



THE UNIVERSITY  
OF ARIZONA®

# GREENHOUSE GAS EMISSIONS REPORT







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FISCAL YEAR 2015

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## INTRODUCTION

The University of Arizona (UA), located in Tucson, Arizona, has a headcount enrollment of more than 42,000 students in more than 360 academic programs. The campus consists of 207 buildings on Main Campus located on 391 acres in central Tucson. The campus is the oldest continually maintained green space in Arizona. The UA recognizes the need to conserve its natural resources and is committed to creating a sustainable community for its students, employees and the neighboring community.

The UA has signed The American College and University Presidents Climate Commitment (ACUPCC) and has pledged to become climate neutral as soon as possible. Climate neutrality is defined as minimizing greenhouse gas (GHG) emissions as much as possible and using carbon offsets, or other measures, to mitigate the remaining emissions. The ACUPCC also requires that a comprehensive inventory of all greenhouse gas emissions be accomplished and updated every other year.

In accordance with its commitment, this report details the UA's GHG emissions for Fiscal Year (FY) 2015. The report is divided into sections according to major sources of emissions. The UA began tracking its environmental impact in FY 2009 and its main sources of measured emissions are purchased utilities, air travel and commuting. The University is pursuing priorities in purchased utilities categories by improving operational efficiencies within all three Utility Plants as well as the associated utility distribution systems and end use.

## METHODOLOGY

The most accurate data available was collected from several departments on campus including Parking and Transportation Services, Facilities Management (Utilities Services, Motor Pool, Grounds Services, Custodial Service, Recycling and Business Services) and the UA Office of Sustainability. Emissions are reported as CO<sub>2</sub> with all emissions given in metric tons of CO<sub>2</sub> equivalent (MtCO<sub>2</sub>e). The UA's FY 2015 greenhouse gas report includes emissions from the Main Campus' electricity use, natural gas use, refrigerant use, fleet fuel use, shuttle bus fuel use, employee air travel, fertilizer use and solid waste disposal. Also included in the report are estimated CO<sub>2</sub> emissions due to faculty, staff and student commuting.

Data supplied for this report covers FY 2015 for the Main UA Campus. The fiscal year starts on the first day of July 2014 and ends on June 30 2015. This report does not include satellite locations or Biosphere 2.

### Billion Dollar Green Challenge

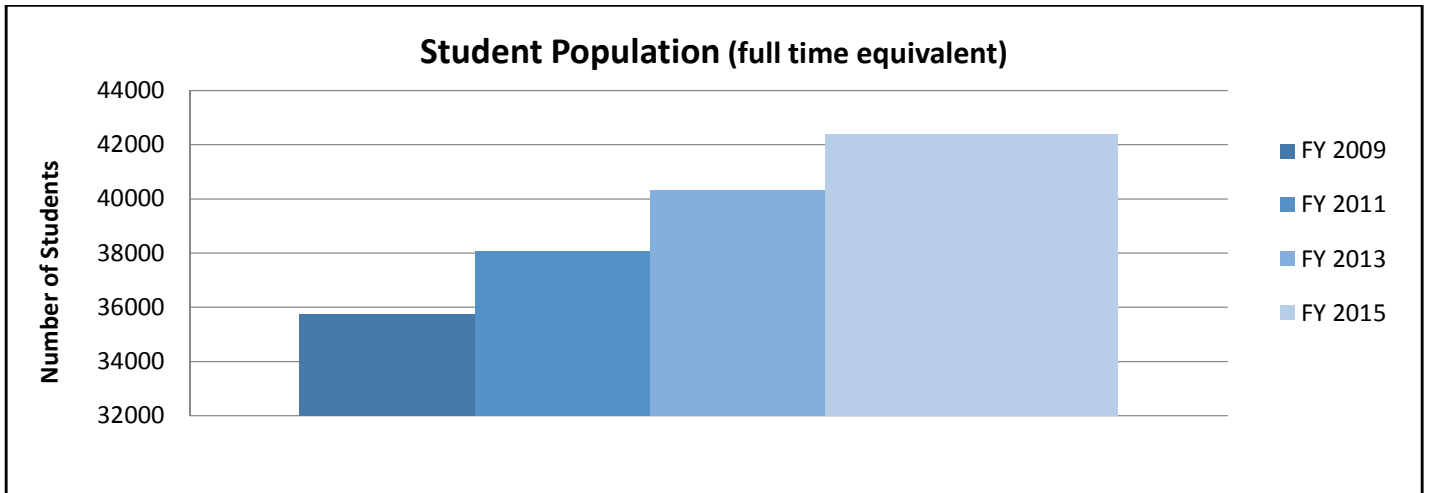
The University of Arizona is a member the Billion Dollar Green Challenge. The goal is to achieve reductions in operating expenses and greenhouse gas emissions, while creating regenerating funds for future projects.

The University is utilizing the "Green Revolving Investment Tracking System (GRITS)", a web tool for tracking projects energy and financial savings and return data throughout the life of the project.

## CAMPUS GROWTH

Since the fiscal year 2009 benchmark, the student population and physical campus continues to grow. Fall 2014 records indicate a full time equivalent student population greater than 42,000, comprised of over 33,000 undergraduate, over 7,000 graduate, and over 700 medical. The University employs more than 15,600 faculty and staff with a full time equivalent employee count of 12,479. The Main Campus size is 391 acres with a count of 207 buildings. The building square footage has increased by 2.0% and student population has increased by 5.1% since fiscal year 2013, the last greenhouse gas reporting year.

