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# University of Delaware

## Greenhouse Gas Inventory for the 2018 – 2019 Academic Year

July 2, 2020

## **Introduction**

The University of Delaware (UD) became a signatory to the Second Nature Presidents' Climate Leadership Commitment (formerly the American College & University Presidents' Climate Commitment - ACUPCC) in 2008. The Presidents' Climate Leadership Commitment is a voluntary program designed to address the "pace and intensity of global climate change and the potential for unprecedented detrimental impacts" by documenting institutional commitments from college and universities to increase awareness around climate change and eliminate net greenhouse gas (GHG) emissions from their own operations. UD, as part of its Presidents' Climate Leadership Commitment requirements, submitted an initial GHG inventory report detailing its carbon emissions for the 2007-2008 academic year in 2009 and, in 2010, filed a Climate Action Plan specifying future emissions reduction targets.

As part of its commitment to Second Nature, and in order to measure progress towards its Climate Action Plan targets, UD works with Siemens to compile greenhouse gas emissions inventory reports annually beginning with the 2011-2012 academic year. Each annual report contains a snapshot of annual emissions and a comparison against the baseline established by the initial 07-08 GHG inventory. This report has been prepared to address UD's commitment to the ACUPCC to submit a GHG emissions inventory for the 2018-2019 academic year. Although University emissions have fallen, these reductions are primarily linked to scope 2 reductions resulting from changes in the power industry and scope 3 reductions. The scope 3 emission reductions are driven primarily by changes in student, faculty, and staff commuting behaviors identified through the 2017 Transportation Survey update.

## **Overview of 2018-2019 GHG Inventory Approach and Results**

Siemens worked with UD personnel to compile the 2018-2019 academic year GHG inventory. The aim of this effort was to replicate the scope and approach of the 2007-2008 GHG inventory and generate a brief, written update for comparison to the 2007-2008 benchmark. This process allows for direct correlations between the two records while measuring the benefits of carbon mitigation actions taken during the intervening ten years.

Direct data records were compiled for building energy use, UD owned fleet vehicles, organic waste outputs, and fertilizer used. Estimates were utilized to assess fuel consumption associated with commuting activities as was required for the 2007-2008 academic year GHG inventory. The Campus Transportation Survey was updated in 2017 and this new information and associated analysis was leveraged to refresh the scope 3 mobile combustion emission models for the 2018-2019 GHG Inventory Report.

Emission factors for the combustion of natural gas, fuel oil, gasoline, diesel fuel, and jet fuel were obtained from the U.S. EPA Mandatory Reporting Rule for Greenhouse Gases (MRR), Table C-1, in keeping with the accounting methodology specified by The Climate Registry's *General Reporting Protocol (GRP)*. This represents a slight departure from the 2007-2008 approach which relied upon emission factors from the U.S. Energy Information Administration (EIA). Another change is that methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) emissions associated with fuel combustion were considered in the 2018-2019 report while only CO<sub>2</sub> emissions were documented in the 2007-2008 report. These modifications are warranted however, because they align UD's GHG accounting approach with current best practices and the resulting difference is less than 1% for all commodities, so this change does not substantially impact the emission totals.

Emission factors for purchased electricity, in keeping with *GRP* methodology, were derived from the U.S. EPA eGRID2018 tables. UD is located within the RFC East Subregion, so the published GHG emission factors representing the fuel mix used in generating electricity in this region were used. This source differs from the one used for the 2007-2008 report, but the eGRID system is a universally accepted source which is regularly updated so, adopting this standard will facilitate future emissions inventory calculations. Scope 3 transmission and distribution losses associated with purchased electricity were calculated based on the loss percentages published in the eGRID2018 for the East region.

Scope 3 GHG emissions from the disposal of mixed waste, food waste, and food composting were calculated using emission factors obtained from the U.S. EPA WARM Model, version 14. This is an updated version of the same source used in the 2007-2008 report.

GHG emissions resulting from usage of nitrogen fertilizer were calculated with an emission factor derived from the U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2001 (April 2003). This is the same value that was used in the 2007-2008 report.

UD emitted a total of 96,156 Metric Tons of CO<sub>2</sub>e from Scope 1 and Scope 2 sources during the 2018-2019 academic year. The largest emission source was purchased electricity, which accounted for 55% of the combined Scope 1 and 2 totals. The other significant source was natural gas, at 40%. The remaining sources were UD's fleet (2%), heating oil (1.5%), and propane and landscaping fertilizer (~0.28% combined).

