



SUSTAINABILITY · UVA
From the Grounds Up

UNIVERSITY OF VIRGINIA

2017 GREENHOUSE GAS
INVENTORY REPORT

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Executive Summary

In 2011, the University of Virginia's Board of Visitors committed to reduce greenhouse gas (GHG) emissions University-wide 25 percent below 2009 levels by 2025. To track progress, UVA's Greenhouse Gas Inventory Report is calculated annually by the Office for Sustainability, and reviewed by others within Facilities Management. This report defines UVA's GHG accounting methodology, documents the current footprint, and analyzes the observed emission trends to target areas for further reductions to meet the 2025 goal.

In Calendar Year 2009, the baseline year for emissions analysis, UVA's GHG emissions footprint was 338,009.6 Metric Tons of Carbon Dioxide Equivalent (MTCDE). **In 2017, emissions decreased to 274,246.4 MTCDE, resulting in an 18.9 percent reduction in emissions compared to 2009.** The reduction relative to 2009 is largely a result of a reduction in total electricity consumption, continued fuel switching on-Grounds, shorter heating season, energy efficiency activities in existing buildings and plants, and improvements made to the electricity grid. Figure 1 and Table 1 below reports UVA's 2017 GHG emissions and energy consumption by both source.

UVA is committed to reducing GHG emissions and energy use across Grounds and meeting the University-wide GHG emissions reduction goal of 25 percent below 2009 levels by 2025. UVA's GHG Action Plan outlines specific emissions reductions strategies as well as provides the UVA community and its partners with a transparent roadmap for how the University will implement these projects and meet the goal.

Figure 1: UVA GHG Emissions by Source (MTCDE), 2009-2017

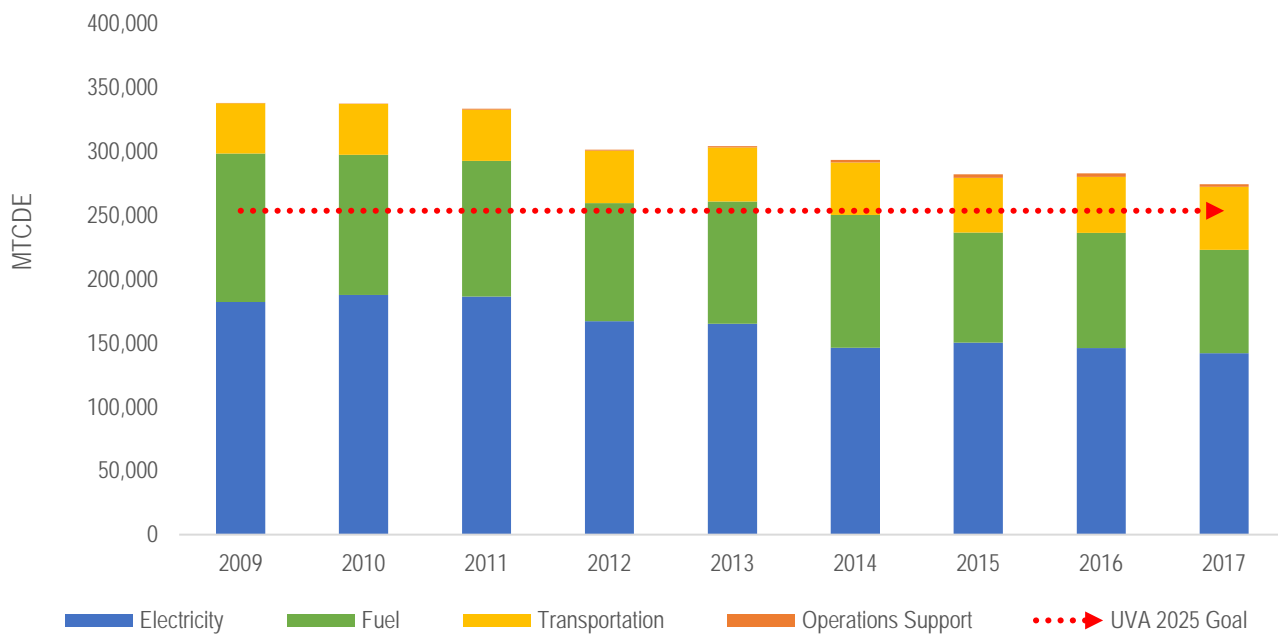


Table 1: UVA GHG Emissions by Source (MTCDE), 2009-2017

GHG Source	2009	2010	2011	2012	2013	2014	2015	2016	2017
Electricity	182,113.0	187,651.7	186,442.7	167,034.4	165,028.4	146,177.7	150,388.8	146,039.8	141,896.6
Fuel	116,298.5	109,720.8	106,096.0	92,332.1	95,827.9	104,140.7	86,174.2	90,045.6	80,953.3
Transportation	39,151.2	39,652.6	39,991.1	41,159.8	42,255.1	40,990.6	42,627.6	43,841.5	49,336.3
Operations Support	447.0	288.8	851.0	725.6	847.4	1,925.9	2,836.2	2,784.7	2,060.3
Total Net Emissions	338,009.6	337,313.7	333,380.8	301,251.9	303,958.9	293,234.8	282,026.7	282,711.6	274,246.4

