Emissions





Glendale 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	*MTCO ₂ e	Percent
Electricity Use	508,175	24.1
Mobile Sources	1,174,579	55.7
Stationary Fuel Combustion	288,525	13.7
Wastewater	53,359	2.5
Solid Waste	36,985	1.8
Manufacturing (Fluorinated Gas Use)	31,821	1.5
Imported Water (Electricity Used)	13,409	0.6
Livestock (Cattle)	0	0
Fertilizer Use	936	0

*Metric tons of carbon dioxide equivalent

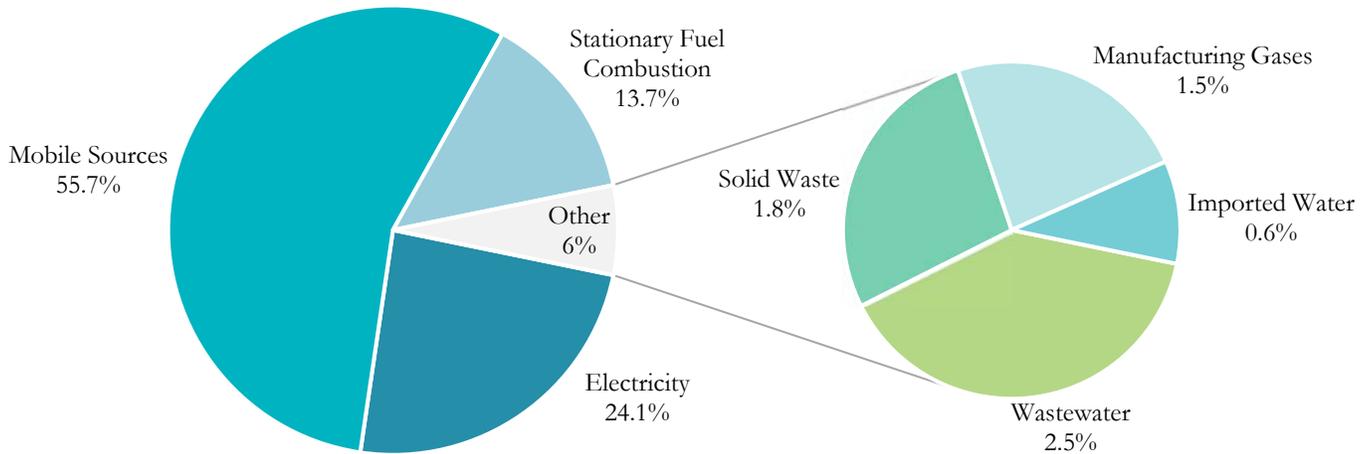
Gross GHG Emissions
2,107,789 MTCO₂e

GHG Reductions (Urban Forestry)
-4,707 MTCO₂e

Net GHG Emissions
2,103,081 MTCO₂e

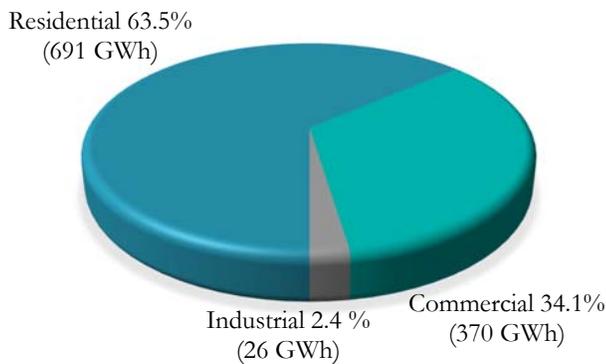
Per Capita Net GHG Emissions
8.3 MTCO₂e

Glendale Greenhouse Gas Emissions by Source Category**

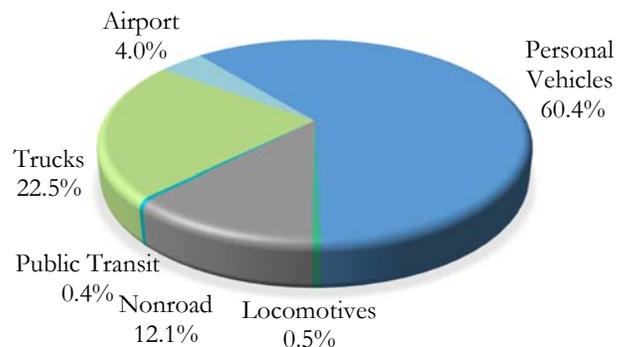


**Fertilizer use and livestock not included

Glendale Electricity Use GHG Emissions by Economic Sector



Glendale Mobile Source GHG Emissions





Goodyear 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	*MTCO ₂ e	Percent
Electricity Use	409,684	41.9
Mobile Sources	411,169	42
Stationary Fuel Combustion	101,000	10.3
Wastewater	18,679	1.9
Solid Waste	12,947	1.3
Manufacturing (Fluorinated Gas Use)	11,139	1.1
Imported Water (Electricity Used)	4,694	0.5
Livestock (Cattle)	2,589	0.3
Fertilizer Use	6,037	0.6

*Metric tons of carbon dioxide equivalent

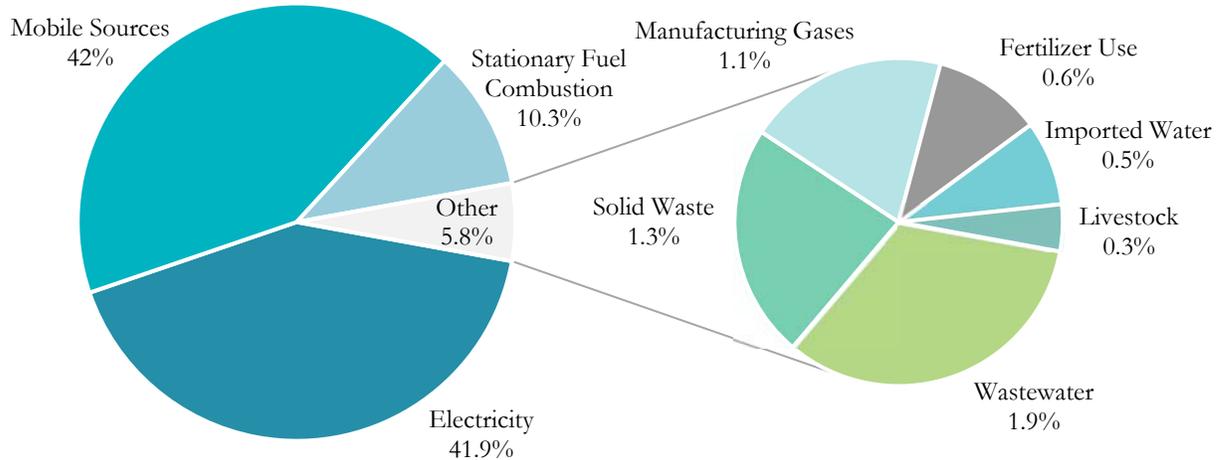
Gross GHG Emissions
977,937 MTCO₂e

GHG Reductions (Urban Forestry)
-1,314 MTCO₂e

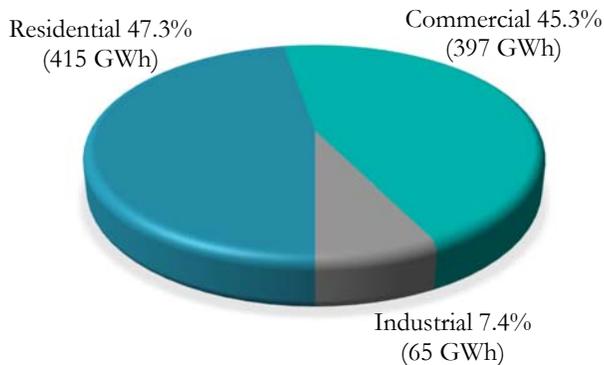
Net GHG Emissions
976,622 MTCO₂e

Per Capita Net GHG Emissions
11.5 MTCO₂e

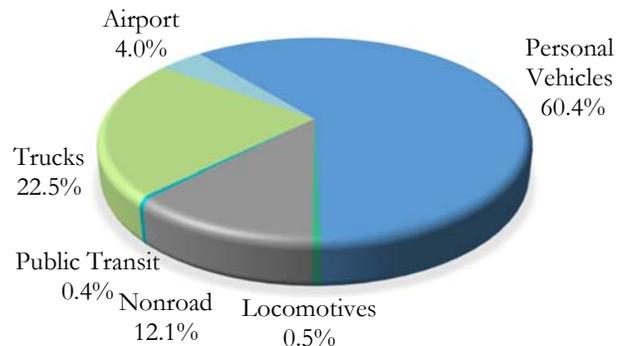
Goodyear Greenhouse Gas Emissions by Source Category



