

Radford University's 2017 Greenhouse Gas Inventory

July 1, 2016 – June 30, 2017

Summary

Radford University conducts an annual inventory of its greenhouse gas emissions. The process collects data about university operations and fuel consumption, converts operations and fuel consumption to greenhouse gas emissions, and accounts for the university's efforts to offset these emissions. The inventory described here encompasses Fiscal Year 2017 (July 1, 2016 through June 30, 2017). During this time, Radford University's estimated net greenhouse gas emissions totaled **39,239.15 metric tons of carbon dioxide equivalent** (MTCO_{2e}).

This report summarizes the 2017 Greenhouse Gas Inventory (GGI), provides important information pertaining to certain measured criteria, and benchmarks Radford University's 2017 performance against university inventories conducted since 2010 (the baseline year for RU's greenhouse gas inventory).

Introduction

In 2009, Radford University became a signatory of the American College & University President's Climate Commitment (ACUPCC). As such, the University pledges to pursue carbon neutrality and to provide students with the knowledge and skills they need to be successful in meeting the challenges of the 21st Century. (See Appendix B). The ACUPCC requires that signatories conduct a GGI during the first year of participation to establish a baseline emissions calculation; the participant then submits a GGI annually, as it enables the university to analyze emissions sources, track progress towards target goals, and ultimately reduce the campus's contribution to climate change. Radford University has conducted a GGI each year since 2010, with the exception of 2015.

Methods

From 2010 - 2016, Radford University used a tool developed at the University of New Hampshire, the Clean Air-Cool Planet Campus Carbon Calculator (CCC), as the instrument for calculating and analyzing its emissions. It was the preferred tool of the ACUPCC and during this time was the industry standard for colleges and universities. In 2017, UNH discontinued technical support for the CCC and launched the web-based SIMAP (Sustainability Indicator Management & Analysis Platform) as its replacement. Radford University transferred all historic data into SIMAP and then used it for the 2017 inventory.

Organizational Boundary: The 2017 GGI included emissions data for all Radford University buildings under operational control of the university. If the university paid the utility bills for a building, it was included in the inventory.

Data Collection: The GGI process requested information and support from many individuals, departments, offices, and the Sustainability Steering Committee. The data included in the inventory is the most up-to-date and accurate information available and provides a comprehensive snapshot of the University's greenhouse gas emissions. Some assumptions and estimations were necessary due to limitations in the data. These assumptions and estimations are outlined below.

- **Faculty, Staff, & Student Commuting:** The Sustainability Office oversaw a commuter survey for the 2015 – 2016 fiscal year. A senior Geo-Spatial Science major, under direct supervision of the department chair, ran a GIS model using the home address data of each commuter parking pass holder. The model calculated the shortest driving distance between each address and the Radford University campus. The student then extrapolated the daily mileage for the entire year by estimating the number of commuting days per year for each classification of permit holder – students, faculty, and staff.

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- **Directly Financed Air Travel:** SIMAP converts the air travel ticket price to mileage based on average cost per airline mile. Radford University Accounts Payable and the local travel agency, Christian Travel, provide the total cost of directly financed air travel.
- **Study Abroad Air Travel:** The Director of International Education provided the air travel costs, which includes both student and university employee air travel related to study abroad programs. SIMAP converts the air travel ticket price to mileage based on average cost per airline mile.
- **Solid Waste:** Radford University hauls all of its trash to the Cloyd's Mountain Landfill in Pulaski County, VA. The landfill weighs all trash per load delivered; this provides us a very accurate measurement of our landfilled trash. At the landfill, Ingenco Distributed Energy is operating a landfill gas capture and electricity production operation. This greatly reduces the greenhouse gas emissions of our organic landfilled trash and is reflected by the calculations in SIMAP.
- **Paper:** Radford University Procurement and Contracts provided the data on purchased paper. The paper figure is limited to general purpose/copier paper purchases from different suppliers and does not include every type of paper utilized within a year by the University. General use and copier paper are delivered in reams, and single ream of paper weighs 4.75 pounds. This weight is used to estimate the total pounds of paper used. While some offices are beginning to move to paperless processes, no major adjustments have been made. The 2016 paper inventory figures are used in again in the 2017 inventory.

Radford University's Sustainability Manager worked with the university's Energy Manager to initiate the GGI process. Radford University's Energy Manager collected most of the data related to facilities and operations, Scopes 1 and 2, by reaching out to the appropriate manager or department contact from each category. The Sustainability Manager coordinated the collection of the Scope 3 data and demographic information.

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During the data collection phase, a Radford University Sustainability Work Study entered the raw data into SIMAP when appropriate and processed other data into units that are compatible with the tool when necessary. When the data collection and entry was complete, the Sustainability Manager and other university employees began analyzing the results for any omissions or unusual discrepancies.

