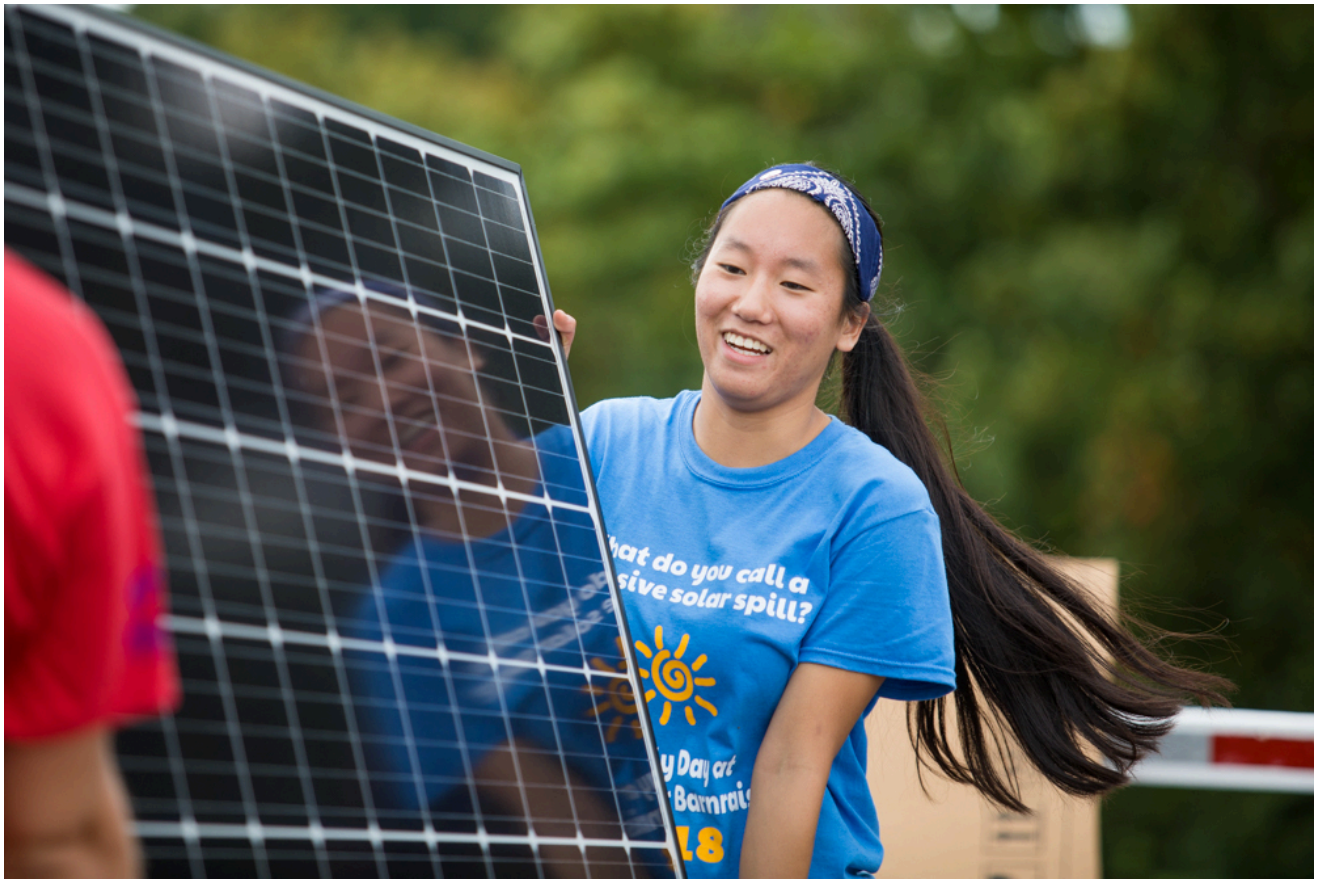
Eastern Mennonite University

2015 Climate Action Plan
Five Year Benchmark Emissions Analysis



During a "solar barn raising" at Eastern Mennonite University, Tessa Waidelich carries one of 186 panels for the arrays on Roselawn and the University Commons. P.c. Macson McGuire

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September 2021

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Executive Summary

Every five years, the 2015 Climate Action Plan (CAP) outlines “benchmark years” for reporting emissions data. The CAP specifies 2020 as the first benchmark year to analyze progress made since its adoption by university leadership. 2020 saw a substantial decrease in overall emissions, due in part to the COVID pandemic. Because of the pandemic’s impacts on many aspects of university related emissions, this analysis uses the 2018-2019 academic year, designated “2019”, as the first benchmark year. 2019 is the most recent year of “business as usual” emissions.[1]

Much progress has been made at EMU to reduce its carbon footprint since tracking began in 2010. Throughout this report, each scope and category is compared to a baseline average to show change over time, according to the earliest available data. The baseline average used for each category was established in the 2015 CAP. Wherever possible, a three year running average was used for the baseline to account for single year fluctuations in emissions. Therefore, percent reduction in emissions per category in this report may be different than in third party reporting software such as SecondNature or SIMAP, which do not aggregate and average multiple baseline years.

While 100% accuracy is impossible when retroactively recording emissions, this analysis confirms a high degree of confidence that EMU’s tracking over the last decade closely follows actual emissions produced. With that confidence, this report aims to address the following questions: How have emissions changed since the benchmark year, and how do they match goals? What areas are most important for any changes? What role has the CAP played in emissions/energy use reduction for the campus community?

Key Takeaways

- EMU achieved a 23% reduction in total emissions in 2019 compared to the baseline average, and a 28% reduction in total emissions in 2020 compared to the baseline average.
- EMU is on track to meet the net emissions reduction goal as detailed in the 2015 CAP.
- The most significant factor contributing to EMU’s carbon reduction, electricity use, was outside of the university’s control.
    - While emissions from electricity production dropped nearly 30% from the baseline, actual electric usage on campus increased 1.3%.
    - The significant drop in emissions from electricity generation can be attributed to cleaner sources of power (i.e. wind and solar) being added to the grid.
- Other categories with the largest carbon emissions reduction in 2019 were faculty/staff air travel, electrical transmission and distribution, cafeteria food, and student commuting.
    - Declining faculty/staff air travel reduced total emissions by 8% in 2019
    - Declining electrical transmission and distribution losses reduced total emissions by 2% in 2019
    - Declining use of carbon intensive food reduced total emissions by 1% in 2019

[1] Appendix one gives an overview of how the pandemic has impacted EMU’s carbon footprint.

    - Declining use of single occupancy vehicles in student commuting reduced total emissions by 0.8% in 2019.
- Four out of twenty categories saw a rise or no reduction in emissions in 2019, compared to the baseline data.
    - These categories include natural gas use, cross-cultural travel, chemical refrigerants and faculty/staff commuting.
- Emissions per weighted campus users rose 2.3% during the five year study period compared to the baseline average, even though total emissions fell.
- Single events can skew the data - One chemical refrigerant spill in 2020 accounted for 6% of the university's total annual emissions.

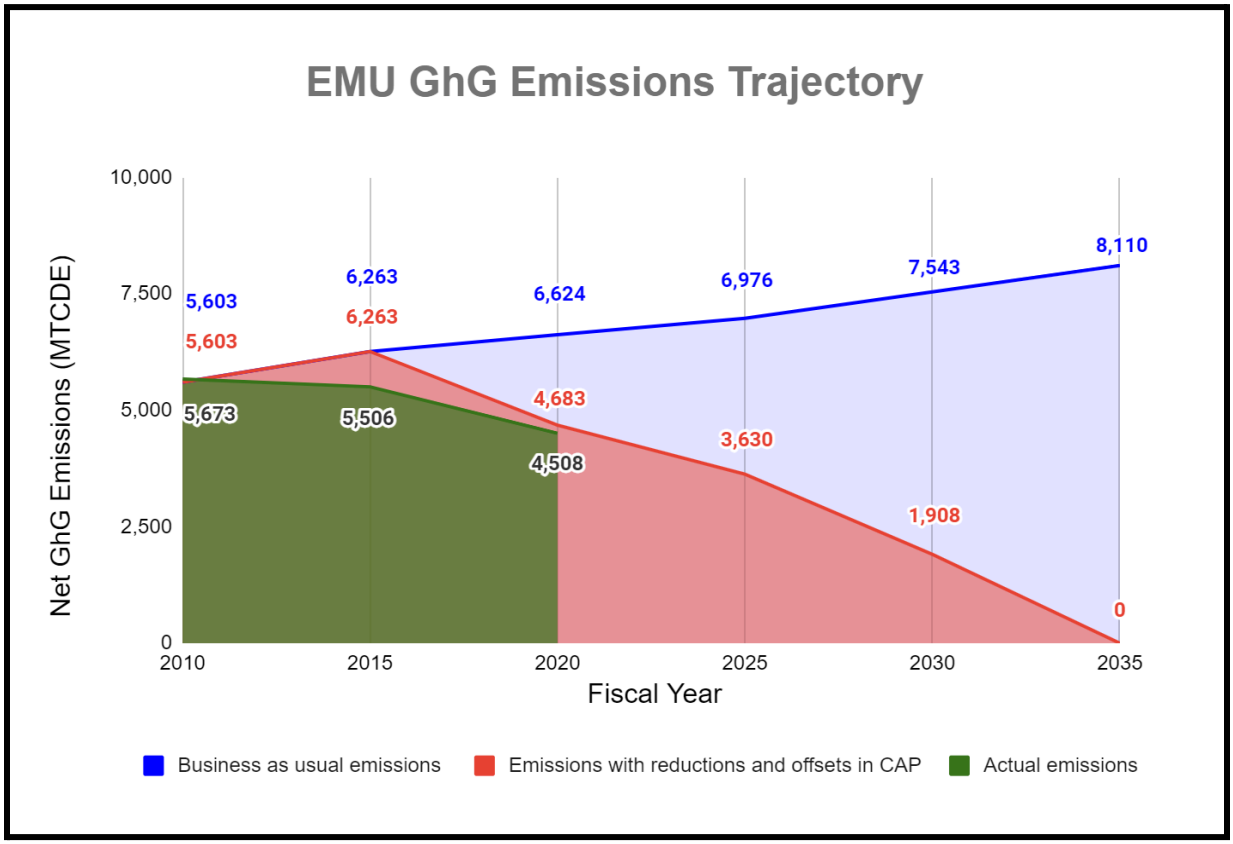


Figure 1: EMU actual emissions overlaid with trajectory in different scenarios. Note that the business as usual and CAP plan (in red) are taken directly from the 2015 CAP.

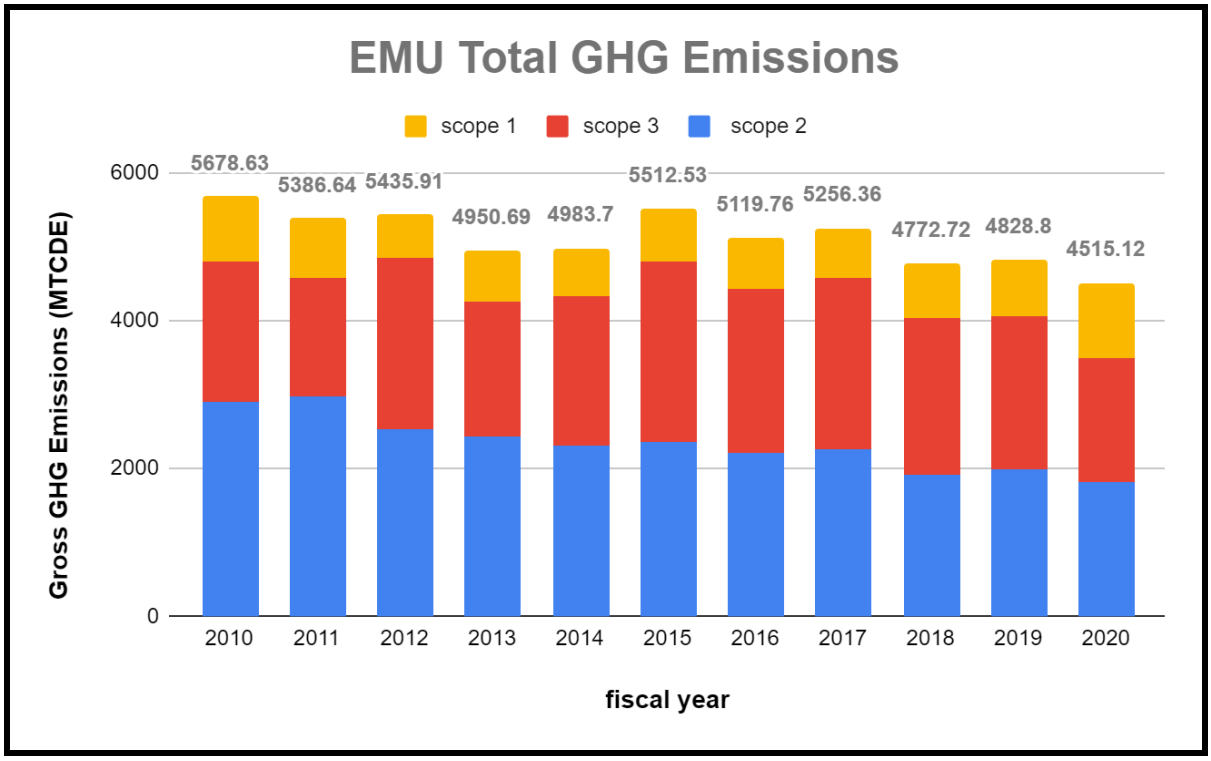


Figure 2: Annual emissions by scope. Note that the largest contributor to falling emissions is scope 2 - purchased electricity.

Baseline Data

The 2015 CAP defines the baseline year to be the 2010 fiscal year (July 2009-June 2010). The reduction targets in each scope are based from that year. However, per the CAP, the baseline for each category in all three scopes is tied to several years of data to account for data fluctuations. Additionally, two categories in scope 3 - “Food”, and “Directly outsourced travel” - were not tracked in 2010, but were in subsequent years, making it challenging to use 2010 as a true baseline. Because of these factors, this report analyzes each scope as a baseline average, and not from a single year. This methodology is a deviation from the 2015 CAP.[2]

Project	Total Baseline Emissions (MTCDE)	Baseline Years from CAP
Scope 1		
Fleet Vehicle Fuel Use	138.7	2008-2009
Natural Gas Use	636.9	2008-2009
Fleet MPG Efficiency Increase	n/a	2008-2009
Fertilizer NO2 Emissions	3.1	2010*

[2] Note that table 2 on page 7 lists emissions reductions versus the baseline year (2010) and the baseline average.

