UMBC 2020 GREENHOUSE GAS REPORT

AUGUST 2021

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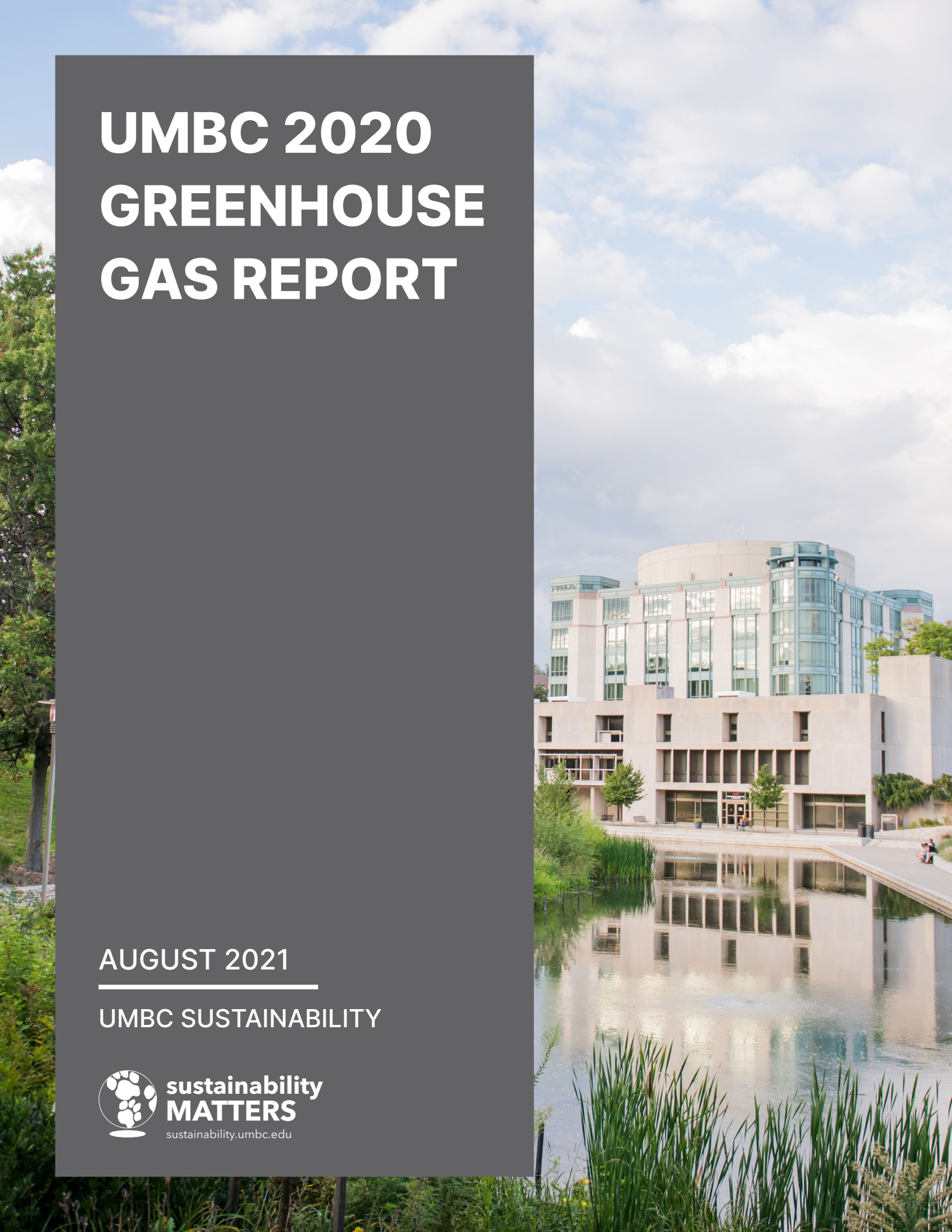

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Executive Summary

This greenhouse gas (GHG) inventory covers emissions data from July 1st, 2019 to June 30th, 2020 (Fiscal Year 2020). The fiscal year (FY) 20 GHG data is significantly different from previous years due to the COVID-19 global pandemic. On March 13, 2020 UMBC shifted to full remote operations and academics. From March until June the campus was essentially unoccupied with only minimal staffing for essential services. In late June some on-campus research activities resumed. In July, many essential support roles began to report to regular duty. Students did not collect their belongings from the residential halls and apartments until August. During this time there was also a moratorium on state sponsored travel, this is why air emissions are significantly lower than before.

In FY 2007, the baseline year for emissions analysis, UMBC's net emissions footprint was 85,876.96 Metric Tons of Carbon Dioxide Equivalent ($MTeCO_2$). In FY 2020, net emissions decreased to 48,071.92 $MTeCO_2$, resulting in a 44% reduction in emissions compared to 2007. This reduction is partly due to the COVID19 pandemic, which reduced approximately 7,037.78 $MTeCO_2$ in Scope 3 emissions alone. However, the reduction relative to 2007 is also largely a result of an increase in renewable energy consumption, energy efficiency projects in existing buildings and plants, and all new buildings are built to meet or exceed LEED Silver standards. Figure 1 and Table 1 below reports UMBC's emissions through 2007-2020 by scope.