Graph 1: University Student Population Growth



## UTILITY OPERATIONS

FY 2015 showed that 73% of overall campus greenhouse gas emissions are attributable to purchased utilities in the form of electricity and natural gas with a combined decrease of 5.4% since FY 2013. The main function of these utilities is to directly support building functions such as lighting, plug loads, cooling, heating, emergency generators, etc. The recognized decrease in utility-based emissions can be attributed to the University's effort in proactively taking steps to reduce the energy usage of new buildings constructed on campus combined with investing in energy-saving projects for existing facilities and utility systems. All new buildings require, at a minimum, LEED Silver certification. The use of solar energy for heating water and photovoltaic systems for generating electricity is highly encouraged in all new building projects.

### New Buildings on Campus

#### Environmental and Natural Resources II (ENRII)

The Environmental and Natural Resources II (ENRII) building is a five story 150,000 square foot building that reached substantial completion in July of 2015. The ground floor is comprised of a 600 seat auditorium, 150 seat lecture hall, and a café/commons area. The upper floors consist of mostly private/open office areas and computer lab space.

The building was designed and constructed to meet LEED Platinum certification. Currently the project design is being submitted to the USGBC for review. Some of the energy saving technologies that are implemented in the design are chilled beams, displacement ventilation, and a lighting system that is fully integrated with the building automation system. The ENRII building is the first building on the university campus to utilize chilled beam technology, using chilled water as the primary cooling medium in lieu of air for a more efficient heat transfer process.

Utility operations consists of natural gas used in turbines, utility plant boilers, building loads (such as stand-alone heating systems), emergency generators, and lab use; and purchased electricity to the campus grid. Combined, these sources produced greenhouse gas emissions equating to 170,413 MtCO<sub>2</sub>e, compared to 180,115 MtCO<sub>2</sub>e in FY 2013. The reduction in utility-based emissions can be attributed to reductions in both natural gas usage and purchased electricity over the past two years, despite ongoing campus growth.

The purchased utility breakdown for electricity and natural gas are shown in Table 1. This data includes the percent change between FY 2011 and FY 2013.

**Table 1: Purchased Utilities – Comparison**

	FY 2013	FY 2015	% Change
<b>Purchased Electricity (kWh)</b>	168,007,398	165,063,041	-1.8%
<b>Purchased Turbine Natural Gas (mmbtu)</b>	1,090,409	1,021,724	-6.3%
<b>Purchased Boiler Natural Gas (mmbtu)</b>	475,398	409,697	-13.8%
<b>Purchased Building Natural Gas (mmbtu)</b>	44,159	27,233	-38.3%

Below are descriptions of significant projects undertaken by UA Facilities Management and UA Planning, Design and Construction. It is anticipated that these projects will reduce the University of Arizona Main Campus greenhouse gas emissions.

### Steam and Chilled Water Tunnel Improvements

A significant amount of tunnel steam and chilled water distribution piping were assessed and repairs were made to leaking valves, steam traps and expansion joints. In addition, all missing or compromised piping insulation was replaced. This effort is considered ongoing and further lengths of utility tunnels are expected to undergo similar improvements in the near term.

It is anticipated that these repairs will significantly reduce system losses attributable to piping transportation and thermal energy. This more efficient transportation system will reflect on the generation capacity required at the utility plants. The steam (and chilled water to a lesser degree) generation requirements will decrease, thus reducing University of Arizona greenhouse gas emissions. Decreased greenhouse gas emissions associated with the water mass flow loss will be garnered by the local Tucson water company.

### Un-Islanding of 4.5 MW Turbine

The AHSC turbine, a 4.5 MW combined cycle unit, was previously islanded to specific equipment located within the refrigeration plant. This precluded the turbine from consistently being able to produce power and steam at maximum output and realize the full benefit of this cogeneration system. The turbine was recently un-islanded and now exports power to the campus electrical grid. This modification in operations now allows the turbine to operate at full power and steam output.

With this change, a corresponding decrease in campus greenhouse gas emissions should result. The University's use of the natural gas turbine in lieu of the local electrical utility, which predominately utilizes coal based production units, is one more step towards reducing the campus carbon footprint.

### High Efficiency Chillers and Boilers Installation

Several new chillers and boilers were installed at the utility plants. The new chillers are the most efficient on campus and will be used for base loading the existing chiller fleet to minimize overall plant kw/ton. The new boilers are modular, high efficient, condensing type, able to quickly respond to changing loads and thus mitigating the requirement for larger, less efficient boilers to maintain standby status.

These measures are expected to reduce source energy requirements, both electrical and natural gas, helping to further reduce the greenhouse gas emissions at the University of Arizona.

### Active Energy Management System and Utilities Metering Upgrade Program

A comprehensive program has been instituted to measure all utilities and auxiliary equipment at the utility plants and at end-use facilities. This measure will enable Facilities Management to analyze its production and distribution systems continually and respond to changes in data indicating possible maintenance issues. All generating equipment (chillers and boilers) are measured for input and output. Additions to the metering system include the pumps and fans associated with production and energy/flow data for the newly installed high efficiency chillers and boilers. Efforts are currently underway to achieve complete optimization on energy and resource metering, including plant make-up water, sewer system discharge, and flow/energy for chilled water and steam.

