OREGON STATE UNIVERSITY Fiscal Year 2022
GREENHOUSE GAS INVENTORY

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Definitions of Key Terms

1. **"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.

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: https://unhsimap.org/home
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 2022 (FY21) 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, staffing shortages and continued enrollment and infrastructure growth have made continued GHG reductions challenging.

FY22 marked the first year of full in-person operations after 15 months of remote operations due to COVID-19. This return to in-person operations in all OSU campuses had a significant impact on OSU's operations compared to FY21.

This report is an update and expansion of the **FY07-FY21** OSU GHG inventories, which themselves are expansions of a CY04 inventory commissioned by the Oregon University System (OUS).

Findings in Brief

- OSU's FY22 **gross emissions** were 117,405.1 metric tonnes (t) carbon dioxide equivalent (CO2e), a **19.1% increase from FY21 and a 14.66% decrease from FY19, a pre-pandemic comparator year**. The increase since FY21 was mainly due to:
    - Increased electricity and natural gas consumption. Increased consumption for this year is attributable to the return of in-person operations as well as the opening of the Gladys Valley Marine Studies Building in Newport.
    - Return of commuters to campus. Increased emissions from commuting were largely attributable to the return of in-person operations. In FY21, approximately 70% of students and employees worked remotely, whereas in FY22 only 12% of students and employees worked remotely.
    - Increased air travel. Increased air travel for this year is largely attributable to the return of domestic and international OSU-sponsored travel for all of FY22.

- **Net emissions** were 116,500.2 t CO2e, a **18.3% increase** from FY21, and a 13.6% decrease from FY19.
    - Sources for this decrease are the same as those noted above for gross emissions.

- **Gross emissions per full-time equivalent (FTE) student** were 4.2 t CO2e, a **13.0% increase** from FY21, and 17.1% decrease from FY19.
    - Sources for this decrease are the same as those noted above.

- **Gross emissions per 1000 square feet of building space** were 11.1 t CO2e, a **19.9% increase** from FY21, and 12.9% decrease from FY19.
    - Sources for this decrease are the same as those noted above. Additionally in FY22, there was a decrease of 79,674 square feet of measured building space. This change was due to net loss of square footage as well as changes in space measurement processes.

- Since 2008, gross emissions have dropped 22.6%
    - Emissions per student have dropped 49.3%
    - Emissions per 1000 square feet of building space have dropped 48.7%.

