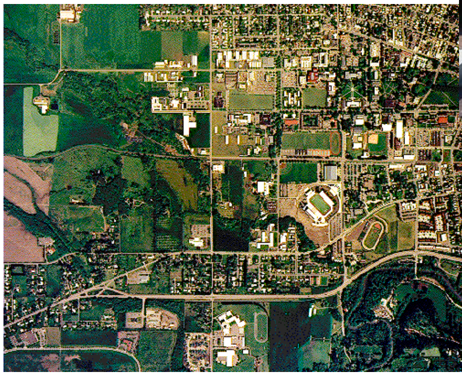
Oregon University System

Greenhouse Gas Inventory

GHG Emissions for the 2004 Calendar Year:
Report and Analysis



July 2007

Oregon University System

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Tables and Figures

Figures

Tables

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Robert Simonton, Director of Capital Construction and Sustainability Coordinator, OUS
Joshua Skov, Principal, Good Company

July 2007

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Executive Summary

The warming of the planet's atmosphere and oceans, and the resulting changes in climate, may comprise the single greatest environmental threat to the social and economic well being of human society. While the precise extent of the human contribution to current warming is still the subject of scientific inquiry, recent consensus statements by the scientific community assert, with high confidence, a central role for human-caused emissions. Accordingly, the call for action has been international, broad-based and decisive.

A necessary first step toward action is assessment of current circumstances. This greenhouse gas (GHG) inventory documents and analyzes the 2004 emissions of the seven-institution Oregon University System. The inventory aims to provide three basic types of insights:

1. A sense of scale: First and foremost, the document provides a snapshot of the major sources of direct and indirect emissions by the seven institutions.
2. Internal and external benchmarking: The document attempts to provide apples-to-apples comparisons of emissions from OUS institutions. This side-by-side assessment is augmented with roughly comparable data from other institutions of higher education.
3. Guidance for other GHG inventories: This document lays out its methodology and reasoning (briefly in the main body, in detail in the relevant appendices) to guide and inspire other Oregon state agencies and higher education institutions nationally to conduct rigorous and clearly framed GHG inventories as a step toward climate action.

A number of universities and colleges have conducted GHG inventories at various levels of detail and rigor, and the number is growing rapidly. However, to our knowledge, this is the first comprehensive GHG inventory of an entire university system. This system-wide view makes sense for OUS since the seven institutions share common threads of governance, funding and regional circumstances. This report also attempts to provide an innovative discussion of boundaries. Throughout, we refer to both *core emissions* using conventional narrow boundaries and *estimated total emissions* that occur inside an expanded set of boundaries. These concepts are discussed in detail in subsequent chapters.

Findings in Brief

- *Core emissions* defined in the report (including direct fossil fuel use, electricity, fleet and solid waste): 195,087 mt CO2e (metric tons of carbon dioxide equivalent).
- *Estimated total emissions*, with an expanded boundary for some *measured* and some *estimated* emissions (including commute travel, refrigerants, air travel and other miscellaneous categories): 253,544 mt CO2e.
- Taken together, direct emissions from natural gas and indirect emissions from electricity are the overwhelming sources of GHG emissions, representing 92.8% of core emissions and 71.4% of estimated total emissions.
- Most major and minor sources (electricity, natural gas, fleet, waste and fugitive emissions of refrigerants), totaling 99.0% of core emissions and 78.2% of estimated total emissions, of system-wide emissions, are under direct control and management of the institutions.
- However, several potentially significant GHG sources are either difficult to limit (air travel), or only partially under the control of the institution (commute travel). Furthermore, we have incomplete and uncertain data on these sources.
- Hard-to-manage sources (e.g., air travel) are a small share of emissions now, but they will represent a larger share in the long run as core emissions are reduced significantly through the most straightforward actions to improve efficiency and infrastructure.

Sense of Scale

Observations regarding overall emissions and boundaries:

- 93% of *core emissions* are from direct emissions from stationary fossil fuel use (overwhelmingly natural gas) and indirect emissions from electricity. Electricity and stationary fossil fuel use specifically account for 57.5% and 34.8%, respectively, of these emissions.
- Even using expanded boundaries, the combined emissions from stationary fossil fuel use and electricity still account for over 70% of *estimated total emissions*.
- OUS emissions, normalized for rough per-campus-user comparisons, seem to be lower than most other institutions, based on the limited external benchmarking data available.
- Clarity on boundary issues (i.e., those emission sources which the university is responsible to document and manage) will be fundamental to any clear, high-consensus discussion of action and implementation. There is probably no short and satisfying answer to this problem.

Comments on individual sources:

- Stationary fuel use, electricity, fleet fuel, fugitive emissions of refrigerants, and solid waste-related emissions represent 78.2% of system-wide *estimated total emissions* (expanded boundaries) and no less than 46.4% at any single institution (EOU).
- Grid mix (the source profile of electricity generation) is a major factor in total GHGs, and the principal driver of cross-institution differences.
- Certain activities for which few and only low-quality GHG data exist could potentially be important sources of emissions, including notably:
    - Mission-related air travel (6.5% of total emissions at OSU).
    - Commute patterns (estimated range of 7-19% at the three institutions with data).
- Waste disposal-related emissions are generally quite small.
- Fugitive emissions of refrigerants are a small source of total C02e emissions now, but it seems possible that fugitive emissions information is incomplete for several institutions.
- If OUS were to purchase 100% of its electricity from carbon-free renewable energy sources, commute-related emissions would then represent 29% of core emissions (and 18% of estimated total emissions, with the expanded boundaries estimated in this report).

Oregon State Agency Inventory and GHG Inventory Guidance

This document reaches completion concurrently with a state-wide summary inventory by Oregon's Department of Administrative Services. We hope this document stands as an aid to climate action planning in Oregon and beyond. An initial testing ground may be in the government of the State of Oregon, whose state agencies have 42 million square feet of facility space. The Oregon University System's seven campuses include 1,172 buildings totaling 21.5 million square feet, just over half of total square footage owned by all Oregon state government agencies. Thus, subsequent chapters also aim to provide guidance for conducting GHG inventories and laying the foundation for climate action planning in OUS and elsewhere. In particular, we expect this report to provide assistance through its discussion of boundary issues, treatment of uneven data sources, the use of existing tools and protocols, and data gathering.

In addition, we believe this report and the methodology used herein will be of particular interest to higher education institutions. Many of the methodological ideas – most notably relating to boundaries – relate most directly to colleges and universities.

Next Steps for Climate Action

The Oregon University System and its constituent institutions are constantly developing and deploying initiatives that will reduce their individual carbon footprints. In support of these efforts, OUS as a multi-institutional entity has additional endeavors of importance. This short section summarizes what OUS is doing, as a separate entity, to facilitate progress among the institutions, and to spur further climate action in a coordinated fashion. We also acknowledge some important concurrent efforts by state government.

Renewable Energy Pilot Projects by OUS

OUS has developed five pilot proposals for renewable energy development on university property. The intent is to meet the Governor's renewable energy goals while also creating facilities where theory and practical application can intersect. The projects would allow student and faculty researchers to develop and test new technologies, thereby increasing the competitiveness of the university system's renewable energy curriculum as well as increasing the value of the research, prior to commercialization.

One project is currently funded, a wave energy project based out of OSU. The project will receive $3 million in state funds and $3 million of grant funds.

Other proposals include:
- geothermal electrical generation at OIT
- bio-fuels and wind power at OSU
- solar power at UO, PSU and several other institutions

We hope these projects will receive state and external support in the future.

Efforts to Coordinate Actions by OUS Institutions

OUS is also increasingly playing a role in coordinating climate action among the institutions. Briefly, there are several key projects:
- Sponsoring this GHG inventory: First, OUS is making this inventory public as a way of raising the shared understanding around institutional carbon footprints and to promote discussion around comprehensive climate action.
- Being a resource for facilities directors: OUS Capital Construction continues to act as forum for facilities directors at all seven institutions. This facilitator role will now include suggestions and guidance on climate action opportunities.
- Organizing working meetings on campus sustainability: OUS will, in the next academic year, convene practitioners of campus sustainability and other stakeholders from the seven institutions. Climate action planning, on-the-ground projects, and other campus sustainability efforts will be the focus of the gatherings.

Legislative Support for OUS Capital Construction Efforts

A wide range of efforts by OUS Capital Construction to upgrade and expand facilities will reduce emissions through energy efficiency, deployment of newer buildings systems and implementation of best practices in construction and renovation. These projects will, in many cases, reduce individual institutions' respective climate footprints.

From a funding standpoint, these project include:

- $50 million for Capital Repair/Code/Safety: The 2007-2009 budget for capital construction will receive $50 million in Lottery Bonds to keep existing facilities operational and stop the growing backlog of deferred maintenance, which has risen to $640 million. The GRB investment will reduce the backlog to $590 million, the first reduction since the early 1990s. All OUS institutions have buildings with failing components and systems, like roofing, HVAC, electrical, and plumbing.
- $89.5 million continuation of the Combined Deferred Maintenance and Seismic Remediation Program: Student and campus community access is compromised when deferred maintenance of OUS facilities results in closure of facilities. By combining sustainable building practices and the latest seismic safety technology, the state will be able to retain the investments made by prior generations of Oregonians. The OUS will realize cost savings in the projects by doing the deferred maintenance and seismic work together.
- $253 million for New and Renovated Buildings related to Academic Program Improvement (54% state funded): Research completed by faculty and students on OUS campuses fuels the Oregon economy by producing the innovations which lead to commercial applications, new companies, and jobs for Oregonians, and the job-ready graduates who help build a strong, diverse workforce. But many of the classrooms, laboratories and research facilities are in critical need of upgrades and/or expansion in order to facilitate the student learning and the research work critical to complement Oregon’s economic strengths, and its diverse industries.
- $135 million for Auxiliary Projects: Auxiliary projects include Campus Housing/Dining, Parking, and Athletics, and are self-supporting and funded primarily through the use of Article XI-F(1) bonds, and repaid through revenues generated by operations.
- State Green Building Design and Construction an Oregon: Green building design and construction is becoming an integral part of OUS Capital Construction, and something for which the state is becoming nationally and internationally recognized for its leadership. All OUS projects must meet the 'Leadership in Energy & Environmental Design' (LEED) Silver guidelines.[i]

State Government Efforts and Recent Legislation

Climate action by OUS and its seven institutions is not taking place in a vacuum: state government and he legislature have a number of other initiatives that relate directly to this report:

- During the 2007/2009 biennium, state government will purchase green tags (renewable energy credits) to cover 50% of state agency electricity use in the first year of the biennium and then 100% of agency electricity use in the second year. (This will include OUS.)
- The legislature passed a bill laying out greenhouse gas emissions reduction goals and timelines to achieve substantial reductions (HB 3543) in 2007.
- The legislature also passed a Renewable Portfolio Standard (SB 838) in 2007. The RPS will require an increasing percentage of electric power generation to be from renewable sources, with 25% coming from new renewables by 2025 (for Oregon’s largest utilities).

Climate Action: the Context in Higher Education and in Oregon

There is now overwhelming scientific and policy consensus that warming of the planet's atmosphere and oceans and the resulting changes in climate pose a significant threat to human economic and social well being in the foreseeable future. Although there is considerable uncertainty about both the precise magnitude of impending changes and the magnitude of human influence, scientists now believe that, with at least 90% certainty, human activities have contributed to recent climate change and will continue to be an important factor.[ii]

Given the urgency of the problem and our role in it, there has been considerable policy activity globally and at smaller scales to measure and reduce anthropogenic greenhouse gas emissions (GHGs). Most prominently, the Kyoto Protocol, an agreement among 160 countries representing well over half of the planet's population, has called for stabilization and then reduction of GHGs to below emissions levels in the common base year of 1990[iii]. Many European countries have taken additional actions. Sixty-nine US cities[iv] have targets, action plans and/or resolutions with similar goals in mind, and the Climate Registry, a collaboration of thirty-one states launched this year, will begin accepting emissions data in January of 2008.[v]

Additionally, individual analysts and governments are increasingly conceptualizing climate change as a *risk management* issue. This suggests that we must manage risks, as well as costs; in other words, we must acknowledge uncertainty and prepare for a range of possible scenarios involving climate, energy availability, regulation and other market and non-market conditions. The attempt to measure current GHG emissions is a crucial first component of the long process of managing an organizational climate footprint and the managerial and financial *climate risk* associated with that footprint.

The Growing Context in Higher Education

In the past several years, more and more North American institutions of higher education have begun to take action on climate issues. Lewis and Clark College, in Portland, Oregon, was the first institution in the United States to establish a clear plan for voluntary compliance with the emissions reduction targets of the Kyoto Protocol, involving both efficiency measures and the purchase of GHG offsets. In addition to many emissions-reducing actions at all scales in higher education, the past year has witnessed increased calls for public leadership on climate issues. The American College & University Presidents Climate Commitment, an effort to garner signatories of top leaders at institutions of all kinds, has, at this writing, enlisted presidents and chancellors from more than three hundred institutions across the country, including Oregon State University, Portland State University and the University of Oregon.

Institutions have sought to document their emissions in support of these actions and this leadership. A short list demonstrates the depth of concern, diversity of institutions involved, and range of activities:

- In 2005, Yale University conducted a comprehensive GHG inventory of the institution's 2002 emissions.[vi]
- The University of California, San Diego completed a GHG inventory for calendar years 2003 and 2004, and sought and received certification for its inventory by the California Climate Action Registry.[vii]
- Oberlin College commissioned a 125-page report by Rocky Mountain Institute to describe a path to the ambitious goal of "climate neutrality" (zero net GHG emissions) by 2020.[viii]

- A student project at Smith College produced an inventory that, while more modestly scaled than efforts at Oberlin and Yale, nonetheless covered major emissions sources for 1990-2004.[ix]
- The Climate Action Partnership (CalCAP)[x] of the University of California, Berkeley released its first emissions inventory in 2007, combined with a feasibility study and list of emissions reductions options.

Numerous other institutions have similar efforts underway.

Concurrently, a number of GHG inventory tools have appeared to make the process of measurement vastly easier than it was as recently as five years ago. Clean Air Cool Planet (CA-CP), a New Hampshire-based environmental NGO, has created, for public use, a set of linked spreadsheets that attempt to describe all possible GHG emissions from a college or university. (The CA-CP spreadsheets formed the basis for this study's data gathering; see the methodology notes in this and other sections.) The California Climate Action Registry (more on the Registry below) now includes a small but growing number of universities and colleges.

Furthermore, for the purpose of reducing indirect GHG emissions from electric power generators, many universities, colleges and university systems have begun to purchase electricity from renewable sources. In many cases, students have voted by large margins to 'tax' themselves (through student fees) to cover the cost premium for green power.[xi]

Climate Action in Oregon State Government

In 2005, Governor Kulongoski issued *The Oregon Strategy for GHG Reductions*. This report is one of the most substantive and far-reaching state-level strategies, and was reinforced by the three-state initiative with Washington and California, which itself has evolved into the Western Regional Climate Action Initiative, a collaboration among six US states and two Canadian provinces.[xii] As of this writing, this report provides the most comprehensive agency-level inventory to date in Oregon.[xiii]

This inventory of OUS' GHG emissions comes amidst a number of related efforts in state government:

- Governor Kulongoski's goal of sourcing all state agency-purchased electricity from renewable sources by 2010.
- The governor's goal to reduce state agencies' total building energy use by 20% (below the year 2000 baseline) by 2010.
- The long-run GHG emissions goals laid out in the *Oregon Strategy for Greenhouse Gas Reductions*[xiv] in 2004, including stabilization by 2010 and 10% below a 1990 baseline by 2020. This goal is now state law with the passage of HR 3543.[xv]
- Various other objectives relating to the use of high-efficiency vehicles and alternative fuels.

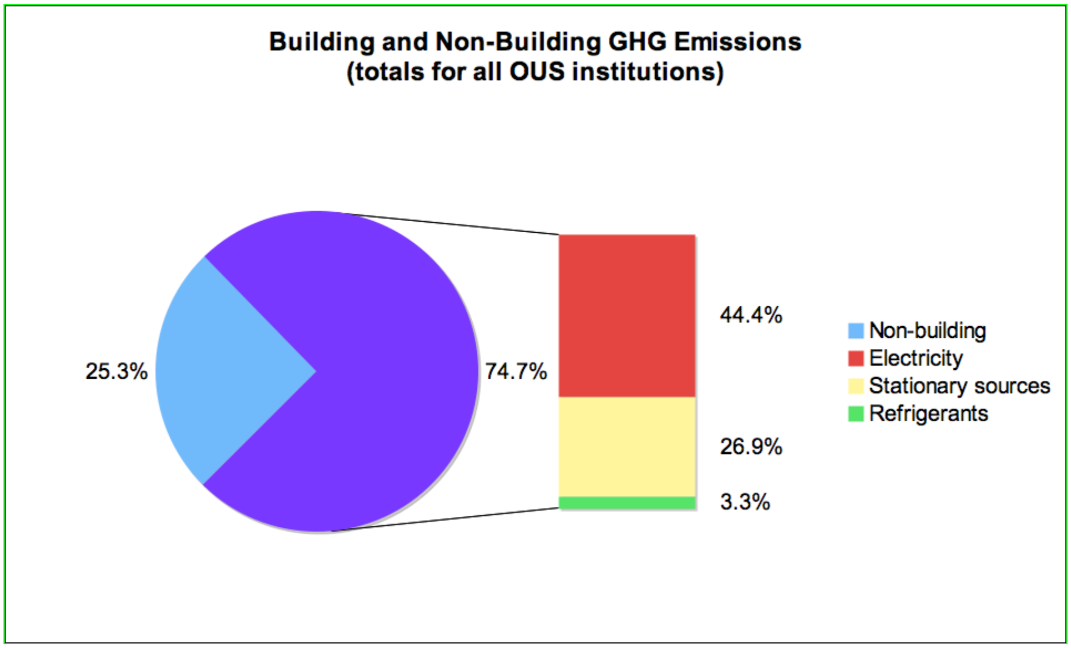
The following section frames these multiple objectives from OUS' point of view. However, given that OUS institutions collectively represent roughly half of all state agency facilities' square footage, we anticipate that this discussion will be helpful to other agencies as a starting point for understanding their respective impacts.

Understanding the Multiple Objectives for OUS

The three objectives – electricity from renewable sources, reduced building energy use, and lower GHG emissions – are inherently related. Electricity is part of total building energy use, and many sources of electricity generation emit GHGs. Most other energy use other than electricity – typically natural gas – in buildings generally involves GHG emissions. Thus, a shift toward renewable electricity sources will reduce the GHG emissions associated with a given level of electricity use. Furthermore, a reduction in total energy use (electricity and fuel) will reduce GHG emissions. In other words, these goals are inextricably linked.

However, it is worthwhile to attach a sense of scale to these various objectives. Consider that building energy use is the overwhelming contributor (74.7%) to *core emissions*, while non-building emissions (fleet and solid waste) represent about a quarter (25.3%) of core emissions.

Figure 1



This figure demonstrates that energy use in buildings must be our first priority in addressing GHGs for core emissions, which are those areas over which an institution has direct control.

These charts demonstrate the substantial GHG-reduction opportunity in shifting to renewable power: electricity, the largest share of building energy use, comprises more than 44% of total GHG emissions. The charts also underscore the importance of reducing total energy use, as we do not have easy substitutes for in-building use of natural gas, far and away the largest component of stationary fossil fuel use for buildings (26.9% of all emissions).

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Methodology and Boundaries

Outline of this section:

- Introduction
- The process (tool selection and tweaking, information gathering, record keeping, time vs. information value/relevancy)
- Information gathered (breakdown of Core Emissions and Additional Documented Emissions, and their sum, Estimated Total Emissions)
- GHG Inventory Boundaries: an Innovative Approach
- Omitted Emissions Sources (for both Core and Estimated Total Emissions)

Introduction

We believe that we have assembled the best available tools for this seven-institution inventory. With modifications, we have oriented those tools to better fit both individual institutional circumstances and the greater mission of a system-wide inventory. Clean Air-Cool Planet's (CA-CP) eCalculator met almost all of our process needs, but some adjustments of emissions factors (mainly related to solid waste and electrical grid mix) were possible to address local variation and thereby refine the calculations beyond what the eCalculator provides by default.