Figure 1: UMBC GHG Emissions by Scope ($MTeCO_2$), 2007-2020

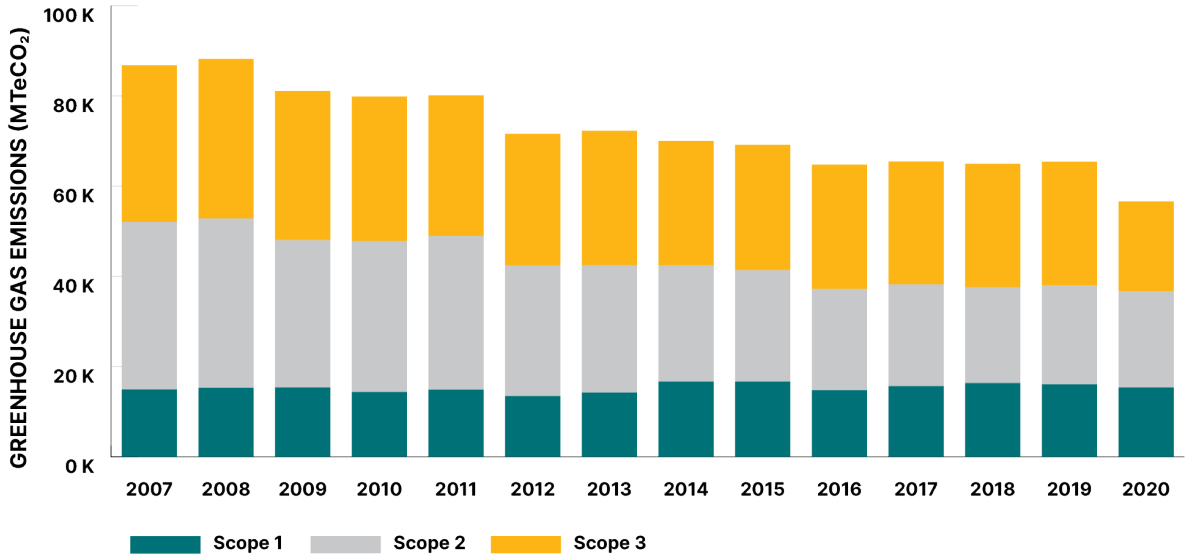


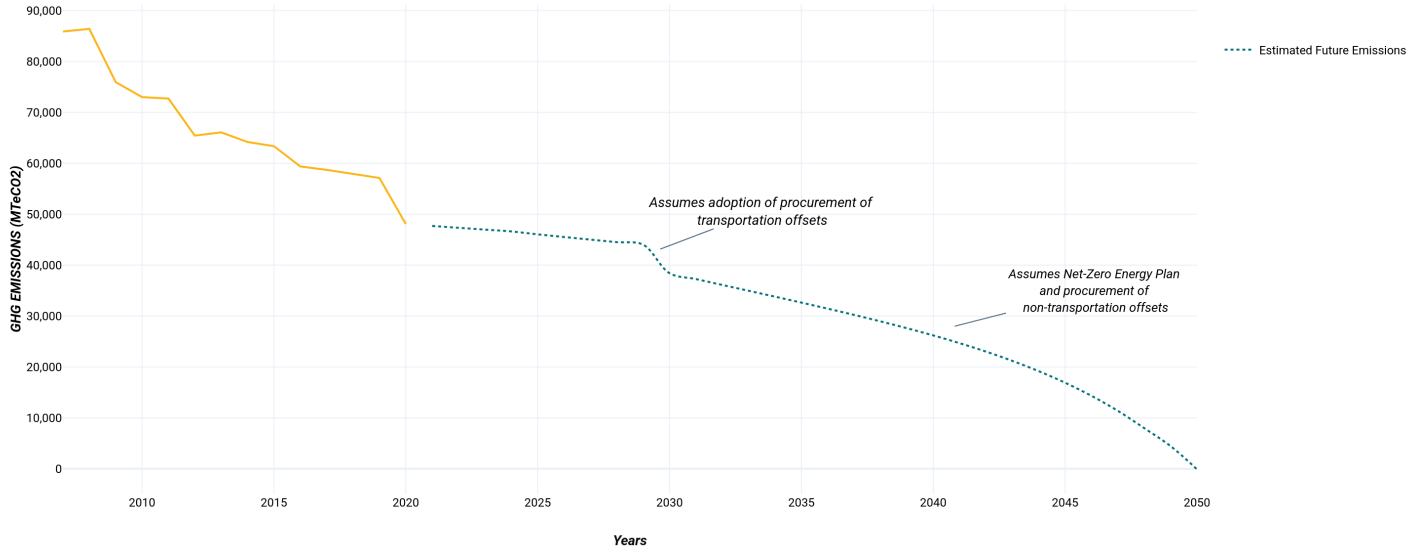
Table 1: UMBC GHG Emissions by Scope ($MTeCO_2$), 2007-2020

GHG Scope	2007	2010	2013	2016	2020
Scope 1	14,916.42	14,364.49	14,218.24	14,748.60	15,374.68
Scope 2	36,222.89	26,639.14	22,026.05	17,072.91	12,828.65
Scope 3	34,737.65	32,003.75	29,826.17	27,568.83	19,868.59
Total Emissions:	**85,876.96**	**73,007.38**	**66,070.46**	**59,390.34**	**48,071.92**

Background

In 2009, UMBC published the University's first Climate Action Plan (CAP) outlining specific goals to become a carbon neutral campus. A little over a decade later, in 2020, UMBC released a revised CAP targeting a date of 2050 for Carbon Neutrality while improving the university's ability to adapt to a changing climate. Other GHG reduction goals outlined in the new plan include: 25% reduction in emissions by 2025 and 50% reduction in emissions by 2030 as compared to the 2007 baseline. To track progress, UMBC's GHG inventory is calculated every fiscal year by the Office of Sustainability and is reported through Second Nature. This report defines UMBC's GHG accounting methodology, documents the current footprint of operations, and analyzes the observed emission trends.