Results

SIMAP processes all raw data with conversion factors that translate different emissions sources to greenhouse gas equivalents. For each emissions source and scope, this tool calculates energy consumption, emissions of Carbon Dioxide, Methane, and Nitrous Oxide, and total metric tons of carbon dioxide equivalent (MTCO_{2e}).

Table 1: Total Emissions by Category and Scope

Select Year - ->	2016	CO ₂	CH ₄	N ₂ O	CO ₂ e
		kg	kg	kg	Metric Tons
Scope 1	Co-Gen Electricity	-	-	-	-
	Co-Gen Steam	-	-	-	-
	Other On-Campus Stationary	8,719,417	868	17	8,748.31
	Direct Transportation	369,311	63	22	376.86
	Refrigerants & Chemicals	-	-	-	183.01
	Agriculture	-	-	118	31.26
Scope 2	Purchased Electricity	21,922	2,628	39	22,005.71
	Purchased Steam/ Chilled Water	-	-	-	-
Scope 3	Faculty/Staff Commuting	2,274,527	475	159	2,330.02
	Student Commuting	2,409,312	504	169	2,468.15
	Directly Financed Air Travel	1,029,812	10	12	1,033.21
	Other Directly Financed Travel	283,460	60	20	290.42
	Study Abroad Air Travel	516,178	5	6	517.88
	Solid Waste	-	-1775	-	-49.69
	Wastewater	-	70	94	26.85
	Paper	-	-	-	48.33
	Scope 2 T&D Losses	1,224,155	147	2	1,228.83
Offsets	Additional				-
	Non-Additional				-
Totals	Scope 1	9,088,728	931	157	9,339.45
	Scope 2	21,921,898	2,628	39	22,005.71
	Scope 3	7,737,445	-503	462	7,894.00
	All Scopes	38,748,071	3056	658	39,239.16
	All Offsets				-
				Net Emissions	39,239.16

Discussion

Total Emissions

Radford University's estimated net greenhouse gas emissions totaled **39,239.15 metric tons of carbon dioxide equivalent** (MTCO_{2e}).

Emissions by Scope

Emissions sources are categorized based on their origin; these categories are referred to as Scopes 1, 2, and 3. Scope 1 emissions are direct sources from campus and include on-campus energy generation and steam production, on-campus mobile fuel usage, refrigerants, and fertilizers. Scope 2 refers to direct, off-campus emissions sources that are directly linked to campus operations, including purchased electricity. Indirect emissions linked to university activities are categorized as Scope 3. These emissions include university financed travel, solid waste disposal, water treatment, and faculty, staff, and student commuting.

Scope 2: Location Based Methodology vs. Market-Based Methodology

In alignment with best practice recommendations, SIMAP provides two methodologies for calculating Scope 2 emissions: location based and market-based. Location Based Methodology uses location and the electrical grid (eGrid) emissions factors and does not factor in market-based efforts to reduce emissions, such as purchasing off-site renewable energy or Renewable Energy Credits (RECs), when calculating gross emissions. The Market-Based Methodology also uses location-based emissions factors, but factors RECs into your Scope 2 calculation directly, rather than subtracting RECs from the Gross Emissions to get a Net Emissions total. This calculation works by adding or subtracting renewable energy purchases (including RECs) directly from your utility consumption figure, and *then* multiplying the remaining consumption number by a

“residual” emissions factor. (Residual emissions factors are factors that exclude generation from any voluntary renewable energy transactions; since those renewables are being subtracted from users’ utility consumption data, it is important not to “double-count those avoided emissions.”) (<https://unhsimap.org/Scope2residualscalculatoin>)

Second Nature, administrative organization of the ACUPCC agreements, tracks Market-Based emissions, and as such, emissions presented in this report are calculated using the Market-Based Methodology.

Emissions by Scope: Percentages

Approximately 56.1% (22,006 MTCO_{2e}) of Radford University’s total emissions are Scope 2 emissions. Scope 2 accounts for purchased electricity, the largest source of the University’s emissions. Scope 1 (9,339 MTCO_{2e}) emissions sources account for 23.8% of total emissions, produced primarily by on campus burning of natural gas to produce steam, along with fueling on-campus vehicles. The remaining emissions are categorized as Scope 3, and account for 20.1% (7,894.00 MTCO_{2e}) of total emissions. The primary sources of Scope 3 emissions are faculty, staff, and student commuting, and directly financed university air and vehicle travel.

