

Greenhouse Gas Inventory Update

PREPARED FOR: BRYN MAWR COLLEGE

THE STONE HOUSE GROUP

BUILDING STEWARDSHIP

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Introduction

Bryn Mawr College is committed to environmental sustainability, and views sustainability as vital to the College’s mission as a socially responsible institution. This report provides a summary and analysis of the College’s FY 2019 GHG emissions inventory, comparing it to previous emissions data that was collected in 2008 and 2014. Equipped with this updated measurement of its environmental impact, Bryn Mawr will have the information it needs to make strategic decisions to reduce campus emissions.

A greenhouse gas (GHG) emissions inventory identifies and quantifies an organization’s anthropogenic sources¹ of greenhouse gases, and is an essential measurement for addressing contributions to climate change. The data presented in this report adhere to methodologies that are consistent with the WRI GHG Protocol² in order to accurately account for each category of emissions at Bryn Mawr College.

¹ Anthropogenic sources of GHG emissions occur as a direct result of human activity.

² The Greenhouse Gas Protocol, developed by the World Resources Institute and the World Business Council for Sustainable Development, is the industry standard for accounting and reporting greenhouse gas emissions.

Sources of Emissions

Greenhouse gases absorb and trap thermal energy in Earth's atmosphere, contributing to the greenhouse effect and global climate change. The six primary GHGs are Carbon Dioxide (CO₂), Methane (CH₄), Nitrous Oxide (N₂O), Sulfur Hexafluoride (SF₆), Hydrofluorocarbons (HFCs), and Perfluorinated Compounds (PFCs). All of these gases are released in vast quantities as a result of human activity, and each one contributes differently to the increase in global average temperature.

Two key ways in which these gases differ from each other are: (1) their ability to absorb and trap heat and (2) the amount of time they remain in the atmosphere. In order to compare the impacts of these GHGs, a factor called the Global Warming Potential (GWP) was developed. GWPs are a relative measurement of how much heat a greenhouse gas traps in the atmosphere over a given period of time, using CO₂ as the reference (GWP = 1). Methane, for example, has a GWP of 28³ since it is more volatile than carbon dioxide over its lifetime. As a result, these GWP values can be used to convert the emissions of each GHG to Carbon Dioxide Equivalent, or CO₂e.

This report will measure Bryn Mawr's greenhouse gas emissions in Metric Tons of Carbon Dioxide Equivalent (MTCDE), and will group the sources of emissions based on the categories utilized by the WRI GHG Protocol. These categories are called "Scopes" and are defined as follows:

Scope 1 – Direct Emissions

Certain activities on campus directly result in the emission of greenhouse gases. Scope 1 emissions are easy to measure since each source is within the control of the College.

- **Stationary Combustion of Fossil Fuels:** Heating oil and natural gas are used to heat facilities on the Bryn Mawr College campus, and emit carbon dioxide and other GHG's as they are consumed.
- **Mobile Combustion of Fossil Fuels:** The fleet of college-owned vehicles uses gasoline, diesel, and natural gas fuels, which contribute additional carbon dioxide and other GHG emissions as they are consumed.
- **Refrigerants and Chemicals:** Various refrigerants are used across campus in air conditioning systems, discharging greenhouse gases with very high GWP.
- **Fertilizer Application:** Synthetic fertilizers that are used on the College grounds utilize nitrogen as the active ingredient, which results in the release of nitrous oxide as the fertilizer interacts with the soil.

³ Values for GWP are based on the UN's Intergovernmental Panel on Climate Change *Assessment Report 5* (IPCC AR5)

Scope 2 – Indirect Emissions from Purchased Utilities

Other activities on campus indirectly result in the emission of greenhouse gases through the purchase of utilities, such as electricity. Although they occur elsewhere where electricity is generated, Scope 2 emissions are attributable to the consumer since customers are creating the demand for the purchased commodity.

- **Electricity:** The electricity consumed on Bryn Mawr's campus that is purchased from electric generators indirectly influences the emission of greenhouse gases elsewhere. Scope 2 emissions are calculated using the Market-Based Approach, which accounts for the specific assortment of power plants across the region and utilizes the average emissions rate provided in the EPA's Emissions & Generation Resource Integrated Database (eGRID) report⁴. The Market-Based approach factors in the Green-e residual mix emissions rate, which is a calculated emissions rate that adjusts to remove all Green-e certified Renewable Energy Credit (REC's) sales. In 2019, Bryn Mawr purchased 16,768.21 MWh's of Green-e certified REC's annually, which offset 100% of emissions from purchased electricity.