Emissions By Scope

When broken down by Scope, UVA's largest contributor to overall net emissions is Scope 2 emissions, which accounts for the impacts of purchased electricity. Since 2009, Scope 2 has consistently accounted for approximately 50 percent of UVA's total net emissions inventory with 2017 following the trend at 49.2 percent. Scope 1 emissions contributed the second most (31.8 percent) while Scope 3 emissions contributed the remainder (19.1 percent). Both Scope 1 and 2 emissions have decreased since 2009, by 27.7 and 18.6 percent, respectively, while Scope 3 emissions have increased by 0.8 percent. Figure 2 and Table 2 below reports UVA's 2017 GHG emissions and energy consumption by scope.

Figure 2: UVA GHG Emissions by Scope (MTCDE), 2009-2017

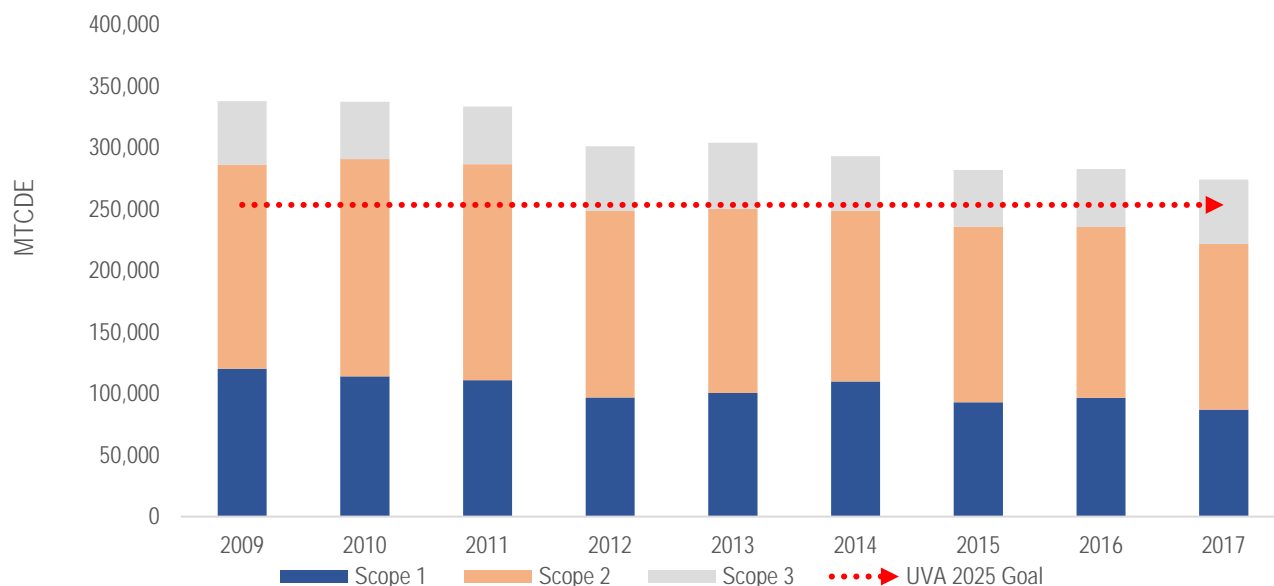


Table 2: UVA GHG Emissions by Scope (MTCDE), 2009-2017

GHG Scope	2009	2010	2011	2012	2013	2014	2015	2016	2017
Scope 1	120,397.5	114,082.9	110,961.0	96,994.3	100,576.1	109,902.2	92,948.8	96,694.3	87,090.1
Scope 2	165,722.8	176,728.5	175,589.9	151,716.8	149,894.8	138,912.7	142,914.4	138,781.7	134,844.3
Scope 3	51,889.4	46,502.4	46,829.9	52,540.8	53,487.9	44,420.0	46,163.5	47,235.7	52,312.0
Total Net Emissions	338,009.6	337,313.7	333,380.8	301,251.9	303,958.9	293,234.8	282,026.7	282,711.6	274,246.4

Addressing Growth

It is important to note that UVA's GHG Inventory include the Health System, which contributes approximately 40 percent of the total emissions produced by the University. Additionally, the expansion to the University's offerings has resulted in growth in both population and building area. Since 2009, there has been a population increase of 3,973 students, faculty, and staff (a 11.8 percent increase). To support UVA's population growth, approximately 2.6 million square feet (a 17.0 percent increase) of building space has been added to University's footprint and included within the boundaries defined for UVA's GHG inventory. The University's commitment to achieving this goal in light of the continuing expansion is driving heavy investments in expanding sustainability efforts to enhance the University's operations and building portfolio.

Methodology

This CY2017 GHG Inventory was developed using the web-based Sustainability Indicator Management & Analysis Platform (SIMAP) developed by the University of New Hampshire. The methodologies in this tool are aligned with the recommendations of the American College and University Presidents' Climate Commitment (ACUPCC) guidance, which refers to The Climate Registry's General Reporting Protocol and the World Resource Institutes' Greenhouse Gas Protocol Corporate Accounting and Reporting Standard.