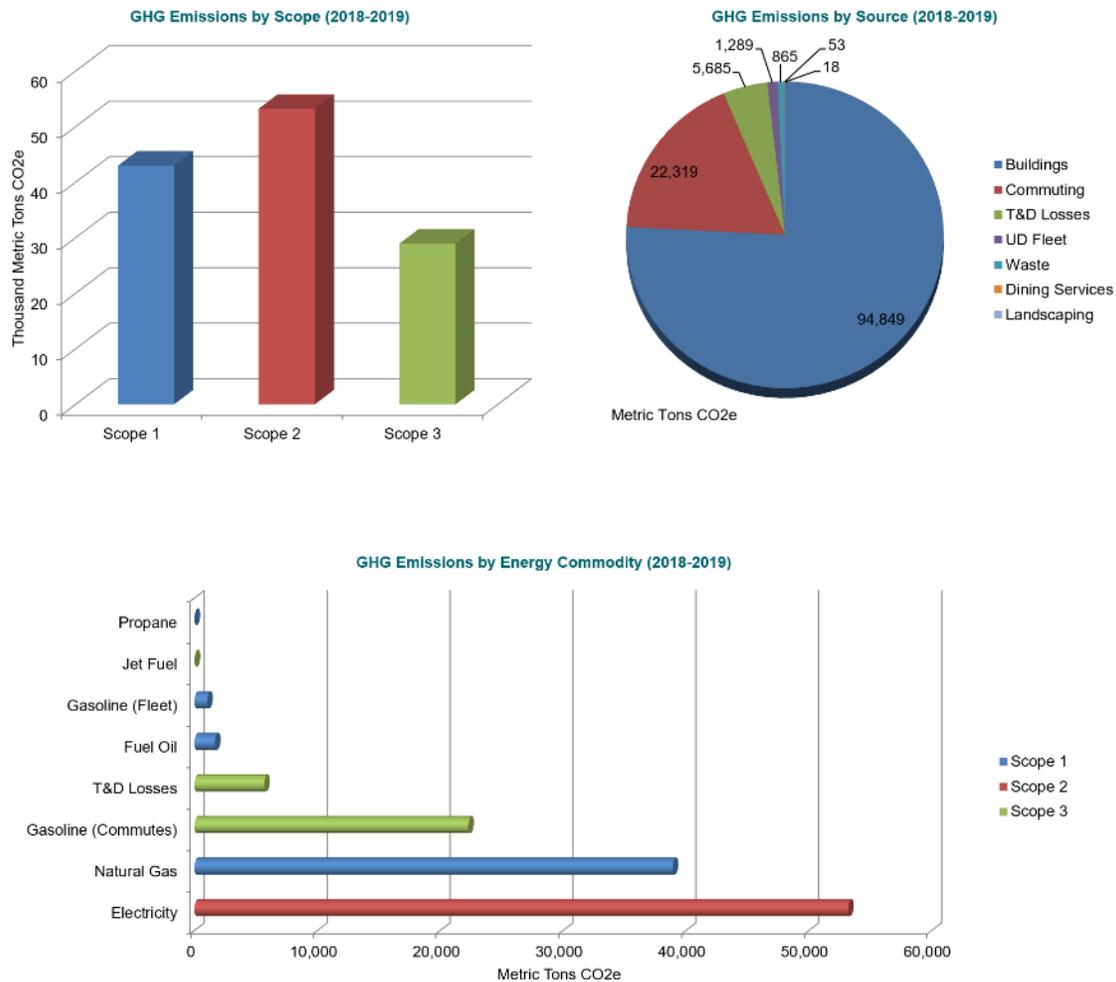
UD's reported Scope 3 emissions totaled 28,922 Metric Tons of CO<sub>2</sub>e. Scope 3 sources included student/staff commuting and trips home (77% of Scope 3 total), electric transmission and distribution losses (20%), municipal solid waste (3%), and air travel from student trips home (less than 0.09%).

Grand total (all scopes) emissions were 125,078 Metric Tons of CO<sub>2</sub>e.

**Table 1: 2018-2019 Total Consumption and GHG Emissions by Source**

Activity	Source	Scope	Consumption	Unit	Emissions (MT CO <sub>2</sub> e)
Natural Gas (combustion)	Buildings	1	712,932	MCF	38,925
Fuel Oil #2 (combustion)	Buildings	1	138,483	gal	1,423
Propane	Buildings	1	3,088	gal	18
Gasoline (transportation)	Fleet	1	148,388	gal	1,303
Diesel Fuel (transportation)	Fleet	1	101,986	gal	1,041
Fertilizer	Landscaping	1	61,945	lb	248
Electricity Purchases	Buildings	2	162,893,345	kWh	53,199
<b>Scope 1 and 2 Total</b>		<b>1 &amp; 2</b>		<b>MT CO<sub>2</sub>e</b>	<b>96,156</b>
Mixed Solid Waste	Buildings	3	2,471	tons	865
Compost/Food Waste	Buildings	3	532	tons	53
Gasoline (commuting)	Non-UD Vehicles	3	2,539,694	gal	22,293
Jet Fuel (air travel)	Non-UD Aircraft		2,510	gal	26
Electricity (T&D Losses)	Power Grid	3	16,445,359	kWh	5,685
<b>Scope 3 Total</b>		<b>3</b>		<b>MT CO<sub>2</sub>e</b>	<b>28,922</b>
<b>All Scopes Total</b>				<b>MT CO<sub>2</sub>e</b>	<b>125,078</b>