Metering will allow the plant operators to determine plant efficiencies for steam and chilled water production and respond to changes in real time. The ability to conveniently ascertain dynamic system discrepancies and inefficiencies will allow facilities personnel to respond to issues immediately and maximize operational efficiencies, allowing for a greater overall usage of energy and yield an associated reduction in overall environmental impact.

### North Campus Building Controls Audit

The North Campus, considered the portion of campus immediately north of Speedway Blvd., is currently undergoing a utility energy usage audit focused on building control systems. As campus buildings continue to grow and adapt to the needs of their occupants, the breadth and function of the building control systems need to adapt as well. Current efforts are underway to conduct audits of the existing control systems to pinpoint outdated functions and equipment and update these systems appropriately in order to optimize heating, cooling, and lighting usage and minimize overall building and, subsequently, campus energy usage.

### Steam Trap Replacement Initiative

In addition to the general utility tunnel improvements projects for specific lengths of the tunnel system, a new initiative is kicking off to address issues with steam traps on a global scale. A full campus steam distribution system steam trap audit is scheduled to commence this year with the intent of locating and replacing all steam traps found to have symptoms of leaking or clogging. Leaking steam traps are a very common inevitability with any steam distribution system and, upon sufficient accumulation, can result in a significant and continuous loss of energy, indiscriminant of weather or system usage. By effecting this plan, the university expects to better secure distributional steam losses and reduce the amount of fired fossil fuels utilized in the steam production process.



## FLEET OPERATIONS

Sources of greenhouse gas emissions from fleet operations consist of the on campus shuttle service operated by UA Parking and Transportation Services and the Motor Pool operated by UA Facilities Management. Fuel consumption is tracked using beginning and end of year inventory data and is therefore an accurate representation of the fuel used in the campus vehicles and the Cat Tran campus shuttle service.

UA's transportation requirements generated 2,493 MtCO<sub>2</sub>e, a 15% increase compared to 2,173 MtCO<sub>2</sub>e in FY 2013. Increase in fuel usage emissions could be correlated to the increase in student population and campus square footage in recent years.

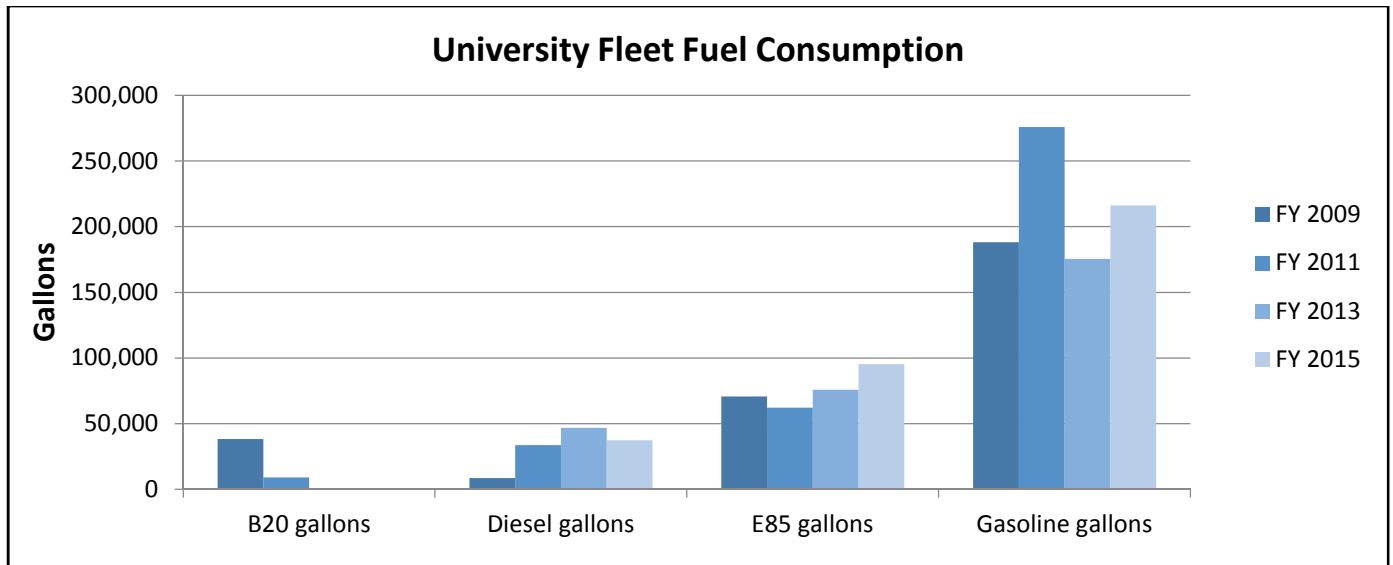
## UNIVERSITY FLEET

Fleet vehicles use gasoline and Ethanol 85 as of FY 2013. The biodiesel fuel used in past years has been eliminated as a fuel source. Correspondingly, Ethanol 85 fuel use continues to increase and has risen 26% over FY 2013 data while gasoline usage has risen by 23%. University fleet fuel also includes propane and diesel, which is provided to the small engine shop for equipment such as forklifts, street sweepers, welders, and mowers.

## CAT TRAN SHUTTLE FLEET

The Cat Tran shuttle traveled 169,923 miles and transported 425,621 passengers during FY 2015. The shuttle fleet utilizes ultra-low sulfur diesel in its buses, having completely transitioned from the use of biodiesel fuel. Diesel fuel use has decreased by 21% since the FY 2013 reporting period.