Inventory Boundary

On the most basic level, UVA emissions include any emissions related to the functional operation of the University. The "Operational Control Approach" best aligns with the boundaries established for this inventory – "accounting for GHG emissions from operations under its operational control, which refers to the authority to introduce and implement operating policies at an operation." This boundary includes all major emission sources on campus (Grounds), including purchased electricity, energy usage on Grounds, transportation, and operational support. The Inventory includes all owned properties in the City of Charlottesville, Albemarle County, as well as some remote research buildings in the Commonwealth of Virginia (namely Mountain Lake Biological Station, and Anheuser-Busch Coastal Research Center). These buildings have either electricity provided through a UVA substation, a direct electricity feed and a bill paid by Facilities Management, or thermal energy provided from one of UVA's heating or chiller plants. Leased properties, UVA Foundation properties, the College at Wise, and UVA property in other geographic locations are not currently included in this GHG Inventory boundary.

SIMAP calculates GHG emissions from activities that produce carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and refrigerants. Emissions of CH₄, N₂O, and refrigerants are converted to metric tons of carbon dioxide equivalent (MTCDE) using Global Warming Potentials (GWPs) provided by the Intergovernmental Panel on Climate Change's Assessment Reports. This allows UVA to calculate a total carbon emissions Inventory for the University.

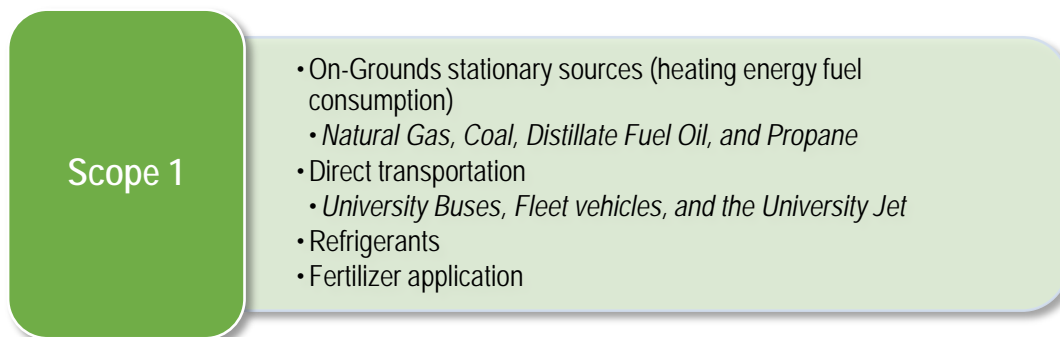
GHG Emission Sources

UVA's GHG emissions are generated from four distinct sources: Electricity, Fuel, Transportation, and Operations Support. Electricity includes purchased electricity as well as transmission and distribution losses. Fuel includes coal, natural gas, distillate oil, and propane used on Grounds. Transportation includes direct emissions from fleet vehicles used as well as student, faculty, and staff commuting. Operations Support includes fertilizer, refrigerants, solid waste, and wastewater emissions, which are all necessary for the functioning of the University. Based on standard GHG accounting protocols and definitions, these emission sources are grouped into three "Scopes" defined on the controllability of each emissions source by the University.

Scope 1

Figure 3 refers to any GHG emissions that are a direct result of operations owned or controlled by the University.

Figure 3: Scope 1 GHG Source Categories



Scope 2

Figure 4 refers to indirect GHG emissions that are a consequence of activities within the organizational boundaries of the institution, but occur at sources owned or controlled by another entity.

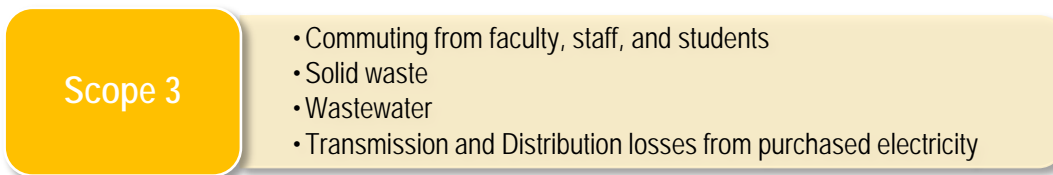
Figure 4: Scope 2 GHG Source Categories



Scope 3

Figure 5 refers to all Scope 3 indirect emissions included in UVA's GHG Inventory. It is important to note there are a number of Scope 3 sources not included in UVA's GHG Inventory such as study abroad travel, holiday travel, and business travel. These emission sources have not been included because University-wide reporting methods do not currently exist in the appropriate capacity to generate accurate information. Likewise, GHG emissions from purchased paper is not included in this Inventory because a method of accurately accounting for paper purchasing on a University-wide basis is not available.

