

OREGON STATE UNIVERSITY
GREENHOUSE GAS INVENTORY
Fiscal Year 2018

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Definitions of Key Terms

1. **“American College and University Presidents Climate Commitment”** (ACUPCC) or **“Carbon Commitment”** is an effort to encourage commitments from institutions of higher learning to neutralize greenhouse gas emissions and prioritize the research and education efforts aimed at stabilizing earth’s climate. In October 2015, the ACUPCC was renamed and rebranded as the Carbon Commitment.
2. **“Bonneville Environmental Foundation (BEF)”** is a Portland, Oregon based non-profit that specializes in carbon offsets, mainly renewable energy certificates (RECs). These credits increase the volume of clean, renewable energy that enters the electrical grid. OSU purchases RECs from BEF as part of the student renewable energy fee.
3. **“Carbon dioxide”** (CO₂) means the chemical compound containing one atom of carbon and two atoms of oxygen.
4. **“Carbon dioxide equivalent”** (CO₂e) represents the quantity of a greenhouse gas multiplied by a Global Warming Potential (GWP) factor, relative to CO₂. This is the **“standard unit”** used to quantify various greenhouse gasses.
5. **“Global Warming Potential factor”** (GWP) means the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of carbon dioxide over a given period of time. For instance, methane (CH₄) has a GWP of 23, meaning that every gram of methane will trap 23 times as much solar radiation as a gram of CO₂.
6. **“Greenhouse gas”** (GHG) is any gas that contributes to anthropogenic global warming including, but not limited to, carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.
7. **“Greenhouse Gas Protocol (GHGP)”** is an internationally-used accounting tool that allows business and governmental leaders to understand, quantify and manage greenhouse gas emissions. It provides a framework for nearly every greenhouse gas standard and program in the world. The WBCSD was an original partner in drafting and creating the GHGP.
8. **“Intergovernmental Panel on Climate Change (IPCC)”** is a scientific body established to provide policymakers with an objective source of information on climate change. The IPCC performs no research nor does it monitor climate data; it instead offers analysis of research and climate data as an objective body with a broad range of views, expertise and wide geographical coverage.
9. **“Metric ton, tonne, or metric tonne”** (t) means one metric tonne (1000 kilograms) or 2204.62 pounds.
10. **“Net emissions”** is the calculated sum of GHGs emitted minus renewable energy certificates, composting activities and carbon offsets.
11. **“Radiative Forcing Index”** (RFI) is a multiplier designed to account for the effects on climate an emission source will cause in addition to the release of fossil carbon. The RFI is most commonly used for aviation emissions, where it accounts for the effects of releasing greenhouse gases at altitude. The Intergovernmental Panel on Climate Change (IPCC) has estimated the RFI multiplier for aviation at 2.0-4.0.

12. **“Renewable Energy Certificate”** (REC) is a tradable certificate that represents a unit of energy produced by renewable energy sources. The owner of a REC can claim that they are using renewable energy equal to the amount of RECs owned.
13. **“Renewable energy fee”** refers to the student-approved initiative that directs \$8.50 per term per student towards the purchase of RECs. These RECs offset a large percent of OSU’s electrical consumption with additions of clean, renewable energy to the electrical grid.
14. **“Renewable energy source”** means any source of energy that is replenished rapidly by natural processes. Renewable sources may include, but are not limited to, wind, solar, hydroelectric, biomass, geothermal, tidal or sea currents etc.
15. **“Statewides”** refers to the inventory that analyzes emissions from statewide, legislatively-mandated OSU entities, specifically the Agricultural Experiment Stations (AES), Extension Services and the Forest Research Laboratories (FRL).
16. **“Sustainability Indicator Management and Analysis Platform”** (SIMAP) is a carbon calculator used by many campuses for calculating greenhouse gas emissions. Originally developed by the former non-profit Clean Air – Cool Planet and the Sustainability Institute at University of New Hampshire (UNH), it is now owned and managed by the Sustainability Institute at UNH.
17. **“Total emissions”** is the calculated sum of GHGs emitted due to OSU-related activities.
18. **“World Business Council for Sustainable Development (WBCSD)”** is a global association of business representatives that deals exclusively with business and sustainable development.

Definition Sources

Oregon Department of Environmental Quality: www.oregon.gov/deq/pages/index.aspx

Bonneville Environmental Foundation: www.b-e-f.org/

World Business Council for Sustainable Development: www.wbcsd.org

Greenhouse Gas Protocol: www.ghgprotocol.org

Intergovernmental Panel on Climate Change: www.ipcc.ch

SIMAP Calculator: sustainableunh.unh.edu/calculator

Carbon Commitment: secondnature.org/climate-guidance/the-commitments/

Executive Summary

Oregon State University (OSU) aspires to be among the top 10 colleges and universities in the United States recognized for excellence in sustainability. This Fiscal Year 2018 (FY18) OSU Greenhouse Gas (GHG) Inventory helps track progress toward that goal. Since OSU President Ed Ray's April 2007 signing of the American College and University Presidents Climate Commitment (ACUPCC), now known as the Carbon Commitment, OSU has made partial progress toward an ambitious goal of becoming carbon neutral by 2025. However, enrollment and square footage growth in recent years have made continued GHG reductions challenging.

This report is an update and expansion of the [FY07-FY17](#) OSU GHG inventories, which themselves are expansions of a [CY04 inventory](#) commissioned by the Oregon University System (OUS).

The FY18 report provides:

1. A snapshot of OSU emissions: quantified greenhouse gas emissions resulting from OSU-related activities for the fiscal year ending June 30, 2018.
2. Comparison with prior OSU inventories and those from other schools: a comparative analysis with FY07-FY17 emissions.
3. Guidance for future inventories: the methodology, successes, challenges and rationale of this expanded report provides a framework for future OSU reports.

Findings in Brief

- OSU's FY17 **gross emissions** were 133,552.55 metric tonnes (t) carbon dioxide equivalent (CO₂e), a **6.25% decrease** from FY17. This decrease was mainly due to:
 - Decreased consumption of purchased electricity, which resulted in a decrease in Scope 2 emissions. Decreased electricity use for this year is largely attributable to the reconstruction of Peavy Hall, taking that building offline during the reporting period, milder than average weather and retrocommissioning projects on various buildings around campus.
- **Net emissions** were 132,841.60 t CO₂e, a **6.29% decrease** from FY17.
 - Sources for this decrease are the same as those noted above for gross emissions.
- **Gross emissions per full-time equivalent (FTE) student** were 4.97 t CO₂e, a **7.43% decrease** from FY17.
 - Sources for this decrease are the same as those noted above.
- **Gross emissions per 1000 square feet of building space** were 12.67 t CO₂e, a **6.0% decrease** from FY17.
 - Sources for this decrease are the same as those noted above.

