

Virginia Tech Greenhouse Gas Inventory and Assessment Report

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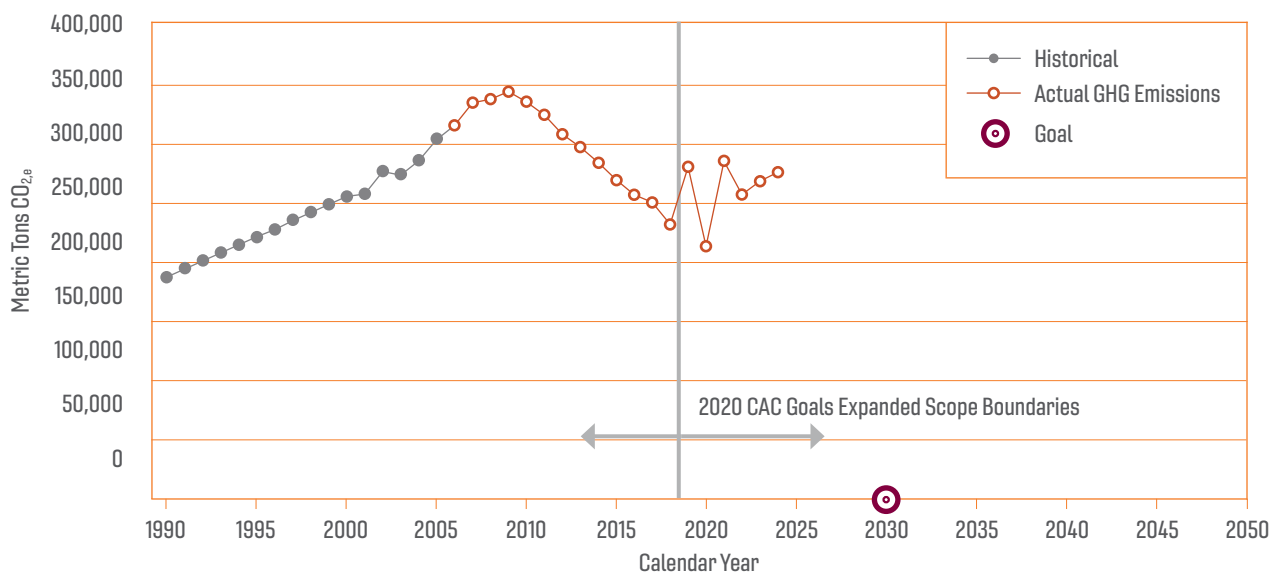
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Executive Summary

This 2024 Virginia Tech Greenhouse Gas (GHG) Inventory and Assessment Report details the analysis and results of the university's annual carbon emissions as required by the 2020 Climate Action Commitment (CAC).

The total emissions for 2024 are 2.8 percent higher than in 2023 and are shown in Figure 1 in historical context.

FIGURE 1. VIRGINIA TECH GHG EMISSIONS PROGRESS



This increase in GHG emissions for 2024 is due to small increases in several campus categories. Overall the Virginia Tech Blacksburg campus electricity usage is higher by approximately two percent due to the addition of new building space and more electric bus use. The carbon dioxide emission coefficient from the university's utility, Appalachian Power Company, has also increased slightly. Passenger miles for business air travel doubled in 2024 which increased the airline emissions by over 100 percent. Also, agricultural animals and fertilizer emissions increased by 32 percent and solid waste emissions increased by 42 percent. A number of the categories including building natural gas decreased in 2024.

Over the last year, Virginia Tech experienced several achievements in energy efficiency and environmental stewardship including opening a new regional hub for bus service in collaboration with the Town of Blacksburg, installing and operating four solar arrays on campus roofs totaling 1.2 megawatts (MW) of capacity, receiving LEED certifications on several buildings, and more.

Introduction

Virginia Tech has completed an annual Greenhouse Gas (GHG) Inventory and Assessment since 2007 as part of its Climate Action Commitment (CAC). This provides a quantitative analysis of the Virginia Tech Blacksburg campus's carbon footprint and emissions sources, which enables the university to develop detailed plans for

future emissions reductions. The annual GHG Inventory and Assessment Report is critical to the university's Climate Action Commitment. Without an accurate GHG assessment, GHG emissions cannot be reduced effectively, and progress cannot be tracked from year to year.

The GHG assessment directly supports Goal 1 of the 2020 CAC which targets a carbon-neutral Virginia Tech Blacksburg campus by 2030. Carbon neutrality in this context is defined as net-zero emissions of carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) across the Blacksburg campus operations, based on geographic and GHG scope defined by the 2020 Climate Action Commitment. Claims of carbon neutrality, in which all GHG emissions within the CAC scope are reduced to zero or offset, require a GHG assessment to confirm compliance.

For a detailed explanation and background on greenhouse gases and the analysis methodology used for this assessment, refer to annual reports 2019-2023. All substantive changes for data and analysis compared to the 2023 analysis methodology are detailed in this report.

Greenhouse gas accounting protocols are continually evolving and standardizing best practices. This report incorporates new methodologies and data as they become available. This is consistent across the broader global greenhouse gas accounting community. Each year the best available accounting methodology at the time of publication is used, and future reports may differ as industry standardization occurs. This GHG assessment uses SIMAP, the Sustainability Indicator Management and Analysis Platform (SIMAP) developed by the University of New Hampshire. This is a well-known GHG analysis platform used by universities around the United States.