Figure 5: Scope 3 GHG Source Categories



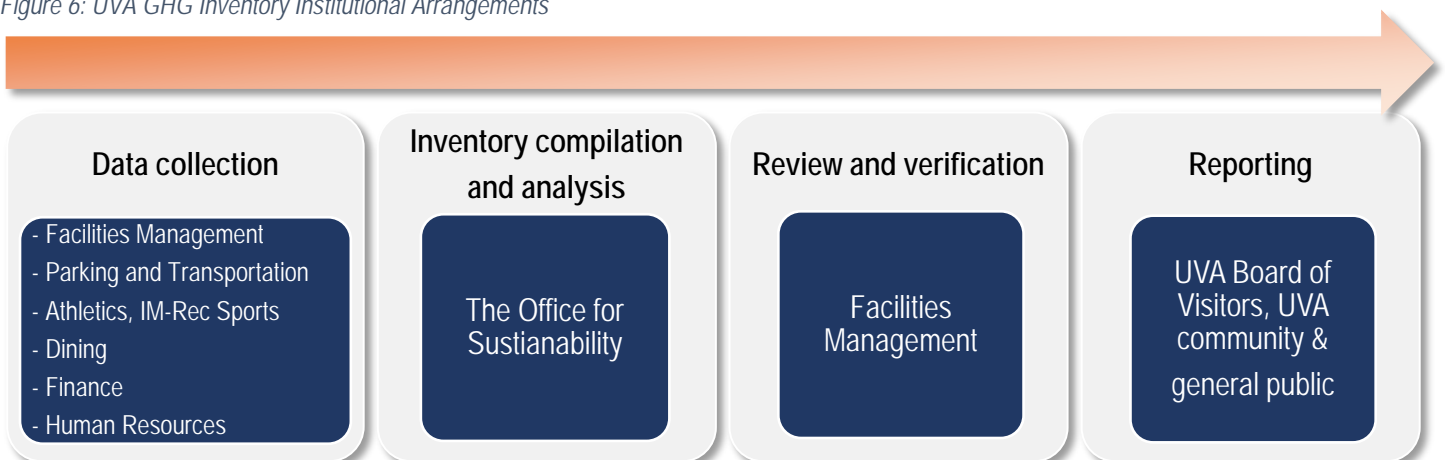
Data Collection

Data input to the CA-CP calculator is derived from a variety of University personnel and sources. Fuel and electricity consumption is metered and records retained by Facilities Management. Direct transportation fuel consumption is maintained by Parking and Transportation. Refrigerant use is sourced from a variety of locations with Facilities Management and Dining being the primary contributors. Fertilizers are used and logged by Landscaping (Facilities Management), Athletics, and Intramural-Recreational Sports (IM-Rec).

Institutional Arrangements

Figure 6 portrays UVA's institutional arrangements regarding the GHG Inventory process.

Figure 6: UVA GHG Inventory Institutional Arrangements



Electricity

Electricity consumption continues to be the largest source of greenhouse gas emissions at the University. In 2017, purchased electricity and its associated transmission and distribution losses accounted for 141,896.6 MTCDE, or 51.7 percent of total UVA emissions. This was a 2.8 percent decrease from 2016 and a 22.1 percent decrease from 2009 levels. UVA purchases the vast majority of electricity from Dominion Virginia Power. This electricity is used primarily for cooling and core electrical services such as lighting and plug loads. Transmission and distribution (T&D) losses stem from electricity (calculated as a percentage of total electricity consumption), and are included in this category despite being tracked as part of Scope 3 emissions.

Electricity GHG emissions were calculated using the regional electricity emissions factors from EPA's eGRID Database. EPA's eGRID Database is the preeminent source of air emission data for the electric power sector. Over time, eGRID's emissions factors (lbs of emissions / MWh of electricity generated) have decreased due to new technologies improving the generation process or the increased use of natural gas and/or renewables to replace dirtier fuels, such as coal. A smaller emissions rate implies that the electricity generation process for that region is more efficient or uses a cleaner fuel mix than that of a region with a higher emissions rate.

UVA continues to implement initiatives to curb the use of electricity on-Grounds. In 2017 UVA saw continued success in implementing LED lighting technology in exterior lighting, building retrofits through Delta Force projects, and in new construction and renovation projects. Additionally, continuous reminders of building occupant energy awareness along with specialized events throughout the year have contributed to UVA's goal. These activities have helped UVA offset the expected consumption and emissions from the new facilities and square footage added by the University since 2009.

Figure 7: UVA Electricity GHG Emissions by Source (MTCDE), 2009-2017, and 2017 Snapshot