Scope 3 – Indirect Emissions (Other)

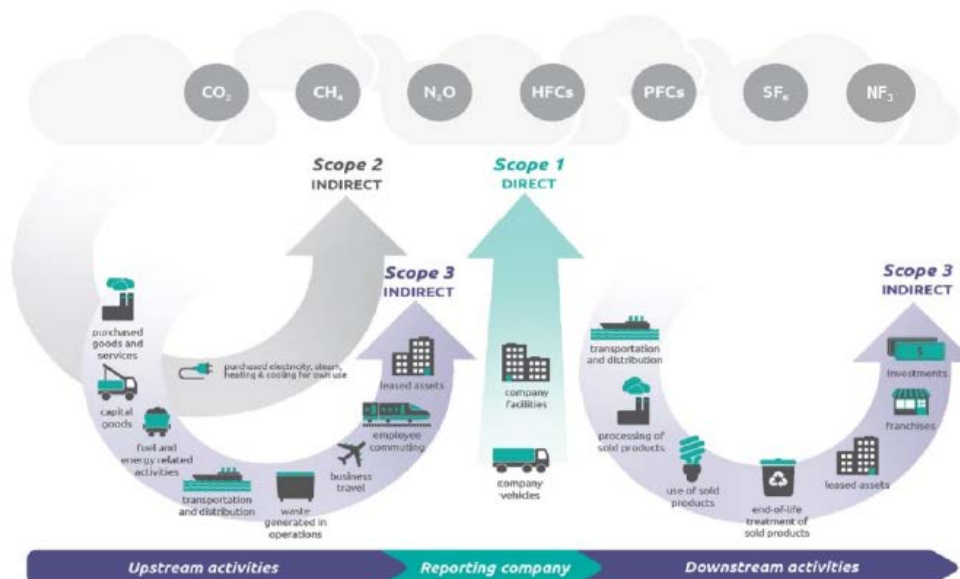
Scope 3 comprises the remaining "other" indirect sources of greenhouse gas emissions. These are generally emissions that occur as a result of an organization's business activity, such as the purchasing of supplies, waste generation, employee & student travel, and commuting. Scope 3 emissions are the most difficult emissions to measure accurately, and there is industry-wide acceptance that overlap exists between the Scope 3 inventories of different organizations. Therefore, it is best to account for as much of the Scope 3 inventory as is possible, given the data that is available.

- **Faculty/Staff Commuting:** As faculty and staff commute to and from Bryn Mawr, their mode of transportation generates greenhouse gases that are attributable to the College – unless they walk or bike to campus. These emissions are estimated based on the zip codes to/from which people are traveling each day, along with an average value for vehicle fuel economy.
- **Student Commuting:** Although a large majority of students are boarded at Bryn Mawr College's residence halls for the semester, there are some students that require transportation to and from the campus each day.
- **Directly Financed Air Travel:** Air travel that is directly financed by the College is required to be included in the Scope 3 emissions inventory. This generally includes air travel by students, faculty, and staff to attend conferences and events.

⁴ EPA eGRID Summary Tables 2018 provides output emission rates in pounds of CO₂e per megawatt-hour for 26 subregions across the country. Bryn Mawr is located in the RFCE subregion.

- **Study Abroad Travel:** Emissions from students flying to their study abroad locations throughout the world are Scope 3 emissions.
- **Solid Waste:** Emissions resulting from managing the institution’s waste are Scope 3 emissions. Bryn Mawr College currently hauls waste to the Conestoga Landfill where methane gas is collected and used to fuel generators that send electricity into the PJM electric grid. This responsible waste hauling process results in a small reduction in campus emissions.
- **Waste Water:** Bryn Mawr’s waste water flows from to the City of Philadelphia’s waste water treatment facilities.
- **Paper Purchasing:** Bryn Mawr College purchases thousands of pounds of paper per year. Approximately 15% of this paper (by weight) has at least 10% recycled content, which helps to reduce Scope 3 emissions.
- **Food Purchasing:** Estimated emissions from producing, transporting, and preparing food are included in this year’s inventory. Organic food as well as locally grown & sourced food help to reduce emissions from food purchasing.
- **Electricity Transmission & Distribution Losses:** As electricity flows over the wires between the power plant and the point where it is consumed, a portion of the energy is lost. This inefficiency results in power plants producing extra electricity in order to deliver what each consumer actually needs. The emissions associated with this extra power generation are attributed to T&D losses, and are counted as part of the Scope 3 inventory.

The graphic below summarizes Scope 1, 2, and 3 sources of GHG emissions.



Source: Adapted from WRI/WBCSD *GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard*.

Methods of Data Collection and GHG Emissions Calculation

Information for this report was gathered by Bryn Mawr College Facilities Services staff following a comprehensive process of working with stakeholders throughout campus to obtain necessary data. A spreadsheet was used to track the information that was needed and helped streamline the data collection process.

THE STONE HOUSE GROUP reviewed data, and clarified estimates & calculations with the College, as needed. Bryn Mawr utilized Sustainability Indicator Management & Analysis Platform (SIMAP) online software to calculate campus emissions. SIMAP is an emissions calculation tool created by The Sustainability Institute at the University of New Hampshire that is recommended as the industry standard by both Second Nature and AASHE. SIMAP's calculations were made using the emissions factors provided by The Climate Registry (2019) and the reporting protocol provided by the WRI/WBCSD GHG Protocol Corporate Reporting Standard.

Members of THE STONE HOUSE GROUP who completed the calculations and analysis for this report have completed coursework with the GHG Management Institute, and have extensive education, professional training, and experience to complete this type of GHG emissions inventory effort.

Greenhouse Gas Offsets

Various on-site and off-site projects can be used to reduce an organization's gross greenhouse gas emissions, all of which fall under the category of "GHG Offsets." The College currently purchases Renewable Energy Credits (REC's) that offset emissions from all electric consumption, which were 16,768,210 kWh's in FY 2019. A REC represents the environmental attributes, but not the electrons, of 1 MWh of renewable energy generation on the electricity grid. REC's are a tool used to track when and where renewable energy is generated, who it is sold to, and who is using it. When electricity is generated, the electrons are all mixed together on the grid, and there is no way to know the sources from which they were generated. REC's make it possible for consumers to choose clean energy and not have it be claimed by anyone else.