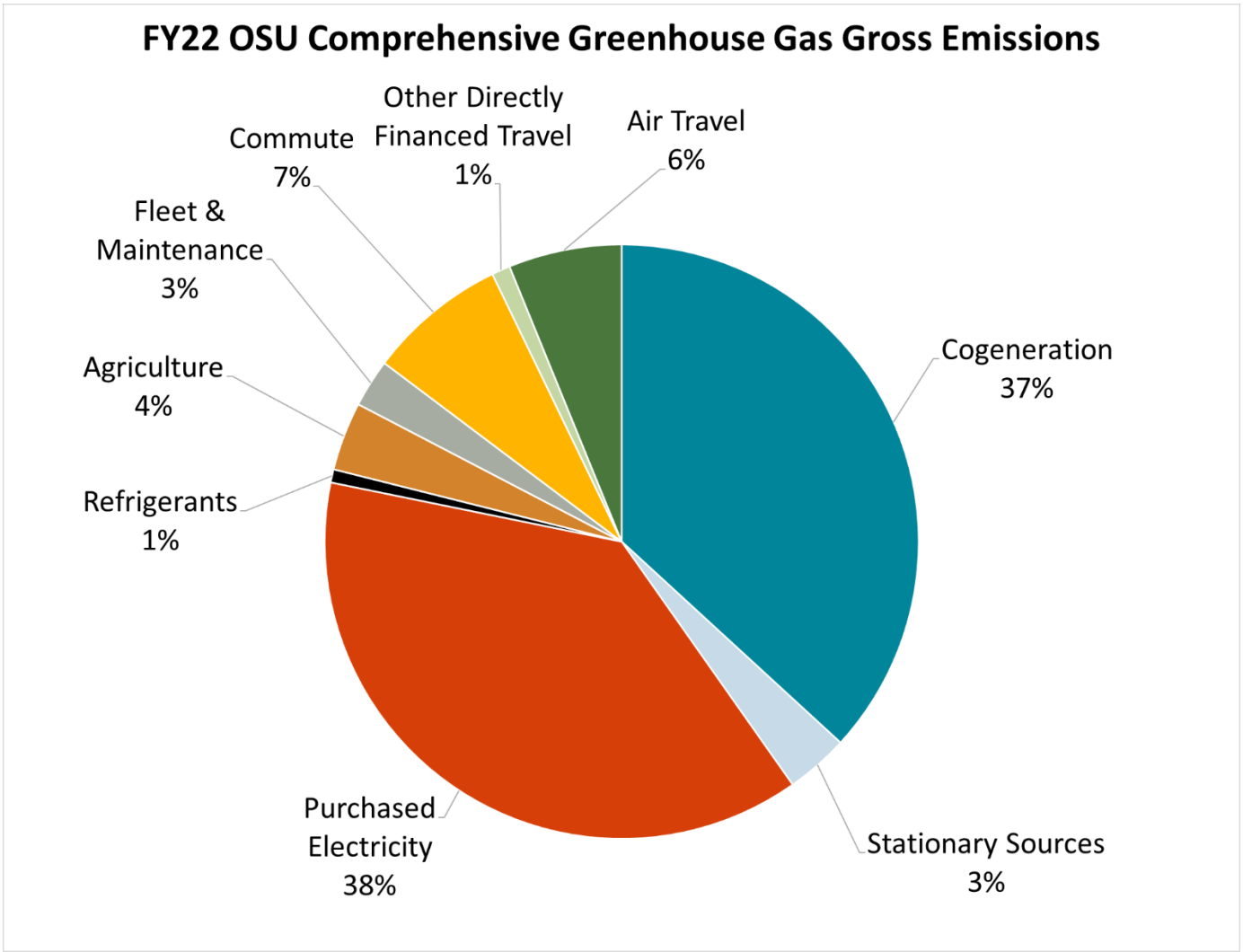


Figure 1. OSU Comprehensive Greenhouse Gas Gross Emissions by Source

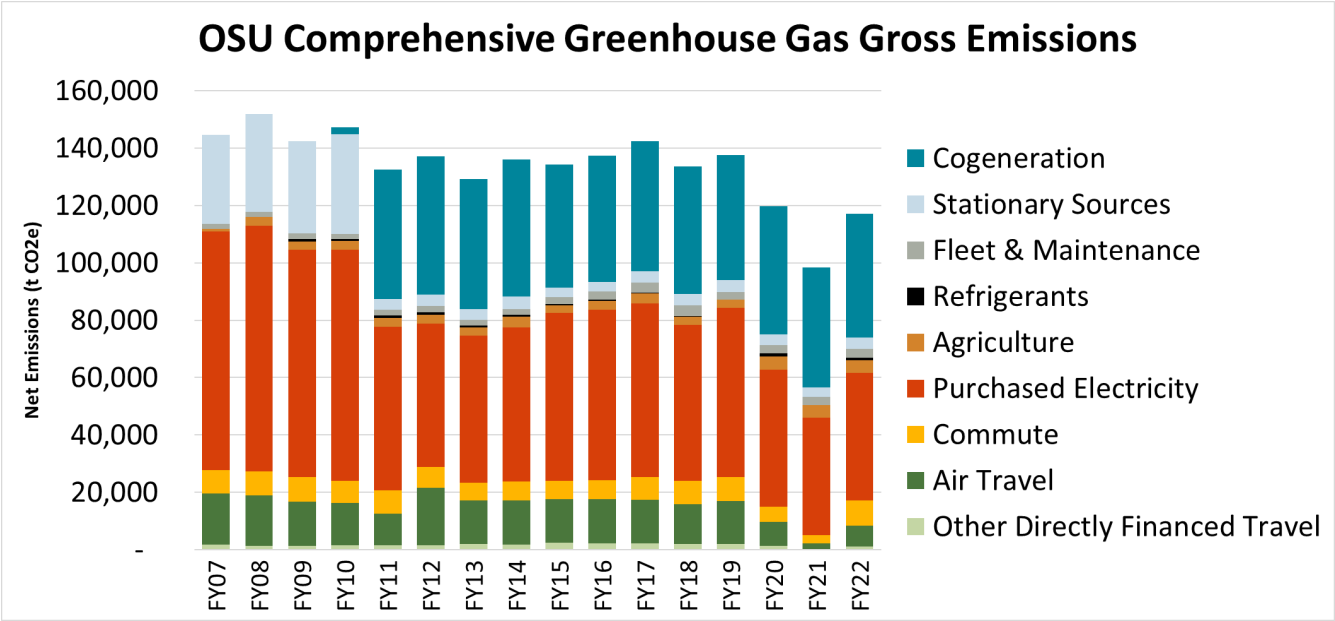


Figure 2. OSU Comprehensive Greenhouse Gas Gross Emissions

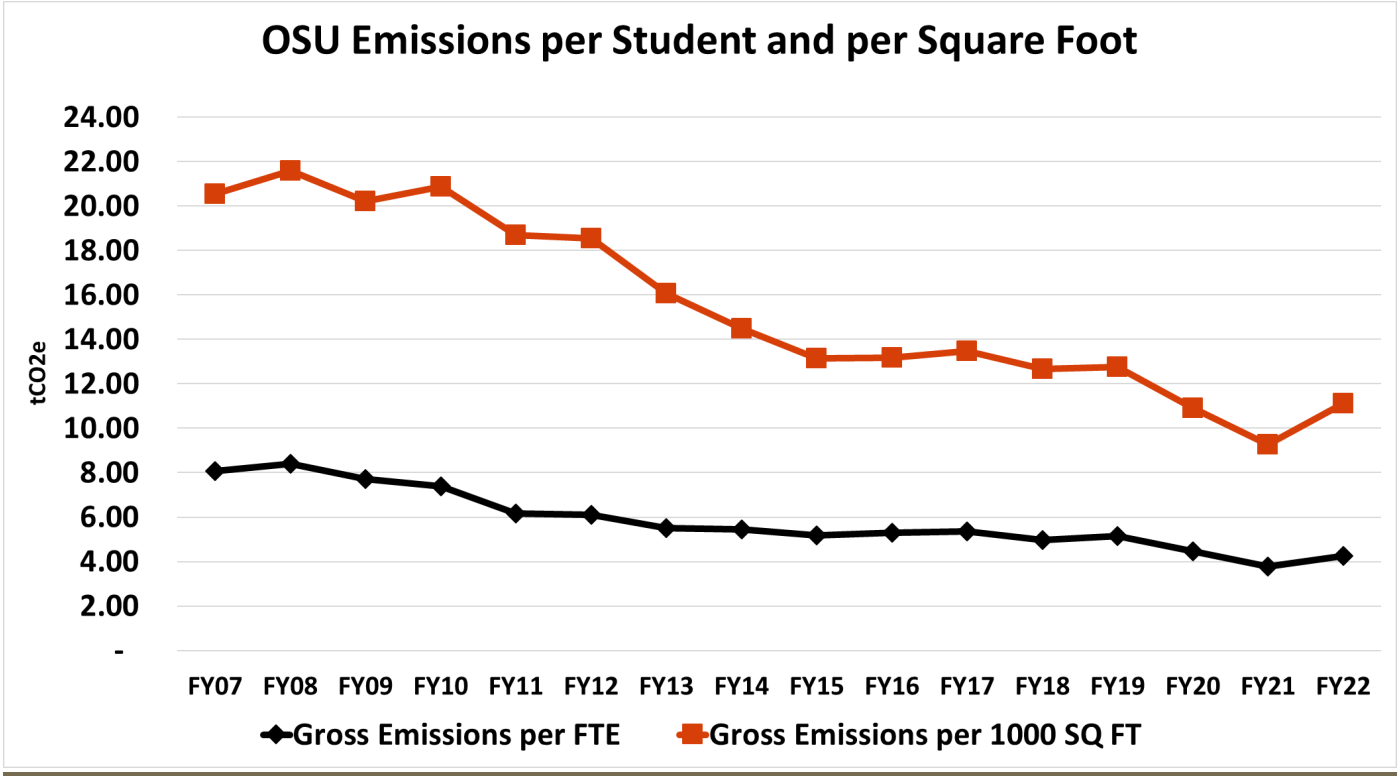


Figure 3. OSU Emissions per Full-time Equivalent Student and per Square Foot of Building Space

Background

Oregon State University's fifteenth 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 2021 (FY21). 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 FY21 report, the science and methods behind best-practice greenhouse gas inventory work are ever-evolving, making year-to-year comparisons complex. OSU's inventory processes excees (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 11. Feedback is appreciated on this document and the processes used to create it. Please visit our **Emissions Measurement and Reporting Webpage** for details and updates.

Methodology

Overview

With operations as broad and far-reaching as Oregon State University's, the largest task in creating this FY22 inventory was data collection. Extensive data were gathered from central sources and from OSU entities across the state. Most large sources of GHG emissions are accounted 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.

As in years past, the Sustainability Indicator Management and Analysis Platform (SIMAP) calculator created and maintained by the University of New Hampshire Sustainability Institute was chosen for FY22 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.

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, except emissions from purchased goods and services.

FY22 essentially mirrors the methodology and reporting structure of FY21; 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 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 94.02% of the university's GHG emissions. At over 400-acres, OSU Corvallis hosts 33,193 students and 5,045 faculty and staff in FY22.

OSU Cascades
Located in Bend, Oregon, this 56-acre campus specializes in degrees like Accountancy, Natural Resources, Tourism and Outdoor Leadership, Hospitality Management, Energy Sciences Engineering and many other programs. 1,247 students enrolled at OSU Cascades in FY22.

Hatfield Marine Science Center (HMSC)
OSU's primary coastal operation and base for oceanographic research is 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 were 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 FY22 inventory is to monitor emissions trends over time. Data presented in this report reflect changes in emissions 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 "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 similar boundaries. Our inventory aims to document all OSU emissions for which data exist, regardless of our mitigation responsibilities. Total emissions OSU is required to mitigate by the Commitment are identified in this 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
Additional 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 (source)	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)					
	FY18	**FY19**	**FY20**	**FY21**	**FY22**
Scope 1					
Gross Emissions	55,245.4	53,353.6	56,829.0	52,335.4	55,369.4
Net Emissions	55,245.4	53,353.6	56,829.0	52,335.4	55,369.4
Scope 2					
Gross Emissions	51,924.9	56,130.1	45,567.4	38,956.4	42,076.5
Net Emissions	51,213.9	53,529.6	42,103.2	38,956.4	41,256.1
Scope 3					
Gross Emissions	26,382.3	28,096.5	17,234.4	7,301.1	19,959.5
Net Emissions	26,382.3	27,959.3	17,098.0	7,221.1	19,876.1
Total					
Gross Emissions	133,552.6	137,580.2	119,630.8	98,592.8	117,405.3
Net Emissions	132,841.6	134,842.4	116,030.2	98,512.8	116,500.2

- 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 112,698 tCO2e.

- Gross emissions from operations in Corvallis represent 94.02% of total university emissions.

- Part of the difference between gross and net emissions is attributable to periodic purchases of renewable energy certificates (RECs) and carbon offsets, partly from OSU's new travel offsets program. Most years since FY03, OSU has purchased RECs in varying quantities. In FY20, the OSU Sustainability Office launched opt-in program to offset carbon emissions from travel. In its first year, 98 carbon offsets were purchased through the program. For FY22, one carbon offset, and 1,200 RECs were purchased.

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

Table 3. Emissions by Inventory (t CO2e)					
	FY18	**FY19**	**FY20**	**FY21**	**FY22**
OSU Corvallis					
Gross Emissions	124,711.1	129,411.4	111,305.8	91,394.8	110,393.8
Net Emissions	124,000.1	126,673.7	107,705.2	91,314.8	109,488.9
Statewides					
Gross Emissions	5,718.2	5,076.6	5,510.8	5,187.3	4,509.2
Net Emissions	5,718.2	5,076.6	5,510.8	5,187.3	4,509.2
OSU Cascades					
Gross Emissions	2,536.6	2,724.4	2,339.2	1,856.7	2,082.2
Net Emissions	2,536.6	2,724.4	2,339.2	1,856.7	2,082.2
HMSC					
Gross Emissions	586.7	367.8	475.1	154.1	420.3
Net Emissions	586.7	367.8	475.1	154.1	420.3
OSU Comprehensive					
Gross Emissions	133,552.6	137,580.2	119,630.8	98,592.8	117,405.3
Net Emissions	132,841.6	134,842.4	116,030.2	98,512.8	116,500.2

Total FY22 gross and net emissions by source category are displayed in Table 4.

Table 4. FY21 OSU Comprehensive Emissions by Emissions Source			
	FY22 Emissions (t CO2e)	**% of Emissions**	**% Change in Emissions from FY21**
Emissions Sources	**Gross Emissions**		
Cogeneration	43,099.8	36.7%	3.5%
Stationary Sources	3,998.7	3.4%	14.8%
Fleet & Maintenance	3,061.5	2.6%	13.2%
Refrigerants	838.9	0.7%	710.2%
Agriculture	4,370.2	3.7%	-0.8%
Purchased Electricity	44,431.3	37.8%	8.8%
Commute	8,857.6	7.5%	210.0%
Air Travel	7,215.0	6.1%	265.5%
Other Directly Financed Travel	1,175.0	1.0%	244.3%
Solid Waste	357.2	0.3%	36.6%
Total Gross Emissions	**117,405.3**	**100.0%**	**19.1%**
Offsets	**Net Emissions**		
Composting	-83.5	-0.1%	0.9%
Purchased Offsets	-1.0	0.0%	100.0%
Purchased RECs	-820.4	-0.7%	100.0%
Total Net Emissions	**116,500.2**	**100.0%**	**18.3%**