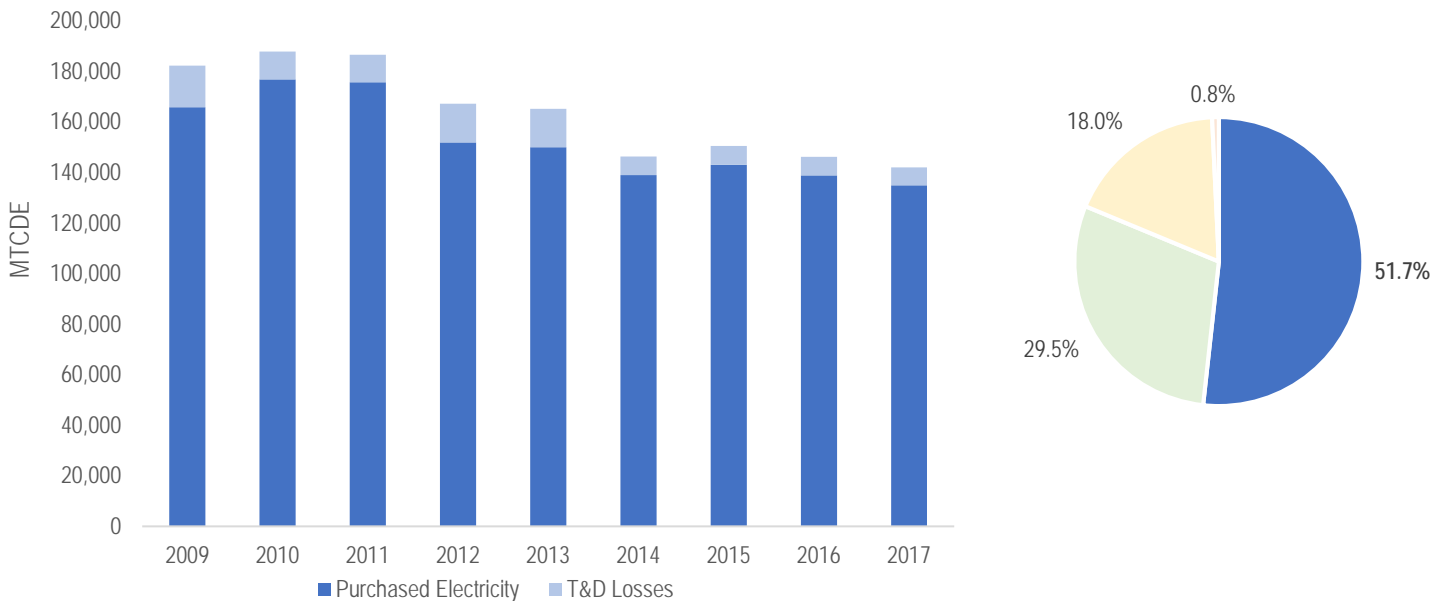


Table 3: UVA Electricity Emissions (MTCDE) Trends, 2009-2017

	2009	201	2017	% change from '16	% change from '09
Purchased Electricity					
Purchased Electricity	165,722.8	138,781.7	134,844.3	-2.8%	-18.6%
T&D Losses	16,390.2	7,258.2	7,052.3	-2.8%	-57.0%
Total Electricity Emissions	182,113.0	146,039.8	141,896.6	-2.8%	-22.1%

Fuel (On-Grounds Stationary Sources)

The majority of UVA's Scope 1 emissions stem from On-Campus Stationary fuels used for heating. These sources include coal, natural gas, distillate oil, and propane gas. In 2017, these sources accounted for 80,953.3 MTCDE, or 29.5 percent of UVA's total net emissions. This was a 10.1 percent decrease from 2016 and a 30.4 percent decrease from 2009 levels.

UVA reduced coal use as the University's primary heating energy source from 2009 to 2017, replacing it with natural gas to continue to meet heating demand. More significantly, the heating plant completely eliminated the use of coal during the summer months (June-September), continuing a practice that occurred in 2015, 2016 and 2009. The fuel switch from coal to natural gas continues to provide UVA with the largest overall emissions reductions from 2009 due to the less intensive combustion of natural gas. Although it has decreased considerably since 2009, the University's coal use fluctuates when Charlottesville experiences a much colder than normal winter, resulting in a shortage of the natural gas supply during this time. In response to these shortages, the Main Heating Plant combusts additional coal to meet peak demand.

While fuel switching has significantly reduced emissions from on-Grounds Stationary Combustion, additional actions also contributed to this success including the replacement of boilers at the North Grounds Mechanical Plant with low temperature hot water generators and heat recovery chillers, the burner replacements at Massie Road Plant, and the continued improvements spearheaded by the Delta Force program.

Figure 8: UVA On-Grounds Stationary Combustion Emissions (MTCDE) Trends, 2009-2017, and 2017 Snapshot