FY18 OSU Comprehensive Greenhouse Gas Gross Emissions

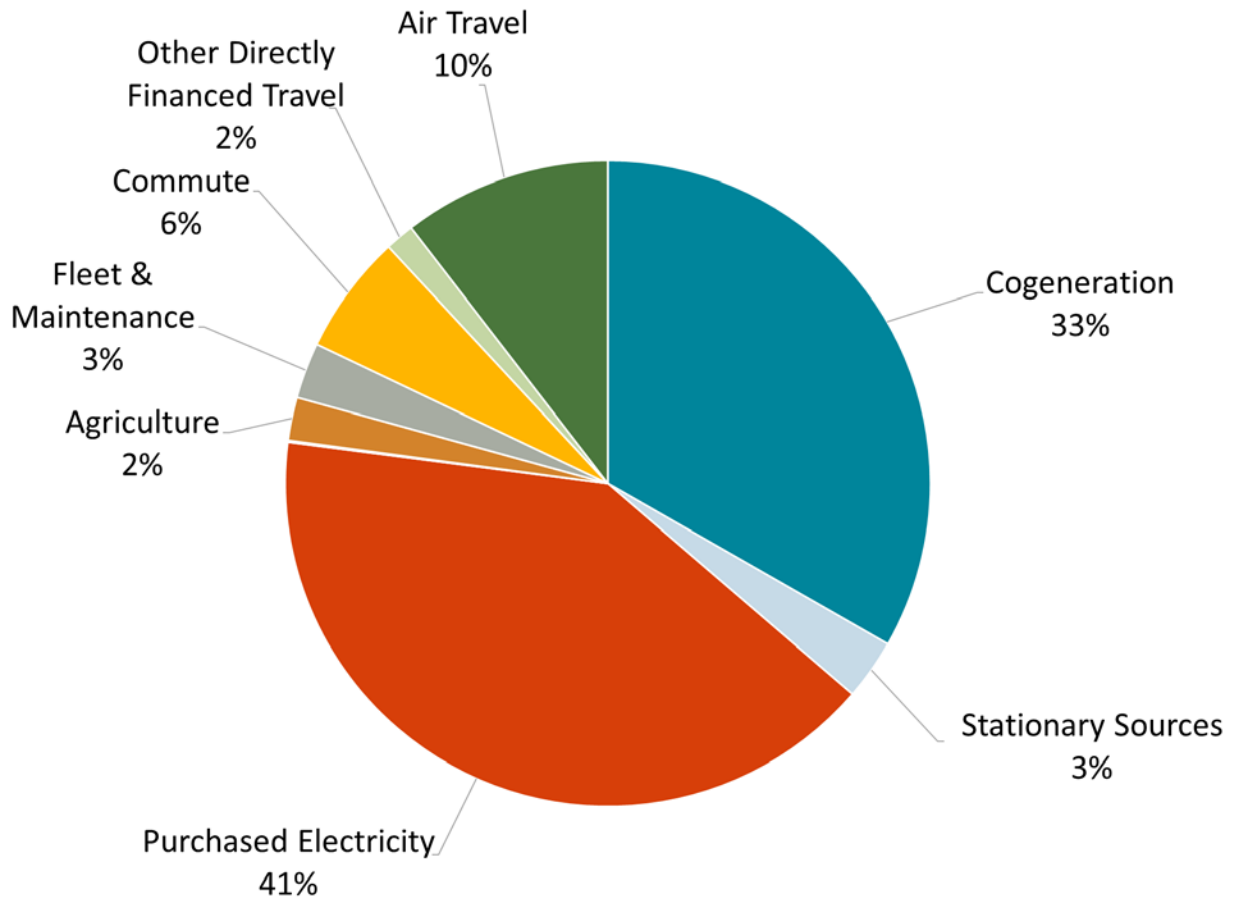


Figure 1. OSU Comprehensive Greenhouse Gas Gross Emissions by Source

FY18 OSU Comprehensive Greenhouse Gas Gross Emissions

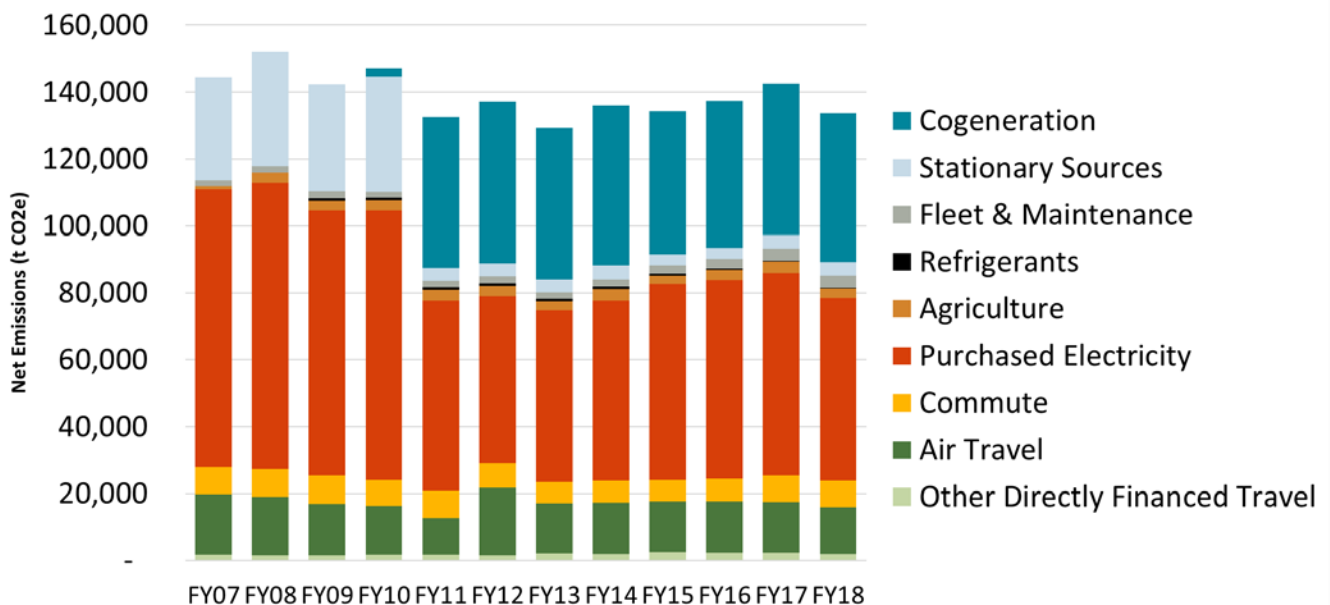


Figure 2. OSU Comprehensive Greenhouse Gas Gross Emissions

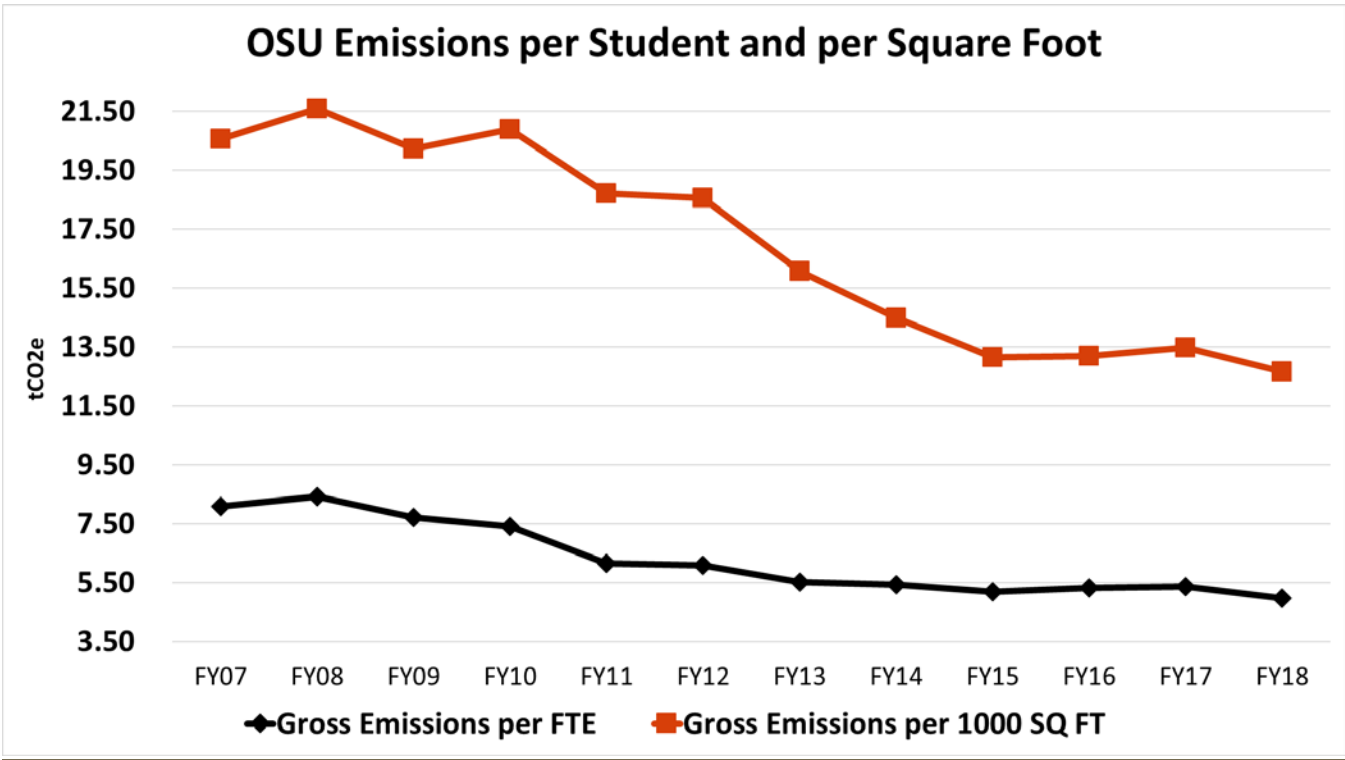


Figure 3. OSU Emissions per Student and per Square Foot of Building Space

Background

Oregon State University's twelfth annual comprehensive greenhouse gas inventory again reflects a continual improvement of data collection methods and analyses. This report includes several changes since the previous annual report issued for Fiscal Year 2017. Although not reflected in this shorter report, constructing an inventory with this level of detail is now, more than ever, a monumental task.

In an effort to streamline the report format, the OSU Sustainability Office has moved to a reporting structure that highlights changes in methods and findings from year to year. Rather than include text that largely remains static, the authors will, when appropriate, direct readers to past reports for specific details and references.

As was the case for the FY17 report, the science and methods behind best-practice greenhouse gas inventory work is ever-evolving, making year-to-year comparisons complex. OSU's inventory processes exceed (with a comfortable margin) the strictest regulatory requirements. It should be noted, however, that this report does not count detailed emissions from purchased goods and services. For more discussion of this topic, please see Omitted Emissions Sources and Sinks on page 10. Feedback is appreciated on this document and the processes used to create it. Please visit our [Emissions Measurement and Reporting Website](#) for details and updates.

Methodology

Overview

With operations as broad and far-reaching as Oregon State University's, the largest task in creating this FY18 inventory was data collection. Extensive data was gathered from central sources and from OSU entities across the state. Most large sources of GHG emissions are accounted for in their entirety. Omissions are described in the [Boundaries](#) section of this document. This is the most complete inventory of OSU's GHG emissions performed to date.

The Sustainability Indicator Management and Analysis Platform (SIMAP) calculator created and maintained by University of New Hampshire was chosen for FY18 due to its focus on university and college campuses, ease of comparison with past inventories and its endorsement by the Carbon Commitment, of which OSU is a charter signatory. SIMAP replaced the Excel-based Campus Carbon Calculator (also from University of New Hampshire), which had been used by OSU in the past years. Other reasons for selecting this tool are found on page 12 of the [FY08 report](#).

Scope and Boundaries

Identifying scope and boundary issues is a critical step in emissions reporting. While some connections to emissions sources – like electrical consumption – are direct, others, such as employee commuting or student air travel to and from the university, are not. In an effort to measure all emissions resulting from OSU activity, the boundaries were drawn to be fairly broad: any emissions from an entity over which OSU has financial and/or operational control were included.

FY18 essentially mirrors the methodology and reporting structure of FY17; a brief history of past reporting structures and the rationale for changes can be found on page 13 of the [FY09 report](#).

Unless otherwise noted, data comparing fiscal years and university-wide totals are drawn from the OSU Comprehensive inventory. Emissions sources like air travel and rental cars were attributed to OSU Corvallis unless otherwise noted.

Inventories

In order to account for and differentiate between all emissions of [OSU's operations across the state](#), this report is comprised of four different inventories: Corvallis Campus, OSU-Cascades, Hatfield Marine Science Center (HMSC), and the Statewide Public Services, or "Statewides." All locations are considered vital facets of the university. Key aspects of each location pertinent to this report are below.

OSU Corvallis

The main Corvallis campus produces the vast majority of the university's GHG emissions. At over 400-acres, OSU Corvallis hosts 24,760 students and 5,181 faculty and staff.

OSU Cascades

Cascades is the only branch campus of OSU. Located in Bend, Oregon, the 56-acre campus specializes in degrees like Accountancy, Natural Resources, Tourism and Outdoor Leadership, Hospitality Management, Energy Sciences Engineering and many other programs. 1,104 students enrolled at OSU Cascades in FY18.