Figure 2: UMBC GHG Emissions Net Zero Timeline



Methodology

UMBC's GHG emissions were calculated using the web-based Sustainability Indicator Management & Analysis Platform (SIMAP) developed by the University of New Hampshire. The methodologies of this tool was based on the Intergovernmental Panel on Climate Change (IPCC) recommendations for national-level inventories[1] and have been adapted to the institutional level. SIMAP's methodologies are currently the most accurate, and are updated with the latest recommendations and calculations from the IPCC.

Electricity emissions in this report were calculated using the Location-Based regional electricity emissions factors for the EPA's eGRID Database. The EPA's eGRID Database is a comprehensive source of data from EPA's Clean Air Markets Division on the environmental characteristics of almost all electric power generated in the United States[2]. Emissions factors are regularly updated by the EPA based on changes in the energy portfolio and technology of a region.

1 https://unhsimap.org/sites/default/files/user-uploads/SIMAP%20User%20Guide_DRAFT6.2_2.21.2018.pdf
2 https://www.epa.gov/egrid

SIMAP measures greenhouse gases emitted by UMBC's activities and includes GHGs specified by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and refrigerants. Emissions of NH_4, N_2O, and refrigerants are converted into metric tons of carbon dioxide equivalent using Global Warming Potentials (GWPs) provided by the IPCC's Assessment Reports. UMBC used the GWP version AR-5 100-year (Figure 3) as recommended by SIMAP for FY20 reporting. This allows UMBC to standardize all GHG emissions into one unit of measurement.

Figure 2: Global Warming Potential for Greenhouse Gases Included in UMBC Inventory (AR-5 100-Year[1])

Greenhouse Gas	Chemical Formula	Global Warming Potential
Carbon Dioxide	CO_2	1
Methane	CH_4	28
Nitrous Oxide	N_2O	265
Hydro Chlorofluorocarbons (HCFC-22)	$CHCLF_2$	1,760
Hydro Fluorocarbons (HFC-32)	CH_2F_2	677
Hydro Fluorocarbons (HFC-125)	CHF_2CF_3	3,170

Inventory Boundary

UMBC's GHG inventory includes emissions related to the functional operations of the university. This aligns with an Operational Control Approach, which includes emission sources the university has the authority to affect through policies.

Since 2007, the university has tracked and inventoried GHG emissions from Scope 1, Scope 2, and Scope 3 activities.

Scope 1: Emissions occurring from sources that are owned or controlled by the institution	• On-Campus stationary combustion of fossil fuels • Mobile combustion of fossil fuels by institution owned vehicles (university fleet) • Emissions associated with application of synthetic fertilizer • Refrigerants

1 https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf

Scope 2: Indirect/off-campus emissions from sources that are not owned/operated by the institution, but whose products are directly linked to on-campus energy consumption	• Purchased electricity • Emission reductions from purchase of Renewable Energy Credits (RECs)
Scope 3: Other emissions that are attributed to the activities to the institution. This includes emissions from sources that are not owned/operated by the University, but are either directly financed or are otherwise linked to the campus operations.	• Student, faculty, and staff commuter emissions • UMBC sponsored/related air travel • Landfilling of municipal solid waste • Transmission and distribution (T&D) losses from purchased energy

Figure 4 is a detailed summary table of emissions from all sources included in this inventory as well as a brief description of each emissions source.

Currently, the only carbon sink the university claims is composting of organic waste. UMBC does not purchase carbon offsets, however the university recognizes that carbon offsets more than likely will be necessary to achieve carbon neutrality by 2050.

The following emissions have been omitted from the GHG inventory because university-wide reporting methods do not currently exist in the appropriate capacity to generate consolidated and complete information.

- Study abroad travel emissions
- Upstream emissions from directly financed purchases
- Paper, food, and fuel extraction
- Wastewater

Data Collection

The data input into SIMAP is collected from a variety of personnel and departments within the University by the Office of Sustainability. Electricity consumption and direct fuel consumption from building heating is collected from utility bills or the Central Plant, which are recorded and maintained by Facilities Management. All campus owned and operated vehicle emissions are recorded and maintained by the Auto Shop. Records of refrigerant use are sourced from a variety of locations within Facilities Management, Dining, and Residential Life. Synthetic fertilizers are used and logged by Grounds (Facilities Management) and Athletics. Records of business travel are maintained by Business Services.