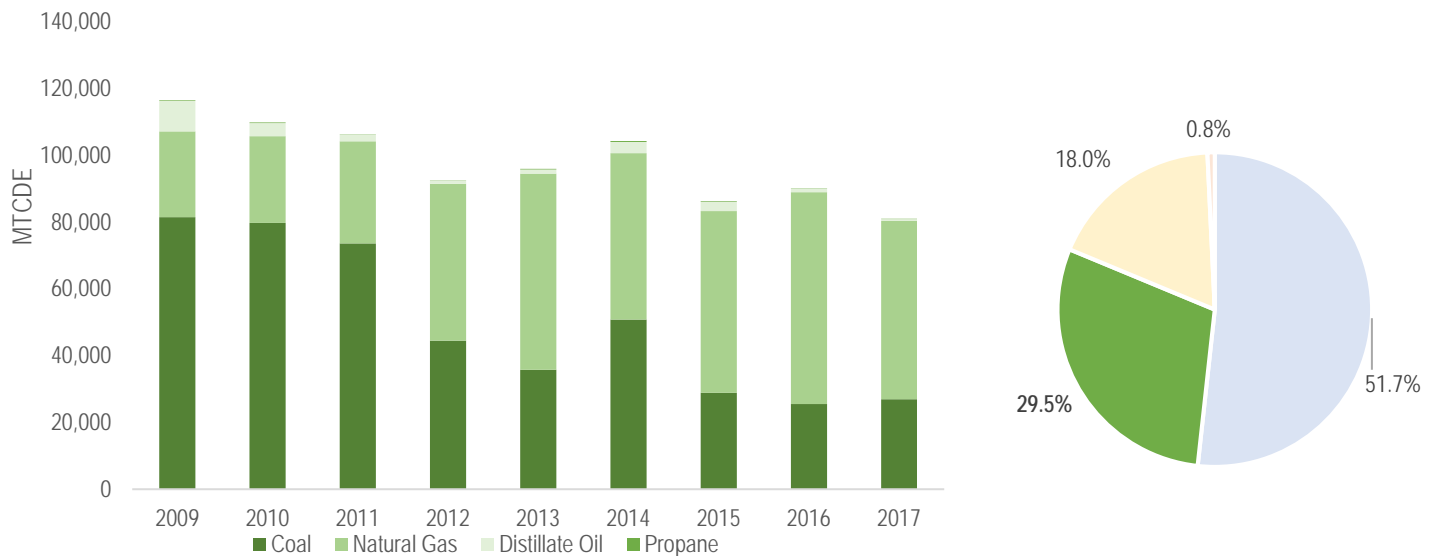


Table 4: UVA On-Grounds Stationary Combustion Emissions (MTCDE) Trends, 2009-2017

	2009	2016	2017	% change from '16	% change from '09
Coal	81,444.7	25,479.1	26,908.6	5.6%	-67.0%
Natural Gas	25,608.1	63,434.8	53,367.4	-15.9%	108.4%
Distillate Oil	9,110.4	1,012.0	555.3	-45.1%	-93.9%
Propane Gas	135.4	119.7	122.0	2.0%	-9.8%
Total On-Grounds Fuel Emissions	116,298.5	90,045.6	80,953.3	-10.1%	-30.4%

Transportation

Transportation emissions includes the impacts of the University's vehicle fleet, categorized as Direct Transportation, as well as the impact of UVA's faculty, staff, and student commuting practices. The UVA vehicle fleet portion of emissions includes the University-owned Transit System buses, cars, maintenance vehicles, and the University jet. These vehicles are considered under Scope 1 emissions because the University has direct control of these sources. The emissions associated with faculty, staff, and student commuting are included in Scope 3 because they are not under the direct control of UVA. These emissions are estimated from the approximate miles students, faculty, and staff travel to and from the University each day. This information is collected through a University-wide survey that is conducted every two to three years. Transportation emissions accounted for 49,336.3 MTCDE, or 18.0 percent of total 2017 UVA emissions. This was a 12.5 percent increase from 2016 and a 26.0 percent increase from 2009 levels.

Since 2009, UVA has established campaigns and incentives to promote more sustainable commuting practices while continuing to offer complementary programs such as the University Transit Service and a partnership with Charlottesville Area Transit (CAT). These programs aim to help faculty, staff, and students get to destinations once arriving on-Grounds. The Carpool program for example, is the most common sustainable, non-single occupant vehicle, commuting program at UVA for faculty and staff while other programs, such as UVA's bicycle sharing program, are more recent additions to commuting options. UVA will continue to explore other options to reduce the impact commuting has on GHG emissions.

Figure 9: UVA Transportation Emissions (MTCDE) Trends, 2009-2017, and 2017 Snapshot