**Graph 2: University Fleet Fuel Consumption:**



## COMMUTING AND AIR TRAVEL

### COMMUTING

In 2007, the UA Parking and Transportation Department conducted a survey to determine the number of miles traveled by students, faculty and staff to and from campus. The survey data was extrapolated for FY 2015 based on updated student, faculty and staff populations.

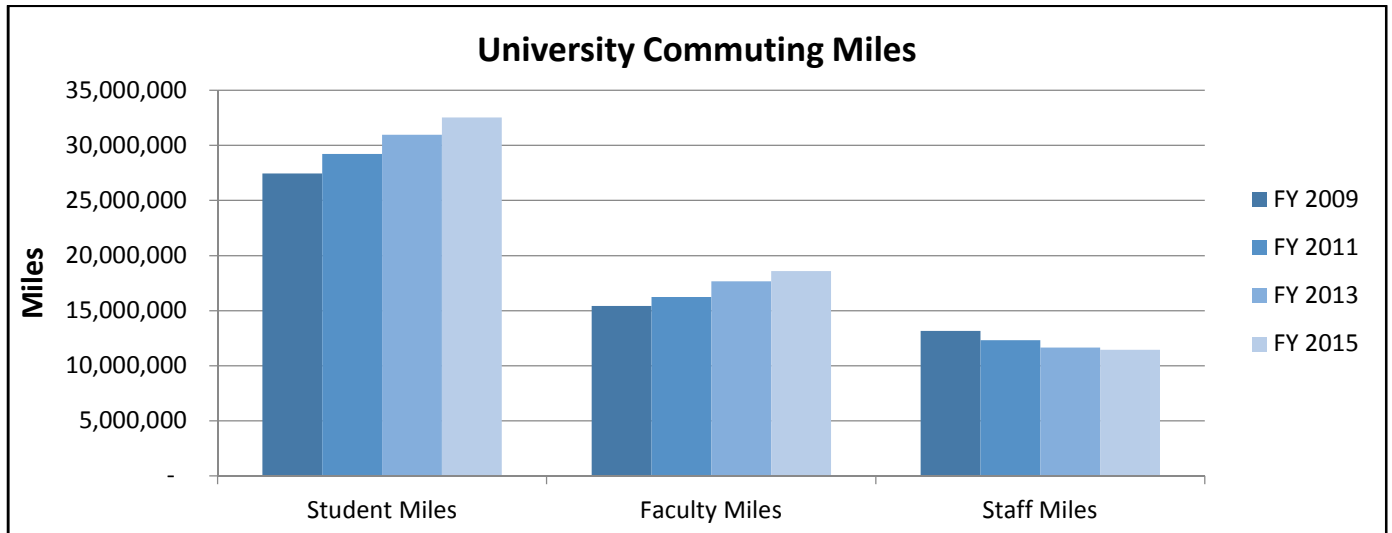
Approximately 60% of the student body uses a personal vehicle to commute to the University. Assuming 4 trips/week for 40 weeks/year at an average length of 8 miles per trip, a total mileage per year can be calculated.

Because commuting values are linearly derived from populations, the greenhouse gas emissions associated with commuting rise and fall with the student, staff and faculty population changes.

Student and faculty population grew by 5.1% and 5.3% while the staff population decreased by 1.7%.

Faculty and staff commuting were calculated similarly. 73% of personnel are assumed to use personal vehicles at a rate of 5 trips/week for 52 weeks (staff) 50 weeks (faculty)/year and an average length of 13 miles per trip.

**Graph 3: University Commuting Miles**



### AIR TRAVEL

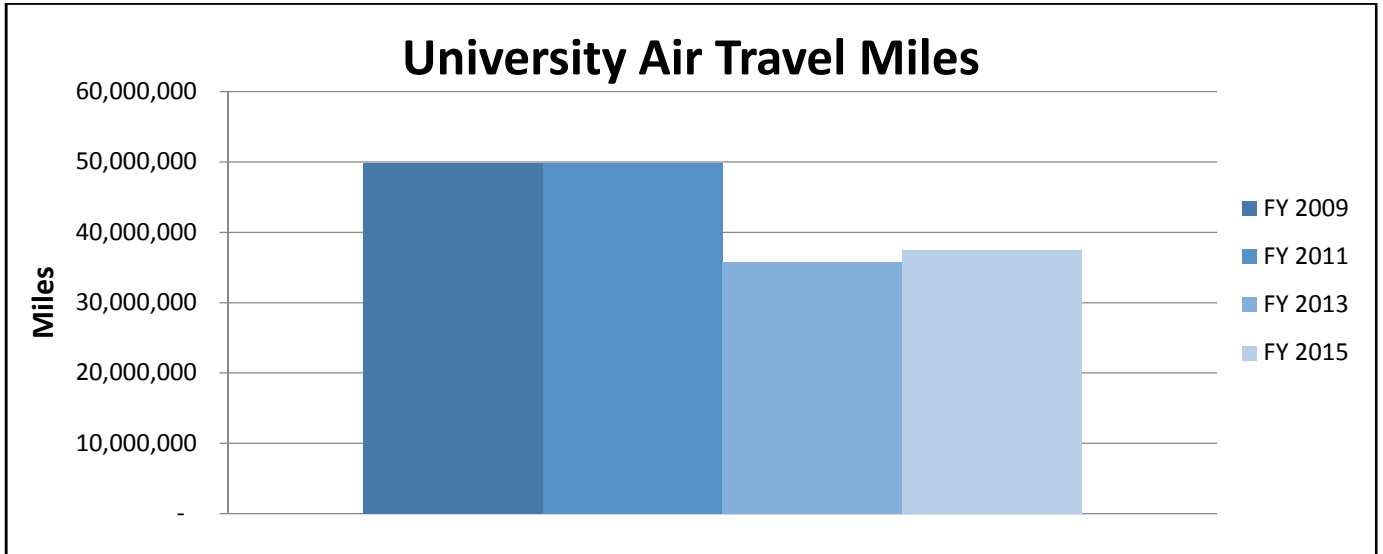
Air travel information was obtained from UA Procurement and Contracting Services Department (Purchasing Card (P-Card) Program). P-Cards are a direct method of charging air travel to the UA Financial Services Office (FSO). Utilizing P-Card usage data, the UA College of Engineering compiled a database with travel dates and origination and destination airport designations to calculate the total annual mileage data.