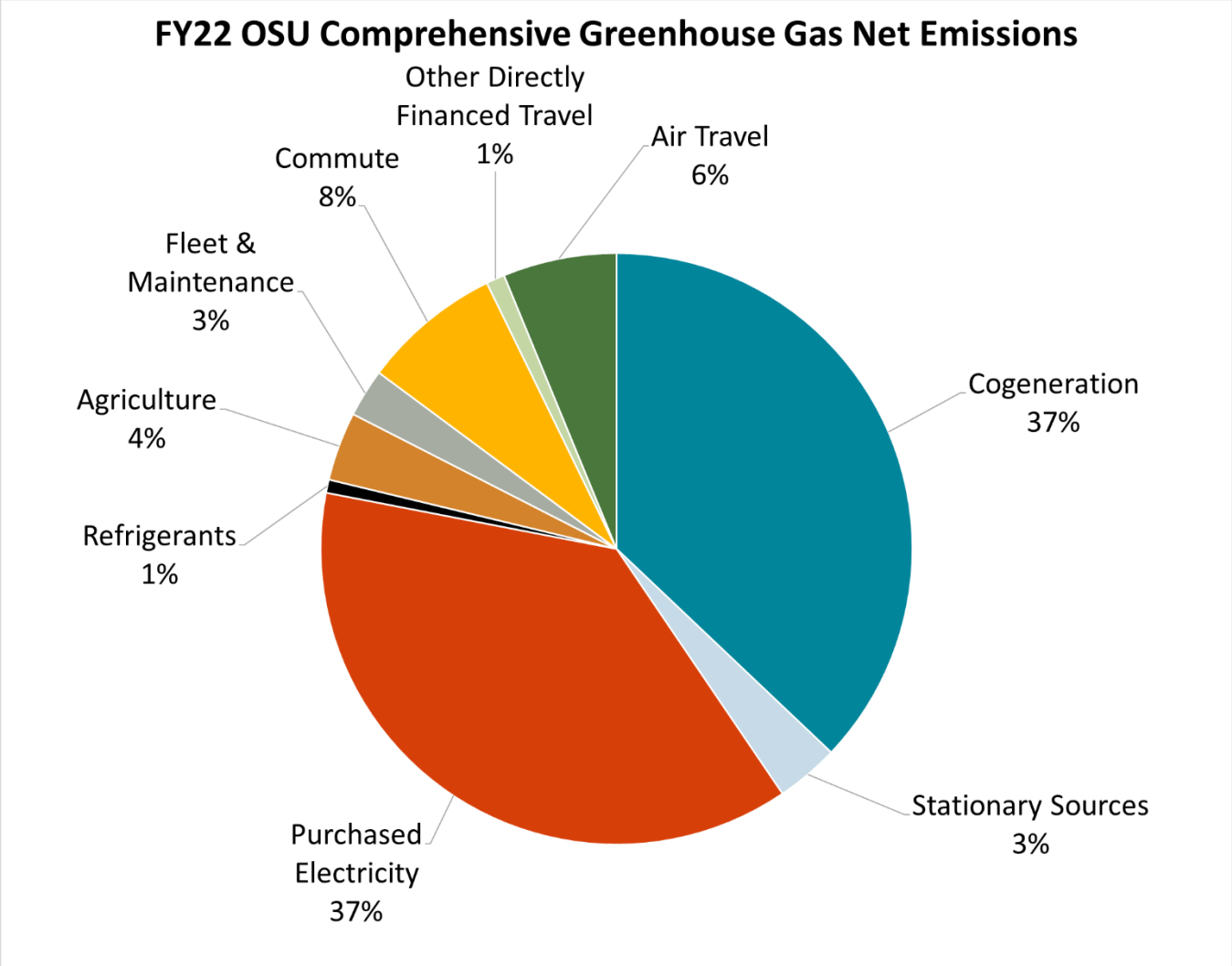


Figure 4. FY22 OSU Comprehensive Greenhouse Gas Net Emissions by Source

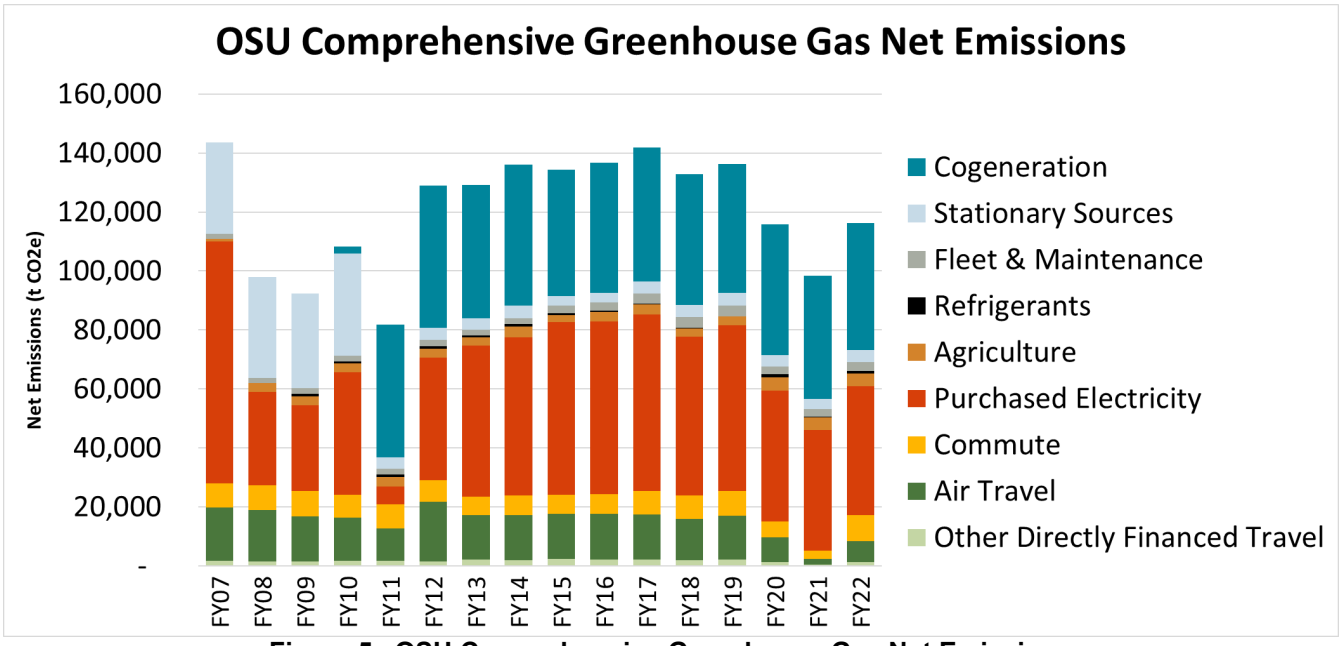


Figure 5. OSU Comprehensive Greenhouse Gas Net Emissions

Changes since the FY21 Inventory

Please see the Analysis of Data and Results section for more details regarding these changes.

In FY19, the Sustainability Office launched an opt-in program for employees and students to offset carbon emissions from university funded travel. The Associated Students of Oregon State University, College of Forestry, University Relations and Marketing, and the Valley Library participated in the program and purchased 98 travel offsets in FY20. Table 5 details offsets related to travel, composting and purchase of renewable energy certificates (RECs). During FY22, one carbon offset was purchased since university funded travel was extremely limited, and 1,200 RECs were purchased.

Table 5. Offsets by Fiscal Year (t CO2e)

Offset Type	FY18	FY19	FY20	FY21	FY22
Renewable Energy Certificates (RECs)	711.0	2,600.5	4,400.0	0.0	1,200.0
Carbon Offsets		85.0	98.0	0.0	1.0

Comparative Analysis

The following comparative data are drawn from the **Carbon Commitment Reporting System website.** Several of OSU's comparable institutions have not published FY22 data as of December 2022.

Table 6. Comparison of OSU Emissions Metrics with Peer Universities

	22 OSU Comprehensive	**21 OSU Comprehensive**	**20 OSU Comprehensive**	20 Cornell University	20 The Ohio State University	20 Utah State
Gross emissions per FTE enrolled (t CO2e)	**4.3**	**3.7**	**4.5**	7.1	7.7	3.4
Gross emissions per 1000 square feet (t CO2e)	**11.1**	**9.3**	**10.9**	10.6	16.9	9.1

Analysis of Data and Results

Table 7. Analysis of Data Changes and Uncertainty	
Emissions Source	**Analysis**
Commute-Faculty/Staff	Source data changes for FY22: None. Methodology changes for FY22: None. Uncertainty Analysis for FY22: While the new OSU transportation survey provides data from a significant % of participants, factors such as total commute days and mileage are estimates in the SIMAP Calculator. Additional factors are discussed on page 19 the **FY09 report**.
Commute-Students	Source data changes for FY22: None. Methodology changes for FY22: None. Uncertainty Analysis for FY22: Same as Faculty/Staff, above.
Directly Financed Travel	Source data changes for FY22: OSU adopted a new travel system in FY22. Methodology changes for FY22: None. Uncertainty analysis: 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.
Direct Transportation	Source data changes for FY22: None. Methodology changes for FY22: None. Uncertainty analysis: Improved data collection has continued to provide more accurate data from Statewides. However, some emissions go unreported due to difficulty in getting consumption data.
Solid Waste	Source data changes for FY22: None. Methodology changes for FY22: None. Uncertainty Analysis: Data are not collected for off-campus sites. It is likely that solid waste emissions are 10-15% different than reported.

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

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 the climate crisis continues to grow, requests and requirements have come from the campus community, the community at-large, and local and state government. 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 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 outline 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. In fall 2018, the OSU Faculty Senate formed the Ad Hoc Committee on the OSU Carbon Commitment, now a permanent standing committee known as the Carbon Commitment Committee (C3), to help promote actions OSU departments can take to reduce carbon emissions. As this group continues its work to broaden the dialogue around action, the Sustainability Office is emphasizing the importance of integrating climate conscience language into department strategic plans, fundraising, budgeting and other functional areas.

More recently in 2021, the Sustainability Office, C3 and university leadership created an updated framework for climate action known as the OSU Path to Carbon Neutrality. The Path outlines nine specific actions to achieve substantial decarbonization and includes funding sources, timelines, carbon impacts and cost estimates. The Path serves as an updated climate plan and implementation plan.

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 for FY22 was 60,496,516 kWh.

The 14 Agricultural Experiment Stations (AES) consumed 3,756,686 kWh.

County Extension offices used 1,290,739 kWh.

Hatfield Marine Science Center used 1,522,827 kWh.

OSU-Cascades consumed 1,811,038 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	49.83%
Natural Gas	18.99%
Hydro	5.89%
Wind	12.07%
Geothermal	0.22%
Biomass	0.11%
Other	12.89%

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 FY22 purchased electricity for OSU: 69,731,478 kWh.

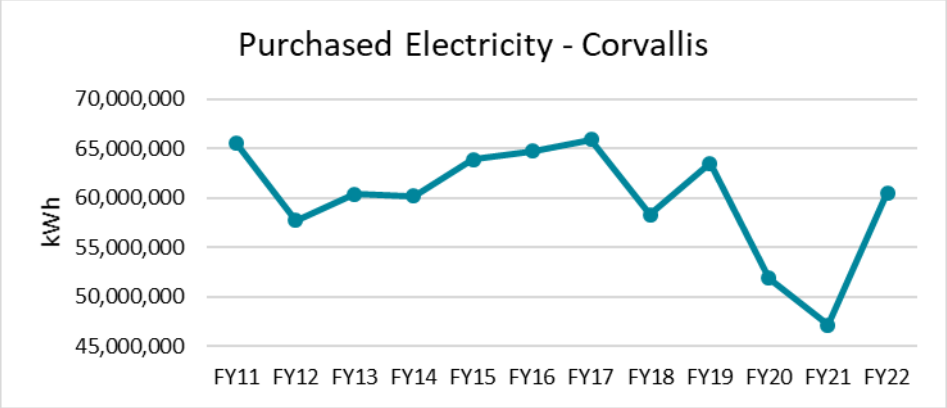


Figure 6. Electricity Consumption OSU-Corvallis FY11-FY22

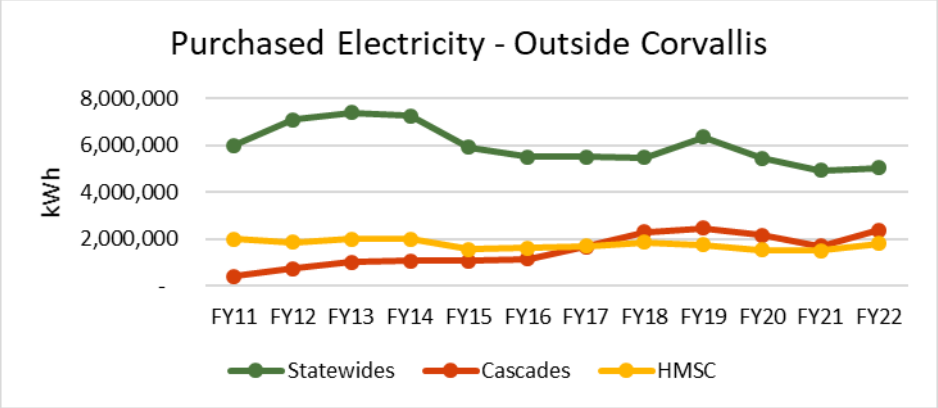


Figure 7. Electricity Consumption Statewides, OSU-Cascades, HMSC FY11-FY22

On-campus Cogeneration

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.

As a cogeneration facility, the Energy Center in FY22 consumed 8,118,900 therms of natural gas. It produced 514,740,713 pounds of steam and 43,603,135 kWh of electricity.