Grounds Related Fuel Use	4.8	2008-2009
Refrigerants and Chemicals	29.5	2010-2012*
Generator Emissions	15.4	2012-2015
Baseline Average Emissions	828.4	
CAP Baseline (2010) Emissions	888.9	2010
Scope 2		
Electricity Use	2,845.6	2008-2012
Baseline Average Emissions	2,845.6	
CAP Baseline (2010) Emissions	2,898.0	2010
Scope 3		
Faculty/Staff Air Travel	564.1	2014-2015
Cross Cultural Air Travel	641.7	2014-2015*
Student Commuting	461.1	2014-2015
Faculty/Staff Commuting	155.0	2014-2015
Other Directly Financed Travel	101.6	2015*
Recycling Rate (%)	0.4	n/a
Waste Stream (By Volume)	223.1	2008-2012
Waste Stream Compost	-7.3	2008-2012
Waste Stream Trash	1.4	2008-2012
Post Consumer Recycled Paper	14.3	2008-2012
Cafeteria Food	422.3	2015*
Electrical Transmission and Distribution	226.4	2008-2012
Potable Water	6.5	2008-2012
Baseline Average Emissions	2,587.7	
CAP Baseline (2010) Emissions	1,891.8	2010
Total Baseline Emissions	6,261.7	
CAP Total Baseline Emissions (2010)	5,678.6	2010

Table 1: Baseline years for each scope and category. A star (*) means that no baseline year was specified in the 2015 CAP and the earliest available data was used for the baseline.

Emissions Reduction by Scope

Standard for institutions tracking their carbon footprint, EMU breaks its carbon budget into three categories. Emissions factors for each scope are calculated using the University of New Hampshire's Sustainability Indicator Management and Analysis Program (SIMAP). The SIMAP program takes raw data, couples that with geographic specific emissions factors to give corresponding values for emissions per scope and category.

- Scope 1 tracks direct onsite emissions
- Scope 2 tracks emissions from electric consumption
- Scope 3 tracks all offsite or other university sanctioned emissions, both up and downstream the supply chain.

This report examines the change in resources consumed and emissions produced by EMU students, faculty and staff over time. As outlined in the 2015 CAP, each scope of study and category within its respective scope are compared to a set of baseline study years. In most cases, each baseline represents the earliest years data was available and recorded. Therefore, baseline data years vary from scope to scope and category to category. Baseline averages were established to account for annual fluctuations in resource consumption.

For comparison, table 2 lists emissions reductions by scope vs the baseline as defined in the 2015 CAP, as well as the baseline average this report uses.

Year	Scope 1	Scope 2	Scope 3	Net Emissions
Five year emission reduction goal in 2015 CAP	20% reduction from baseline (2010)	20% reduction from baseline (2010)	15% reduction from baseline (2010)	**25% reduction**
2019 - Versus 2010 baseline	15% reduction	31% reduction	9% increase	**15% reduction**
2019 - Versus baseline averages	9% reduction	29% reduction	20% reduction	**23% reduction**
2020 - Versus 2010 baseline	14% increase	37% reduction	12% reduction	**21% reduction**
2020 - Versus baseline average	22% increase	35% reduction	36% reduction	**25% reduction**

Table 2: Analysis of actual GhG emissions emitted by EMU in study years versus emission reduction goals set in 2015 CAP. Each scope's reduction goal was achieved with the exception of 2020 scope 1 emissions. For baseline averages years, see table 1.

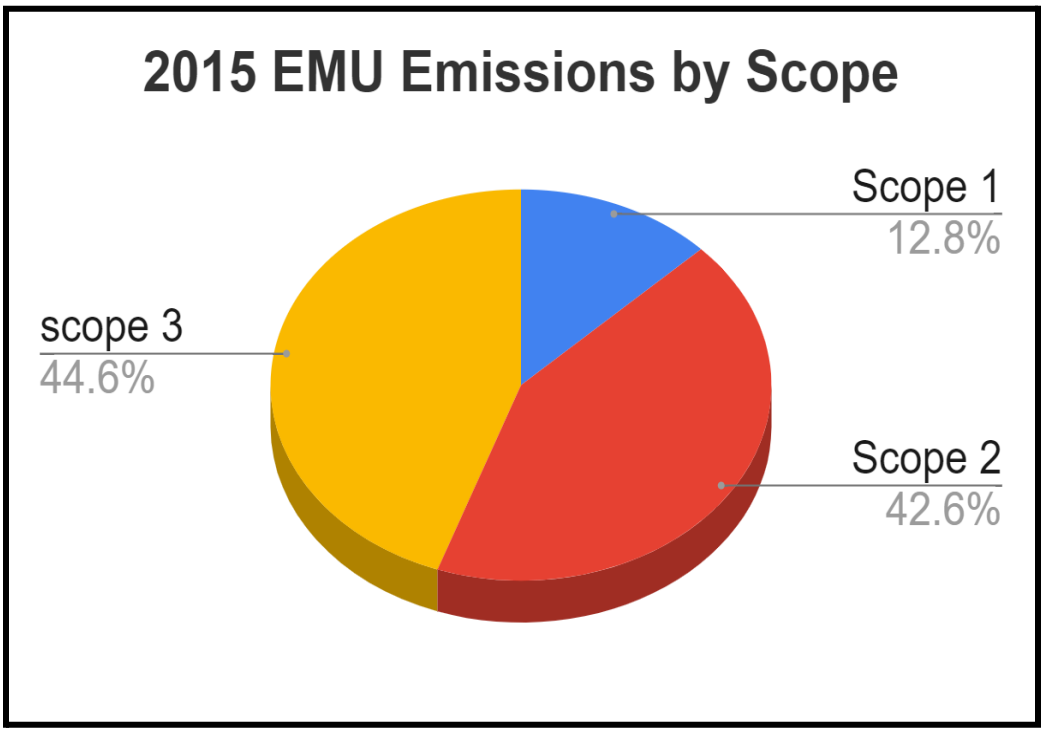


Figure 3: Total university emissions by scope in 2015. The fiscal year 2015 is displayed because it is the last year prior to the CAP.

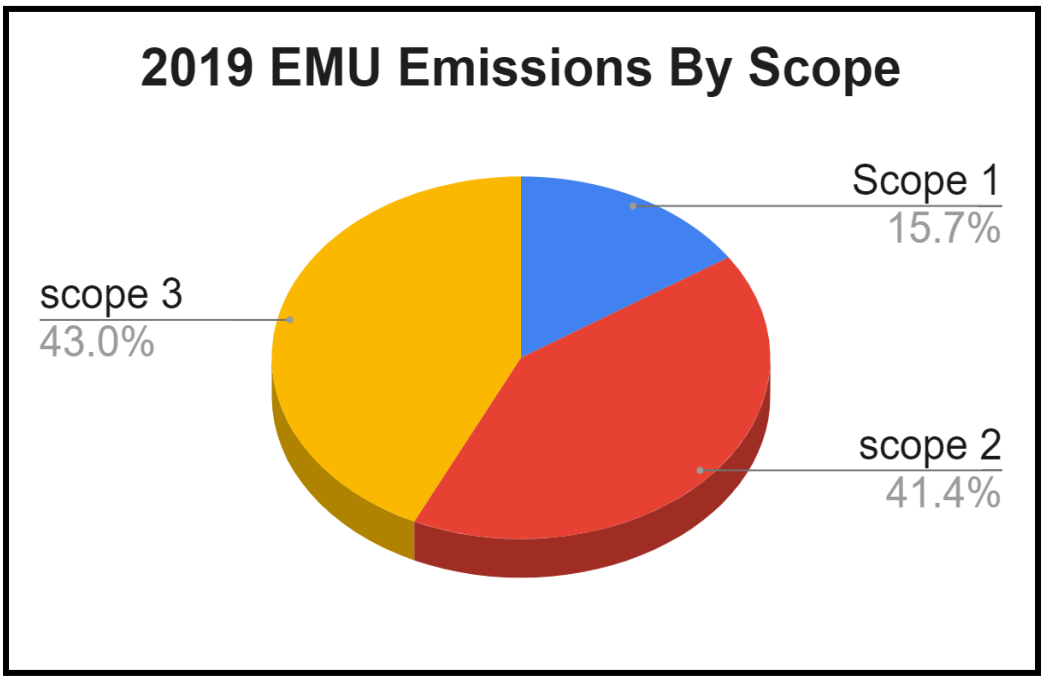


Figure 4: Total university emissions by scope in 2019.

Scope 1 - Direct Onsite Emissions

- Scope 1 emissions represent the smallest percentage of total emissions by scope, at 16%.
- Emissions reduction goal of 20% was not met. Emissions actually increased both in 2019 and 2020 compared to the baseline.
- An gradual increase in use of natural gas fired generators to shave university peak demand counteracted significant reduction in fleet vehicle fuel use and generator emissions for an 8.7% reduction in scope 1 emissions.[3]
- Scope 1 emission sources represent 5% of the total emissions reduction from the baseline to 2019.

Emission Source	Baseline Emissions Average	Total 2019 Emissions	Percent of Total 2019 Emissions	2019 Emissions Reduction from baseline	% of Total Emission Reduction from Baseline to 2019
Fleet Vehicle Fuel Use	138.6	54.9	1.13%	60.39%	5.8%
Natural Gas Use	636.9	691.4	14.2%	-8.56%	-3.8%
Fleet MPG Efficiency Increase	n/a	n/a	n/a	0.51%	n/a
Fertilizer NO2 Emissions	3.1	2.9	0.06%	4.52%	0.01%
Grounds Related Fuel Use	4.8	2.5	0.05%	48.14%	0.2%
Refrigerants and Chemicals	29.5	0	0.00%	n/a	2%
Generator Emissions	15.4	4.5	0.09%	70.80%	0.8%
Scope 1 total	828.397	756.29	15.7%	8.7%	5%

Table 3: Detailing emissions totals for scope 1. Cells highlighted in red represent a rise or no change in emissions from the baseline, cells highlighted in tan represent a decrease in emissions but below the target threshold, and cells highlighted in green represent a decrease in emissions above the target goal as defined in the 2015 CAP.. The 60% decrease in fleet vehicle fuel use is due to an outsourcing of fleet vehicles to rental companies. Some of this change is captured in scope 3 emissions.

Fleet Vehicle Fuel Use

- The significant drop in emissions from fleet vehicles over the study years is largely due to the outsourcing of university sponsored travel from fleet vehicles to rental vehicles.
- Although fleet fuel usage dropped significantly, this category only represented 1.1% of total emissions in 2019.

[3] Generator emissions are defined as Liquid Propane (LP) and distillate oils #1-4. Although natural gas is used in part to fire electric generators, it is categorized separately from other generator emissions.

- Some of the emissions from outsourcing fleet usage are accounted for in scope 3 under “other direct sponsored travel” and some are not accounted for in the current data collection model.
- The sharp reduction in emissions can also be partially attributed to a university policy enacted in 2015 to reduce faculty/staff travel for cost savings.

Natural Gas Use

- An 8.5% increase in emissions from the baseline average can be attributed to the installation of two natural gas fired electric generators in 2018.
    - The generators were installed to create a campus microgrid, effectively islanding the campus off the grid on days of peak demand, thus saving money on otherwise very expensive electricity.
- Largest emissions source in scope 1, at 14% of total university emissions in 2019.
- Increased reliance on natural gas is a cost saving strategy, but this approach marries the university to fossil fuel dependency for an unforeseen number of years.

Fleet MPG Efficiency

- Nominal efficiency increase of 0.51% over baseline average.
- National average fuel efficiency (MPG) increased 13% over the same period.
    - Likely cause of stagnation of efficiency increase is due to an aging fleet.

Fertilizer NO2 Emissions

- Minor reduction of 4.5% in NO2 emissions from baseline average.
- The reduction could be an anomaly, because every other year in the study period experienced a significant rise in emissions, compared to the baseline.
- Nominal contributor to overall emissions, at 0.06% of the 2019 total.

Grounds Related Fuel

- Significant reduction of 48% in diesel use compared to baseline average.
- Emissions decrease could be due to less mowing of campus hill due to installation of the meadow and orchards, as well as insufficient record keeping, and not actual usage decrease.
- Nominal contributor to overall emissions, at 0.05% of the 2019 total.

Generator Emissions

- Significant reduction of 70% of emissions from baseline average.
- Largest emissions reduction, by percent, of any scope 1 category.
- This category includes distillate oils and liquid propane, both used primarily for heating buildings during winter.
- Decrease can be attributed to phasing out of oil/propane burning heating units, to electric ones.

Refrigerants and Chemicals

- No reporting data for 2019
- All other years prior to 2019 show no change in emission production, with annual emissions at 29.5 MTCDE.

Scope 2 - Electricity Emissions

- Scope 2 emissions represent the largest percentage of total emissions in 2019.
- Emissions from electricity production by the regional grid dropped nearly 30% from the baseline average to 2019, as electric utilities shift their generation to less carbon intensive sources, thus supplying EMU with cleaner electricity.
- Actual electric usage on campus increased 1.3% from the baseline to 2019.
- Total electricity usage (kWh) per weighted campus user (WCU) fell by 0.25% from the baseline period.
    - Despite institutional electricity conservation measures, electric consumption per WCU rose during the four year study period to near baseline levels.
- Energy conservation projects (see appendix 2) that were implemented to reduce the electric load of the university were offset by new loads being added to the campus, such as dorm minifridges, personal TV's and more electronic charging.
- Scope 2 emission sources represent 59% of the total emissions reduction from the baseline to 2019.

Emission Source	Baseline Average Emissions	Total 2019 Emissions	Percent of Total 2019 Emissions	2019 Emissions Reduction from baseline	% of Total Emission Decrease from Baseline to 2019
Purchased Electricity	2,846	1,998.2	41.4%	29.78%	59%

Table 4: Detailing emissions totals for scope 2. Cells highlighted in red represent a rise or no change in emissions from the baseline, cells highlighted in tan represent a decrease in emissions but below the target threshold, and cells highlighted in green represent a decrease in emissions above the target goal as defined in the 2015 CAP.

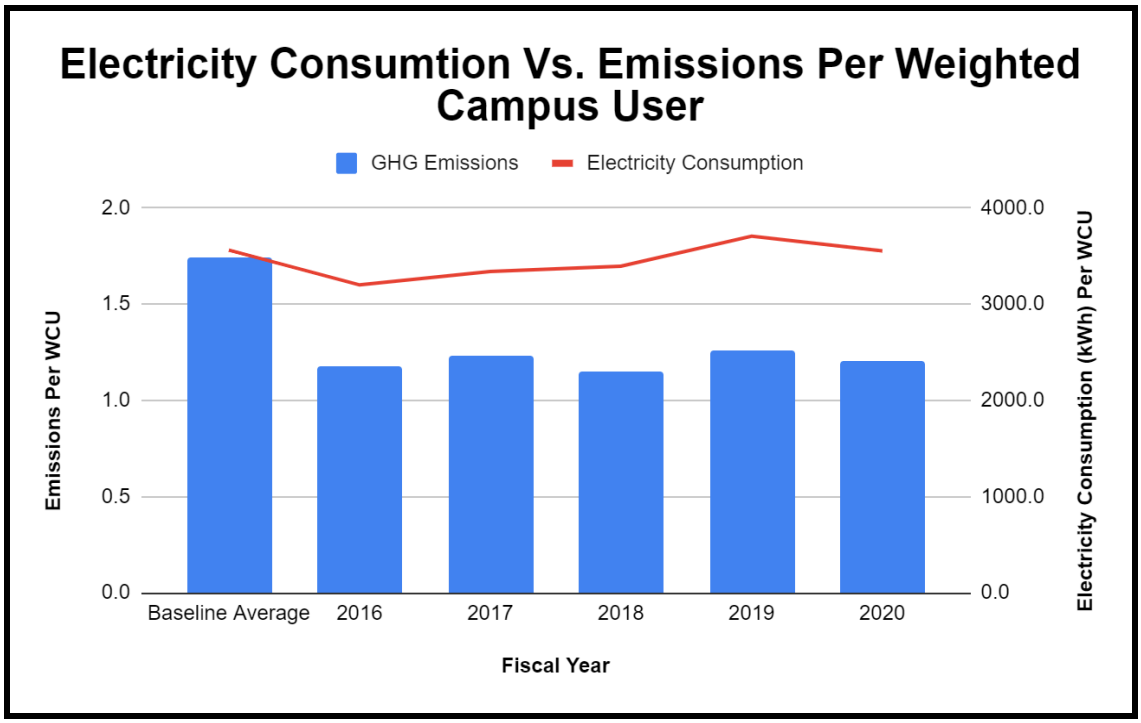


Figure 5: Emissions and electricity consumption per weighted campus user.