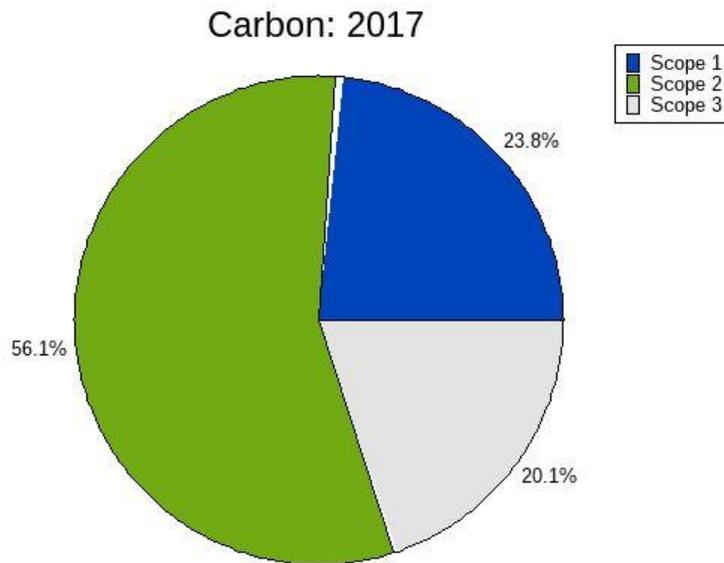


Figure 1. FY2017 Emissions by Scope

2017 Results: Top 5 Sources of Emission

1. **Purchased Electricity and T&D Losses** – 59% of Total Emissions: Purchased electricity, a Scope 2 emission source, continues to be the university's largest emissions source (56%). During FY2017, Radford University purchased 41,191,087 kilowatt hours of electricity from Radford City. The approximate fuel mixture for producing electricity in the university's eGrid Subregion, RFC West, is used to calculate these emissions.

Electricity Transmission and Distribution Losses, or T&D Losses, account for the electricity that is lost between the power station and the final user. The U.S. Energy Information Administration (EIA) estimates that T&D losses average about 5% of the electricity that is transmitted and distributed annually in the United States.¹ T&D Losses will increase or decrease based on the amount of

1. Frequently Asked Questions. How much electricity is lost in transmission and distribution in the United States. U.S. Energy Information Administration: Independent Statistics & Analysis. <https://www.eia.gov/tools/faqs/faq.php?id=105&t=3>. Feb 16, 2017.

electricity that the University purchases and/or the sources from which it is produced, and is currently 3% of total emissions.

Purchased Electricity and T&D Losses produced 23,235 MTCO_{2e} in FY2017.

- 2. On-Campus Stationary – 22.2% of Total Emissions:** This emissions source is a Scope 1 emission and represents fuel sources consumed on the Radford University campus. In FY2017, the University used 439 gallons of propane and 164,412 MMBtu of natural gas. During this time, natural gas was the primary fuel source used to generate steam for heating on-campus buildings and water. Propane and natural gas are heat sources for several on-campus and off-campus university-owned or operated buildings.

On-campus Stationary produced 8,748 MTCO_{2e} in FY2017.

- 3. Faculty, Staff, and Student Commuting – 12.3% of Total Emissions:** In FY2017 Faculty, Staff, & Students logged an estimated 12,546,759 miles in their personal vehicles during their regular daily commute to campus. This is a Scope 3 emission source.

Faculty, Staff, and Student commuting produced 4,798.17 MTCO_{2e} in FY2017.

- 4. Directly Financed Air Travel – 2.6% of Total Emissions:** Cost of Faculty and Staff air travel was \$303,462.90, an increase from 2015 – 2016. After four years of decreasing, Directly Financed Air Travel increased in 2017.

Directly Financed Air Travel produced 1,029.81 MTCO_{2e} in FY2017.

5. **Study Abroad Air Travel – 1.3% of Total Emissions:** The cost of student and faculty air travel for study abroad programming was \$152,106.33. This is a significant increase from 2016, likely resulting from acquisition of better data.

Study Abroad Air Travel produced 517.88 MTCO₂e in FY2017.