Hatfield Marine Science Center (HMSC)

OSU's primary coastal operation and base for oceanographic research are located 50 miles west of Corvallis. Originally established as a marine laboratory for Oregon State University, HMSC currently hosts collaborative research and education programs from seven OSU colleges and six state and federal agencies on its 49-acre campus.

Statewides

As part of OSU's designation as the state's land, sea, space and sun grant institution, OSU's Statewide Public Service Programs identify emerging community issues, discover new research-based solutions, and apply new discoveries through engaged learning. The Statewides consist of three divisions, with operations in all 36 Oregon counties:

- The **OSU Extension Service** connects Oregonians to research-based knowledge for economic development, healthy and productive life choices, and sustainable ecosystems.
- The Oregon **Agricultural Experiment Station** is Oregon's principal research engine related to food, agriculture, and natural resources.
- The **Forest Research Laboratory** is a dynamic source of knowledge about the science and management of forests, the connections of people to forests, and the use of renewable materials to benefit businesses, communities, and quality of life in Oregon.

Data Gathering and Management

OSU facilities are spread throughout the state, requiring data from a large number of sources. Not all data was readily available or in a useable format. The need to balance timeliness with attaining trivial data resulted in some intentional omissions. Other emissions sources were omitted because of incomplete data and a limited ability to reliably extrapolate. Rationale for these omissions is discussed in further detail in the [FY08 report](#).

Past Inventory Comparison

An important function of this FY18 inventory is to monitor emissions trends over time. Data presented in this report reflects changes in emissions between FY17 and FY18, based on use of the highest quality data and best calculation practices available. Previous years inventories are recalculated every time there is a new version of the calculator, to account for updates in calculation methods and factors.

In an effort to present the best data using the latest calculation methods, past, current and future inventories may not be absolutely comparable for all sources. Issues of comparison over time will continue to be noted in these reports.

Boundaries

Overview

The scope and boundaries of this greenhouse gas inventory aim to be comprehensive, expanding beyond what is typically required of organizational inventories. Using terminology common to greenhouse gas reporting, most inventories at minimum examine a “Scope 1,” which includes all direct emissions from sources owned or directly controlled by the subject organization. “Scope 2” sources, which cover GHG emissions that result from importing or buying electricity, steam, heated or chilled water, are also often included. “Scope 3” includes all other indirect sources of GHG emissions that result from organization activities from sources not owned or controlled by the organization. These scopes are defined by the World Business Council for Sustainable Development (WBCSD) and are used to ensure consistency and prevent double-counting or double-crediting. The Carbon Commitment requires that signatories mitigate emissions only from Scope 1 and 2 sources, as well as commute and air travel from Scope 3. Most OSU peer institutions focus on these boundaries. Our inventory aims to document all OSU emissions for which data exist, regardless of our mitigation responsibilities. Total emissions that OSU is required to mitigate by the Commitment will be specifically identified throughout the report.

Omitted Emissions Sources and Sinks

It was not possible to precisely inventory every emissions source or sink due to diverse university operations across the state and existing business practices and accounting methods not well suited for reporting the types of data needed. Those intentional omissions are discussed below. If emissions from a source or sink are expected to contribute more than 1% to total emissions it is considered significant; those that are expected to contribute less than 1% are considered negligible and not included in this analysis.

Omitted sources and sinks are shown in Table 1:

Table 1. Omitted Sources and Sinks	
Omitted Source or Sink	Expected Impact
Water treatment and distribution (source)	Significant
Personally-financed student travel (travel abroad, to/from home) (source)	Significant
<u>Additional</u> biological sequestration (sink)	Significant
Lifecycle/embodied emissions* (source)	Significant
Off-campus vehicle use (source)	Negligible
Solid waste and commuting for Statewides, HMSC and OSU Cascades	Unknown
Recycled materials (transportation and processing) (source)	Unknown

*A [lifecycle greenhouse gas analysis](#) was performed for the Oregon University System by [Good Company](#) in August 2009 based on the Carnegie Mellon Economic Input-Output Life-Cycle Assessment (EIO-LCA) model. Quantifying emissions using FY08 expenditures for food, construction, retail goods, computers, paper, lab equipment and much more, **Good Company found that OSU’s emissions from the procurement of goods and services were estimated at nearly 85,000 t CO₂e, or more than 73% of FY08 gross emissions.**

Unfortunately, accurate measurement of emissions from procurement of goods and services is extraordinarily difficult due to a lack of emissions-related data throughout the supply chain. This report omits this source category, since current staffing levels do not support this level of research and analysis.

Findings and Analysis

Findings

Total gross and net emissions for each scope are shown in Table 2 below.

Table 2. OSU Comprehensive Emissions by Scope (t CO2e)					
	FY14	FY15	FY16	FY17	FY18
Scope 1					
Gross Emissions	58,480.76	51,715.42	53,743.83	56,595.06	55,245.38
Net Emissions	58,480.76	51,715.42	53,743.83	56,595.06	55,245.38
Scope 2					
Gross Emissions	51,185.94	55,884.41	56,628.60	57,788.20	51,924.88
Net Emissions	51,183.59	55,882.05	55,917.66	57,077.25	51,213.93
Scope 3					
Gross Emissions	26,288.79	26,746.14	27,009.91	28,075.49	26,382.29
Net Emissions	26,288.79	26,746.14	27,009.91	28,075.49	26,382.29
Total					
Gross Emissions	135,955.49	134,345.97	137,382.34	142,458.75	133,552.55
Net Emissions	135,953.14	134,343.61	136,671.40	141,747.80	132,841.60

- Scope 1 emissions are mainly from fossil fuel combustion, refrigerants and agriculture; Scope 2 emissions are from purchased electricity; Scope 3 emissions include air travel, other university financed travel (personal mileage reimbursement, Athletics bus travel, etc.), commute, solid waste, and losses due to transmission and generation of electricity. Under the requirements of the Carbon Commitment, OSU is responsible for mitigation of emissions from Scope 1 and Scope 2, as well as emissions from commute and air travel.
- OSU is required by the Carbon Commitment to mitigate *net* emissions of 129,143.16 tCO2e.
- Gross emissions from operations in Corvallis represent 93.37% of total university emissions.

Total gross and net emissions for each inventory are shown in the Table 3 below.

Table 3. Emissions by Inventory (t CO2e)					
	FY14	FY15	FY16	FY17	FY18
OSU Corvallis					
Gross Emissions	127,998.85	127,173.58	130,198.15	133,916.92	124,711.06
Net Emissions	127,996.50	127,171.22	129,487.21	133,205.97	124,000.11
Statewides					
Gross Emissions	5,752.93	5,021.72	5,062.92	5,828.83	5,718.19
Net Emissions	5,752.93	5,021.72	5,062.92	5,828.83	5,718.19
OSU Cascades					
Gross Emissions	1,230.24	1,202.96	1,312.21	1,979.20	2,536.57
Net Emissions	1,230.24	1,202.96	1,312.21	1,979.20	2,536.57
HMSC					
Gross Emissions	973.47	947.71	809.06	733.80	586.73
Net Emissions	973.47	947.71	809.06	733.80	586.73
OSU Comprehensive					
Gross Emissions	135,955.49	134,345.97	137,382.34	142,458.75	133,552.55
Net Emissions	135,953.14	134,343.61	136,671.40	141,747.8	132,841.60

Total FY18 gross and net emissions by source category are displayed in Table 4.

Table 4. FY18 OSU Comprehensive Emissions by Emissions Source						
Emissions Sources	FY18 Gross Emissions (t CO2e)	% of Gross Emissions	% Change in Gross Emissions from FY17	FY18 Net Emissions (t CO2e)	% of Net Emissions	% Change in Net Emissions from FY17
Cogeneration	44,459.46	33.48%	-1.86%	44,459.46	33.48%	-1.86%
Stationary Sources	4,048.09	3.05%	-0.05%	4,048.09	3.05%	-0.05%
Fleet & Maintenance	3,737.66	2.81%	3.00%	3,737.66	2.81%	3.00%
Refrigerants	118.09	0.09%	0.00%	118.09	0.09%	0.00%
Agriculture	2,882.08	2.17%	-17.55%	2,882.08	2.17%	-17.55%
Purchased Electricity	53,720.40	40.46%	-10.26%	54,431.35	40.99%	-10.26%
Commute	8,022.00	6.04%	1.60%	8,022.00	6.04%	1.60%
Air Travel	13,950.90	10.51%	-8.41%	13,950.90	10.51%	-8.41%
Other Directly Financed Travel	1,947.57	1.47%	-11.24%	1,947.57	1.47%	-11.24%
Solid Waste	-44.65	-0.03%	27.00%	-44.65	-0.03%	27.00%
Total	133,552.55	100%	-6.29%	132,841.60	101%	-6.25%