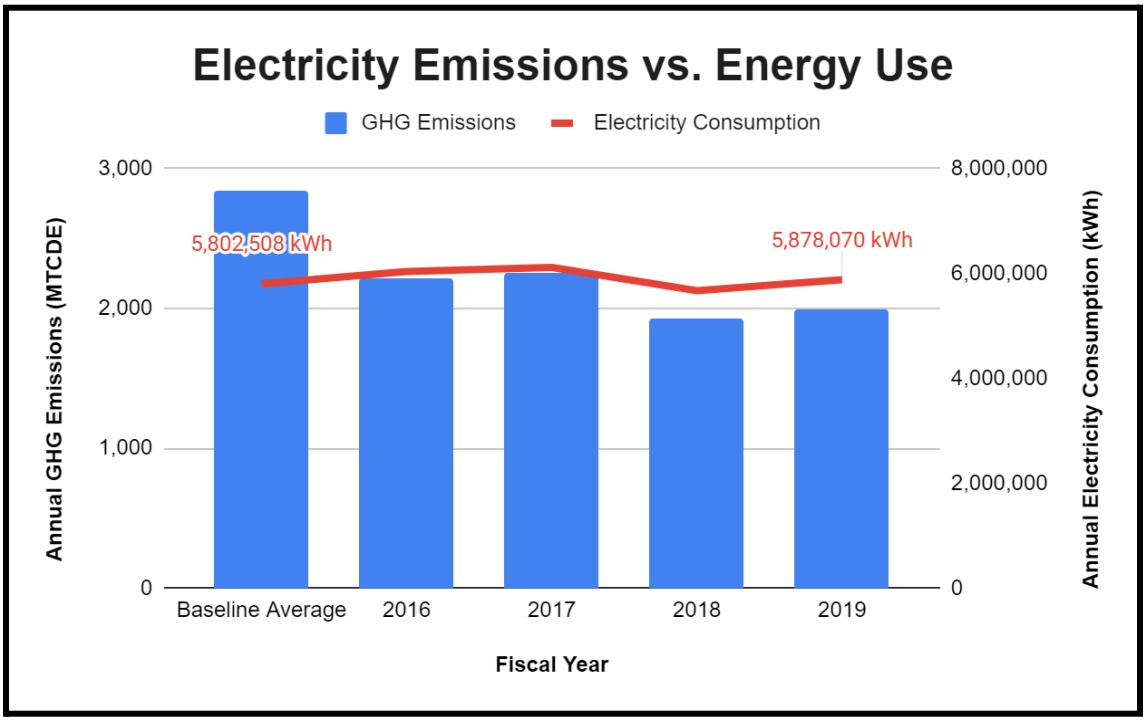


Figure 6: Emissions from electricity generation vs. raw energy use. Although emissions fell by 30% (blue columns) from the baseline to 2019, actual energy use actually grew by 1% (red line)

Scope 3 - Upstream and Downstream Emissions

- Scope 3 emissions represent the largest percentage of total emissions by scope, at 42.8%.
- Emissions reduction goal of 15% was exceeded.
- Some uncertainty exists in scope 3 emissions, due to shifting emissions from scope 1 to scope 3.
- Scope 3 represents the categories in which individual behavioral change has the greatest impact on emissions reductions.
- Scope 3 emission sources represent 36% of the total emissions reduction from the baseline to 2019.

Emission Source	Baseline Average Emissions	Total 2019 Emissions	Percent of Total 2019 Emissions	2019 Emissions Reduction from baseline	% of Total Emission Decrease from Baseline to 2019
Faculty/Staff Air Travel[4]	564.1	174.3	3.59%	69.09%	27%
Cross Cultural Air Travel	642	694.7	14.32%	-8.26%	-4%
Student Commuting	461	412	8.49%	10.65%	3%
Faculty/Staff Commuting	155	173	3.57%	-11.81%	-1%
Other Directly Financed Travel	101.6	67	1.38%	34.02%	2%
Waste Stream Compost	-7.3	-7.6	-0.16%	4.53%	0.02%
Waste Stream Trash	1	55	1.13%	-3700.69%	-4%
Post Consumer Recycled Paper	14.3	12.2	0.25%	14.58%	0.1%
Cafeteria Food	422	381	7.86%	9.73%	3%
Electrical Transmission and Distribution	226.4	99.6	2.05%	56.02%	9%
Potable Water	6.5	5.0	0.10%	24.04%	0.1%
Scope 3 Total	2,587.7	2,067.2	42.9%	20.12%	36%

Table 5: Detailing emissions totals for scope 3. Cells highlighted in red represent a rise or no change in emissions from the baseline, cells highlighted in tan represent a decrease in emissions but below the target threshold, and cells highlighted in green represent a decrease in emissions above the target goal as defined in the 2015 CAP.

[4] Uncertain about accuracy of data in 2019 due to accounting.

Faculty/Staff Air Travel

- A 69% reduction in emissions from the baseline average exceeded the 2015 CAP goal of a 15% reduction from the baseline.
- The data show a sharp dropoff in air travel and associated emissions after the 2015 fiscal year, suggesting institutional policy change.
- Being a carbon intensive mode of travel, minor fluctuations in miles traveled year-to-year heavily influence this category's percentage of total campus emissions.

Cross Cultural Air Travel

- An 8.26% increase in emissions did not meet the 2015 CAP goal of 25% reduction from the baseline average.
- Being a carbon intensive mode of travel, minor fluctuations in miles traveled year-to-year heavily influence this category's percentage of total campus emissions.
    - Fewer miles traveled in 2018 resulted in a 16% decrease in emissions from the baseline.
- Largest emissions source in scope 3, at 14.3% of total emissions.
- An institutional plan is in place to reduce future emissions in this category.

Commuting

- 4.8% emissions reduction for overall (faculty/staff and student) commuting did not meet the goal of 15% reduction from baseline average.
- Commuting emissions represent 12% of total university emissions in 2019.
- Student commuting emissions reduced by 10.6% from the baseline average.
    - 11.3% reduction in single passenger student vehicle miles.
- Faculty/staff commuting emissions rose 11.8% from the baseline.
    - 20% increase in emissions per faculty/staff weighted campus users from the baseline, driven by a decline of 21 faculty/staff weighted campus users from the baseline.

Other Directly Financed Travel

- Sub-categories include personal mileage reimbursement, charter bus, public bus, train, taxi, ferry, and rental cars.
- Only one year of baseline data, with reporting starting in 2015.
    - Hard to measure change over time for each sub-category due to lack of record keeping by transportation type.
- Emissions reduction of 34% compared to baseline.
    - No reduction goal set in 2015 CAP
- Accounted for 1.3% of total emissions in 2019.

Waste Stream

- Overall recycling rate of 50.78%, falling short of the 2015 CAP goal of a 75% recycling rate.

    - Items recycled include paper, cardboard, cans, bottles, mixed scrap metals, compost, pallets, and e-waste.
- Recycling rate increased 6.6% from baseline average.
- Total landfill waste by volume decreased by 41% from the baseline average, exceeding the 2015 CAP goal of 20% overall waste stream reduction.
    - Emissions from landfill waste increased by 3700%, indicating incomplete data for the baseline period, or a calculation discrepancy in SIMAP's software.
- Total volume of compost increased 33% from the baseline period.
- Very high recycling rate of 135 pounds per weighted campus user. For context, Loyola Marymount University, the 2019 RecycleMania winner had a recycling rate of 79 pounds per weighted campus user.

Food

- Emissions reduction of 9.7% from baseline average, despite the total volume of food consumed increasing by 24%.
- Did not meet 2015 CAP goal of 25% local and community-based, fair, ecologically sound and/or humane food purchases as defined by Real Food Challenge.
    - Locally purchased or organically grown food accounted for 1.6% of total food by volume.
    - Locally purchased or organically grown food accounted for 0.38% of total food by carbon emissions.
- Emissions per weighted campus user rose by 8% from the baseline average due to fewer meals served per year to weighted campus users.
- Emissions reduction of 3.9% from meat consumption compared to baseline average.
    - 10% reduction in beef emissions
    - 0.6% reduction in pork emissions
    - 18% increase in chicken emissions
- Emissions reduction of 45% from dairy consumption compared to baseline.
- Accounted for 7.8% of total emissions in 2019.

Water

- Emissions reduction of 24% from baseline average exceeded the CAP reduction goal of 20% reduction from the baseline average.
    - Indication of water conservation measures making an impact in use reduction.
- Gallons of water used per weighted campus users per year fell from 6,958 in 2015 to 5,544 in 2019
- Accounted for 0.1% of total emissions in 2019.

Electrical Transmission and Distribution

- Emissions reduction of 60% from baseline average exceeded the CAP reduction goal of 35%.
    - The emissions factor (outside of EMU's control) for T&D losses from the grid decreased by 34% from the baseline.

    - Campus based conservation and onsite generation projects had a tangible impact of reducing T&D losses by 26% from the baseline.
- Accounts for 2.5% of total emissions in 2019.

Weighted Campus Users

Emission reductions alone only tell part of the story of EMU's carbon footprint. It is important to compare overall emissions by category, scope and net total to the number of users on campus actually responsible for those emissions produced. In the SIMAP software, Weighted Campus User (WCU) is a measurement of an institution's population that is adjusted to accommodate how intensively certain community members use the campus. This figure is used to normalize resource consumption and environmental impact figures in order to accommodate the varied impacts of different population groups. For example, an institution where a high percentage of students live on campus would witness higher greenhouse gas emissions, waste generation, and water consumption figures than otherwise comparable nonresidential institutions since students' residential impacts and consumption would be included in the institution's totals.

Fiscal Year	GHG Emissions Per WCU (MTCDE)	FTE Students	FTE Faculty	FTE Staff	Total FTE users
2009	4.3	1,243	201	117	1,561
2010	4.6	1,320	204	127	1,651
2011	4.3	1,339	204	135	1,678
2012	4.3	1,320	210	138	1,668
2013	3.9	1,355	222	139	1,716
2014	3.3	1,463	222	141	1,826
2015	3.5	1,536	242	152	1,930
2016	3.3	1,494	248	146	1,888
2017	4.0	1,458	234	140	1,832
2018	4.1	1,317	223	132	1,672
2019	4.2	1,251	212	124	1,587
2020	3.7	1,192	195	127	1,514

Table 6: Weighted campus users and associated carbon footprint per year. Users are broken down into student, faculty, and staff population segments.

In the years that EMU has tracked emissions, WCU data can be overlaid as another benchmark of success in emissions reductions. This is also a helpful lense to compare emissions to other

academic institutions that may have a larger student body or physical campus space. The colleges in table six represent some of the most sustainability focused institutions in the country, all with much deeper pockets than EMU. Regardless, EMU outperformed all but Dickinson College and the College of the Atlantic in 2019 in emissions per weighted campus user.

Greenhouse Gas Emissions Per Weighted Campus User				
	2009	2015	2019	2020
EMU (VA)	4.3	3.5	4.2	3.7
Dickinson College (PA)	5.8	4.4	3.9	3.4
Randolph College (VA)	10.1	12.2	8.4	8.6
Warren Wilson College (NC)	5.7	6.1	4.5	n/a
College of the Atlantic (ME)	4.5	3.9	3.05	2.8
Oberlin College (OH)	14.5	13.4	10.6	n/a
Middlebury College (VT)	7.2	4.23	4.4	n/a
Colorado State (CO)	6.1	n/a	4.9	n/a

Table 7: Comparing EMU to other universities that rank in the Harvard college review top 50 list of "Green Colleges". Note that many universities have not uploaded data to the Second Nature reporting portal for 2020.

Sustainability in the Curriculum

In the spring of 2015, EMU completed a five year Quality Enhancement Plan (QEP) focused on incorporating sustainability teaching into the core curriculum. This QEP drew together EMU students, faculty and staff around the theme of sustainability and how it relates to Anabaptist beliefs concerning creation care, peace and social justice.

The "Peace with Creation: Sustainability from an Anabaptist Perspective" QEP incorporates the following components.

Principles of Sustainability

We acknowledge that individual, institutional, and community actions have local and global impacts on the current and future health and prosperity of all humans and other species. These impacts include the:

- The fairness, equity, stability and security of human cultures and social systems
- Economic opportunity for all current and future humans
- Ecological diversity and integrity

Therefore, we strive to transform and renew social, economic and ecological systems to create just and peaceful relationships between humanity and the rest of Creation.

Principles for Teaching Sustainability

The following principles are essential aspects of teaching sustainability:

- Emphasize the interconnectedness of all people, disciplines and actions (i.e. systems thinking)
- Engage students in actions that are experiential and include real world problem solving
- Explore economic, environmental, and social justice through connections to people both locally and globally

Student Learning Outcomes

1. Define sustainability according to the Principles of Sustainability
2. Justify sustainability from a theological perspective
3. Explain how individual, institutional, and community actions impact sustainability
4. Name and defend actions that promote sustainability at the individual, institutional, and community levels
5. Integrate the Principles of Sustainability within the student's discipline
6. Incorporate sustainability into one's values system

This component of EMU's sustainability initiatives were not evaluated in this study due to lack of time and challenges acquiring data. Further research should take place to determine how broadly student learning outcomes were actually incorporated into the curriculum.

Appendix 1- How did the pandemic impact each scope and category?

Supposed to be the five year benchmark period, the 2020 fiscal year (July 2019-June 2020) was left out of this analysis because of the impact the COVID pandemic had on the university's resource consumption. Some categories saw significant declines in use during the Pandemic, while others actually increased. Thus, it would be inaccurate to base the university's progress in emissions reductions against data that is not "business as usual".

The data from 2020 sheds light into a future scenario where campus use changes, but the university still operates. What programs would need to be changed or added to meet emission reduction goals? How would emissions reduction projects get funded with a tighter budget? How would energy use shift to certain buildings at certain times of the day? Would emissions per weighted campus user rise or fall?

Net Emissions (MTCDE)	Baseline Average	2019	2020	2020 decrease from Baseline Average
Scope 1	828	756	1,014	-22.4%
scope 2	2,846	1,998	1,827	35.7%
scope 3	2,587	2,067	1,666	35.6%
Total	6,261	4,821	4,508	28%

Table 8: Annual emissions per scope. 2020 saw a decline in overall emissions but also a significant increase in scope 1 emissions due to a chemical spill.