Figure 4: Detailed Description of UMBC's FY2020 GHG Emissions, by Source

Scope	Emission Source	GHG Emissions ($MTeCO_2$)	Description
Scope 1	**Natural Gas/Fuel Oil**	14,443.61	UMBC used 270,406.20 MMBtu of natural gas to fuel on site boilers, heating equipment, and cooking equipment. The University also used 8,692 gallons of #2 fuel oil, for emergency/ back/temporary use.
	Direct Transportation (University Fleet)	630.41	The university fleet includes gas - and - diesel powered buses, vans, trucks, passenger vehicles, and utility/equipment vehicles. This past year they used 55,320.60 gallons of gasoline and 14,794.50 gallons of diesel.
	Refrigerants	293.78	Two refrigerants used for HVAC equipment were reported for fugitive emissions: 168 lbs of HCFC-22 (hydro-chlorofluorocarbon) and 183 lbs of R-410a (hydro-fluorocarbon).
	Fertilizer	6.88	A total of 8,712 lbs of synthetic fertilizer was applied to the grounds of the main campus with a nitrogen content of 19%. The Athletics fields applied 1,093 lbs of synthetic fertilizer this past fiscal year with nitrogen content of 100%. The greenhouse gas emissions from fertilizer application is the volatilization of nitrous oxide.
Scope 1 Subtotal: 15,374.68 $MTeCO_2$			
Scope 2	**Purchased Electricity**	12,828.65	The UMBC campus purchased and used 65,464.44 MWh of energy. 26,186 MWh of that energy had zero-net emissions associated with it through the purchase of RECs. The remaining 39,278.44 emissions were multiplied by an emission factor of 0.36 tons/MWh[1], which is the eGRID 2018 emission factor for the RFC East.
Scope 2 Subtotal: 12,828.65 $MTeCO_2$			
Scope 3	**Student Commuting**	10,014.93	It was assumed, based on Office of Institutional Research (OIR) enrollment and housing data, that 11,997 students commuted round trip 5 times a week for 17 weeks*. Each trip was assumed to be 40 miles, which was an average calculated from off-campus student zip code data. Assumptions for the percentage of trips of each mode of transportation were calculated based on information by Parking Services and UMBC Transit.

1 https://www.epa.gov/egrid/power-profiler#/

Figure 4 Continued: Detailed Description of UMBC's FY2020 GHG Emissions, by Source

Scope	Emission Source	GHG Emissions ($MTeCO_2$)	Description
Scope 3	Staff Commuting	2,083.54	According to OIR staff data, there were 1,286 Full-Time (FT) and Part-Time (PT) staff as of Fall 2019. It was assumed that all staff commuted round trip 5 times a week for 34 weeks* during the fiscal year. Each trip by staff was assumed to be 30 miles, which was an average calculated from employee zip code data obtained by Human Resources (HR). Assumptions for the percentage of trips for each mode of transportation was calculated based on information gathered by Parking Services and UMBC Transit.
	Faculty Commuting	2,326.44	According to OIR staff data, there were 1,118 FT/PT faculty as of Fall 2019. It was assumed that all faculty commuted round trip 5 times a week for 26 weeks* during the fiscal year. Each trip by faculty was assumed to be 40 miles, which was an average calculated from faculty zip code data obtained by Human Resources. Assumptions for the percentage of trips for each mode of transportation was calculated based on information gathered by Parking Services and UMBC Transit.
	Air Travel	4,117.59	Business Services must track travel receipts of all University financed travel. Based on reported destination information from that data, it was calculated that UMBC financed 9,371,864 miles of air travel in FY 20.
	T & D Losses	1,097.01	The transmission and distribution (T&D) of electricity is not 100% efficient. The T&D loss factor used was 4.88%[2], which is the grid gross loss from eGRID 2018 for the RFC East region.
	Solid Waste	229.08	UMBC generated 1,461 short tons of solid waste, which was sent to a local facility that recovers methane to generate electricity. This recovery practice still releases methane into the atmosphere and contributes to GHG emissions.
Scope 3 Subtotal: 19,868.59 $MTeCO_2$			
Total Emissions: 48,071.92 $MTeCO_2$			

2 https://www.epa.gov/sites/production/files/2020-01/egrid2018_summary_tables.xlsx

Our Growing Campus

The UMBC population and building square footage have grown in size since the first GHG inventory. Since 2007, there has been a population increase of 1,682 students, faculty, and staff (11.83% increase)[1]. New buildings have come online to accommodate the expansion of the university, with 767,733 sq ft (24% increase) of additional building space. It should be noted that a little over 732,000 sq ft, 95.41%, of that additional space is considered research space. Due to equipment like fume hoods and freezers, research spaces are one of the most energy intensive spaces at UMBC.

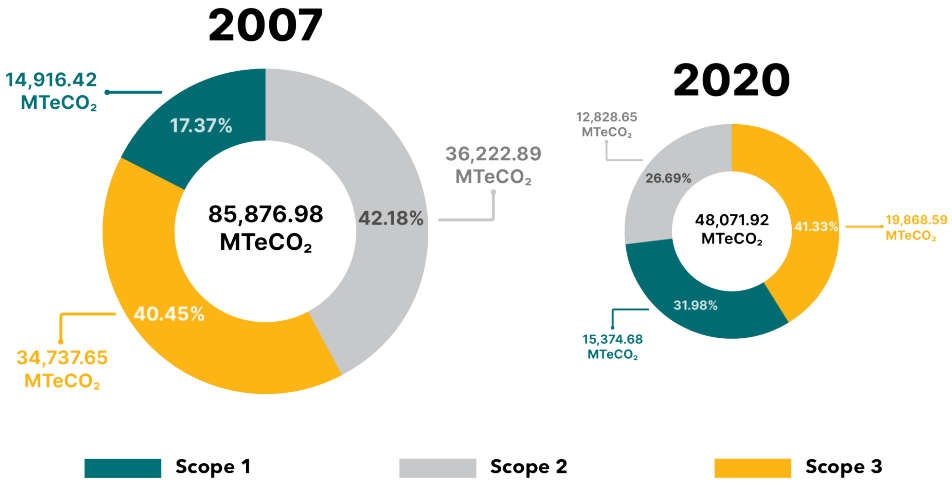
The university's commitment to net-zero emissions takes into account future campus growth by prioritizing smart growth. Smart growth is achieved through conservation measures that reduce the campus energy consumption to a level that offsets the increase of energy demand associated with future campus growth.