Bryn Mawr purchases REC's that are Green-e certified, meeting the environmental standards established by the non-profit Center for Resource Solutions.

Additionally, Bryn Mawr College generates on-campus non-additional offsets through preservation of trees in the College's Morris Woods. In 2018 & 2019, the College undertook a detailed assessment of trees on campus, determining that there are 1,298 large trees on the main campus. An additional 1,702 trees are located on the Morris Woods area of campus, which the College has no plans for development. Since the trees located in Morris Woods are being preserved, they are being counted as a 37 MTCDE carbon offset. This internal carbon offset project has not been verified by a third party, such as the American Carbon Registry or Verified Carbon Standard. Therefore, the offset is being categorized as a non-additional offset for FY 2019.

Factors Impacting Changes in Campus Emissions

In the time since the baseline GHG Inventory report was prepared for Bryn Mawr in 2008, several changes in GHG accounting practices and Bryn Mawr College campus operations have resulted in variations in campus emissions. These changes are highlighted below:

1. **Changes in Campus Building Use.** Bryn Mawr College has completed several facilities renovations since 2008 that have impacted campus energy consumption:
 - a. In 2015 Bryn Mawr undertook a major project on the site of the former Haffner Hall. The Cook Center is a complete renovation of what had been Haffner Hall. Additionally, New Residence Hall is made up of 101 single rooms and was the first residence hall to be built on Bryn Mawr's campus since 1969. New Dorm is the site of one of the two dining halls on campus.
 - b. In 2017 Bryn Mawr College received the Grand Jury Award from the Preservation Alliance for Greater Philadelphia for the multi-year renovation of Thomas Great Hall. The Preservation Alliance lauded the renovation as "not only a model of excellence in stewardship by an academic institution, but also of innovative design techniques that balance preservation with the demands of modern building use."
 - c. In 2018 Phase One of the Park Science Center was completed, which included a 10,000 GSF addition and renovation of existing space to create new collaborative learning spaces, technology-rich classrooms, and student study areas.
2. **Change in campus size and enrollment.** In FY 2008 the Bryn Mawr College campus consisted of 1,340,225 gross square feet with student enrollment at 1,649 FTE's. As of FY 2019 the campus has contracted by approximately 3% to 1,297,065 gross square feet with student enrollment slightly increased at 1,686 FTE's. While the campus size has slightly decreased, renovations have increased the density of energy consuming systems on campus.
3. **New Scope 1 and 3 Emissions Categories.** Since 2008, GHG accounting has expanded to become more comprehensive and accurate. Refrigerants, fertilizers, study abroad travel, wastewater, paper purchasing, and food purchasing are new categories of Scope 1 & 3 emissions that have increased Bryn Mawr's emissions by 2,219.2 MTCDE through their inclusion. Of these categories, refrigerants, fertilizer, wastewater, and food purchasing are new categories since the 2014 GHG Inventory. SIMAP has indicated that they intend to continue expanding Scope 3 emissions categories. Examples could include computer equipment and/or furniture purchasing. Colleges and universities purchase a substantial amount of new office, classroom, and dormitory furniture annually. College Instructional & Information Technology Services purchases many computers, and peripheral equipment. Emissions resulting from these purchases are not currently included as a Scope 3 emissions category, but could be in the future.

4. **More Detailed Data Collection Processes.** The Greenhouse Gas Protocol considers emissions sources that add to less than 5% to be considered “de minimus.” Rather than investing resources in precise calculations for minor sources of emissions, institutions use reasonable estimates. At Bryn Mawr College, several categories of emissions are de minimus. However, the College’s facilities staff completed a highly detailed investigation of all emissions categories. As the College continues to complete GHG Inventories, it is likely that processes and sources of data will continue to improve over time.

5. **Updated Global Warming Potentials.** The update to the values for Global Warming Potential that was provided in the UN Intergovernmental Panel on Climate Change’s Fifth Assessment Report (AR5). As scientists continue to study the effects of various greenhouse gases, the GWP values are refined.