Figure 2: FY2017 Percent of Total Emissions by Source

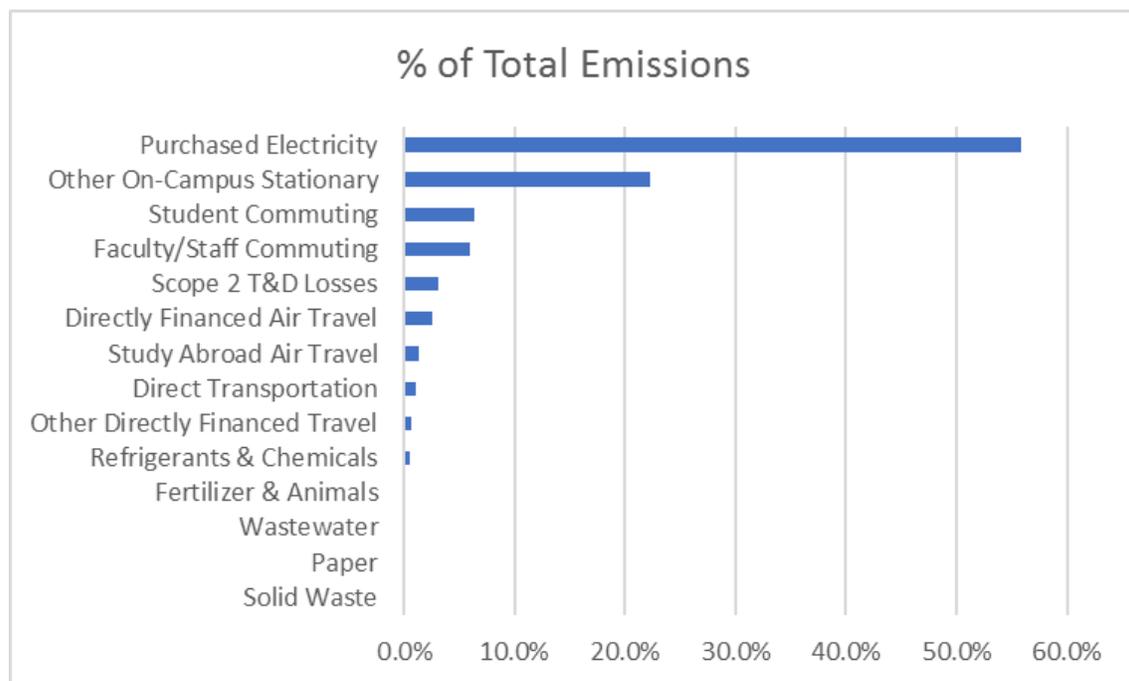


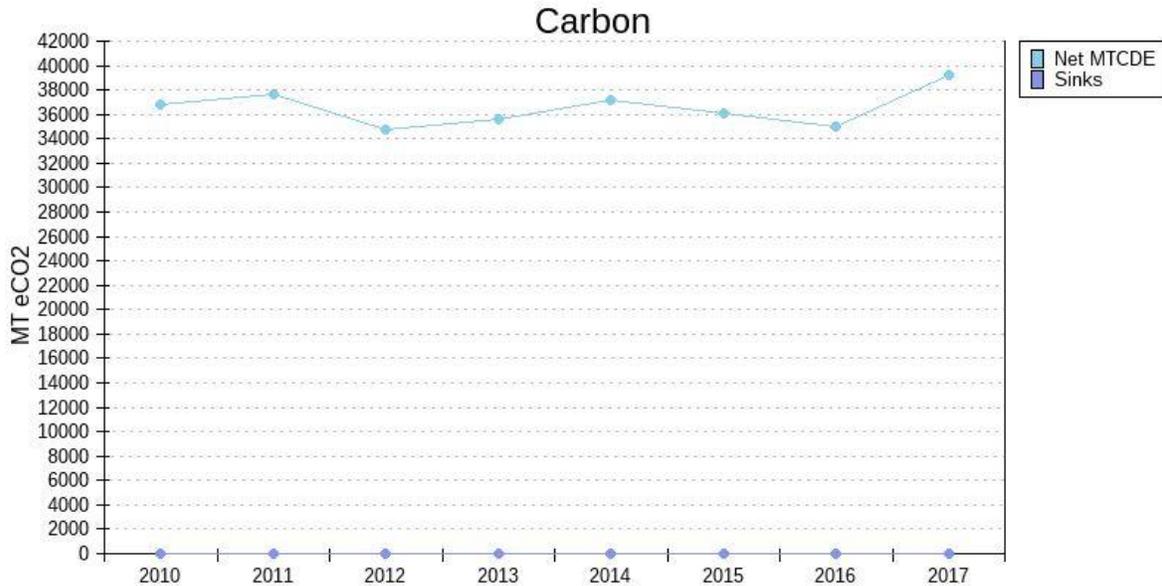
Table 2: FY2017 Percent of Total Emissions by Source

Emissions Source	% of Total Emissions
Purchased Electricity	55.9%
Other On-Campus Stationary	22.3%
Student Commuting	6.3%
Faculty/Staff Commuting	6.0%
Scope 2 T&D Losses	3.1%
Directly Financed Air Travel	2.6%
Study Abroad Air Travel	1.3%
Direct Transportation	1.0%
Other Directly Financed Travel	0.7%
Refrigerants & Chemicals	0.5%
Paper	0.1%
Wastewater	0.1%
Fertilizer & Animals	0.1%
Solid Waste	0.0%

Normalization & Trends

For Radford University's 2017 Greenhouse Gas Inventory, SIMAP processed data manually entered from the University's inventories dating back to 2010. Due to personnel constraints, the University did not conduct an inventory in 2015 and completed an abbreviated version in 2014. As such, there is some estimated and extrapolated data for these two years based on data trends. In addition, aside from 2016, there has not been a commuter survey since 2009. Therefore, this report uses the 2016 data for all years.