- Emissions in 2020 fell overall by 28% driven by sharp declines in scope 2 and scope 3 emissions.
- Scope 3 emissions fell primarily because of reduced student and faculty commuting, cross cultural flights, and meals consumed on campus.
- Scope 2 emissions primarily fell due to less occupancy in student dorms, and the associated reduced electric load.
- Although not caused by the pandemic, scope one emissions increased by 34% due to a single event spill of chemical refrigerants.

	Project	Actual 2019 Emissions Reduction from baseline	Actual 2020 Emissions Reduction from Baseline	Percent of Total 2020 Emissions
Scope 1	Fleet Vehicle Fuel Use	60%	65%	1.08%
	Natural Gas Use	-9%	-4%	14.62%
	Fleet MPG Efficiency Increase	0.5%	0.5%	n/a
	Fertilizer NO2 Emissions	5%	-79%	0.12%
	Grounds Related Fuel Use	48%	43%	0.06%
	Refrigerants and Chemicals	0%	-896%	6.51%
	Generator Emissions	71%	71%	0.10%
	subtotal	9%	-22%	22.50%
Scope 2	Electricity Use	30%	36%	40.54%
	subtotal	30%	36%	40.54%
Scope 3	Faculty/Staff Air Travel	69%	41%	7.42%
	Cross Cultural Air Travel	-8%	37%	9.01%
	Student Commuting	11%	32%	6.96%
	Faculty/Staff Commuting	-12%	23%	2.65%
	Other Directly Financed Travel	34%	-8%	2.44%
	Recycling Rate (%)	51%	55%	
	Overall Waste Stream (By Volume)	5%	9%	
	Compost (By Volume)	-53%	-41%	
	Waste Stream Trash	-3701%	-3701%	1.04%
	Post Consumer Recycled Paper	15%	36%	0.20%
	Cafeteria Food	10%	44%	5.23%
	Electrical Transmission and Distribution	56%	60%	2.01%
	Potable Water	24%	2%	0.14%
	subtotal	20%	36%	36.96%
	Total Emissions	**23%**	**28%**	**100%**

Table 9: Detailing emissions totals for 2020. Cells highlighted in red represent a rise or no change in emissions from the baseline, cells highlighted in tan represent a decrease in emissions but below the target threshold, and cells highlighted in green represent a decrease in emissions above the target goal as defined in the 2015 CAP. The 3,000 percent increase in emissions from trash between the baseline and 2019 and 2020 is due to a difference in how carbon is accounted for when incinerated vs. stored in the landfill.

Appendix 2 - Implementation of Energy Reduction Projects

The 2015 CAP outlines potential projects to achieve the emissions reductions goals in each scope. The tables below list each potential project and its implementation status.

In 2017, EMU entered a performance contract with Siemens with the goal of reducing energy costs for the university, while at the same time phasing in new technology. Another positive benefit of this contract is a reduction in emissions as a result of upgrades to more energy efficient pumps, compressors, HVAC systems, etc. The performance contract included seven projects which were implemented from 2017-2018. Projects included in the performance contract are noted in tables 11, 12, and 13 in the “notes” column.

In year 2, the performance contract with Siemens saved EMU $193,000, 9% over the guaranteed savings of $177,000. Energy savings as a result of the projects in the performance contract can be seen in table 10. The project overview also claims an emissions reduction of 352 MTCDE from the baseline[5].

A list of additional energy reduction projects that were studied but not included in the final scope of work for the Siemens performance contract can be found in table 14.

Energy Savings from Siemens Performance Contract Projects				
Savings Type	**Electric Energy Savings (kWh)**	**Electric Demand Savings (kW)**	**Natural Gas Savings (MCF)**	**Water Savings (Gal)**
Realized Savings	874,519	2,047	1,076	2,057,641
Guaranteed Savings	781,485	1,354	735	1,919,998
Variance	93,034	693	341	137,642

Table 10: Energy savings from projects in Siemens performance contract.

Scope 1

Project	Was it Implemented?	Notes
Electric car for security	Not implemented	
tow behind reel mowers	Not implemented	
campus car share program	Not implemented	

[5] The baseline in Siemens performance contract overview uses a single fiscal year, 2015. Siemen’s carbon reduction calculation estimates the project’s carbon footprint reduction based on realized electric energy and natural gas savings.

with solar- charged EVs and/or hybrids for students and employees		

Table 11: Project status for reduction of scope 1 emissions.

Scope 2

Project	Was it Implemented?	Notes
Solar Phase II	Yes	Roselawn and university commons
LED light bulb retrofits	Yes	Siemens performance contract. Campus wide - includes timers and motion sensors.
higher efficiency lighting in parking lots	Partially implemented	
fees on student dorm fridges that would fund local offsets or a green loan fund	Not implemented	
fan and blower efficiency upgrades	Yes	Siemens performance contract. Northlawn kitchen, Suter Science center.
Variable Frequency Drives (VFDs) on large pumps	Yes	Siemens performance contract. Northlawn kitchen, Lehman Auditorium, campus wide cooling towers.
purchases of high quality wind power Renewable Energy Credits (RECs)	Not implemented	
changes to student laundry to reduce dryer run times and hot water use	Not implemented	
window film on west facing windows to reduce cooling loads	Not implemented	
Campus and inter-campus energy	Partially implemented	Recyclemania

competitions to encourage behavior change		
Upgrade electric hot water heaters in Parkwoods Apartments	Not implemented	Last remaining electric heaters in campus dorms. All other heaters are natural gas fired.
Domestic water conservation	Yes	Siemens performance contract. Retrofitting toilets for low flow technology. Retrofit faucets with aerators.
Wastewater recovery/preheat	Not implemented	
require new buildings and renovations to meet LEED Gold or strict in-house greenbuilding guidelines	Partially implemented	
Energy audits with airsealing/insulating	Not implemented	
Installing swipe card system for laundry with quotas similar to printing that would cut abuse	Not implemented	

Table 12: Project status for reduction of scope 2 emissions.

Scope 3

Project	Was it Implemented?	Notes
Priority parking or incentives for fuel-efficent employee vehicles	Not implemented	
subsidize and expand public transit	Not implemented	
improve bike commuter facilities (covered parking, showers, bike hub with repair) green purchasing guidelines	Not implemented	
100% recycled content paper on campus	Not implemented	
high-quality offsets for cross cultural travel	?	

increase campus-grown food including dairy and meat	?	
increased parking fees to discourage car commuting	Not implemented	
rideshare program	Not implemented	
meatless Mondays	Not implemented	
green office program	?	

Table 13: Project status for reduction of scope 3 emissions.

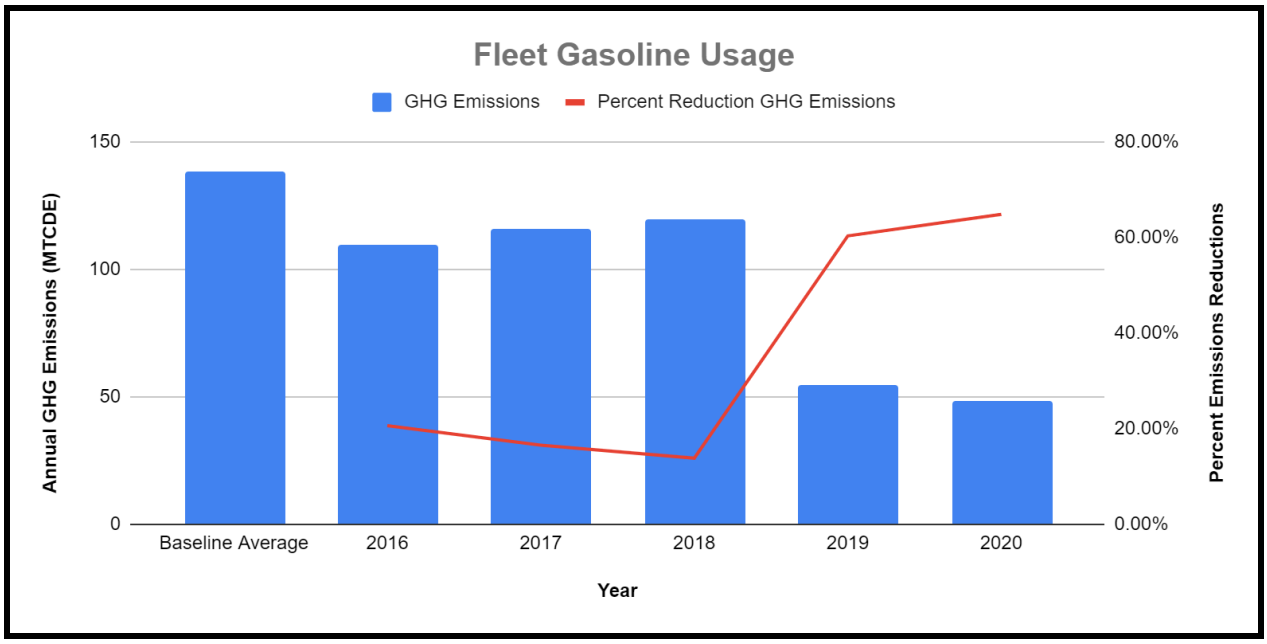
Projects considered but not implemented in Siemens Performance Contract	
Project Name	Notes
Suter Science Center Heat Recovery Loop	The rooftop units serving SSC are equipped with the necessary coils for a heat recovery system. Siemens investigated the possibility of installing the remaining components required to commission the heat recovery system as operational. The investigated scope of work included installing heat recovery coils in the exhaust air ducts, pipes and pumps to circulate fluid between the supply air and exhaust air energy recovery coils, and all necessary sensors and wiring to connect with the building automation system. This facility improvement measure (FIM) was abandoned once the savings were determined to be insufficient to fund the improvements based on EMU's target project payback criteria.
Campus Wide High Efficiency Motor Replacements	EMU has numerous large-sized electric motors for pumps distributed across campus associated with water source heat pump loops, chiller loops, cooling towers, etc. Many of these motors were observed to be older and less efficient than modern premium efficiency motors. Motors in excess of 3 HP in size were evaluated as potential high efficiency motor upgrade candidates. This FIM was abandoned once the age and run hours associated with the motors were determined to be insufficient to represent significant savings.
Library/Suter/Lehman Chilled Water Expansion (TES)	EMU indicated an interest in evaluating the feasibility of utilizing thermal energy storage at Lehman Auditorium, as a measure for reducing peak Demand. Thermal Energy Storage (TES) systems operate as a measure by shifting electric Demand associated with cooling to "off-peak" hours by creating chilled water (or ice) that can be used during the day. This FIM was

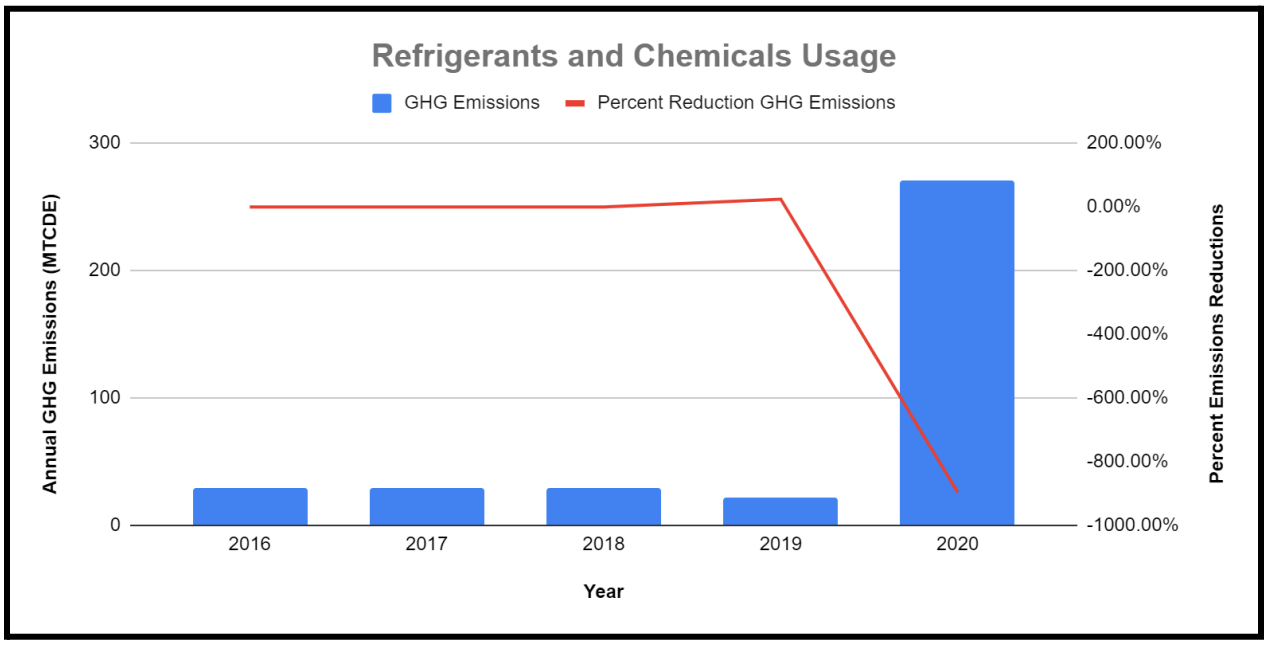
	abandoned once Siemens determined that EMU's Demand was not reliability driven by the cooling season, and thus the cost of adding the equipment and infrastructure was in excess of the potential for Demand reduction-savings.
Campus Wide Air Separator Replacement	Air and dirt separators are installed on nearly all pumping systems. Some companies produce separators that do a better job at removing bubbles from the system than others. Reducing the entrained air in the system can increase system efficiency by increasing fluid heat transfer rates and decreasing pump power requirements. This FIM was abandoned once the savings for which Siemens was prepared to guarantee were determined to be insufficient to fund the new equipment based on EMU's project payback criteria.
Northlawn Freezer Energy Recovery	Northlawn has a combination of freezers, refrigerators, and ice makers. This equipment requires the use of condensers to reject heat to the outdoors. Energy recovery devices exist which can redirect the waste heat into processes that require heat such as the domestic hot water system. This FIM was abandoned once Siemens determined that the amount of recoverable water heating energy did not represent savings sufficient to meet FIM payback targets, and the scope of work associated with providing sufficient room for the tanks over-inflated the cost of implementation.
Lehman Auditorium Windows Upgrades	EMU shared an interest in replacing some windows on the bottom floor of Lehman Auditorium for the purpose of addressing comfort concems. While the existing windows are quite old and drafty, the FIM was abandoned once it was determined to not represent significant value as an energy conservation measure.
Campus Wide Transformer Replacements	Most buildings require transformers to "step-down" high voltage power from the grid to a voltage which is acceptable for distribution throughout the buildings. All transformers lose energy to heat during this conversion process. A new generation of ultra-efficient transformers reduces the losses by more than one haif. This FIM was abandoned after determining that the savings were insufficient to pay for the new transformers.
Suter Science Center	Autoclaves represent significant energy consumption as part of normal operation. The existing autoclave located in SSC is turned off from 11:00pm