FY18 OSU Comprehensive Greenhouse Gas Net Emissions

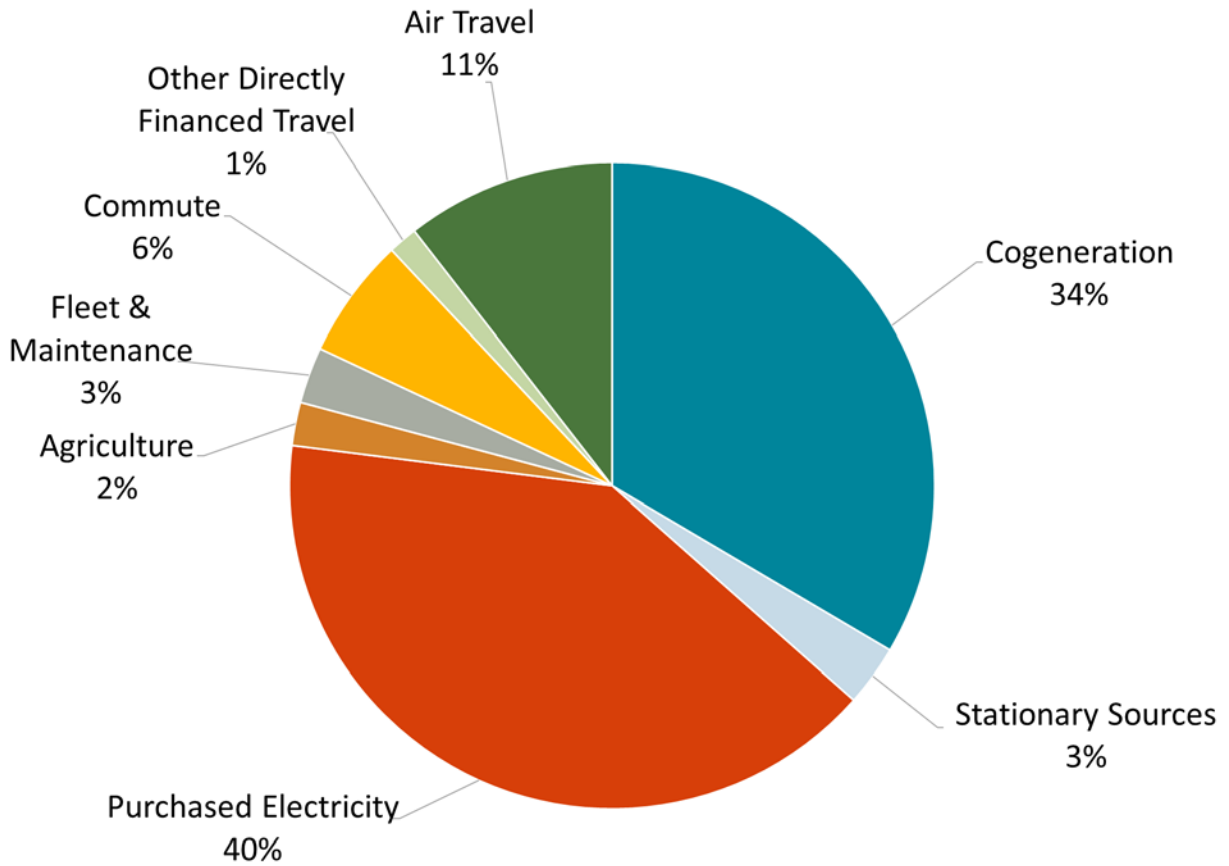


Figure 4. FY18 OSU Comprehensive Greenhouse Gas Net Emissions by Source

FY18 OSU Comprehensive Greenhouse Gas Net Emissions

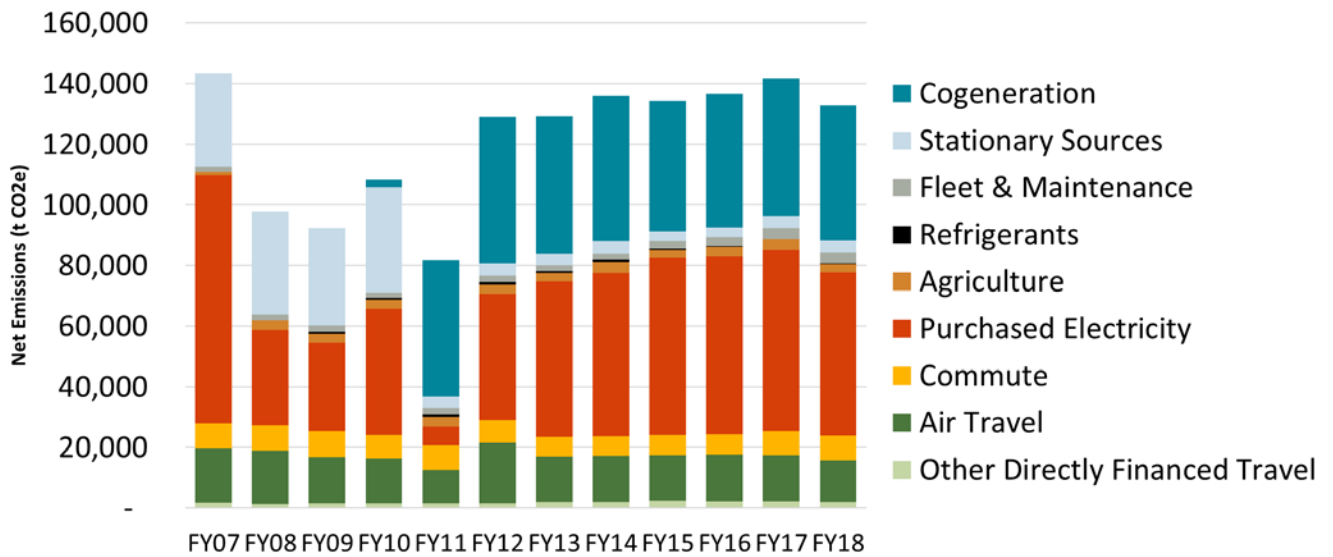


Figure 5. OSU Comprehensive Greenhouse Gas Net Emissions

Changes since the FY17 Inventory

Please see the [Analysis of Data and Results](#) section for more details regarding these changes.

Table 5 details offsets related to composting activities and purchase of renewable energy certificates (RECs). Wind power provides the majority of the RECs, which also include some biogas and biomass.

Table 5. OSU Offsets by Fiscal Year (t CO ₂ e)					
Offset Type	FY14	FY15	FY16	FY17	FY18
Renewable Energy Certificates (RECs)	3.77	2.35	2.36	710.95	710.95

Comparative Analysis

The following comparative data are drawn from the [Carbon Commitment Reporting System website](#). Several of OSU's comparable institutions have not published their FY18 data as of December 2018.

Table 6. Comparison of OSU Emissions Metrics with Peer Universities								
	'18 OSU Comprehensive	'17 OSU Comprehensive	'16 OSU Comprehensive	'15 OSU Comprehensive	'17 Cornell University	'18 The Ohio State University	'17 Utah State	'15 Washington State - Pullman
Gross emissions per FTE enrolled (t CO ₂ e)	4.9	5.3	5.3	5.2	8.8	13.8	4.2	7.3
Gross emissions per 1000 square feet (t CO ₂ e)	12.6	13.4	13.1	13.1	12.9	25.0	10.8	12.0

Analysis of Data and Results

Table 7. Analysis of Data Changes and Uncertainty	
Emissions Source	Analysis
Commute-Faculty/Staff	<p><u>Source data changes for FY18:</u> None.</p> <p><u>Methodology changes for FY18:</u> None.</p> <p><u>Uncertainty Analysis for FY18:</u> While the new OSU Transportation survey provides current data from a significant % of participants, factors such as total commute days and mileage are estimates in the SIMAP Calculator. Additional factors are reported on at page 19 the FY09 report.</p>
Commute-Students	<p><u>Source data changes for FY18:</u> None.</p> <p><u>Methodology changes for FY18:</u> None.</p> <p><u>Uncertainty Analysis for FY18:</u> Same as Faculty/Staff, above.</p>
Directly Financed Travel	<p><u>Source data changes for FY18:</u> None.</p> <p><u>Methodology changes for FY18:</u> None.</p> <p><u>Uncertainty analysis:</u> Improved data collection has continued to provide more accurate data from vendors, some minor emissions may go unreported, with an estimated impact of less than 5% of the category total.</p>
Direct Transportation	<p><u>Source data changes for FY18:</u> Data from gas and diesel consumption for Statewides was collected for the first time in FY17.</p> <p><u>Methodology changes for FY18:</u> None.</p> <p><u>Uncertainty analysis:</u> Improved data collection has continued to provide more accurate data from Statewides. However, some emissions go unreported due to difficulty in getting consumption data.</p>
Refrigerants	<p><u>Source data changes for FY18:</u> Due to changes in the data collection system for refrigerants, FY17 data was used for FY18.</p> <p><u>Methodology changes for FY18:</u> None.</p> <p><u>Uncertainty analysis:</u> None.</p>
Solid Waste	<p><u>Source data changes for FY18:</u> None.</p> <p><u>Methodology changes for FY18:</u> None.</p> <p><u>Uncertainty Analysis:</u> Data is not collected for off-campus sites. It is likely that solid waste emissions are 10-15% higher than reported.</p>

Analysis of Data Quality

Due to varied data quality and completeness, assumptions and extrapolations were used for the following areas:

- mission-related air travel
- student and faculty/staff commuting for the Corvallis campus
- gasoline and diesel fleet
- Enterprise rental car mileage.

Areas requiring further investigation and enhanced recordkeeping include:

- backup generator fuel consumption
- propane use
- fertilizer use
- solid waste and composting.

Future Action

OSU Climate Plan

As awareness and demand for action around global climate change continues to grow, requests and requirements have come from the campus community, the community at-large, and local, state and federal governments. To respond to this increasing attention and to meet the requirements of the Carbon Commitment, the OSU Sustainability Office created the [OSU Climate Plan](#) in September 2009. The Plan developed goals, frameworks and strategic steps necessary for OSU to achieve net carbon neutrality (no net emissions) by 2025.

While the 2009 Plan set a goal and vision for carbon neutrality and started some productive actions and conversations, it did not set a clear implementation mechanism. This has resulted in underutilization of the Plan and a 2025 goal that the university is not on a trajectory to meet. To address these issues, the Sustainability Office and several campus partners in 2016 launched a [Carbon Planning Toolkit](#). This Toolkit is intended to help academic colleges and administrative divisions create college and division (unit) level carbon plans that reduce carbon emissions and integrate sustainability and climate change education across curriculum and research efforts. The goal is to increase and standardize practices that help reach OSU's aggressive carbon emissions reduction target and support OSU's Strategic Plan.

Additionally, in fall 2018, the OSU Faculty Senate formed the Ad Hoc Committee on the OSU Carbon Commitment to help promote actions OSU departments can take to reduce carbon emissions. As this group begins its work to broaden the dialogue around action, the Sustainability Office is emphasizing the importance of integrating climate conscience language into department strategic plans.

Creating a 1990 Baseline

Creating an organizational baseline, or reference emissions level, is critical to goal-setting and tracking progress over time. Although detailed measurement like those in this report didn't begin at OSU until 2007, it is still possible to create a rough baseline for years past.