Scope and Methods

The analysis reports on Virginia Tech's scope 1, 2, and 3 carbon emissions on a calendar-year basis from Jan. 1 – Dec. 31, 2024. The geographic scope in this analysis includes all Virginia Tech-owned lands and buildings on the Virginia Tech Blacksburg campus, buildings leased by university departments and the Virginia Tech Foundation in Blacksburg, and agricultural operations in the Blacksburg region. Including both the main campus and leased spaces, this inventory covers approximately 11.5 million square feet. The scope boundaries for this report are consistent with reporting years 2019-2023 and are further detailed in past reports: vt.edu/sustainability/reports.

The scope categories are based on reporting standards from the Greenhouse Gas (GHG) Protocol.¹ Scope 1 are direct emissions from university owned or controlled sources like on-campus power plants, fleet vehicles, and back-up generators. Scope 2 are indirect emissions from the generation of purchased energy from utilities (i.e. electricity). Scope 3 are all other indirect emissions due to campus operations (e.g. commuter miles, water/wastewater, commercial business travel miles, etc.). While scope 1 and scope 2 emissions are consistently reported by universities and businesses, these entities do not always report the same scope 3 emissions since there are many more and broader categories that are not always applicable or actionable.

This analysis uses the Sustainability Indicator Management and Analysis Platform (SIMAP) to convert university inventory data into equivalent carbon emissions.² All GHG emissions in this analysis are converted to metric tons carbon dioxide equivalent (MTCDE) as this is a common standardized unit for reporting emissions. The Global Warming Potentials (GWPs) for chemicals emitted into the atmosphere were 100-yr factors from The Sixth Assessment Report (AR6) of the International Panel on Climate Change (IPCC).³

Inventory Data

Inventory data was collected from units and departments across the Virginia Tech Blacksburg campus as facilitated by the Division of Facilities. Scope 1 inventory detailed in Table 1 from 2019 – 2024 include stationary fuels which are fuels consumed directly on campus. The campus energy data is more complete and accurate than the leased space data which has less submetering and more challenges in compiling the data.

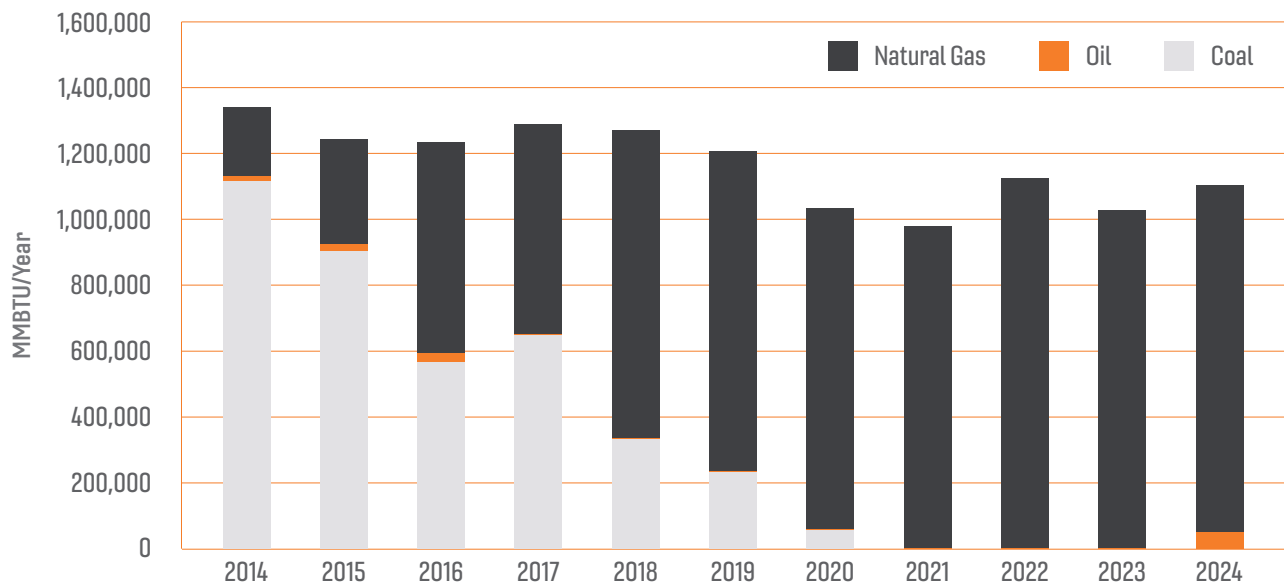
TABLE 1. VIRGINIA TECH STATIONARY FUEL USAGE

Stationary Fuels	2024	2023	2022	2021	2020	2019
Coal (VT Power Plant – short tons)	0	0	0	0	2,162	8,835
VT Power Plant - Oil (gallons)	50,593	7,000	16,838	11,150	14,622	3,600
VT Power Plant - Natural Gas (MMBtu)	1,059,136	1,033,495	1,125,701	1,015,091	1,009,530	1,005,230
E&G and Auxiliary Building Natural Gas (MMBtu)	134,176	161,207	130,672	118,557	122,477	130,955
Leased Space Building Natural Gas (MMBtu)*	3,805	5,045	3,367	7,409	23,744	23,744

*Estimates were applied where direct values were unavailable. All methodology is documented in the SIMAP platform.