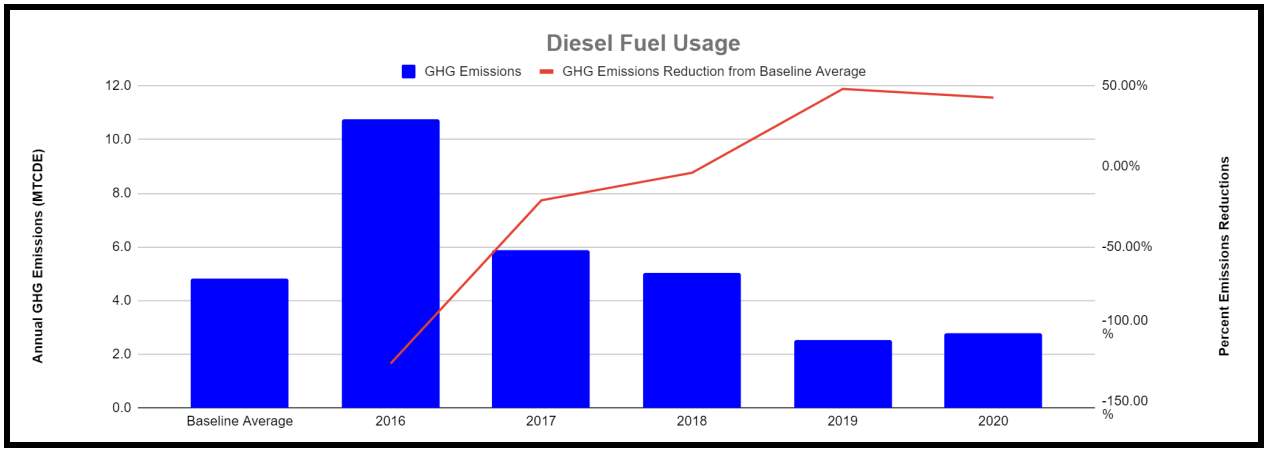
Autoclave Optimization	to 6:00am; otherwise the unit operates in standby mode maintaining operational readiness. Standby mode continues to consume thousands of units of energy per year. By operating the equipment in a way that minimizes standby operation to specific times, meaningful savings can be achieved. According to the manufacturer, even if the machine needs to be started from the off position, it only takes several minutes to achieve readiness. It was determined that scheduling the unit to turn off when not in use instead of remaining in standby represents 9,700 kWh in savings per year, without risk of negative affect from increased thermal cycling (verified by the manufacturer, R-V Industries*).* This FIM still represents savings and should be taken into EMU consideration. It was abandoned as part of this project because Siemens could not contractually guarantee that the equipment life would not be affected without formal documentation by the manufacturer (which they could not provide).
Campus Wide NG Procurement	Siemens has internal resources that specialize in procuring the best commodity prices for its customers. They evaluated the potential for changing procurement providers, but determined that Stand Energy Corporation currently procures EMU's natural gas at a competitive rate.
Parkwood Apartments Unit Replacement	The heat pump units serving Parkwood Apartments are nearing the end of their useful life and will need to be replaced soon. These units are approximately 30 years old and some have already begun to fail. Siemens evaluated the potential for replacing both the indoor and outdoor units with modern equipment. This FIM was abandoned based on high implementation cost with relatively low potential savings.

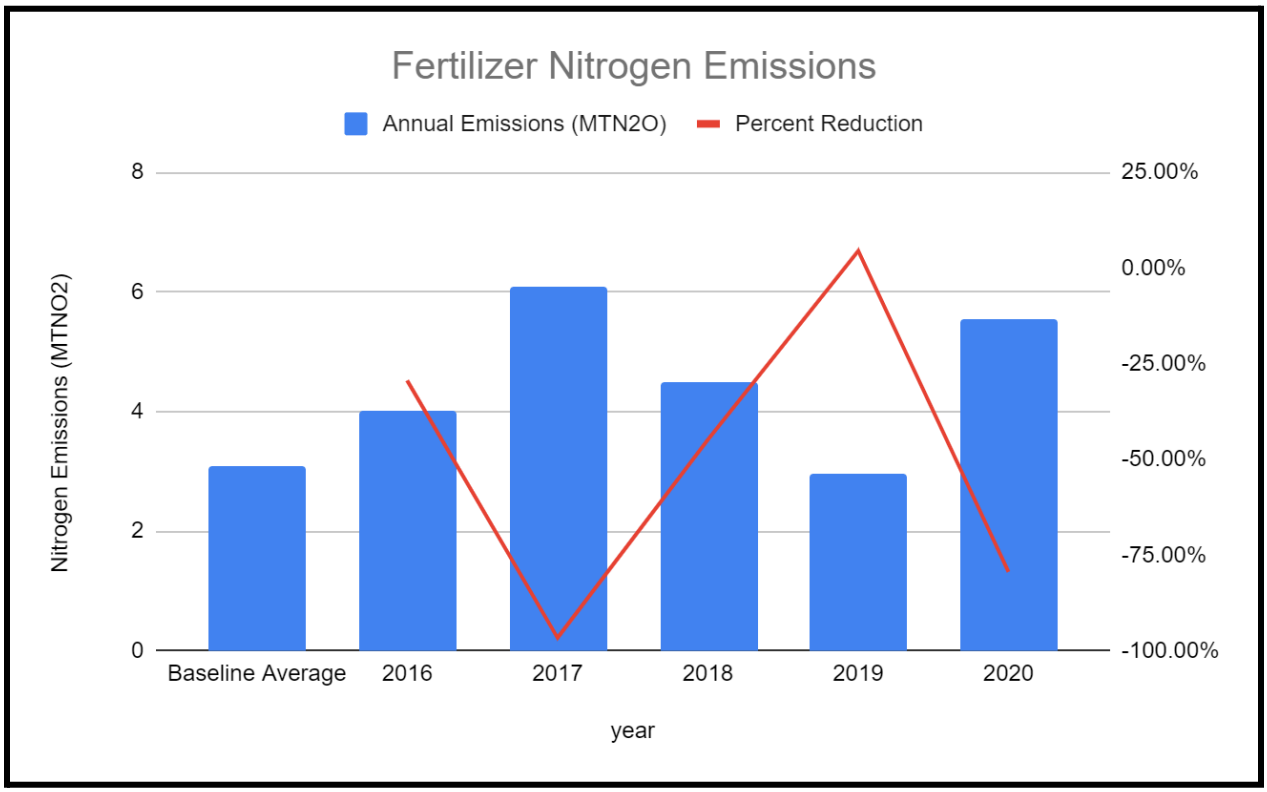
Table 14: Project considered but not included in Siemens 2016 performance contract.

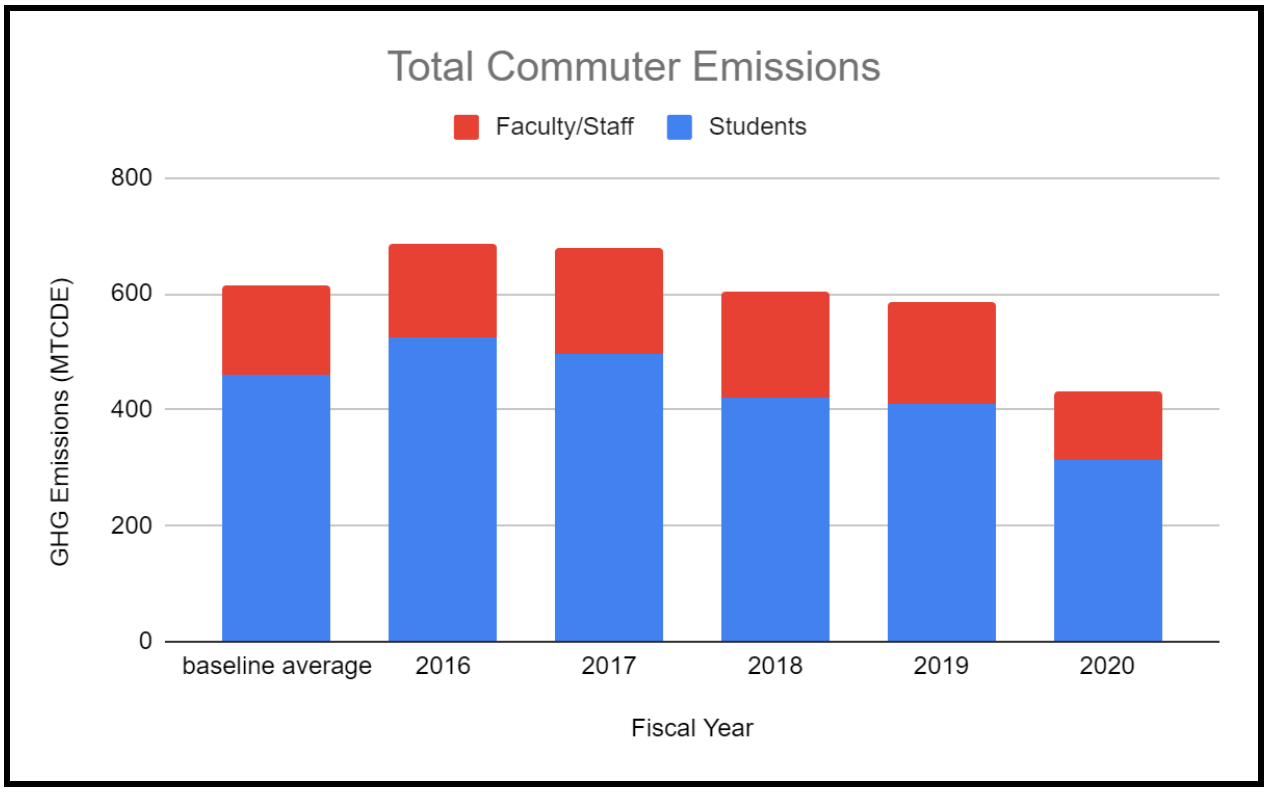
Appendix 3 - Additional Graphs and Charts

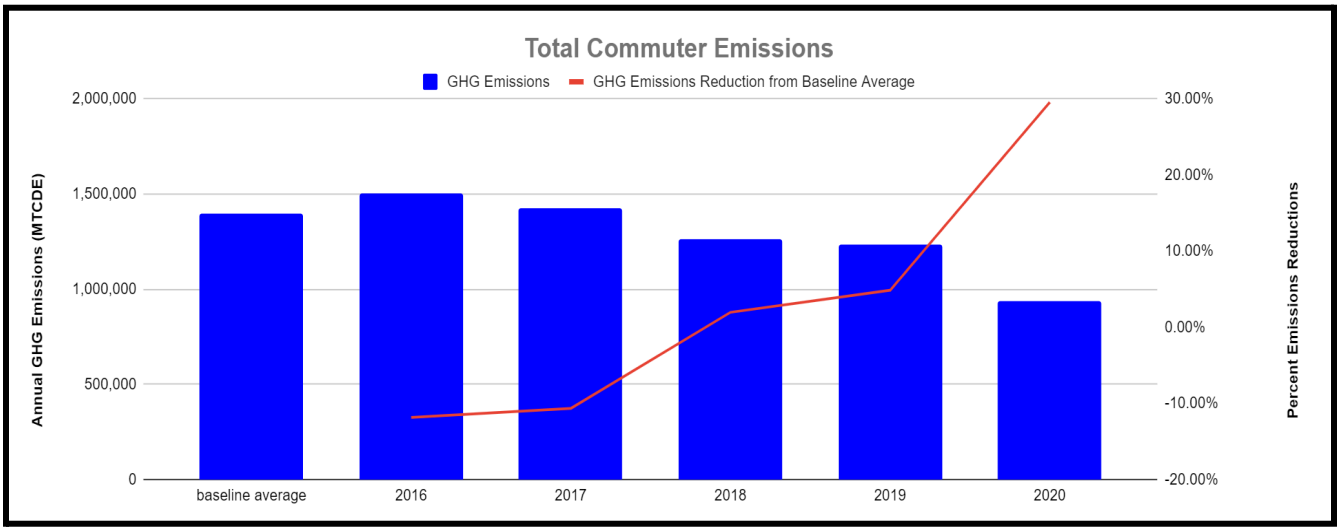

Fleet Gasoline Usage
GHG Emissions
Percent Reduction GHG Emissions
150
100
50
0
80.00%
60.00%
40.00%
20.00%
0.00%
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
Baseline Average
2016
2017
2018
2019
2020
Year

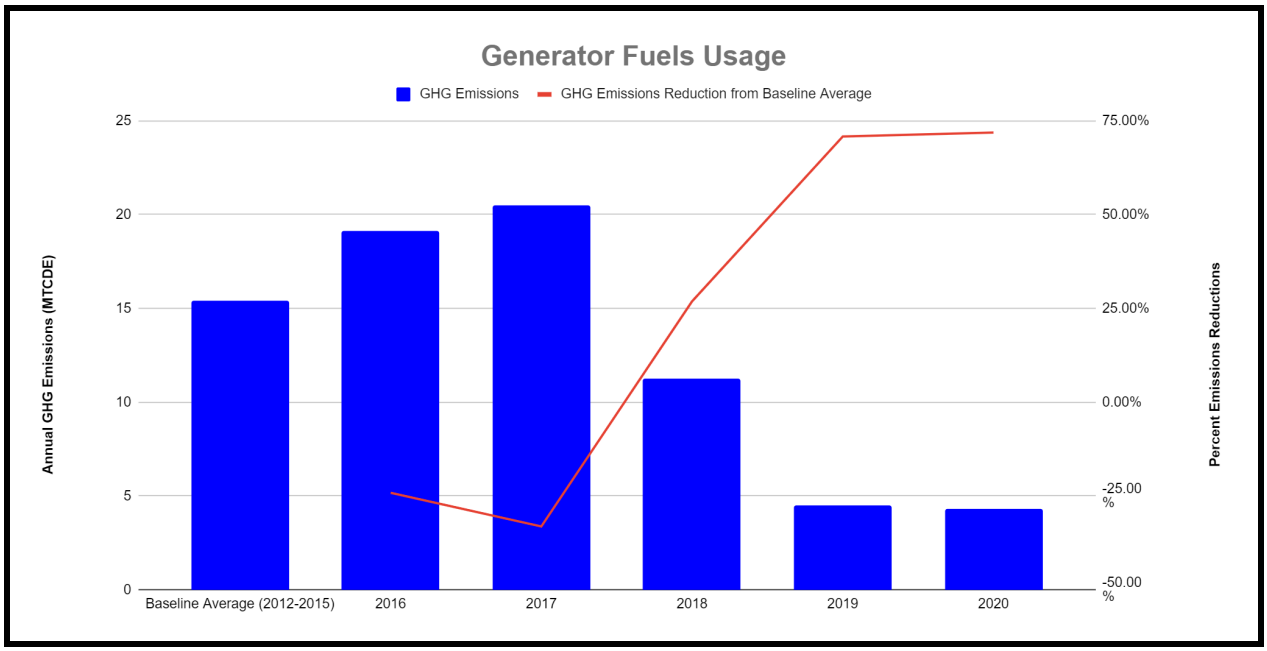

Refrigerants and Chemicals Usage
GHG Emissions
Percent Reduction GHG Emissions
300
200
100
0
200.00%
0.00%
-200.00%
-400.00%
-600.00%
-800.00%
-1000.00%
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
2016
2017
2018
2019
2020
Year