Another avenue for funding air travel is via direct reimbursement from UA FSO. UA FSO was able to provide the total number of trips reimbursed. Air travel mileage was not available. The average trip length from the P-Card data set was used as a multiplier to determine a reasonable total air travel mileage where evaluating the direct reimbursement data.

Although having decreased by 28% in FY 2013, air travel and resulting greenhouse gas emissions have shown an increase of 5% since then. The confidence level in existing air travel data is less than desired due to averages, extrapolations, and assumptions that are necessary in order to derive the final data, specifically for direct reimbursement flights.

For improvement to future data collection methods, the University could consider working with the Financial Services Office and/or Procurement and Contracting Services to develop custom computer queries to extract the required mileage data for all air travel by UA faculty and staff. Consideration might also be taken with respect to implementing an alternate means of logging air travel miles at the time of ticket purchasing/reimbursing.

**Graph 4: University Air Travel Miles**



## WASTE MANAGEMENT

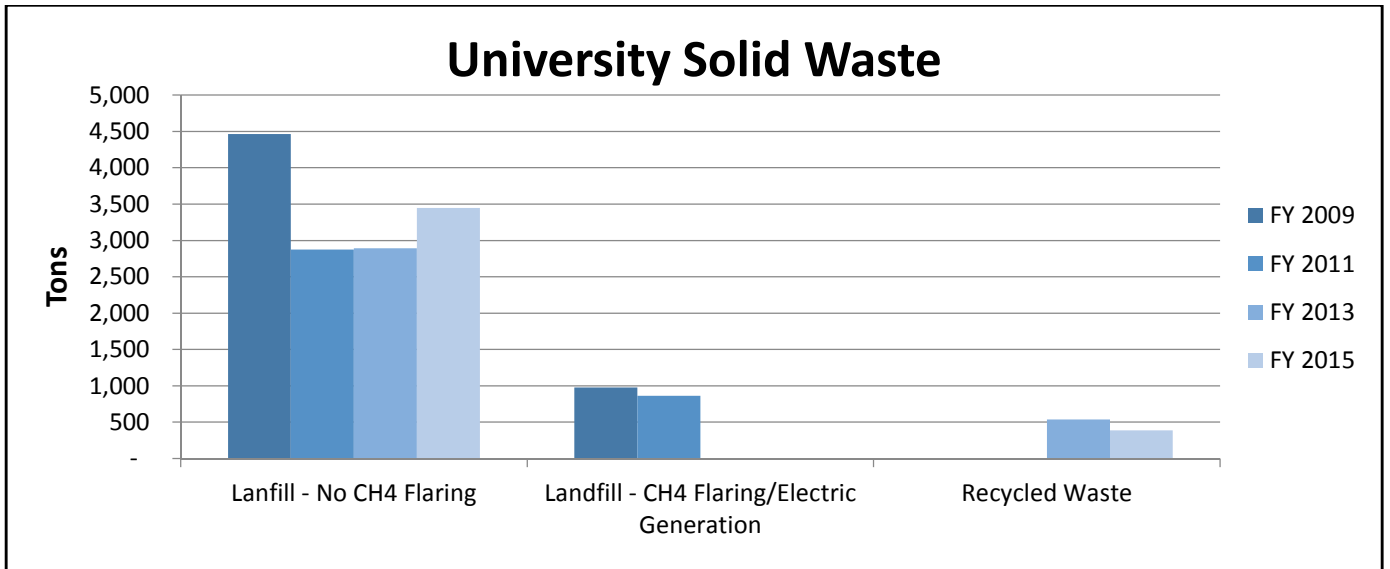
In FY 2015, the UA sent approximately 3,446 tons of commercial, roll-off and owner-hauled waste to the landfill, and recycled 387 tons of paper and baled old corrugated cardboard (OCC). The campus recycled 10.1% of total waste in fiscal year 2015 to include recycled paper, construction and demolition material, mixed metal, animal bedding and pallets. The overall amount of University solid waste generation increased by 11.8% since FY 2013, corresponding with an increase in resultant emissions from 8,965 MtCO<sub>2</sub>e in FY 2013 to 10,683 MtCO<sub>2</sub>e in FY 2015 (19.2%). The increase in overall waste can be attributed to the fact that FY 2015 was the first year that information on Student Union solid waste was available, weighing in at a total of 728 tons.