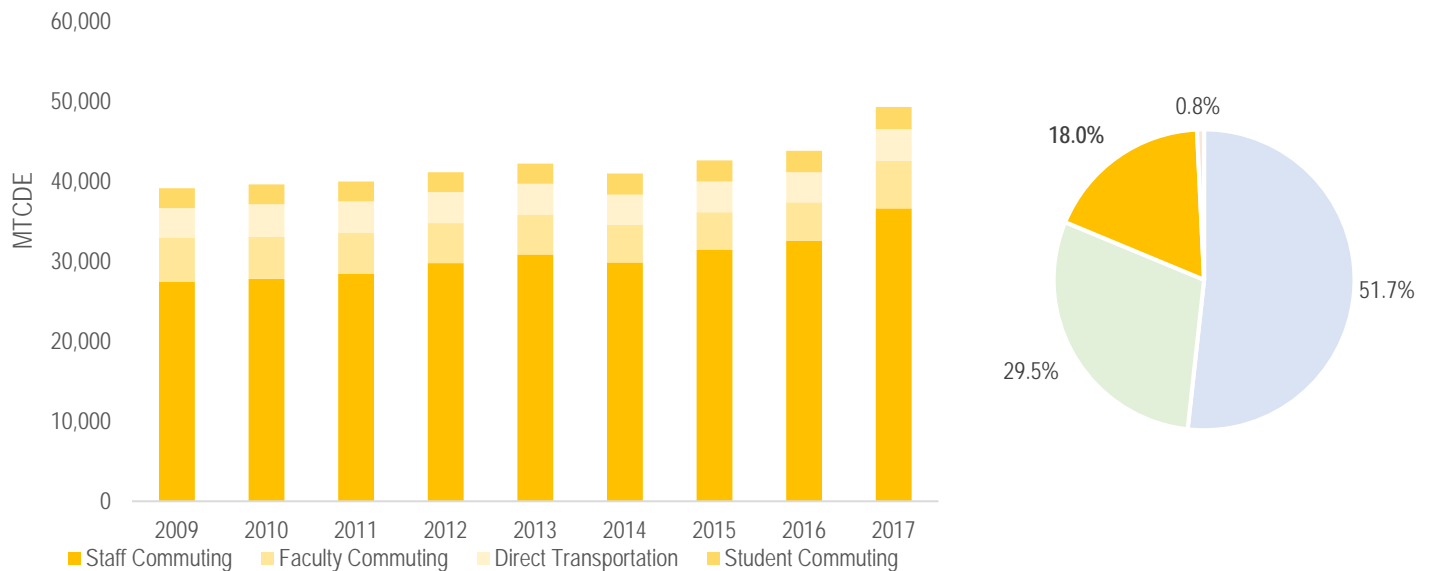


Table 5: UVA Transportation Emissions (MTCDE) Trends, 2009-2017

	2009	2016	2017	% change from '16	% change from '09
Faculty Commuting	5,543.4	4,787.8	5,971.0	24.7%	7.7%
Staff Commuting	27,467.3	32,616.2	36,634.2	12.3%	33.4%
Student Commuting	2,487.0	2,670.8	2,766.9	3.6%	11.3%
Direct Transportation	3,653.6	3,766.8	3,964.2	5.2%	8.5%
Total Transportation Emissions	39,151.2	43,841.5	49,336.3	12.5%	26.0%

Operations Support

Operations support includes the emissions generated from the release of refrigerants and other chemicals into the atmosphere, off-gassing from fertilizers, and emissions associated with treating wastewater. This category also includes the mitigation of methane production by landfilling solid waste to facilities that capture the methane and use for power generation, equaling a negative emissions value. While operations support is the smallest contributor to overall emissions at UVA, accounting for 0.8 percent of total 2017 emissions, its impact has increased by 360.9 percent since 2009. As such, operational support emissions are easily the fastest growing emissions source at UVA.

The primary contributor to operational support emissions is the release of refrigerants and chemicals in appliances such as air conditioners. As UVA continues to centralize cooling by connecting buildings with previously stand-alone chillers to central chilled water plants, the global warming potential of the refrigerants employed for building conditioning are being reduced due to advances in technology used by the newer equipment in the plants. Additionally, the centralization of the chillers will result in more frequent monitoring for refrigerant leaks by individuals likely to see and prevent problems before they become major issues.

Figure 10: UVA Operations Support Emissions (MTCDE) Trends, 2009-2017, and 2017 Snapshot