The gathered data goes beyond requirements for the California Climate Action Registry (CCAR) in that we accounted for emissions from waste disposal and, in some cases, commuting and mission-related travel.

The completion of such an inventory provides an essential foundation for focused, effective communication on the issue of climate change at a college or university, and the basis for institutional action to address it. In order to encourage on-going measurement and tracking of GHG inventory information, OUS could register emissions under CCAR. To begin the process, a Registry-approved certifier would verify the 2004 annual emissions at each institution. In subsequent years, to maintain registration, the emission inventory and verification processes would be repeated and registered.

The Process

In general, the process for this inventory began with a determination of the best available tools for information storage and emissions calculations. Not only is there broad consensus about which greenhouse gases matter based on their impacts relative to CO2, but there has also been a great deal of convergence in the style and content of various GHG inventory tools. This report draws primarily on Clean Air-Cool Planet and the California Climate Action Registry for process tools and conceptual guidance. CA-CP offers a Campus Greenhouse Gas Emissions Inventory Calculator, a Microsoft Excel-based spreadsheet tool, for use in completing this type of activity. CA-CP's calculator, or eCalculator, was then adjusted either to include new and more up-to-date information or to better fit our specific needs (see eCalculator Changes in Appendix D).

Once we established the most effective tool for our needs, we began to collect information from each of the seven OUS institutions. Generally, we began information gathering with either the Sustainability Coordinator or the Environmental Health and Safety (EH&S) Director for guidance on campus contacts for specific information needs. From interviews with these contacts we were able to determine the appropriate links to gain access to our specific informational need. The data gathering process required collaboration with many people and departments on campus.

We attempted to gather information from each institution in all areas with GHG emission impacts. As expected, not all of that information was readily available. Below is a breakdown according to data-gathering success of the information gathering areas:

- Gathered for all institutions (referred to hereafter as “Core Emissions”)
    - Purchased electricity for core campus and major off-campus facilities
    - On-campus stationary sources (primarily natural gas)
    - Solid waste
    - Fleet, maintenance and personal vehicles
    - Refrigerants
    - Animal agriculture
    - Offsets
- Gathered for some institutions (hereafter “Additional Documented Emissions”)
    - Mission-related air travel
    - Commute
- Gathered for no institutions
    - Student travel from hometown to/from campus[xvi]
    - Emissions embodied in purchases
    - Sequestration on owned lands

To ensure apples-to-apples comparisons across institutions, all multi-institution discussion and analysis hereafter, refers to ***Core Emissions*** *as described by the first set of bulleted categories above.* However, as part of our sensitivity analysis (i.e to understand quantitatively the impact of other emissions from sources where data is relatively difficult to gather), we examine ***Additional Documented Emissions*** *as described by the second set of bulleted categories above*. We have also estimated these additional emissions for institutions where we could not measure them in order to generate what we refer to as ***Estimated Total Emissions***.

It was important to maintain a log of contacts for each specific piece of information. This proved necessary when looking for clarification on an item and will be useful for information gathering in future years. We found it most effective to organize each institution’s contact log according to the information sought.

When information was not readily available, it was necessary to make a determination of whether the time to gather information outweighed its impact on the whole. This was the case for mission-related travel on most campuses. For example, air miles traveled (or even destinations) for campus-related business or athletics is not something that is regularly tracked or recorded.

Once all the data was gathered, it was entered into the eCalculator, which then automatically calculates total emissions and generates charts and graphs comparing usage from year to year. For our purposes, and since we gathered data for only one year (calendar year 2004), those comparisons are not especially helpful. What proved most interesting was the analysis of the data and a limited comparison across institutions.

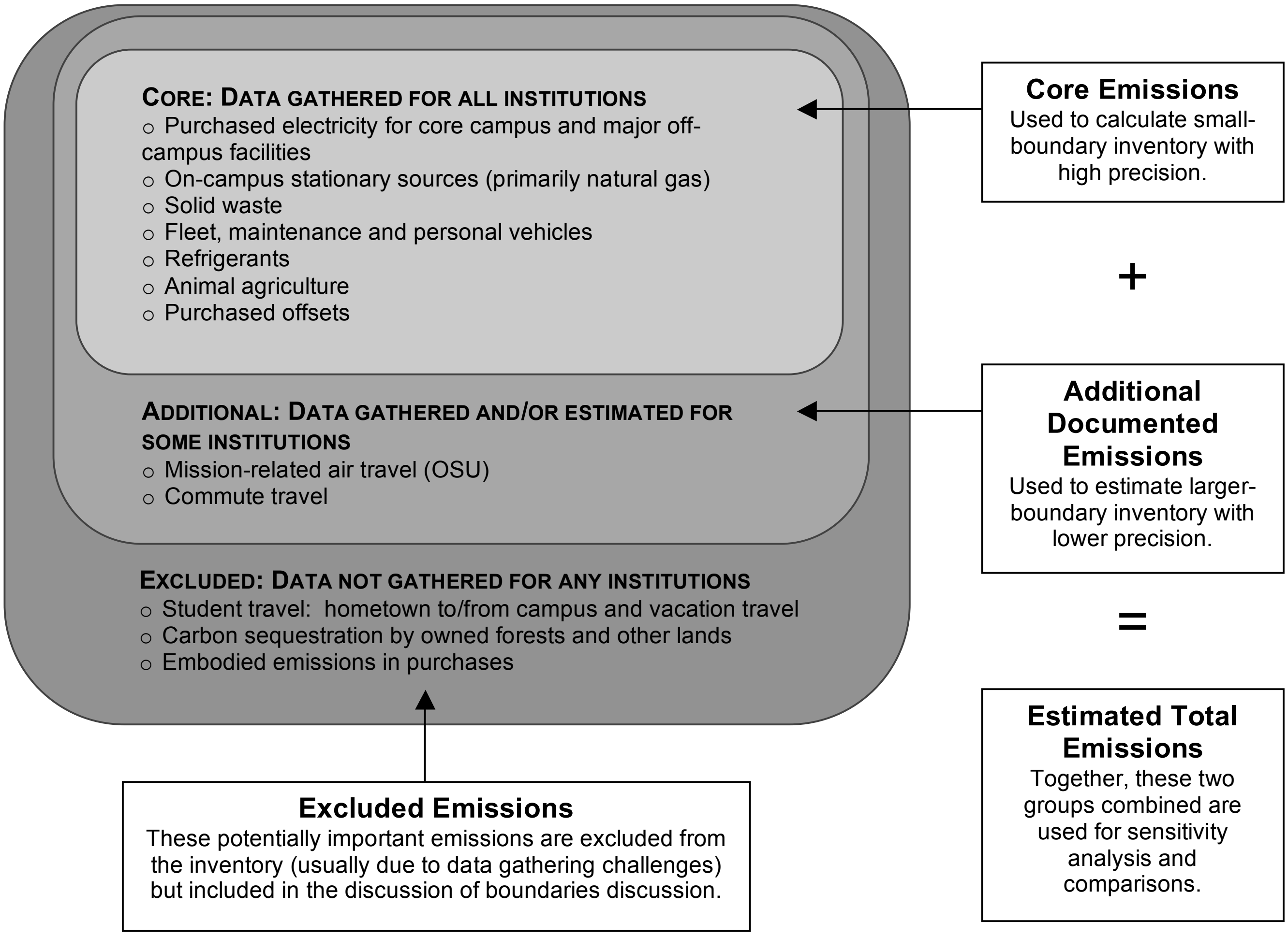
As explained below, our boundaries reached beyond what is normally included in GHG inventories – and beyond areas where comprehensive data is readily available. In brief, in order to calculate estimated total emissions:

- We used reported numbers for purchased electricity, stationary sources, fleet, solid waste and animal agriculture.

- For refrigerants, we used reported numbers from OSU and WOU, which we believe are the most accurate, to determine an average usage per modified headcount. Using that average, we then calculated estimated usage for all other campuses.
- For air travel, we used reported numbers from OSU to determine an average use per modified headcount. Using that average, we then calculated estimated usage for all other campuses.
- For commute, we used reported numbers from OSU, PSU and UO to determine an average use per modified headcount. Using that average, we then calculated estimated usage for all other campuses.
- We then summed actual and estimated totals for all emission categories for each institution.

Figure 2

OUS Greenhouse Gas Inventory Boundaries



CORE: DATA GATHERED FOR ALL INSTITUTIONS

- ○ Purchased electricity for core campus and major off-campus facilities
- ○ On-campus stationary sources (primarily natural gas)
- ○ Solid waste
- ○ Fleet, maintenance and personal vehicles
- ○ Refrigerants
- ○ Animal agriculture
- ○ Purchased offsets

ADDITIONAL: DATA GATHERED AND/OR ESTIMATED FOR SOME INSTITUTIONS

- ○ Mission-related air travel (OSU)
- ○ Commute travel

EXCLUDED: DATA NOT GATHERED FOR ANY INSTITUTIONS

- ○ Student travel: hometown to/from campus and vacation travel
- ○ Carbon sequestration by owned forests and other lands
- ○ Embodied emissions in purchases

Core Emissions
Used to calculate small-boundary inventory with high precision.

+

Additional Documented Emissions
Used to estimate larger-boundary inventory with lower precision.

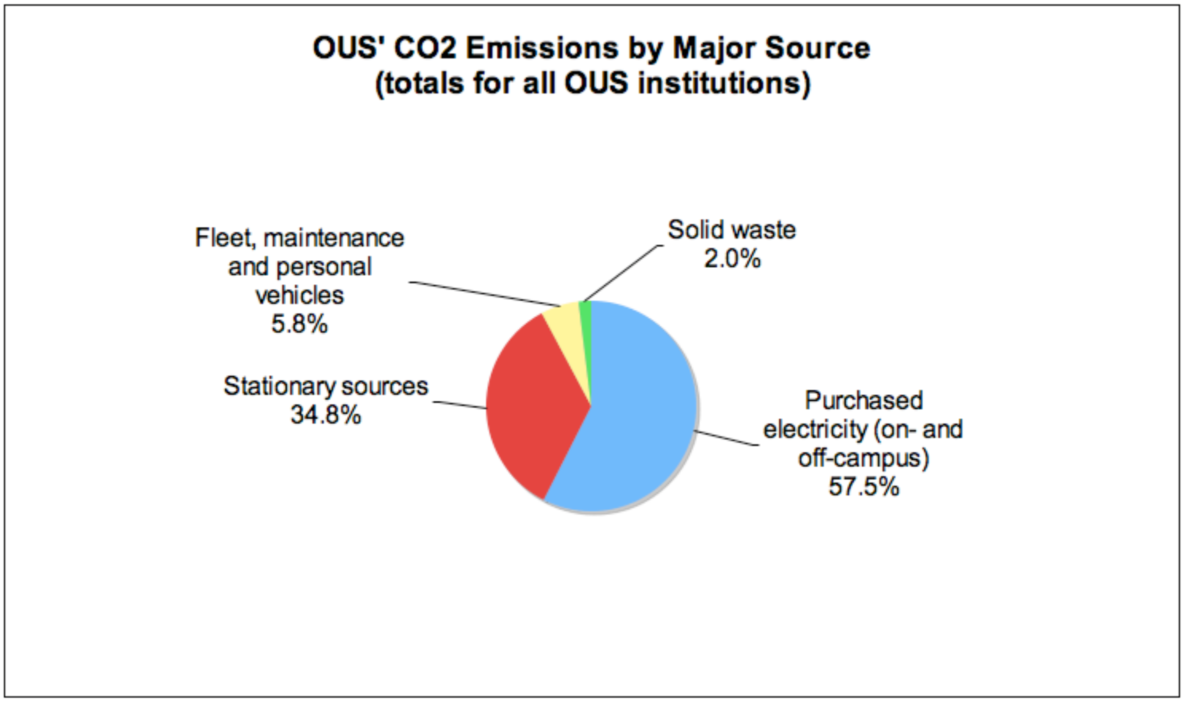
=

Estimated Total Emissions
Together, these two groups combined are used for sensitivity analysis and comparisons.

Excluded Emissions
These potentially important emissions are excluded from the inventory (usually due to data gathering challenges) but included in the discussion of boundaries discussion.

The chart below provides an overview of Core Emissions, the narrowest boundary definition.

Figure 3



This boundary includes those emissions that are most typical of GHG inventories for most organizations. The next section describes this report's attempt to think beyond this narrow definition of a higher education institution's emissions.

GHG Inventory Boundaries: an Innovative Approach

While there is broad consensus around which greenhouse gases matter most, there is less consensus around the definition, conceptualization and (especially) presentation of boundaries. We link our methodology here to boundary issues explicitly.

Several GHG tools and protocols have drawn explicit boundaries. For example, the California Registry looks exclusively at emissions that an organization controls most obviously, largely direct use of fossil fuels and purchases of electricity. We agree that, for a typical office-based business or manufacturing enterprise, this may provide a sufficiently detailed snapshot.

However, this is a problematic approach for a higher education institution. Universities and colleges are different from most corporations in important respects related to the measurement and management of GHG emissions at an organizational level. Our approach is based on these observations:

- Fixed location: A college or university is typically the steward, in perpetuity, of a swath of the built environment, and an institution generally owns all or a large majority of its facilities. This long-term relationship with a location provides opportunities and responsibilities that are less frequently the case for other organizations, including corporations and even government agencies.
- Low turnover of employees: Most classes of higher education employees have low rates of turnover compared to the private sector and even government (or, in the case of public

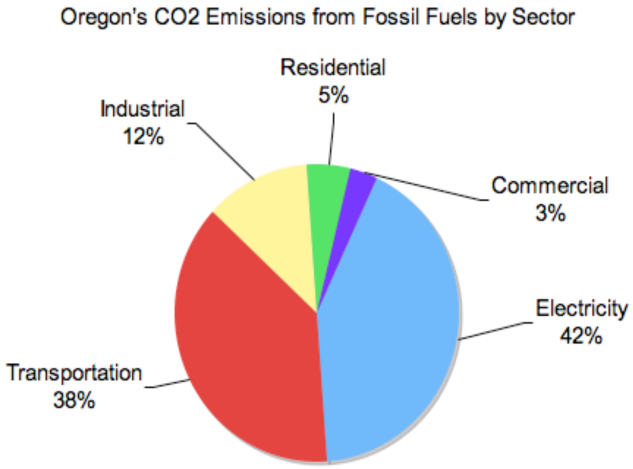
institutions, other aspects of government). By having long-term relationships with staff and faculty, higher education institutions can not only shape infrastructure to meet employee needs (e.g., bus routes and park-and-ride programs), but also shape and incentivize personal behavior (e.g., support alternative and multimodal transportation habits).

- Deep involvement in student life: Student populations are not simply casual customers of their colleges and universities. Rather, they often live in on-campus or campus-owned housing; and even when they do not live in housing owned by the institution, their lives often center on campus-based activities. This involvement is an opportunity to influence behavior in systematic ways, including areas as wide ranging as waste and recycling, energy and water use, food choice and disposal, and transportation.
- Opportunity to shape the mission: The standard missions of higher education institutions – research, teaching and service – need not be met in old-fashioned and static ways. An institution is free to innovate new forms for on-going functions. By focusing attention and informing discussion in its community on carbon-intensive lifestyle and activities, an institution can potentially reshape these activities and change business as usual.

For these reasons, a higher education institution should, when possible, use more expansive boundaries than currently expected of other types of organizations. Accordingly, we have attempted to provide comparisons throughout the document based on core emissions and estimated total emissions.

The pie chart below shows the GHG emissions from fossil fuel use in the state of Oregon. A comparison with the previous pie chart (of system-wide Core Emissions) highlights that transportation emissions – 38% of all emissions in the state – are clearly underrepresented in a typical GHG inventory of a higher education institution.

Figure 4



Oregon's CO2 Emissions from Fossil Fuels by Sector, from *Oregon Strategy for Greenhouse Gas Reductions*, Governor's Advisory Group On Global Warming, December 2004.

This apparent under representation of transportation-related emissions is the motivation behind the expanded boundaries represented by Estimated Total Emissions. Nonetheless, there are still important emissions – transportation-related and otherwise – that this inventory necessarily left out. The next section describes these categories briefly.

Omitted Emissions Sources (for both Core and Estimated Total Emissions)

As with any study addressing a topic of this breadth, there are omissions. We briefly discuss three, with specific rationale for each: (1) sequestration at forests owned and operated by OSU; (2) embodied emissions in purchases by the institutions; and (3) home-to-school travel (especially long-distance travel) by students.

Biological sequestration (by forestry or agriculture) is often included in inventories as a way of offsetting impacts. This is, in our opinion, inappropriate for a variety of reasons, at least for institutions of higher education. To a significant degree, the goal of a GHG inventory is to understand our overwhelming reliance on fossil energy and our opportunities for decreasing and, eventually, eliminating that dependence. We know that, at a global scale, we cannot "sequester our way out of the problem" (i.e., there simply is not enough biologically productive land to absorb all CO_2 emissions from fossil fuel combustion at its current rate). The happenstance of an institution's ownership of a swath of forest should not provide a loophole for that institution's use of fossil energy. This is especially true when ownership of that forest – in this case, by a land grant institution with a public mission – is formally on behalf of the country as a whole. Thus, while it might be admissible to include forest sequestration of CO_2 for the United States as a whole, OSU (or by extension OUS) should not take credit for this offset.

A potentially significant but omitted category is the *embodied emissions* of purchases, i.e., the GHGs emitted in the resource extraction, production and distribution of all material items purchased by OUS institutions. To our knowledge, these emissions have been included in only one GHG inventory of a higher education institution[xvii]; we acknowledge them because they are a future frontier for innovative boundary conditions in the future, with growing precedent in the corporate world.[xviii] Embodied emissions, like all emissions, clearly represent financial risk, as these emissions will, under eventual GHG regulations, result in "carbon costs" shared by sellers and buyers alike. Measuring and then decreasing embodied emissions may therefore become an aspect of managing an institution's carbon risk. However, we did not consider these omissions for three related reasons of practicality that together are overwhelming: first, there is no standardized methodology for analyzing the GHG intensity of purchases or a supply chain; second, and more important, OUS does not have easily accessible information on purchases at a sufficiently disaggregated level to categorize purchases without an extremely labor-intensive effort; and last, an institution's purchases represent a GHG inventory boundary issue that is too complex to handle in this report. Again, we hope future work considers embodied emissions.

At first glance, long-distance student travel may appear well beyond any reasonable boundaries: it is a series of personal decisions, under the control of and financed by students as individuals. By juxtaposition, a college would certainly not consider the emissions embodied in the manufacture of its students' iPods as a carbon liability for the institution!

And yet it is not so simple. Some elite colleges and universities pride themselves not only on social and ethnic diversity, but also on the diverse geographic origins of their respective student bodies. In other words, these institutions have made their long reach part of their identities and their business models. To some extent, then, such institutions bear some responsibility for the CO_2-intensity of this travel. For lack of data and resources, we omit this emissions source, though we similarly exhort future inventories to include it or at least estimate its scale. At least one previous study (of an elite private college drawing students nationally) suggests that student travel can be a major GHG emissions source.[xix]

Findings and Analysis

Overview of Findings

This section provides a detailed summary of the GHG emissions for the seven OUS institutions. The boundaries methodology used is described in the previous section.

1. A sense of scale: First and foremost, the document provides a snapshot of the major sources of direct and indirect emissions by the seven institutions.
2. Internal and external benchmarking: The document attempts to provide apples-to-apples comparisons of emissions from OUS institutions. This side-by-side assessment is augmented with roughly comparable data from other institutions of higher education.
3. Guidance for other GHG inventories: This document carefully lays out its methodology and reasoning (briefly in the main body, in detail in the relevant appendices) to guide and inspire other Oregon state agencies and higher education institutions nationally to conduct rigorous and clearly framed GHG inventories as a step toward climate action.

This report attempts to be innovative in the discussion of boundaries. Throughout, we refer to two sets of boundaries -- *core emissions*, using conventional narrow boundaries, and *estimated total emissions*, using expanded boundaries. These concepts are discussed in detail in the previous section, Methodology and Boundaries.