The Virginia Tech Power Plant is a co-generation power facility that produces centralized steam and simultaneously uses some of the steam as a by-product to generate up to 6.25 MW of electricity. The steam-turbine-powered generator produced 17,151,190 kWh of electricity at the plant from January – December 2024. This value is approximately 30 percent higher than in 2023 when the turbine was taken offline for roughly half of the year for improvements. The power plant natural gas fuel usage was 2.5 percent higher, while oil consumption was more than six times higher in 2024 compared to 2023. This is due to the increased use of oil during extreme winter cold periods when natural gas Operational Flow Orders (OFO) and demand charges were high. Figure 2 shows the total power plant fuel consumption (natural gas, oil, and coal) for the calendar years 2014 to 2024.

FIGURE 2. POWER PLANT FUEL CONSUMPTION BY TYPE, CALENDAR YEAR 2014-2024



Direct transportation fuel use on the Virginia Tech Blacksburg campus was collected from fleet services and agricultural operations and detailed in Table 2. Default emissions factors for gasoline and diesel fuel were used in SIMAP. Aviation fuel (jet fuel A) includes the fuel used by Virginia Tech flights using the university’s planes. The EPA GHG Emission Hub gives an emissions factor for Kerosene-Type Jet Fuel as 9.75 kg CO₂/gallon.⁴ This factor was multiplied by a radiative factor of 2.7 to get the custom emissions factor applied in SIMAP for aviation fuel of 26.325 kg CO₂/gallon.⁵

TABLE 2. VIRGINIA TECH TRANSPORT FUELS IN GALLONS

Virginia Tech Fleet, Agriculture Operations and Aviation Fuels	2024	2023	2022	2021	2020	2019
Fleet Services (Diesel)	28,670	30,700	13,790	29,358	23,967	33,363
Fleet Services (Gasoline)	211,561	211,564	117,106	190,630	152,135	230,001
Agriculture Operations (Diesel)	27,247	29,007	30,184	32,617	32,617	32,617
Agriculture Operations (Gasoline)	19,943	18,331	21,406	23,884	23,884	23,884
Aviation Fuel (Jet Fuel A)	48,086	63,642	60,887	32,468	44,148	66,304

The transport fuels used by Blacksburg Transit (BT) for buses and service vehicles are detailed in Table 3. Electricity to charge the BT electric fleet is also listed for comparison with diesel fuel and gasoline but is categorized as a scope 2 emission with the rest of the purchased electricity. In 2024, 10 electric buses were in operation, increasing BT’s electric consumption as they utilized their electric fleet more compared to 2023.

TABLE 3. BLACKSBURG TRANSIT BUS SYSTEM FUELS

Blacksburg Transit Buses	2024	2023	2022	2021	2020	2019	Units
Diesel	229,032	244,723	212,110	262,517	253,055	297,712	gallons
Gasoline	25,715	24,933	21,295	23,581	n/a	19,077	gallons
Electricity	282,355	153,362	110,715	109,113	n/a	0	kWh

In addition to the fuel used for agricultural operations on the Virginia Tech Blacksburg campus, this analysis also includes emissions from livestock, fertilizers and land-use. Emissions from animals were calculated both for the animal digestive process (enteric fermentation) and their manure based on the numbers of each type of livestock in Tables 4 and 5.

TABLE 4. VIRGINIA TECH AGRICULTURAL ANIMALS

Livestock	2024	2023	2022	2021	2020	2019
Beef cows (heads)	750	773	730	800	800	800
Dairy cows (heads)	547	290	500	1,425	1,500	1,425
Horses (heads)	55	36	50	110	110	110
Sheep (heads)	450	456	500	750	750	750
Swine (heads)	537	310	80	465	465	465

There are different types of fertilizer that are applied at Virginia Tech agricultural lands as shown in Table 5. Nitrogen from the fertilizer oxidizes to volatile N₂O so various conversion factors are applied based on the amount of nitrogen in different fertilizers and scientific estimates of the amount that is emitted into the atmosphere.

TABLE 5. 2024 AGRICULTURE OPERATION FERTILIZER ANALYSIS

Fertilizer Type	TKN	Total N (lb)	% N in Fertilizer	Total Fertilizer Mass (lb)
Applied Liquid Dairy Manure	13.1 lb/kgal	60,836	0.16	39,473,490
Applied Liquid Swine Manure	1.5 lb/kgal	593	0.02	3,357,500
Applied Solid Dairy Manure	11.28 lb/ton	41,962	0.56	7,440,000
Applied Solid Mixed Animal Manure	16.38 lb/ton	30,504	0.82	3,720,000
Applied Synthetic Fertilizer	N/A	27,293	46	59,333
Applied Synthetic Fertilizer	N/A	12,000	30	36,000
Cattle Manure (land droppings)	N/A	489,365	3.0	16,312,175
Sheep/Horse Manure (land droppings)	N/A	8,237	3.3	247,575

The scope 2 GHG inventory includes the electricity usage and generation on campus shown in Table 6. Steam plant turbine production electricity is in parenthesis in this table since it subtracts from the electricity that Virginia Tech needs to purchase from the utility. The total electric consumption including campus, leased buildings, and electric buses was up 2.1 percent in 2024 compared to 2023. This is due to the slightly higher energy consumption of Education and General (E&G) buildings on Virginia Tech’s Blacksburg campus and electric buses. This is a small increase despite the evolving Blacksburg campus with 1.5 percent more square footage in new and renovated buildings (Hitt Hall, Undergraduate Science Laboratory Building, and War Memorial Hall) in 2024 compared to 2023. This increase in electricity usage would be higher without the energy saving initiatives such as LED lighting upgrades and retro-commissioning efforts underway by Facilities to curb electricity consumption and the construction of more energy efficient buildings to LEED standards.

