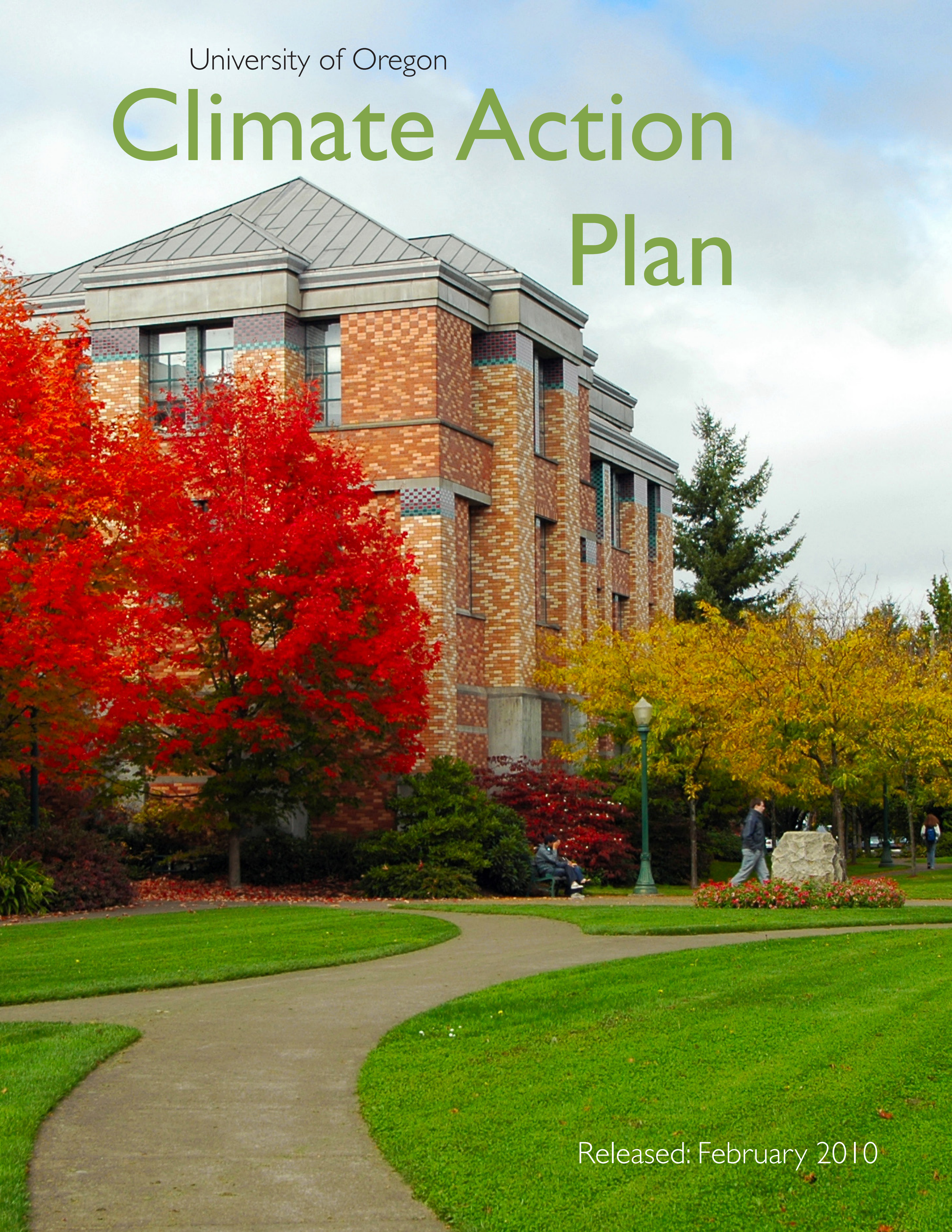
University of Oregon

Climate Action Plan



Released: February 2010

"Let us focus on a more practical, more attainable peace, based not on a sudden revolution in human nature but a gradual evolution in human institutions." -- John F. Kennedy

acknowledgments

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UO Climate Leadership Initiative
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Office of Sustainability
"Shrinking our footprint, raising awareness"

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UNIVERSITY OF OREGON

CLIMATE ACTION PLAN
March 2010

In signing the American College and University Presidents' Climate Commitment, the University of Oregon continues down the path to sustainability. Many of our green initiatives in academics and operations have been nationally recognized over the years. Working towards climate neutrality is a significant undertaking for a large research institution and requires us to explore new territory, and we will continue to lead the way.