1. Total Carbon Emissions (MTCO_{2e}) have increased since 2010.

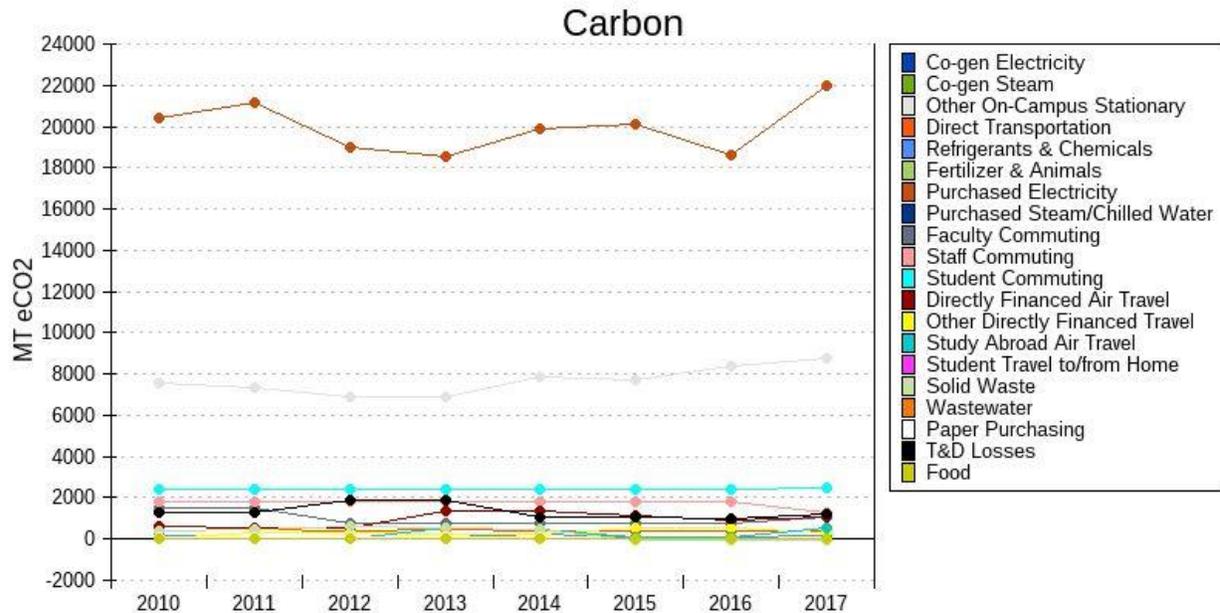


After a 6-year period of fluctuating, but steady emissions, University emissions reached a record high in 2017. Between 2016 and 2017, total carbon emissions increased by 4196.43 MTCO_{2e}, a 12% increase.

Total carbon emissions (MTCO_{2e}) during FY2017 are much less than the 2010 Greenhouse Gas Inventory “Business As Usual” projection for total emissions (MTCO_{2e}).

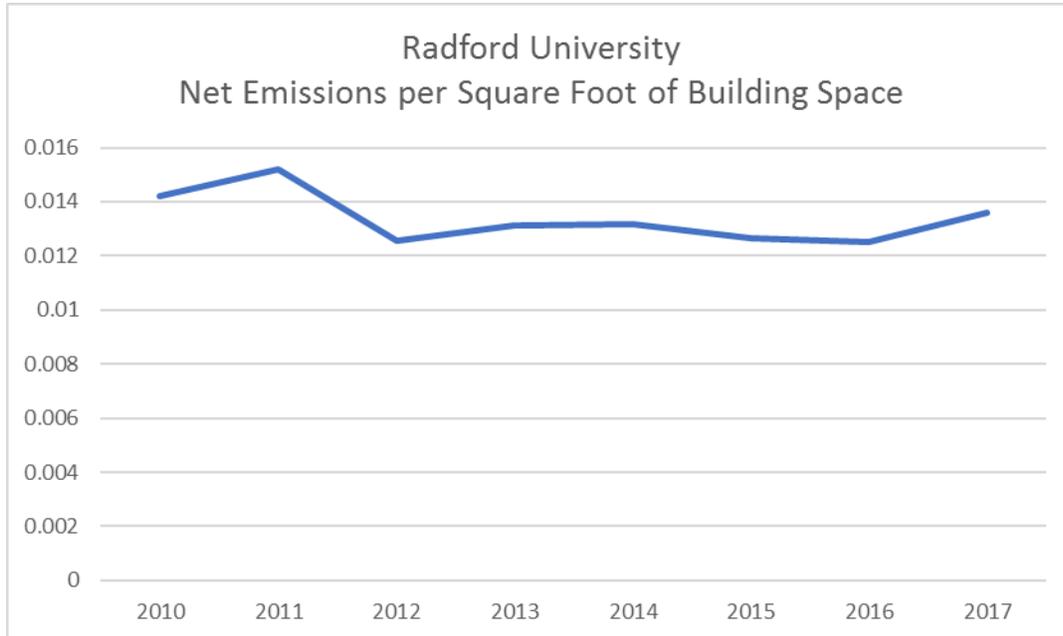
- Total emissions have increased from 36,792.69 MTCO_{2e} in 2010 to 39,239.15 MTCO_{2e} in 2017. A total increase of 4,196.43 MTCO_{2e} or approximately 7%.
- The “Business as Usual” projection for 2017 was over 50,000 MTCO_{2e}, an increase of approximately 12,250 MTCO_{2e}, or approximately 32%.