Leased building electricity data includes some estimates where there is limited submetering and access to utility information for each space. These spaces include the Virginia Tech Foundation (VTF), the Virginia Tech Corporate Research Center (VTCRC), and Virginia Tech Electric Services (VTES) rental spaces. The latter electricity use has been scaled to 60 percent due to use of some of these spaces by non-Virginia Tech tenants.

TABLE 6. BLACKSBURG CAMPUS ELECTRIC CONSUMPTION AND THE VIRGINIA TECH POWER PLANT ELECTRICITY GENERATION IN KWH

Electricity Category	2024	2023	2022	2021	2020	2019
Education and General (E&G)	127,917,455	124,487,705	122,225,361	124,567,951	129,103,468	144,214,379
Auxiliary	60,216,462	59,468,163	60,006,828	59,113,525	55,027,068	63,108,898
Steam Plant Turbine Production	(17,151,190)	(13,197,748)	(19,800,181)	0	(11,748,217)	(25,785,220)
Leased Buildings	39,689,153	39,084,208	40,208,790	36,881,742	32,664,729	38,429,092
BT Electric Buses	282,355	153,362	110,715	109,113	-	-
Totals	228,105,425	223,193,438	222,551,694	220,672,331	216,795,265	245,752,369

Custom emissions factors which convert electricity to GHG emissions are shown in Table 7 and used in SIMAP to better reflect the electricity mix in Blacksburg from Appalachian Power Company (APCO) compared to the broader regional electricity grid. The custom CO₂ emissions factor of 0.661 kg CO₂/kWh is the Utility Specific Residual Mix Emissions Rate from Appalachian Power Company (APCO) in VA/WV provided in the Edison Electric Institute (EEl) Electric Company Carbon Emissions and Electricity Mix Reporting Database. This data was obtained directly from APCO since the EEl database was not updated at the time of the analysis.⁶ This value is more accurate than the lower emission factor in the EPA eGrid summary Tables since the APCO fuel mix for Blacksburg is significantly higher in coal than the ReliabilityFirst Corporation West (RFCW) regional grid.

The CH₄ and N₂O emissions values are not provided in the EEl database so these were taken from the EPA eGrid summary Tables for the RFCW grid region.⁷ This same database provided the transmission and distribution (T&D) losses for electricity at 4.2 percent. While T&D losses are associated with electricity consumption, the emissions associated with them are considered scope 3. This data are based on 2023 values since the 2024 values were not yet available at the time of analysis as has also been the case in past reports. This is consistent with the prior year values also used in previous years.

TABLE 7. UTILITY EMISSIONS FACTORS FROM APPALACHIAN POWER (APCO) AND CONVERTED FOR SIMAP UNITS

GHG	APCO (lb GHG/MWh)				SIMAP 2023 (kg GHG/kWh)			
	2024	2023	2022	2021	2024	2023	2022	2021
Carbon Dioxide (CO ₂)	1,458	1,455	1,384	1,522	0.661	0.660	0.628	0.690
Methane (CH ₄)	0.070	0.087	0.095	0.095	0.0000317	0.0000395	0.0000431	0.0000431
Nitrous Oxide (N ₂ O)	0.010	0.012	0.014	0.014	0.00000454	0.00000054	0.00000635	0.00000635

No Renewable Energy Credits (RECs) were purchased from 2020-2024. The Perry Street Garage solar array generated approximately 104,000 kWh of electricity in 2024. There are Solar Renewable Energy Credits (SRECs) associated with this renewable energy generation, but they were not retired so they are available as future RECs to offset campus electricity use.

The scope 3 inventory includes all other categories that lead to indirect emissions from the Virginia Tech Blacksburg campus operations. This includes commuter miles, waste/recycling/compost, water/wastewater, commercial business travel miles, and fuel- and energy-related activities (FERA).

The commuter inventory and emissions analysis was done using the Virginia Tech Transportation Service’s permit data from academic year 2024 – 25. The 2023 transportation survey data was used again since the Virginia Tech Transportation Service did not conduct a survey in 2024. The analysis method was similar to that used in 2023 – 24. The data is summarized in Table 8. Due to the different permit time lengths (annual, semester, monthly, daily, etc.), the number of commuters is weighted in terms of commuter permit years. For each category, the number of Commuting Weeks was weighted based on the Commuter survey data. The following permit categories were not included as part of the scope of this analysis since they don’t involve active university faculty/staff/students: contractors, visitors, football RV, retiree, 30-year employee, and athletic events. The Student Commuting data was entered separately for Graduate Commuters, Undergraduate Commuters, and Undergraduate Residents (on campus). The number of faculty and staff, as well as their relative percentages, were adjusted based on Human Resources data with the update this year of Administrative/Professional Faculty categorized as faculty rather than staff as in previous years. Overall, Virginia Tech permit purchases were higher this year mainly due to more

daily permits, but total vehicle miles traveled (VMT) are approximately five percent less. This is largely due to the adjustment of the faculty versus staff percentages and their average commuting distances.