**Figure 1: 2018-2019 GHG Emissions Overview**



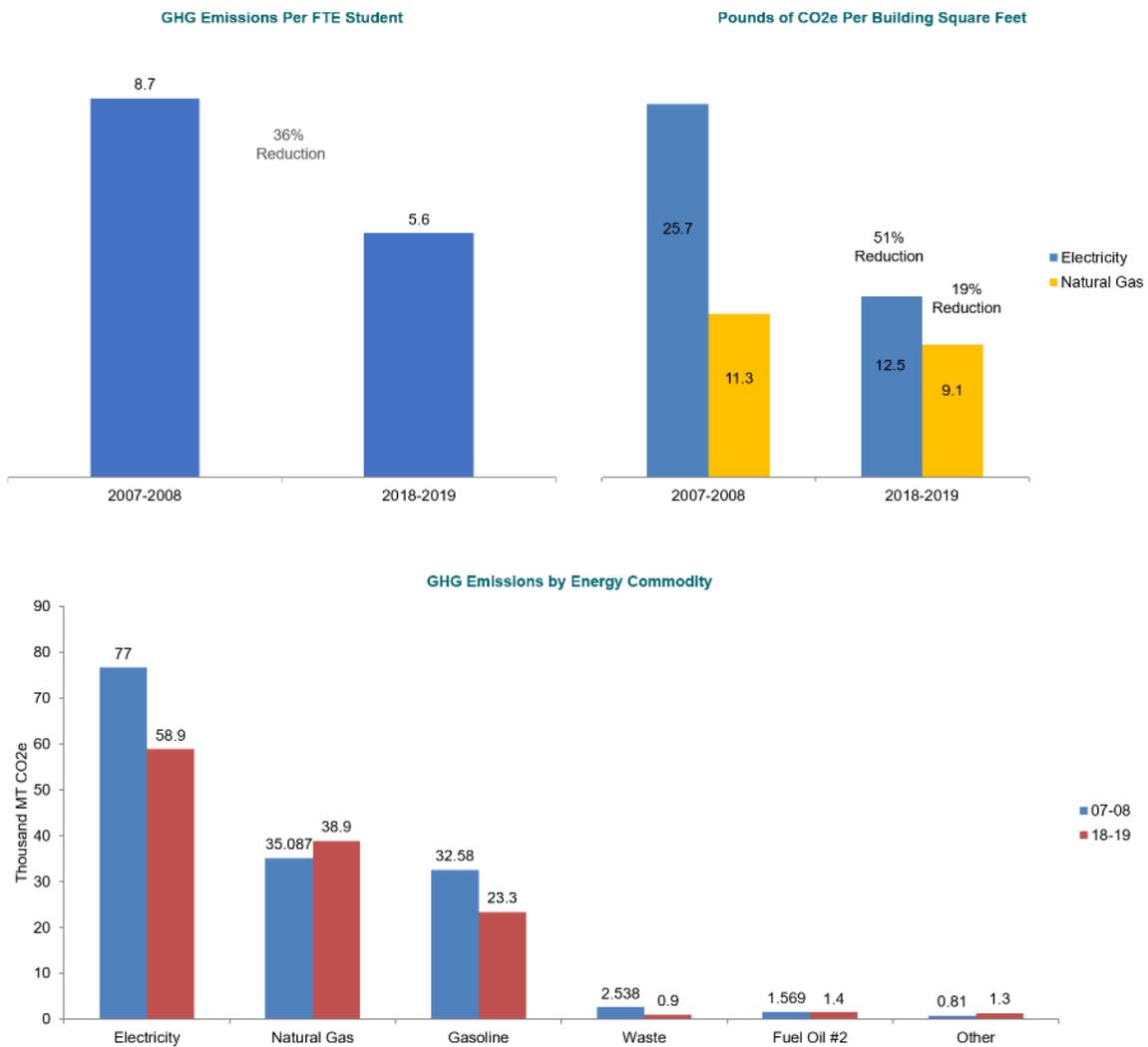
**Comparison of 2018-2019 Results to 2007-2008 Results**

UD’s measured GHG emissions declined from 149,207 MT CO<sub>2</sub>e during the 2007-2008 academic year to 125,078 Metric Tons of CO<sub>2</sub>e during 2018-2019. This GHG emissions reduction of 24,129 MT CO<sub>2</sub>e represents an approximate 16.2% decline.

A net emissions reduction was achieved even though student enrollment at the University increased from 17,631 Full-Time Equivalents (FTE) in 2007-2008 to 22168 FTEs in 2018-2019. In 2007-2008, 8.7 MTCO<sub>2</sub>e were emitted for each FTE student. In 2018-2019 that ratio dropped to 5.6 MTCO<sub>2</sub>e per FTE student, a decrease of 36%.

Newark Campus’s aggregate building area also increased from 6,863,991 square feet in 2007-2008 to 9,391,978 square feet in 2018-2019. However, efficiencies caused the GHG emissions rate per building square foot to outpace this facility growth and emissions intensity fell by 51% for electricity (from 25.7 lbs. CO<sub>2</sub>e per square foot to 12.5) and fell by 19% for natural gas (11.3 to 9.1 lbs. CO<sub>2</sub>e per square foot). These results are summarized in Figure 2.

**Figure 2: 2007-2008 v 2018-2019 GHG Emissions Comparisons**



**Notes:**

- 1 - "Electricity" includes emissions from both consumption (Scope 2) and T&D losses (Scope 3)
- 2 - "Gasoline" includes emissions from both UD fleet (Scope 1) and student/staff commuting (Scope 3)
- 3 - "Other" category includes emissions from fleet diesel fuel and nitrogen fertilizer (Scope 1) and jet fuel (Scope 3)

**Student/Staff Commuting and Trips Home**

UD conducted an initial transportation survey in 2012 with an addendum in 2013 and, in 2017, this survey was updated. Based on the results from the updated survey, it was estimated that for the 2018-2019 academic year students and staff consumed approximately 2.5 million gallons of gasoline and a share of 2.5 thousand gallons of jet fuel during daily commutes and trips home to permanent residences. This equates to 22,319 metric tons CO<sub>2</sub>e, which is down 27% from the 2008 total of 30,609 metric tons.

### **Mixed Solid Waste/Composting**

UD compiles data annually on quantity of mixed solid waste generated and wasted diverted to a digester project. Mixed Solid Waste generation has declined from 2,937 short tons in 2008 to 2,471 short tons in 2018-2019. 506 short tons of compost were generated in 2008 (532 in 2018.) UD now leverages an aerobic digester to process organic waste. Combined GHG emissions from these sources during this period have declined from 1,301 Metric Tons CO<sub>2</sub>e to 918 (~29% decrease.)

### **Electricity Transmission and Distribution Losses**

As electricity is transmitted from the power plant to the final consumer, a portion is lost along the way. This means that, in order to generate a kilowatt-hour of electricity for the end user, slightly more than a kilowatt-hour must be produced by the power plant. Most published electricity emission factors, like those from eGRID, are based on generated, rather than delivered electricity.

In previous annual inventories (though not originally in the base year) UD reported the emissions from grid losses as part of its Scope 3 total. This was calculated based on the eGRID RFC East subregion GHG emission factor and the eGRID East Region grid loss %.

While electricity consumption has increased 18.1% from 2008 to 2018, the grid emissions factor has decreased by ~45% and grid losses have decreased from 6.47 % to 4.97 %. As a result, estimated scope 3 emissions from transmission and distribution losses have increased slightly from 4,958 metric in 2008 to 5,685 metric tons in 2018.