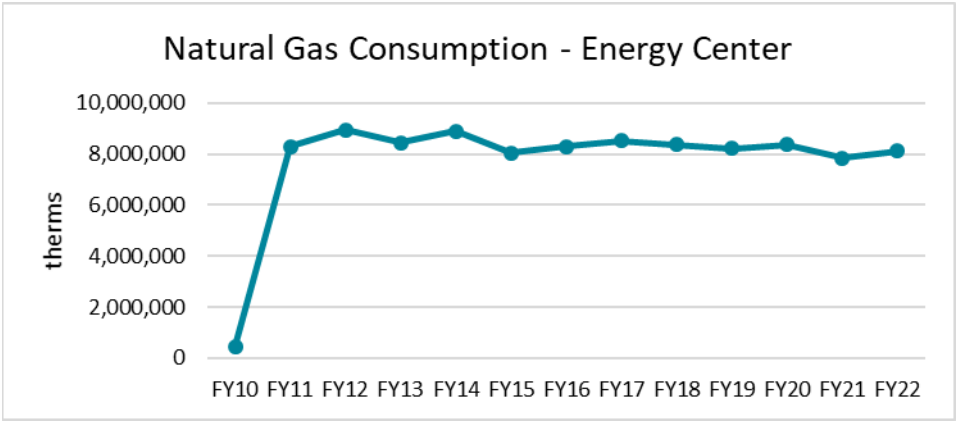


Figure 8. Natural Gas Consumption Energy Center FY10-FY22

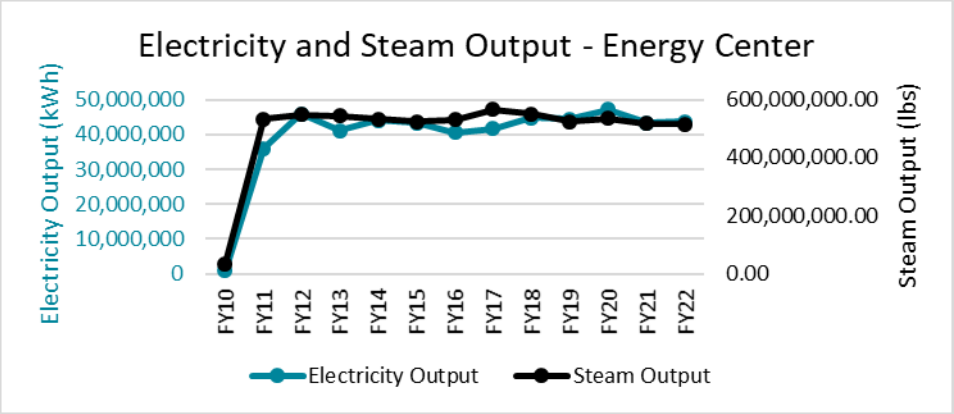


Figure 9. Electricity and Steam Output Energy Center FY10-FY22

Natural Gas (Scope 1)

OSU Corvallis consumed 608,127 therms of natural gas in FY22 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.

The Agricultural Experiment Stations used a combined 54,365 therms.

The Extension Service county offices used a total of 35,229 therms.

Hatfield Marine Science Center consumed 53,388 therms.

Cascade campus used 49,669 therms.

Total FY22 consumption of natural gas, excluding use at the Energy Center: 800,778 therms or 80,077 MMBtu

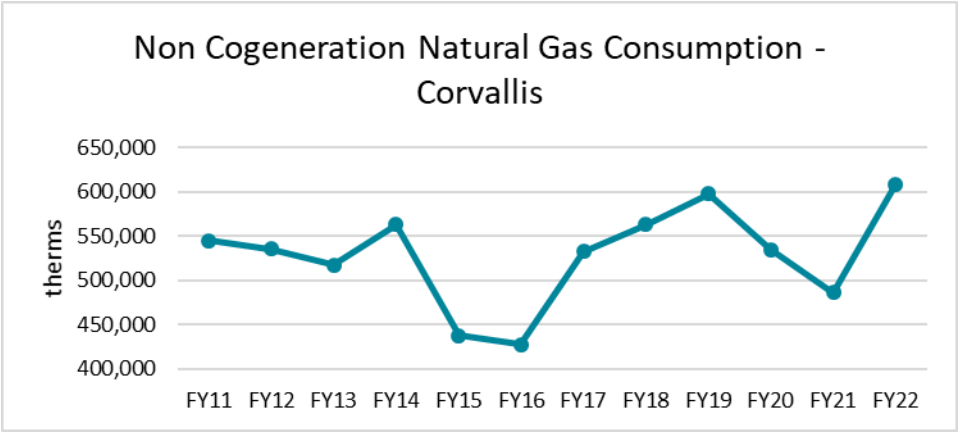


Figure 10. Non Cogeneration Natural Gas Consumption Corvallis FY11-FY22

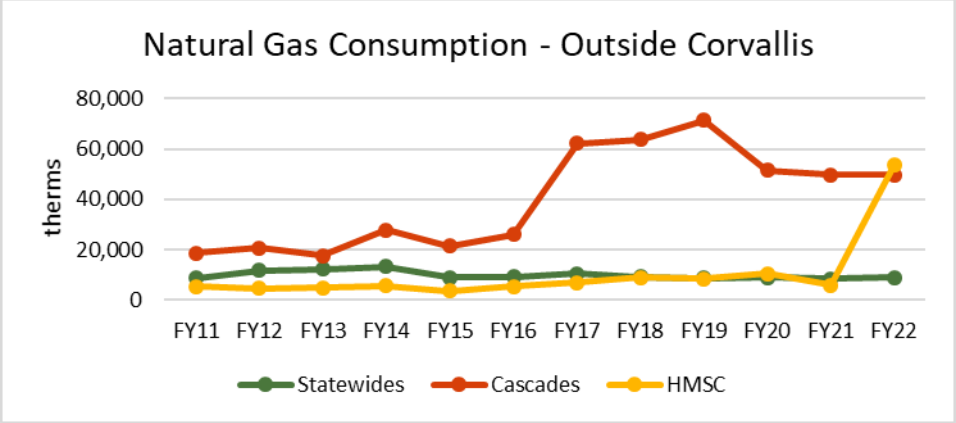


Figure 11. Natural Gas Consumption Statewides, OSU-Cascades, HMSC FY11-FY22

Steam and Chilled water purchased	N/A – no steam or chilled water is purchased from non-OSU sources.
Residual oils (#5, #6) and Distillate oils (#1, #2, #3, #4) (Scope 1)	Agricultural Experiment Stations used 2,789 gallons of diesel #2 for heating in FY22.

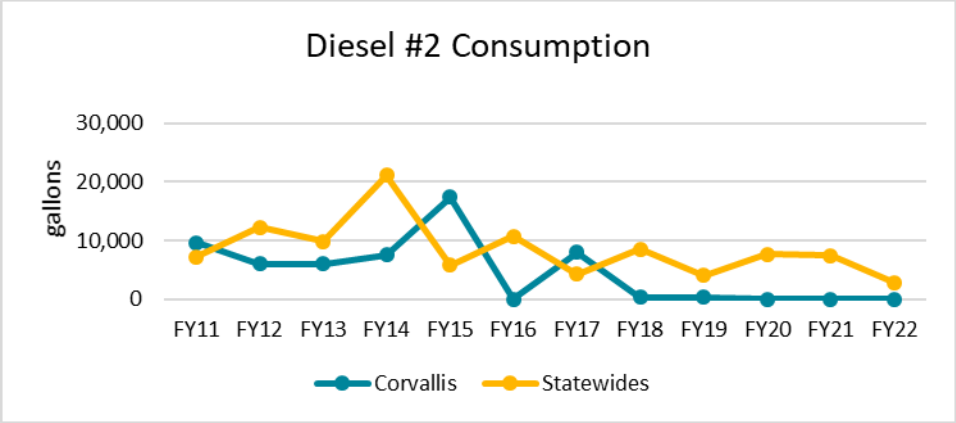


Figure 12. Diesel #2 Consumption Corvallis, Statewides, FY11-FY22

Propane (Scope 1 & 3)	Total documented propane use at OSU Corvallis was 8,789 gallons, used mainly for heating, backup generator priming and forklifts. Purchasers of propane are scattered throughout campus and there is no centralized recordkeeping. Agricultural Experiment Stations used 14,459 gallons of propane for heating, forklifts and backup generators. The Extension Service used 5,521 gallons. Total FY22 consumption of propane: 28,769 gallons.

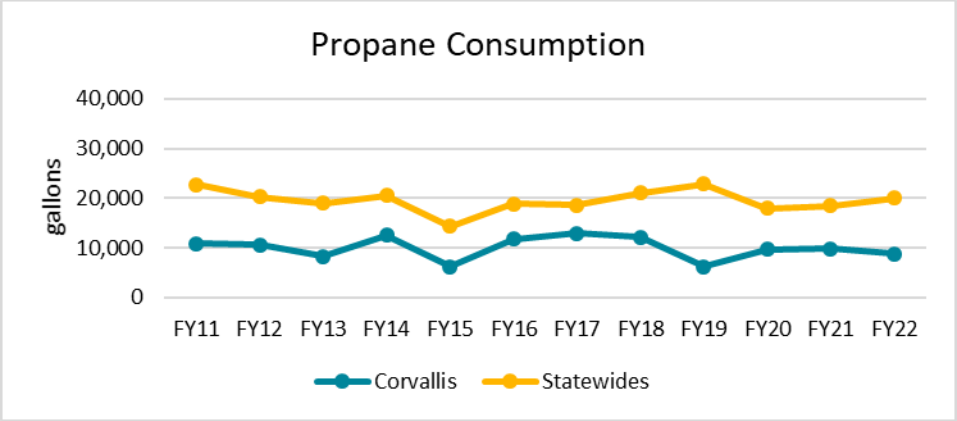


Figure 13. Propane Consumption Corvallis, Statewides, FY11-FY22

Coal	N/A – no coal is directly consumed by OSU.
Solar / Wind / Biomass	Multiple photovoltaic (PV) solar systems serve OSU operations. The estimated FY22 output from all sites was 2,351,178 kWh.

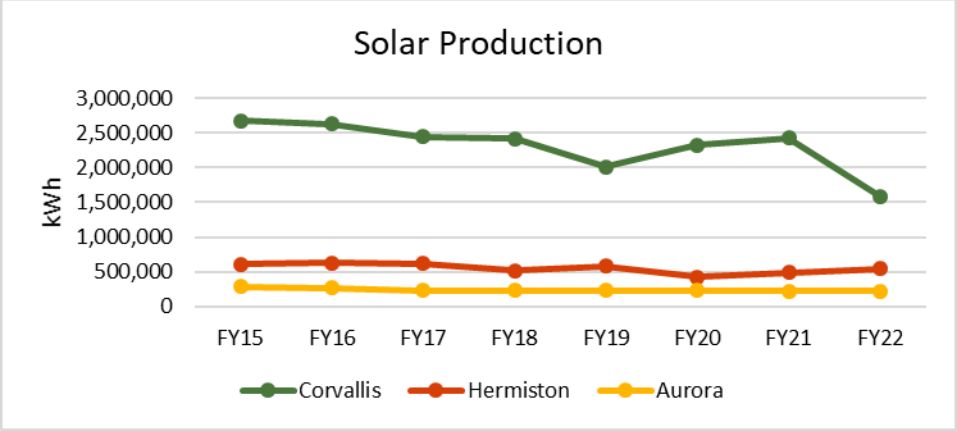


Figure 14. OSU Solar Production FY15-FY22

Data sources: Les Walton, Energy Operations Supervisor; Facilities Services; Carson Oil; 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	
Fleet and Maintenance (Scope 1)	**Gasoline** 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 FY22 was 285,859 gallons. OSU also received deliveries of 2,438 gallons of gasoline from Carson Oil. This fuel was primarily used in landscape equipment and vehicles.