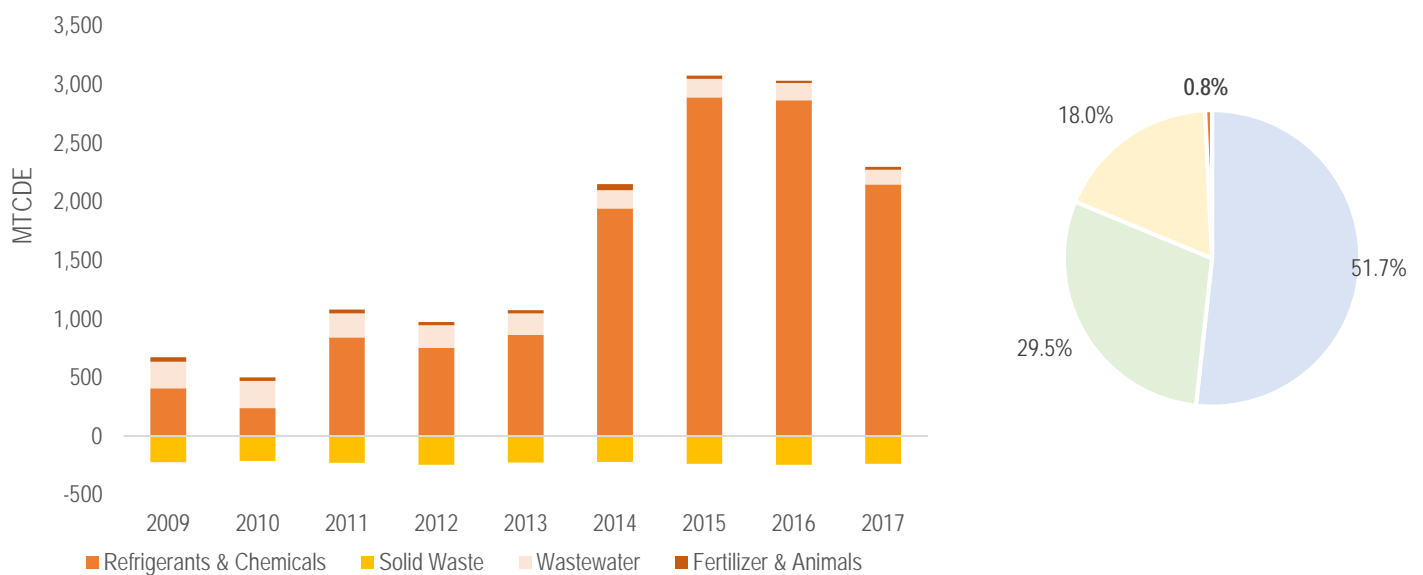


Table 6: UVA Operations Support Emissions (MTCDE) Trends, 2009-2017

	2009	2016	2017	% change from '16	% change from '09
Refrigerants & Chemicals	408.1	2,863.2	2,146.8	-25.0%	426.0%
Agriculture	37.3	18.7	25.8	37.8%	-30.8%
Solid Waste	(224.0)	(245.5)	(237.1)	-3.4%	5.8%
Wastewater	225.6	148.2	124.7	-15.9%	-44.7%
Total Operations Support Emissions	447.0	2,784.7	2,060.3	-26.0%	360.9%

Appendix A: Emissions and Energy Data

Table 7: UVA 2009 GHG Emissions by Source and Scope

GHG Scope	Energy Consumption (MMBtu)	CO ₂ (kg)	CH ₄ (kg)	N ₂ O (kg)	MTCDE (Metric Tons)	Percent of Total Gross Emissions
Scope 1 Totals	1,430,888.9	119,124,378.0	13,352.0	1,783.0	120,397.5	35.6%
On-Grounds Stationary	1,358,413.7	115,532,962.0	12,899.0	1,487.0	116,298.5	34.4%
Direct Transportation	72,475.2	3,591,416.0	453.0	171.0	3,653.6	1.1%
Refrigerants & Chemicals	NO	NO	NO	NO	408.1	0.1%
Agriculture	NO	NO	NO	125.0	37.3	0.0%
Scope 2 Totals	1,936,936.5	164,810,023.0	3,423.0	2,776.0	165,722.8	49.0%
Purchased Electricity	1,936,936.5	164,810,023.0	3,423.0	2,776.0	165,722.8	49.0%
Scope 3 Totals	675,858.7	50,916,024.0	(1,063.0)	3,356.0	51,889.4	15.4%
Faculty Commuting	75,651.6	5,400,277.0	1,146.0	384.0	5,543.4	1.6%
Staff Commuting	374,853.2	26,758,350.0	5,677.0	1,903.0	27,467.3	8.1%
Student Commuting	33,788.7	2,457,505.0	204.0	82.0	2,487.0	0.7%
Solid Waste	NO	NO	(8,962.0)	NO	(224.0)	
Wastewater	NO	NO	533.0	712.0	225.6	0.1%
Scope 2 T&D Losses	191,565.2	16,299,892.0	339.0	275.0	16,390.2	4.8%
Total Gross	4,043,684.1	334,850,425.0	15,712.0	7,915.0	338,009.6	

NO = Not Occurring

Note: Totals may not sum due to independent rounding

Table 8: UVA 2017 GHG Emissions by Source and Scope

GHG Scope	Energy Consumption (MMBtu)	CO ₂ (kg)	CH ₄ (kg)	N ₂ O (kg)	MTCDE (Metric Tons)	Percent of Total Gross Emissions
Scope 1 Totals	1,325,681.4	84,516,715.0	7,979.0	763.0	87,090.1	31.8%
On-Grounds Stationary	1,233,469.5	80,614,835.0	7,533.0	504.0	80,953.3	29.5%
Direct Transportation	92,211.9	3,901,880.0	446.0	172.0	3,964.2	1.4%
Refrigerants & Chemicals	NO	NO	NO	NO	2,146.8	0.8%
Agriculture	NO	NO	NO	87.0	25.8	0.0%
Scope 2 Totals	1,883,479.5	133,828,991.0	14,955.0	2,152.0	134,844.3	49.2%
Purchased Electricity	1,883,479.5	133,828,991.0	14,955.0	2,152.0	134,844.3	49.2%
Scope 3 Totals	717,896.5	51,253,567.0	517.0	3,509.0	52,312.0	19.1%
Faculty Commuting	81,539.7	5,818,951.0	1,219.0	408.0	5,971.0	2.2%
Staff Commuting	500,270.6	35,701,010.0	7,479.0	2,504.0	36,634.2	13.4%
Student Commuting	37,581.6	2,734,447.0	224.0	90.0	2,766.9	1.0%
Solid Waste	NO	NO	(9,482.0)	NO	(237.1)	
Wastewater	NO	NO	295.0	394.0	124.7	0.0%
Scope 2 T&D Losses	98,504.6	6,999,159.0	782.0	113.0	7,052.3	2.6%
Total Gross	3,927,057.4	269,599,273.0	23,451.0	6,424.0	274,246.4	

NO = Not Occurring

Note: Totals may not sum due to independent rounding