Goodyear Electricity Use GHG Emissions by Economic Sector



Goodyear Mobile Source GHG Emissions





Guadalupe 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	*MTCO ₂ e	Percent
Electricity Use	11,995	22.2
Mobile Sources	30,802	57.1
Stationary Fuel Combustion	7,566	14
Wastewater	1,399	2.6
Solid Waste	970	1.8
Manufacturing (Fluorinated Gas Use)	834	1.5
Imported Water (Electricity Used)	352	0.7
Livestock (Cattle)	0	0
Fertilizer Use	0	0

*Metric tons of carbon dioxide equivalent

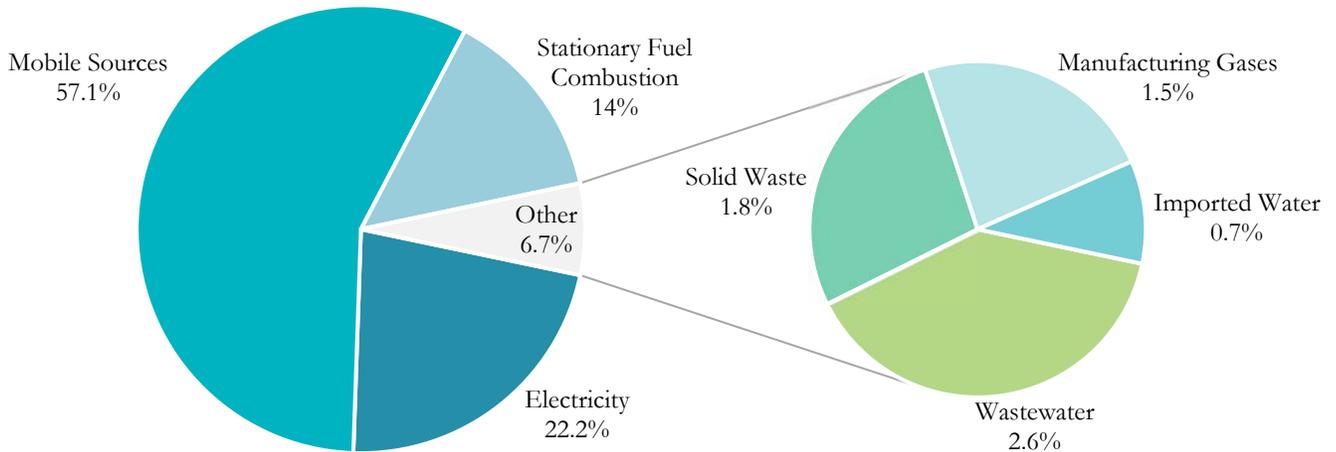
Gross GHG Emissions
53,918 MTCO₂e

GHG Reductions (Urban Forestry)
-107 MTCO₂e

Net GHG Emissions
53,812 MTCO₂e

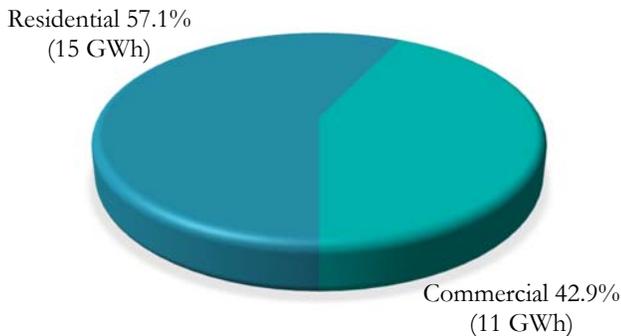
Per Capita Net GHG Emissions
8.5 MTCO₂e

Guadalupe Greenhouse Gas Emissions by Source Category**

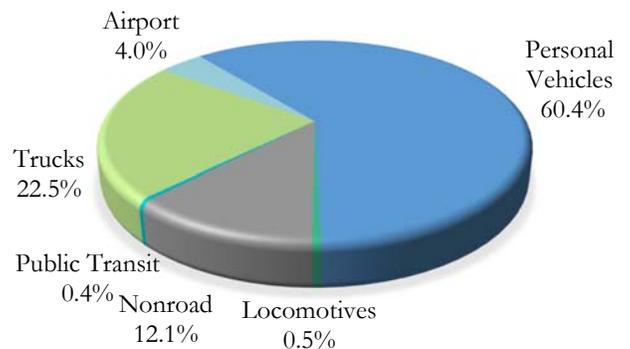


**Fertilizer use and livestock not included

Guadalupe Electricity Use GHG Emissions by Economic Sector



Guadalupe Mobile Source GHG Emissions





Litchfield Park 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	116,062	72.4
Mobile Sources	32,487	20.3
Stationary Fuel Combustion	7,980	5
Wastewater	1,476	0.9
Solid Waste	1,023	0.6
Manufacturing (Fluorinated Gas Use)	880	0.5
Imported Water (Electricity Used)	371	0.2
Livestock (Cattle)	0	0
Fertilizer Use	14	0

*Metric tons of carbon dioxide equivalent

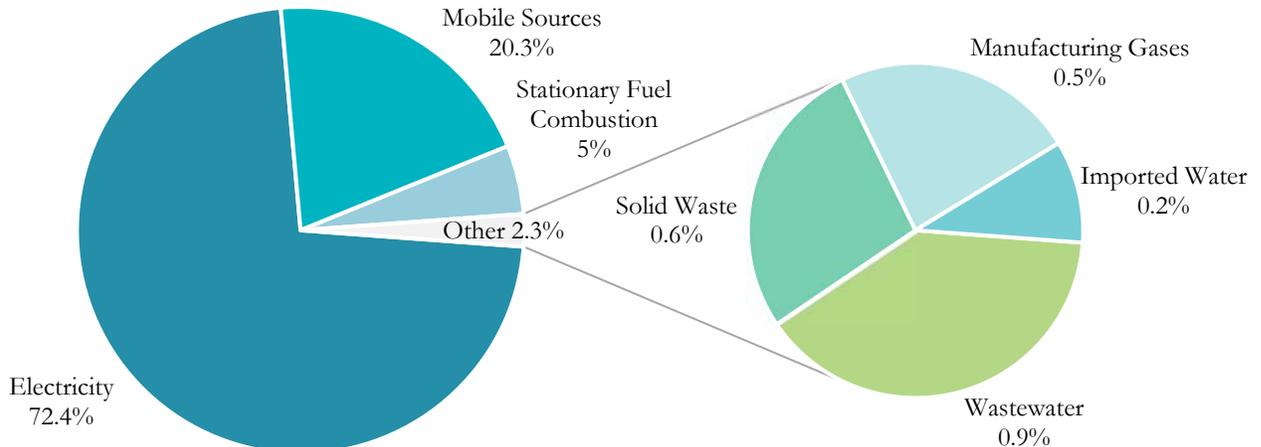
Gross GHG Emissions
160,293 MTCO₂e

GHG Reductions (Urban Forestry)
-671 MTCO₂e

Net GHG Emissions
159,622 MTCO₂e

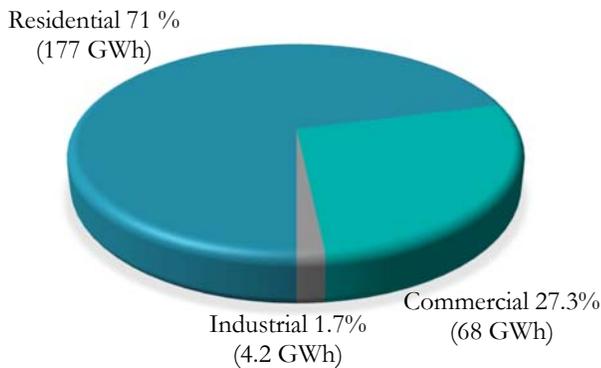
Per Capita Net GHG Emissions
23.9 MTCO₂e