Emissions by Scope & Source

UMBC's largest contributor to overall net emissions is Scope 3, even though these emissions were substantially impacted by COVID19. Although Scope 2 has historically been the largest source of emissions for UMBC, they have been significantly reduced by approximately 64% through energy efficiency projects, purchase of Renewable Energy Credits (RECs), and the Clean Horizons Power Purchase Agreement (PPA). It is worth noting that as one piece of the carbon footprint pie is successfully reduced, the other pieces of the pie will increase proportionally. For example, Figure 5 shows the reduction in Scope 2 emissions from 42.18% in 2007 to 26.69% in 2020, has contributed to increased percentage for Scope 1 (from 17.37% in 2007 to 26.69% in 2020) and Scope 3 (from 40.45% in 2007 to 41.33% in 2020).

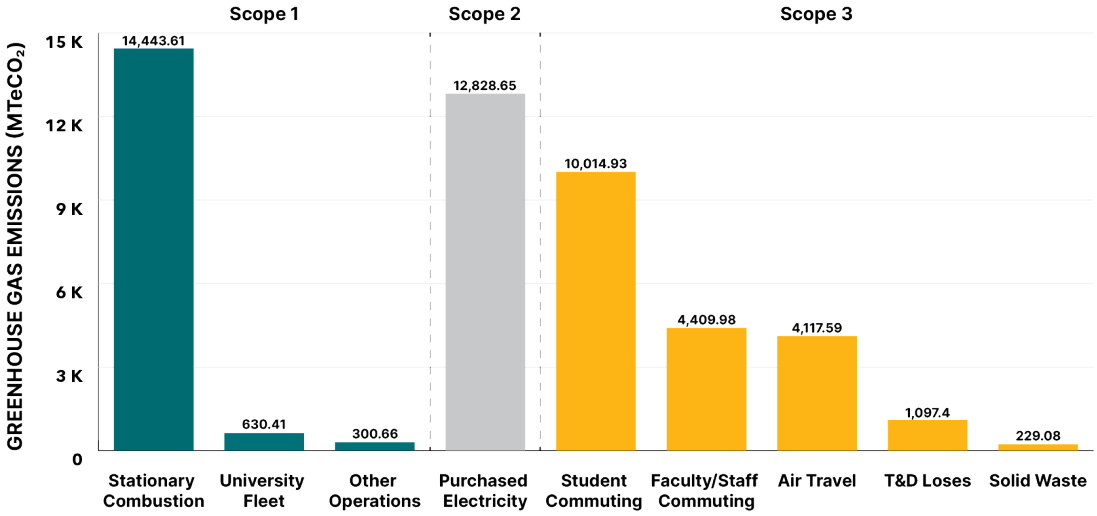
UMBC's highest sources of emissions are: campus stationary combustion of fuels at 30.05% (14,443.61 $MTeCO_2$), purchased electricity at 26.69% (12,828.65 $MTeCO_2$), and student commuting at 20.83% (10,014.93 $MTeCO_2$). Since 2007, these sources have consistently comprised the majority of the university's emissions.

Figure 5: FY 2007 vs. FY 2020 Emissions by Scope



1 https://www.usmd.edu/IRIS/DataJournal/Enrollment/?report=Fall-Headcount-by-Level#

Figure 6: UMBC's GHG Emissions by Scope/Source (FY 2020)



Purchased Electricity

Electricity continues to be one the largest sources of GHG reduction for the university. In 2020, purchased electricity and T&D losses made up 13,926.05 $MTeCO_2$, which was 24.6% of overall emissions. This is a 65% reduction in net emissions since the 2007 baseline year. In 2020, 44% (26,186 MWh) of UMBC's purchased electricity came from renewable sources through the purchase of RECs. As mentioned above, emissions from purchased electricity are calculated using the Location-Based method. Review Figure 4, for a detailed explanation of how net-emissions of electricity are calculated.

Large reductions in electricity emissions are also a result of successful energy conservation measures and projects implemented by UMBC. In 2020, the university purchased 65,464.44 MWh of energy, which is a 14.91% reduction of energy use. Normalized to account for campus growth, Energy-Use Intensity (EUI) per sq ft of condition space of the campus has decreased from 82.06 kBTU/GSF in 2007 to 56.31 kBTU/GSF (31.38%).

Figure 7: UMBC's Net GHG Emissions of Purchased Electricity (2007-2020)