### **Comparison Against Climate Action Plan**

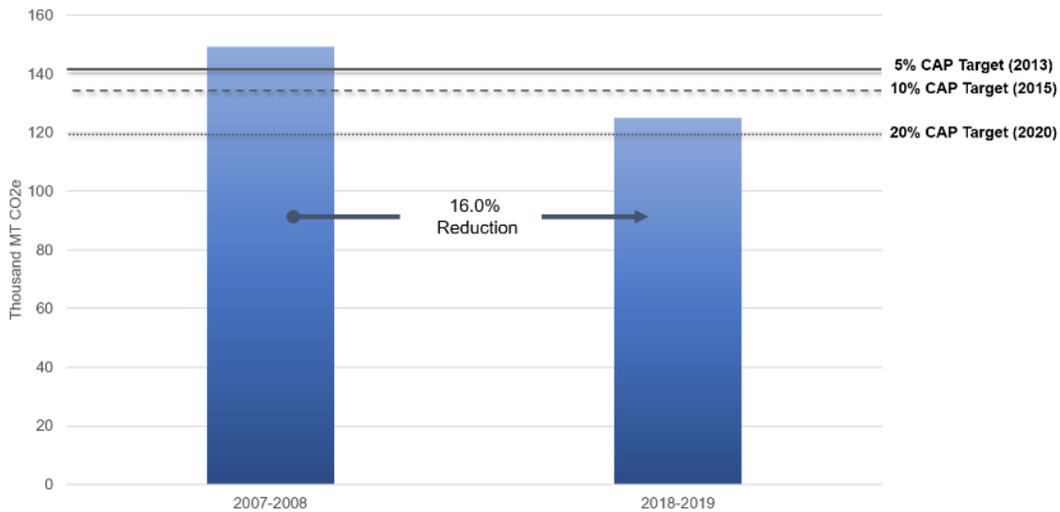
UD, as part of the ACUPCC Climate Action Plan, adopted emission reduction target milestones to be achieved by 2013 (a 5% reduction target from 2007-2008), 2015 (10%), and 2020 (20%).

The results of the 2018-2019 GHG inventory report demonstrate that the UD emission totals are below the 2013 and 2015 reduction targets (5% and 10%, respectively). Presently, with an estimated 16% reduction from the baseline, the 2018-2019 academic year emissions remain above the 2020 20% GHG reduction target.

It is important to note that largest component of the university's absolute emissions reduction was a result electricity supply generation shifts from coal to natural gas and renewable resources due to state, regional, and national policy changes. Also significant is the updated information associated by commuting behaviors as detailed within the 2017 update to the Campus Transportation Survey. Emissions from electricity T&D losses were slightly higher compared to the 2007-2008 baseline year (+17.7%), but the net contribution to the university totals were similar (4% in 2007-2008 compared to 4.5% in 2018-2019).

Finally, due to increases in enrollment, UD's FTE-normalized emissions declined by a much greater proportion than did absolute emissions.

**Figure 3: Emissions Progress Against 2020 Climate Action Plan Target**



### **Peer Analysis**

During the development of the 2018-2019 GHG inventory report, UD's sustainability program and key performance metrics were benchmarked against a defined set of peer institutions. Secondary research was performed to evaluate peer institutions for comparison to UD. The results of this research are summarized herein, but details are provided only for institutions for which information was readily available. Some peer institutions had little, publicly available information so, UD was not benchmarked against these campuses.

Table 2 provides an overview of campus sustainability programmatic activities. Most institutions evaluated have set a carbon reduction goal and many have established a zero-carbon goal for 2050. Approximately half of the evaluated peers are signatories to the Second Nature Presidents' Commitment and hold an AASHE STARS rating of Gold or higher.

**Table 2: University of Delaware Peer Institution Sustainability Programs**

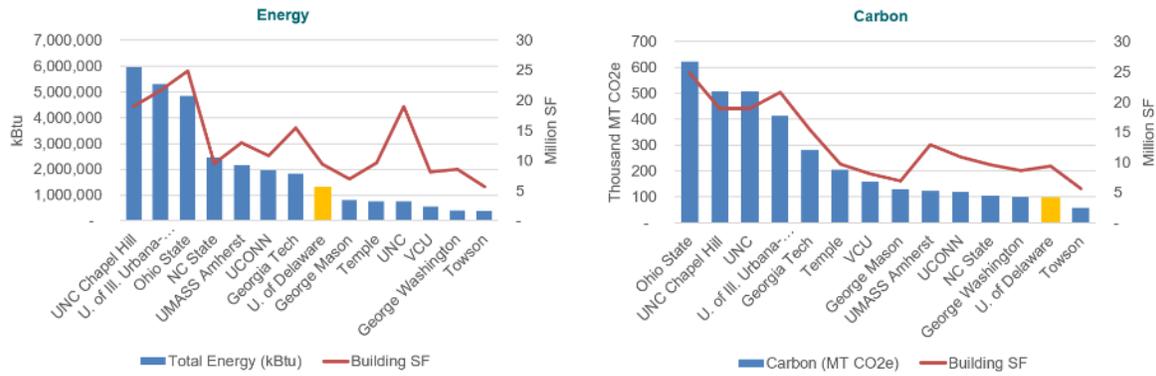
School	Carbon Goal	Presidents' Commitment Signatory	AASHE STARS Rating
Boston College		No	Reporter
Brown University	Zero Carbon by 2040	No	No
Carnegie Mellon University		No	Gold
College of William and Mary		No	Silver
University of Delaware	Zero Carbon by 2050	Yes	Bronze
Georgia Institute of Technology	Zero Carbon by 2050	Yes	Gold
Lehigh University		No	Silver
Pennsylvania State University	35% by 2020	No	Gold
University of Maryland	25% by 2020; 35% by 2030; 50% by 2040	Yes	Gold
University of North Carolina	Zero Carbon by 2050	Yes	Silver
University of Notre Dame	83% by 2050	No	Silver
University of Pittsburgh		No	Silver
University of Virginia	25% by 2025	No	Gold
Case Western University	Zero Carbon by 2050	Yes	Silver
Indiana University	80% by 2050	No	Gold
Iowa State University	65% by 2030	No	Gold
Michigan State University	65% by 2030	No	Silver
NC State University	Zero Carbon by 2050	Yes	Gold
Ohio State University	Zero Carbon by 2050	Yes	NA
Purdue University		No	Silver
Rutgers University		No	NA
Stony Brook University	Zero Carbon by 2050	Yes	Reporter
Texas A&M University		No	Gold
University of Arizona	Zero Carbon by 2050	Yes	Gold
University of Connecticut	Zero Carbon by 2050	Yes	Gold
University of Illinois Urbana-Champaign	Zero Carbon by 2050	Yes	Gold
University of Massachusetts Amherst	Zero Carbon by 2050	Yes	Gold
University of Michigan	25% by 2025	No	Gold
University of Minnesota	Zero Carbon by 2050	Yes	Gold
University of North Carolina Chapel Hill	Zero Carbon by 2050	Yes	Gold
University of Utah	Zero Carbon by 2050	Yes	Silver
Virginia Polytechnic Institute and State University	80% by 2050		NA
Temple University	Zero Carbon by 2050	Yes	Silver
George Washington University	Zero Carbon by 2050	Yes	Gold
Virginia Commonwealth University	Zero Carbon by 2050	Yes	Silver
George Mason University	Zero Carbon by 2050	Yes	Gold
Towson University	Zero Carbon by 2050	Yes	Bronze