Litchfield Park Greenhouse Gas Emissions by Source Category**

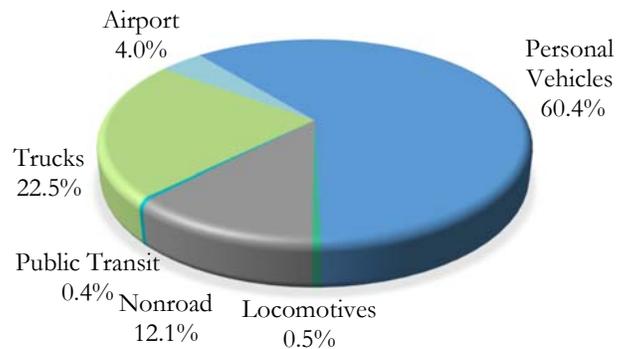


**Fertilizer use and livestock not included

Litchfield Park Electricity Use GHG Emissions by Economic Sector



Litchfield Park Mobile Source GHG Emissions





Mesa 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	2,274,831	41.2
Mobile Sources	2,374,594	43
Stationary Fuel Combustion	583,297	10.6
Wastewater	107,874	2
Solid Waste	74,771	1.4
Manufacturing (Fluorinated Gas Use)	64,332	1.2
Imported Water (Electricity Used)	27,108	0.5
Livestock (Cattle)	11,554	0.2
Fertilizer Use	1,936	0

*Metric tons of carbon dioxide equivalent

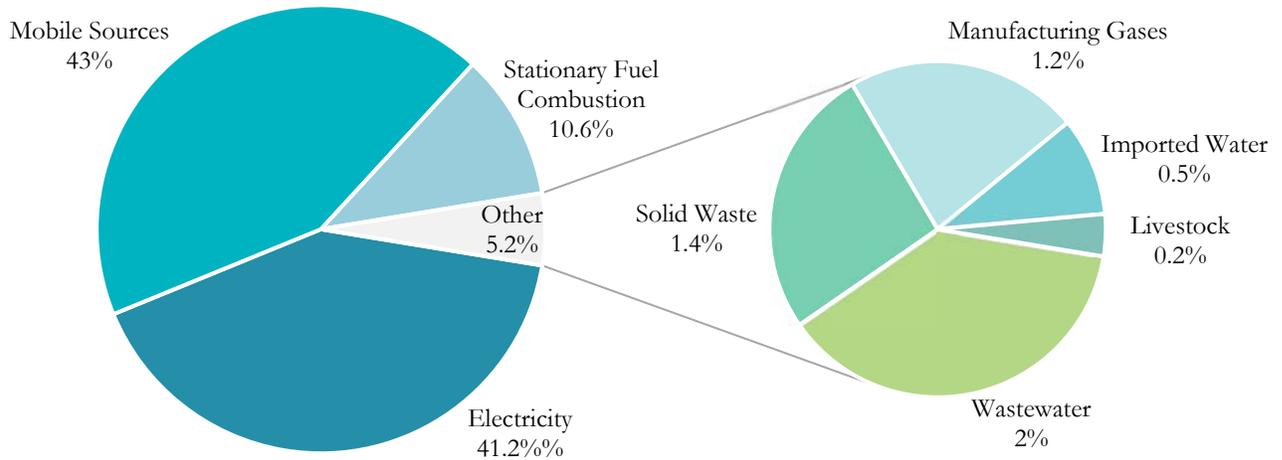
Gross GHG Emissions
5,520,296 MTCO₂e

GHG Reductions (Urban Forestry)
-17,743 MTCO₂e

Net GHG Emissions
5,502,553 MTCO₂e

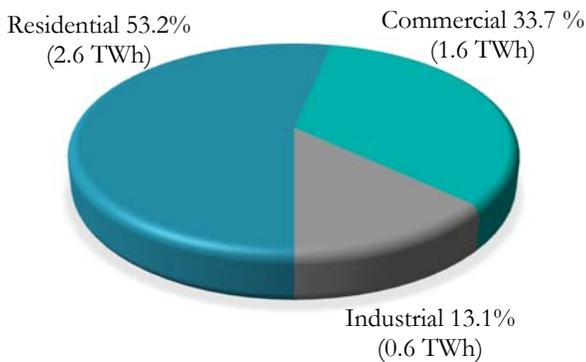
Per Capita Net GHG Emissions
11.3 MTCO₂e

Mesa Greenhouse Gas Emissions by Source Category**

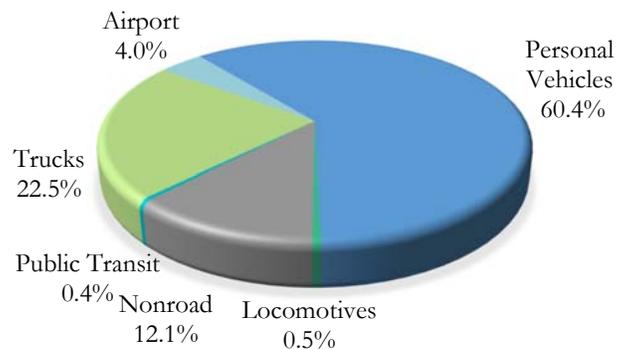


**Fertilizer use not included

Mesa Electricity Use GHG Emissions by Economic Sector



Mesa Mobile Source GHG Emissions





Paradise Valley 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	182,855	66.4
Mobile Sources	68,048	24.7
Stationary Fuel Combustion	16,715	6.1
Wastewater	3,091	1.1
Solid Waste	2,143	0.8
Manufacturing (Fluorinated Gas Use)	1,844	0.7
Imported Water (Electricity Used)	777	0.3
Livestock (Cattle)	0	0
Fertilizer Use	26	0

*Metric tons of carbon dioxide equivalent

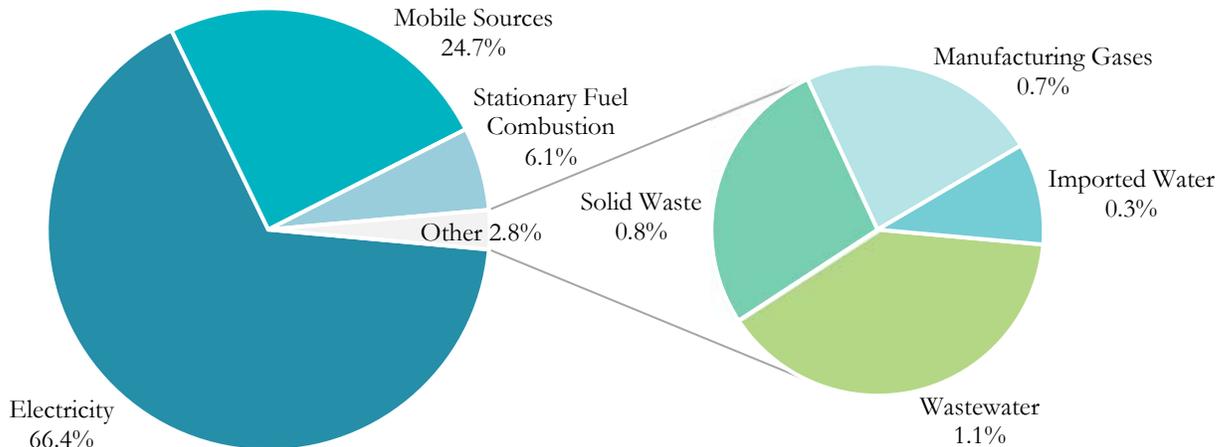
Gross GHG Emissions
275,499 MTCO₂e

GHG Reductions (Urban Forestry)
-2,914 MTCO₂e

Net GHG Emissions
272,585 MTCO₂e

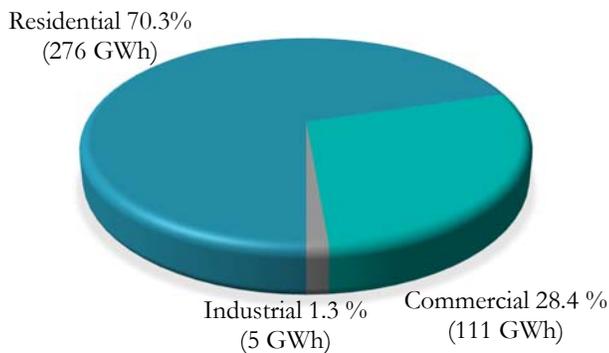
Per Capita Net GHG Emissions
19.5 MTCO₂e

Paradise Valley Greenhouse Gas Emissions by Source Category**

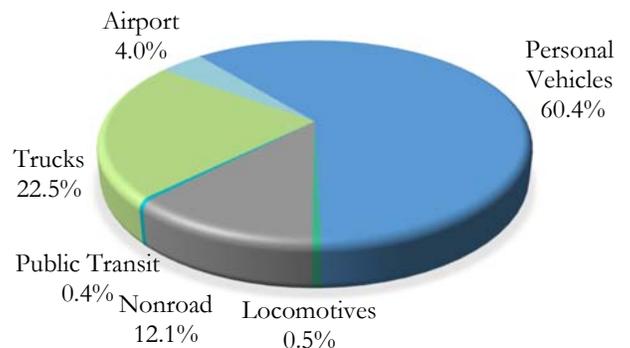


**Fertilizer use and livestock not included

Paradise Valley Electricity Use GHG Emissions by Economic Sector



Paradise Valley Mobile Source GHG Emissions





Peoria 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	GHG Emissions Percent
Electricity Use	731,191	38.5
Mobile Sources	855,364	45.1
Stationary Fuel Combustion	210,112	11.1
Wastewater	38,858	2
Solid Waste	26,933	1.4
Manufacturing (Fluorinated Gas Use)	23,173	1.2
Imported Water (Electricity Used)	9,765	0.5
Livestock (Cattle)	1,994	0.1
Fertilizer Use	290	0