Waste removal from campus is either by UA hauling to a local landfill or the contracted waste disposal service (Waste Management (WM)) hauling both commercial and roll off waste to a local landfill. UA-hauled waste was transported to the Ina Road Land Reclamation Facility which only accepts clean inert or clean green waste and CH<sub>4</sub> recovery is not accomplished. In the past, the University did haul to a local landfill with CH<sub>4</sub> recovery and electrical generation (Los Reales Landfill) but this opportunity is no longer available.

Waste removed by WM is taken to the Marana Regional Landfill. CH<sub>4</sub> recovery is not accomplished at this facility.

The University now additionally employs a composting operation (Compost Cats) at San Xavier Mission, aiding in campus carbon offsetting. According to the UA Office of Sustainability, a total of 3,903,793 lbs of wet organic compost was produced this fiscal year for an additional offset amount of 574 MtCO<sub>2</sub>e.

**Graph 5: University Solid Waste**

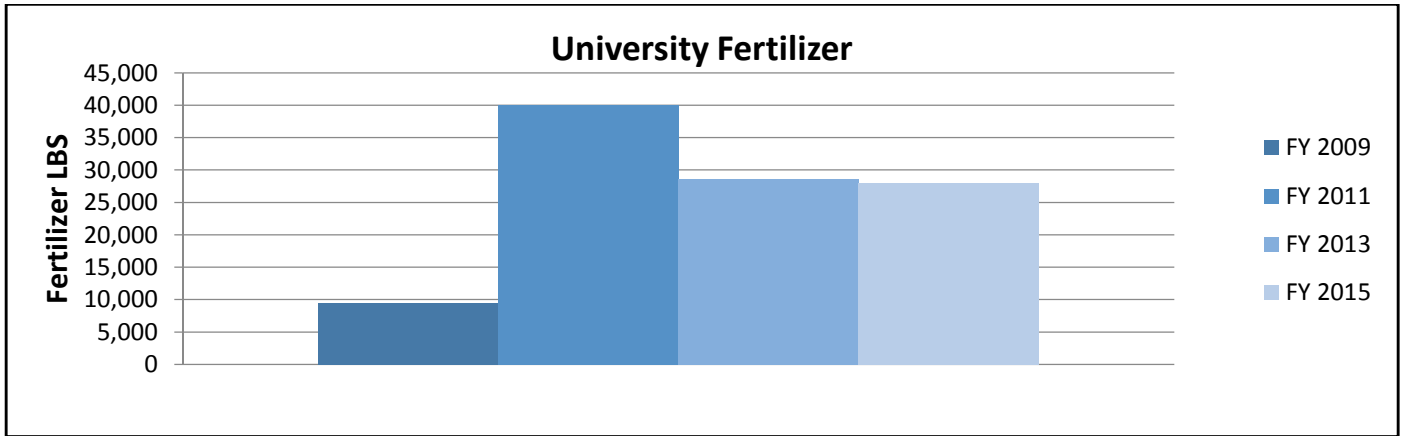


## GROUNDS MANAGEMENT

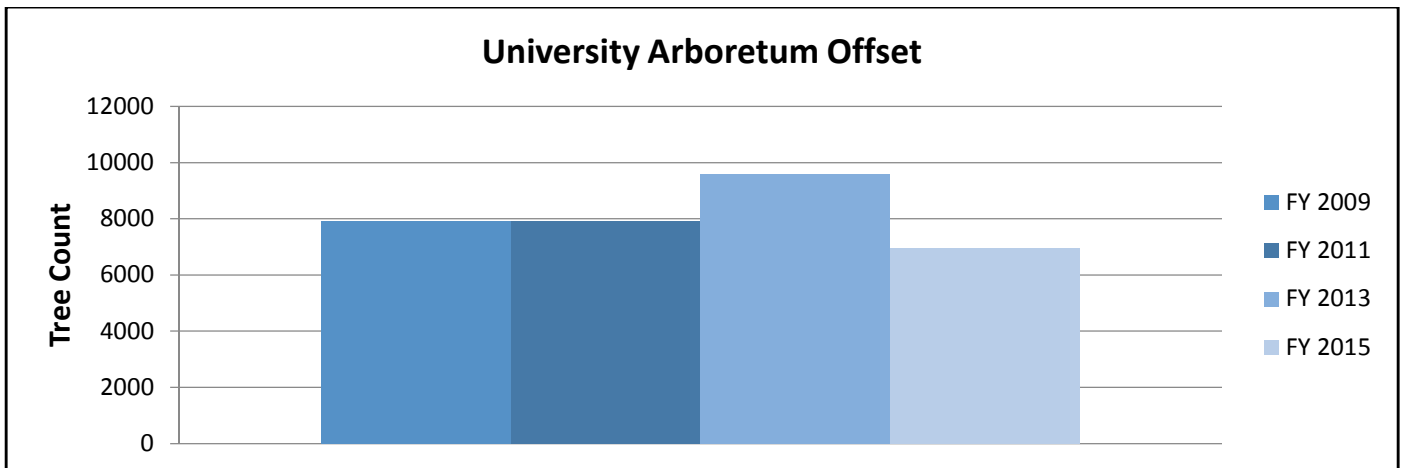
The University of Arizona has over 390 acres of mostly landscaped land. During FY 2015, the campus continued to decrease its dependency on synthetic fertilizer and has now begun to utilize organic fertilizer (11% of total). The amount of synthetic fertilizer used in FY 2015 and its subsequent MtCO<sub>2</sub>e emissions decreased from the previous year; 25,000 pounds of synthetic fertilizer was utilized in FY 2015 compared to 28,625 pounds in FY 2013. Additionally, 3,000 pounds of compost was purchased for use on the University property during fiscal year 2015.