**Notes:**

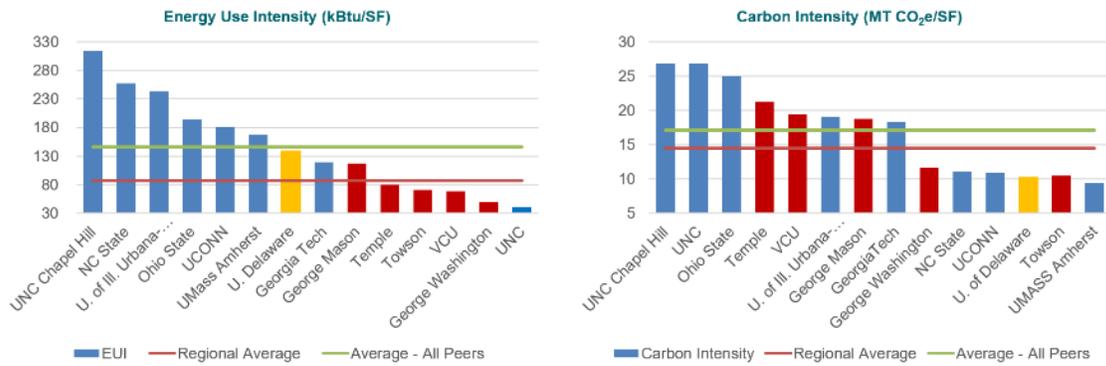
NA – Denotes that the institution is an AASHE STARS “member” but either has not reported or has not reported in recent years. “  
 No – Denotes that the institution is not a member or a reporter to the designated organization.

Figures 4 and 5 charts UD’s energy and carbon performance along with those peers for which similar data was available. Figure 4 provides absolute energy usage and GHG emissions along with each institution’s building square footage. Figure 5 considers energy and GHG emissions normalized against building square footage. For the EUI comparison charts, two average EUI lines were drawn for the entire peer group and a subset of “regional” peers. Energy usage at UD compares favorably compared to the entire peer group, but energy intensity is higher at UD compared to regional peers. UD’s carbon performance compares favorably against peers, regional weather differences and the generation mix associated with electricity supplies appear to be the significant drivers of this result.

**Figure 4: University of Delaware Peer Institution Sustainability Performance Analysis**



**Figure 5: University of Delaware Peer Institution Intensity-based Performance Analysis**



**Notes:**

The "Regional" Peer group includes George Mason, Temple, Towson, VCU, George Washington, and University of Delaware

## Appendix A: Data

**Table A1: 2018-2019 Consumption Data and GHG Emission Factors**

Scope	Source	Commodity	Usage	Unit	CO2 Factor	CO2 Unit	CH4 Factor	N2O Factor	CH4/N2O Unit
1	Building	Natural Gas	712,932	MCF	0.0544	Kg/CF	5	0.1	g/mmBtu
1	Building	Fuel Oil #2	138,483	Gal	10.21	Kg/gal	11	0.6	g/mmBtu
1	Building	Propane	3,088	Gal	5.67732	Kg/gal	0.28	0.06	g/gal
1	Fleet	Gasoline	148,388	Gal	8.7775	Kg/gal	0.000788	0.0008717	g/gal
1	Fleet	Diesel	101,986	Gal	10.21	Kg/gal	0.000027	0.0000531	g/gal
1	Landscaping	Fertilizer	61,945	lb	0.004	MT/lb			
2	Building	Electricity	162,893,345	kWh	720	lb CO2e/MWh			
3	Waste	MSW	2,471	Tons	0.35	MT/ton			
3	Waste	Food Comp.	532	Tons	0.54	MT/ton			
3	Commuting (Daily)	Gasoline	2,119,080	Gal	8.7775	Kg/gal	0.000788	0.0008717	g/gal
3	Commuting (Long Trips)	Gasoline	420,614	Gal	8.7775	Kg/gal	0.000788	0.0008717	g/gal
3	Commuting (Long Trips)	Jet Fuel (Trips)	2,706	Gal	9.5684	Kg/gal	0.27	0.31	g/gal
3	T&D Losses	Electricity	16,445,359	kWh	858.56	lb/MWh	26.44	11.49	lb/GWh