Corvallis Farm Unit received 3,120 gallons of gasoline in FY22. The fuel was primarily used in farm vehicles.

Hatfield Marine Science Center used 4,989 gallons of gasoline for their fleet.

The Agricultural Experiment Stations used 20,114 gallons of gasoline for their fleet.

Diesel
In Corvallis, diesel is primarily used in the small diesel fleet run by the Motor Pool.

Reported diesel use at the campus Motor Pool filling station and the Motor Pool credit card system was 10,174 gallons.

The Agricultural Experiment Stations used 23,628 gallons of diesel for their fleet.

Total gasoline in FY22: 310,963 gallons

Total diesel used in mobile sources: 38,298 gallons.

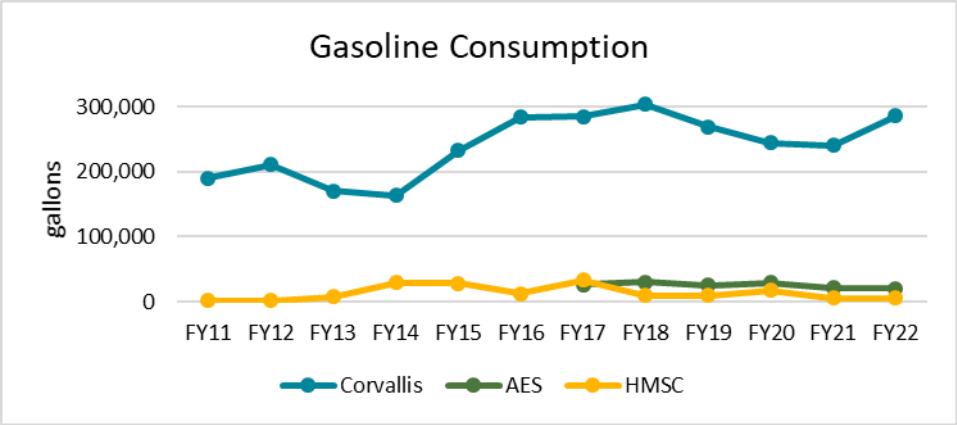


Figure 15. Gasoline Consumption Corvallis, HMSC FY11-FY22

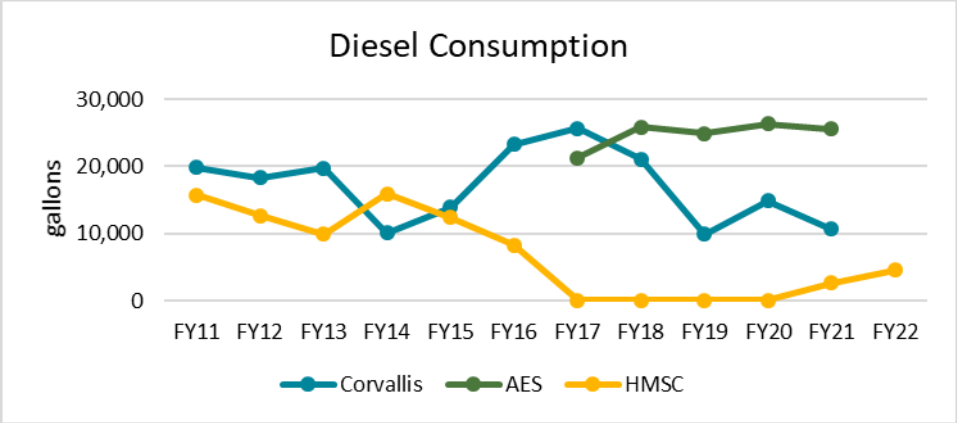
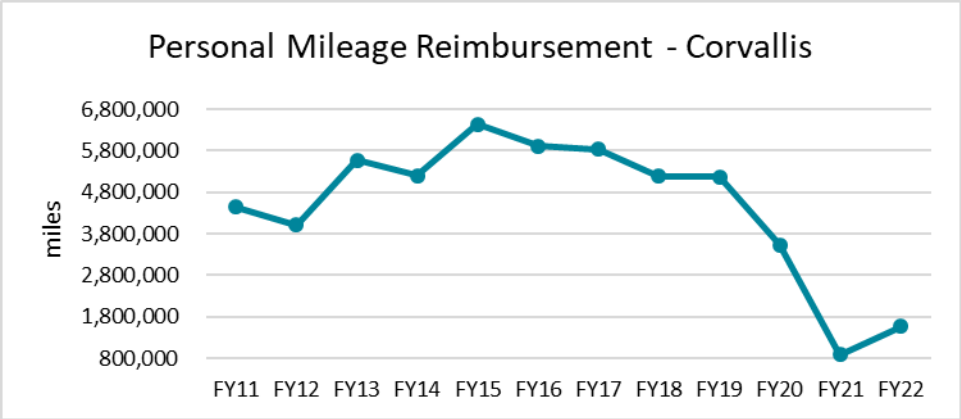
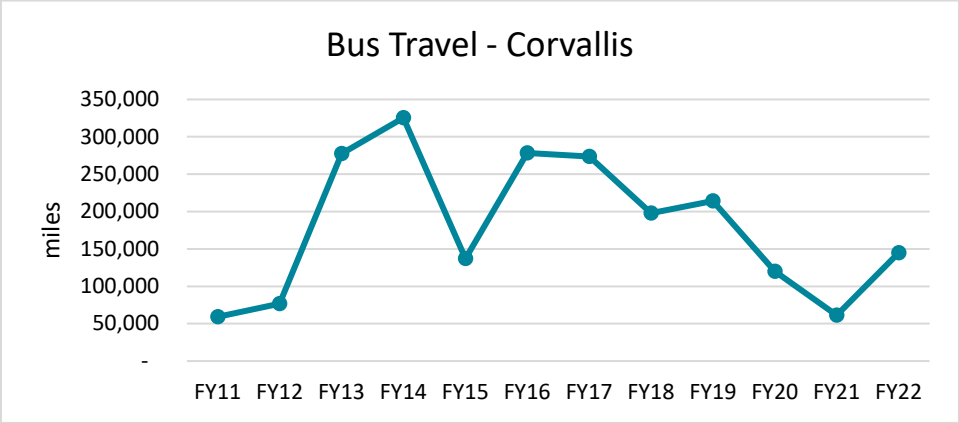
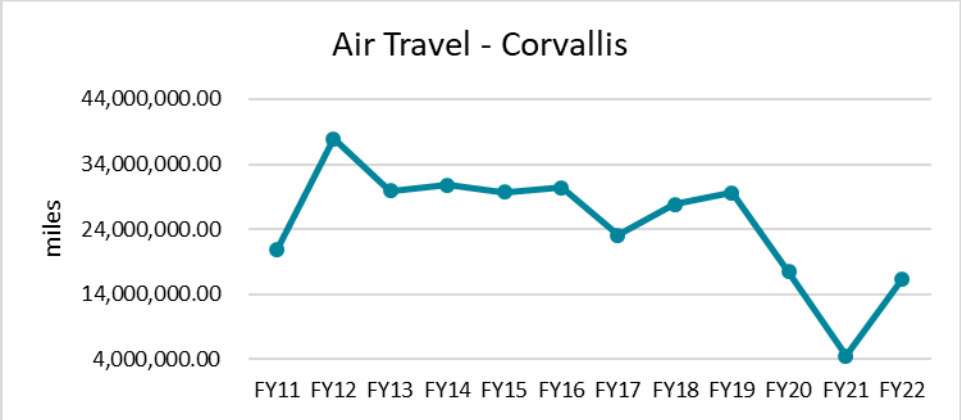


Figure 16. Diesel Consumption Corvallis, HMSC FY11-FY22

Data sources: Justin Fleming, Motor Pool Manager; Chelle Boswell, HSMC Office Specialist; Carson Oil.

Directly Financed Travel (Scope 3)	In FY22, 1,352,014 miles were reimbursed by Travel Reimbursement. OSU also contracts rental cars through Enterprise Rent-a-Car. Enterprise reported OSU accounts driving 209,277 miles in FY22. 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. 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 $650,820. Assuming this rate of $4.49/mi is representative of all chartered bus travel, Athletics' chartered buses drove 144,949 miles in FY22. In FY22, a reported 1,561,290 car miles were directly financed by OSU.  **Figure 17. Personal Mileage Reimbursement FY11-FY22**  **Figure 18. Bus Travel FY11-FY22**
Data sources: Justin Fleming, Motor Pool Manager; Stephanie Smith, Fiscal Coordinator Business Affairs; Katie Landgren, OSU Athletics.	
Commute (Scope 3)	It is assumed each person made one trip to campus per day. Students and staff/faculty were counted separately in the calculator. An average commute distance of 11 miles was used for personal vehicle travel and based on OSU's 2021 Transportation Survey.

	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. 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.
Data sources: Kellie Ann Walker, Institutional Research; Sarah Bronstein, Transportation Services.	
Air Travel (Scope 3)	OSU used a new travel software where all travel transactions are recorded. 16,641,700 miles were booked in FY22 for Corvallis. No information was available for any of the other locations. 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 2021 football schedule at http://www.osubeavers.com/ and Webflyer.com, an airport distance calculator, the calculated distance flown by chartered football jets was 10,074 miles. The European Environmental Agency[1] 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 separately from the SIMAP calculator, as it is not equipped to accurately calculate emissions resulting from a dedicated jet flight: $\frac{11{,}608 \text{ kg fuel}}{2482 \text{ mi}} \times \frac{1 \text{ gal jet fuel}^2}{3.06 \text{ kg fuel}} \times \frac{21.095 \text{ lb } CO_2^2}{1 \text{ gal jet fuel}} \times \frac{1 \text{ t}}{2205 \text{ lbs}} = \frac{0.0146 \text{ t } CO_2}{\text{mi}}$ $\frac{0.0146 \text{ t } CO_2}{\text{mi}} \times 10{,}074 \text{ miles} = 147.08 \text{ t } CO_2 \times 2.8 \text{ RFI} = 411.8 \text{ t } CO_2e$ 411.8 t CO2e x 0.90718474 MT = 373.60 MT CO2e Emissions resulting from chartered football air travel are reported under the Directly Financed Travel category.  **Figure 19. Air Travel Corvallis FY11-FY22**

Data sources: Stephanie Smith. Webflyer.com; [1] - European Environmental Agency Emission Inventory Guidebook http://www.eea.europa.eu/publications/EMEPCORINAIR4 ; [2]- Energy Information Agency https://www.eia.gov/environment/emissions/co2_vol_mass.php

Other Major Sources

Table 10. Findings – Other Major Sources

Solid Waste (Scope 3)

Total weight of solid waste sent to Coffin Butte Landfill in FY22: 2,061 short tons or 4.06 million lbs.

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.