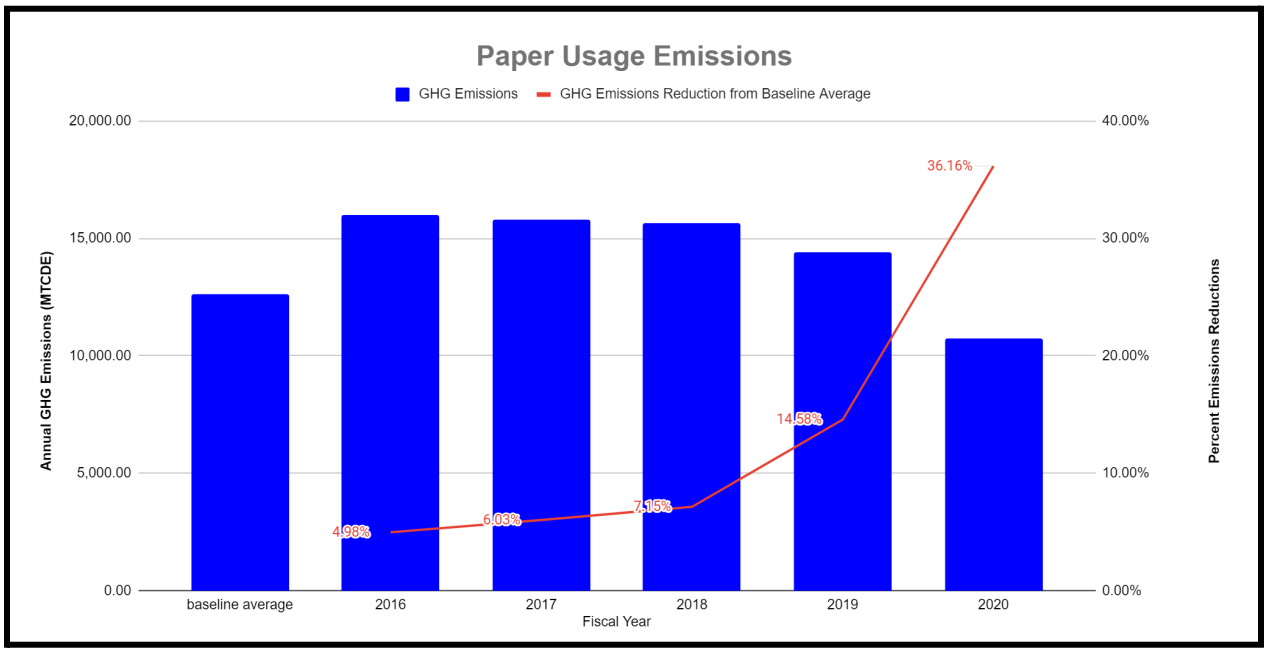

Diesel Fuel Usage
GHG Emissions
GHG Emissions Reduction from Baseline Average
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
12.0
10.0
8.0
6.0
4.0
2.0
0.0
50.00%
0.00%
-50.00%
-100.00 %
-150.00 %
Baseline Average
2016
2017
2018
2019
2020

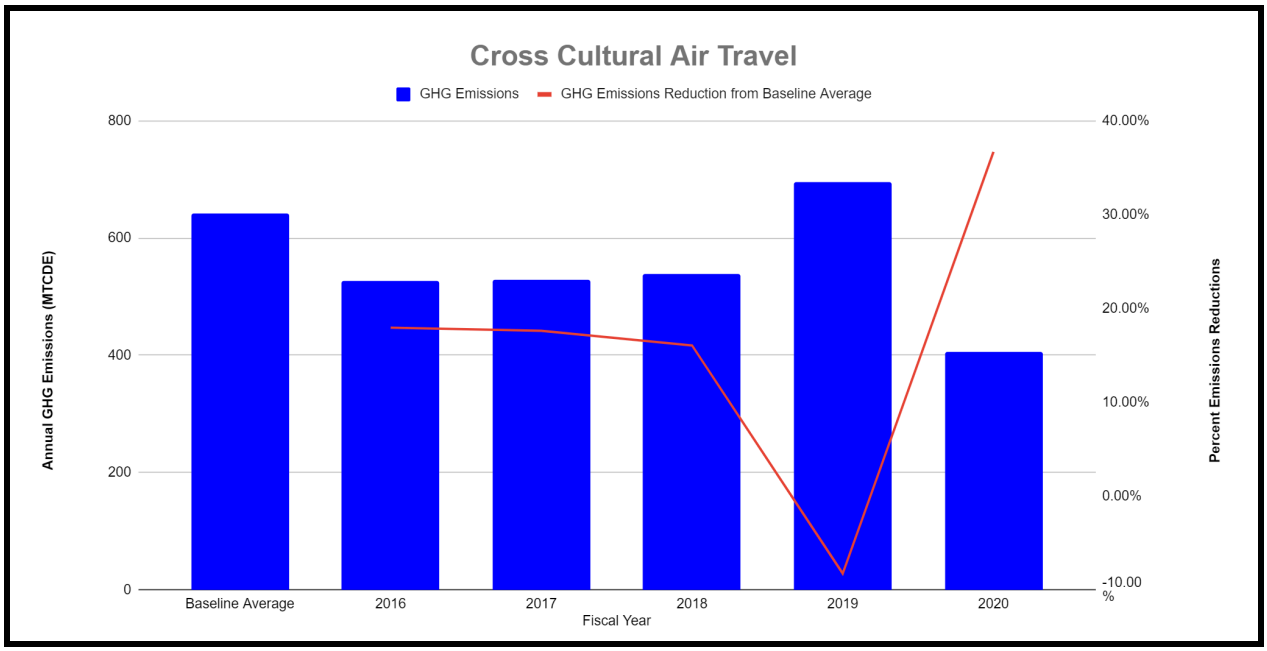

Fertilizer Nitrogen Emissions
Annual Emissions (MTN2O)
Percent Reduction
Nitrogen Emissions (MTNO2)
8
6
4
2
0
25.00%
0.00%
-25.00%
-50.00%
-75.00%
-100.00%
Baseline Average
2016
2017
2018
2019
2020
year

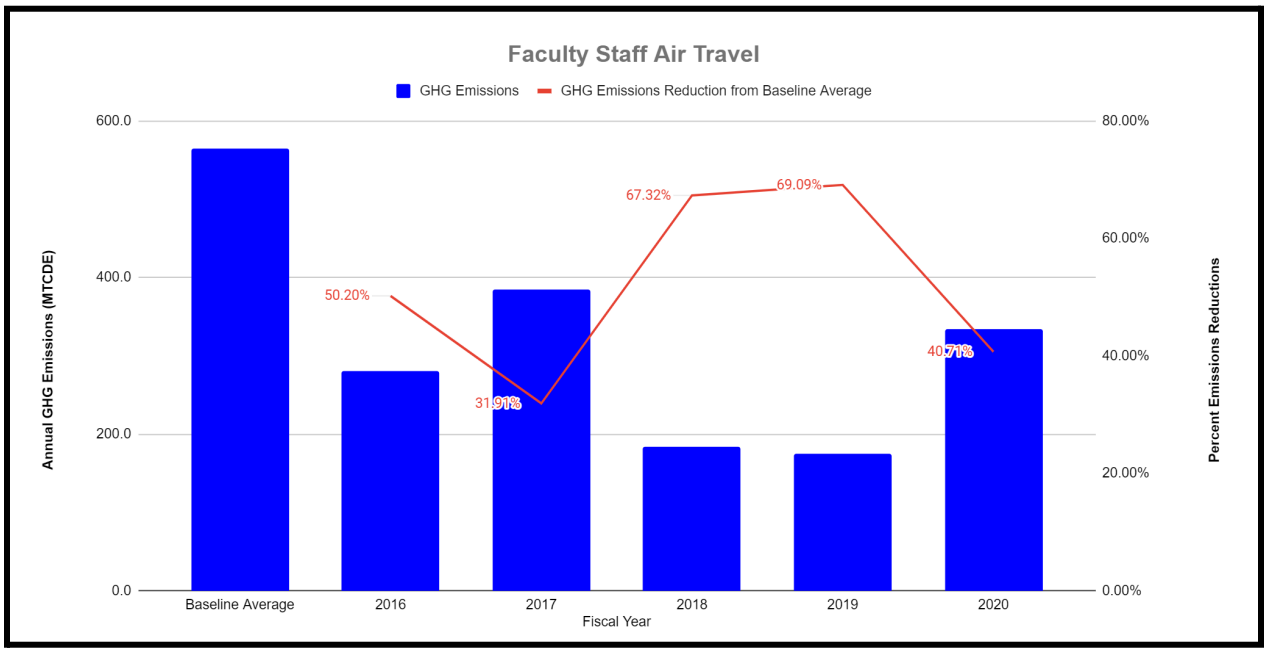

Total Commuter Emissions
Faculty/Staff
Students
800
600
400
200
0
GHG Emissions (MTCDE)
baseline average
2016
2017
2018
2019
2020
Fiscal Year

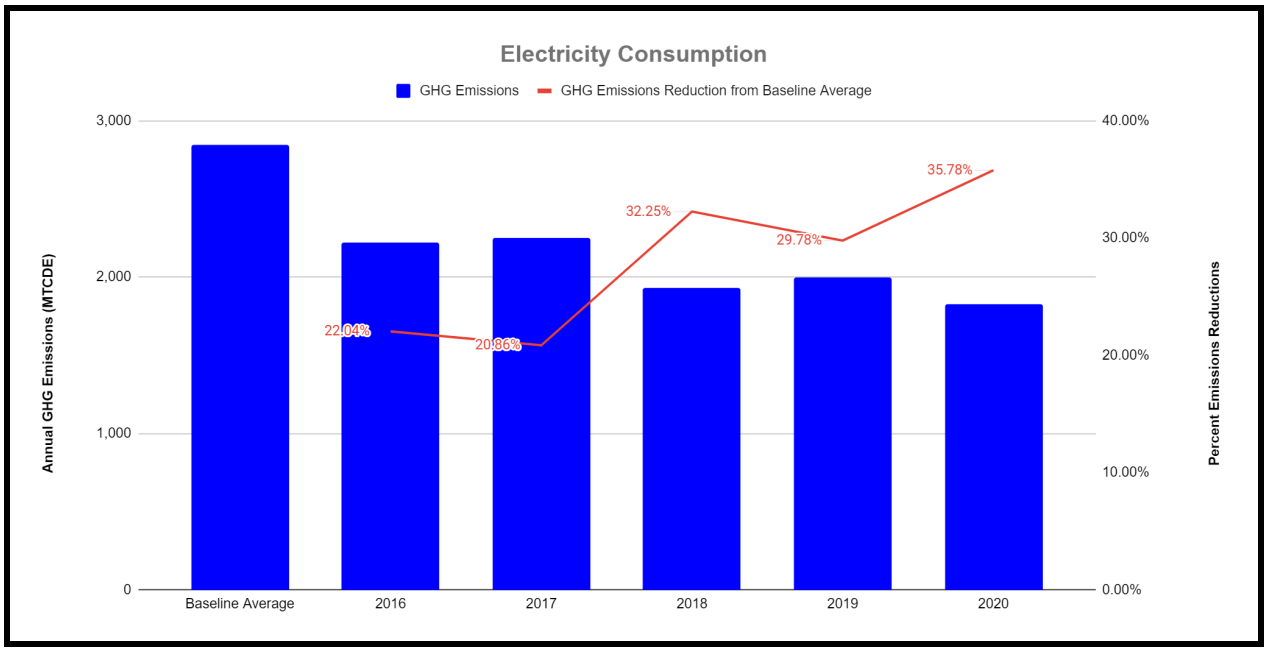

Total Commuter Emissions
GHG Emissions
GHG Emissions Reduction from Baseline Average
2,000,000
1,500,000
1,000,000
500,000
0
Annual GHG Emissions (MTCDE)
30.00%
20.00%
10.00%
0.00%
-10.00%
-20.00%
Percent Emissions Reductions
baseline average
2016
2017
2018
2019
2020

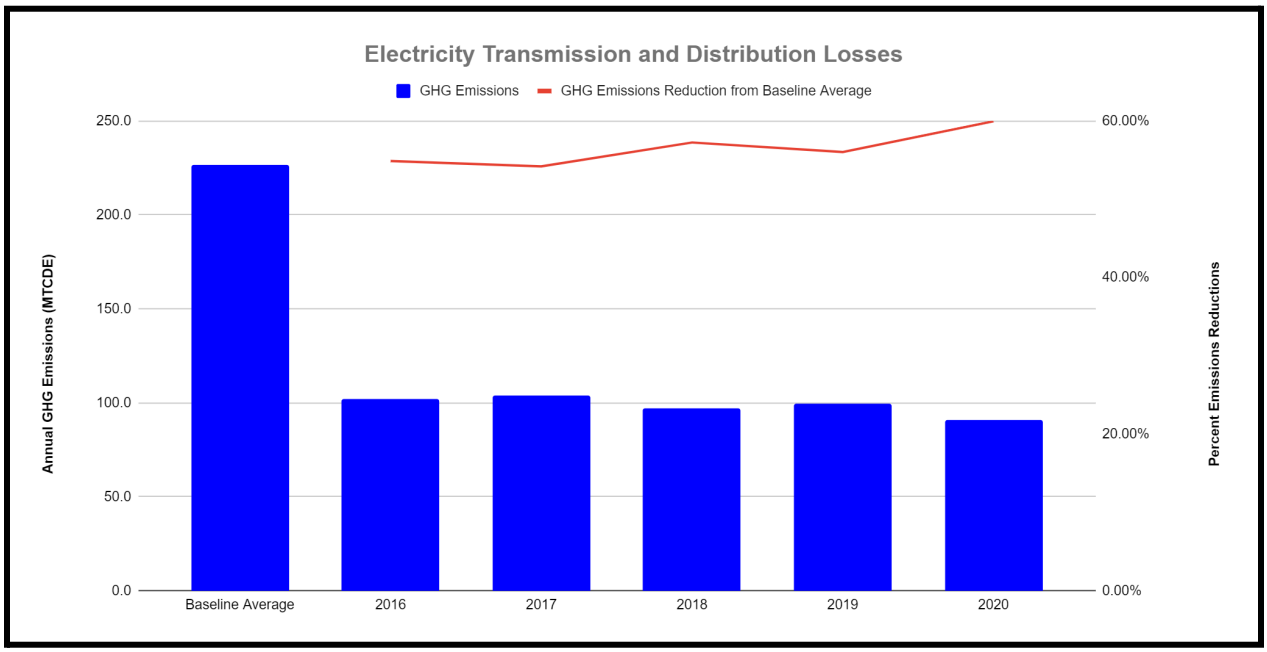

Generator Fuels Usage
GHG Emissions
GHG Emissions Reduction from Baseline Average
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
25
20
15
10
5
0
75.00%
50.00%
25.00%
0.00%
-25.00 %
-50.00 %
Baseline Average (2012-2015)
2016
2017
2018
2019
2020