Tree data is used as an offset to the University of Arizona's greenhouse gas emissions. Total tree count for FY 2015 is 6,940 while the FY 2013 data showed a tree count of 9,579. The perceived sharp drop in trees since FY 2013 can be attributed to the FY 2013 arboretum report including some amount of artifact data on trees that had actually been lost since reporting began; this yielded a deceptively larger tree count than warranted for FY 2013.

**Graph 6: University Fertilizer Use**



**Graph 7: University Arboretum Offset**





## FISCAL YEAR 2015 GREENHOUSE GAS EMISSIONS FINDINGS

According to available data, the University of Arizona produced a net total emissions count of 231,824 MtCO<sub>2</sub>e in FY 2015 as compared to 238,939 MtCO<sub>2</sub>e in FY 2013. This represents a 3.0% decrease in overall CO<sub>2</sub> equivalent emissions in the past two years.

The largest contributors to greenhouse gas emissions are listed below, in descending order of contribution (greatest to least, not including transmission/distribution losses or offsets):

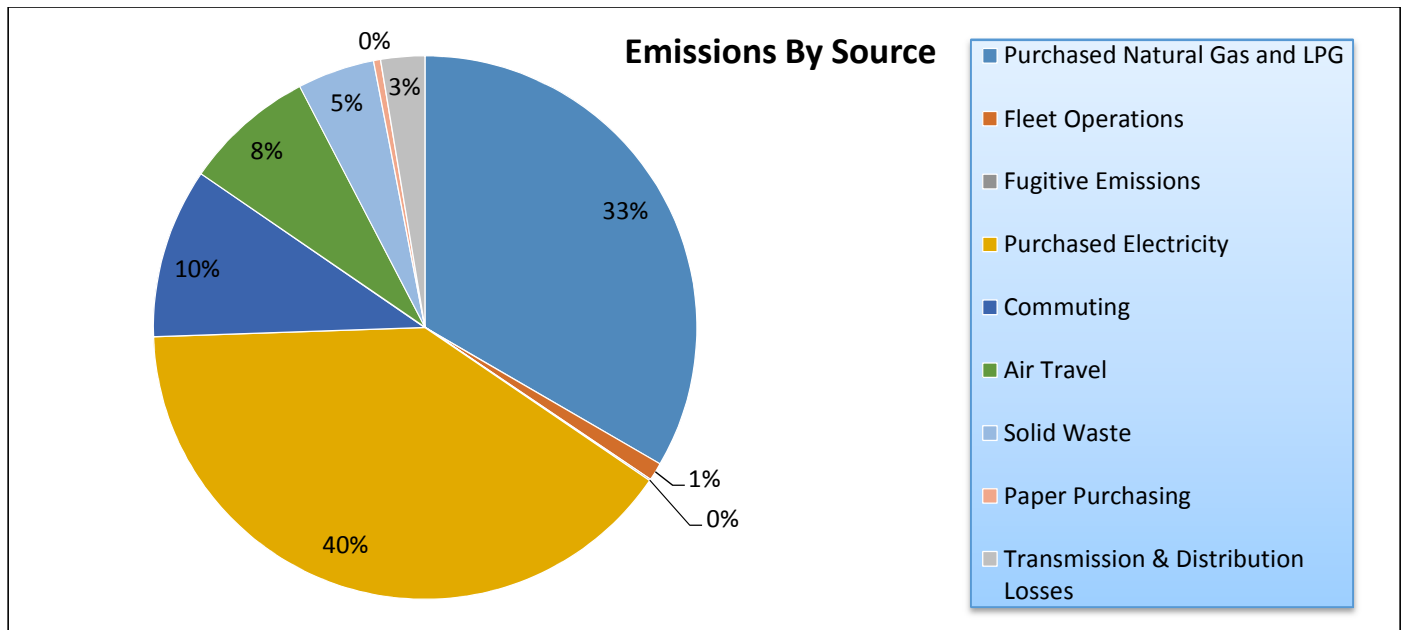
1. Purchased electricity
2. Purchased natural gas and propane - stationary combustion
3. Commuting
4. Air Travel
5. Waste Management
6. University fleet operations – mobile combustion
7. Paper Purchasing
8. Fugitive emissions – refrigerants, chemicals, fertilizer

The following tables and graphs present data of general interest regarding the University of Arizona greenhouse gas emissions for fiscal year 2015.