Determining an appropriate baseline year is both critical and challenging. OSU selected Fiscal Year 1990 as its baseline year due to the prevalence of 1990 as a baseline for many state, federal and international climate initiatives.

However, using 1990 as a baseline year imposes considerable challenges, including low data quality and availability. Much of the data central to emissions calculations are simply not available for this time period. When data are available, quality and scope are often questionable. IPCC emissions from sources like electricity and air travel from that time period are difficult to calculate. The combination of these factors makes estimating a 1990 baseline difficult.

OSU's 1990 baseline was calculated after analyzing a number of factors that correlate with emissions. They were: student enrollment FTE; faculty/staff FTE; gross square footage (GSF); natural gas use; and electricity use. Using a blend of historical data and estimations, FY90 emissions levels were calculated based on the rates of change of these factors.

Upon analysis of these factors, it was determined that emissions from electricity were best suited to use as a proxy for 1990 emissions. This is due to a number of reasons:

- Emissions from electricity represent a significant portion of OSU's gross emissions
- Prior to the cogeneration capability at the OSU Energy Center, the rate of consumption of natural gas and other heating fuels has closely mirrored the increase in electricity consumption; also, together, these sources accounted for nearly 75% of OSU's gross emissions
- The calculated emissions for 1990 based on electricity were "middle of the road" when compared with the other analyzed factors as well as other baseline estimations.

OSU's FY90 emissions are estimated to be 110,977 t CO₂e from all major sources now included in recent GHG inventories.

In the summer of 2009, the Oregon University System Chancellor's Office contracted with [Good Company](#) to provide an estimate of 1990 emissions from buildings (essentially all Scope 1 & 2 emissions) for the seven public universities in Oregon. Using campus square footage, estimated emissions coefficients for the electrical grid in 1990, and energy intensity of buildings (based on a multi-year report for the Western United States), OSU's 1990 emissions from buildings were estimated at 49,855 t CO₂e.

Due to its limited scope, the Good Company estimate could not stand alone as the 1990 emissions baseline; no Scope 3 emissions (air travel, waste, commute, etc.) were included, and some Scope 1 and 2 sources (refrigerants, fleet, etc.) were also missing. However, it does provide some assurance that the 1990 baseline calculated by the OSU Sustainability Office is reasonable.

While a relatively sound estimate for 1990 emissions is important, an exact value for 1990 emissions cannot be calculated. The value of the 1990 baseline is to set a reference point for institutional emissions reductions goals.

Findings Table

Energy

Table 8. Findings - Energy

Purchased Electricity (Scope 2)

OSU Corvallis purchased electricity usage for FY18 was 58,490,028 kWh.

The 14 Agricultural Experiment Stations (AES) consumed 3,935,036 kWh.

County Extension offices used 1,662,810 kWh.

Hatfield Marine Science Center used 1,872,261 kWh.

OSU-Cascades consumed 2,313,100 kWh.

Four Extension offices (in Aurora, Hood River, Hermiston and Central Point) are covered in the AES data, as they are combined units of both Extension and AES and share facility space.

The SIMAP calculator allowed for a grid mix specific to the electric utility. Using information from Pacific Power the following utility grid mix was used for the OSU Corvallis and OSU-Cascades. Since Statewides use a more diverse electricity resources, the utility grid mix for Statewides was determined from [EPA eGrid](#) data for the Northwest Power Pool (NWPP) utility grid mix.

Pacific Power Grid Mix	
Fuel	% of total
Coal	63.0%
Natural Gas	14.7%
Hydro	8.3%
Wind	3.6%
Geothermal	0.4%
Biomass	1.1%
Other	9.4%

NWPP Subregional Grid Mix	
Fuel	% of total
Coal	31.3%
Natural Gas	14.3%
Hydro	43.6%
Wind	4.8%
Geothermal	0.7%
Biomass	1.2%
Nuclear	3.4%
Oil	0.3%
Other	0.1%

Central Lincoln PUD reported the following utility grid mix for HMSC.

Central Lincoln PUD Grid Mix	
Fuel	% of total
Hydro	87.0%
Nuclear	9.0%
Other	4.0%

Total FY18 purchased electricity usage for OSU: 68,623,065.1 kWh.

On-campus Cogeneration	<p>In July 2009, the \$40 million Energy Center, a cogeneration facility, began producing steam from its two boilers. In June 2010, it began producing electricity under non-test conditions.</p> <p>As a cogeneration facility, the Energy Center consumed 8,359,110 therms of natural gas. It produced 550,452,255 pounds of steam and 44,740,730 kWh of electricity.</p>
Natural Gas (Scope 1)	<p>OSU Corvallis consumed 562,832.6 therms of natural gas in FY18 not including use at the OSU Energy Center. Most of this was used for space and water heating in buildings not served by steam from the Energy Center.</p> <p>The Agricultural Experiment Stations used a combined 54,880 therms.</p> <p>The Extension Service county offices used a total of 28,405 therms.</p> <p>Hatfield Marine Science Center consumed 8,793 therms.</p> <p>Cascade campus used 63,646 therms.</p> <p>Total FY18 consumption of natural gas, excluding use at the Energy Center: 718,556 therms or 71,855.6 MMBtu</p>
Steam and Chilled water purchased	<p>N/A – no steam or chilled water is purchased from non-OSU sources.</p>
Residual oils (#5, #6) and Distillate oils (#1, #2, #3, #4) (Scope 1)	<p>OSU Corvallis used 286 gallons for backup generators.</p> <p>Agricultural Experiment Stations used 1,444 gallons of diesel #2 for heating.</p> <p>Extension Service consumed 5,499 gallons of diesel #2.</p> <p>Total FY18 consumption of distillate oil #2 (diesel) for non-transportation uses was 7,230.25 gallons</p>
Propane (Scope 1 & 3)	<p>Total documented propane use at OSU Corvallis was 12,085 gallons, used mainly for heating, backup generator priming and forklifts. Purchasers of propane are scattered throughout campus and there is no centralized recordkeeping.</p> <p>Agricultural Experiment Stations used 14,328 gallons of propane for heating, forklifts and backup generators.</p> <p>The Extension Service used 2,298 gallons.</p> <p>Total FY18 consumption of propane: 28,711 gallons.</p>
Incinerated Waste	<p>The Research Animal Isolation Lab (RAIL) reported 1,516 pounds of incinerator waste for FY18.</p>
Coal	<p>N/A – no coal is directly consumed by OSU.</p>

Solar / Wind / Biomass / Human Power	During FY11, three new ground mounted photovoltaic (PV) systems were installed on OSU properties around the state. These systems are in addition to Kelley Engineering Center, Salmon Disease Lab, Research Animal Isolation Lab, and the OSU Solar Trailer. HMSC has a PV system as well. The estimated FY18 output from all sites was 2,414,660 kWh.
Data sources: Les Walton, Energy Operations Supervisor; Facilities Services; Carson Oil; Travis Feldsher, RAIL; Terri Libert, OSU-Cascades; Amerigas; Chelle Boswell, HMSC Office Specialist; numerous staff contacts at Extension county offices and Ag. Experiment Stations.	

Transportation

Table 9. Findings - Transportation	
<p>Fleet and Maintenance (Scope 1)</p>	<p>Gasoline</p> <p>Fossil fuels used in transportation are reported separately from fuels used in stationary sources. OSU has a fuel pump located at the Motor Pool that fills maintenance and fleet vehicles. There is also a credit card system that allows individuals on business trips to fill fleet vehicles wherever needed. Total volume from these sources in FY18 was 303,505.7 gallons.</p> <p>OSU also received deliveries of 2,350 gallons of gasoline from Carson Oil. This fuel was primarily used in landscape equipment and vehicles.</p> <p>Corvallis Farm Unit received 2,537 gallons of gasoline in FY18. The fuel was primarily used in farm vehicles.</p> <p>The shuttles used 14,648.5 gallons of gasoline in FY18.</p> <p>Hatfield Marine Science Center used 20,326.3 gallons of gasoline for their fleet.</p> <p>The Agricultural Experiment Stations used 29,892.3 gallons of gasoline for their fleet.</p> <p>Diesel</p> <p>In Corvallis, diesel is primarily used in the small diesel fleet run by the Motor Pool.</p> <p>Reported diesel use at the campus Motor Pool filling station and the Motor Pool credit card system was 21,100.8 gallons.</p> <p>The Agricultural Experiment Stations used 25,907.7 gallons of diesel for their fleet.</p> <p>Total gasoline in FY18: 323,832 gallons</p> <p>Total diesel used in mobile sources: 21,100.8 gallons.</p>
Data sources: Justin Fleming, Motor Pool Manager; Chelle Boswell, HSMC Office Specialist; Carson Oil	

<p>Directly Financed Travel (Scope 3)</p>	<p>In FY18, 2.94 million miles were reimbursed by Travel Reimbursement.</p> <p>Mileage reimbursed to accounts outside of TRES totaled 295,420 miles.</p> <p>OSU also contracts rental cars through Enterprise Rent-a-Car. Enterprise reported OSU accounts driving 1,804,776 miles in FY18.</p> <p>Mileage driven in non-contracted vendor rental vehicles totaled 132,515.42 miles in FY18. These values were based on charges and reimbursements, and used data given by Enterprise to extrapolate a mileage total. Travel on non-contracted vendor rental vehicles is assumed to be the same as Enterprise.</p> <p>OSU Athletics charters buses to provide short- and long-distance transportation to its teams. Using a medium-length route with a known distance and typical cost, an extrapolation was made using bus charter payment information.</p> <p>A one-way trip to Portland Airport from the Corvallis Campus is 98 miles. The standard one-way rate to the airport is \$440 per bus. Total bus expenditures were calculated to be \$889,352. Assuming this rate of \$4.49/mi is representative of all chartered bus travel, Athletics' chartered buses drove 198,074 miles in FY18.</p> <p>In FY18, a reported 5,179,045.52 car miles were directly financed by OSU.</p>
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Data sources: Justin Fleming, Motor Pool Manager; Stephanie Smith, Fiscal Coordinator Business Affairs; Michelle Barnes, Enterprise Rent-a-Car; Garrett Haldeman, OSU Athletics; Anthony Travel; Azumano Travel.