2. The increase between FY2016 and FY2017 was caused primarily by increased emissions from purchased electricity.



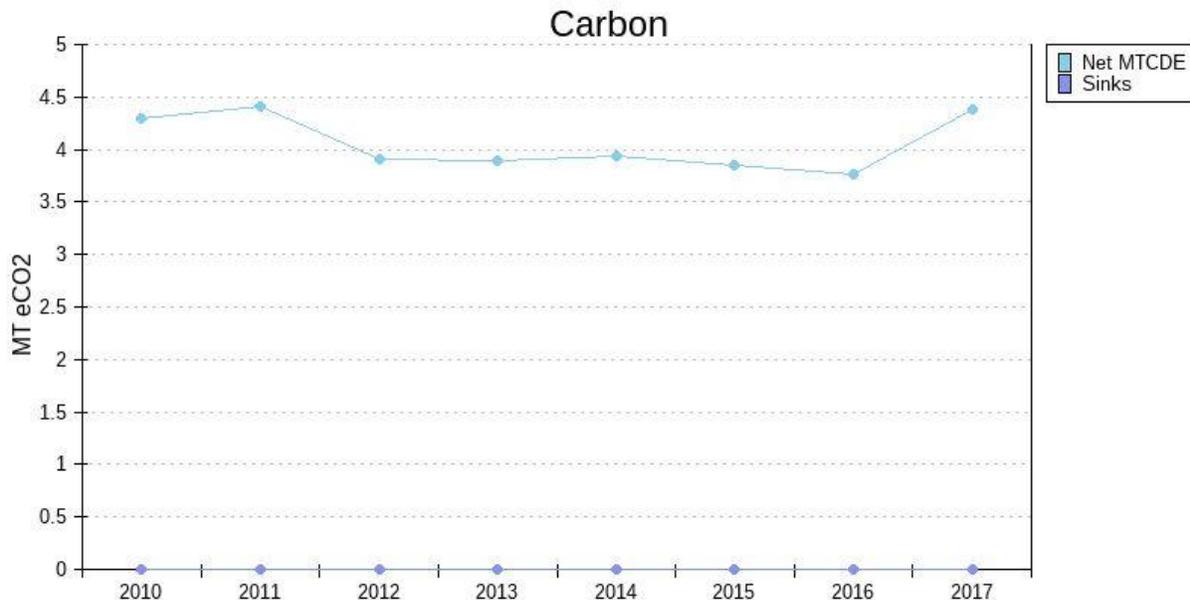
Carbon emissions from purchased electricity increased by 18% between 2016 and 2017, from 18,628 MTCO_{2e} to 22,005 MTCO_{2e}. No other emissions category increased more than 4%.

3. Emissions per square foot down from 2010, but increased during FY2017.



Between 2016 and 2017, total carbon emission per square foot remained fairly constant. The square footage of total building space increased by 82,188 square feet, a 3% increase, and total carbon emissions increased by 12%. Since 2010, square footage of total building space has increased 23%, while total carbon emissions (have increased 7%.

4. Emissions per Full Time Equivalent (FTE) Student increased during FY2017.



Emissions per student increased by 16% (.62 MTCO₂e) between 2016 and 2017. However, since 2010, total net emissions have increased 2% (.08 MTCO₂e). In 2010, Radford University served 8,558 FTE students and 8,950 FTE students in 2017, a 5% increase.

Conclusions & Looking Ahead

University emissions reached a record high in 2017 (since the inventory began in 2010). Between 2016 and 2017, total carbon emissions increased by 4196.43 MTCO₂e, a 12% increase. The primary driver of this increase in emissions was the increase in purchased electricity. In FY2017, Radford University purchased 41,191 mWh of electricity, an increase of over 25% from 2016 (32,755 mWh). As such, carbon emissions from purchased electricity increased by 18% between, from 18,628 MTCO₂e to 22,005 MTCO₂e. No other emissions category increased more than 4%.

Next year, the 2017 - 2018 Greenhouse Gas Inventory will reflect a renovated Whitt Hall brought online August 2017 and Reed-Curie Hall taken offline due to renovations. Additionally, there will be no new building space during FY2018 and as such, total square footage of building space will be slightly down. Enrollment is also down slightly.