Essential Findings

- *Core emissions* defined in the report (including direct fossil fuel use, electricity, fleet and solid waste): 195,087 mt CO2e (metric tons of carbon dioxide equivalent).
- *Estimated total emissions*, with an expanded boundary for some measured and some estimated emissions (including commute travel, refrigerants, mission-related air travel and other miscellaneous categories): 253,544 mtCO2e.
- Taken together, direct emissions from natural gas and indirect emissions from electricity are the overwhelming sources of GHG emissions, representing 92.8% of core emissions and 71.4% of estimated total emissions.
- Most major and minor sources (electricity, natural gas, fleet, waste and fugitive emissions of refrigerants), totaling 99.0% of core emissions and 78.2% of estimated total emissions of system-wide emissions, are under direct control and management of the institutions.
- However, several potentially significant GHG sources are either difficult to limit (air travel), or only partially under the control of the institution (commute travel). Furthermore, we have incomplete and uncertain data on these sources.
- Hard-to-manage sources are a small share of emissions now, but they will represent a larger share in the long run as core emissions are reduced significantly through the most straightforward actions to improve efficiency and infrastructure.

Sense of Scale

- Direct emissions from stationary fossil fuel use (overwhelmingly natural gas) and indirect emissions from electricity use together comprise the vast majority (nearly 93%) of system-wide emissions: 57.8% and 35.0%, respectively, of core emissions.
- Even using expanded boundaries, the combined emissions from stationary fossil fuel use and electricity account for over 70% of total emissions: 44.4% and 26.9%, respectively.

- If OUS were to purchase 100% of its electricity from carbon-free renewable energy sources, estimated total emissions would therefore fall by nearly half (44.4%).
- Stationary fuel use, electricity, fleet fuel, fugitive emissions of refrigerants, and solid waste-related emissions represent 78.2% of system-wide estimated total emissions (expanded boundaries) and no less than 46.4% emissions at any particular institution (EOU).
- Grid mix (the source profile of electricity generation) is a major factor in total GHGs, and the principal driver of cross-institution differences.
    - Energy use varies less across institutions than does GHG emissions per square foot or per campus user. (This underscores the effect of grid mix differences.)
    - Thus, the differences in grid mix (i.e., the indirect GHG emissions resulting from electricity generation) account for most cross-institution variation in emissions per square foot or per campus user. (These differences should also result in different climate action plans at each institution.)
- Certain activities for which few and only low-quality GHG data exist could potentially be important sources of emissions, including notably:
    - Mission-related air travel (6.5% of total emissions at OSU, the one institution for which we have data).
    - Commute patterns (estimated range of 7-19% at the three institutions for which we have partial data).
- Miscellaneous secondary observations and conclusions
    - Waste disposal-related emissions are small as long as destination landfills are capped for methane flaring or capture. (Flaring or methane capture is in place at landfills serving six of the seven institutions.)
    - The single greatest apparent emissions source is electricity use by Oregon State University. (This result is important but potentially misleading, due mainly to the coal-heavy grid mix of the University's electricity provider in 2004. We discuss the finding in detail in the report.)
    - Fugitive emissions of refrigerants are a small source of total CO2e emissions, but their share could grow as emissions from other sources fall, especially if OUS does not make an effort to capture existing refrigerants and to avoid refrigerants with high Global Warming Potential (GWP). Furthermore, it seems possible that fugitive emissions information is incomplete for several institutions.
- If OUS were to purchase 100% of its electricity from carbon-free renewable energy sources, commute-related emissions would then represent 29% of core emissions (and 18% of estimated total emissions, with the expanded boundaries estimated in this report).

Cross-Campus OUS Benchmarking

The report does not capture "performance" per se, but it sheds light on the circumstances of the various institutions in the following ways:

- The two major urban research universities (UO and PSU) have not only the majority of absolute impacts but also higher per-person and per-square-foot impacts.
- OSU's emissions are a disproportionately large share of total OUS emissions, driven overwhelmingly by indirect emissions from electricity: the grid mix of the utility serving OSU is significantly more carbon-intensive than those of utilities serving other OUS institutions.
- OIT's emissions are a disproportionately small share of total OUS emissions, driven by the significant geothermal resource exploited by that institution, lowering both natural gas and electricity needs.
- OUS emissions, normalized for rough per-campus-user comparisons, appear lower than most other institutions.

Guidance for OUS and Other State Agencies for GHG Inventories

This inventory was initially undertaken during a period when other Oregon state agencies were considering similar efforts to document GHG emissions. Thus, we have attempted to collect insights from the data gathering process and report assembly process:

- Use existing inventories (including this one) to:
  - Assess likely major sources before gathering data.
  - Narrow scope to major sources in order to focus data gathering efforts and minimize effort and expense.
- Do not completely ignore potential major sources simply because of lack of data.
- Specifically, while some emissions (e.g., stationary fuel use on site and fuel use for fleet vehicles) are unambiguously part of the institution, others lie outside of an institution's direct control but are nonetheless central to the institution's existence and functions (e.g., commute impacts travel and long-distance travel for research).
- Similarly, explicitly address boundary issues. Specifically, determine the timeframe for the inventory and which locations and activities will be included. Acknowledge partial responsibility for emissions when there is shared control, rather than simply excluding those sources.
- Use existing GHG inventory tools and protocols from credible organizations that have put their work in the public domain, such as Clean Air-Cool Planet and the California Climate Action Registry.
- Determine the location of the necessary pieces of information, which will likely be scattered across various departments and/or individuals. The process of tracking down the location of information is often the most time consuming. It is best to start with someone who has a broad understanding of the organization who can help you find individuals with the specific information you seek.
- Determine how info is stored (electronic or hard copy) and if any regular compilation and examination of data occurs.
- As data arrives, ensure consistent units of measurement and enter data into your chosen inventory tool.
- Clarity on boundary issues (i.e., those emission sources which the university is responsible to document and manage) will be fundamental to any clear, high-consensus discussion of action and implementation. There is probably no short and satisfying answer to this problem.
- Data quality and reliability vary significantly across emissions sources.

Seeking a Sense of Scale: Rough Cross-Institution Comparisons

This section examines how and to what extent cross-institution comparisons are appropriate or meaningful. This section is built around the boundaries methodology described in the previous section. Fortunately, we are not on entirely new ground here. For rough comparison, we draw on summary data from recent GHG inventories by public and private institutions, Tufts University, the University of Colorado, the seven OUS institutions and OUS as a whole. However, this report provides a rare opportunity to compare seven institutions that have some common history and (for four of the seven institutions) similar climate, so we begin with a discussion of the OUS institutions.

The following table is an attempt to put the results of this inventory in the broader context of inventories to date in higher education.

Table 1

College / University Ranking by GHG Emissions Per Campus User

College / University (ranked by GHG emissions per campus user)	Per Capita Metric Tonnes CO2e	Total Emissions Metric Tonnes CO2e*
Yale University[xx]	12.6	284,663
Smith College[xxi]	8.7	33,025
Oberlin College	8.4	50,417
University of Vermont	6.2	63,900
Oregon State University	5.1	112,620
University of California, San Diego[xxii]	3.38	178,896
OUS (all institutions, estimated total emissions)	**3.00**	**253,544**
Tulane University	2.8	52,981
Oregon Institute of Technology	2.47	7,399
OUS (all institutions, core emissions only)	**2.31**	**195,087**
Portland State University	1.81	33,627
Tufts University	1.3	17,783
University of Oregon	1.29	29,610
University of Colorado – Boulder	1.0	34,567
Southern Oregon University	0.95	5,320
Western Oregon University	0.92	5,090
Eastern Oregon University	0.46	1,421

* Baseline years vary: 2004 for all OUS institutions; 2002 for Yale; 2000 for Oberlin; 1998 for Tufts; 2003 for UCSD; 2000 for Tulane; 2004 for Smith; 1990-2000 average for University of Vermont; unknown for other institutions. All OUS data based on this report, using 2004 core emissions only (stationary fuel use, indirect emissions from electricity, fleet vehicles), unless specified. OUS emissions normalized by *modified headcount*, as explained elsewhere in this report. See endnotes for sources for non-OUS institutions.

It is crucially important to note that, unlike the intra-OUS comparisons, this table does not provide apples-to-apples comparisons. In addition to the diverse circumstances of the institutions mentioned here – including differences of climate, age and composition of infrastructure, square footage per campus user and other factors – *there is no assurance that the respective GHG inventory methodologies were the same* across these varied studies. This graph is provided only for general sense of scale.

For example, the only close apples-to-apples comparison would be Yale's number (12.6 mt CO2e) to OSU's *core emissions plus travel and commute* (5.79). This OSU number is slightly different from what appears in the table for OSU and other OUS institutions since we can only estimate emissions corresponding to those specific boundaries for institutions other than OSU.

Table 2

OUS Rough Cross-Institution Comparisons

	EOU	OIT	OSU	PSU	SOU	UO	WOU
MTCO2e / square foot	4.1	23.0	38.1	4.3	8.1	12.5	9.9
square foot / headcount	245	236	335	198	66	1,108	50
MTCO2e / headcount	0.46	2.47	5.79	0.38	0.24	6.29	0.22

Among the seven OUS institutions, it is similarly challenging to make comparisons. The institutions differ in scale, scope (from undergraduate-focused college to diverse research university), setting (urban vs. rural), and a number of other important ways. These differences mean that we cannot create a blanket definition of "good" or "bad" performance.

OUS Institutions: Boundaries Comparisons

The process of assembling this report demonstrated that data availability differs widely from one institution to the next. In general, core emissions are available and emissions in the areas of least control (e.g., long-distance travel by students) are not available. To indicate data availability and to relate it directly to an institution's control of emissions from particular sources, we assembled what we call an "availability-control matrix" for each institution. The following figure shows the availability-control matrix for GHG emissions for all of OUS.

Figure 5

Availability-Control Matrix for OUS GHG Emissions

		Level of institutional control over usage and type		
		High control	**Moderate control**	**Low control (or long time horizon for change)**
Level of availability of relevant information	**High availability**	• Core campus utilities • Housing • Fleet	• Grid mix • Landfill	
	Moderate availability	• Athletics travel	• Academic and business travel	• Commute
	Low availability	• Refrigerants		• Long-distance student travel

By control, we mean an institution's authority over the activities that generate emissions. For example, energy use on the core campus is considered to be an area of high control, while the grid mix of electricity is an area of low or at most medium control, not controllable directly but perhaps alterable by subscription to renewable energy.

By availability, we mean the ability of the institution (or independent researchers) to locate and retrieve information about activities that generate emissions. For example, we have generally easily accessible information on energy use by the core campus, while it is difficult to find or generate high-quality data on commute patterns (though such information exists for some institutions). At the extreme, it is extremely difficult to find information on start-of-year, end-of-year, and vacation travel by students.

The classification implied by the matrix above is not uniformly applicable across institutions or over time. An institution can't unilaterally and completely control commute patterns on a given day, but over years or decades it can transform its transportation system gradually to favor certain modes and discourage others. Similarly, over time an institution can make a commitment to new information-gathering activities or to transforming information and tracking systems to meet emerging needs.

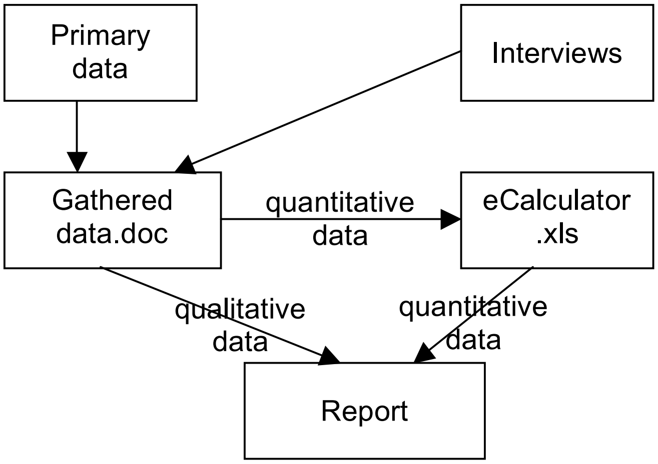
Appendix A: Research and Data Gathering Lessons

Data Gathering Process

We gathered information from campus contacts, often drawing on spreadsheets and other resources maintained at the campus level. For each institution, the primary data and the interviews were combined into a single source document and then used to create an eCalculator spreadsheet. The results of the eCalculator spreadsheet and other qualitative insights were combined to create the report. The diagram shows the elements of this process in brief:

Figure 6

Data Gathering Path for OUS GHG Inventory



Overview of Relevant GHG Inventory Tools

There have been many useful tools, reports and guidelines used as inputs to the formation, structure and information gathering efforts of this inventory. A complete list is available in a later appendix. Two tools were especially useful: the California Climate Action Registry and Clean Air-Cool Planet's eCalculator.

The California Climate Action Registry (CCAR or the Registry) is a voluntary greenhouse gas registry with goals to "protect, encourage and promote early actions to reduce GHG emissions." The purpose of the Registry is to help companies and organizations to establish GHG emissions baselines against which any future GHG emission reduction requirements may be applied. Registry participants include businesses, non-profit organizations, municipalities, state agencies, and other entities. The Registry was established by California statute as a non-profit voluntary registry for greenhouse gas (GHG) emissions. The organization's focus is on California emissions, but reporting of nationwide emissions is encouraged. The State of California implies a promise of support to ensure that participants receive appropriate consideration for early actions in the event of any future state, federal or international

GHG regulatory scheme. Reporting is done in a consistent, certified format. Other universities have reported emissions, but OUS would be the first university system to report. The Registry supports The Climate Action Registry Reporting Online Tool (CARROT), which is both a greenhouse gas (GHG) emissions calculation tool and a reporting tool. It serves as the companion to the Registry's General Reporting and Certification Protocols. The CARROT has four main functions:

- It helps Registry participants calculate their annual GHG emissions and/or report these emissions to the Registry;
- It allows approved certifiers to review participants' Annual GHG Emission Reports and submit their certification information to the Registry;
- It permits the general public to view aggregated reports of participants' annual GHG emissions and their progress in managing these emissions;
- It enables the Registry staff to efficiently manage and track participants' data.

Clean Air – Cool Planet (CA-CP) is a non-profit organization dedicated to finding and promoting solutions to global warming. Most of the organization's efforts are focused on the Northeast United States working with campuses, communities, and companies to help reduce their carbon emissions. One of its main goals is to help organizations and individuals understand the impacts of global warming and its best available solutions. CA-CP has a Campus GHG Emissions Inventory Calculator (eCalculator), a tool for gathering emissions data and calculating impacts of sources of heat-trapping gases produced by the operations of a college or university. The eCalculator provided the basis for our information gathering, data compiling and emissions calculations. A number of important changes were made to the eCalculator to match our needs. Those changes are described in the Appendix.

CCAR is focused on California organizations with an eye towards future reporting requirements. CA-CP, on the other hand, is focused on raising awareness about the issue of climate change and improving self-awareness of each organization's impact. Both outcomes serve the needs of Oregon University System as it continues to assess and benchmark its performance, then begin to determine the most feasible methods for reducing related impacts.

Notes on Information Gathering for Each Section

For verification of this inventory and for simplification of future inventories, the following notes about information gathering for each section should prove useful

- General energy
  - Clear and comparable boundaries for each institution must be determined in advance. In some cases, that distinction was left to campus personnel to determine and describe.
  - In general, on-campus energy usage is easier to gather since, in most cases, record keeping is centralized for on-campus buildings.
  - Record keeping for off-campus facilities varied by institution. In some cases, energy usage information is centralized for all campus facilities, whether they are on- or off-campus. In other cases, where each off-campus facility is responsible for payment of its own energy bills, information is difficult and time-consuming to gather and was oftentimes omitted from this inventory.
- Mission-related travel
  - Fleet, maintenance and personal vehicles
    - The Oregon Department of Administrative Services requires mileage reports each quarter from each institution for the following vehicle classes:
      - Private miles: mileage reimbursed to individuals for private vehicle use for institutional business.

            - Agency miles: miles driven in campus-owned vehicles for institutional business. Includes maintenance vehicles.
        - A third category of automobile mileage, Motor Pool miles, reports institutional usage of DAS' Motor Pool vehicles and is compiled by DAS.
        - This reporting and compiling protocol makes the collection of vehicle miles traveled data relatively easy. The expectation was that, due to these reporting protocols, the reliability of the mileage numbers would be high. However, we have found discrepancies between the numbers reported to DAS and actual usage. For example, information was gathered from both DAS and OSU on the number of private vehicle miles reimbursed by OSU. Those numbers differed significantly. OSU reports submitted to DAS showed 3,543,570 reimbursed miles. DAS records reported 2,784,092 miles. We were unable to determine the reason for the discrepancy.
    - Commute
        - Only three of the seven OUS institutions have completed surveys of faculty, staff and students on commute modes. There was no data available on commute distance traveled.
    - Air travel
        - This segment of travel was difficult to compile. OUS institutions use Banner accounting software, which has codes for in-state and out-of-state travel that provide insight into an institution's total expense in these areas. Banner data from these accounting codes includes costs for airfare and ground transportation, areas with a measurable GHG impact, but it also includes activities that do not have a measurable GHG impact, such as meals and lodging. In the end, Banner data in accounting codes for in- and out-of-state travel was not useful in determining GHG impact.
        - One contracted travel agency, Teel's Travel Planners, which serves OSU, was interested in compiling data on OSU's air travel purchases. The information they were able to generate did not provide air miles traveled so some additional, time-consuming information gathering was necessary to convert the provided information into useable data.
    - Student travel from hometown to/from campus and vacation travel
        - None of the OUS institutions gather information in this area. There was no easily obtained information on student hometown locations or vacation travel.
    - Other
        - There are a few other categories of automobile usage that are more difficult to quantify. These include miles in rental vehicles such as automobile rentals at distant locations (see air travel above), and bus and van rentals for sports teams traveling to away games. We were not able to gather data from any institution for these impact areas.
- Solid waste
    - Information-gathering for this area varied by institution. In some cases, campus personnel maintain careful records of waste and recycling generated. However, in most cases, there is no record keeping by campus personnel and data collection relied on waste haulers for information. Waste hauler practices varied as well. Some haulers collect weight information and provide that data on invoices. Other haulers do not collect weight information so volumes were converted to weights with the assumption that all waste containers were full when tipped.
- Animal agriculture – see assumptions under Oregon State University.
- Refrigerants
    - Institutional record keeping varied greatly. Some institutions have refrigerant management software that readily provides detail on refrigerant type, usage, purpose

and any loss. Some institutions contract out management of refrigerant use to outside organizations. Some institutions do not have any sort of management system for refrigerants. Information gathering from those institutions was more time consuming and less reliable.

- Normalization data
  - *Determination of student population numbers*
    - Data was collected from OUS Institutional Research Services University Profiles – Fast Facts – 2004[xxiii]
    - The following formulas were used to determine campus populations:
      - Full Time Students = (Fall 2003 Headcount) – (Undergraduates x Percent part-time)
      - Part Time Students = Undergraduates x Percent part-time
      - Summer School Students = excluded due to lack of uniform data availability and difficulties in making cross-institutional comparisons.
  - Building inventory information
    - Each institution compiles data on all facilities. Specifically, we used gross square footage
- Offsets
  - Green electric credits: Our calculations allow for the possibility of purchasing electricity from renewable sources in order to offset emissions in the default grid mix.
  - Composting: Our calculations allow for composting of large-volume landscape waste, which results in lower emissions than sending it to a landfill. (Not all institutions track this information.)

Appendix B: GHG Inventories for Individual OUS Institutions

The sections below describe the GHG inventory for each of the seven institutions. We have attempted to make notes on assumptions, methodology and sources for each institution as well. We hope this appendix will be the starting point for future GHG inventories.