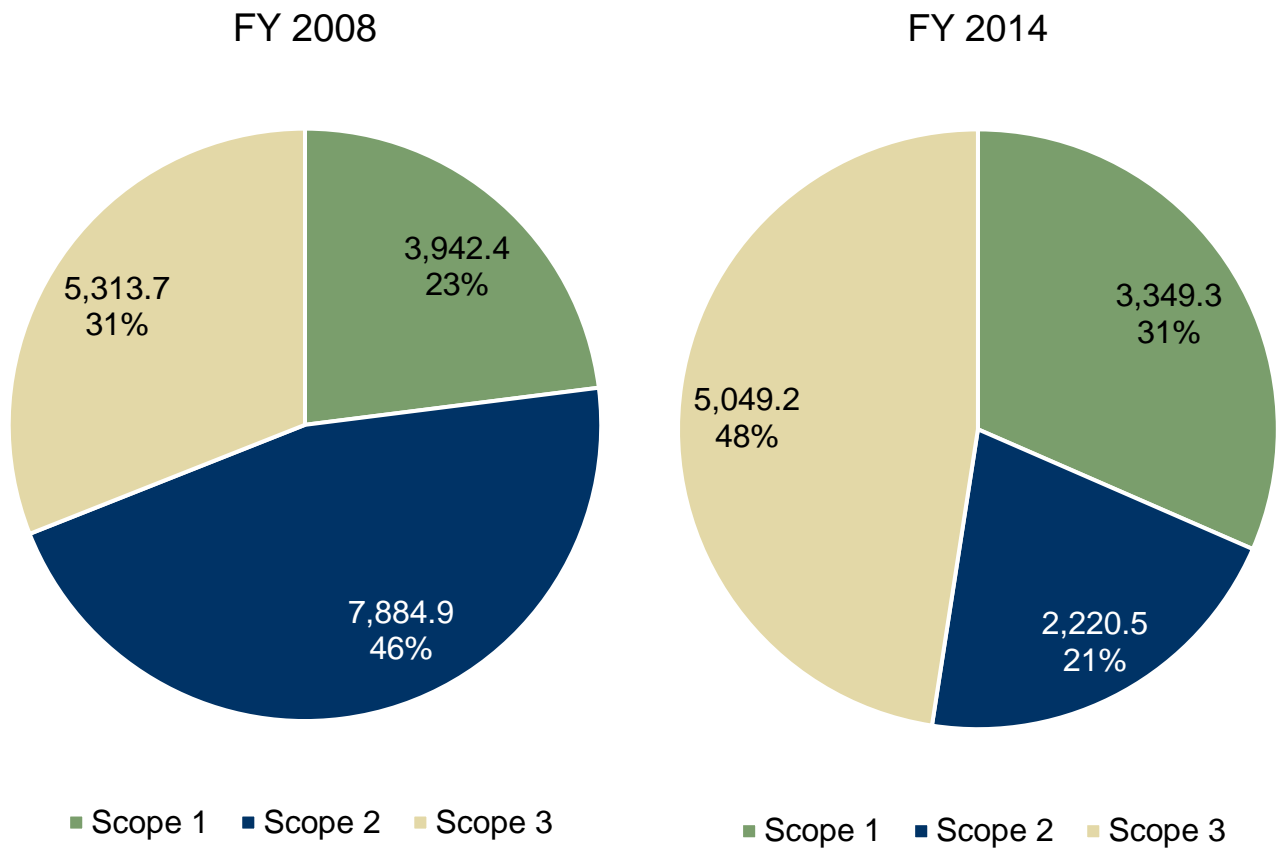
Changes to Global Warming Potentials			
GHG Name	Chemical Formula	AR4 ⁵	AR5 ⁶
Carbon Dioxide	CO ₂	1	1
Methane	CH ₄	25	28
Nitrous Oxide	N ₂ O	298	265

⁵ IPCC, 2007: *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, Pachauri, R.K. and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.
(http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_full_report.pdf)

⁶ IPCC, 2014: *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.
(http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full_wcover.pdf)

Comparison to FY 2008 (Base Year) and FY 2014 Emissions

Bryn Mawr College uses FY 2008 (June 1, 2007 – May 31, 2008) data as the College's Base Year for emissions. A GHG Inventory was most recently completed using FY 2014 operating data. Both the 2008 and 2014 inventories will be used as comparison points for the FY 2019 GHG Emissions presented in this report. In this report, gross emissions reflect all campus emissions and net emissions account for Renewable Energy Credits and Carbon Offsets that the College has retired.



Figures 1 & 2: Base Year (2008) net GHG emissions totaled 17,141 MTCDE (left). FY 2014 net GHG emissions totaled 10,619 MTCDE (right).

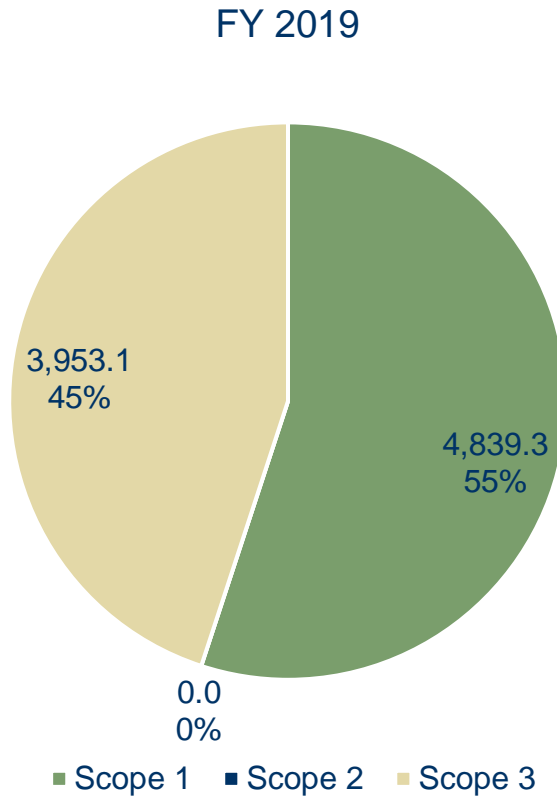


Figure 3: FY 2019 net GHG emissions totaled 8,792 MTCDE.