<p>Commute (Scope 3)</p>	<p>It is assumed each person made one trip to campus per day. Students and staff/faculty were counted separately in the calculator. Institutional Research reports 146 teaching days per year (excluding summer) and that number was used for commuting days for students. Staff and faculty commuting days were determined by dividing the number of regular and overtime payroll hours for classified staff and faculty by the FTE of the respective classification. This method yielded 233 working days for classified staff and 245 for faculty.</p> <p>An average commute distance of 5 miles was used for personal vehicle travel and based jointly on the 2003 OSU commute survey, and a 2003 Portland State University GHG inventory estimated commute distance of 7.5 miles. While Corvallis is a much smaller community, many students commute from outside the area. More accurate information on commuting distances is needed to definitively determine commute emissions. This estimated distance was also applied to the OSU-Cascades. While the estimation is reasonable, further commuting studies should be performed to better model commute patterns there.</p> <p>An average commute distance of 3 miles was used for bus travel. This reflects the likelihood of bus commuters traveling shorter distances, as the majority of the transit system is based around Corvallis.</p> <p>Staff and faculty FTE provided by Institutional Research include OSU-Cascades, AES, Extension and the FRL. Commute distance and mode splits are most likely different from those of Corvallis Campus, yet no reliable commute data exists for these auxiliaries.</p>
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Summer students were included in commute calculations for the first time in FY13.

Data sources: Terence Merritt, Institutional Research; Rebecca Houghtaling, Senior Planner Campus Operations.

**Air Travel
(Scope 3)**

OSU used two travel agents in FY18: Anthony Travel, and Azumano Travel. They both provided significant amounts of information, as well as advice and guidance. Air travel is also reimbursed by OSU's Travel Reimbursement office.

Azumano Travel provided a report detailing all OSU activity booked through their firm and included mileage, number of trip segments and cost. Anthony Travel provided a report detailing OSU activity booked through their firm and included mileage and cost. OSU Travel Reimbursement provided a similar list. All of these reports included non-packaged, non-tour Athletics travel.

Since OSU does not have complete information on segments for FY18, the extrapolation calculation used in previous years will not be used for FY18.

32,660,108 miles for OSU were booked through Azumano Travel and Anthony Travel.

In addition, non-TRES reimbursements accounted for 58,538 miles (based on reimbursement amounts).

All air travel emissions were applied to the OSU Corvallis inventory due to lack of specific data for non-Corvallis sites.

Assumptions: Travel booked through Azumano is representative of all OSU travel.

For each away game, the OSU Football team charters an Airbus 320 to take the team from Eugene, OR to the game destination. Using the fall 2017 football schedule at <http://www.osubeavers.com/> and Webflyer.com, an airport distance calculator, the calculated distance flown by chartered football jets was 6,974 miles.

The European Environmental Agency¹ has fuel burn rates for numerous jetliners. It is estimated that for a 2,482 mile flight, an A320 will burn 11,608 kg of jet fuel.

The following calculations were made separate from the CCC calculator, as it is not equipped to accurately calculate emissions resulting from a dedicated jet flight:

$$\frac{11,608 \text{ kg fuel}}{2482 \text{ mi}} \times \frac{1 \text{ gal jet fuel}^2}{3.06 \text{ kg fuel}} \times \frac{21.095 \text{ lb CO}_2^2}{1 \text{ gal jet fuel}} \times \frac{1 \text{ t}}{2205 \text{ lbs}} = \frac{0.0146 \text{ t CO}_2}{\text{mi}}$$

$$\frac{0.0146 \text{ t CO}_2}{\text{mi}} \times 6,974 \text{ miles} = 101.45 \text{ t CO}_2 \times 2.8 \text{ RFI} = 285.17 \text{ t CO}_2\text{e}$$

$$285.17 \text{ t CO}_2\text{e} \times 0.90718474 \text{ MT} = 258.70 \text{ MT CO}_2\text{e}$$

Emissions resulting from chartered football air travel are reported under the Directly Financed Travel category.

Data sources: Teel’s Travel Planners; Enterprise; Azumano Travel; Stephanie Smith. Webflyer.com; ¹ - European Environmental Agency Emission Inventory Guidebook <http://www.eea.europa.eu/publications/EMEP/CORINAIR4> ; ² Energy Information Agency <http://www.eia.doe.gov/oiaf/1605/coefficients.html>

Other Major Sources

Table 10. Findings – Other Major Sources

Solid Waste (Scope 3)

Total weight of solid waste sent to Coffin Butte Landfill in FY18: 4.78 million lbs. (2,170.47 tons).

Coffin Butte recovers methane and produces power, but it is unknown how much methane produced could be attributed to OSU waste.

No solid waste information was available for the Statewides, HMSC or OSU-Cascades.

Data source: Andrea Norris, Campus Recycling

Animals and Agriculture (Scope 1)

Animals

Animals are raised and cared for at several OSU facilities. Their totals are displayed in the table below.

Type	Animal Science	Union Station	Burns Station	Vet Med	Soap Creek	Total
Dairy Cows	125	-	-	1	-	126
Beef Cattle	10	475	610	1	105	1,201
Horses	14	-	3		1	18
Poultry	100	-	-	-	-	100
Sheep	110	-	-	-	-	110
Swine	20	-	-	-	-	20
Goats	20	-	-	-	-	20

The College of Veterinary Medicine provided the number of treatment days for each type of animal. This annual total was divided by 365, giving a yearly equivalent for each type. One category, ‘large animals’ was determined to be mostly llamas and alpacas. Because SIMAP had no category or emissions factor for camelids, these animals were categorized as sheep because of their size and type of digestion system.

Emissions from animals kept at the Burns and Union stations were reported under the Statewides inventory. Emissions from Animal Science and Vet Med were reported under the OSU Corvallis Campus inventory.

Fertilizer

Fertilizer application on OSU grounds inadequately tracked. Even so, this emissions source is likely small. Emissions from fertilizer applied to Burns, Union and AES

grounds were reported in the Statewides inventory. Emissions from the Dairy, OSU Corvallis grounds and the Soap Creek and Berry Creek cattle ranches were reported in the OSU Corvallis inventory.

Location	Weight (lbs)	% Nitrogen
Corvallis	78,050.0	36%
Ag. Exp. Stations	117,699.3	31%
Extension Service	204.0	27%
Total	195,953.32	34.6%

Data sources: Seth Spencer, Farm Superintendent; David Bohnert, Burns & Union Stations; Bill Calender, OSU Landscape; Mandy Seals, Coordinator Client Service Vet Med.

Refrigerants (Scope 1)

Refrigerants can be powerful greenhouse gases and their tracking is required by the EPA. Small amounts can escape during typical equipment use or in cases of equipment failure. The following table outlines the type and amount of refrigerants used in FY18 and their 100-year global warming potential (GWP). OSU is currently in the planning stages for creating a system to become more compliant with legal requirements for tracking refrigerants.

Refrigerant	Weight (lbs)	GWP (100 year)
R-22	126.5	1,780
R-404A	8.0	3,260

Data source: Maureen Clarke, Facilities Services

Offsets (green tags, RECs, composting etc.)

Renewable Energy Certificates (RECs)

Total REC purchases for the OSU Corvallis campus were 903 MWh.

Total offsets for FY18: 903 MWh. Offsets with Additions

Approximately 168.9 tons of waste are composted by various campus entities. The Republic Services wood drop box, Organic Growers Club, Crop and Soil Sciences Department and the Student Sustainability Initiative compost dairy solids, pre- and post-consumer food waste from campus dining centers and landscape debris. OSU-based waste composted offsite by a third party, such as Republic Services, will not be counted as an offset by OSU. The benefit of this type of composting is instead realized in the reduced reported weight of landfill solid waste.

Comprehensive FY18 Summary

Scope	Source	CO2 (MTCDE)	CH4 (MTCDE)	N2O (MTCDE)	GHG MTCDE	% change from FY7
1	Co-gen Electricity	19,578.10	48.70	11.61	19,638.40	3.79%
	Co-gen Steam	24,744.84	61.55	14.68	24,821.06	-5.92%
	Stationary Sources	4,034.33	10.38	3.38	4,048.09	-0.05%
	Fleet & Maintenance	5,476.43	24.73	78.82	3,737.66	3.00%
	Refrigerants	-	-	-	118.09	0.00%
	Agriculture	-	2,438.96	443.12	2,882.08	-17.55%
2	Purchased Electricity	51,868.79	213.32	250.56	51,924.88	-3.47%
3	Faculty Commuting	613.33	5.15	12.76	629.28	0.41%
	Staff Commuting	2,568.04	22.18	53.53	2,634.97	2.60%
	Student Commuting	4,637.58	24.06	96.11	4,757.75	1.22%
	Air Travel	13,615.76	3.37	46.26	13,950.90	-8.41%
	Other Directly Financed Travel	1,897.77	9.98	39.82	1,947.57	-11.24%
	Solid Waste	-	(44.65)	-	(44.65)	62.72%
	T&D Losses	2,484.25	10.23	12.00	2,506.47	-9.90%

Scope	GHG MTCDE
1	55,245.37
2	51,924.88
3	26,325.92

Gross MTCDE	Offsets (MTCDE)	Compost (MTCDE)	Non-Additional Sequestration (MTCDE)	Biogenic (MTCDE)	Net MTCDE
133,552.56	(710.95)	-	-	0.50	132,841.61