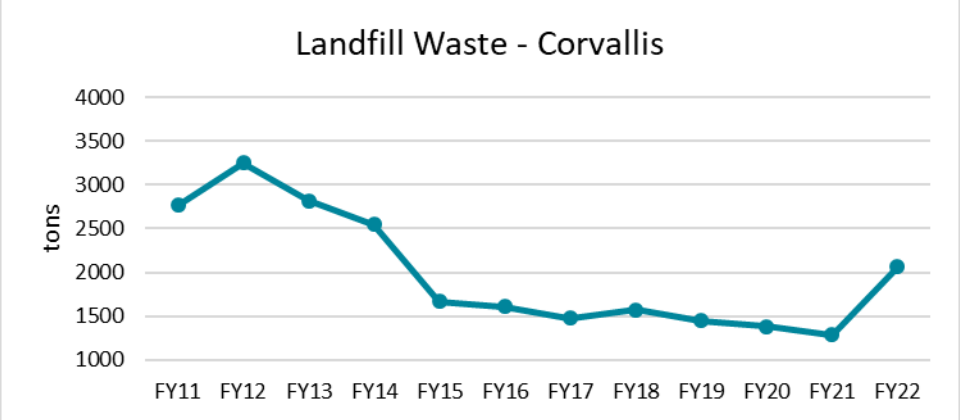


Figure 20. Landfill Waste FY11-FY22

Data source: John Deuel, 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	225	-	-	1	-	226
Beef Cattle	10	452	615	1	145	1,223
Horses	13	-	3		1	17
Poultry	50	-	-	-	-	50
Sheep	250	-	-	-	-	250
Swine	15	-	-	-	-	15
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 is 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	75,200	44%
Ag. Exp. Stations	99,07	13%
Extension Service	204	27%
Total	175,007	28%

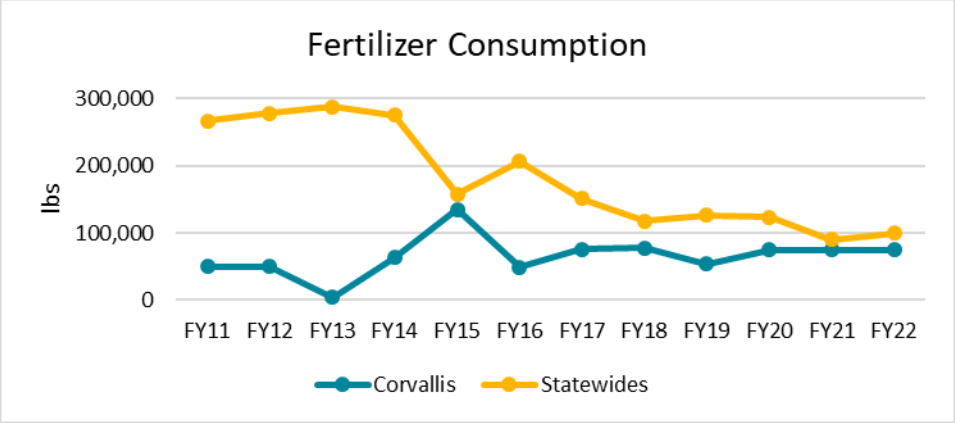


Figure 21. Fertilizer Consumption Corvallis, Statewides FY11-FY22

Data sources: David Bohnert, Director Burns & Union Stations; Bill Coslow, OSU Landscape Shop.

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 purchased in FY22 and their 100-year global warming potential (GWP). OSU is currently implementing a system to become more compliant with legal requirements for tracking refrigerants.

Refrigerant	Weight (lbs)	GWP (100 year)
R-134A	150	1,300
R-404A	168	3,922
R-22	30	1,810
R-407C	25	1,774
R-410A	450	1,890
R-513A	30	573

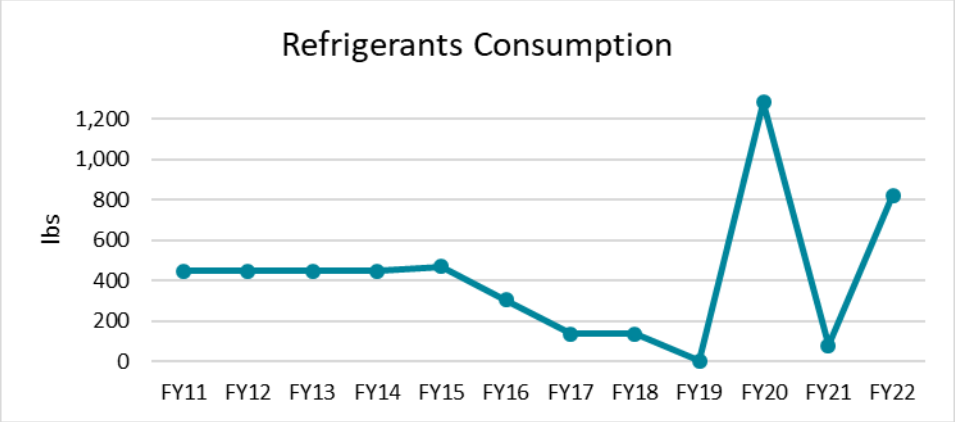


Figure 22. Refrigerants Consumption FY11-FY22

Data source: Jonathan Champney, Facilities Services

Offsets (green tags, RECs, composting etc.)

Renewable Energy Certificates (RECs)
Total REC purchases for the OSU Corvallis campus were 1,200 MWh.

Approximately 94 tons of waste were composted by various campus entities. The Republic Services, Organic Growers Club, and Crop and Soil Sciences Department 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.

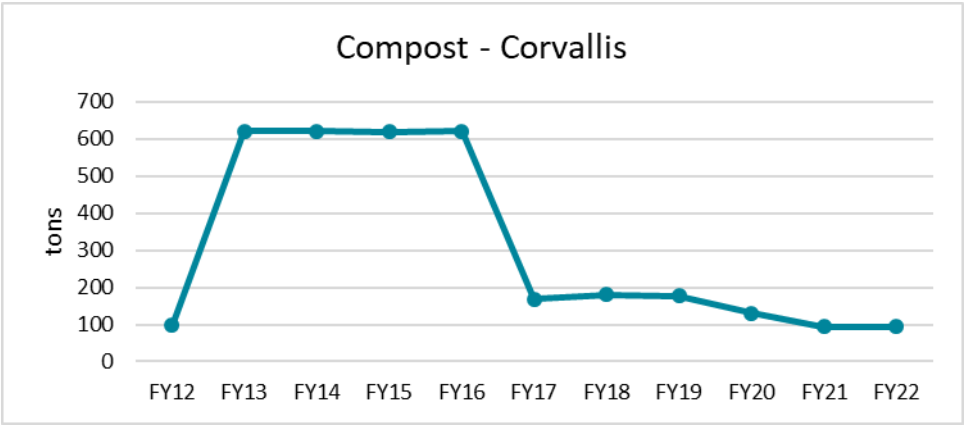


Figure 23. Compost FY12-FY22

Comprehensive FY22 Summary

Scope	Source	CO2 (MTCDE)	CH4 (MTCDE)	N2O (MTCDE)	GHG MTCDE	% change from FY21
1	Co-gen Electricity	19,413.5	54.2	10.3	19,478.0	4.0%
	Co-gen Steam	23,543.6	65.7	12.5	23,621.8	3.1%
	Stationary Sources	3,985.1	11.4	2.5	3,999.0	14.8%
	Fleet & Maintenance	4,558.7	8.9	32.5	3,061.5	13.2%
	Refrigerants	-	-	-	838.9	100.0%
	Agriculture	-	4,001.6	368.6	4,370.2	-0.8%
2	Purchased Electricity	41,720.6	127.3	228.6	41,256.1	5.9%
3	Faculty Commuting	434.7	0.6	4.1	439.4	85.1%
	Staff Commuting	1,857.7	2.7	17.7	1,878.2	107.0%
	Student Commuting	6,471.4	9.7	58.9	6,539.9	281.8%
	Air Travel	7,191.0	2.2	21.8	7,215.0	265.5%
	Other Directly Financed Travel	1,162.1	1.8	10.8	1,174.7	244.5%
	Solid Waste	-	357.2	-	357.2	36.7%
	T&D Losses	2,335.0	7.1	12.8	2,354.9	26.2%

Scope	GHG MTCDE
1	55,369.4
2	41,256.1
3	19,959.5

Gross MTCDE	Offsets (MTCDE)	Compost (MTCDE)	Non-Additional Sequestration (MTCDE)	Biogenic (MTCDE)	Net MTCDE
117,405.3	(821.4)	(83.6)	-	-	116,500.2