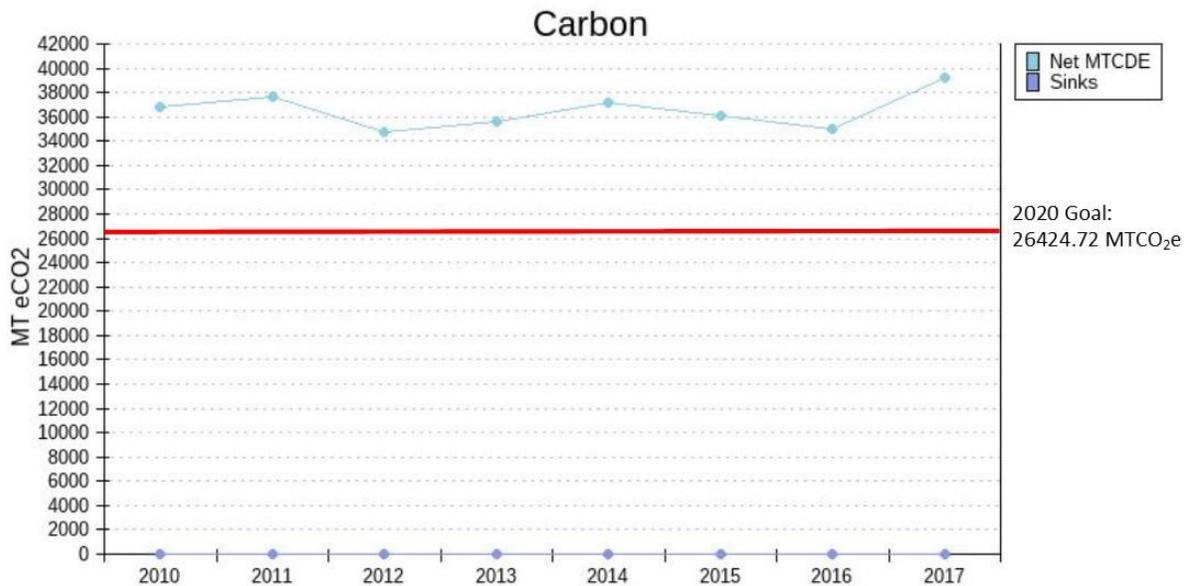
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Looking ahead, the University is striving to increase enrollment. An increase in students will demand more energy, though with increased efficiencies and conservation measures in place, a collaborative education and outreach campaign could keep greenhouse gas emissions from increasing.

Radford University is committed to reducing greenhouse gas emissions and pursuing carbon neutrality. In 2010, the University's Sustainability Steering Committee set interim targets of a 30% reduction by 2020 and 60% reduction by 2030 from the 2010 baseline, and reaching net zero emissions in 2040. There are three primary methods for reducing net greenhouse gas emissions: employing energy efficiency and conservation practices; purchasing or producing carbon-free energy; and purchasing offsets to carbon emissions. To achieve its emissions reduction goals, the University will implement some combination of actions and strategies from these three methods.

The University's goal of a 30% reduction from the 2010 baseline by 2020 will require our emissions to decrease from 39239.15 MTCO₂e in 2017 to 26424.72 MTCO₂e. This is now a 39% difference based on the 2017 carbon footprint.



To achieve its 2020 greenhouse gas emissions reduction goal, Radford University should develop an action plan for reducing greenhouse gas emissions that considers new data and all available options. This plan will outline specific reductions strategies, their financial cost and benefit, their impact on greenhouse gas emissions, and the most effective and feasible combination of strategies for achieving the interim and final goals. Once complete, Radford University, the community, and its partners will

have a transparent roadmap for reaching its emissions reduction targets. The plan should be a working document, as technology is improving rapidly and the cost of renewable energy is now competitive with more traditional fuel sources.

Acknowledgements

Completing a Greenhouse Gas Inventory is a collaborative effort and requires contributions from every corner of the University. RU Sustainability is grateful to everyone for participating and assisting the university in achieving its ambitious goals for reducing greenhouse gas emissions.

A special thanks to Accounting Services, Christian Travel, Enterprise Holdings, Facilities Management, Institutional Research, Procurements and Contracts, the Sustainability Steering Committee, and all others who collaborated during the process.