Table 11. Comprehensive FY18 Summary

FY18 OSU Comprehensive Greenhouse Gas Net Emissions

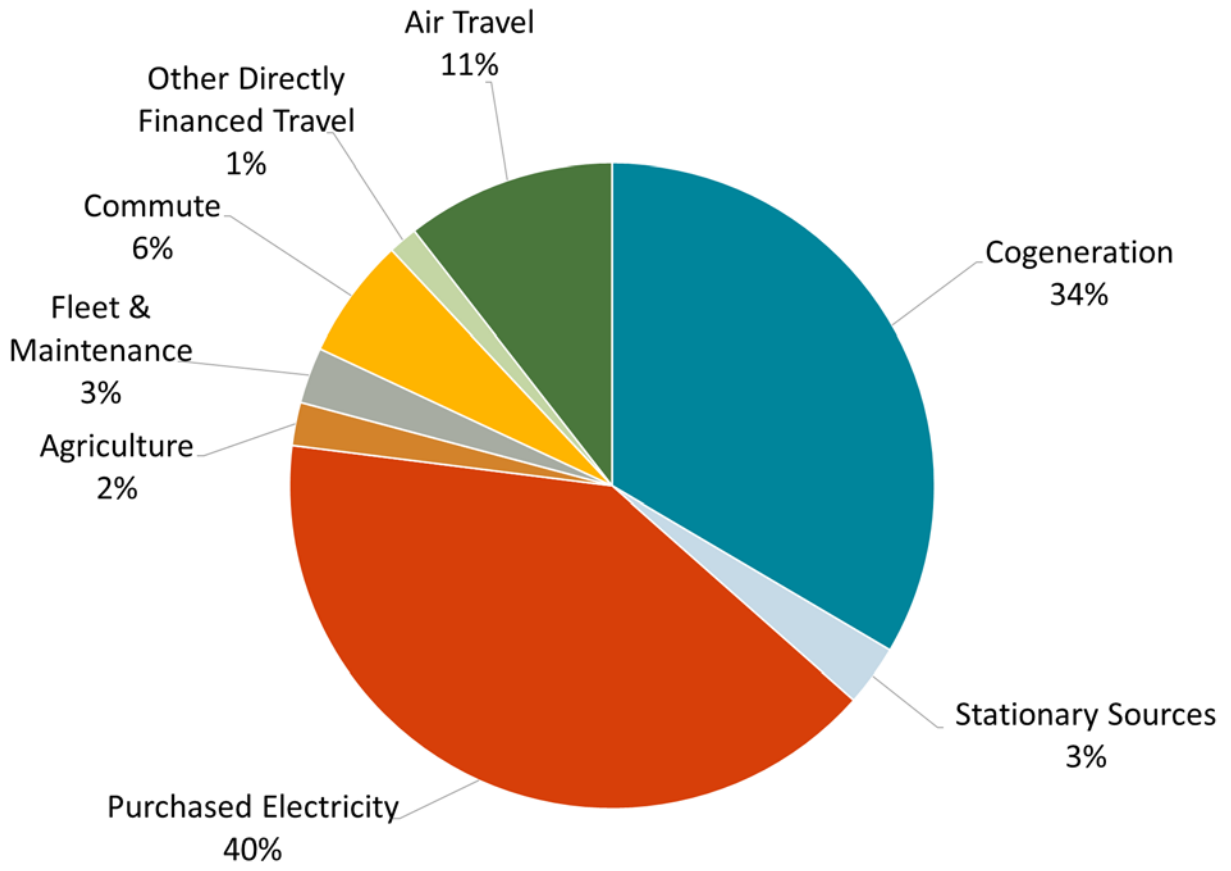


Figure 6. OSU Comprehensive Greenhouse Gas Net Emissions

OSU-Corvallis FY18 Summary

Scope	Source	CO2 (MTCDE)	CH4 (MTCDE)	N2O (MTCDE)	GHG MTCDE	% change from FY7
1	Co-gen Electricity	19,578.10	48.7	11.61	19,638.40	3.79%
	Co-gen Steam	24,744.84	61.55	14.68	24,821.06	-5.92%
	Stationary Sources	3,050.64	7.7	2.44	3,060.78	2.39%
	Fleet & Maintenance	2,907.47	14.46	58.04	2,979.96	4.12%
	Refrigerants	0	0	0	118.09	0.00%
	Agriculture	0	862.98	188.81	1,051.79	-33.28%
2	Purchased Electricity	47,404.20	198.87	229.45	47,424.75	-11.84%
3	Faculty Commuting	572.53	2.99	11.95	587.48	0.12%
3	Staff Commuting	2,489.53	13.02	51.97	2,554.52	2.56%
3	Student Commuting	4,430.56	23.04	92.02	4,545.62	0.99%
3	Air Travel	13,380.61	3.31	45.46	13,714.89	-8.08%
3	Other Directly Financed Travel	1,897.77	9.98	39.82	1,947.57	-11.24%
3	Solid Waste	0	-44.65	0	(44.65)	62.72%
3	T&D Losses	2,290.11	9.61	11.08	2,310.80	-11.45%

Scope	GHG MTCDE
1	51,670.08
2	47,424.75
3	25,616.21

Gross MTCDE	Offsets (MTCDE)	Compost (MTCDE)	Non-Additional Sequestration (MTCDE)	Biogenic (MTCDE)	Net MTCDE
124,711.06	(710.95)	-	-	0.50	124,000.11

Table 12. Corvallis FY18 Summary

FY18 OSU-Corvallis Greenhouse Gas Net Emissions

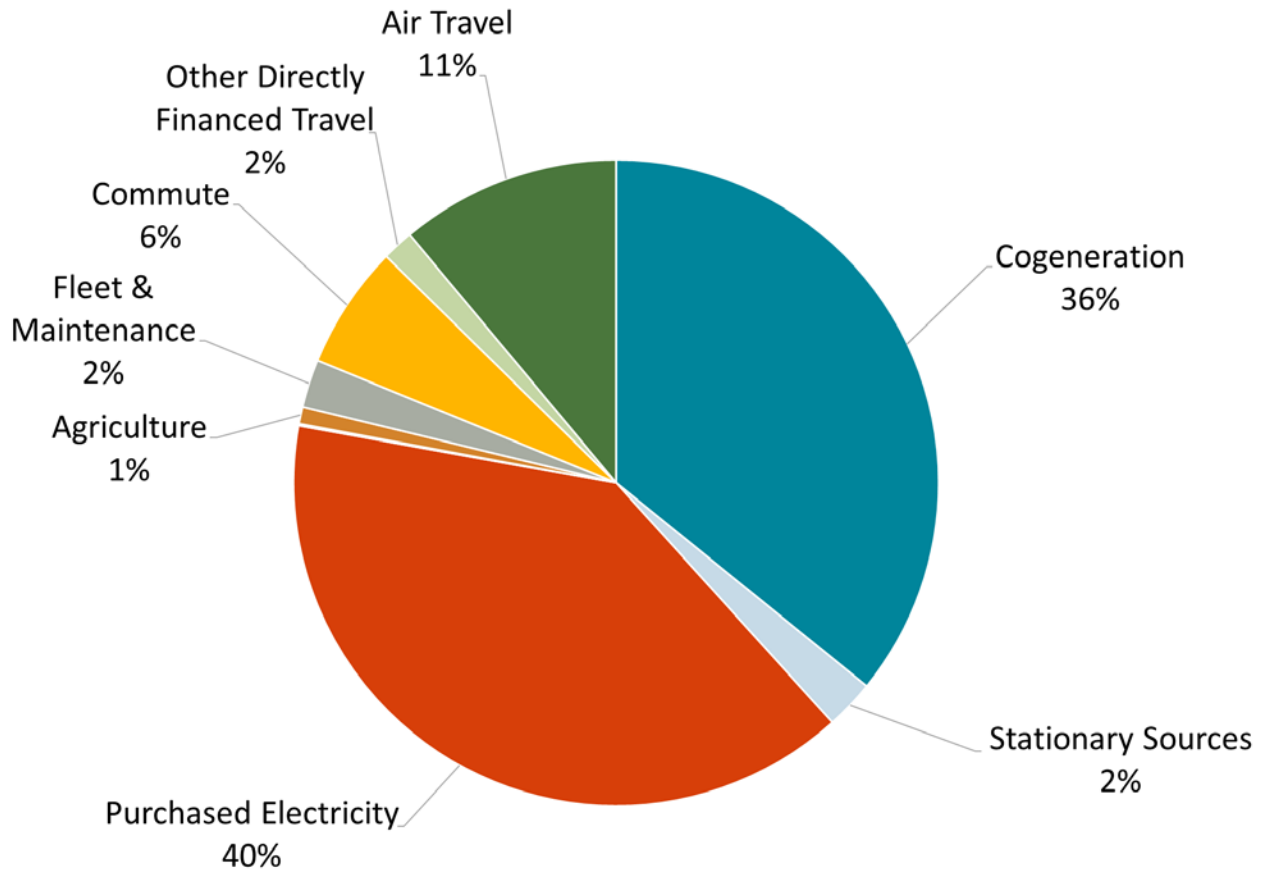


Figure 7. OSU Corvallis Greenhouse Gas Net Emissions

OSU-Cascades FY18 Summary

Scope	Source	CO2 (MTCDE)	CH4 (MTCDE)	N2O (MTCDE)	GHG MTCDE	% change from FY7
1	Stationary Sources	337.45	0.84	0.2	338.49	2.40%
2	Purchased Electricity	1826.13	7.39	8.79	1,842.31	38.32%
3	Faculty Commuting	31.63	0.16	0.63	32.41	6.16%
	Staff Commuting	32.67	0.16	0.65	33.48	9.84%
	Student Commuting	207.02	1.02	4.09	212.13	6.35%
	T&D Losses	77.07	0.31	0.37	77.75	38.32%

Scope	GHG MTCDE
1	338.49
2	1842.31
3	355.78

Gross MTCDE	Offsets (MTCDE)	Compost (MTCDE)	Non-Additional Sequestration (MTCDE)	Biogenic (MTCDE)	Net MTCDE
2,536.58	0	0	0	0	2,536.58