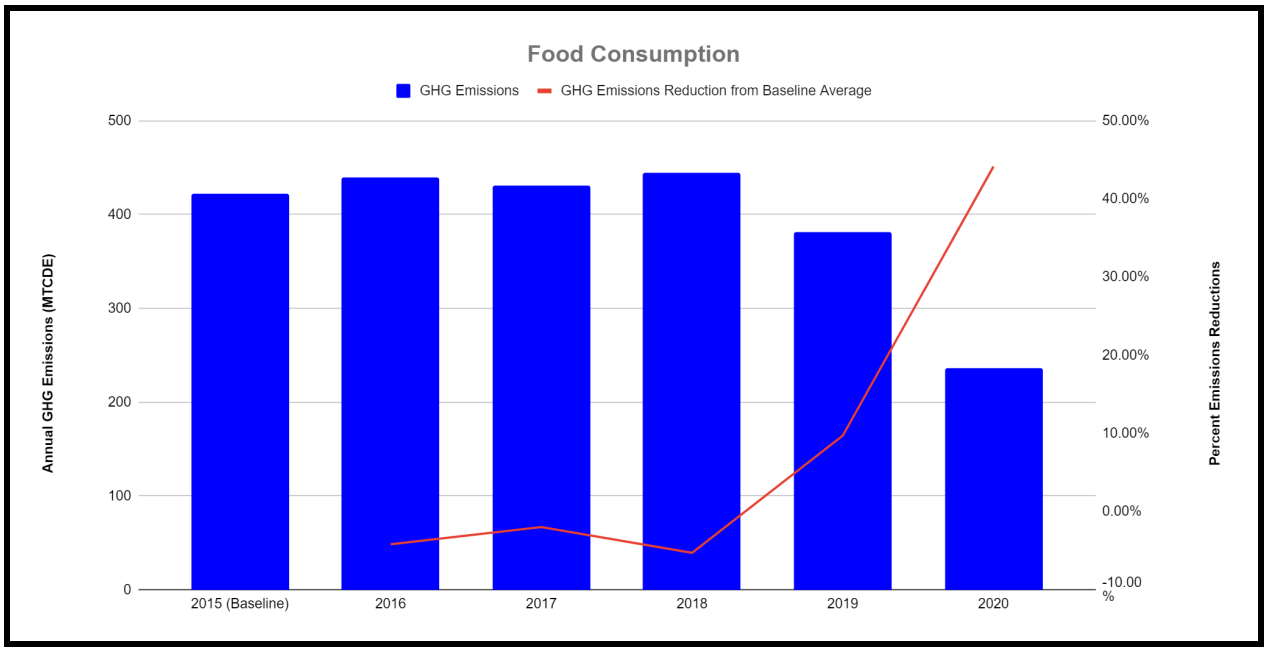

Paper Usage Emissions
GHG Emissions
GHG Emissions Reduction from Baseline Average
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
20,000.00
15,000.00
10,000.00
5,000.00
0.00
40.00%
30.00%
20.00%
10.00%
0.00%
4.98%
6.03%
7.15%
14.58%
36.16%
baseline average
2016
2017
2018
2019
2020
Fiscal Year

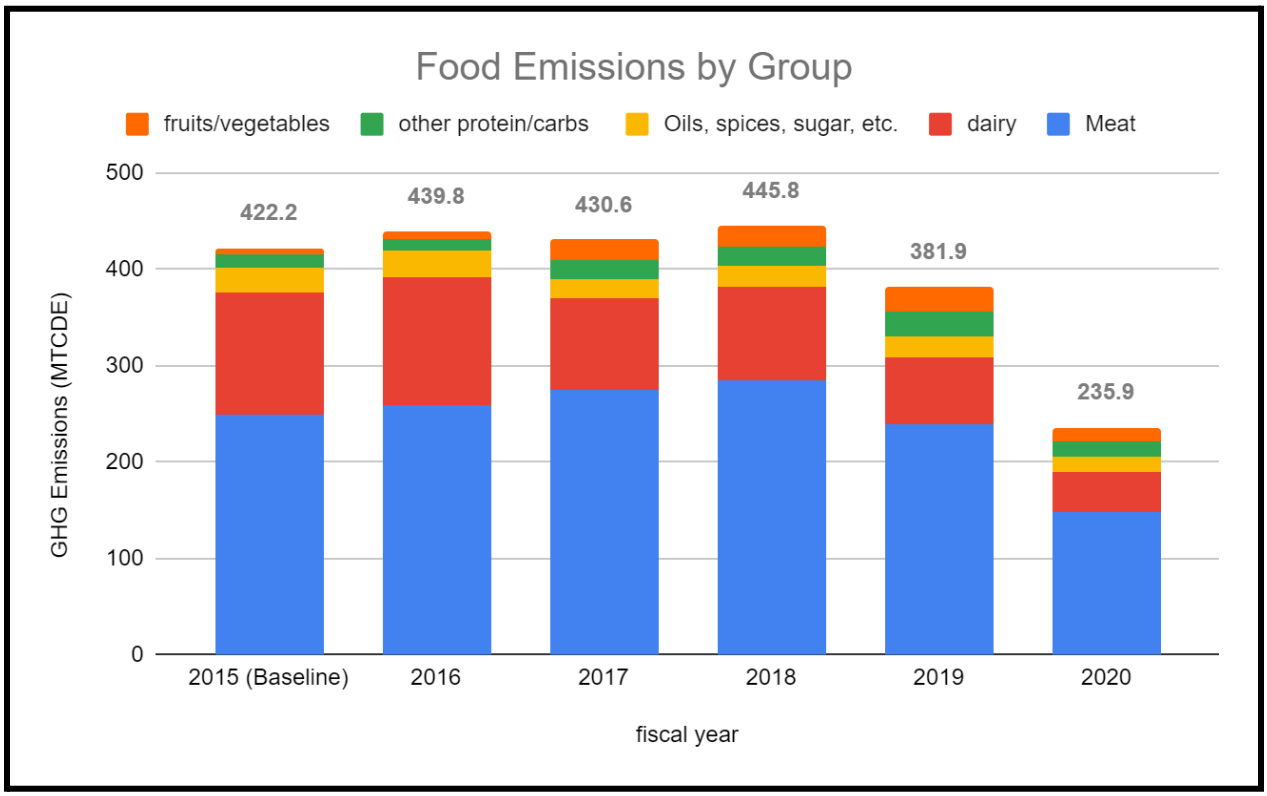

Cross Cultural Air Travel
GHG Emissions
GHG Emissions Reduction from Baseline Average
800
600
400
200
0
40.00%
30.00%
20.00%
10.00%
0.00%
-10.00 %
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
Baseline Average
2016
2017
2018
2019
2020
Fiscal Year

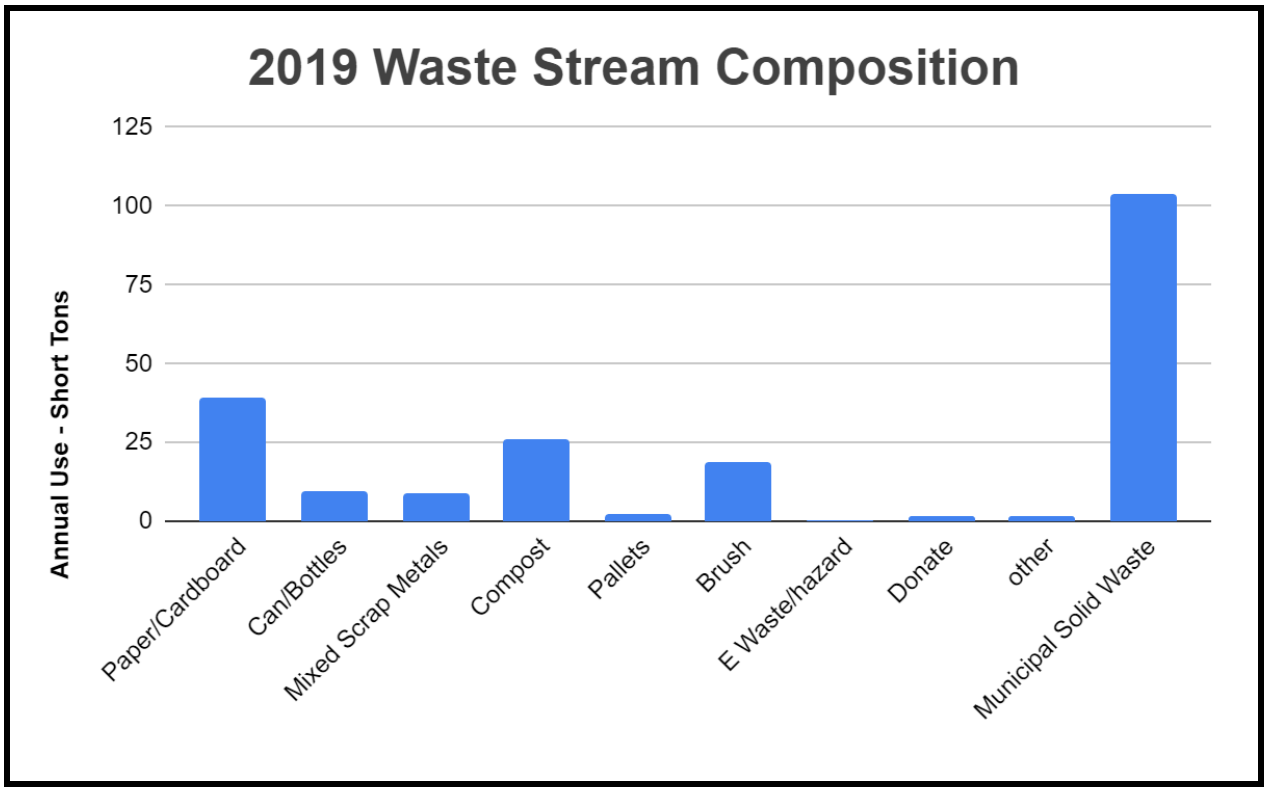

Faculty Staff Air Travel
GHG Emissions
GHG Emissions Reduction from Baseline Average
600.0
400.0
200.0
0.0
80.00%
60.00%
40.00%
20.00%
0.00%
50.20%
31.91%
67.32%
69.09%
40.71%
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
Baseline Average
2016
2017
2018
2019
2020
Fiscal Year

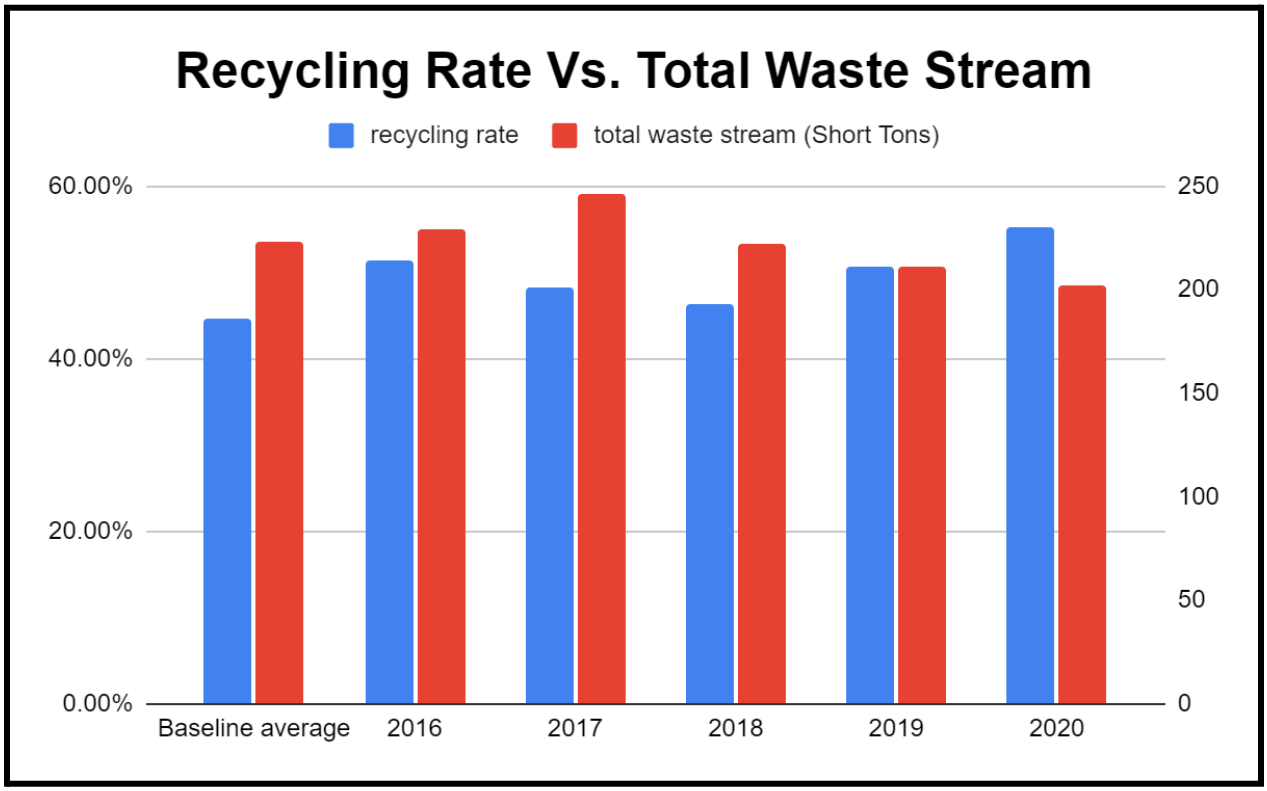

Electricity Consumption
GHG Emissions
GHG Emissions Reduction from Baseline Average
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
3,000
2,000
1,000
0
40.00%
30.00%
20.00%
10.00%
0.00%
22.04%
20.86%
32.25%
29.78%
35.78%
Baseline Average
2016
2017
2018
2019
2020

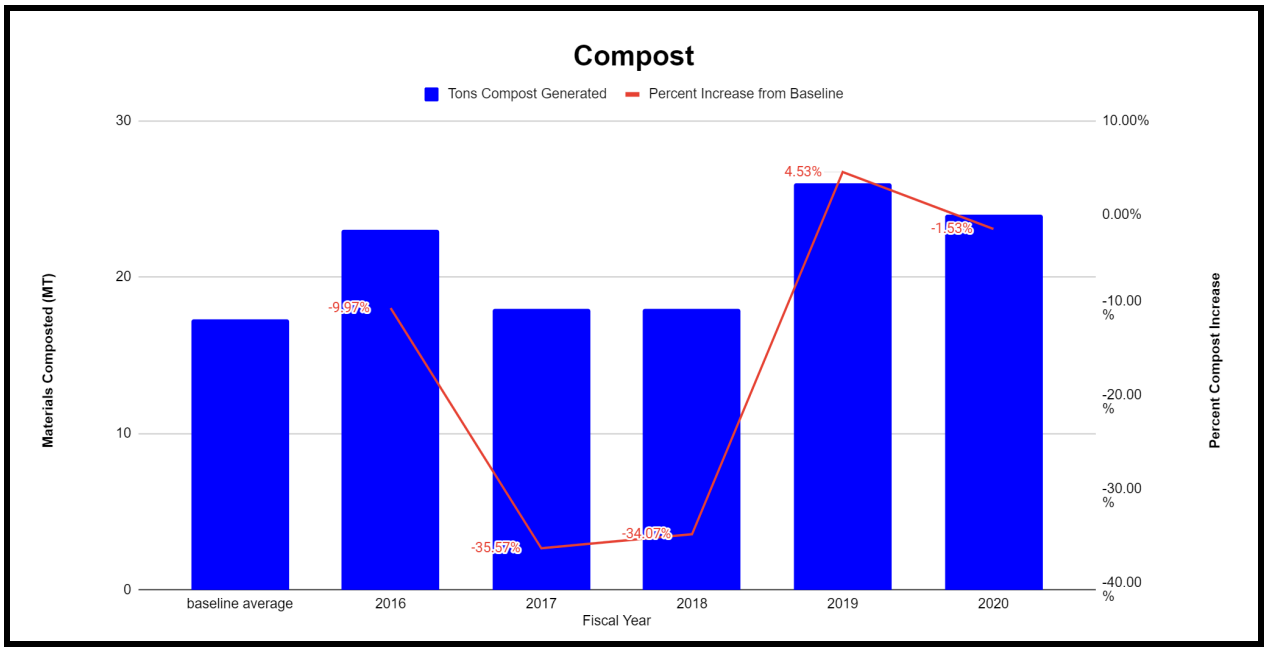

Electricity Transmission and Distribution Losses
GHG Emissions
GHG Emissions Reduction from Baseline Average
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
250.0
200.0
150.0
100.0
50.0
0.0
60.00%
40.00%
20.00%
0.00%
Baseline Average
2016
2017
2018
2019
2020