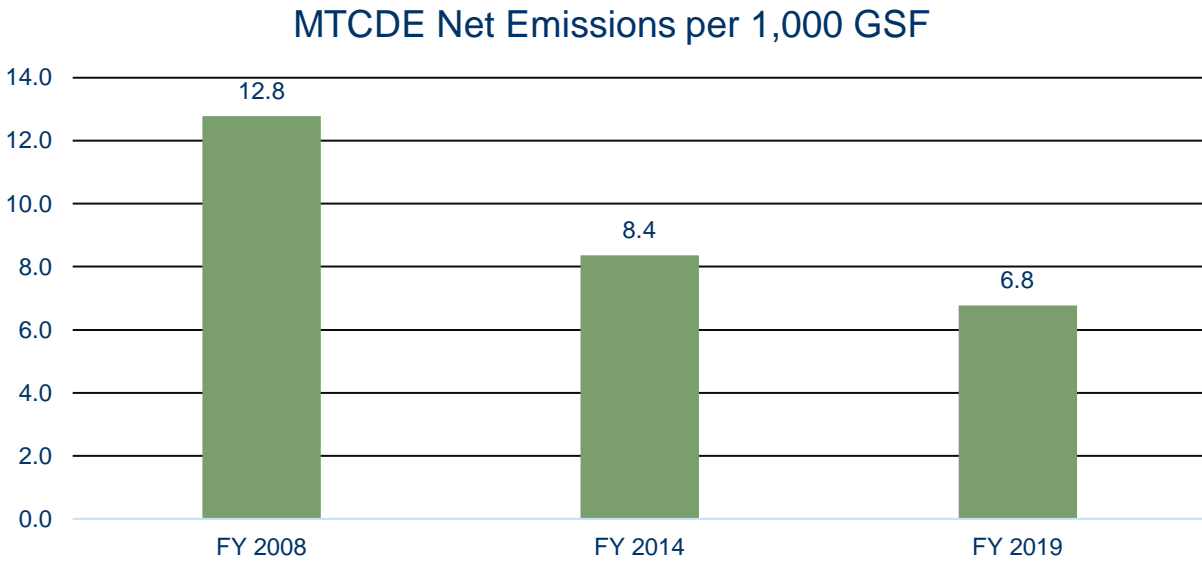


Figure 4: Comparison of Net GHG Emissions per 1,000 gross square feet of building space.

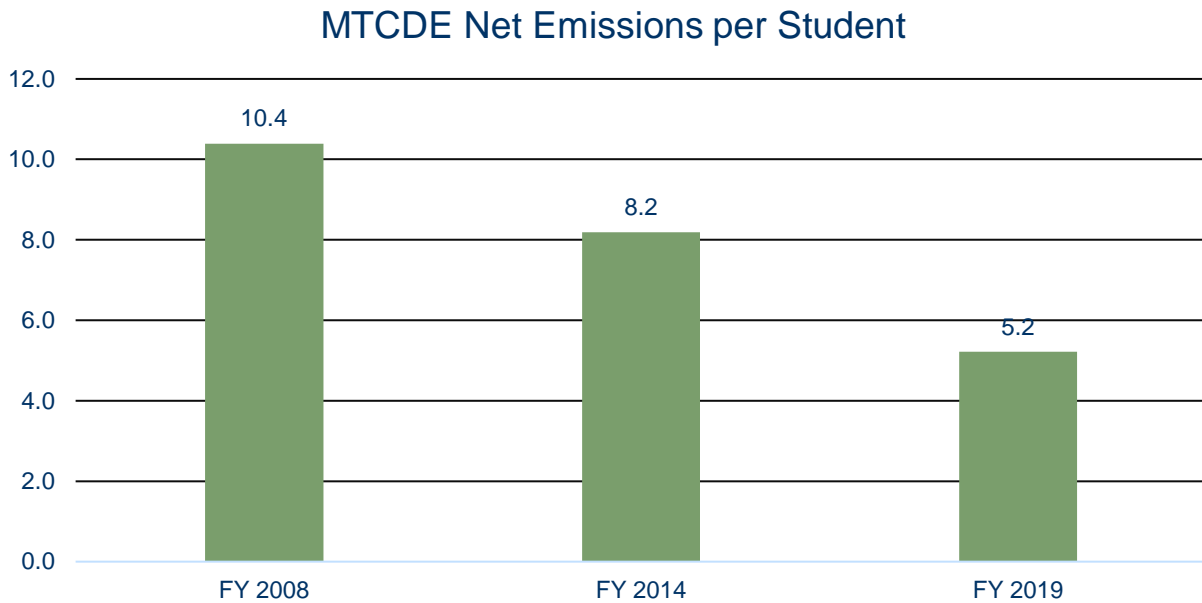


Figure 5: Comparison of Net GHG Emissions per FTE student.