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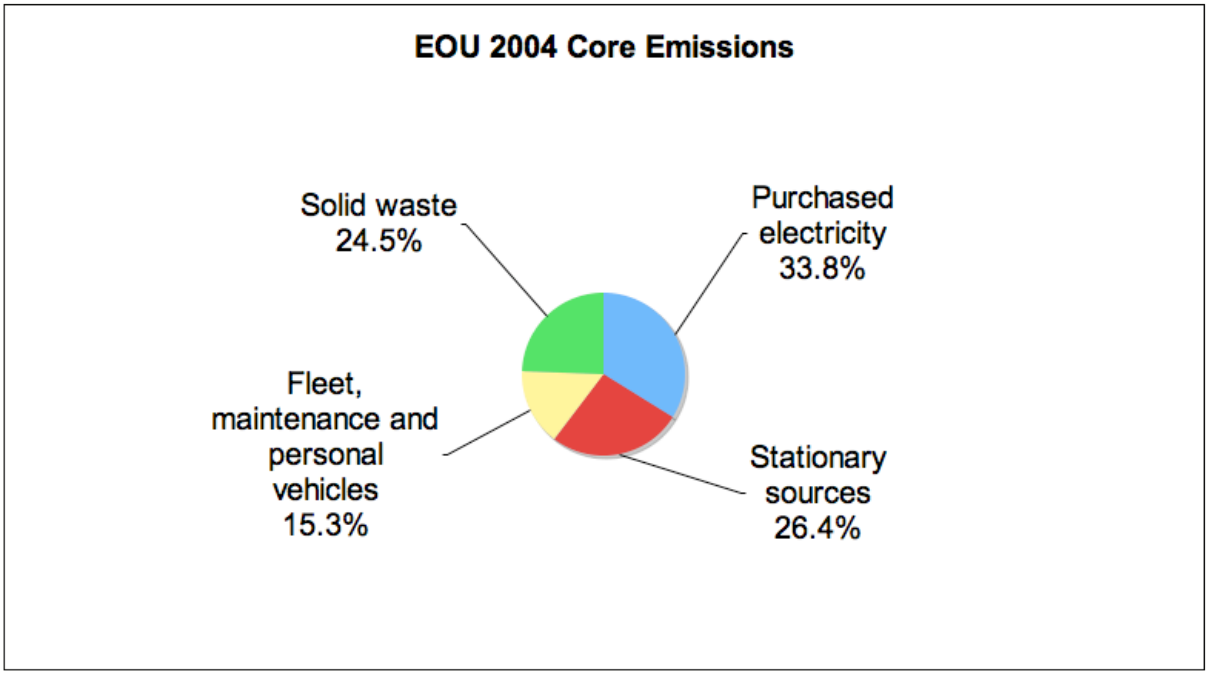
Eastern Oregon University 2004 Greenhouse Gas Inventory

Overview of Emissions						
Eastern Oregon University						
Year	**2004**	Energy Consumption	CO2	CH4	N2O	CO2e
		MMBtu	kg	kg	kg	Metric tonnes
Purchased electricity		39,524	476,011	15	15	**481**
Stationary sources		7,084	374,512	37	1	**376**
Transportation total		3,010	211,598	41	14	**217**
	Fleet	3,010	211,598	41	14	**217**
	Commute	-	-	-	-	**-**
	Air travel	-	-	-	-	**-**
Animal agriculture		-	-	-	-	**-**
Solid waste		-	-	15,132	-	**348**
Refrigerants (specific GHGs not represented in this table)						**-**
Total		**49,618**	**1,062,120**	**15,225**	**30**	**1,421**
Offsets						**-**
	'Green' electric credits					-
	Composting					-
Net Emissions						**1,421**

The chart below summarizes the availability of information for this inventory versus the level of control that EOU has over the type and amount of energy used.

		Level of institutional control over usage and type		
Level of availability of relevant information		**High control**	**Moderate control**	**Low control (or long time horizon for change)**
	High availability	• Core campus utilities • Off-campus utilities • Fleet	• Grid mix • Landfill	
	Moderate availability	• Refrigerants		
	Low availability	• Athletics travel	• Commute • Mission-related travel	• Long-distance student travel



(There is no pie chart for additional documented emissions for EOU because our study documented only core emissions.)

Energy	
Purchased electricity	9,716,888 kWh
Natural gas	7,063.15 MMBtu
Steam and chilled water produced off-campus	NA
On-campus cogeneration	NA
Residual oils (#5 & #6) and Distillate oils (#1, #2, #3 & #4)	140 gallons of residual oil
Propane	NA
Incinerated waste	NA
Coal	NA
Solar / wind / biomass	NA
Offsets (green tags etc.)	NA
Sources	Steve Wadner, Campus HVAC and Security Supervisor, Facilities and Planning; Mike Rhodes, Director of Facility Operations, Facilities and Planning
Assumptions	NA

Transportation, solid waste and other major categories	
Fleet, maintenance and mission-related personal vehicle miles	EOU has an on-campus fuel pump that is used exclusively for campus-owned vehicles and equipment. Since campus-owned vehicles are fueled at the on-campus cardlock, there is overlap in the two data sets. EOU-owned gasoline consumption from on-campus pump for CY2004 • 6,644 gallons. There is also an on-campus diesel pump that is used exclusively for maintenance equipment. Gallons of diesel pumped are not documented, but they do have the total cost of diesel purchased in CY2004 - $1,873. DAS CY 2004 Quarterly Mileage Report information: • Private miles - 233,462. Gallons = 233,462 / 22.1= 10,564 gallons • Agency miles - 45,930. Gallons = 45,930 / 22.1= 2,078 gallons (This is significantly less than the 6,644 gallons from on-campus fueling station, so using the 6,644 gallons for the inventory.) • Motor Pool miles - 131,994. Gallons = 131,994 / 22.1 = 5,973 gallons Total gallons gasoline = 10,564 + 6,644 + 5,973 = 23,181 Total cost of diesel during 2004 = $1,873 Average price of diesel during CY2004[xxiv] = $1.91 Total gallons diesel = 1,873 / $1.91 = 980.6 gallons Sources: Cheryl Higgins, Property Specialist, Facilities and Planning; Carol Franks, Administrative Program Specialist, Facilities and Planning; Robert Nies, DAS Assumptions: Used 22.1 mpg as average for fleet.
Commute	No commute survey has been conducted at EOU. Sources: Charles Bleak, Director of Institutional Research Assumptions: NA
Other mission-related travel	*Air travel* No information available for air miles traveled. *Student travel from hometown to/from campus and vacation travel* No information available for student travel. Source: Doug Garton, Accounting Manager, Business Services Assumptions: NA
Solid waste	City Garbage Service hauls EOU's solid waste. EOU collects waste from all parts of campus into a central compactor. There is also an 8-yard dumpster at Hoke Hall that is dumped 3 times per week. City Garbage includes waste weight data on invoices for the compactor, but not for the dumpster. During CY2004, 164.35 tons of waste were hauled from the compactor and 187.20 tons of waste were hauled from the dumpster outside Hoke Hall for a total of 351.55 tons. All solid waste goes to Fox Hill Landfill, which has no methane recovery. Sources: Carol Franks, Admin Program Specialist, Facilities and Planning; Rob Yuodelis, Director, Environmental Health and Safety

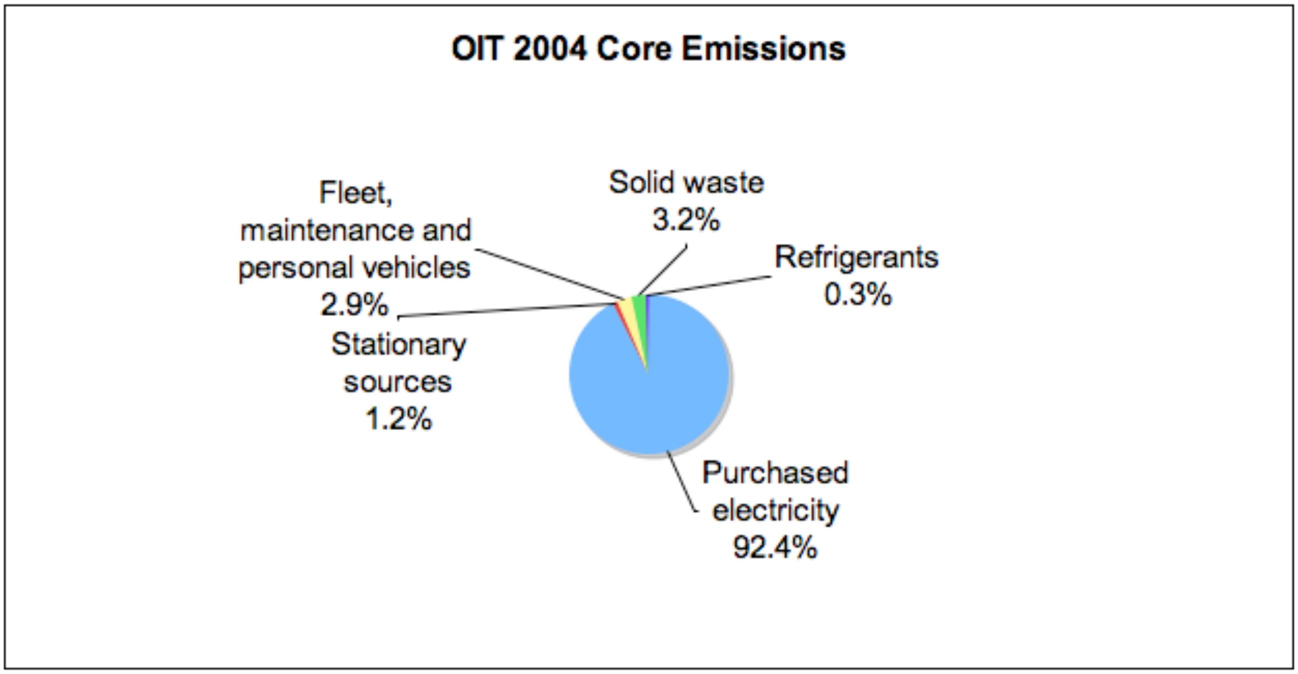
Solid waste (continued)	Assumptions: Hoke Hall dumpster invoices have no weight information so volumes were converted to weights at a rate of 0.15 tons/cubic yard (uncompacted). Assumed all dumpsters were 100% full. Two overcharges on the dumpster during CY2004 were not included since overages were likely offset by tips when dumpsters were not completely full.
Animal agriculture	EOU has no livestock animals except at Union and Burns stations. Those animals are part of OSU's Agriculture Department and are included in OSU's calculations for the inventory. Sources: Larry Larson, Professor, Program Director, OSU Department of Agriculture Assumptions: NA
Refrigerants	No refrigerants used during CY2004. Sources: Mike Rhodes, Director of Facility Operations, Facilities and Planning Assumptions: NA

Oregon Institute of Technology 2004 Greenhouse Gas Inventory

Overview of Emissions						
Oregon Institute of Technology						
Year	**2004**	Energy Consumption	CO2	CH4	N2O	CO2e
		MMBtu	kg	kg	kg	Metric tonnes
Purchased electricity		31,703	6,834,231	12	12	**6,838**
Stationary sources		1,702	89,890	10	0	**90**
Transportation total		2,986	209,906	41	14	**215**
	University fleet	2,986	209,906	41	14	**215**
	Commute	-	-	-	-	**-**
	Air travel	-	-	-	-	**-**
Animal agriculture		-	-	-	-	**-**
Solid waste		-	-	10,312	-	**237**
Refrigerants (specific GHGs not represented in this table)						**19**
Total		**36,391**	**7,134,027**	**10,373**	**26**	**7,399**
Offsets						**-**
	'Green' electric credits					-
	Composting					-
Net Emissions						**7,399**

The chart below summarizes the availability of information for this inventory versus the level of control that OIT has over the type and amount of energy used.

		Level of institutional control over usage and type		
Level of availability of relevant information		**High control**	**Moderate control**	**Low control (or long time horizon for change)**
	High availability	• Core campus utilities • Off-campus utilities • Fleet	• Grid mix	
	Moderate availability	• Refrigerants	• Landfill	
	Low availability	• Athletics travel	• Mission-related travel • Commute	• Long-distance student travel



(There is no pie chart for additional documented emissions for EOU because our study documented only core emissions.)

Energy	
Purchased electricity	7,794,221 kWh
Natural gas	1,697 MMBtu
Steam and chilled water produced off-campus	NA
On-campus cogeneration	NA
Residual oils (#5 & #6) and Distillate oils (#1, #2, #3 & #4)	Distillate oils - The Snell Hall generator uses approximately 50 gallons diesel per year. The Residence Hall generator uses approximately 150 gallons diesel per year.
Propane	56.8 gallons of propane for forklift fuel
Incinerated waste	NA
Coal	NA
Solar / wind / biomass	OIT has been tapping geothermal energy since 1964. OIT's direct-use system uses three geothermal wells between 1,300 feet and 1,800 feet deep. These wells supply all heating needs for the 11 building, 600,000 square foot campus. Additionally, the wells meet some of the campus's cooling requirements. OIT's geothermal system costs $35,000 to operate each year, which is considerably cheaper than the operational cost of a natural gas fired boiler. Geothermal energy use was not included in this inventory.
Offsets (green tags etc.)	NA

Sources	Chris Campbell, Facilities Services Business Manager
Assumptions	NA

Transportation, solid waste and other major categories	
Fleet, maintenance and mission-related personal vehicle miles	Fuel usage from OIT's on-campus pump for 2004 was not available due to erroneous record keeping and reporting prior to January 2005. There was little reason for any sizeable variance between 2004 and 2005 fuel usage so 2005 fuel usage numbers were used. There is no overlap between any of the mileage reported and fuel used at the on-campus pump. Fuel usage from on-campus pump (CY2005): • Gasoline: 5,878.12 gallons • Diesel: 970.97 gallons DAS mileage reports: • Private miles: 316,096. Gallons = 316,096 / 22.1 = 14,302.99 • Agency miles: 57,463. Gallons = 57,463 / 22.1 = 2,600.14 • Motor Pool miles: 0 Other: • President Martha Dow's Honda van mileage: 4,784 miles. Gallons = 4,784/22.1 = 216.47 Total gallons gasoline = 14,302.99 + 2,600.14 + 216.47 + 5,878.12 = 22,997.72 Sources: Chris Campbell, Facilities Services Business Manager; Gary Morris, Auto Mechanic, Facilities Services; Jeannie Steckley, Director of Business Affairs; Robert Nies, DAS Assumptions: An average of 22.1 mpg was used for all fleets unless noted otherwise.
Commute	No commute survey has ever been conducted at OIT. Sources: Joe Holliday, Vice President Student Affairs Assumptions: NA
Other mission-related travel	*Air travel* Through OIT's accounting system, air travel information is available for expenditures and number of trips, but nothing is available on air miles traveled. 95% of airfare is purchased through Jackson Travel in Medford. Jackson Travel has information on the number of tickets purchased, routing, and cost, but nothing about miles. Jackson Travel generated a report listing departure and destination points, but to convert that into air miles would be very time consuming. Total air travel purchases during 2004 were $154,500. *Student travel from hometown to/from campus and vacation travel* No information available. Sources: Jeannie Steckley, Director of Business Affairs; Kay McCarty, Accounting Technician, Business Affairs; Glena Rasmussen, Jackson Travel Assumptions: NA
Solid waste	Waste Management hauls most of OIT's waste. On occasion, campus personnel will self-haul large loads of construction and demolition waste. There is one drop box on campus and various cubic yard dumpsters.

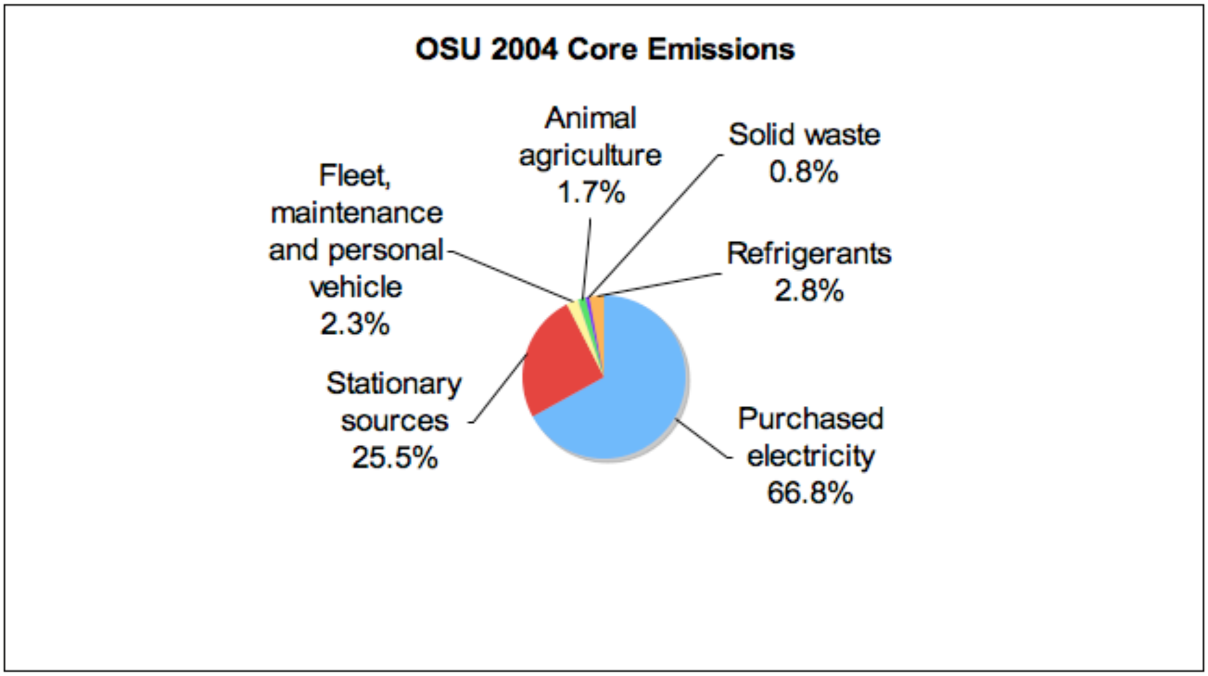
Solid waste (continued)	OIT self-hauled 25.08 tons to Klamath County Landfill in CY2004. This was from 1.5 acres of juniper trees that were cleared. Waste Management serves OIT with two lines of business: • Physical Plant dumpster invoices contain weight information. • All other campus pick up sites do not have weight information. From the Physical Plant dumpster, Waste Management hauled 50.62 tons in CY2004. Assumptions were used by Waste Management to determine waste generation from other campus pick up sites at 26,841.25 yards for CY2004. Using volume to weight conversion at a rate of 0.15 tons/cubic yard (uncompacted) assuming all dumpsters were 100% full: 26,841.25*.15 = 4,026.19 tons. This estimate, combined with the weighed waste and self-hauled waste, produced an unreasonably large amount of waste for OIT when compared to other OUS institutions. Using a modified headcount of faculty, staff and students, OIT produced 1.358 tons of solid waste per modified headcount. The institution with the next highest ratio was OSU with 0.284 tons of solid waste per modified headcount. For the inventory, we lowered OIT's tons of solid waste per modified headcount to match OSU's. This provided a total solid waste of 852.37 tons. Total weight of solid waste landfilled: = 25.08 tons (self hauled) + 50.62 tons (WM hauled from Physical Plant + 776.67 tons (WM hauled from other sites) = 852.37 total tons. There are two sites where OIT's waste is landfilled: • Roosevelt Regional Landfill, the primary landfill as of October 2003, has methane recovery and flaring[xxv] • Klamath County Landfill, used exclusively for construction and demolition waste, has no methane recovery. During CY2004, 25.08 tons went to Klamath County Landfill and 827.29 tons went to Roosevelt Regional Landfill. Sources: Chris Campbell, Facilities Services Business Manager; Erin Foley, Housing Dean of Students; Ben Hirengen, Waste Management Assumptions: Weight estimates assume dumpsters and containers were full when emptied. Volume to weight conversion at a rate of 0.15 tons per cubic yard (uncompacted) and 0.35 tons per cubic yard (compacted). OIT's waste generation to modified headcount ratio is approximately equal to OSU's.
Animal agriculture	No farm animals managed by OIT. Sources: Ed Guy, Director, Campus Safety Assumptions: NA
Refrigerants	In 2004, OIT demolished a split system with 100 lbs of R-22 that was recaptured. De Minimis emissions of 5 lbs of R-22 (HCFC-22) were used in the inventory. Kitchen contracts out maintenance on OIT's deep freeze. There were no emissions of MP-66 during CY2004. Sources: Bruce Masl, Electrical/Control System Technician; Paul Budden, Trades Maintenance Coordinator, College Union Assumptions: NA