The University of Oregon's Climate Action Plan represents the work of staff, students, external consultants, and many faculty members who provided feedback that further strengthened our final draft. This plan represents the best information we currently have about how much we are emitting and where opportunities exist for reductions. Following are examples of the initiatives we will undertake:

- **Monitoring** - Reliable, accessible, and sufficiently granular building energy consumption data are essential to effective conservation and efficiency initiatives. Facilities Services plans to pilot an energy metering and dashboard project on a small number of campus buildings in fall 2010. We will evaluate its effectiveness and, when proven, identify funding for full-scale deployment.

- **New construction** - Green design can dramatically reduce heating, cooling, and plug loads in our buildings. Currently, all new construction and large renovations must be LEED silver equivalent and exceed state energy code by 20%. However, we will explore adopting more aggressive design standards. A review will be completed within a year and results reported on the UO sustainability website.

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- **Leadership and coordination** - Frequent communications and feedback are necessary to ensure our strategies and initiatives are effective. We will establish a permanent faculty-led sustainability council to advise senior administrators regarding future programs and opportunities, strategic investments and policies that help achieve national prominence in research, education, service, and campus operations.

- **Curriculum** – Preparing students to confront sustainability challenges is as important as reducing emissions. We will work with donors to establish a competitive fund that provides faculty with the resources they need to create these transformational experiences for our students.

Our Climate Action Plan will always be a work in progress. The ideas, technologies, and regulations that shape emissions reduction initiatives are rapidly evolving, and we will remain open to better ideas and ready to take advantage of new discoveries.

We look forward to the challenges and opportunities to come.

Sincerely,

Richard W. Lariviere
President

introduction

GETTING STARTED

We are all aware of the imminent threat of global climate change due to excessive concentrations of greenhouse gases (GHG) in the atmosphere. While exact numbers are difficult to confirm, there is a strong consensus in the scientific community that a drastic reduction in GHG emissions is required to avoid catastrophic changes to the biosphere. Our current situation presents us with a monumental challenge. Fast and effective action on many levels – governmental, institutional, and individual – is necessary to bring about this reduction.

As institutions of higher learning, colleges and universities are well positioned to meet this challenge and lead the charge. Our faculties are at the cutting edge of research in clean technology, our classrooms engage the minds of the next generation of leaders and our dedicated staff and administrators manage campuses that can provide shining examples of business done right. These resources provide us with great opportunity and thus great responsibility to make meaningful changes to the way we run our campuses, and by extension, how we live our lives.

On April 16, 2007 former University of Oregon President David Frohnmayer signed the American College and University President's Climate Commitment (ACUPCC), joining what has now become more than 650 colleges and universities across the nation. This commitment, signed by all seven institutions comprising the Oregon University System (OUS), sets a goal of achieving net zero GHG emissions on all campuses. OUS is supporting a coordinated effort to assess our status and make plans to reach our shared goals.

The ACUPCC requires signatories to develop a comprehensive Climate Action Plan (CAP) to achieve climate neutrality as soon as possible. This document is the first incarnation of that plan. We will strive to maintain our CAP as a ***living document***, able to shift and adapt to changing circumstances and understandings.

The Commitment also requires that universities initiate two "tangible actions" from a list of seven aggressive policies. The University of Oregon was already fulfilling three actions from this list; requiring a minimum of LEED silver certification in all new buildings, providing free public transportation to all campus users and participating in large-scale waste minimization programs. This speaks to UO's long history of supporting sustainability through administrative commitments and academic programs. Please visit our sustainability website to learn more and to get involved: http://sustainability.uoregon.edu/

We hope to move our universities, in the words of former President Frohnmayer, "from the realm of all-too-easy promises to that of challenging but meaningful progress."[1] We are honored and excited to be a part of a movement of such magnitude and importance.