*Metric tons of carbon dioxide equivalent

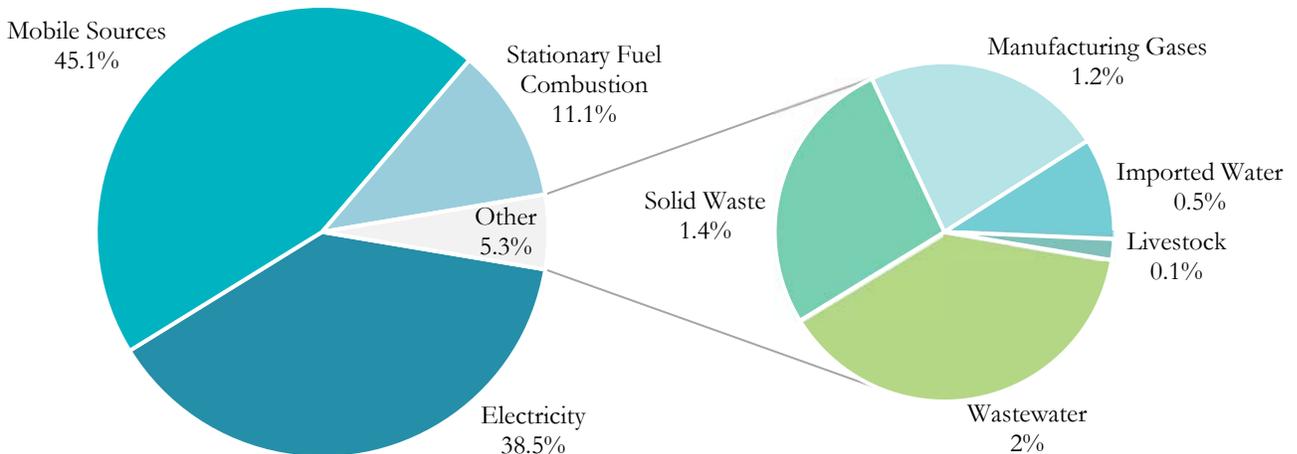
Gross GHG Emissions
1,897,679 MTCO₂e

GHG Reductions (Urban Forestry)
-6,990 MTCO₂e

Net GHG Emissions
1,890,689 MTCO₂e

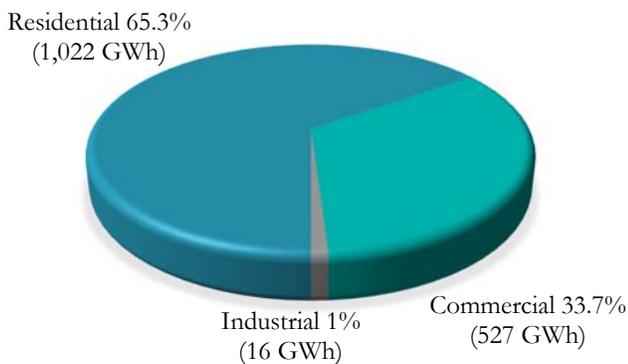
Per Capita Net GHG Emissions
10.7 MTCO₂e

Peoria Greenhouse Gas Emissions by Source Category**

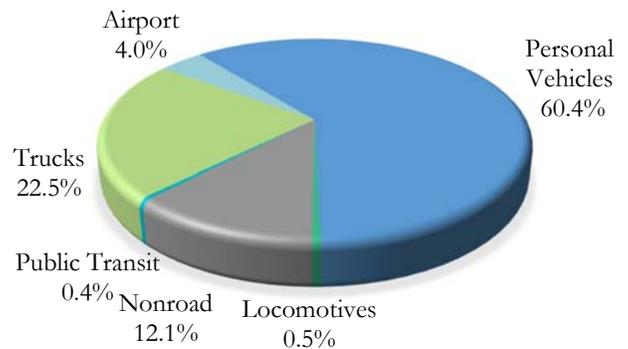


**Fertilizer use not included

Peoria Electricity Use GHG Emissions by Economic Sector



Peoria Mobile Source GHG Emissions





Phoenix 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	*MTCO ₂ e	Percent
Electricity Use	7,385,485	41.1
Mobile Sources	7,759,837	43.2
Stationary Fuel Combustion	1,906,134	10.6
Wastewater	352,516	2.0
Solid Waste	244,340	1.4
Manufacturing (Fluorinated Gas Use)	210,228	1.2
Imported Water (Electricity Used)	88,585	0.5
Livestock (Cattle)	28,031	0.2
Fertilizer Use	4,637	0

*Metric tons of carbon dioxide equivalent

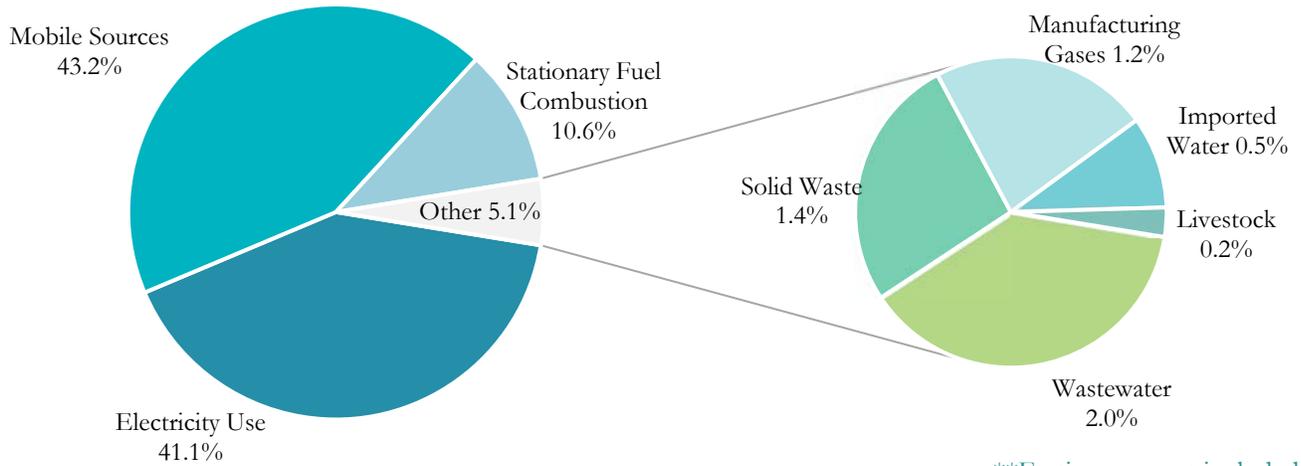
Gross GHG Emissions
17,979,792 MTCO₂e

GHG Reductions (Urban Forestry)
-44,294 MTCO₂e

Net GHG Emissions
17,935,498 MTCO₂e

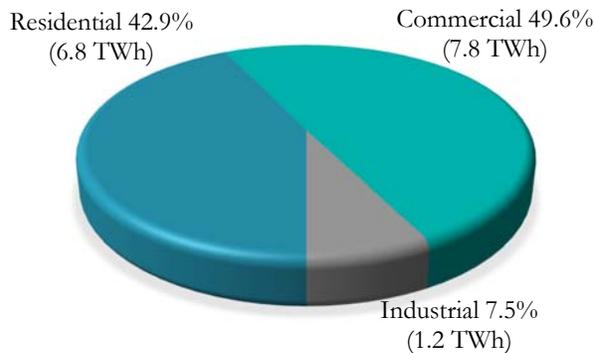
Per Capita Net GHG Emissions
11.2 MTCO₂e