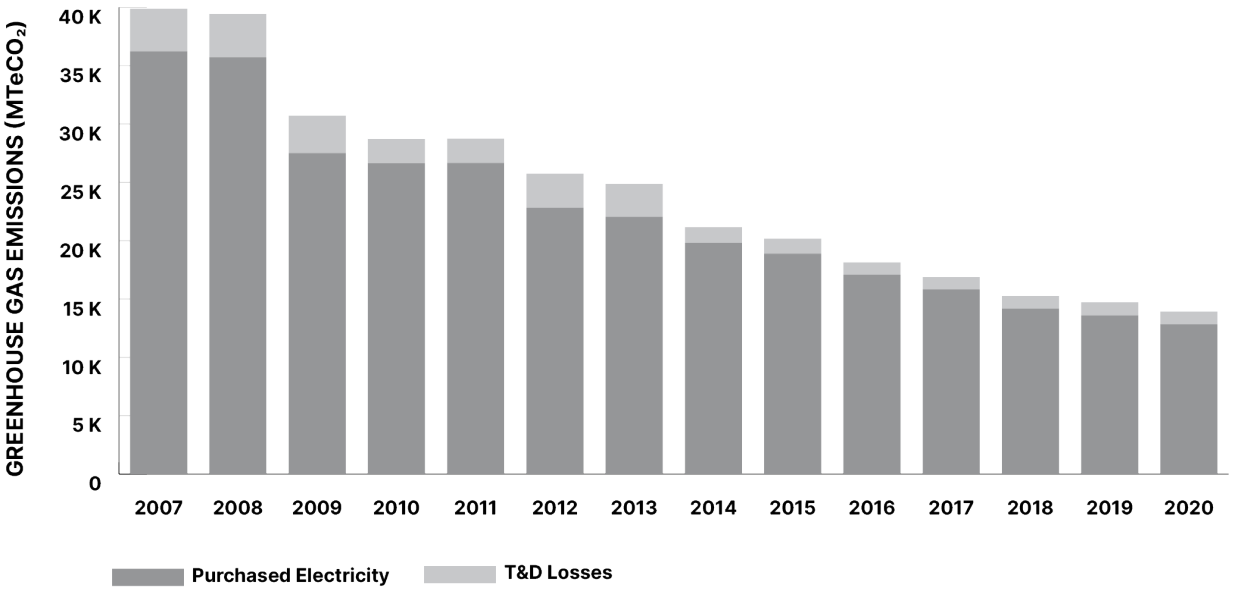
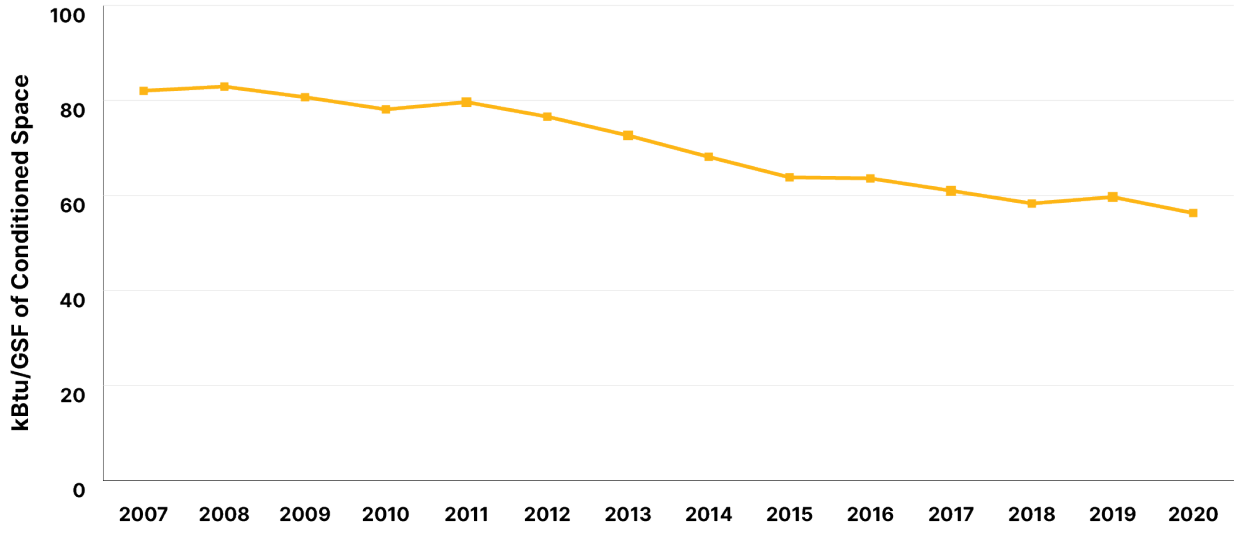


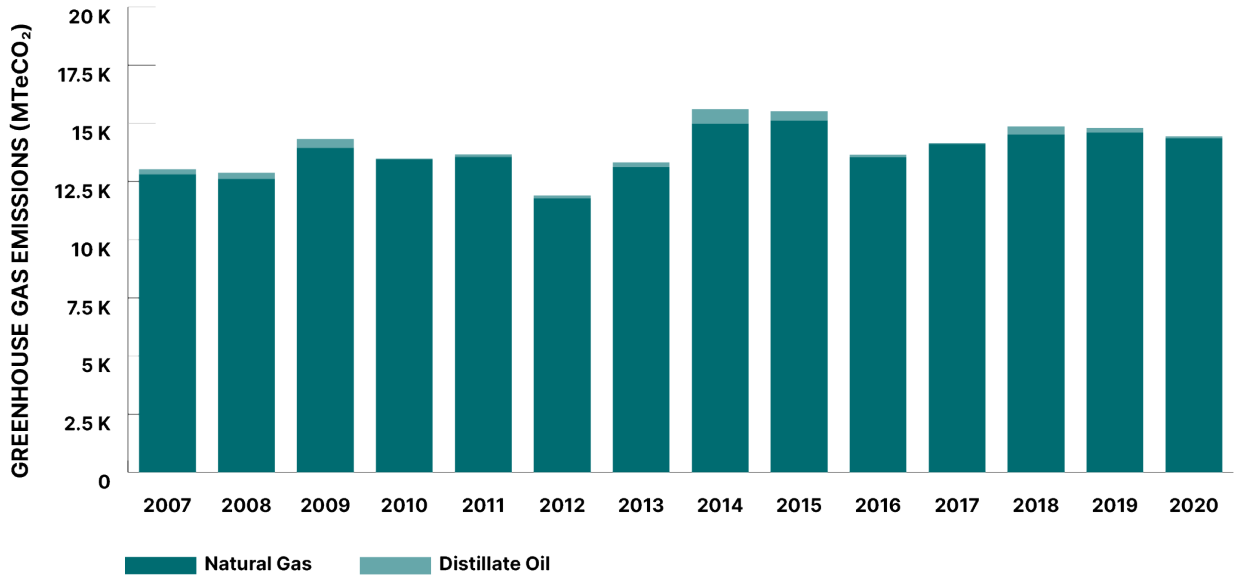
Figure 8: UMBC Average Campus EUI (2007-2020)