OUR DRAFTING AND REVIEW PROCESS

The University of Oregon's Climate Action Plan took more than a year to complete. In Fall 2008, UO sustainability director Steve Mital began meeting with UO and OUS staff to identify available data and gaps in knowledge about campus emissions and mitigation opportunities. At the same time, the Environmental Issues Committee began developing the emissions responsibility chart contained in this report. Beginning in January 2009 OUS staff convened several meetings to develop data collection and analysis processes and timelines. OUS then hired consultants and most completed their work by August 2009. At that time a graduate student, Ethan Rainwater, was hired by the Office of Sustainability to organize the assembled information into a draft report. Ethan worked with Steve Mital and consulted with staff from UO Planning and Real Estate and Facilities Services.

Ethan produced the first rough draft in September 2009. At that time graduate student Mark Nystrom assumed responsibility for additional updates to the plan. In early October the draft 1.0 CAP was completed and released to the university community. A two-month open review and comment period began with coverage in the Daily Emerald, the campus newspaper. Faculty, staff, and students were invited to more than 10 scheduled presentations about the CAP and directed to provide feedback via an online forum. Over a two-month period more than 200 people attended a presentation and dozens including the dean Architecture department and staff from the Climate Leadership Initiative, Community Planning Workshop, Campus Planning and Real Estate, and Energy Studies in Buildings Lab provided detailed written feedback.

In January 2010 Mark Nystrom and Steve Mital carefully reviewed all feedback. Much of it was incorporated into this FINAL DRAFT 1.0 of the University of Oregon's Climate Action Plan. The report layout was then completed by Allen Hall Advertising, a faculty-advised team of students in the School of Journalism and Communications. The final document was presented to University of Oregon President Richard Lariviere for his review and signature in late January 2010.

The online forum remains open and comments recorded there will be reviewed before future updates to the CAP are completed.

executive summary

By signing the American College and University Presidents Climate Commitment (ACUPCC), the University of Oregon (UO), along with the other six institutions that comprise the Oregon University System (OUS), is committing to achieving net zero greenhouse gas emissions. While OUS has supported efforts to draft institutional climate action plans, appropriate actions and assessment will be managed at the institutional level.

Current targets for the University of Oregon are:

- 2010: Stabilize and begin to reduce greenhouse gas emissions
- 2020: Achieve greenhouse gas levels 10% below 1990 levels
- 2050: Climate Neutrality

The following table drafted by the Environmental Issues Committee and modified slightly here, defines emissions classes and outlines UO's goals and responsibilities.

Scope 1: Direct Emissions	
Definition	Scope I emissions come from sources that are owned or controlled by the University, such as combustion facilities (i.e. boilers, furnaces, burners, turbines, heaters, incinerators, engines, flares, etc), combustion of fuels in transportation (i.e. cars, buses, planes, ships, barges, trains etc), and physical or chemical processes.
Sources	UO Central Power Station, vehicles owned by UO, and release of refrigerants.
Goals	Using 1990 emissions as the baseline UO will stabilize emissions by 2010, reduce emissions by 10% by 2020, and neutralize emissions by 2050.
Actions	UO will take action to reduce these emissions as much as possible through switching to less carbon intensive fuel sources, efficiency upgrades, and demand-side conservation practices. Remaining Scope I emissions will be neutralized by purchase of carbon offsets.
Boundaries	All University of Oregon owned and operated or leased buildings listed on the University's Space Inventory. All UO owned fleet vehicles. (Leased properties less than 10,000 square feet – which combined represent less than 1% of total UO owned or leased property - shall be omitted.)
Monitoring & Reporting	Measure Scope I carbon emissions annually. The Director of Sustainability may use his/her discretion to estimate emissions from buildings where obtaining actual utility data would be onerous such as off-campus student housing. Estimation methods and the buildings that rely on estimates shall be clearly documented. Emissions will be reported in absolute terms, per building square foot, and per full time registered student.

Scope II: Indirect Emissions	
Definition	Scope II emissions come from the generation of electricity by another party that is purchased and consumed by the University.
Sources	Purchased electricity, steam, and/or chilled water from Eugene Water and Electric Board (EWEB) and utilities serving our operations in Bend, Charleston and Portland.
Goals	Using 1990 emissions as the baseline UO will stabilize emissions by 2010, reduce emissions by 10% by 2020, and neutralize emissions by 2050.
Actions	UO will take action to reduce these emissions as much as possible through efficiency upgrades and demand-side conservation practices. Remaining Scope II emissions will be neutralized by purchase of renewable energy credits and/or carbon offsets.
Boundaries	All University of Oregon owned and operated or leased buildings listed on the University's Space Inventory. All UO owned fleet vehicles. (Leased properties less than 10,000 square feet – which combined represent less than 1% of total UO owned or leased property - shall be omitted.)