Phoenix Greenhouse Gas Emissions by Source Category**

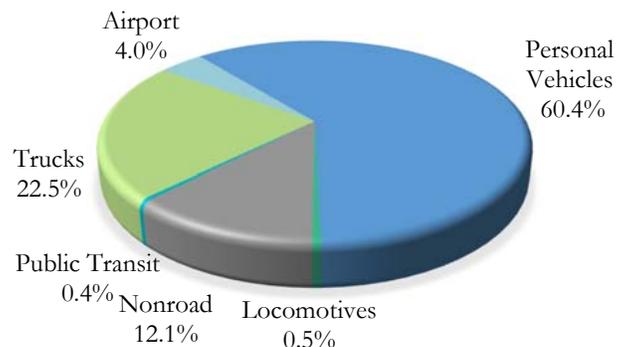


**Fertilizer use not included

Phoenix Electricity Use GHG Emissions by Economic Sector



Phoenix Mobile Source GHG Emissions





Queen Creek† 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	GHG Emissions Percent
Electricity Use	416,282	58.7
Mobile Sources	209,759	29.6
Stationary Fuel Combustion	51,525	7.3
Wastewater	9,529	1.3
Solid Waste	6,605	0.9
Manufacturing (Fluorinated Gas Use)	5,683	0.8
Imported Water (Electricity Used)	2,395	0.3
Livestock (Cattle)	4,926	0.7
Fertilizer Use	2,525	0.4

Gross GHG Emissions
709,228 MTCO₂e

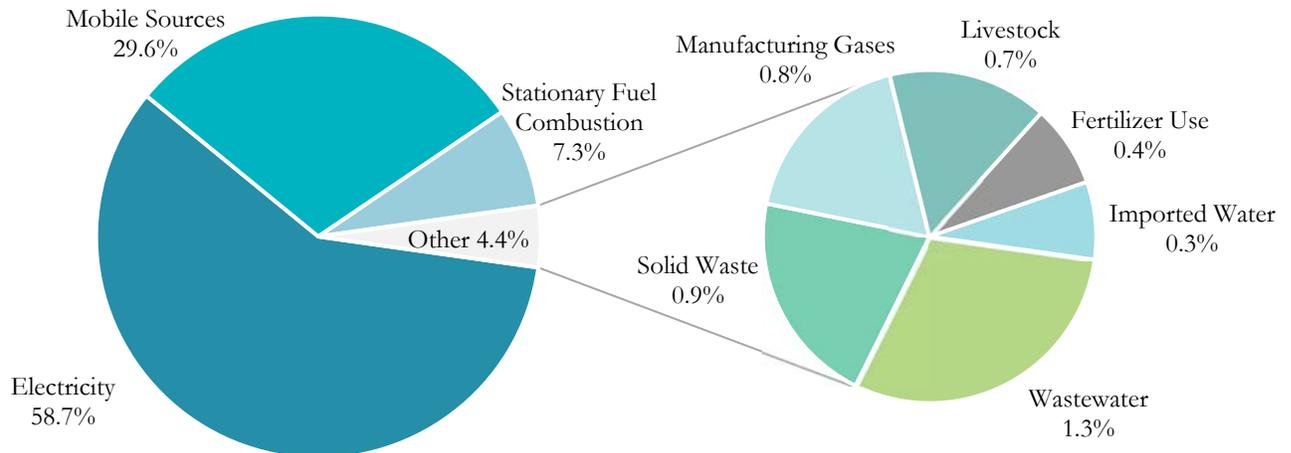
GHG Reductions (Urban Forestry)
-1,188 MTCO₂e

Net GHG Emissions
708,040 MTCO₂e

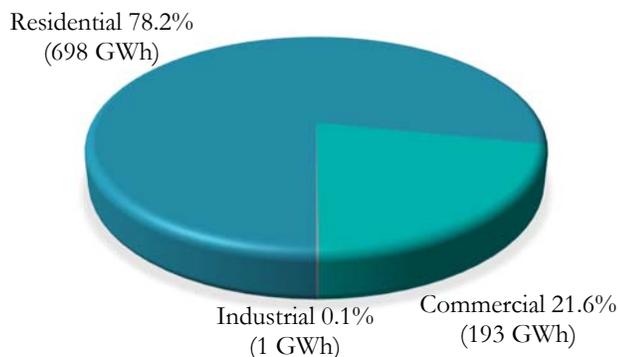
Per Capita Net GHG Emissions
16.4 MTCO₂e

*Metric tons of carbon dioxide equivalent; †Emissions from Maricopa County portion of Queen Creek

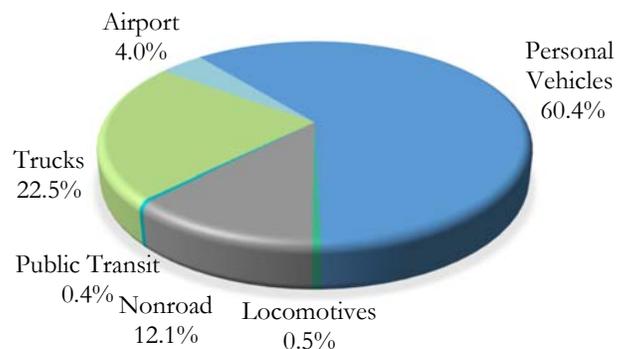
Queen Creek Greenhouse Gas Emissions by Source Category



Queen Creek Electricity Use GHG Emissions by Economic Sector



Queen Creek Mobile Source GHG Emissions





Scottsdale 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	2,083,410	56.2
Mobile Sources	1,191,933	32.2
Stationary Fuel Combustion	292,787	7.9
Wastewater	54,147	1.5
Solid Waste	37,531	1
Manufacturing (Fluorinated Gas Use)	32,292	0.9
Imported Water (Electricity Used)	13,607	0.4
Livestock (Cattle)	760	0
Fertilizer Use	226	0

*Metric tons of carbon dioxide equivalent

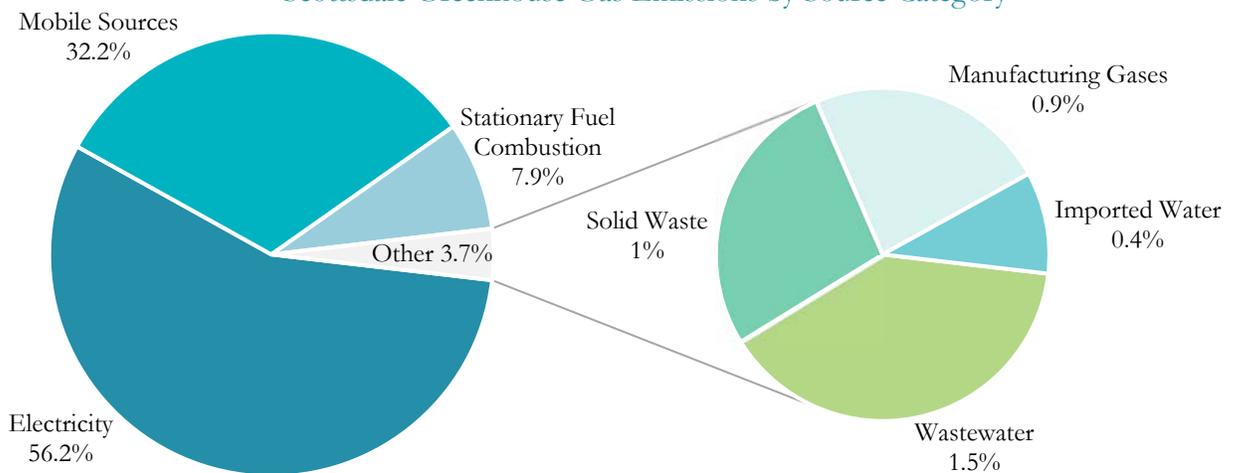
Gross GHG Emissions
3,706,693 MTCO₂e

GHG Reductions (Urban Forestry)
-19,855 MTCO₂e

Net GHG Emissions
3,686,839 MTCO₂e

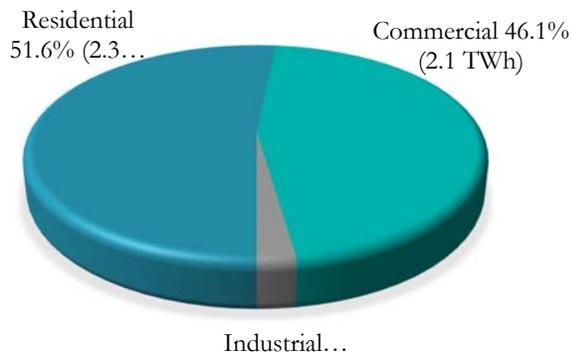
Per Capita Net GHG Emissions
15 MTCO₂e

Scottsdale Greenhouse Gas Emissions by Source Category**

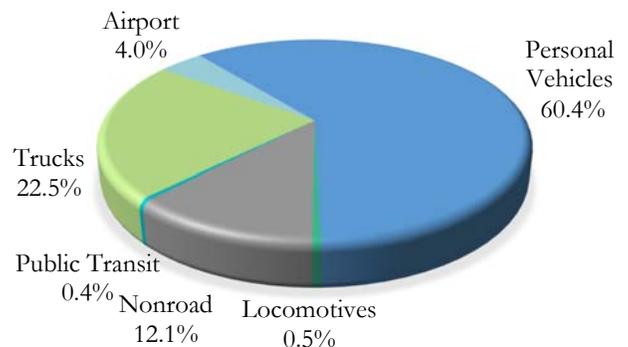


**Fertilizer use and livestock not included

Scottsdale Electricity Use GHG Emissions by Economic Sector



Scottsdale Mobile Source GHG Emissions





Surprise 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	*MTCO ₂ e	Percent
Electricity Use	458,266	34.3
Mobile Sources	645,231	48.2
Stationary Fuel Combustion	158,495	11.8
Wastewater	29,312	2.2
Solid Waste	20,317	1.5
Manufacturing (Fluorinated Gas Use)	17,481	1.3
Imported Water (Electricity Used)	7,366	0.6
Livestock (Cattle)	715	0.1
Fertilizer Use	507	0