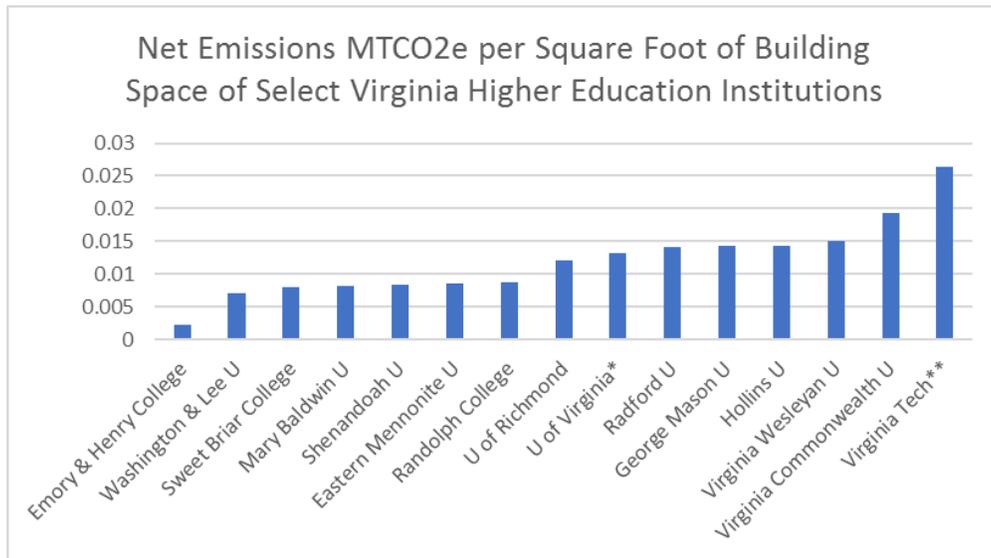
Appendix A

Normalization & Benchmarking with Other Virginia Institutions

Making meaningful comparisons between higher education institutions is a challenging endeavor; each institution is unique, information is unverified, and unbiased normalization metrics are not available. This data, unless otherwise noted, is from Second Nature's online reporting dashboard and is the most up to date information available. Second Nature is the organization managing the implementation of the ACUPCC (now Carbon or Climate Commitment) and there are currently 15 higher education institutions in Virginia that are ACUPCC reporting signatories. Radford University is one of only three public higher education institutions in this group (George Mason University and Virginia Commonwealth University). Both the University of Virginia and Virginia Tech are public universities and are not signatories, but recently reported their emissions; as such, they are included in this comparison.

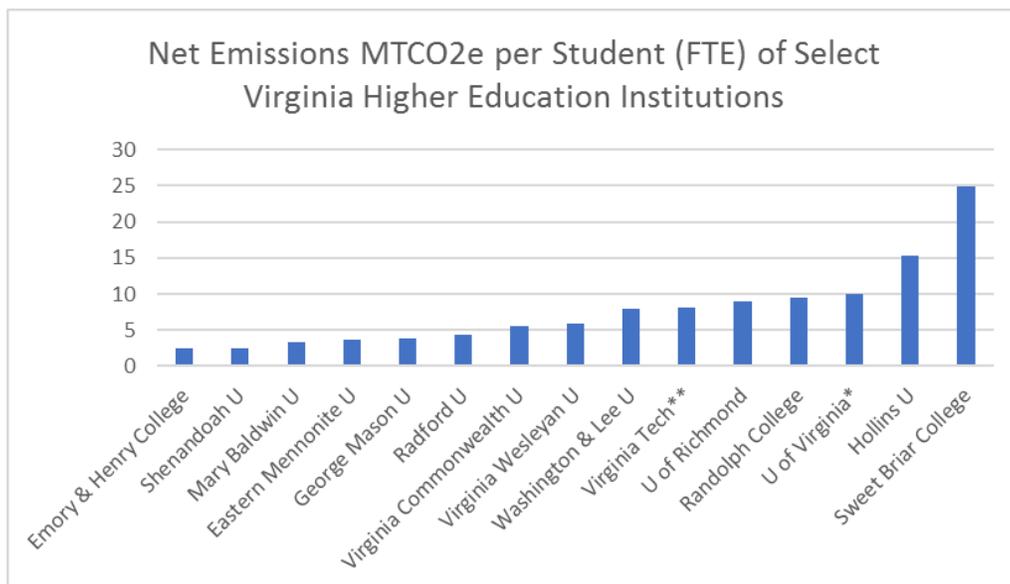
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*Not an ACUPCC signatory. Data from the University of Virginia's 2018 STARS report.
<https://stars.aashe.org/institutions/university-of-virginia-va/report/2018-03-01/>

**Not an ACUPCC signatory. Data from Virginia Tech's 2017 STARS report.
<https://stars.aashe.org/institutions/virginia-tech-va/report/2017-12-19/>



*Not an ACUPCC signatory. Data from the University of Virginia's 2018 STARS report.
<https://stars.aashe.org/institutions/university-of-virginia-va/report/2018-03-01/>

**Not an ACUPCC signatory. Data from Virginia Tech's 2017 STARS report.
<https://stars.aashe.org/institutions/virginia-tech-va/report/2017-12-19/>

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Appendix B

Links to Other Reports & Resources

American College and University President's Climate Commitment:

<http://www.radford.edu/content/dam/departments/administrative/Sustainability/Documents/ACUPCC-Commitment.pdf>

Radford University Climate Action Plan:

<http://www.radford.edu/content/sustainability/home/climate-plan.html>

Radford University 2010 Greenhouse Gas Inventory Narrative:

<http://www.radford.edu/content/dam/departments/administrative/Sustainability/Documents/greenhouse-gas-narrative.pdf>

Second Nature: www.secondnature.org

SIMAP - Sustainability Indicator Management & Analysis Platform: www.unhsimap.org