**Table A2: 2018-2019 Emission Totals (Metric Tons)**

Scope	Source	Commodity	CO2	CH4	CH4 CO2e	N2O	N2O CO2e	Total CO2e
1	Building	Natural Gas	38,812	3.65734	91.433479	0.07315	21.7977	38,925
1	Building	Fuel Oil #2	1,414	0.21022	5.255411	0.011466	3.4169	1,423
1	Building	Propane	18	0.000865	0.021616	0.000185	0.055213	18
1	Fleet	Gasoline	1,303	0.00012	0.003086	0.000137	0.040707	1,303
1	Fleet	Diesel	1,041	0.000003	0.000072	0.000006	0.001704	1,041
1	Landscaping	Fertilizer	248					248
2	Building	Electricity						53,199
3	Waste	MSW	865					865
3	Waste	Food Waste /Comp.	53					53
3	Commuting	Gasoline (Daily)	18,600	0.001763	0.044065	0.001951	0.581321	18,601
3	Commuting	Gasoline (Trips)	3,692	0.000350	0.008746	0.000387	0.115386	3,692
3	Commuting	Jet Fuel (Trips)	26	0.000731	0.018267	0.000839	0.249999	26
3	T&D Losses	Electricity						5,685

**Notes:**

Sources: EPA Final Mandatory Reporting of Greenhouse Gases, Table C-1 (CO<sub>2</sub> factors for Natural Gas, Fuel Oil, Gasoline, Diesel, Jet Fuel), EPA Climate Leaders (CH<sub>4</sub>/N<sub>2</sub>O factors for Gas, Fuel Oil, Gasoline,

*Diesel, Jet Fuel), EPA Inventory of Emissions and Sinks (Fertilizer), EPA WARM Model v14 (MSW Waste, Food Waste), EPA eGRID (Electricity)*

*CO<sub>2</sub>e calculations are based on IPCC Global Warming Potential Factors (CH<sub>4</sub> = 25; N<sub>2</sub>O = 298)*

*Fertilizer and Waste emission factors are expressed in their source documents terms of CO<sub>2</sub>e.*

*For Natural Gas and Fuel Oil #2, heat content values of 1.026 mmBtu/MCF and 0.138 mmBtu/gal, respectively, were assumed (EPA).*

*CH<sub>4</sub> and N<sub>2</sub>O factors for transportation emissions are mileage-based in sources, and have been converted to volume-based factors based on national average fuel economy.*

### **Appendix B: Emissions Without Scope 3**

While the ACUPCC reporting protocol encourages the reporting of Scope 3 emissions, many other reporting programs do not require these to be reported. This is in part due to the inherent difficulties associated with quantifying these types of emissions.

Below is a comparison of only UD's Scope 1 and Scope 2 emission sources between the 2007-2008 and 2018-2019 academic years.

**Table B1: 2007-2008 Scope 1 and 2 Emissions Only**

Source	Sector	Category	Consumption	Unit	Emissions (MT CO <sub>2</sub> e)
Natural Gas	Buildings	1	642,625	MCF	35,087
Fuel Oil #2		1	154,525	gal	1,569
Electricity		2	137,925,068	kWh	71,665
Gasoline	Transportation	1	229,697	gal	2,022
Diesel Fuel		1	72,451	gal	735
Fertilizer	Landscaping	1	13,427	lb	54
<b>Total Emissions</b>				MT	111,132

**Table B2: 2018-2019 Scope 1 and 2 Emissions Only**

Source	Sector	Category	Consumption	Unit	Emissions (MT CO <sub>2</sub> e)
Natural Gas	Buildings	1	712,932	MCF	38,925
Fuel Oil #2		1	138,483	gal	1423
Propane		1	3,088	gal	18
Electricity		2	162,893,345	kWh	53,199
Gasoline	Transportation	1	148,388	gal	1,303
Diesel Fuel		1	101,986	gal	1,041
Fertilizer	Landscaping	1	61,945	lb	248
<b>Total Emissions</b>				MT	96,156

**Table B3: 2018-2019 Presidents' Climate Commitment Summary Statistics**

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	Total (MT CO2e)	Per Full-Time Enrollment	Per 1000 Square Feet	% Offset
Gross Emissions (Scope 1 + 2)	96,156	5.5	10.2	0%
Gross Emissions (Scope 1 + 2 + 3)	125,078	5.6	13.3	0%
Net Emissions	125,078	5.6	13.3	N/A

**Table B4: 2018-2019 Presidents' Climate Commitment Summary Statistics**

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	Total (MT CO2e)
Stationary Combustion	40,365.4
Mobile Combustion	2,343.8
Process Emissions	0.0
Fugitive Emissions	247.8
Total Scope 1 Emissions	42,957.0

**Appendix C: Satellite Campus Data**

Building energy data was compiled for the STAR, Lewes, Georgetown, Dover, and Wilmington campuses for the 2018-2019 academic year. The following data is provided as supplemental information. These metrics were not combined with the Newark campus data at this time.

**Table C1: 2018-2019 Energy and GHG Emissions at Satellite Campuses**

Campus	Electricity (kWh)	Natural Gas (MCF)	Fuel Oil #2 (gal)	Propane (gal)	Scope 2 Emissions (MT CO <sub>2</sub> e)	Scope 1 Emissions (MT CO <sub>2</sub> e)	Total Emissions (MT CO <sub>2</sub> e)
STAR	2,311,492	9,337			755	509	1,264
Lewes	4,741,772				1,548		1,548
Georgetown	1,648,286		1,078	66,811	538	399	937
Dover	233,320				76		76
Wilmington	1,007,734	2,140			329	117	446
<b>Totals</b>	<b>9,942,604</b>	<b>11,477</b>	<b>1,078</b>	<b>66,811</b>	<b>3,247</b>	<b>1,024</b>	<b>4,271</b>

## **Appendix D: ACUPCC GHG Report Inputs**

Below are the input values for 2018-2019 for the ACUPCC GHG Report:

**Table A5: 2018-2019 Presidents' Climate Commitment Summary Statistics**

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	Total (MT CO <sub>2</sub> e)	Per Full-Time Enrollment	Per 1000 Square Feet	% Offset
Gross Emissions (Scope 1 + 2)	96,156	5.5	10.2	0%
Gross Emissions (Scope 1 + 2 + 3)	125,078	5.6	13.3	0%
Net Emissions	125,078	5.6	13.3	N/A

### **Emissions Inventory Methodology and Boundaries:**

*Start date of the 12-month period covered in this report:*

July 1, 2018

*Consolidation methodology used to determine organizational boundaries:*

The University of Delaware greenhouse gas inventory covered all buildings which the university controls operations at on its Newark Campus.