*Metric tons of carbon dioxide equivalent

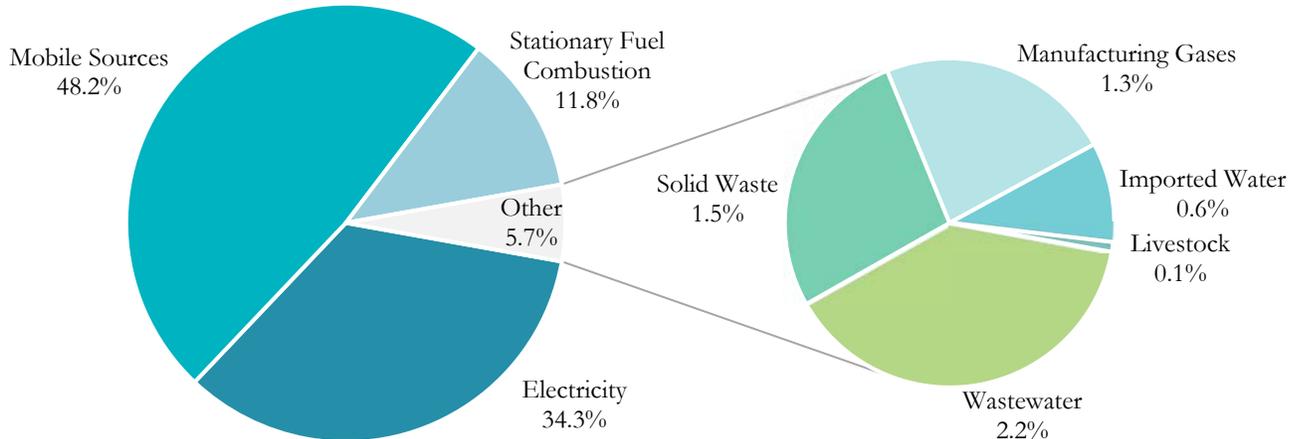
Gross GHG Emissions
1,337,689 MTCO₂e

GHG Reductions (Urban Forestry)
-2,052 MTCO₂e

Net GHG Emissions
1,335,637 MTCO₂e

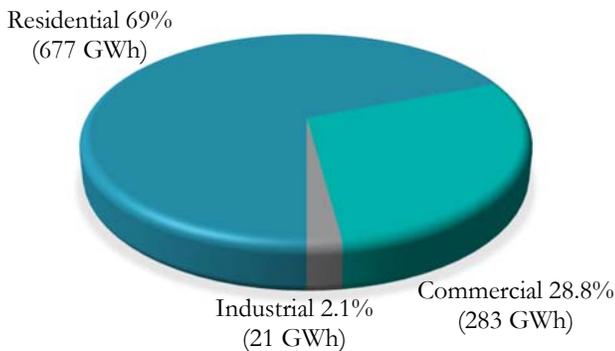
Per Capita Net GHG Emissions
10.1 MTCO₂e

Surprise Greenhouse Gas Emissions by Source Category**

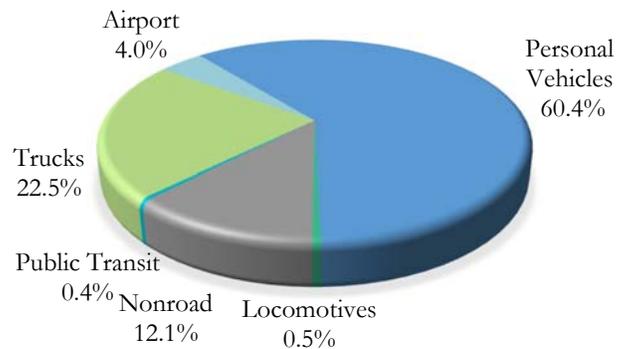


**Fertilizer use not included

Surprise Electricity Use GHG
Emissions by Economic Sector



Surprise Mobile Source GHG
Emissions





Tempe 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	*MTCO ₂ e	Percent
Electricity Use	1,408,759	53.5
Mobile Sources	899,963	34.2
Stationary Fuel Combustion	221,068	8.4
Wastewater	40,884	1.6
Solid Waste	28,338	1.1
Manufacturing (Fluorinated Gas Use)	24,382	0.9
Imported Water (Electricity Used)	10,274	0.4
Livestock (Cattle)	846	0
Fertilizer Use	40.4	0

*Metric tons of carbon dioxide equivalent

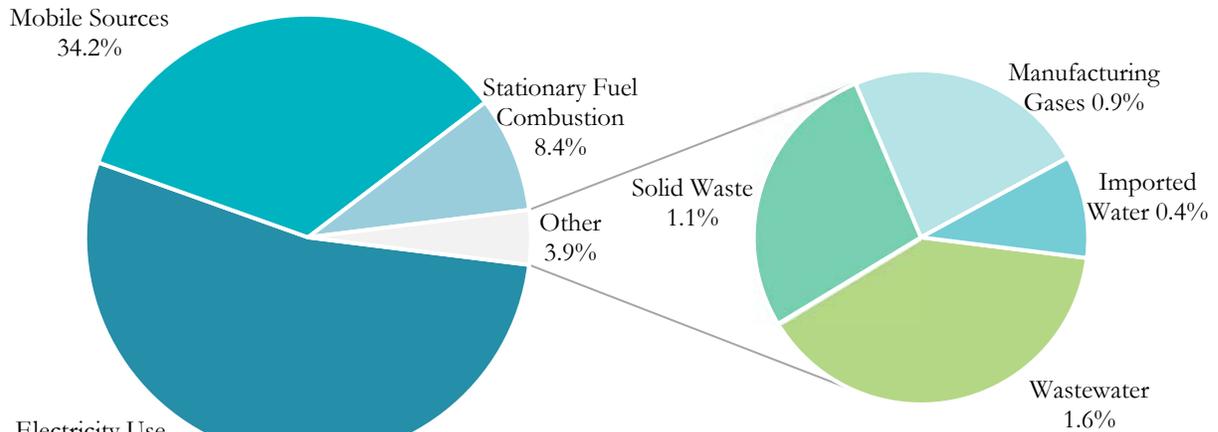
Gross GHG Emissions
2,634,553 MTCO₂e

GHG Reductions (Urban Forestry)
-8,198 MTCO₂e

Net GHG Emissions
2,626,356 MTCO₂e

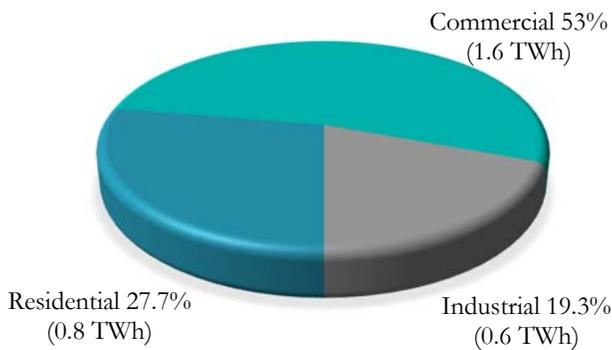
Per Capita Net GHG Emissions
14.2 MTCO₂e