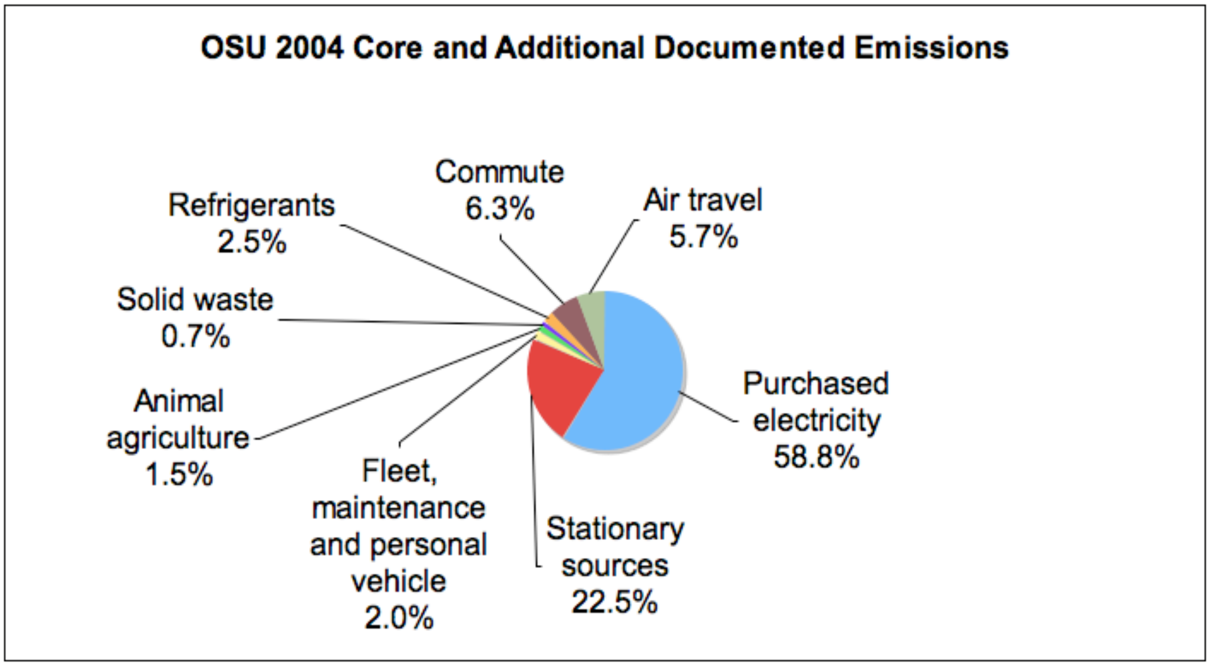
Oregon State University 2004 Greenhouse Gas Inventory

Overview of Emissions						
Oregon State University						
Year	**2004**	Energy Consumption	CO2	CH4	N2O	CO2e
		MMBtu	kg	kg	kg	Metric tonnes
Purchased electricity		349,012	75,236,256	128	132	**75,278**
Stationary sources		542,882	28,684,293	2,868	59	**28,768**
Transportation total		250,971	17,615,594	2,271	943	**17,947**
	Fleet	35,652	2,503,064	500	172	**2,566**
	Commute	111,858	7,852,935	1,571	541	**8,049**
	Air travel	103,460	7,259,595	200	230	**7,332**
Animal agriculture		-	-	76,495	409	**1,881**
Solid waste		-	-	40,009	-	**920**
Refrigerants (specific GHGs not represented in this table)						**3,207**
Total		**1,142,864**	**121,536,143**	**121,771**	**1,543**	**128,001**
Offsets						**-**
	'Green' electric credits					-
	Composting					-
Net Emissions						**128,001**

The chart below summarizes the availability of information for this inventory versus the level of control that OSU has over the type and amount of energy used.

		Level of institutional control over usage and type		
Level of availability of relevant information		**High control**	**Moderate control**	**Low control (or long time horizon for change)**
	High availability	• Core campus utilities • Fleet • Refrigerants	• Grid mix • Landfill • Commute	
	Moderate availability	• Off-campus utilities	• Mission-related travel	
	Low availability	• Athletics travel		• Long-distance student travel





Energy	
Purchased electricity	General campus electricity usage in 2004 amounted to 85,680,038 kWh. This includes all Corvallis-area operations. In addition to the Corvallis area operations, OSU has a presence in all 36 Oregon counties. These include 35 Extension field offices, 14 Ag Experiment Stations, and one Forest Research Station. Success of information gathering efforts for those areas varied. The Extension offices are often in shared spaces and do not pay for electricity

Purchased Electricity (continued)	usage. Others owned by Extension are really owned by the taxing district. In those cases no electricity usage information was gathered because each office would need to be contacted for their usage and some offices are in shared spaces. Each Ag Experiment Stations is billed separately for usage. No electricity usage information was gathered because there are no centralized records for consumption so each station would need to report usage. Data was collected for the Forest Research station at Peavy Arboretum. Electricity provides all energy at that site. Usage in 2004 was 124,491 kWh. Total CY2004 electricity usage for OSU: 85,804,529 kWh
Natural gas	541,618 MMBtu
Steam and chilled water produced off-campus	NA
On-campus cogeneration	OSU does not have an on-campus cogeneration plant, although one is currently under consideration.
Residual oils (#5 & #6) and Distillate oils (#1, #2, #3 & #4)	In 2004, OSU used 9,158.70 gallons of #2 diesel fuel for backup generators.
Propane	We do not include emissions from propane use because the data available was of insufficient quality to make calculations with any certainty. (Although OSU was able to provide information on purchases, only a small number of line items included any information on the specific type of gas or quantity purchased. Based on examination of available data, we have assumed that emissions from propane are *de minimus*, but this issue may be worth further examination in future inventories.
Incinerated waste	NA
Coal	NA
Solar / wind / biomass	NA
Offsets (green tags etc.)	NA
Sources	Brandon Trelstad, Sustainability Coordinator; Roger Admiral, Associate Director of the Forest Research Lab and Director of Forestry Operations
Assumptions	NA

Transportation, solid waste and other major categories	
Fleet, maintenance and mission-related personal vehicle miles	OSU has a fuel pump on campus that is used for maintenance and fleet vehicles. There is considerable overlap between Agency vehicle miles and gallons of fuel used from the on-campus pump since some OSU vehicles are fueled on campus. Beginning on March 1, 2006, OSU will track the number of gallons of fuel used according to vehicle, which will eliminate that overlap. For this inventory, this overlap was estimated (see below). In 2004, the on-campus fuel pump at OSU used • 120,000 gallons of gasoline and

Fleet, maintenance and mission-related personal vehicle miles (continued)	• 500 gallons of biodiesel (B20, or 20% biodiesel, 80% diesel). DAS mileage reports: • Private miles - 2,784,092 or 3,543,570 • Agency miles - 6,000,000 or 2,300,000 • Motor Pool miles - 146,215 There was some discrepancy in two areas of the DAS mileage reports: • For Private miles, forms submitted by OSU to DAS totaled 3,543,570 miles, while DAS' report listed the smaller amount. For this inventory, the OSU-submitted total of 3,543,570 was used. • For Agency miles, OSU's 6 million miles represented nearly 90% of the total for all institutions. This seemed improbable. OSU's Motor Pool Manager, Ed Vnenchak agreed but did not have actual data. Instead, historical data was used to estimate the 2.3 million miles used in the inventory. The overlap created when Agency vehicles fuel at the on-campus pump was addressed as follows: • It is estimated by the Motor Pool Manager that 95% of the gasoline at the on-campus pump is used for Agency vehicles, which represents 114,000 of the 120,000 gallons pumped. • Gallons of gasoline, rather than Agency vehicle miles, was included in the inventory for the following reasons: o Most, if not all, of the Agency miles driven were fueled by gasoline from the OSU on-campus pump o A calculation using 22.1 average fleet mpg (the standard for 2004) gives 104,072 gallons of gasoline used, a deficit of nearly 10,000 gallons from the on-campus fuel pump usage total. o The remaining 6,000 gallons were used for OSU equipment. Total gallons of gasoline used by OSU fleet, maintenance and mission-related personal vehicles: (3,543,570 Private miles + 146,215 Motor Pool miles) / 22.1 mpg = 166,958.6 gallons gasoline + 120,000 gallons gasoline from on-campus pump = 286,958.6 total gallons gasoline Sources: Ed Vnenchak, OSU Motor Pool Manager; Robert Nies, Oregon Department of Administrative Services; Joyce Fred, Risk Officer, Business Services Assumptions: An average of 22.1 mpg was used for all fleets unless noted otherwise.
Commute	The City of Corvallis recently conducted a city-wide survey on commuting habits. OSU, as a major employer in the City was requested to participate. The survey had a small and non-randomized sampling set and was not used in this inventory. Instead, a 2003 commute survey conducted by OSU was used. Data from the Travel Survey Report, dated September 2003, provides the following mode splits for campus users: • Bike – 10% • Walk – 25% • Bus – 3% • SOV – 56% • Carpool – 5% • OSU shuttle – 2% Sources: Brandon Trelstad, Sustainability Coordinator

Commute (continued)	Assumptions: We were unable to locate information on average commute distance for UO students, faculty and staff so the one-way commute distance of 5 miles was based on PSU's 2003 Greenhouse Gas Inventory commute distance of 7.5 miles. Since Eugene is a smaller community than Portland with shorter commutes, this is a fair estimate. Commute days per year for faculty and students is based on OUS' Academic Calendar, which provides the number of teaching days each term. For the number of staff commute days, we assumed 173.3 hours per month, or 2,080 hours per year, or 260 days per year (excluding vacation days and holidays). We assumed 5 weeks, or 25 days, of vacation and holidays per person per year. This gives a total of 235 commute days per person per year. We assumed one trip to campus per person per day. Summer students and faculty were not included in our calculations.
Other mission-related travel	*Air travel* OSU's main travel agency, Teel's Travel Planners, was unique in that the owner was interested in the GHG inventory and willing to provide detailed information on air miles traveled. This provided the opportunity to generate an estimate of OSU's air miles traveled. *Note, however, that in order to make this process significantly less labor intensive, we have a combination of calculation, estimation and extrapolation, as described below.* Teel's Travel books most but not all of OSU's air travel – an estimate of 65.2% of all air travel goes through Teel's. (Teel's books approximately 6,000 flights per year, another contracted travel agency, Azumano, books approximately 3,000 flights per year, and individuals at OSU purchase approximately 200 flights per year on the internet.) The data provided by Teel's Travel has two important caveats: • Information provided by Teel's Travel does not account for approximately 5-10% of domestic flights and 60% of international flights that are purchased through Teel's Travel. This is due to airline participation in databases. For example, domestic travel on Southwest Airlines and JetBlue is not included. • The information represents an estimated 65.2% of OSU's total purchased air travel. Teel's Travel books approximately 6,000 flights per year, Azumano Travel books approximately 3,000 flights per year and OSU reimburses individuals for approximately 200 flights purchased on the web per year. o .652 = (.925 x domestic + .4 x foreign) / (all OSU flights) The methodology for calculating air miles for Oregon State University follows: Brad Teel, from Teel's Travel Planners, the primary source for air travel purchases for OSU, compiled data for OSU's 2004 air travel purchases. This data was relatively quickly extracted from software commonly used in travel agencies. Information was provided in text format for the following fields: • Departure city name and airport code • Arrival city name and code • Fare • Segment count (number of flights between cities) The text data was converted to Excel format for ease of coding and calculations. In order to calculate total distance traveled, we did the following: • Sort data in descending order by segment count. Then enter mileage for point-to-point travel distances for the 200 most frequently traveled routes. Those routes represent 82% of the 1,252 total segments. Point-to-point travel mileage gathered from http://www.airtimetable.com/Air_mile_calculator.htm.

Other mission-related travel (continued)

- Code each flight segment into one of the following categories:
  - Domestic short (< 1,200 miles or travel exclusively west or east of the Rocky Mountains if mileage unknown)
  - Domestic long (> 1,200 miles or travel generally across the Rockies if mileage unknown)
  - International short (< 1,500 miles)
  - International long (> 1,500 miles)
- Determine average distance for and total segment count of each of the four categories. Then calculate total estimated miles:

Flight segment category	Number of segments B	Average segment length C	Total estimated miles B * C
Domestic short	6009	680	4,086,841
Domestic long	3691	1,959	7,230,854
International short	292	700	204,458
International long	474	3,405	1,613,795

Estimated domestic miles: 11,317,695
Estimated international miles: 1,818,253

To determine total air miles traveled, we extrapolated the data provided by Teel's to include other air travel purchases (based on travel agency's estimates, described above):

- To extrapolate totals to include the 10% of domestic flights booked by Teel's that are not included in the report:
  $T_{DomExt} = T_{DomEst} * (1/.9) = 12,575,216$ miles
- To extrapolate totals to include the 60% of international flights booked by Teel's that are not included in the report:
  $T_{ForExt} = T_{ForEst} * (1/.4) = 4,545,633$ miles
- Total extrapolated miles (total mileage for bookings by Teel's Travel Planners):
  $T_{TotalEst} = T_{DomExt} + T_{ForExt} = 12,575,216 + 4,545,633 = 17,120,849$ miles
- To calculate total OSU air travel, extrapolate total Teel's mileage to include air travel booked through other travel agencies and the internet:
  $T_{TotalExt} = T_{TotalEst}*(1/.652) \quad = 26,258,971$ miles

In the future, OSU's Travel Reimbursement Entry System will most likely compile mileage data.

We can thus summarize the use of the methodology in calculating, estimating and extrapolating air miles:

Percent of air travel miles calculated:	40.9%
Percent of air travel miles estimated:	9.1%
Percent of air travel miles extrapolated:	50.0%

Student travel from hometown to/from campus and vacation travel

No information available.

Sources: Mary Page, Accounts Payable, Business Affairs; Tri Schodorf, Payables Manager, Business Affairs; Julie Stratton, Administrative Program Specialist, Business Affairs; Bob Nies, Oregon Department of Administrative Services; Brad Teel, Teel's Travel Planners

	Major assumption: Air travel purchased from Teel's Travel Planners is representative of all air travel purchases.
Solid waste	OSU's waste hauler provides no weight information on invoices. Original weight estimates provided to Good Company were based on 116 pounds per loose cubic yard. Adjustments made using Oregon Department of Environmental Quality standards[xxvi] of 0.15 tons per cubic yard (uncompacted) yield 6,274 tons of solid waste generated in 2004. No composting information is available. All landfilled waste is sent to Coffin Butte Landfill, which recovers methane and produces power. Source: Justin Fleming, Campus Recycling Coordinator; Assumptions: Weight estimates assume dumpsters were full when emptied. Volume to weight conversion at a rate of 0.15 tons per cubic yard (uncompacted).
Animal agriculture	OSU's Animal Science Department houses many farm animals either on-campus or in facilities near to Corvallis and provided the following number of animals as of mid-2004: • Dairy cows - 200 • Beef cows - 266 • Swine - 9 • Goats - 0 • Sheep - 455 • Horses - 27 • Poultry - 812 Eastern Oregon University houses animal agriculture operations at Union and Burns, Oregon, which are an extension of OSU's Animal Science Department and were included in OSU's inventory. They include: • 250 head of beef cattle at Union • 300 head of beef cattle at Burns In addition, the College of Veterinary Medicine treats a variety of animals throughout the year and provided the following numbers of treatments from the annual AVMA Report for 2004: • Food animal cases (cows, bulls, sheep) - 337. Yearly equivalent: 28 (classified as 'beef cows') • Camelid cases (llamas and alpacas) - 205. Yearly equivalent: 17 • Equine cases - 1084. Yearly equivalent: 90 Sources: Nora Ross, Assistant to the Dean, Animal Science Department; Debrah Rarick, Assistant to the Dean, College of Veterinary Medicine; Tim DelCurto, Superintendent, Union Station Assumptions: Yearly equivalent emissions for the College of Veterinary Medicine were calculated based on an average one-month stay. Note: Due to methodological difficulties and lack of data, this report did not include emissions related to the use of fertilizer. We believe this is likely to be an extremely small emissions source.
Refrigerants	OSU has used a refrigerant tracking program, Refrigerant Compliance Manager, since the late 1990s. This software tracks inventory and usage and refrigerants reclaimed or disposed. It provides easy information access. Many of their purchases are to replace older refrigerants with more environmental options. For example, the Meat Laboratory has large coolers, one of which had a breakdown in 2004. The compressor was replaced and the refrigerant (R-12) was

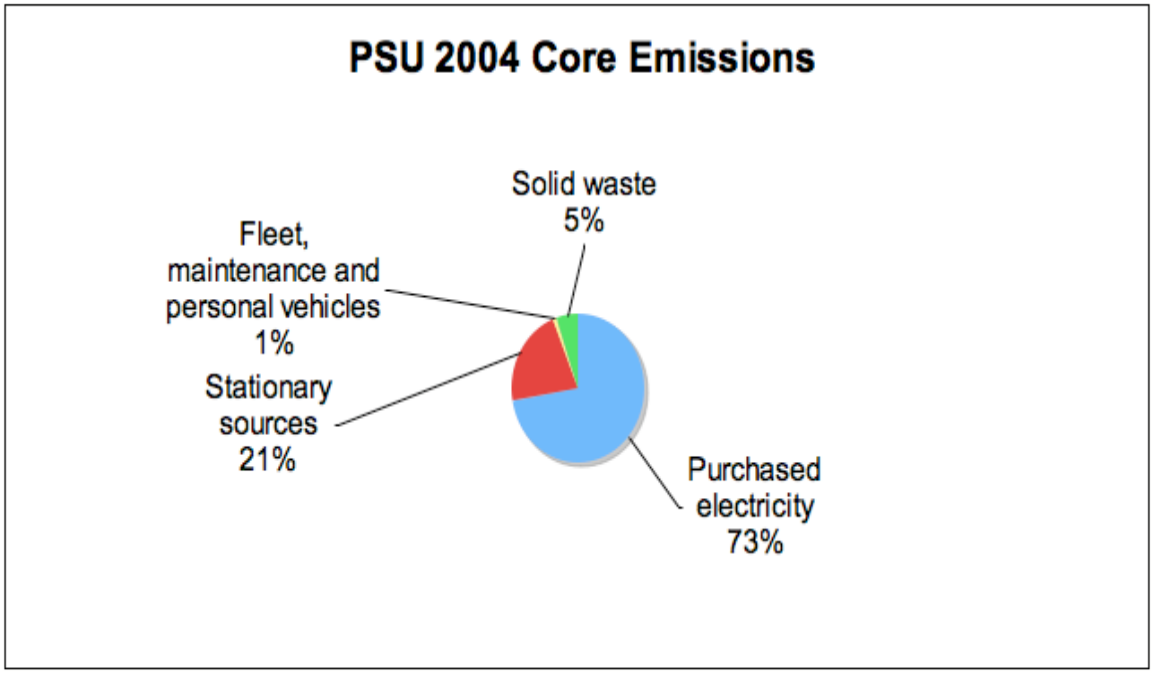
Refrigerants (continued)	captured. A more environmental refrigerant (HP-80) was used in the new compressor. OSU has over 20,197 lbs. of refrigerant use on file. Usage amounts for CY2004 were: • R-12 (CFC-12): 48.375 lbs • R-22 (HCFC-22): 491 lbs • R-404a (HFC-404A, a blend of HFC-125 (44%), HFC-134a (4%), and HFC-143a (52%)[xxvii]): 22 lbs • R-500 (since R-500 is a blend containing CFC-12[xxviii] (), and since no information on the GWP of R-500 could be found, we are using the GWP of CFC-12 for this study): 2.5625 lbs Sources: Greg Riutzel, Refrigeration Mechanic, Facilities Services Assumptions: NA