TABLE 8. COMMUTER ANALYSIS DATA SUMMARY

	Permit Data 2024-25	Spring 2023 Transportation Survey Data			VMT Estimate
SIMAP Category	Commuter Permit Years	Commuting Weeks/Yr	1-Way Trips/Week	Vehicle Miles/Trip	Total Vehicle Miles/Yr
Faculty Commuting	3,665	42.8	8.6	10.7	14,434,441
Staff Commuting	2,246	46.8	8.5	14.9	13,312,536
Graduate Student Commuting	1,594	40.4	9.1	8.8	5,156,960
Undergraduate Student Commuting	6,374	25.9	9.7	3.3	5,284,422
Undergraduate Resident Commuting	2,638	14.7	2.9	1.3	146,195
Total					38,334,555

The Virginia Tech airline emissions are calculated based on the passenger miles traveled for university business. These emissions include airline trips booked through travel agencies, but not airline trips purchased by individuals. Airline travel data for trips booked through the three primary university-approved travel agencies (AAA Corporate Travel, Covington Travel, and Anthony Travel for Athletics) for calendar year 2024 was obtained from the Virginia Tech Controller’s Office. For each agency and trip, the city pairs (departure and arrival) and the mileage between them were provided. These city-pair miles were summed and then sorted into long ($\geq 2,300$ miles), medium (≥ 300 and $< 2,300$ miles) and short haul flights (< 300 miles). This data is summarized in Table 9. Travel miles have rebounded in 2024 and are nearly back to pre-COVID-19 values.

TABLE 9. VIRGINIA TECH AIRLINE PASSENGER TRAVEL MILES SORTED BY DISTANCE

Flight Distance	2024	2023	2022	2021	2019
Long (≥ 2300 mi)	15,698,830	5,776,474	8,993,456	13,994,951	13,994,951
Medium (≥ 300 mi and < 2300 mi)	5,469,581	4,755,044	5,904,585	7,758,533	7,758,533
Short (< 300 mi)	832,772	639,034	154,285	264,593	264,593
Total	22,001,183	11,170,552	15,052,326	22,018,077	22,018,077

SIMAP uses a single set of CO₂, CH₄, and N₂O emissions factors in its calculations for airline emissions. A more accurate set of custom emissions factors was calculated using the EPA emissions factors based on the weighted flight distances shown in Table 10. The total CO₂, CH₄, and N₂O emissions for airline travel were determined for long, medium and short haul flight distances using the EPA carbon emission factors based on flight distance. These total carbon emissions by chemical were then summed and divided by the total number of flight miles to provide the custom set of CO₂, CH₄, and N₂O emission factors (kg/passenger mile) shown in the last row of Table 10.

TABLE 10. EPA CLIMATE LEADERSHIP HUB AIRLINE EMISSIONS FACTORS⁹ AND SIMAP CUSTOM EMISSIONS FACTORS (KG/PASSENGER MILE)

Flight Distance	CO ₂	CH ₄	N ₂ O
Long (≥2300 mi)	0.163	0.0000006	0.0000052
Medium (≥300 mi and <2300 mi)	0.129	0.0000006	0.0000041
Short (<300 mi)	0.207	0.0000064	0.0000066
Custom Emissions Factor (SIMAP)	0.156	0.00000082	0.00000498

In 2024, Virginia Tech disposed of 6,630 tons of municipal solid waste (MSW) and sent more than 589 million gallons of wastewater to the Blacksburg Water Authority as detailed in Table 11. Virginia Tech also composted 246 tons of food waste and recycled 5,843 tons of various materials. The

recycled materials are not credited in SIMAP since this absolute number does not account for the amount of raw materials and their emissions at the front end of the life cycle.

TABLE 11. VIRGINIA TECH WASTE AND WASTEWATER

Year	Total MSW Produced (tons)	Total Wastewater Produced (gallons)
2024	6,630	589,359,604
2023	5,194	510,289,811
2022	4,590	516,645,201
2021	3,510	556,819,167
2020	2,597	512,620,000
2019	3,937	461,610,000

Upstream energy, emissions, and methane leakage are calculated in SIMAP under the Fuel- and Energy-Related Activities (FERA) category. This FERA category includes emissions that occur upstream from the scope 1 direct combustion of a fuel including extraction, production, refining, transportation, and distribution of coal, oil, and natural gas. It does include upstream methane leakage which was called out specifically as an added scope item in the 2020 CAC. This methodology was first used in the 2023 analysis and is a more accurate estimate compared to calculations before 2023 which only included methane leakage during distribution.

Carbon sinks refer to environmental processes which absorb CO₂ and remove it from the atmosphere. Sequestration is the technical term for processes that remove carbon dioxide by different carbon sinks. The estimated sequestration from managed trees on campus was reported in SIMAP as a carbon sink. The i-Tree database/software is used on the Blacksburg campus to estimate carbon emissions based on the number, size, and species of the individual trees. This database was not updated for the 2024 analysis due to very few changes, so the previous year’s emissions were used. The 11,414 trees currently inventoried in the i-Tree database store approximately 5,811 metric tons of carbon and annually sequester another 335 metric tons of CO₂. SIMAP does not subtract these emissions from the overall footprint but includes this information to help universities manage land and trees with regard to GHG emissions.