Tempe Greenhouse Gas Emissions by Source Category**

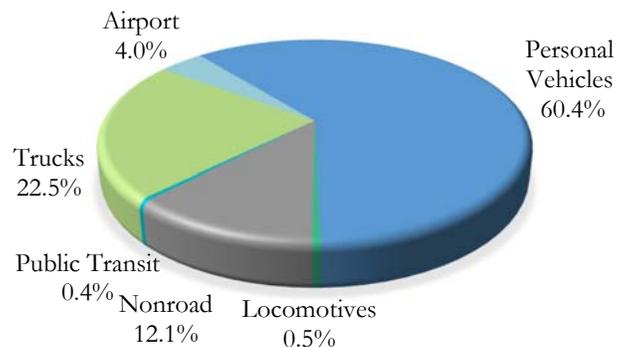


**Fertilizer use and livestock not included

Tempe Electricity Use GHG Emissions
by Economic Sector



Tempe Mobile Source GHG
Emissions





Tolleson 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	*MTCO ₂ e	Percent
Electricity Use	260,330	82.5
Mobile Sources	34,080	10.8
Stationary Fuel Combustion	8,371	2.7
Wastewater	1,548	0.5
Solid Waste	1,073	0.3
Manufacturing (Fluorinated Gas Use)	923	0.3
Imported Water (Electricity Used)	389	0.1
Livestock (Cattle)	8,612	2.7
Fertilizer Use	115	0

*Metric tons of carbon dioxide equivalent

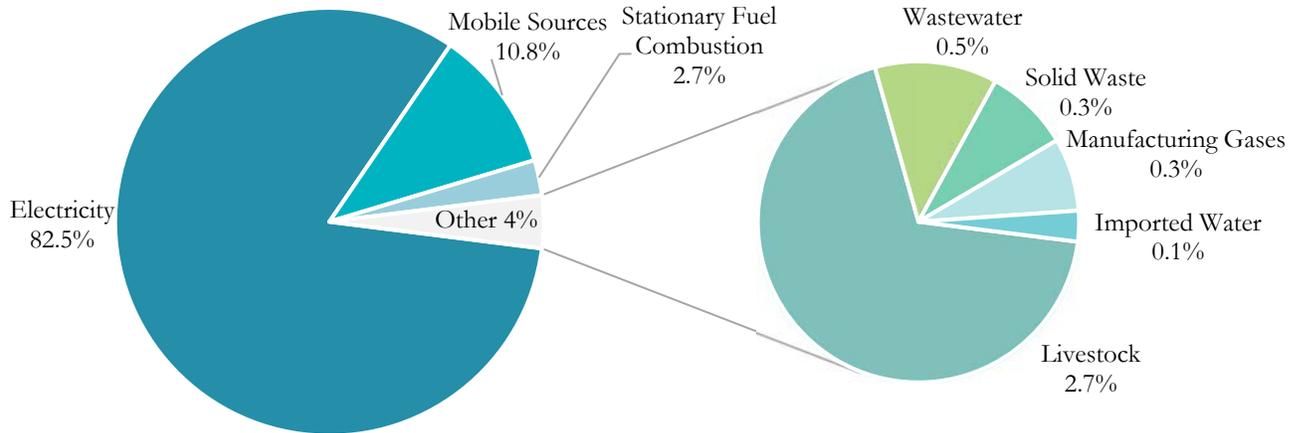
Gross GHG Emissions
315,442 MTCO₂e

GHG Reductions (Urban Forestry)
-368 MTCO₂e

Net GHG Emissions
315,074 MTCO₂e

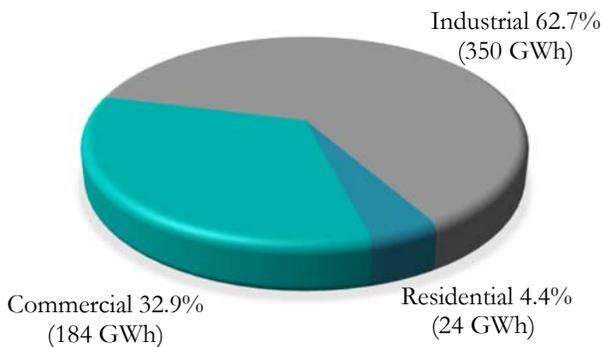
Per Capita Net GHG Emissions
44.9 MTCO₂e

Tolleson Greenhouse Gas Emissions by Source Category**

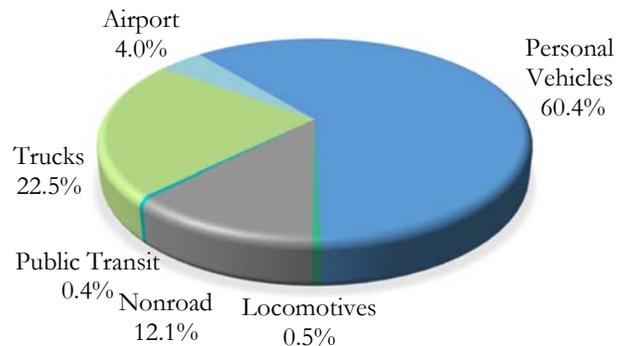


**Fertilizer use not included

Tolleson Electricity Use GHG Emissions by Economic Sector



Tolleson Mobile Source GHG Emissions





Wickenburg 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	33,375	42.1
Mobile Sources	33,735	42.5
Stationary Fuel Combustion	8,287	10.4
Wastewater	1,533	1.9
Solid Waste	1,062	1.3
Manufacturing (Fluorinated Gas Use)	914	1.2
Imported Water (Electricity Used)	385	0.5
Livestock (Cattle)	0	0
Fertilizer Use	10	0

*Metric tons of carbon dioxide equivalent

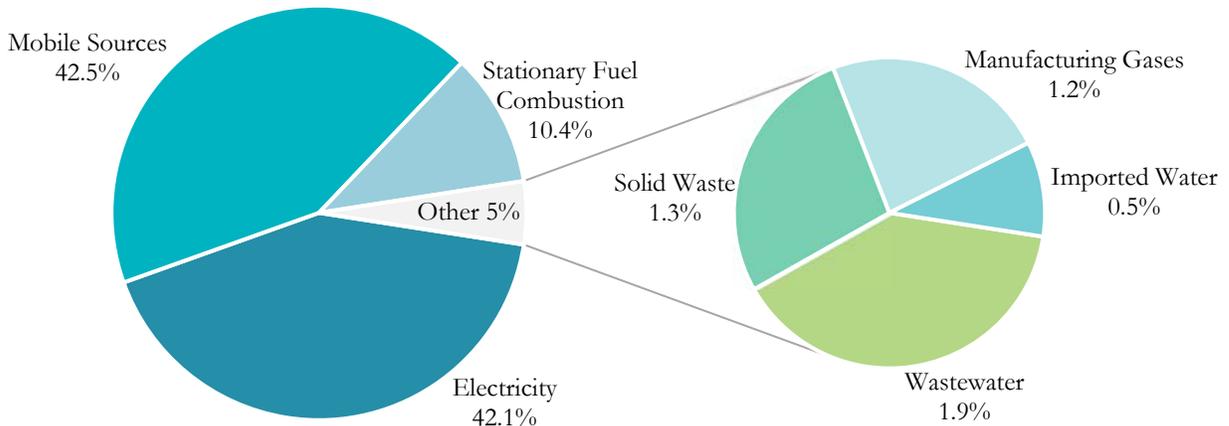
Gross GHG Emissions
79,301 MTCO₂e

GHG Reductions (Urban Forestry)
-0 MTCO₂e

Net GHG Emissions
79,301 MTCO₂e

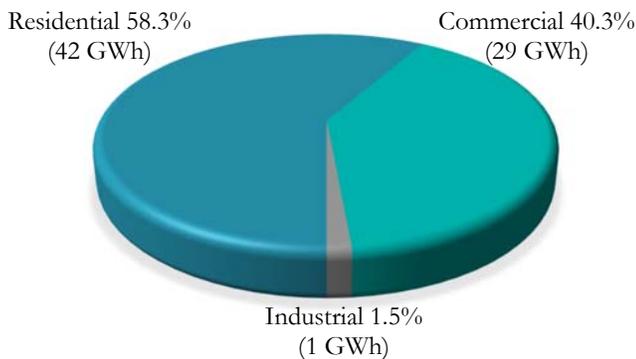
Per Capita Net GHG Emissions
11.4 MTCO₂e

Wickenburg Greenhouse Gas Emissions by Source Category**

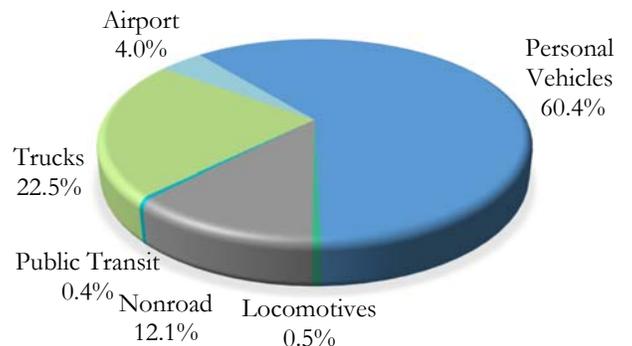


**Fertilizer use and livestock not included

Wickenburg Electricity Use GHG Emissions by Economic Sector



Wickenburg Mobile Source GHG Emissions





Youngtown 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	20,571	32.1
Mobile Sources	32,006	49.9
Stationary Fuel Combustion	7,862	12.3
Wastewater	1,454	2.3
Solid Waste	1,008	1.6
Manufacturing (Fluorinated Gas Use)	867	1.4
Imported Water (Electricity Used)	365	0.6
Livestock (Cattle)	0	0
Fertilizer Use	1	0