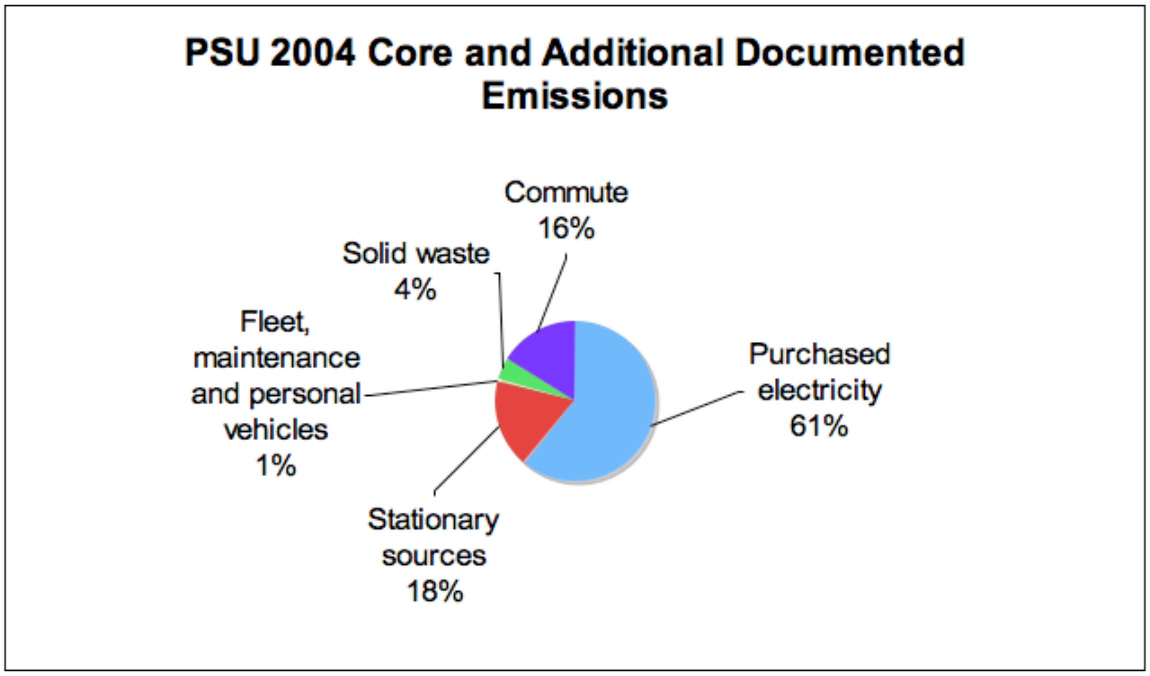
Overview of Emissions
Portland State University

Year	**2004**	Energy Consumption	CO2	CH4	N2O	CO2e
		MMBtu	kg	kg	kg	Metric tonnes
Purchased electricity		204,663	24,306,599	75	77	**24,331**
Stationary sources		136,372	7,199,668	724	14	**7,221**
Transportation total		92,939	6,524,728	1,305	449	**6,688**
	Fleet	3,850	270,319	54	19	**277**
	Commute	89,089	6,254,409	1,251	431	**6,411**
	Air travel	-	-	-	-	**-**
Animal agriculture		-	-	-	-	**-**
Solid waste		-	-	78,158	-	**1,798**
Refrigerants (specific GHGs not represented in this table)						**-**
Total		**433,974**	**38,030,996**	**80,262**	**541**	**40,037**
Offsets						**(27)**
	'Green' electric credits					(27)
	Composting					-
Net Emissions						**40,011**

The chart below summarizes the availability of information for this inventory versus the level of control that PSU has over the type and amount of energy used.

	Level of institutional Control Over Usage and Type		
Level of availability of relevant information	**High control**	**Moderate control**	**Low control (or long time horizon for change)**
High availability	- Fleet	- Grid mix - Landfill - Commute	
Moderate availability	- Core campus utilities - Off-campus utilities		
Low availability	- Athletics travel - Refrigerants	- Mission-related travel	- Long-distance student travel





Energy	
Purchased electricity	50,316,327 kWh
Natural gas	136,331 MMBtu
Steam and chilled water produced off-campus	NA
On-Campus cogeneration	NA

Residual oils (#5 & #6) and Distillate oils (#1, #2, #3 & #4)	NA – The backup fuel for the steam plant is diesel and has been sitting in the tank for nine years. Recently PSU has been burning some due to its age, but none was burned in 2004.
Propane	480 gallons for one forklift
Incinerated waste	NA
Coal	NA
Solar / wind / biomass	NA
Offsets (green tags etc.)	55,200 kWh. Purchased for Epler Hall in 2004 only.
Sources	Steve Hiscoe, HVAC Controls Tech, Facilities; Chuck Cooper, Safety & Environmental Consultant; John MacLean, Financial Services Manager, Facilities; Dresden Skees-Gregory, Sustainability Coordinator; Ron Church, Electrician Supervisor

Transportation, solid waste and other major categories	
Fleet, maintenance and mission-related personal vehicle miles	PSU does not have an on-campus fueling station. Faculty and staff use DAS' Motor Pool and Flexcar. PSU offers free Flexcar to non-SOV commuters who are enrolled in the Transportation Demand Management Program (TDM) for both personal and mission-related travel. There are seven Flexcar vehicles and 16 DAS Motor Pool vehicles parked on campus. Flexcar usage is paid for with parking revenues. Over the past 2 years, since the use of Flexcar vehicles, there has been an 8% reduction in SOV commuters. TDM Program eligibility is confirmed in one of three ways: • The individual has a transit pass • The individual does not have a parking pass • The individual is a member of the bicycle coop ($10/yr). Flexcar usage in 2004 – 14,362 miles DAS CY 2004 Quarterly Mileage Report information: • Private miles - 243,385 • Agency miles - 41,756 • Motor Pool miles - 386,749 PSU has a forklift and a high lift that use propane for fuel. 40 gallons used per month on average. Total fuel usage 2004: • Gasoline: (14,362 (Flexcar miles) + 243,385 (Private miles) + 41,756 (Agency miles) + 386,749 (Motor Pool miles)) / 22.1 (average fleet mpg) = 31,052.13 gallons • Diesel: none • Propane: 40 gallons per month x 12 months = 480 gallons Sources: Dan Zalkow, Manager, Transportation and Parking; Brodie Hylton, Flexcar; Farhad Khoshnahad, Supervisor, Shipping/Delivery/Mail; Dresden Skees-Gregory, Sustainability Coordinator; Avis Bertoli, Facilities; Robert Nies, DAS Assumptions: An average of 22.1 mpg was used for all fleets unless noted otherwise.
Commute	PSU's most recent employee commute survey was conducted during Spring 2004. A summary report is available online.[xxix]

	Results: • Bike – 6% • SOV – 33% • Transit – 44% • Carpool – 10% • Walk – 5% • Telecommute (‘ees) – 3% A student transportation survey was conducted in Spring 2005. A summary report is available online.[xxx] Results: • Bike – 6% • SOV – 29% • Transit – 38% • Carpool – 4% • Walk – 18% • Other (students only) – 1% • Dropped off – 3% Sources: Dan Zalkow, Manager, Transportation and Parking Assumptions: The average commute distance of 7.5 miles (one way) for PSU faculty, staff and students is based on PSU’s 2003 Greenhouse Gas Inventory and was provided to students assembling inventory data by Dan Zalkow, Manager of the Office of Transportation and Parking Services. Commute days per year for faculty and students is based on OUS’ Academic Calendar which provides the number of teaching days each term. For the number of staff commute days, we assumed 173.3 hours per month, or 2,080 hours per year, or 260 days per year (excluding vacation days and holidays). We assumed 5 weeks, or 25 days, of vacation and holidays per person per year. This gives a total of 235 commute days per person per year. We assumed one trip to campus per person per day. Summer students and faculty were not included in our calculations.
Other mission-related travel	*Air travel* Information on air miles traveled is not available. Dollar amounts for airfare would even be difficult to ascertain since the account codes include everything related to travel – meals, ground travel, airfare, lodging. *Long-distance student travel* No information available. Sources: Jacquelyn Vo, Travel Technician, Business Affairs; Assumptions: NA

Solid waste	PSU generated 1,815.79 tons of solid waste in 2004. Waste goes to the Columbia Ridge Landfill in Arlington, Oregon, a landfill with no CH4 recovery. Sources: Kim Dinan, Recycling Coordinator Assumptions: NA
Animal agriculture	PSU manages no farm animals. Sources: Dresden Skees-Gregory, Sustainability Coordinator; Chuck Cooper, Environmental Health and Safety Consultant Assumptions: NA
Refrigerants	Unable to gather information on refrigerant usage at PSU.

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Southern Oregon University 2004 Greenhouse Gas Inventory

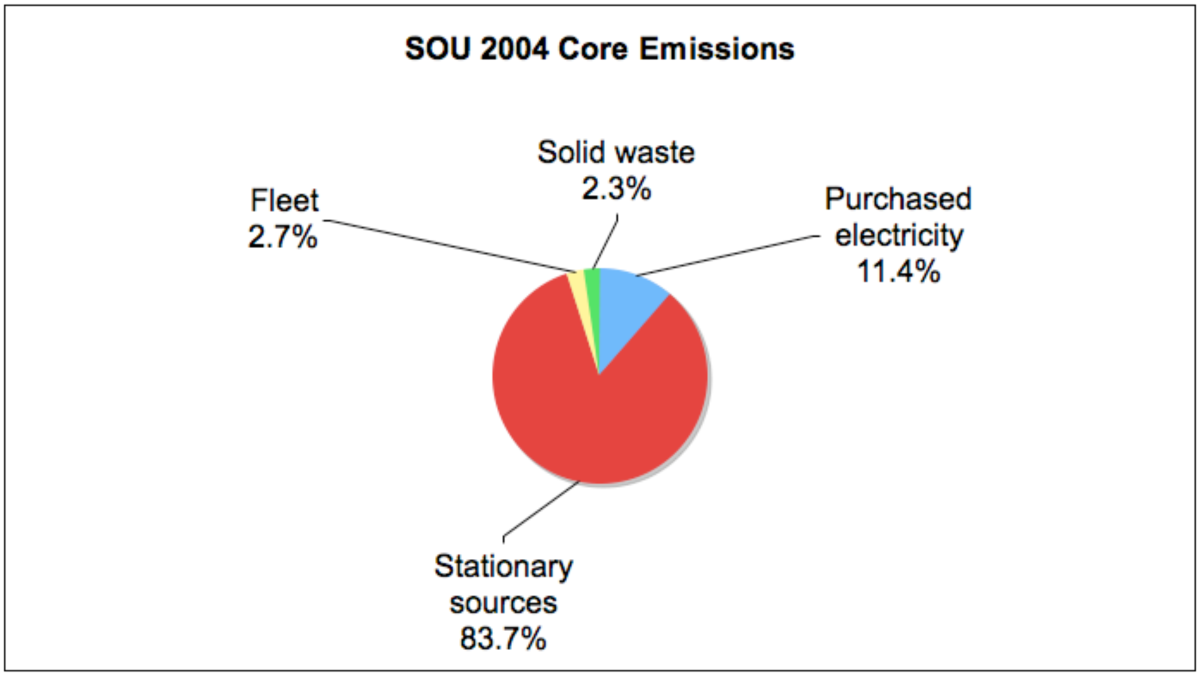
Overview of Emissions

Southern Oregon University

Year	**2004**	Energy Consumption	CO2	CH4	N2O	CO2e
		MMBtu	kg	kg	kg	Metric tonnes
Purchased electricity		49,805	599,841	18	19	**606**
Stationary sources		84,059	4,437,640	443	9	**4,450**
Transportation total		1,981	139,691	25	9	**143**
	Fleet	1,981	139,691	25	9	**143**
	Commute	-	-	-	-	**-**
	Air travel	-	-	-	-	**-**
Animal agriculture		-	-	-	-	**-**
Solid waste		-	-	5,242	-	**121**
Refrigerants (specific GHGs not represented in this table)						**-**
Total		**135,845**	**5,177,173**	**5,729**	**36**	**5,320**
Offsets						**-**
	'Green' electric credits					-
	Composting					-
Net Emissions						**5,320**

The chart below summarizes the availability of information for this inventory versus the level of control that SOU has over the type and amount of energy used.

		Level of institutional control over usage and type		
Level of availability of relevant information		**High control**	**Moderate control**	**Low control (or long time horizon for change)**
	High availability	• Core campus utilities • Off-campus utilities • Refrigerants		
	Moderate availability	• Fleet	• Commute • Grid mix	
	Low availability	• Athletics travel	• Landfill • Mission-related travel	• Long-distance student travel



(There is no pie chart for additional documented emissions for EOU because our study documented only core emissions.)

Energy	
Purchased electricity	12,244,662 kWh
Natural gas	84,056.5 MMBtu
Steam and chilled water produced off-campus	NA
On-campus cogeneration	NA
Residual oils (#5 & #6) and Distillate oils (#1, #2, #3 & #4)	NA
Propane	NA
Incinerated waste	NA
Coal	NA
Solar / wind / biomass	SOU has a very small solar generation project on the library building. There was no specific data available on generation and it was not included in the inventory.
Offsets (green tags etc.)	NA
Sources	Jared Fuhriman, Utility Operations Supervisor, Physical Plant
Assumptions	NA

Transportation, solid waste and other major categories	
Fleet, maintenance and mission-related personal vehicle miles	SOU has an on-campus fuel pump that delivers gasoline, diesel and propane fuels. Usage during CY2004: • Gasoline: 12,585 gallons • Diesel: 2,111 gallons • Propane: 34 gallons Gasoline is used for SOU vehicles and equipment, but since there were no Agency miles reported, there is no overlap. Diesel usage is for landscape equipment. Propane usage is for one forklift. Information reported to and provided by DAS for vehicle miles driven during CY2004: • Private miles: 0 (no estimates available) • Agency miles: 0 (no estimates available) • Motor Pool miles: 22,945. Gallons calculation: 22,945 miles / 22.1 mpg = 1,038.24 gallons Total gasoline usage = 12,585 + 1,038.24 = 13,623.24 gallons Sources: Leon Crouch, Maintenance Labor Coordinator, Physical Plant; Robert Nies, DAS Assumptions: An average of 22.1 mpg was used for all fleets unless noted otherwise.
Commute	A commute survey was being conducted at SOU during the information gathering period for this report. The data from this survey is not included here. Sources: Assumptions: NA
Other mission-related travel	*Air travel* No information available on air miles traveled. *Student travel from hometown to/from campus and vacation travel* No information available. Sources: Sheila Johnson, Travel Clerk, Business Services Assumptions: NA

Solid waste

Information availability is limited due to practices of the hauler, Ashland Sanitary, who does not weigh waste when picked up. All solid waste landfilled at Dry Creek Landfill in White City, OR, which captures and flares methane, but currently has no energy production.

Estimates are based on one 25-yard dumpster at Physical Plant that was emptied 43 times during 2004. That waste is compacted in the dumpster with a backhoe. In addition, SOU has approximately 5 other accounts with Ashland Sanitary - 1, 1.5 and 2-yard containers and a 10-yard dropbox. Assumptions for calculating total waste weight

- All containers dumped 43 times during 2004
- All containers full when dumped

Volume to weight conversion:

dumpster / container size (cu yd)	dumps / 2004	cu yards dumped	tons/cubic yard (uncompacted)	tons/cubic yard (compacted)	total tons
25	43	1075		0.35	376.25
10	43	430	0.15		64.5
2	43	86	0.15		12.9
1.5	43	64.5	0.15		9.675
1	43	43	0.15		6.45
				Total	469.775

Total solid waste landfilled in CY2004: 469.775 tons

Sources: Rex Hendricks, Supervisor, Custodial Services; Russ Chapman, Ashland Sanitary; Lee Fortier, Dry Creek Landfill
Assumptions: For densities of mixed waste, DEQ's standard is 0.15 tons/cubic yard (uncompacted) and 0.35 tons/cubic yard (compacted).

Animal agriculture

SOU manages no farm animals.

Sources: Byron Patton, Director, Environmental Health and Safety
Assumptions: NA

Refrigerants

No refrigerant escape or venting in 2004.

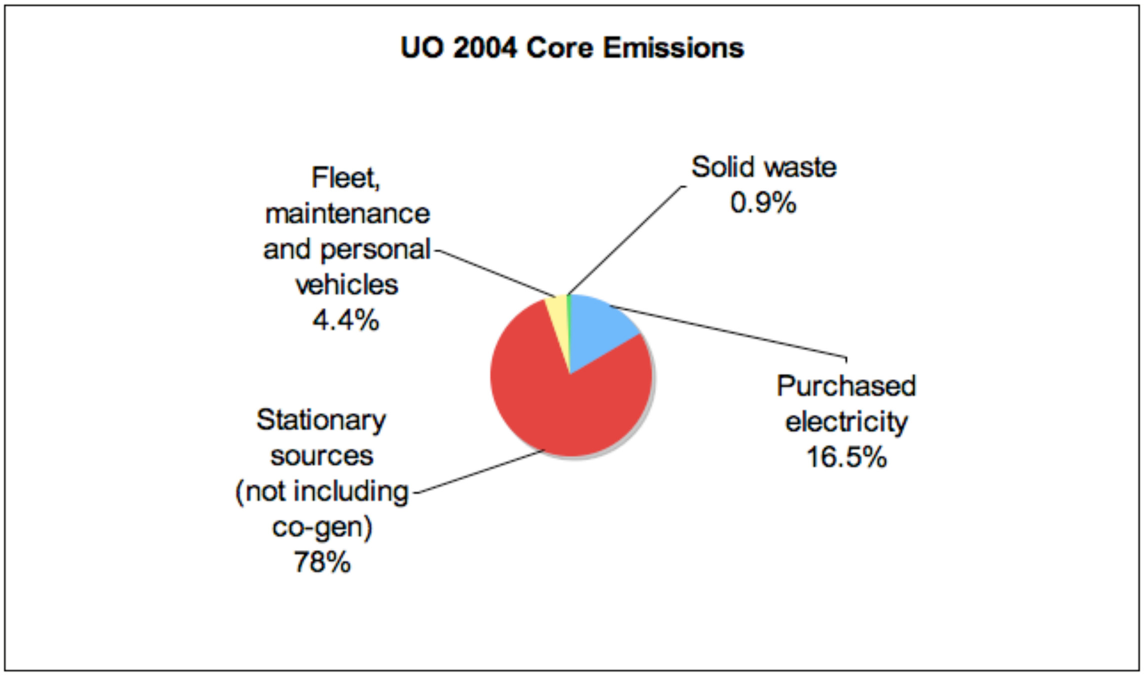
Sources: Jared Fuhriman, Utility Operations Supervisor, Physical Plant
Assumptions: NA

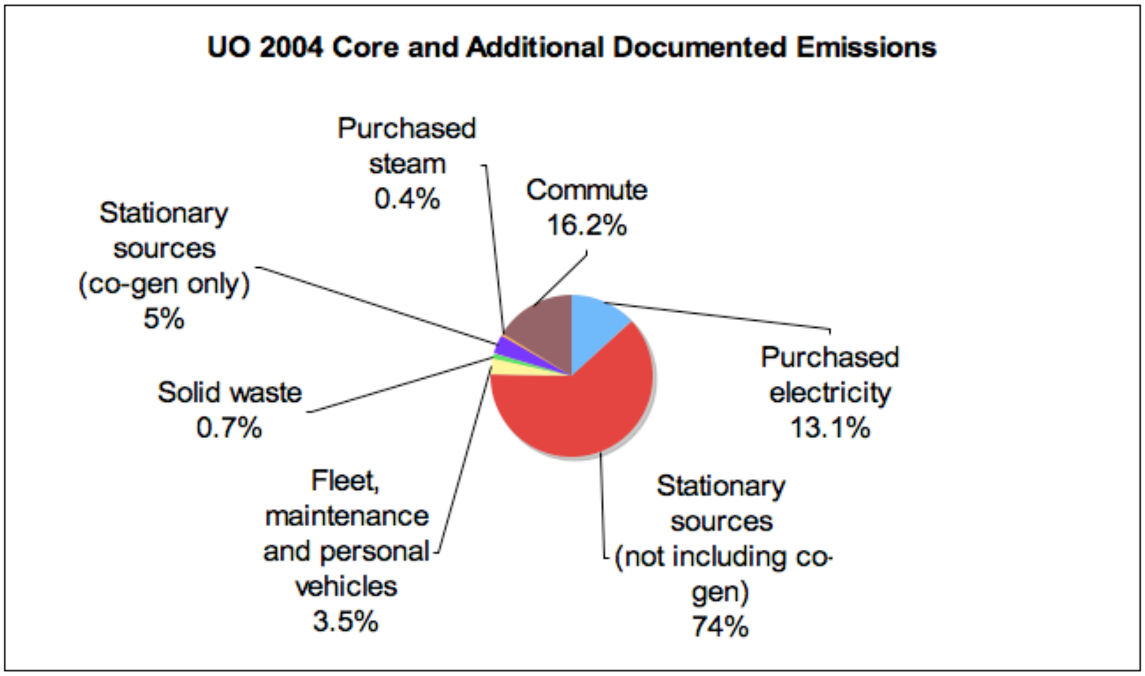
University of Oregon 2004 Greenhouse Gas Inventory

WORKSHEET	**Overview of Annual Emissions**					
UNIVERSITY	**University of Oregon**					
Year	**2004**	Energy Consumption	CO2	CH4	N2O	eCO2
		MMBtu	kg	kg	kg	Metric Tonnes
Purchased electricity		229,645	4,609,629	84	87	**4,637**
Purchased steam		3,234	133,844	23	2	**135**
Stationary sources		440,712	23,273,754	2,332	47	**23,341**
	Non Co-gen	414,114	21,862,246	2,190	44	**21,926**
	Co-gen electric	24,855	1,318,965	133	3	**1,323**
	Co-gen steam	1,744	92,543	9	0	**93**
Transportation		96,719	6,791,030	1,354	466	**6,960**
	Fleet	17,148	1,204,811	236	82	**1,234**
	Commute	79,571	5,586,220	1,118	385	**5,726**
	Air travel	-	-	-	-	**-**
Animal agriculture		-	-	-	-	**-**
Solid waste		-	-	11,396	-	**262**
Refrigerants (specific GHGs not represented in this table)						**-**
Total		**770,310**	**34,808,257**	**15,189**	**602**	**35,336**
Offsets						**(52)**
	'Green' electric credits					-
	Composting					(52)
Net Emissions						**35,284**

The chart below summarizes the availability of information for this inventory versus the level of control that UO has over the type and amount of energy used.