Results

Tables 12 and 13 summarize the GHG emissions results by scope and category. The 2023 totals in these Tables are slightly different in a few categories from those in the final report from last year due to minor corrections and revisions of some of the data and analysis factors which were updated in the process of completing this year’s analysis. GHG emissions are provided in units of both kilograms (kg) and the more common standard units of metric tons of carbon dioxide equivalent (MTCDE). One metric ton is equal to 1000 kilograms.

The total calculated GHG emissions for the 2024 assessment are 276,323 metric tons CO₂. This is 2.8 percent higher than the emissions of 2023. The detailed university emissions by category in Table 13 and Figure 3 show that scope 1 emissions account for 28 percent of the overall footprint. Scope 2 emissions, due to purchased electricity, account for just over half of the total GHG emissions. The Virginia Tech power plant is the next largest contributor at just over 20 percent of the total GHG emissions. The emissions from the various categories of scope 3 are 21 percent of the total carbon footprint. This scope distribution is similar to previous years' inventories.

Business air travel is the largest component of the 2.8 percent increase in emissions from 2023. Passenger miles traveled almost doubled from 2023 to 2024 leading to more than a doubling of emissions in this category. Fertilizer and animal emissions plus solid waste emissions also increased significantly from last year, but all three of these categories are less than ten percent of the total emissions.

TABLE 12. VIRGINIA TECH GHG EMISSIONS BY SCOPE

Scope	Scope Descriptions ¹	2024 GHG (MTCDE)	2024 Scope (%)
1	Direct emissions from university owned or controlled sources like on-campus power plants, fleet vehicles, and back-up generators	77,898	28%
2	Indirect emissions from the generation of purchased energy from utilities (i.e. electricity)	139,888	51%
3	All other indirect emissions due to campus operations (e.g. commuter miles, water/wastewater, commercial business travel miles, etc.)	58,536	21%
TOTAL		276,323	100%

TABLE 13. SIMAP GHG EMISSIONS BY CATEGORY

Scope	Category	2024 GHG (MTCDE)	2024 GHG (%)	2023 GHG (MTCDE)	% Change
1	Power Plant Steam + Electricity	56,744	20.5%	54,936	3.3%
1	Fertilizer & Animals	7,350	2.7%	5,558	32%
1	Fleet Transportation and Buses	6,477	2.2%	7,060	0.5%
2	Purchased Electricity	139,888	50.6%	139,140	0.5%
3	Building Natural Gas	7,327	2.7%	8,829	-17.0%
3	Utility T&D Losses	6,133	2.3%	6,100	-8.3%
3	Upstream Fuel Emissions (FERA)	25,847	9.4%	25,748	0.4%
3	Commuting (Faculty/Staff/Students)	11,803	4.3%	12,749	-7.4%
3	Business Air Travel	9,297	3.4%	4,569	103%
3	Solid Waste	4,276	1.5%	3,002	42%
3	Waste Water	1,181	0.4%	1,022	16%
	Total	276,323	100%	268,715	2.8%

Figures 3 and 4 show these emissions by scope and category from these tables graphically.