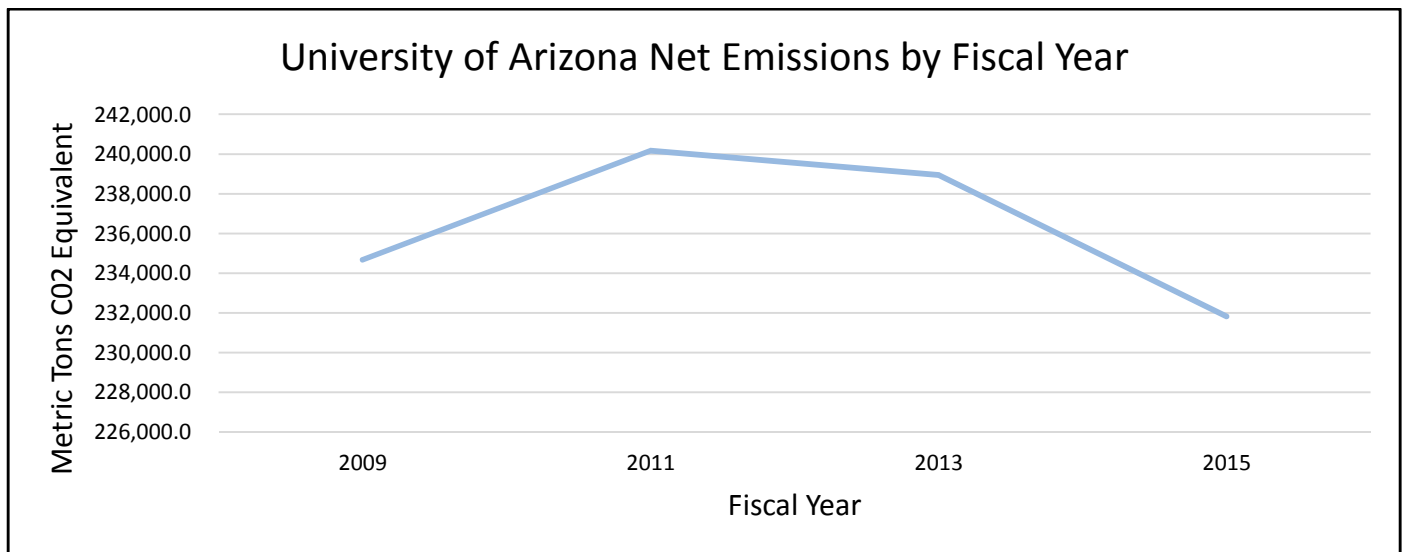
**Table 2: Metric Tons of CO<sub>2</sub> Equivalent (MtCO<sub>2</sub>e)**

Category	FY 2013	FY 2015	Change
<b>Utility Operations</b>			
Purchased Electricity	94,493	92,837	-1.8%
Purchased Natural Gas and LPG	85,622	77,576	-9.4%
<b>Commuting</b>	22,663	23,540	+3.9%
<b>Air Travel</b>	17,251	18,113	+5.0%
<b>Waste Management</b>	8,965	10,683	+19.2%
<b>University Fleet Operations</b>	2,173	2,493	+14.7%
<b>Paper Purchasing</b>	1,307	941	-28.0%
<b>Fugitive Emissions</b>			
Refrigerants, Chemicals and Fertilizers	442	199	-55.0%
<b>Transmissions and Distribution Losses</b>	6,224	6,115	-1.8%
<b>Offsets</b>			
Arboretum Tree Count	-201	-116	+42.3%
Organic Composting	N/A	-557	N/A
<b>TOTAL</b>	<b>238,939</b>	<b>231,824</b>	<b>-3.0%</b>

**Graph 8: Emissions by Source**



**Graph 9: Metric Tons of CO2 Equivalent (MtCO2e) by Fiscal Year**



**Table 3: Normalization Data for MtCO2 Emissions**

Fiscal Year	MtCO <sub>2</sub> /SF	MtCO <sub>2</sub> /Student	MtCO <sub>2</sub> /Total Population
2009	.0251	6.5734	4.9375
2011	.0244	6.3063	4.8109
2013	.0239	5.9250	4.5516
2015	.0215	5.4691	4.2252

\*Total Population (FTE) = Student + Staff + Faculty

## INSTITUTIONAL DATA FY 2015

Population			
FTE students	42,388	(note 1)	
Residential students'	not available		
Full time commuting students	not available		
Part time commuting students	not available		
Noncredit students	not available		
Summer students	not available		
Full time staff	4,637	(note 2)	
Part time staff	not available		
Full time faculty	7,842	(note 3)	
Part time faculty	not available		

Budget			
Total Operating budget	\$2,093,239,000	(note 4)	
Research budget	\$629,466,000	(note 5)	
Energy budget	not available		

Physical Space Data			
Total Space GSF (excludes residential and parking)	9,490,442	(note 6)	
Health Sciences	1,302,942	(note 6)	
Laboratory Space	not available		
Parking Structure	not available		
Dining Space	not available		
Residential Space	not available		
Athletic	not available		

## SOURCES: 2014-2015 FACT BOOK DATA

Note 1: Students/FTE

<http://factbook.arizona.edu/2014-15/students/fte>

Note 2: Employees (use FTE value for classified staff and Administrator)

<http://factbook.arizona.edu/2014-15/employees>

Note 3: Employees (use FTE value for Faculty, Other appointed, and GA and Associates)

<http://factbook.arizona.edu/2014-15/employees>

Note 4: Total Operating Budget (use total funds)

<http://factbook.arizona.edu/2014-15/finances>

Note 5: Research Budget (use Total R&D)

<http://factbook.arizona.edu/2014-15/finances/research>

Note 6: Total Space GSF, Residential, permanent and non-permanent, and Parking Structures (use Main Campus)

<http://factbook.arizona.edu/2014-15/facilities>