		Level of institutional control over usage and type		
		High control	**Moderate control**	**Low control (or long time horizon for change)**
Level of availability of relevant information	**High availability**	Core campus utilities Fleet	Grid mix Landfill Commute	
	Moderate availability	Off-campus utilities Refrigerants		
	Low availability	Athletics travel	Mission-related travel	Long-distance student travel





Energy	
Purchased electricity	56,458,301 kWh
Natural gas	414,048 MMBtu (not including inputs to co-gen plant (see below))
Steam and chilled water produced off-campus	1,693 MMBtu for Baker Downtown Center

On-campus co-generation	Inputs • Natural gas - 26,225 MMBtu • #2 fuel oil - 2,709 gallons Outputs • Electric - 6,147,000 kWh • Steam - 431,292 MMBtu Efficiency • Electric efficiency estimated at 80% • Steam efficiency estimated at 80%.
Residual oils (#5 & #6) and Distillate oils (#1, #2, #3 & #4)	See co-gen inputs (above)
Propane	770 gallons
Incinerated waste	NA
Coal	NA
Solar / wind / biomass	NA
Offsets (green tags etc.)	NA
Sources	Josh Ruddick, Facilities Engineer
Assumptions	

Transportation, solid waste and other major categories	
Fleet, maintenance and mission-related personal vehicle miles	UO has a cardlock fuel pump on campus that is used exclusively for campus-owned vehicles and equipment. Off-campus fuel purchases for all vehicles are most often made on Voyager Gas Cards, a program that is run through the Oregon Department of Administrative Services (DAS). There is no record of mileage or quantity of fuel purchased on Voyager Gas Cards. DAS vehicles used by UO staff historically do not fill up at the campus cardlock. However, UO vehicles do use gasoline from the cardlock. Record keeping changes that began in 2005 will allow for easier mileage and fuel accounting in the future. The UO's campus cardlock pumped four types of fuel in the following quantities for CY2004: • Unleaded gasoline: 40,148 gallons • Diesel (B20 (20% biodiesel)): 4,000 gallons • Biodiesel (B100 (100% biodiesel)): 500 gallons • Propane: 736 gallons The fuel used at the campus cardlock does not encompass all fuel used by vehicles for UO's mission-related travel. DAS' Quarterly Mileage Reports for CY2004 showed the following uses: • Private miles – 1,075,525. • Agency miles – 509,538 • Motor Pool miles - 1,014,643. Since, in the case of UO, campus-owned vehicles are fueled at the on-campus cardlock, there is overlap in the two data sets. To determine total gallons of fuel used by vehicles driven for institutional business, the following steps were necessary: • Determine exactly where the fuel from the campus cardlock goes o Unleaded gasoline – 40,148 gallons (100% used to UO vehicles,

Fleet, maintenance and mission-related personal vehicle miles (continued)	included in DAS mileage report as Agency miles). o B20 biodiesel – 4,000 gallons (Used in Facilities' equipment and vehicles. Garbage trucks use approximately 60% of total, and garbage truck miles are reported in DAS mileage. Average fuel efficiency of garbage trucks is 8.6 mpg. Therefore, miles driven in garbage trucks = 4000 x 0.6 x 8.6 = 20,640 miles.) o B100 – 500 gallons (100% to equipment, not included in DAS mileage report.) o Propane – 736 gallons (custodial equipment) • Adjust DAS mileage report and cardlock fuel usage numbers to eliminate overlap in Agency miles: o Garbage trucks: ▪ Subtract miles driven in garbage trucks from Agency miles total = 509,538 – 20,640 = 488,898 total agency miles. o UO-owned vehicles fueling at cardlock: ▪ Since UO owned vehicles fuel up almost exclusively at the campus cardlock, and Agency miles remaining accounts for less than the total gallons of gasoline (UO's fleet averages 15 mpg, therefore total gallons used for remaining 488,898 miles = 488,898 / 15 = 32,593.2 gallons). This is less than the reported 40,148 gallons of gasoline pumped in CY2004. We used gallons of unleaded gasoline and disregarded the remaining Agency mileage numbers reported by DAS. • Convert miles driven to gallons of gasoline used. Standard fleet fuel efficiency of 22.1 mpg. o Private miles: 1,075,525. Total Private gallons = 1075525 / 22.1 = 48,666.29 gallons o Agency miles: 509,538. Total Agency gallons = 40,148 gallons (CY2004 unleaded gasoline usage from cardlock) o Motor pool miles: 1,014,643. Total Motor Pool gallons = 1014643 / 22.1 = 45,911.45 gallons • UO's total fuel use for fleet, maintenance and mission-related personal vehicle miles during CY2004 o Total gallons gasoline (all uses) = 48,666.29 + 40,148 + 45,911.45 = 134,725.74 gallons o Total gallons B20 = 4,000 o Total gallons B100 = 500 o Total gallons Propane = 736 DAS requests an annual report on usage of alternative fuel vehicles (AFVs), including fuel type and usage and miles driven. In 2004, UO reported usage on its 27 AFVs, which included vehicles powered by electricity, liquid propane gas and biodiesel. Usage figures from UO's report to DAS for those fuels are not included as additional uses since those usage numbers are accounted for elsewhere. Sources: Bill Kasper, Facilities Services Purchasing Supervisor; Robert Nies, Oregon Department of Administrative Services; Collin Partridge, Mobile Equipment Manager; Dan Clem, Oregon Department of Administrative Services; Dan Patten, Accounts Payable Manager, Business Affairs; Jan Alldridge, Accountant, Intercollegiate Athletics Assumptions: No B20 or B100 purchased outside of UO cardlock. The UO-owned fleet averages approximately 15 mpg. Emissions factors for biodiesel fuels: • B20 assumed to be 80% of standard diesel • B100 assumed to be zero An average of 22.1 mpg was used for all fleets unless noted otherwise[xxxi].

Commute	Commute data is compiled from a commute survey[xxxii] of faculty, staff and students. The survey showed the following use of modes of transportation: • Single Occupancy Vehicle (SOV) - 39% • Walk - 29.4% • Bike - 15.6% • Public transit - 13.6% • Carpool - 2% • Other - 0.4% Sources: Christopher Ramey, Director and Architect, University Planning; Steve Mital, Service Learning Program Coordinator, Environmental Studies Program and Sustainability Coordinator Assumptions: We were unable to locate information on average commute distance for UO students, faculty and staff so the one-way commute distance of 5 miles was based on PSU's 2003 Greenhouse Gas Inventory commute distance of 7.5 miles. Since Eugene is a smaller community than Portland with shorter commutes, this seemed like a fair estimate. Commute days per year for faculty and students is based on OUS' Academic Calendar, which provides the number of teaching days each term. For the number of staff commute days, we assumed 173.3 hours per month, or 2,080 hours per year, or 260 days per year (excluding vacation days and holidays). We assumed 5 weeks, or 25 days, of vacation and holidays per person per year. This gives a total of 235 commute days per person per year. We assumed one trip to campus per person per day. Summer students and faculty were not included in our calculations.
Other mission-related travel	The remaining areas of mission-related travel did not provide accessible information. In particular, there are no mechanisms in place to gather information on how much travel is done by air, bus, or rental cars. That information, which likely comprises a significant portion of this segment of the overall inventory, would be time consuming to gather and would likely rely on significant assumptions. *Air travel* UO has three contracted travel agencies that individuals and Departments use. In addition, some individuals purchase tickets on-line. Neither method provides miles traveled in any format that is easily compiled. The accounting system used by OUS campuses, Banner, has codes for in- and out-of-state travel and include not only airfare but also meals, lodging and ground transportation. Until other methods of accounting for miles traveled are implemented, any data the travel agency or the institution has would require looking at individual paperwork, which would be extremely time consuming. *Student travel from hometown to/from campus and vacation travel* No information available to calculate this impact area. Sources: Robert Nies, Finance Analyst, Oregon Department of Administrative Services; Carolyn Wooley, Travel Coordinator, Accounts Payable; Carol McCornack, Premier Travel; Nancy Cameron, Associate Director, Campus Business Services; Shereé Johnson, Risk Coordinator, Business Affairs; Jody Haury, Oregon Department of Administrative Services; Jan Alldridge, Accountant, Intercollegiate Athletics; Assumptions: NA

Solid waste	Weight information for several categories of waste and recycling is compiled each month by the campus Recycling Program. All landfilled waste goes to either Short Mountain Landfill or Coffin Butte Landfill, both of which generate electricity from recovered methane. Sources: Karyn Kaplan, Recycling Program Manager Assumptions: NA
Animal agriculture	UO does not manage any farm animals. Sources: Kay Coots, Environmental Health and Safety Director Assumptions: NA
Refrigerants	Since 2002, no refrigerant has been added to chillers at UO. Therefore, there were no fugitive emissions of significance from UO chillers during that period. Based on discussions with staff at UO, other sources of refrigerant use were deemed too small to compile. Sources: Josh Ruddick, Facilities Engineer Assumptions: NA

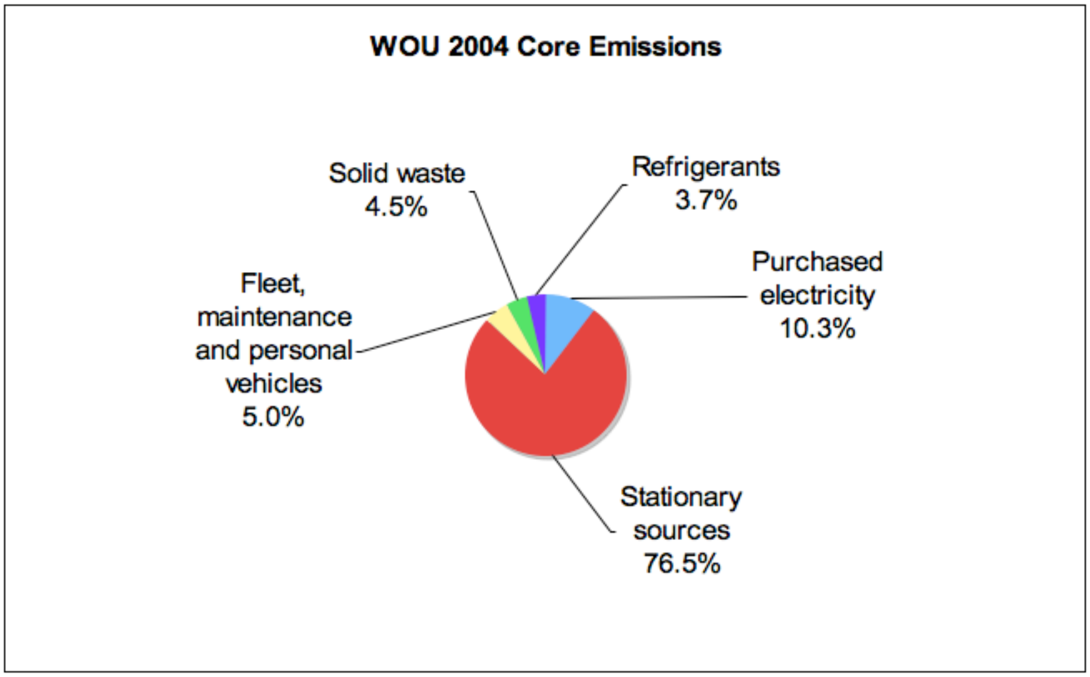
Overview of Emissions

Western Oregon University

Year	**2004**	Energy Consumption	CO2	CH4	N2O	CO2e
		MMBtu	kg	kg	kg	Metric tonnes
Purchased electricity		43,285	521,316	16	16	**527**
Stationary sources		73,587	3,884,809	388	8	**3,896**
Transportation total		3,512	246,945	47	16	**253**
	Fleet	3,512	246,945	47	16	**253**
	Commute	-	-	-	-	**-**
	Air travel	-	-	-	-	**-**
Animal agriculture		-	-	-	-	**-**
Solid waste		-	-	9,882	-	**227**
Refrigerants (specific GHGs not represented in this table)						**187**
Total		**120,384**	**4,653,069**	**10,333**	**41**	**5,090**
Offsets						**-**
	'Green' electric credits					-
	Composting					-
Net Emissions						**5,090**

The chart below summarizes the availability of information for this inventory versus the level of control that WOU has over the type and amount of energy used.

		Level of institutional control over usage and type		
Level of availability of relevant information		**High control**	**Moderate control**	**Low control (or long time horizon for change)**
	High availability	• Core campus utilities • Off-campus utilities • Fleet	• Grid mix	
	Moderate availability	• Refrigerants	• Landfill	
	Low availability	• Athletics travel	• Commute • Mission-related travel	• Long-distance student travel



(There is no pie chart for additional documented emissions for EOU because our study documented only core emissions.)

Energy	
Purchased electricity	10,641,706 kWh
Natural gas	73,584.5 MMBtu
Steam and chilled water produced off-campus	NA
On-campus cogeneration	NA
Residual oils (#5 & #6) and Distillate oils (#1, #2, #3 & #4)	NA
Propane	NA
Incinerated waste	NA
Coal	NA
Solar / wind / biomass	NA
Offsets (green tags etc.)	NA
Sources	Dave Morris, Physical Plant Accountant; Tom Neal, Director of Physical Plant & Facilities Operations
Assumptions	NA

Transportation, solid waste and other major categories	
Fleet, maintenance and mission-related personal vehicle miles	WOU has an on-campus fuel pump that delivers both gasoline and diesel fuels that are used exclusively for campus maintenance vehicles. There is no overlap between fuel used from the on-campus pump and miles reported to DAS. Fuel usage from the on-campus pump for CY2004: • Diesel - 1,352 gallons • Gasoline - 7,356 gallons DAS Quarterly Mileage Report information: • Private miles - 219,210. Gallons = 219,210 miles / 22.1 mpg = 9,919 gallons • Agency miles - 34,950. Gallons = 34,950 miles / 22.1 mpg = 1,581 gallons • Motor pool miles - 175,889. Gallons = 175,889 miles / 22.1 mpg = 7,959 gallons Total gasoline gallons = 7,356 + 9,919 + 1,581 + 7,959 = 26,815 gallons. No information available on propane usage. WOU has one fork truck that uses propane so usage is minimal. As an estimate, propane usage from SOU's one forklift was used (34 gallons). Sources: Dave Morris, Physical Plant Accountant; Robert Nies, DAS Assumptions: An average of 22.1 mpg was used for all fleets unless noted otherwise.
Commute	No commute survey has been conducted at WOU. Source: Jay Carey, Public Safety Assumptions: NA
Other mission-related travel	*Air travel* Airfare is purchased roughly equally through a contracted travel agency and the internet. No information available on air miles traveled. *Student travel from hometown to/from campus and vacation travel* No information available. Source: Lucinda Milligan, Accounts Payable Technician, Business Services Assumptions: NA
Solid waste	WOU's waste hauler, Brandt's Sanitary Service, invoices 10 campus billing entities. The invoice for Physical Plant's dumpster is the only one that includes any weight information. Physical Plant is charged a monthly fee plus weight fees. All others are simply charged a base monthly fee. Of the total solid waste charges for CY2004, Physical Plant's invoices represented 16.9% of the total. WOU personnel do not have a sense of what percentage of the institution's total waste comes from the Physical Plant dumpster so total waste data was extrapolated from Physical Plant data as a share of the total. Total weight of waste from Physical Plant dumpsters during CY2004: 261.89 tons Percentage of total waste charges represented by Physical Plant dumpsters: 16.9%

Solid waste (continued)	Therefore, total campus waste = 261.89 tons x (1/.169) = 1,549.64 tons All landfilled waste is sent to Coffin Butte Landfill, which recovers methane and produces power. Source: Dave Morris, Physical Plant Accountant Assumptions: The extrapolation of Physical Plant waste data to the entire campus is reasonable because the weight and cost of waste disposed should be closely correlated. This is likely an underestimate of waste disposed because if the hauler is not accountable to report tonnage, they will likely charge higher rates.
Animal agriculture	No farm animals are managed by WOU. Source: Dave Morris, Physical Plant Accountant Assumptions: NA
Refrigerants	WOU used an estimated 50 lbs. of various types of refrigerant in CY2004. Institutional record keeping does not list specific refrigerants by type so, without significant research time, an estimate is all that is available. Refrigerant use is primarily for chillers, so for this inventory we used Global Warming Potential factors for R-22 (HCFC-22). Source: Dave Morris, Physical Plant Accountant Assumptions: Refrigerant use is primarily for chillers, so for this inventory we used Global Warming Potential factors for R-22 (HCFC-22).

Appendix C: Sensitivity Analysis

The main themes of this section are two-fold:

1. For most of those emissions sources for which we have data, little sensitivity analysis is needed or attempted, mainly because we have trustworthy data with fairly deterministic Global Warming Potential (GWP).
2. Those emissions sources most in need of sensitivity analysis – namely, commute and air travel – are also those areas with the spottiest data and the most complex boundary issues.

In short, sensitivity analysis is inextricably linked to data issues and boundary issues. The main intention of this section is to spark future data gathering to fill these important gaps and provide the foundation for more informed discussion of boundaries.

Purchased electricity

The report contains no sensitivity analysis for electricity. Data sources appeared accurate and certain for all institutions. The accuracy and certainty extend to both total electricity use and composition of the grid mix (CO2/kWh).

Stationary sources

The report contains no sensitivity analysis for stationary fossil fuel use. Data sources appeared accurate and certain for all institutions. The accuracy and certainty extend to both total stationary fossil fuel use and GWP of those fuels.

Solid waste

Change factor: MT CO2e per ton of landfilled waste

Reasoning: The eCalculator provides negative emissions coefficients for emissions from landfilled waste with methane (CH4) recovery. This means that when an institution produces more waste, its emissions actually go down. The theoretical rationale for a negative emissions coefficient is that a portion of the carbon in the waste stream isn't able to break down and stays locked up in the landfill. The landfill, in this view, sequesters carbon that otherwise would have re-entered the carbon cycle. The figures in the column designated "low" appeared in the eCalculator before our alterations.