FIGURE 3. VIRGINIA TECH GHG EMISSIONS BY SCOPE

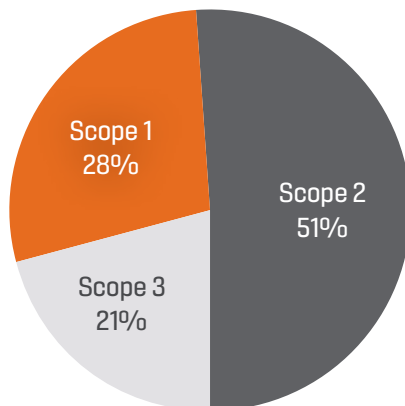


FIGURE 4. VIRGINIA TECH GHG EMISSIONS BY CATEGORY

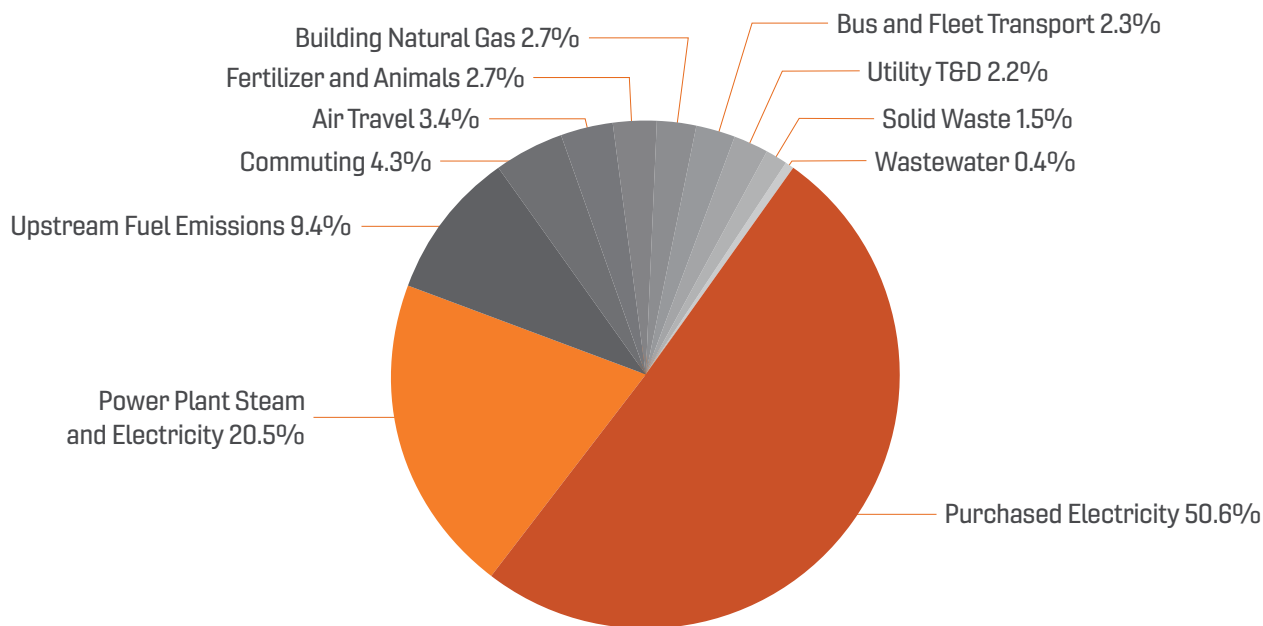


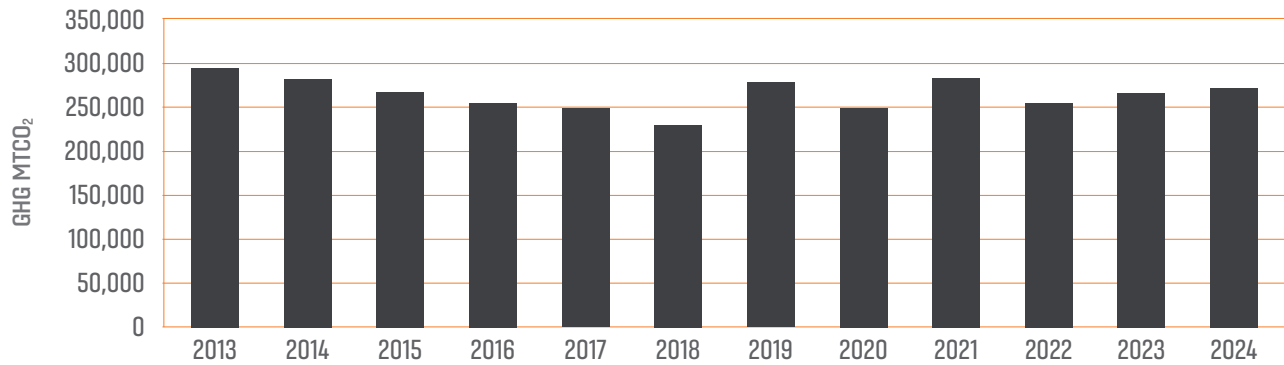
Table 14 and Figure 5 show the Virginia Tech total annual GHG emissions from 2013 to 2024. The baseline year for the 2020 CAC is 2019. The 2020 analysis was estimated with significantly limited data due to the COVID-19 pandemic so it is not representative for comparisons. Also note that the absolute GHG emissions values in this table have changed slightly since they were initially published due to more accurate data and emissions factors.

TABLE 14. ANNUAL TOTAL EMISSIONS FROM 2013 TO 2024

Year	GHG (MT CO ₂)	Year	GHG (MT CO ₂)	Year	GHG (MT CO ₂)	Year	GHG (MT CO ₂)
2024	276,323	2021	285,613	2018	232,260	2015	269,874
2023	268,715	2020*	205,970*	2017	250,867	2014	284,489
2022	257,437	2019	280,781	2016	257,244	2013	297,488