Emissions inventoried in this study address activities at the Newark Campus of the University of Delaware. This includes Laird Campus, the Main Campus, and South Campus. UD's off campus farm facilities were outside of the scope of this inventory, as were its Dover, Wilmington, Lewes and Georgetown satellite campuses.

*Emissions calculation tool used:*

ecolink™ by Siemens was used for the 2007-2008 base year calculations. 2018-2019 calculations were performed offline in Excel spreadsheets.

*Please describe why this tool was selected.*

Siemens' ecolink® tool was leveraged to assist with data management and emissions calculations. This platform ensures that all emissions factors are clearly documented and correctly applied. This tool also provides safe and transparent data warehousing which will allow UD to re-analyze its organizational carbon footprint or solicit external validation of the UD carbon accounting practices.

*Please describe the source(s) of the emissions coefficients used.*

Emission factors for the combustion of natural gas, fuel oil, gasoline, diesel fuel, and jet fuel were obtained from the U.S. EPA Mandatory Reporting Rule for Greenhouse Gases (MRR), Table C-1, in keeping with the accounting methodology specified by The Climate Registry's *General Reporting Protocol (GRP)*.

Emissions factors for purchased electricity, in keeping with *GRP* methodology, were derived from the U.S. EPA's eGRID2018 tables. Specifically, UD is located within the RFC East Subregion, so the published GHG emission factors representing the fuel mix used in generating electricity in this region were used.

Scope 3 GHG emissions from the disposal of mixed waste, food waste, and food composting were calculated using emission factors obtained from the U.S. EPA WARM Model, version 14.

GHG emissions resulting from usage of nitrogen fertilizer were calculated with an emission factor derived from the U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2001 (April 2003).

*Which version of IPCC's list of global warming potentials did you use?*

Fourth Assessment Report

*Who primarily conducted this emissions inventory?*

Siemens

*Please describe the process of conducting this inventory.*

Siemens worked with UD personnel to compile the 2018-2019 academic year GHG inventory. The aim of this effort was to replicate the scope and approach of the 2007-2008 GHG inventory and generate a brief, written update for comparison to the 2007-2008 benchmark. This process allows for direct correlations between the two records while measuring the benefits of carbon mitigation actions taken during the intervening five years.

Direct data records were compiled for building energy use, UD owned fleet vehicles, organic waste outputs, and fertilizer used. Estimates were utilized to assess fuel consumption associated with commuting activities as was required for the 2007-2008 academic year GHG inventory and, in 2017, this Survey process was updated.

Please see the formal inventory for further detail.

*Please describe any emissions sources that were classified as de minimis and explain how a determination of the significance of these emissions was made.*

No emissions sources were excluded due to being classified as *de minimis*.

*Please describe any data limitations related to this submission and any major assumptions made in response to these limitations.*

Several sources of UD's emissions are excluded because of a lack of sufficient data. The omitted activities include UD related ground travel for which the UD fleet was not used; and UD related air travel. At UD, it is common for individuals to make their own travel arrangements, which precludes any ability to collect data on number of miles traveled or frequency of trips. Furthermore, the UD transportation survey scope only extended to travel around campus.

In addition, data limitation prevented UD from estimating the potential value of carbon sinks due to UD vegetation.

**Emissions Data***all values in MT CO2e*

## Scope 1 Emissions

Stationary Combustion	40365.4
Mobile Combustion	2343.8
Process Emissions	0.0
Fugitive Emissions	247.8
<b>Total Scope 1 Emissions</b>	<b>42957.0</b>

## Scope 2 Emissions

Purchased Electricity	53198.8
Purchased Heating	0.0
Purchased Cooling	0.0
Purchased Steam	0.0
<b>Total Scope 2 Emissions</b>	<b>53198.8</b>

## Scope 3 Emissions

Commuting	22292.9
Air Travel	26.2
Solid Waste	918.0
Transmission & Distribution Losses	5685.0
<b>Total Scope 3 Emissions</b>	<b>28922.0</b>

## Biogenic Emissions

Biogenic Emissions from Stationary Combustion	0.0
Biogenic Emissions from Mobile Combustion	0.0

**Mitigation Data:**

N/A

**Normalization and Contextual Data:**

## Building space

Gross square feet of building space	9,391,978
Net assignable square feet of laboratory space	1,464,799
Net assignable square feet of health care space	27,265
Net assignable square feet of residential space	2,510,473

Population

Total Student Enrollment (FTE)	22,168
Residential Students	No information provided
Full-time Commuter Students	No information provided
Part-time Commuter Students	No information provided
Non-Credit Students	No information provided
Full-time Faculty	No information provided
Part-time Faculty	No information provided
Full-time Staff	No information provided
Part-time Staff	No information provided

Other Contextual Data

Endowment Size	No information provided
Heating Degree Days	4,632
Cooling Degree Days	1,555

**Supporting Documentation:**

(link to inventory here)

**Auditing and Verification:**

These emissions data have not been audited, verified, or peer-reviewed.