MT CO2e per ton of landfilled waste	Landfilled Waste with no CH4 Recovery	Landfilled Waste with CH4 Recovery and Flaring	Landfilled Waste with CH4 Recovery and Electric Generation
Original values	43.04	11.16	6.38
High	NA	NA	NA
Low	27.10	-3.19	-9.57

"Getting credit" for waste generation was, in our view, clearly wrong because landfills are not indefinite sinks of carbon. Thus, we used estimates of emissions coefficients from solid waste that do not include landfill carbon sequestration from *Solid Waste Management and Greenhouse Gases*[xxxiii], the same report used to derive the coefficients in the eCalculator. eCalculator values were changed to .27 MTCE / short ton of landfilled waste without landfill gas recovery; .07 MTCE / short ton of landfilled waste with landfill gas recovery and flaring; and .04 MTCE / short ton of landfilled waste with landfill gas recovery and electric generation, which is the sum of methane generation and emissions from transporting the waste to the landfill.

Fleet

Change factor: MPG

Reasoning: The fuel efficiency figures used in the calculator to calculate emissions from fleet usage are for passenger cars only and therefore don't reflect the increased use of SUVs and light trucks. By failing to account for the shift towards inefficient SUVs and light trucks since 1990, the calculator overstates the overall improvements in fuel economy and therefore results in lower fleet emissions in later years than is warranted.
Original value: 22.1 mpg
High: 14 mpg. Reasoning: Institution has higher-than-average use of lower-than-average fuel efficiency vehicles.
Low: 24 mpg. Reasoning: Institution has higher-than-average use of better-than-average fuel efficiency vehicles.

Refrigerants

This draft of the report contains no sensitivity analysis for refrigerants. Data sources appeared somewhat uncertain (indeed, missing) for some institutions. However, this is a small emissions category overall so we did not dedicate resources to additional analysis.

Animal agriculture

This draft of the report contains no sensitivity analysis for animal agriculture. Data sources appeared accurate and certain for all institutions. Furthermore, this is a small source (less than 2%), even for OSU, the one institution where it was relevant.

Air travel

Change factor: MT CO2e emissions per passenger mile

Reasoning: The Intergovernmental Panel on Climate Change's *Aviation and the Global Atmosphere* report indicates that the overall radiative forcing (i.e. contribution to climate change) due to air travel is believed to be several times higher than the radiative forcing due to CO2 emissions from air travel alone. Indeed, the ratio of total radiative forcing to that from CO2 emissions alone ranges between 2.2 and 3.4 for the various scenarios evaluated by the IPCC. This is because other effects of air travel, including upper atmosphere emissions of NOx and the formation of contrails, also contribute to climate change.   (We acknowledge additional commentary here from Julian Dautremont-Smith of AASHE.)

Original value: 0.000279228
High value: 0.000949376
Low value: NA

Commute

Change factor: MPG

Reasoning: The fuel efficiency figures used in the calculator to calculate emissions from commuting to and from campus are for passenger cars only and therefore don't reflect the increased use of SUVs and light trucks. By failing to account for the shift towards inefficient SUVs and light trucks since 1990, the calculator overstates the overall improvements in fuel economy and therefore results in lower commuting emissions in later years than is warranted. Also, emissions from commuters who travel by bus are not included at all.

Original value: 22.1 mpg
High value: 14 mpg   Reasoning: Commuters have higher-than-average use of lower-than-average fuel efficiency vehicles. Also accounts for some bus commute travel.
Low value: 24 mpg Reasoning: Commuters have higher-than-average use of better-than-average fuel efficiency vehicles.

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Appendix D: Supporting Data and CA-CP eCalculator Changes

[For space considerations, we have omitted the complete raw data and the eCalculator sheets from this draft. To receive a draft with all eCalculator changes or for our final eCalculator Excel spreadsheets, please contact Joshua Skov of Good Company at joshua.skov@goodcompany.com or 541-341-4663, ext. 11.]

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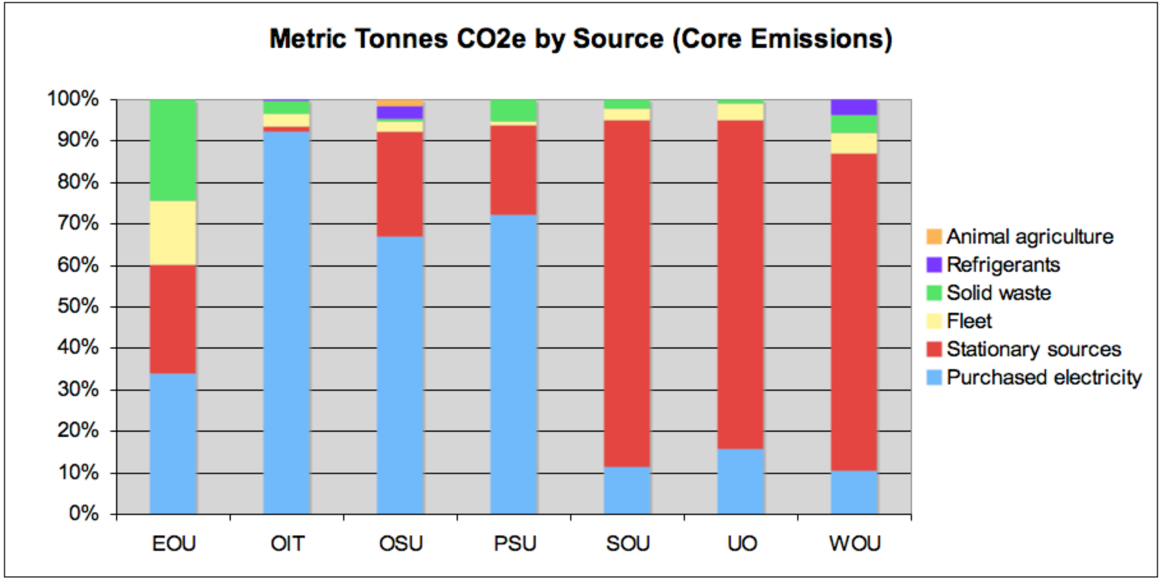
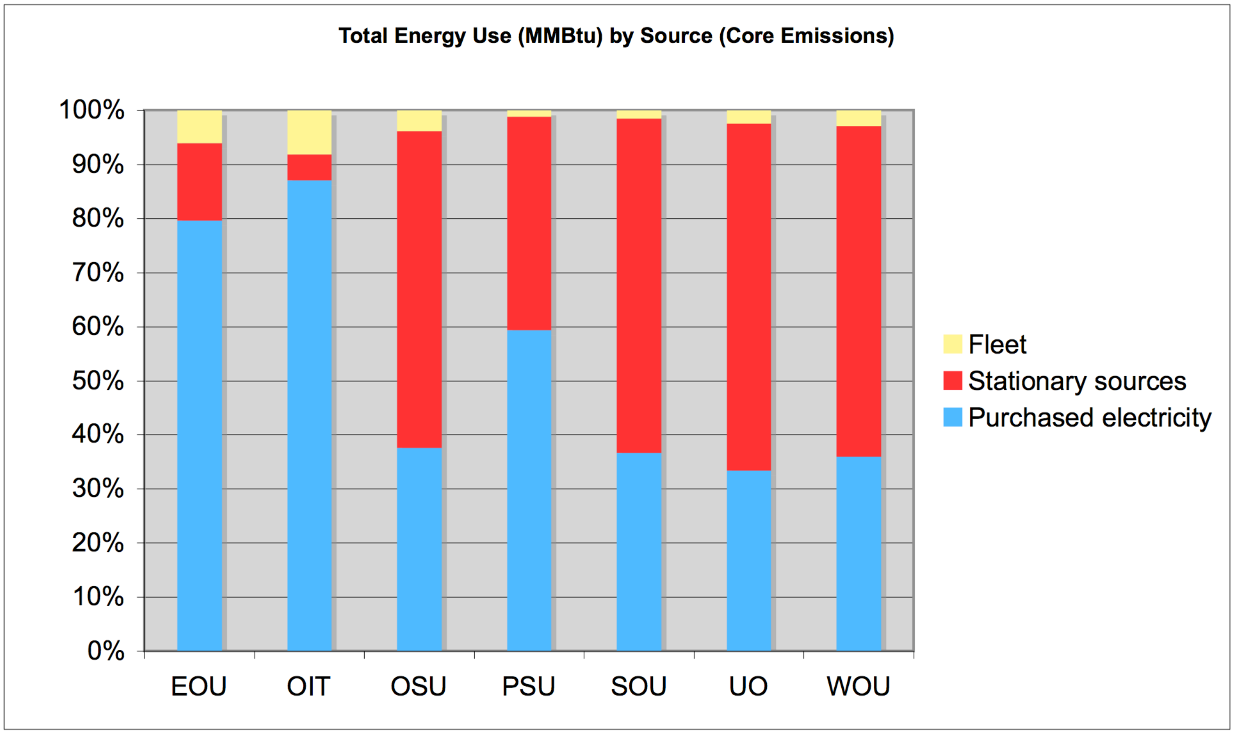
Appendix E: OUS Facts and Figures for Reference

OUS total purchased electricity	Unit of measure	Description of unit of measure
277,655,142	kWh	A kilowatt-hour (kWh) is the basic unit for pricing electricity. 1,000 watts = 1 kWh
947,637,000,000	Btu	A British thermal unit (Btu) is the amount of energy needed to raise the temperature of one pound of water one degree Fahrenheit. A kitchen match has about one Btu of energy. 1 kWh = 3,413 Btu
947,637	MMBtu	Million British thermal units 1 MMBtu = 1,000,000 Btu
277,655	MWh	Megawatts (MW) is a unit of measurement indicating how fast a plant can produce energy. MW is the standard measure of the generating capacity of a power plant. A generator with a capacity of one MW produces one-megawatt hour (MWh) when run consistently for one hour. Thus, if run consistently for one year (24 hours x 365 days) the one MW generator will produce 8,760 MWh (8,760,000 kWh). 1 MWh = 1,000 kWh MW denotes peak megawatts, as opposed to average megawatts (aMW)
277.66	GWh	Gigawatt-hours 1,000 MWh = 1 GWh
31.696	aMW	Average megawatts (aMW) is used to emphasize the intermittency of electricity generation from some sources. The size of wind power projects is often reported as aMW.

Metric CO2e by core source [stacked 100%]



- ○ Total core activities by source [stacked 100%]



3 tables (for both core and other)

Metric tonnes CO2e by source (core emissions)

	EOU	OIT	OSU	PSU	SOU	UO	WOU
Purchased electricity	481	6,838	75,278	24,331	606	4,637	527
Stationary sources	376	90	28,768	7,221	4,450	23,476	3,896
Fleet	217	215	2,566	6,688	143	1,234	253
Solid waste	348	237	920	1,798	121	262	227
Refrigerants	0	19	3,207	0	0	0	187
Animal agriculture	0	0	1,881	0	0	0	0

Note: PSU info does not include on- and off-campus electricity and natural gas usage

Metric tones CO2e by source (additional documented emissions)

	EOU	OIT	OSU	PSU	SOU	UO	WOU
Mission-related air travel	-	-	7,332	-	-	-	-
Commute	-	-	8,049	6,411	-	5,726	-

CO2e/MH (with data table)

○ Core CO2e (all 7 and OUS weighted average)

Metric Tonnes CO2e per Modified Headcount (with weighted average for OUS)

	EOU	OIT	OSU	PSU	SOU	UO	WOU	OUS
Total Metric Tonnes CO2e (Core Emissions)	1,421	7,399	112,620	33,627	5,320	29,610	5,090	195,087
Modified headcount	3,096	3,002	22,094	22,153	5,614	22,944	5,523	84,424
Metric Tonnes CO2e per Modified Headcount (Core Emissions)	0.46	2.47	5.10	1.52	0.95	1.29	0.92	2.31

- Air (OSU)

	OSU
Total Core Emissions (Metric Tonnes CO_2e)	112,620
Total Emissions for Air Travel (Metric Tonnes CO_2e)	7,332
Total Core and Air Travel Emissions (Metric Tonnes CO_2e)	119,952
Modified Headcount	22,094
Per Capita Core and Air Travel Emissions (Metric Tonnes CO_2e)	5.43

- Commute (OSU, PSU, UO)

	OSU	PSU	UO
Total Core Emissions (Metric Tonnes CO_2e)	112,620	33,627	29,610
Total Emissions for Commute (Metric Tonnes CO_2e)	8,049	6,411	5,726
Total Core and Commute Emissions (Metric Tonnes CO_2e)	120,669	40,038	35,336
Modified Headcount	22,094	22,153	22,944
Per Capita Core and Commute Emissions (Metric Tonnes CO_2e)	5.46	1.81	1.54

Electricity as % of institution's total building energy use (electricity/(elec + stationary))
[not included]

Metric Tonnes eCO2

	EOU	OIT	OSU	PSU	SOU	UO	WOU
Purchased electricity	481	6,838	75,278	24,331	606	4,637	527
Stationary sources	376	90	28,768	7,221	4,450	23,476	3,896
Purchased electricity as % of total building energy use	56.1%	98.7%	72.4%	77.1%	12.0%	16.5%	11.9%

or MMBtu

	EOU	OIT	OSU	PSU	SOU	UO	WOU
Purchased electricity (MMBtu)	39,524	31,703	349,012	204,663	49,805	229,645	43,285
Stationary sources (MMBtu)	7,084	1,702	542,882	136,372	84,059	440,712	73,587
Purchased electricity as % of total building energy use	84.8%	94.9%	39.1%	60.0%	37.2%	34.3%	37.0%

OIT's use of geothermal energy for building heat is an important component of its overall energy needs, contributing to its low energy needs outside of electricity for in-building energy use.

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End Notes

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[i] See Oregon Department of Administrative Services Policy Manual, No. 125-6-010, November 1, 2004, *Sustainable Facilities Standards and Guidelines*, available at www.oregon.gov/DAS/FAC/docs/1256010.pdf.

[ii] For documents describing the scientific consensus on climate change, visit the web site of the Intergovernmental Panel on Climate Change at www.ipcc.ch.

[iii] http://unfccc.int/essential_background/kyoto_protocol/items/3145.php.

[iv] http://iclei.org/index.php?id=1387&region=NA.

[v] For a description of The Climate Registry, see www.dec.ny.gov/environmentdec/33719.html.

[vi] The full inventory document is available from the web page of Yale's Office of Sustainability (http://www.yale.edu/sustainability/reports.htm). More information is available at the web page of the Yale Climate Initiative (http://www.xylophone.net/yci/).

[vii] http://www.climateregistry.org/Default.aspx?TabID=3413#UCSD

[viii] *Oberlin College: Climate Neutral by 2020*, prepared by Rocky Mountain Institute, Snowmass, Colorado www.rmi.org, January 2002. Available at http://www.nicholas.duke.edu/news/roberstonseminars/swisher-oberlin2020final.pdf.

[ix] The press release on Smith's effort is at www.smith.edu/newsoffice/releases/03-066.html. The student project, by Elizabeth Thomas, is at www.smith.edu/physplant/greenteam/ghgreport.pdf.

[x] The web site of CalCAP is http://sustainability.berkeley.edu/calcap/.

[xi] This has become so common that the list of institutions grows too quickly to keep track. Some examples include Duke University (http://www.duke.edu/sustainability/green_power_challenge.html) and the University of Wisconsin – Green Bay (http://www.irecusa.org/articles/static/1/1139943715_987099548.html)

[xii] For a summary of Oregon's climate action efforts, as well as the documents of the three-state initiative, see the climate page of the web site of Sustainable Oregon at www.sustainableoregon.org/climate/. For a description of WRCAI, see www.azclimatechange.gov/download/022607wrca.pdf.

[xiii] For more information, see: *Greenhouse Gas Emissions Interagency Team Report: Baseline Assessments and Recommended Best Practices*, Department of Administrative Services, December 2006.

[xiv] More information and the complete report are at www.oregon.gov/ENERGY/GBLWRM/Strategy.shtml and at www.sustainableoregon.net/climate/.

[xv] For the full text of HR 3543, see www.leg.state.or.us/07reg/measures/hb3500.dir/hb3543.a.html.

[xvi] Student start-of-year, end-of-year and vacation travel can comprise a significant percentage of an institution's total GHG emissions. Good Company's 2002 study of Reed College in Portland, Oregon, found that this long-distance travel comprised an estimated 11-20% of total emissions, depending on various assumptions used in the sensitivity analysis. Although this study does not include student travel inside the study boundaries, we recommend that it be included in some future study as a sensitivity analysis exercise.

[xvii] The University of California, Berkeley's inventory estimated emissions embodied in purchases. For details, see sustainability.berkeley.edu/calcap/inventory-footprint.html.

[xviii] Wal-Mart has publicly spoken of efforts to examine GHG emissions in its supply chain, but at the time of this writing, we found no off-the-shelf calculation tools in the public domain. See "Wal-Mart Sustainability Meeting Focuses on Climate Change, Supply Chain" (www.greenbiz.com/news/news_third.cfm?NewsID=33279) and "Wal-Mart Eyes Carbon Bounty in its Supply Chain" (www.planetark.org/dailynewsstory.cfm?newsid=38765).

[xix] See *Greenhouse Gas (GHG) Inventory for Reed College (period covered: 2001 calendar year)*, Good Company, Eugene, Oregon, 2002. Using a survey of staff, faculty and students by the student environmental organization, this inventory estimated that home-to-school travel by students amounted to 11-20% of all GHG emissions for the institution. For an electronic copy of this study, contact Joshua Skov (joshua.skov@goodcompany.com).

[xx] *Inventory and Analysis of Yale University's Greenhouse Gas Emissions*, The Yale Climate Initiative Team, Yale School of Forestry & Environmental Studies, 2005.

[xxi] Smith College enrollment numbers (2,588 for 2003-2004 academic year) came from the web site of the Smith College Registrar (http://www.smith.edu/registrar/EnrollmentCounts.php). Number of faculty (285) was taken from http://www.smith.edu/about_justthefacts.php. Number of staff (930) estimated from http://www.smith.edu/budgetoffice/faq.php. Total headcount used for generating normalized GHG figure: 3,803.

[xxii] GHG inventory total (155,810.63 (direct) + 23,085.26 (indirect) = 178,895.89 metric tons CO_2e) from California Registry (www.climateregistry.org). Staff, faculty and student numbers (26,876 students, 26,000 employees) from UCSD (ucsdnews.ucsd.edu/about/index.html).

[xxiii] OUS Institutional Research Services University Profiles – Fast Facts – 2004, available at http://www.ous.edu/irs/04_profiles/

[xxiv] CY2004 average price for a gallon of diesel fuel in Oregon determined using one year average retail price chart at http://www.oregongasprices.com/retail_price_chart.aspx

[xxv] http://rabanco.com/regional_landfill/default.aspx

[xxvi] "Solid Waste Disposal Report/Fee Calculation" (form), Oregon Department of Environmental Quality.

[xxvii] http://www.epa.gov/EPA-AIR/2002/December/Day-20/a32130.htm

[xxviii] http://epa.gov/ozone/snap/regs/Notice19.pdf

[xxix] See www.fap.pdx.edu/planning/public_cppc_1/campus_planning_documents/2005%20Transportation%20Mode%20Split%20Surveys.pdf (second half of the document).

[xxx] See http://www.fap.pdx.edu/planning/public_cppc_1/campus_planning_documents/2005%20Transportation%20Mode%20Split%20Surveys.pdf.

[xxxi] Bureau of Transportation Statistics, *National Transportation Statistics 2005*, December 2005, available at http://www.bts.gov/publications/national_transportation_statistics/2005/. Average fuel efficiency is from Table 4-11 and includes passenger cars, light trucks and motorcycles.

[xxxii] Transportation System Analysis, prepared by BRW, Inc. completed in March 8, 1996, available at darkwing.uoregon.edu/~uplan/subjects/transpo/BRWreport.html#anchor1564050

[xxxiii] Derived from Exhibit 7-6 on p. 110 of *Solid Waste Management And Greenhouse Gases,* available at http://www.epa.gov/epaoswer/non-hw/muncpl/ghg/greengas.pdf.