Table 13. Cascades FY18 Summary

FY18 OSU-Cascades Greenhouse Gas Net Emissions

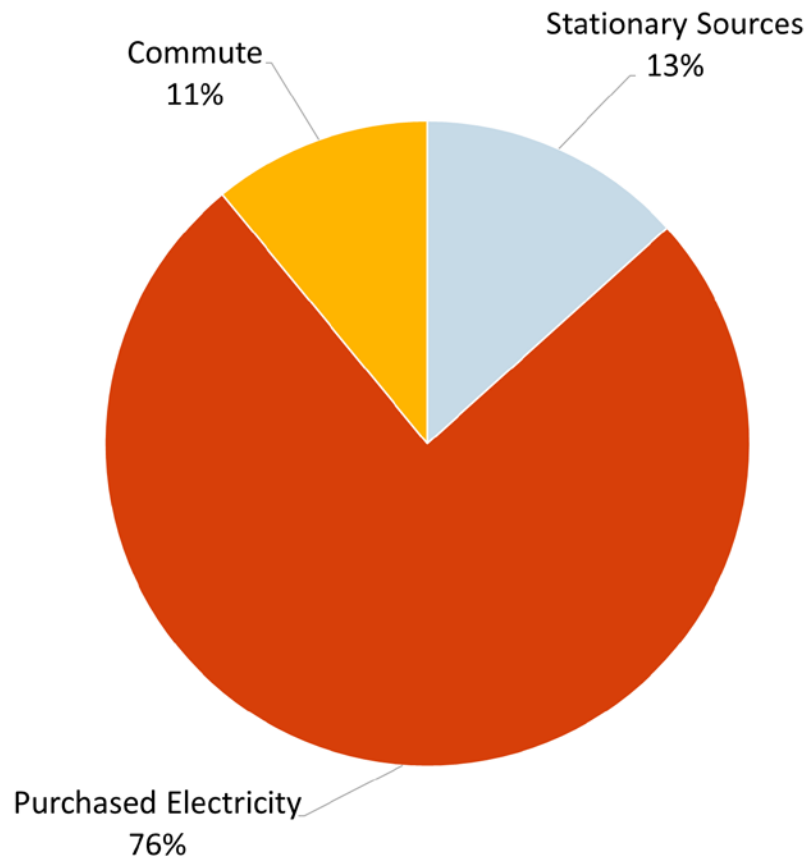


Figure 8. OSU Cascades Greenhouse Gas Net Emissions

HMSC FY18 Summary

Scope	Source	CO2 (MTCDE)	CH4 (MTCDE)	N2O (MTCDE)	GHG MTCDE	% change from FY7
1	Stationary Sources	46.62	0.12	0.03	46.77	29.13%
	Fleet & Maintenance	212.05	1.12	4.45	217.62	-28.68%
2	Purchased Electricity	28.63	0.02	0.12	28.76	17.10%
3	Faculty Commuting	9.17	2	0.18	9.39	0.00%
	Staff Commuting	45.84	9	0.91	46.97	0.00%
	Air Travel	235.15	0.06	0.8	236.01	-23.99%
	T&D Losses	1.21	0	0.01	1.21	16.35%

Scope	GHG MTCDE
1	264.38
2	28.76
3	237.22

Gross MTCDE	Offsets (MTCDE)	Compost (MTCDE)	Non-Additional Sequestration (MTCDE)	Biogenic (MTCDE)	Net MTCDE
586.73	0	0	0	0	586.73

Table 14. HMSC FY18 Summary

FY18 HMSC Greenhouse Gas Net Emissions

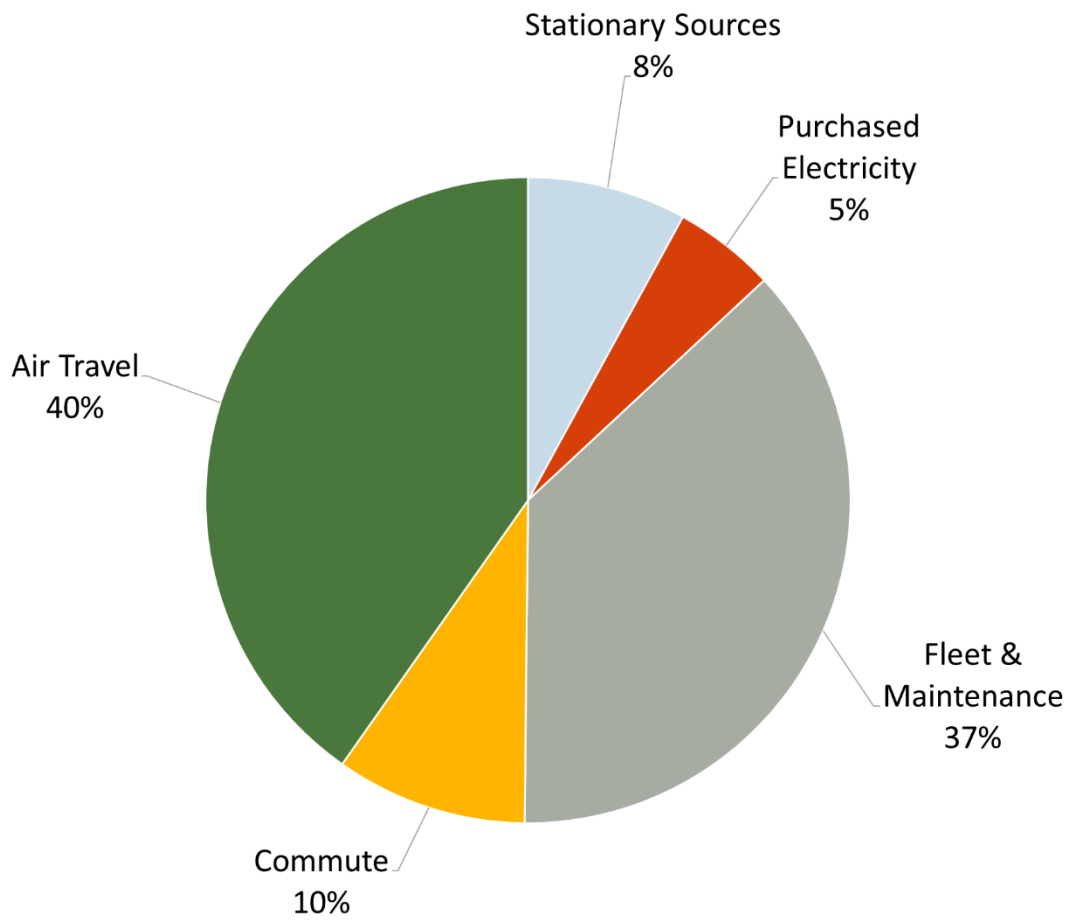


Figure 9. OSU HMSC Greenhouse Gas Net Emissions

Statewides FY18 Summary

Scope	Source	CO2 (MTCDE)	CH4 (MTCDE)	N2O (MTCDE)	GHG MTCDE	% change from FY7
1	Stationary Sources	599.62	1.72	0.71	602.05	-13.24%
	Fleet & Maintenance	530.78	1.76	7.54	540.08	16.98%
	Agriculture	0	1575.98	254.31	1,830.29	-4.62%
2	Purchased Electricity	2,609.83	7.04	12.2	2,629.06	-0.38%
3	T&D Losses	115.86	0.31	0.54	116.71	1.47%

Scope	GHG MTCDE
1	2,972.42
2	2,629.06
3	116.71

Gross MTCDE	Offsets (MTCDE)	Compost (MTCDE)	Non-Additional Sequestration (MTCDE)	Biogenic (MTCDE)	Net MTCDE
5,718.19	0	0	0	0	5,718.19

Table 15. Statewides FY18 Summary

FY18 Statewides Greenhouse Gas Net Emissions

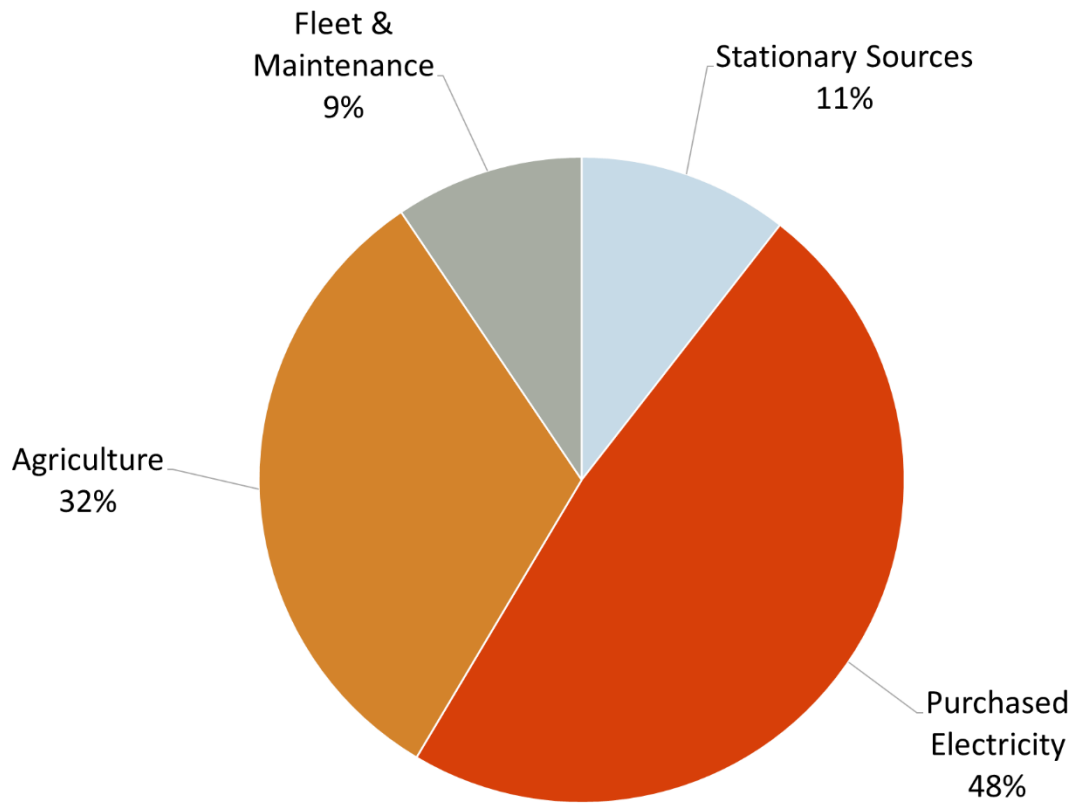


Figure 10. OSU Statewides Greenhouse Gas Net Emissions