**Appendix E: UD Historical Enrollment Data**

<b>FY</b>	<b>Total – All</b>	<b>FTE - All</b>	<b>Full Time - All</b>	<b>Part Time - All</b>	<b>Total - Newark</b>	<b>FTE - Newark</b>	<b>Full Time - Newark</b>	<b>Part Time - Newark</b>
FY08	20,342	18,567	17,679	2,663	18,723	17,596	17,033	1,691
FY09	20,500	18,754	17,881	2,619	18,855	17,767	17,223	1,632
FY10	21,138	19,359	18,469	2,669	19,391	18,272	17,713	1,678
FY11	21,176	19,472	18,620	2,556	19,556	18,429	17,866	1,690
FY12	21,489	19,844	19,022	2,467	19,957	18,851	18,298	1,659
FY13	21,856	20,257	19,458	2,398	20,363	19,262	18,712	1,651
FY14	22,166	20,512	19,685	2,481	20,550	19,426	18,864	1,686
FY15	22,680	21,153	20,389	2,291	21,141	20,124	19,616	1,525
FY16	22,852	21,325	20,562	2,290	21,327	20,306	19,795	1,532

**Appendix F: Historical Degree Day Data (Wilmington Airport)**

FY	Date	HDD	CDD
FY09	Jul-08	0	412
FY09	Aug-08	0	255
FY09	Sep-08	18	163
FY09	Oct-08	301	12
FY09	Nov-08	592	0
FY09	Dec-08	818	0
FY09	Jan-09	1128	0
FY09	Feb-09	794	0
FY09	Mar-09	674	0
FY09	Apr-09	351	39
FY09	May-09	108	66
FY09	Jun-09	19	190
FY10	Jul-09	0	277
FY10	Aug-09	0	367
FY10	Sep-09	34	87
FY10	Oct-09	304	5
FY10	Nov-09	463	0
FY10	Dec-09	914	0
FY10	Jan-10	1008	0
FY10	Feb-10	949	0
FY10	Mar-10	527	0
FY10	Apr-10	277	20
FY10	May-10	101	116
FY10	Jun-10	3	352
FY11	Jul-10	0	460
FY11	Aug-10	0	374
FY11	Sep-10	7	184
FY11	Oct-10	254	10
FY11	Nov-10	546	0
FY11	Dec-10	1023	0
FY11	Jan-11	1128	0
FY11	Feb-11	814	0
FY11	Mar-11	701	0
FY11	Apr-11	295	29
FY11	May-11	76	119
FY11	Jun-11	0	277
FY12	Jul-11	0	494
FY12	Aug-11	0	317
FY12	Sep-11	32	180
FY12	Oct-11	278	8
FY12	Nov-11	459	0
FY12	Dec-11	727	0
FY12	Jan-12	859	0
FY12	Feb-12	725	0
FY12	Mar-12	424	3
FY12	Apr-12	356	13
FY12	May-12	52	121
FY12	Jun-12	13	239

FY	Date	HDD	CDD
FY13	Jul-12	0	478
FY13	Aug-12	0	358
FY13	Sep-12	42	139
FY13	Oct-12	239	27
FY13	Nov-12	675	0
FY13	Dec-12	700	0
FY13	Jan-13	905	0
FY13	Feb-13	849	0
FY13	Mar-13	761	0
FY13	Apr-13	342	16
FY13	May-13	125	89
FY13	Jun-13	0	251
FY14	Jul-13	0	452
FY14	Aug-13	0	266
FY14	Sep-13	72	104
FY14	Oct-13	229	49
FY14	Nov-13	629	0
FY14	Dec-13	844	0
FY14	Jan-14	1164	0
FY14	Feb-14	938	0
FY14	Mar-14	824	0
FY14	Apr-14	377	7
FY14	May-14	76	59
FY14	Jun-14	2	236
FY15	Jul-14	0	345
FY15	Aug-14	0	245
FY15	Sep-14	39	146
FY15	Oct-14	218	16
FY15	Nov-14	635	0
FY15	Dec-14	769	0
FY15	Jan-15	1069	0
FY15	Feb-15	1126	0
FY15	Mar-15	838	0
FY15	Apr-15	331	1
FY15	May-15	56	164
FY15	Jun-15	18	266
FY16	Jul-15	0	372
FY16	Aug-15	0	335
FY16	Sep-15	1	230
FY16	Oct-15	288	3
FY16	Nov-15	425	6
FY16	Dec-15	478	1
FY16	Jan-16	1015	0
FY16	Feb-16	822	0
FY16	Mar-16	504	2
FY16	Apr-16	383	11
FY16	May-16	175	78
FY16	Jun-16	5	222

FY	Date	HDD	CDD
FY17	Jul-16	0	433
FY17	Aug-16	2	441
FY17	Sep-16	30	245
FY17	Oct-16	225	45
FY17	Nov-16	496	4
FY17	Dec-16	835	0
FY17	Jan-17	832	0
FY17	Feb-17	628	4
FY17	Mar-17	731	5
FY17	Apr-17	242	55
FY17	May-17	168	77
FY17	Jun-17	27	295
FY18	Jul-17	0	417
FY18	Aug-17	0	277
FY18	Sep-17	25	183
FY18	Oct-17	145	75
FY18	Nov-17	558	0
FY18	Dec-17	924	0
FY18	Jan-18	1037	0
FY18	Feb-18	671	0
FY18	Mar-18	788	0
FY18	Apr-18	440	8
FY18	May-18	36	117
FY18	Jun-18	8	233
FY19	Jul-18	3	394
FY19	Aug-18	2	403
FY19	Sep-18	24	233
FY19	Oct-18	280	75
FY19	Nov-18	650	6
FY19	Dec-18	786	0
FY19	Jan-19	988	0
FY19	Feb-19	809	0
FY19	Mar-19	717	5
FY19	Apr-19	248	31
FY19	May-19	107	128
FY19	Jun-19	18	280