Scope II: Indirect Emissions	
Monitoring & Reporting	Measure Scope II carbon emissions annually. The Director of Sustainability may use his/her discretion to estimate emissions from buildings where obtaining actual utility data would be onerous such as off-campus student housing. Estimation methods and the buildings that rely on estimates shall be clearly documented. Emissions will be reported in absolute terms, per building square foot, and per full time registered student.

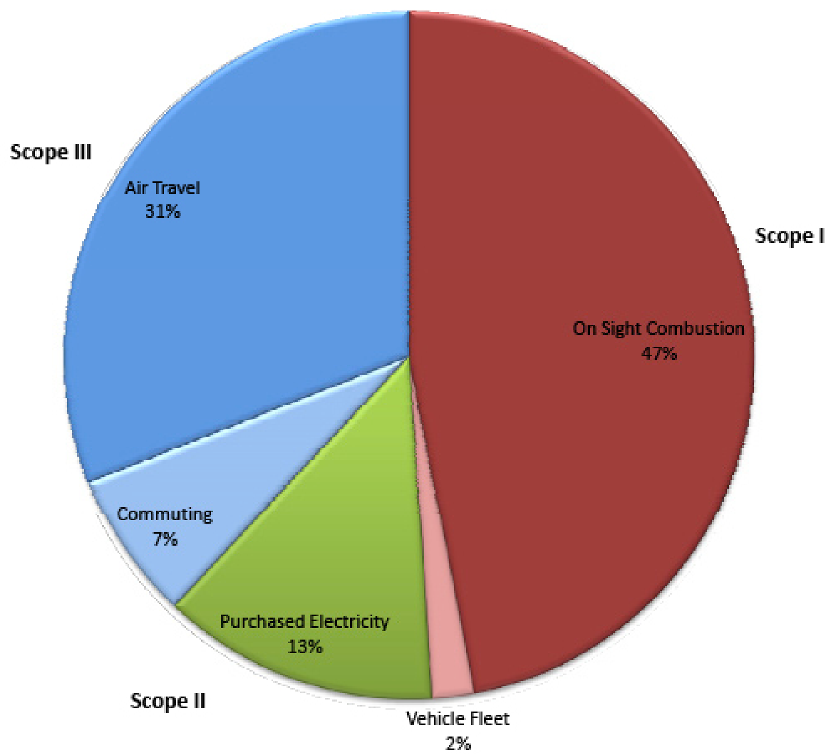
Scope IIIa: Direct Transportation Activities	
Definition	Emissions resulting from travel conducted on behalf of and/or sanctioned by the University of Oregon.
Sources	Auto travel for University business, faculty and staff air travel, athletic staff and student travel, student travel to and from UO sanctioned study abroad programs.
Goals	Reduce business travel where appropriate. Encourage transportation modes that emit fewer emissions. Develop carbon offset programs for travel emissions.
Actions	Work with Department of Administrative Services to develop appropriate data collection program and increase mpg requirements for motor pool vehicles. Remaining emissions will be neutralized by purchasing carbon offsets.
Boundaries	All UO faculty and staff air travel, athletic staff and student travel, student travel to and from UO sanctioned study abroad programs.
Monitoring & Reporting	Estimate (or measure when possible) emissions annually. Report in absolute terms and per user.

Scope IIIb: Indirect Transportation Activities	
Definition	Emissions resulting from travel to and from campus by current users that are not paid for by the University of Oregon.
Sources	Daily commute travel.
Goals	Provide and expand transportation alternatives for all faculty, staff, and students. Encourage faculty, staff, and students to take personal responsibility for reducing their commute emissions. Increase on-campus housing stock.
Actions	UO will continue to provide and support safe low-carbon alternatives to automobile commuting.
Boundaries	All current Eugene based employees and registered students attending classes at Eugene main campus.
Monitoring & Reporting	Conduct survey to estimate commute emissions every five years. Develop method to estimate annual emissions for each of the following four years based on survey data. Report total estimated emissions annually.