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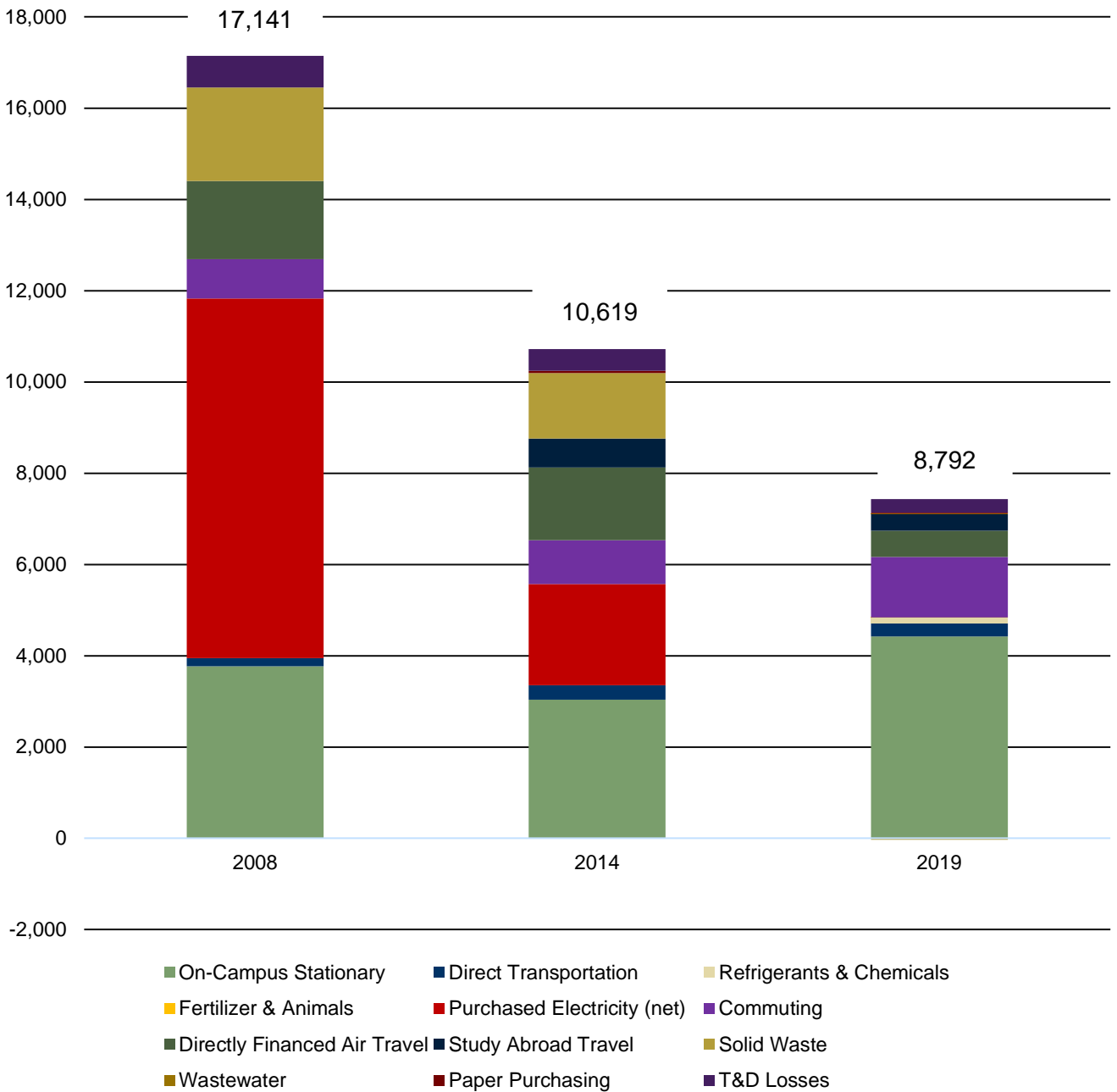


Figure 6: Comparison of net campus emissions, by category and fiscal year.

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Greenhouse Gas Inventory Update FY 2019