*Metric tons of carbon dioxide equivalent

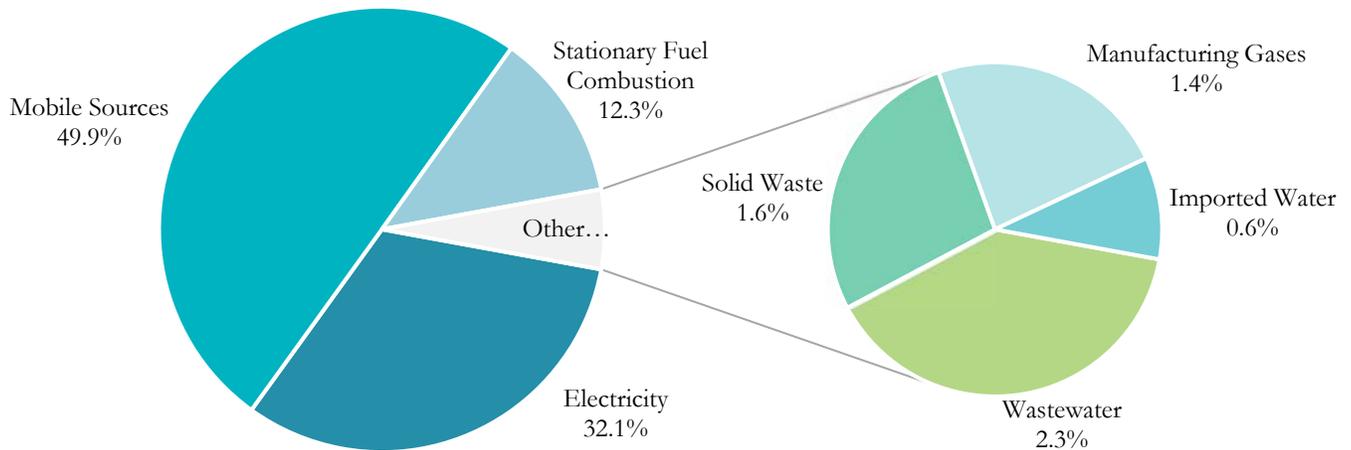
Gross GHG Emissions
64,134 MTCO₂e

GHG Reductions (Urban Forestry)
-106 MTCO₂e

Net GHG Emissions
64,028 MTCO₂e

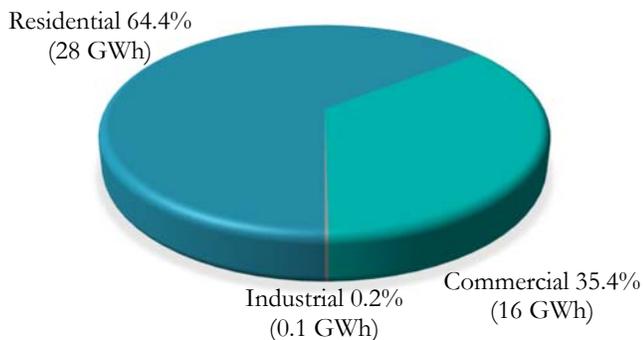
Per Capita Net GHG Emissions
9.7 MTCO₂e

Youngtown Greenhouse Gas Emissions by Source Category**

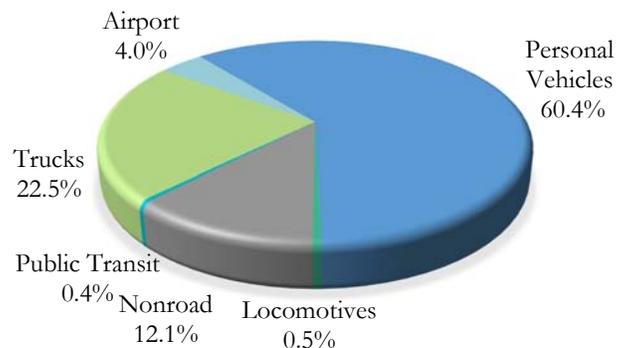


**Fertilizer use and livestock not included

Youngtown Electricity Use GHG Emissions by Economic Sector



Youngtown Mobile Source GHG Emissions





Maricopa County Unincorporated Area 2018 Community Greenhouse Gas (GHG) Emissions Inventory

GHG Emissions by Source Category	GHG Emissions *MTCO ₂ e	Percent
Electricity Use	1,188,114	28.7
Mobile Sources	1,488,987	36
Stationary Fuel Combustion	365,756	8.8
Wastewater	67,642	1.6
Solid Waste	46,885	1.1
Manufacturing (Fluorinated Gas Use)	40,339	1
Imported Water (Electricity Used)	16,998	0.4
Livestock (Cattle)	823,863	19.9
Fertilizer Use	94,313	2.3

*Metric tons of carbon dioxide equivalent

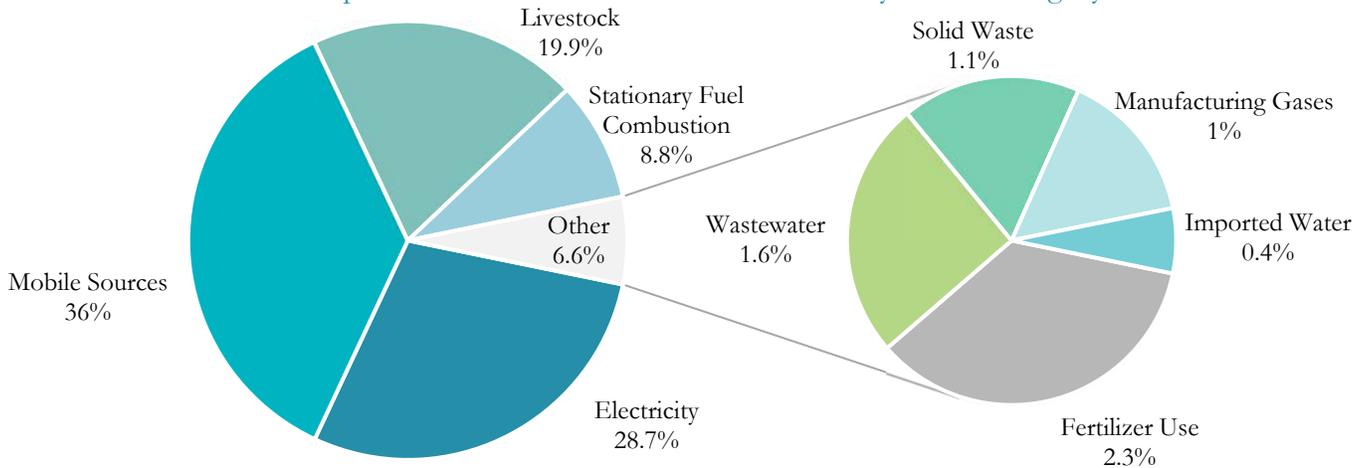
Gross GHG Emissions
4,132,897 MTCO₂e

GHG Reductions (Urban Forestry)
-20,345 MTCO₂e

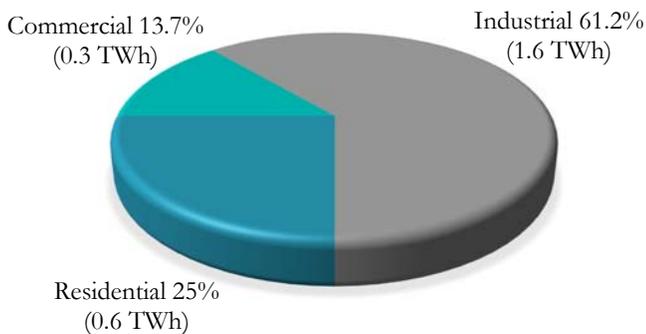
Net GHG Emissions
4,112,552 MTCO₂e

Per Capita Net GHG Emissions
13.4 MTCO₂e

Unincorporated Area Greenhouse Gas Emissions by Source Category**



Unincorporated Area Electricity Use
GHG Emissions by Economic Sector



Unincorporated Area Mobile Source
GHG Emissions