Scope IIIc: Goods and Services	
Definition	Emissions resulting during any stage of the life cycle (manufacturing, processing, distribution, decay) of materials purchased for use by the University of Oregon.
Sources	Embodied energy and greenhouse gas emissions in purchases (food, paper, computers, construction materials, etc).
Goals	UO will consider embodied energy in all of its purchases and reduce these related emissions through smarter purchasing decisions.
Actions	UO will continue to support and enhance the campus recycling program (Reduce, Reuse, and Recycle) and purchase wisely.
Boundaries	UO will not be responsible to mitigate or offset remaining emissions associated with its goods and services as these are Scope I and II emissions from the businesses that manufactured and/or provided these goods and/or services.
Monitoring & Reporting	To be developed as tools and procedures become available.

EMISIONS PROFILE

Total emissions for fiscal year 2008 equaled 70,778 MTeC02 (metric tons of carbon dioxide equivalent). The following chart categorizes these emissions.



In 2008 UO's emissions per 1000 gross square feet (GSF) was 11.60 $MTeCO_2$ as compared to an average of 21.39 for other schools in its Carnegie class[2] . Gross emissions per FTE student were 3.67 $MTeCO_2$ in 2008, compared to the class average of 8.81 $MTeCO_2$. This difference results mainly from UO's low carbon electricity derived from hydropower. A long history of building efficiency investments also is to be credited.

MITIGATION STRATEGY

UO will reduce its emissions as much as possible through direct means and purchase carbon offset credits to neutralize emissions that cannot be otherwise eliminated. The campus has already implemented many of the "low-hanging fruit" efficiency upgrades but an even more aggressive mitigation program is required to meet stated goals. Experts estimate the University of Oregon can further reduce annual emissions by 9,576 $MTeCO_2$ (13.5%) at a cost of $25.8 million and with a simple payback of 18 years. UO's emissions reduction strategy should take the following into consideration:

- Electricity provided by EWEB and used for campus cooling, lighting, and plug loads has a very small carbon footprint. The majority of emissions – and thus the focus of our efforts – comes from the ***combustion of natural gas for heating.***
- ***External developments*** – in technology and trends in behavior – are likely to create emissions reduction opportunities that cannot be assessed or fully appreciated at this point in time. Thus, our strategy should remain open-ended and flexible.
- ***Carbon offsets*** are likely to remain an important piece of our strategy, due to the large amount of emissions from air travel and commuting, and the difficulty of mandating direct reductions. (Note: UO has decided not to offset emissions from commuting, due to the potential for a perverse incentive, but will continue to support a robust range of transportation alternatives.)
- The most important first step to emissions management, is the ***development of a robust emissions monitoring and reporting plan.*** Reliable, sufficiently granular, and frequently updated emissions data for UO buildings and air travel are essential to emissions reduction initiatives.

In order for the Climate Action Plan to be effective, efforts must be made to ***tie into the existing academic programs at UO***. Opportunities exist for faculty, staff, and students, to engage with the carbon neutrality goals. The effort will benefit from the leveraging of academic resources to the problem at hand