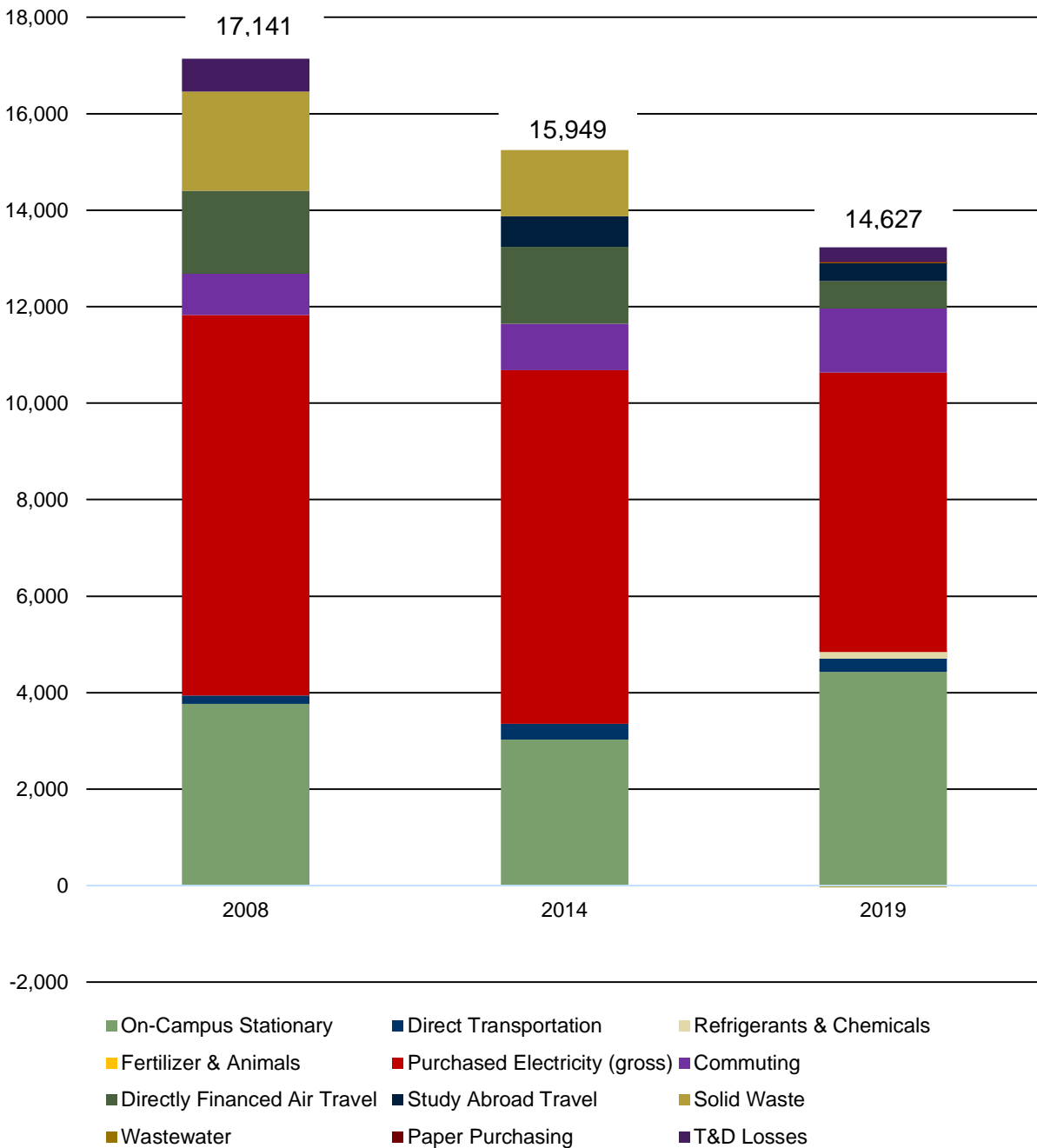


Figure 7: Comparison of gross campus emissions, by category and fiscal year.

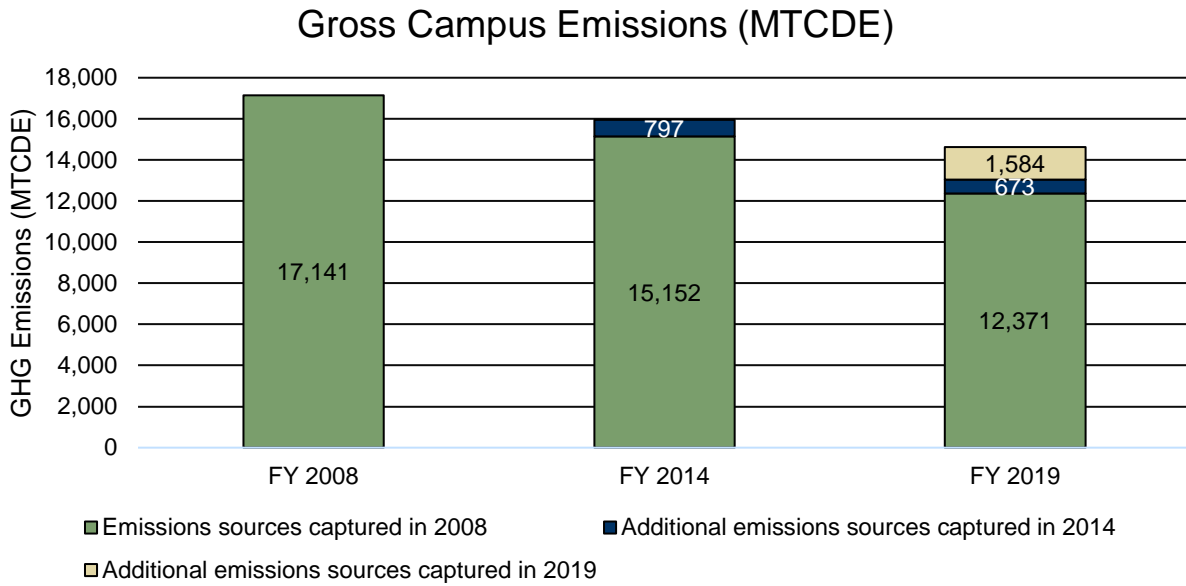


Figure 8: Illustration of new gross emissions categories, by fiscal year.