Table 11. Comprehensive FY22 Summary

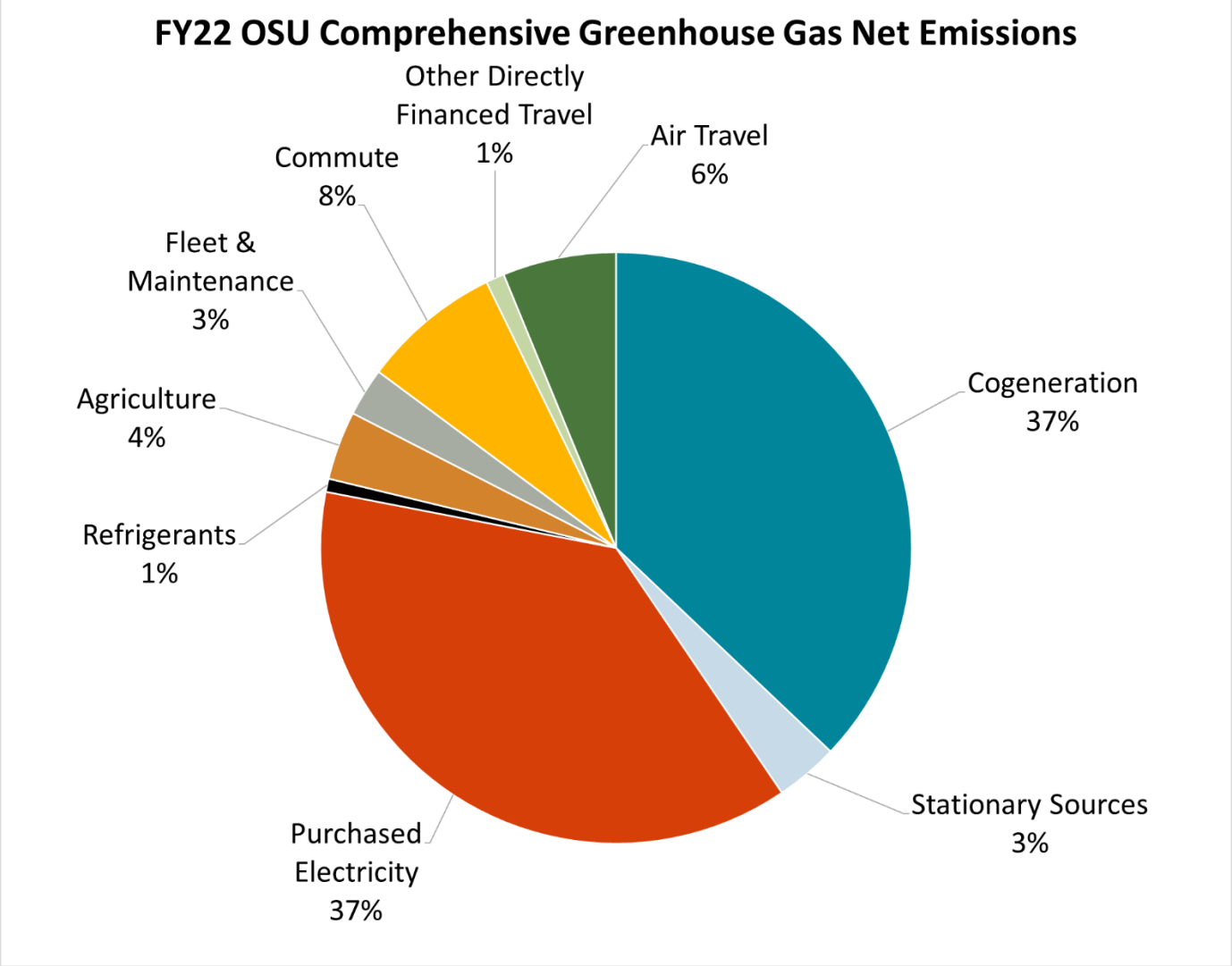


Figure 24. OSU Comprehensive Greenhouse Gas Net Emissions

OSU-Corvallis FY22 Summary

Scope	Source	CO2 (MTCDE)	CH4 (MTCDE)	N2O (MTCDE)	GHG MTCDE	% change from FY21
1	Co-gen Electricity	19,413.5	54.2	10.3	19,478.01	4.0%
	Co-gen Steam	23,543.6	65.7	12.5	23,621.81	3.1%
	Stationary Sources	3,262.4	9.2	1.8	3,273.37	24.5%
	Fleet & Maintenance	2,532.9	3.7	22.9	2,559.51	16.8%
	Refrigerants	0.0	0.0	0.0	838.91	100.0%
	Agriculture	0.0	1,736.7	203.2	1,939.88	0.1%
2	Purchased Electricity	38,805.8	122.0	186.9	38,294.28	6.2%
3	Faculty Commuting	408.3	0.6	3.9	412.84	113.4%
3	Staff Commuting	1,806.2	2.7	17.3	1,826.10	115.5%
3	Student Commuting	6,325.6	9.4	57.7	6,392.70	326.9%
3	Air Travel	7,191.0	2.2	21.8	7,215.00	265.5%
3	Other Directly Financed Travel	1,162.1	1.8	10.8	1,174.66	244.5%
3	Solid Waste	0.0	357.2	0.0	357.17	36.7%
3	T&D Losses	2,171.8	6.8	10.5	2,189.10	26.5%

Scope	GHG MTCDE
1	51,711.5
2	38,294.3
3	19,567.6

Gross MTCDE	Offsets (MTCDE)	Compost (MTCDE)	Non-Additional Sequestration (MTCDE)	Biogenic (MTCDE)	Net MTCDE
110,393.8	(821.4)	(83.5)	-	-	109,488.9

Table 12. Corvallis FY22 Summary

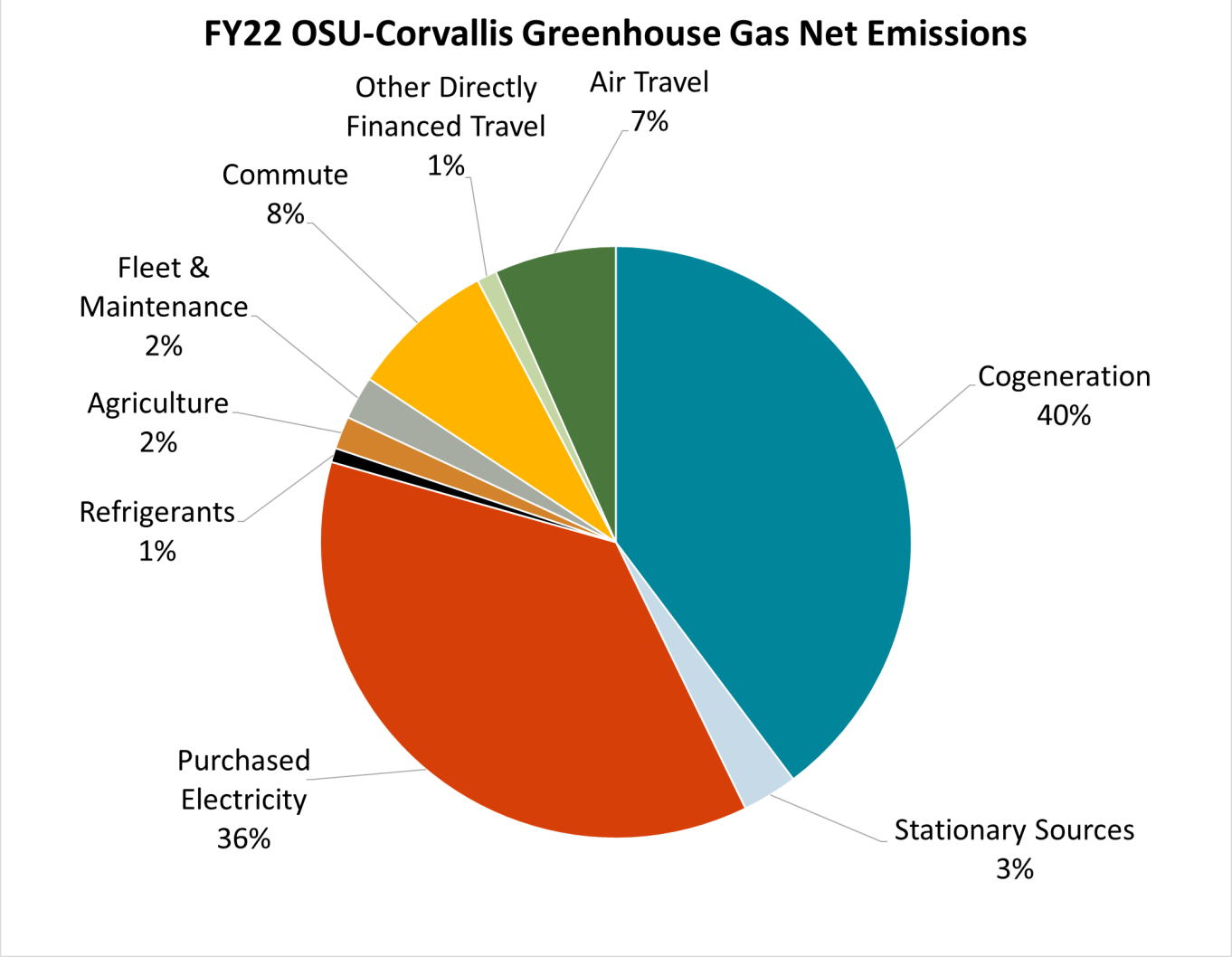


Figure 25. OSU Corvallis Greenhouse Gas Net Emissions

OSU-Cascades FY22 Summary

Scope	Source	CO2 (MTCDE)	CH4 (MTCDE)	N2O (MTCDE)	GHG MTCDE	% change from FY21
1	Stationary Sources	262.8	0.7	0.1	263.67	0.1%
2	Purchased Electricity	1,526.4	4.8	7.4	1,538.55	23.3%
3	Faculty Commuting	21.4	0.0	0.2	21.66	-43.3%
	Staff Commuting	24.7	0.0	0.2	24.98	-13.6%
	Student Commuting	145.8	0.2	1.3	147.24	-31.7%
	T&D Losses	85.4	0.3	0.4	86.11	36.7%

Scope	GHG MTCDE
1	263.7
2	1,538.6
3	280.0

Gross MTCDE	Offsets (MTCDE)	Compost (MTCDE)	Non-Additional Sequestration (MTCDE)	Biogenic (MTCDE)	Net MTCDE
2,082.2	0	0	0	0	2,082.2