Fuel (On-Campus Stationary Sources)

The large majority of Scope 1 emissions is primarily from natural gas, which fuels the boilers, heating equipment, cooking equipment, etc. The campus additionally uses distillate fuel oil #2, but only during emergencies to run generators during a power outage or to fuel Central Plant and Satellite Plant boilers during natural gas interruption. In 2020, these sources from on-campus stationary sources accounted for 14,443.61 $MTeCO_2$, or 30.05% of UMBC's total net emissions. Emissions from stationary sources have slightly increased since the 2007 baseline year by 10.85% (1,413.66 $MTeCO_2$). This can largely be attributed to the increase of the campus footprint or changes in the weather which impact heating and cooling of buildings. When normalizing to account for campus growth, UMBC's stationary source carbon footprint per gross square foot ($MTeCO_2$/GSF) was 10.6% percent less in 2020 than in 2007.

Figure 9: UMBC's GHG Emissions of On-Campus Stationary Sources (2007-2020)



Transportation

Transportation's GHGs impact includes emissions from university owned vehicles, listed as university fleet, commuting practices of staff, faculty, and students, and university sponsored air travel. It should be noted that $MTeCO_2$ contributions attributed to transportation during pre-COVID operations have seen a decrease of 4.18% from. It is expected that this trend would have continued had it not been for travel restrictions set in due to COVID19.

In March of 2020, UMBC discontinued air-travel and transitioned all classes to virtual or online for the remainder of the year. All staff and faculty worked remotely, until June 2020 when some essential staff were approved to return to work on campus. The assumed amount of commuting weeks for the fiscal year included in the calculations were modified to reflect this change. Figure 10 below denotes the change in assumptions from FY 2019 to FY 2020 due to the pandemic. It is important to note that it was assumed that all staff were remote from mid-March and all resumed commuting to campus in the beginning of June.

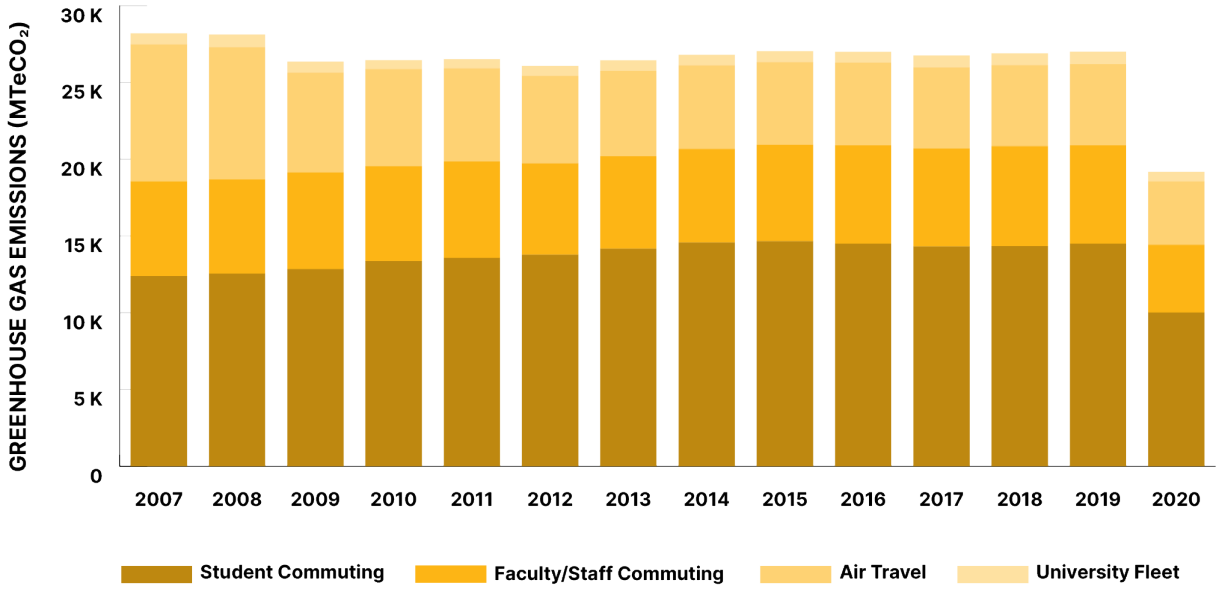
In 2020, transportation emissions accounted for 19,172.91 $MTeCO_2$, or 39.88% of UMBC's total net emissions. This is a reduction of 29.04% from FY 2019 levels, which can be attributed to travel restrictions due to the pandemic. The increase in virtual classes, conferences and remote work have shown to have incredible positive impacts on the carbon footprint of the university.

Historically the university has had limited remote working options for faculty and staff, so it was previously assumed that almost no staff/faculty work remotely. However, the pandemic has shown that many positions can be done successfully in a remote setting. As the expansion of full/partial remote work continues, future calculations of staff and faculty commuting habits will include direct data on telework arrangements.