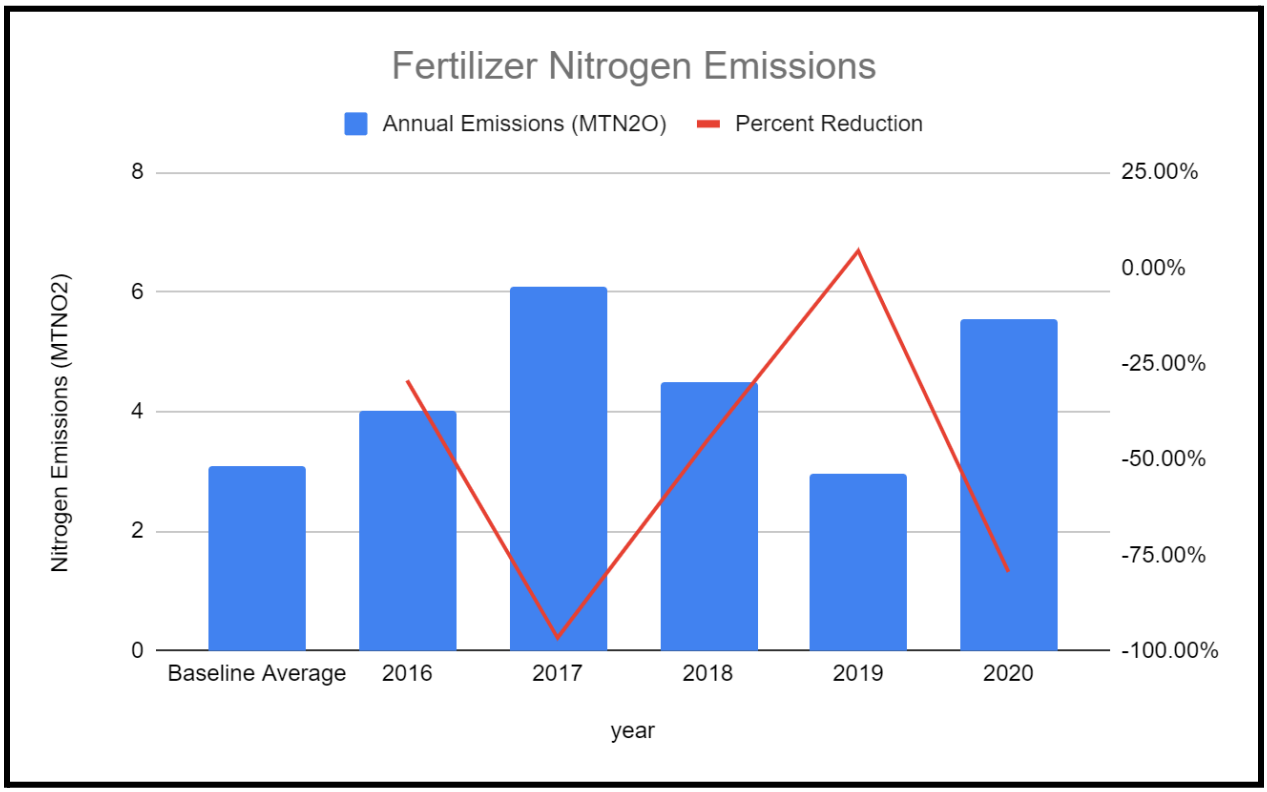

Food Consumption
GHG Emissions
GHG Emissions Reduction from Baseline Average
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
500
400
300
200
100
0
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
-10.00 %
2015 (Baseline)
2016
2017
2018
2019
2020

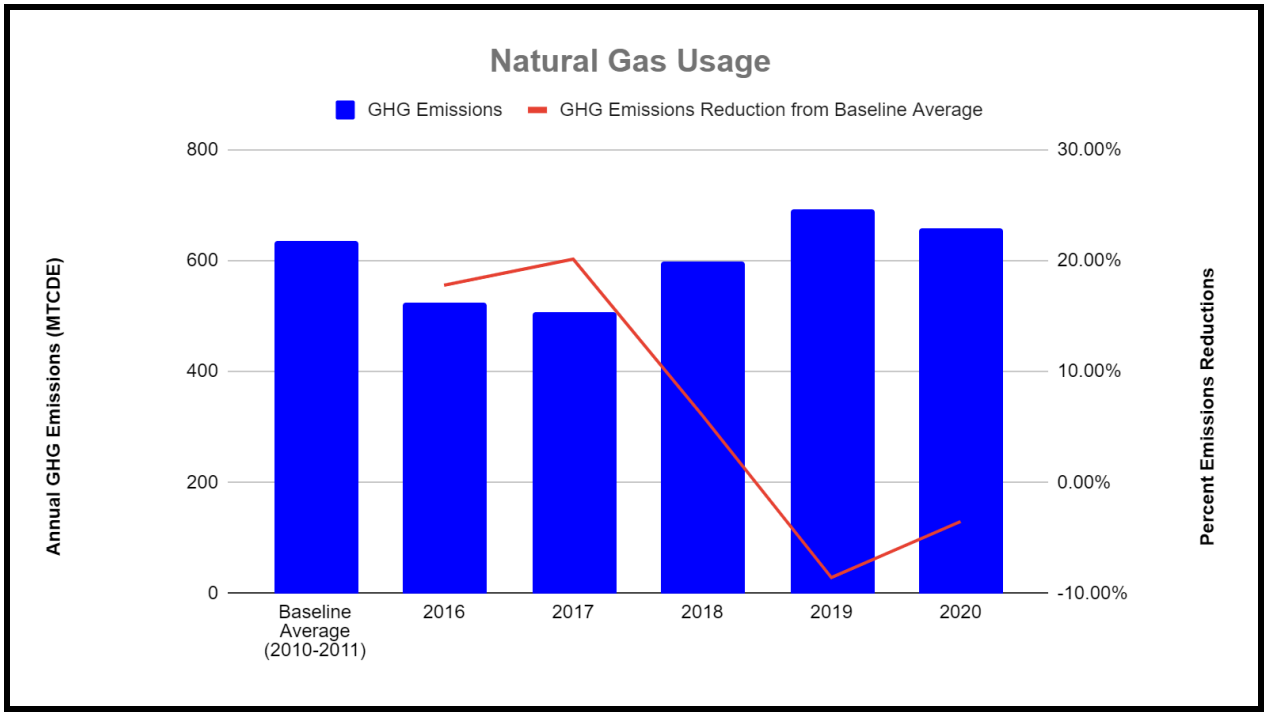

Food Emissions by Group
fruits/vegetables
other protein/carbs
Oils, spices, sugar, etc.
dairy
Meat
GHG Emissions (MTCDE)
500
400
300
200
100
0
422.2
439.8
430.6
445.8
381.9
235.9
2015 (Baseline)
2016
2017
2018
2019
2020
fiscal year

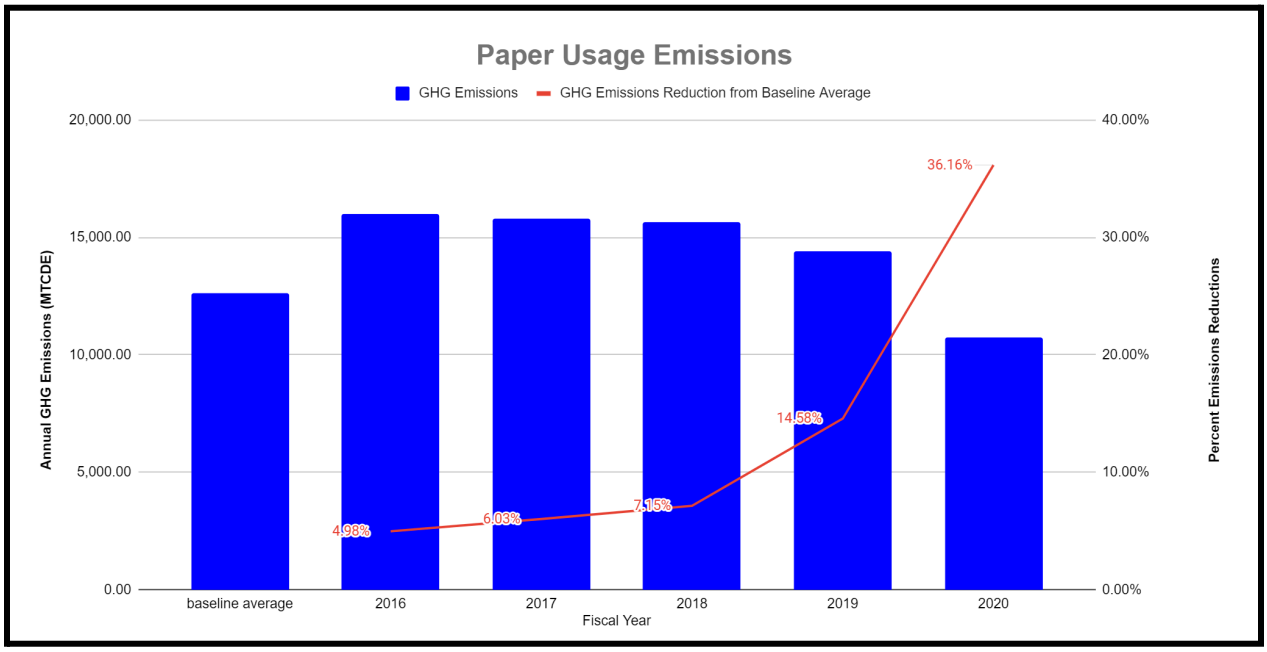

2019 Waste Stream Composition
Annual Use - Short Tons
125
100
75
50
25
0
Paper/Cardboard
Can/Bottles
Mixed Scrap Metals
Compost
Pallets
Brush
E Waste/hazard
Donate
other
Municipal Solid Waste

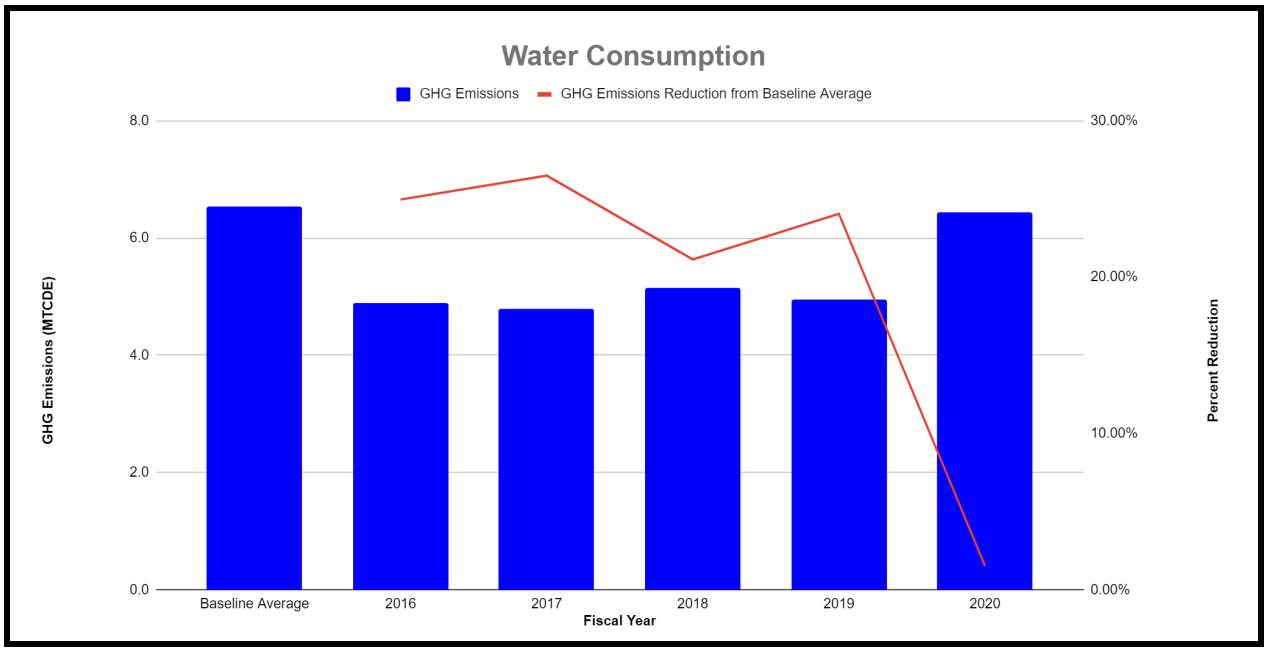

Recycling Rate Vs. Total Waste Stream
recycling rate
total waste stream (Short Tons)
60.00%
40.00%
20.00%
0.00%
250
200
150
100
50
0
Baseline average
2016
2017
2018
2019
2020


Compost
Tons Compost Generated
Percent Increase from Baseline
Materials Composted (MT)
Percent Compost Increase
30
20
10
0
10.00%
0.00%
-10.00 %
-20.00 %
-30.00 %
-40.00 %
-9.97%
-35.57%
-34.07%
4.53%
-1.53%
baseline average
2016
2017
2018
2019
2020
Fiscal Year


Fertilizer Nitrogen Emissions
Annual Emissions (MTN2O)
Percent Reduction
Nitrogen Emissions (MTNO2)
8
6
4
2
0
25.00%
0.00%
-25.00%
-50.00%
-75.00%
-100.00%
Baseline Average
2016
2017
2018
2019
2020
year


Natural Gas Usage
GHG Emissions
GHG Emissions Reduction from Baseline Average
800
600
400
200
0
30.00%
20.00%
10.00%
0.00%
-10.00%
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
Baseline Average (2010-2011)
2016
2017
2018
2019
2020


Paper Usage Emissions
GHG Emissions
GHG Emissions Reduction from Baseline Average
20,000.00
15,000.00
10,000.00
5,000.00
0.00
40.00%
30.00%
20.00%
10.00%
0.00%
Annual GHG Emissions (MTCDE)
Percent Emissions Reductions
4.98%
6.03%
7.15%
14.98%
36.16%
baseline average
2016
2017
2018
2019
2020
Fiscal Year


Water Consumption
GHG Emissions
GHG Emissions Reduction from Baseline Average
8.0
6.0
4.0
2.0
0.0
30.00%
20.00%
10.00%
0.00%
GHG Emissions (MTCDE)
Percent Reduction
Baseline Average
2016
2017
2018
2019
2020
Fiscal Year