*Covid year with limited operations and data

FIGURE 5. VIRGINIA TECH CALENDAR YEAR GHG ASSESSMENTS FROM 2013 – 2024



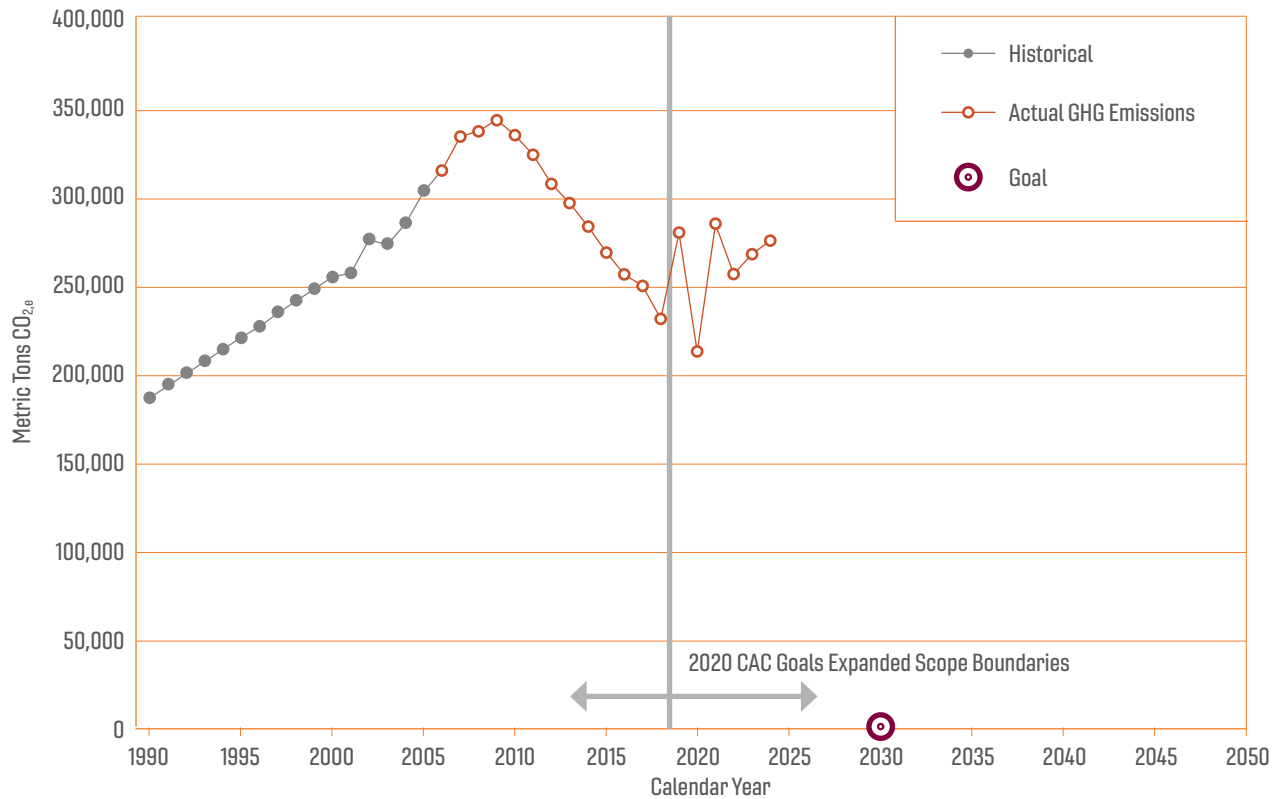
The GHG emissions by chemical, category, and scope which are summarized above are detailed in Table 15 for additional analysis and insight. For example, the power plant emissions consist of fuel emissions attributed both to electricity and steam since these are both outputs of the co-generation plant on campus. Commuting is further broken down in faculty, staff, and student commuting emissions. The mass of GHG emissions (kg) is different from the MTCDE emissions (kg) since each of these chemicals has a different global warming potential which converts the values to equivalent carbon dioxide emissions. CO₂ dominates the GHG emissions at 89 percent of the total.

TABLE 15. SIMAP GHG EMISSIONS RESULTS BY CATEGORY

Scope	Source	CO ₂ (kg)	CO ₂ (MTCDE)	CH ₄ (kg)	CH ₄ (MTCDE)	N ₂ O (kg)	N ₂ O (MTCDE)	Total GHG (MTCDE)
1	Co-gen Electricity	11,212,297	11,212	1,121	31	23	6	11,250
1	Co-gen Steam	45,341,900	45,342	4,538	127	93	25	45,494
1	Building Natural Gas	7,302,968	7,303	728	20	15	4	7,327
1	Fleet Transportation & Buses	6,438,690	6,439	108	3	128	35	6,477
1	Fertilizer & Animals	0	0	184,00	5,134	8,119	2,217	7,350
2	Purchased Electricity	139,440,280	139,440	6,687	187	958	261	139,888
3	Faculty Commuting	4,416,939	4,417	130	4	87	24	4,444
3	Staff Commuting	4,073,636	4,074	120	3	80	22	4,099
3	Student Commuting	3,239,799	3,240	95	3	64	17	3,260
3	Business Air Travel	9,266,898	9,267	18	1	110	30	9,297
3	Solid Waste	132,600	133	148,512	4,143	0	0	4,276
3	Wastewater	0	0	10,538	294	3,247	887	1,181
3	Upstream Fuel Emissions	8,232,996	8,233	630,479	17,590	85	23	25,847
3	T&D Losses	6,113,248	6,113	293	8	42	11	6,133
			245,212		27,548		3,563	276,323
			89%		10%		1%	100%

In Figure 6, Virginia Tech historical emissions are plotted to chart progress against the 2020 CAC Goals. The 2.8 percent increase in 2024 moves the university a bit away from the current net-zero emissions goal for 2030. The specific path and progress toward carbon-neutrality will depend on specific pathways and implementation strategies that are taken by the university.

FIGURE 6. VIRGINIA TECH HISTORICAL GHG EMISSIONS AND CAC TARGETS



Looking Ahead

Virginia Tech continues to make progress on toward sustainability goals highlighted in its 2020 Climate Action Commitment -- including reaching carbon neutrality -- through the pursuit of energy efficient projects, exploration of renewable energy sources, and use of LEED Silver standards as a minimum for new construction and major building renovation efforts. Specifically, four solar arrays totaling 1.2 megawatts were installed on building rooftops (Sterrett Center, Durham Hall, the Virginia-Maryland College of Veterinary Medicine, and McComas Hall) on campus in 2024. The arrays will generate approximately 2,300 megawatt-hours of electricity annually. Further opportunities are being explored to integrate sustainability projects and analysis into academics through the Climate Action Living Laboratory (CALL). This includes analysis of solar agrivoltaics, on-campus composting, sustainable procurement, and big-data analysis of upstream food emissions to allow for more informed decisions regarding dining service sustainability efforts. For more updates on other sustainability and Climate Action Commitment progress, please view the most recent Sustainability Annual Report available at vt.edu/sustainability. During the 2025- 26 academic year, the 2020 CAC goals will be reviewed and assessed by the CAC subcommittees and the Climate Action, Sustainability, and Energy (CASE) Committee to note progress, challenges, and barriers since 2020 and to make recommendations for the next decade.

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