Figure 10: Changes in Assumptions of Commuting Habits

	Assumptions for FY 19		Assumptions for FY 20	
	# of Round Trips per Week	# of Commuting Weeks	# of Round Trips per Week	# of Commuting Weeks
Students	5	24 (6 months)	5	17 (4 ¼ months)
Staff	5	48 (12 months)	5	34 (8 ½ months
Faculty	5	36 (9 months)	5	26 (6 ½ months)

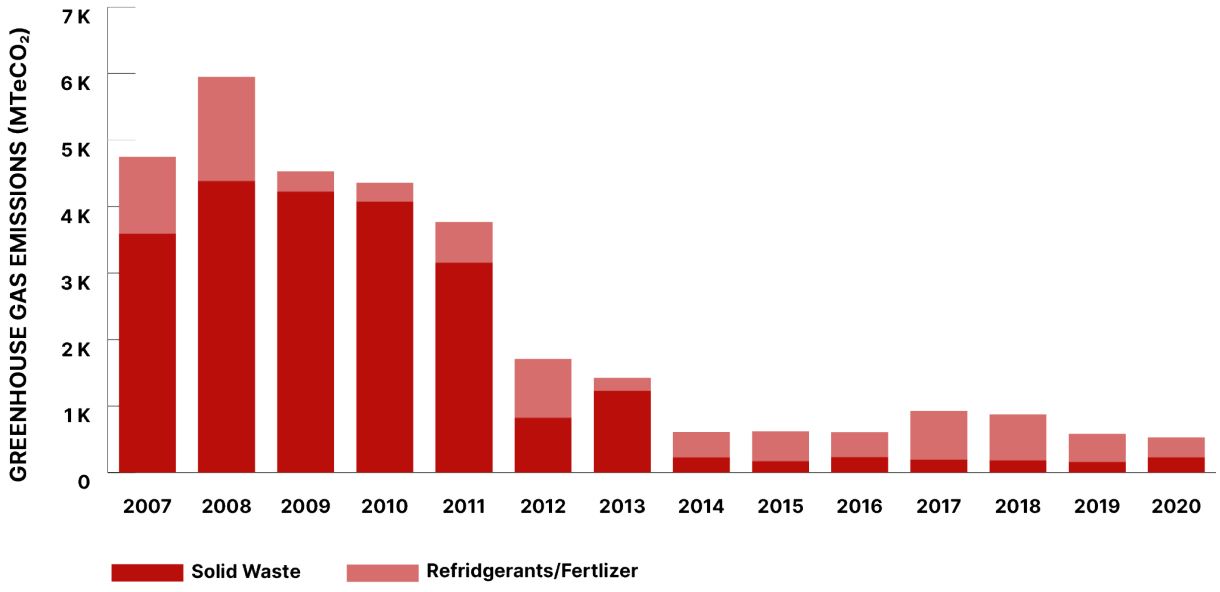
Figure 11: UMBC's GHG Emissions of Transportation Sources (2007-2020)



Operations Support

Other university operations include emissions generated from the release of refrigerants, application of fertilizer, and methane generated during the disposal of solid waste. Operations support is the smallest contributor to overall emissions at UMBC, accounting for 1.1% (529.74 $MTeCO_2$) of overall net emissions. The University has decreased emissions of solid waste from 3,591.38 $MTeCO_2$ to 229.08 $MTeCO_2$ (an 88.85% decrease). These reductions are largely attributed to a change in disposal methods of campus solid waste. UMBC currently sends all solid waste to a landfill with methane recovery, whereas historically the solid waste was sent to a waste incineration facility.

Figure 12: UMBC's GHG Emissions from Operations Support (2007-2020)



Appendix A - Emissions Data

Table 2: UMBC's Net GHG Emissions of Purchased Electricity ($MTeCO_2$)

GHG Source:	2007	2010	2013	2016	2020
Purchased Electricity	36,222.89	26,639.14	22,026.05	17,072.91	12,828.65
T&D Losses	3,674.32	2,069.79	2,850.91	1,056.19	1,097.40
GHG Total:	**39,897.21**	**28,708.93**	**24,876.96**	**18,129.10**	**13,926.05**

Table 3: UMBC's GHG Emissions of On-Campus Stationary Sources ($MTeCO_2$)

GHG Source:	2007	2010	2013	2016	2020
Natural Gas	12,809.02	13,454.82	13,113.24	13,536.19	14,354.73
Distillate Oil	220.93	24.50	209.98	119.79	88.88
GHG Total:	**13,029.95**	**13,479.32**	**13,323.22**	**13,655.98**	**14,443.61**

Table 4: UMBC's GHG Emissions of Transportation Sources ($MTeCO_2$)

GHG Source:	2007	2010	2013	2016	2020
Student Commuting	12,391.89	13,359.29	14,167.94	14,490.11	10,014.93
Staff Commuting	3,564.44	3,537.38	3,528.92	3,780.67	2,326.44
Faculty Commuting	2,591.79	2,643.81	2,496.75	2,633.56	2,083.54
Air Travel	8,923.82	6,319.10	5,555.94	5,377.41	4,117.59
University Fleet	727.01	601.36	695.50	717.00	630.41
GHG Total:	**28,198.95**	**26,460.94**	**26,445.05**	**26,998.75**	**19,172.91**

Table 5: UMBC's GHG Emissions from Operations Support ($MTeCO_2$)

GHG Source:	2007	2010	2013	2016	2020
Solid Waste	3,591.38	4,074.38	1,225.72	231.36	229.08
Refrigerants	1,158.43	283.22	198.64	372.41	293.78
Fertilizer	1.03	0.59	0.88	3.21	6.88
GHG Total:	**4,750.84**	**4,358.19**	**1,425.24**	**606.98**	**529.74**