Table 13. Cascades FY22 Summary

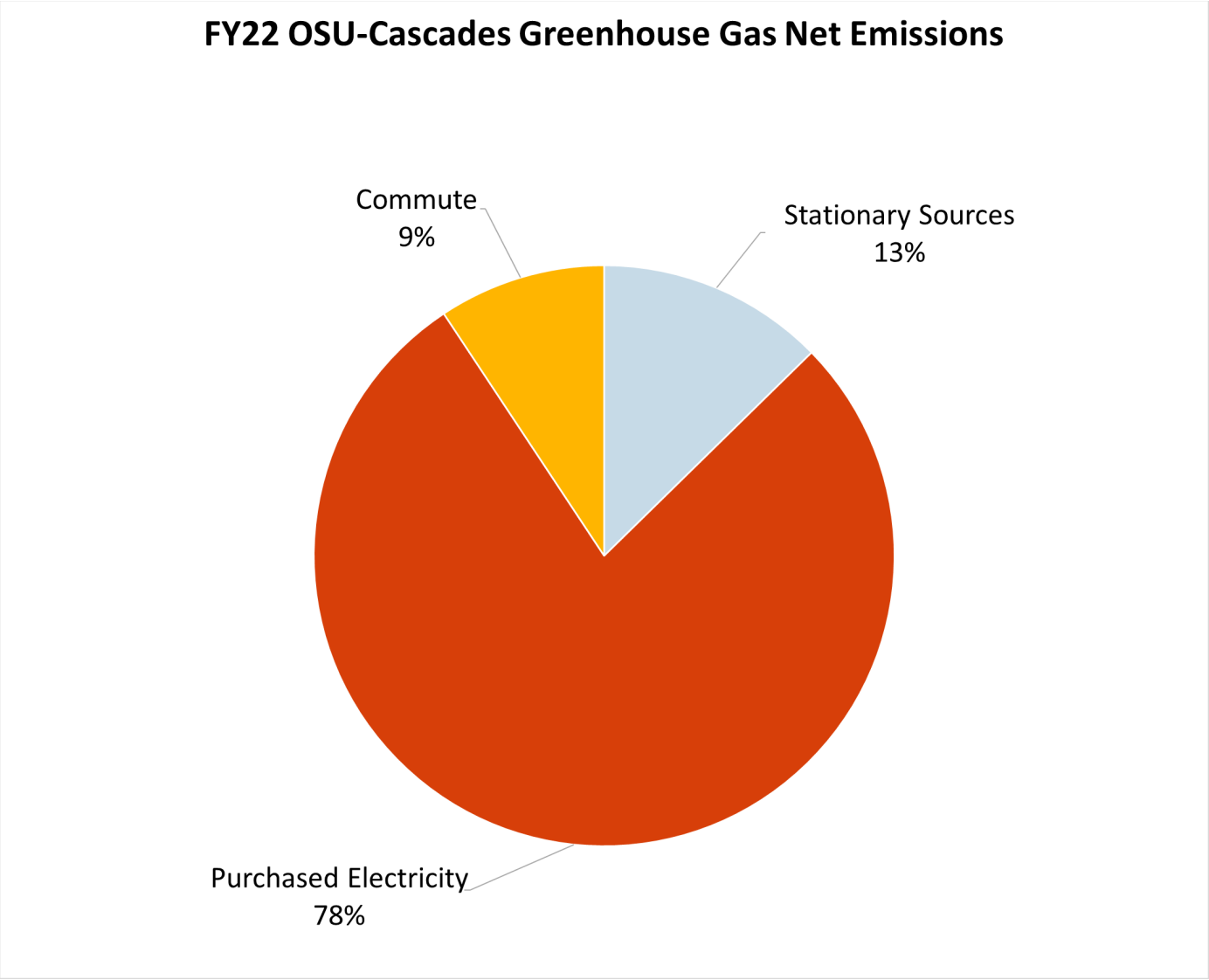


Figure 26. OSU Cascades Greenhouse Gas Net Emissions

HMSC FY22 Summary

Scope	Source	CO2 (MTCDE)	CH4 (MTCDE)	N2O (MTCDE)	GHG MTCDE	% change from FY21
1	Stationary Sources	282.4	0.8	0.2	283.37	803.9%
	Fleet & Maintenance	88.1	0.1	0.4	88.59	23.4%
2	Purchased Electricity	14.8	0.0	0.4	15.16	13.6%
3	Faculty Commuting	4.9	0.0	0.0	4.94	-12.7%
	Staff Commuting	26.8	0.0	0.2	27.09	-12.6%
	Air Travel	0.0	0.0	0.0	0.00	0.0%
		0.3	0.0	0.0	0.30	0.0%
	T&D Losses	0.8	0.0	0.0	0.85	26.9%

Scope	GHG MTCDE
1	372.0
2	15.2
3	33.2

Gross MTCDE	Offsets (MTCDE)	Compost (MTCDE)	Non-Additional Sequestration (MTCDE)	Biogenic (MTCDE)	Net MTCDE
420.3	0	0	0	0	420.3

Table 14. HMSC FY22 Summary

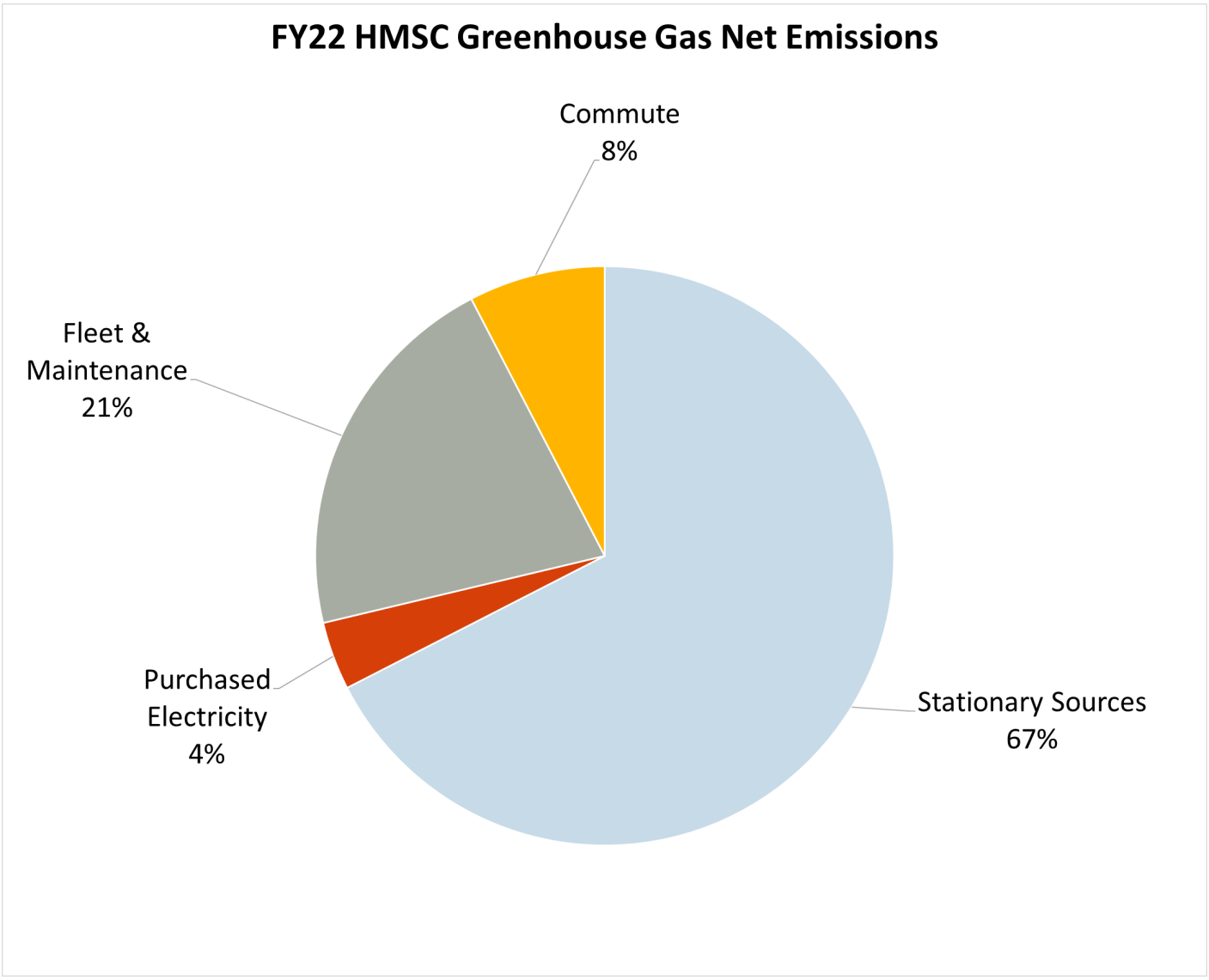


Figure 27. OSU HMSC Greenhouse Gas Net Emissions

Statewides FY22 Summary

Scope	Source	CO2 (MTCDE)	CH4 (MTCDE)	N2O (MTCDE)	GHG MTCDE	% change from FY21
1	Stationary Sources	177.5	0.7	0.4	178.57	-68.0%
	Fleet & Maintenance	411.3	0.3	1.8	413.40	100.0%
	Agriculture	-	2,264.8	165.4	2,430.27	-1.5%
2	Purchased Electricity	1,373.6	0.5	34.0	1,408.11	-14.6%
3	T&D Losses	76.9	0.0	1.9	78.81	8.3%

Scope	GHG MTCDE
1	3,022.2
2	1,408.1
3	78.8

Gross MTCDE	Offsets (MTCDE)	Compost (MTCDE)	Non-Additional Sequestration (MTCDE)	Biogenic (MTCDE)	Net MTCDE
4,509.2	0	0	0	0	4,509.2

Table 15. Statewides FY22 Summary

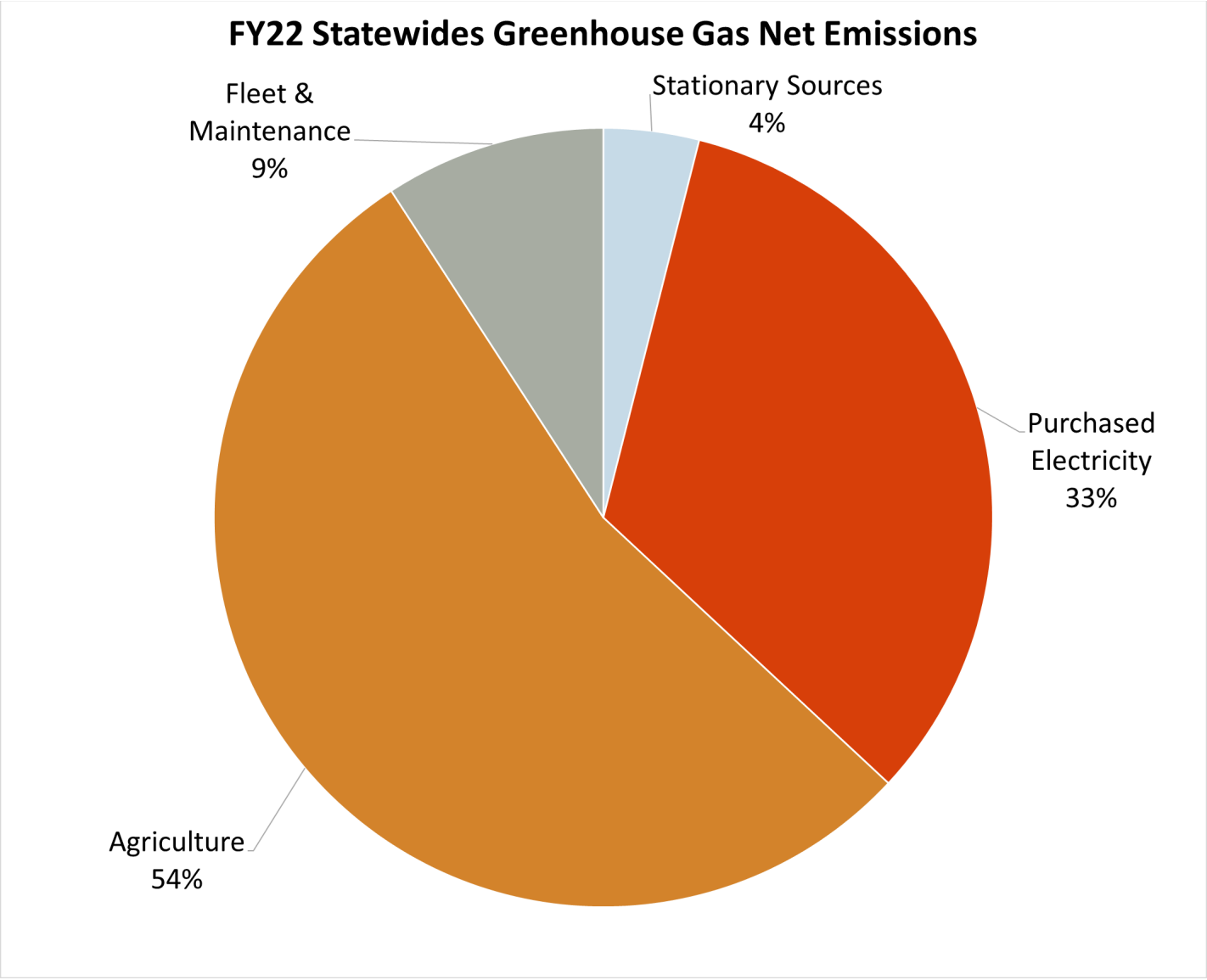


Figure 28. OSU Statewides Greenhouse Gas Net Emissions