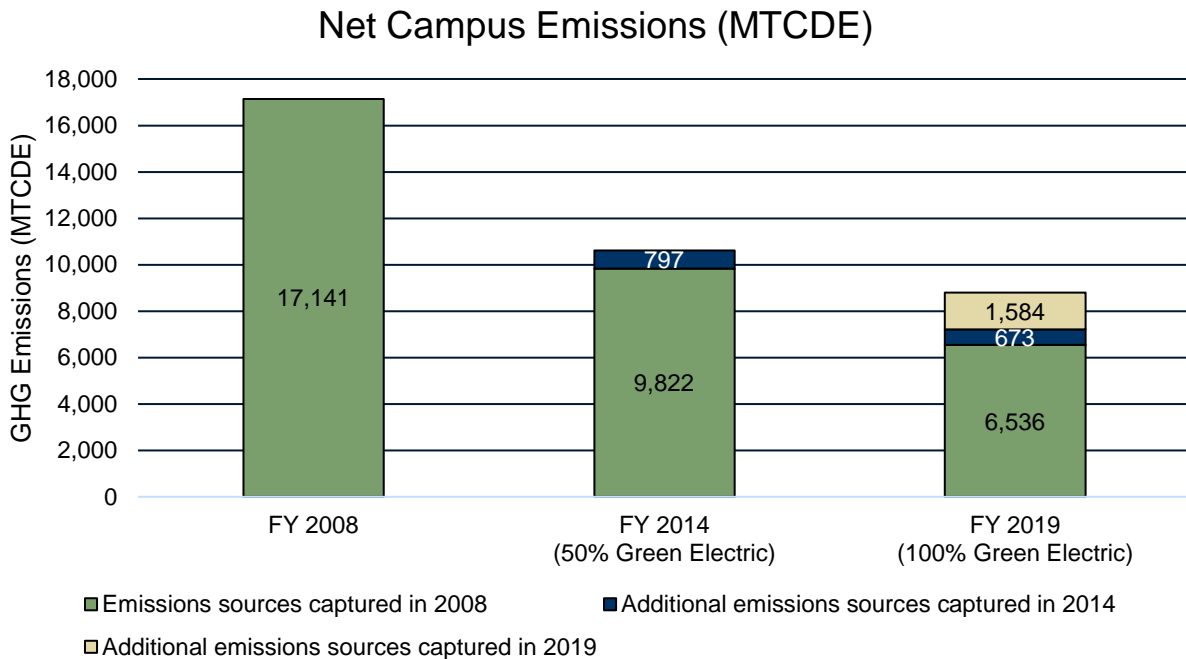


Figure 9: Illustration of new net emissions categories, by fiscal year.

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**Bryn Mawr College,
2019 GHG Inventory Summary**

	2008 GHG Inventory (Base Year)		2014 GHG Inventory		2019 GHG Inventory		2019 vs. Base Year	2019 vs. 2014
	MTCDE	% of Net	MTCDE	% of Net	MTCDE	% of Net	% Change	% Change
Scope 1	3,942.4	23%	3,349.3	32%	4,839.3	55%	23%	44%
On-Campus Stationary	3,771.0	22%	3,030.3	29%	4,425.7	50%	17%	46%
Direct Transportation	171.4	1%	319.0	3%	278.7	3%	63%	-13%
Refrigerants & Chemicals	0.0	0%	0.0	0%	134.1	2%		
Fertilizer & Animals	0.0	0%	0.0	0%	0.8	0%		
Scope 2	7,884.9	46%	2,220.5	21%	0.0	0%	-100%	-100%
Purchased Electricity	7,884.9		7,336.5		5,797.9		-26%	-21%
Purchased Wind REC's	0.0		-5,116.0		-5,797.9			
Purchased Electricity (net)	7,884.9	46%	2,220.5	21%	0.0	0%		
Scope 3	5,313.7	31%	5,263.2	46%	3,990.1	45%	-25%	-24%
Faculty Commuting	857.1	5%	956.9	6%	257.6	3%		
Staff Commuting					790.1	9%	54%	38%
Student Commuting	0.0	0%	111.6	1%	274.1	3%		
Directly Financed Air Travel	1,714.1	10%	1,594.9	15%	560.6	6%	-67%	-65%
Other Directly Financed Travel	0.0		0.0	0%	11.2	0%		
Study Abroad Travel	0.0		638.0	6%	374.7	4%		-41%
Solid Waste	2,056.9	12%	1,435.4	14%	-37.1	0%	-102%	-103%
Wastewater	0.0		0.0		3.5	0%		
Paper Purchasing	0.0		47.8	0%	23.7	0%		-50%
T&D Losses	685.6	4%	478.5	5%	297.6	3%	-57%	-38%
Food	0.0	0%	0.0	0%	1,434.1	16%		

**Bryn Mawr College,
2019 GHG Inventory Summary**

	2008 GHG Inventory (Base Year)		2014 GHG Inventory		2019 GHG Inventory		2019 vs. Base Year % Change	2019 vs. 2014 % Change
	MTCDE	% of Net	MTCDE	% of Net	% Change	% Change		
Offsets	0.0	0%	-214.0	-2%	-37.0	-0.4%		-83%
Compost	0.0	0%	-214.0	-2%	0.0	0%		
Non-Additional Sequestration	0.0	0%	0.0	0%	-37.0	-0.4%		
GROSS TOTAL CAMPUS GHG EMISSIONS	17,141.0		15,949.0		14,627.3		-15%	-8%
NET TOTAL CAMPUS GHG EMISSIONS	17,141.0	100%	10,619.0	100%	8,792.4	100%	-49%	-17%
Campus GSF	1,340,225		1,269,335		1,297,065		-3%	2%
Student Enrollment (FTE)	1,649		1,297		1,686		2%	30%
MTCDE Net Emissions per 1,000 GSF	12.8		8.4		6.8		-47%	-19%
MTCDE Net Emissions per Student	10.4		8.2		5.2		-50%	-36%

Figure 10: Detailed report of emissions by category for fiscal years 2008, 2014, and 2019.