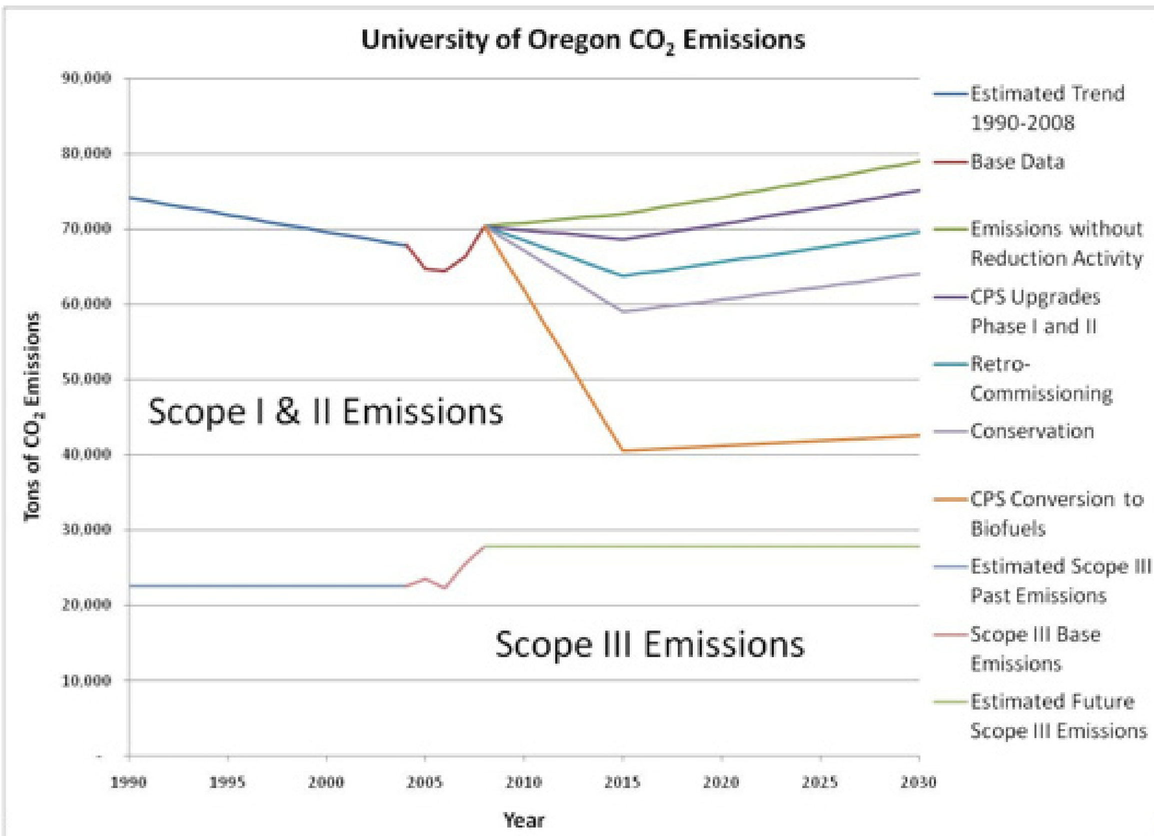
and the campus community will be provided a rich education experience supporting this large-scale experiment in institutional emissions reduction. Faculty, staff, and students should be given opportunities to identify their own best fit in this project.

The Climate Action Plan (CAP) must also ***harmonize with the mission of the University and any existing strategic plans*** that are relevant. In particular the CAP should be integrated into the 2005 Campus Plan, the Sustainable Development Plan, and the 2008 Academic Plan.

A broad-based ***communications plan*** is also essential to the implementation of this Plan. A strong statement from senior leadership will provide traction for individual units to pursue their interests in line with this effort. Also, an educational campaign will ensure the widest level of individual commitment to and participation in the Climate Action Plan.

Finally, this plan is intended to be a ***living document***, not a mandate for a range of specific actions on a fixed timeline. Rather, through this document, areas of opportunity have been identified and analyzed and left up to more thorough consideration by the individuals who will be directly involved. In this way, the CAP will be more inclusive and our strategy will be open to unforeseen developments.

THE BIG PICTURE



The above graph summarizes the overall emissions trends and reduction scenarios for the University of Oregon. The 1990 Scope I and II baseline was estimated by Good Company. The 1990 Scope III baseline was estimated by the UO sustainability office. Total emissions from 2004 to 2008 represents actual data collected and analyzed by Sightlines and the UO Office of Sustainability.

Based on the estimated 1990 emissions and those measured annually beginning in 2004, we have seen a significant reduction (greater than 10%) in Scope I and II emissions. However overall emissions have only decreased slightly due to the rise in Scope III travel emissions. Scope I and II reductions are due to a shift to less carbon intensive energy sources provided by EWEB (our local utility) and energy efficiency upgrades implemented by Facilities Services. The estimated increase in Scope III emissions between 1990 and 2004 reflects the increase in University staffing and the establishment of academic support accounts in 1992. These accounts provide faculty additional resources to travel to conferences and research sites. Scope III emissions are assumed to remain constant over the next 20 years due to a balancing of increased fuel efficiency and travel alternatives with an increase in the numbers of students and staff at the UO who travel.

Each of the lines extending from 2008 represents different possible future scenarios:

- **Emissions without reduction activity** - The uppermost line represents emissions based on projected campus growth without any concerted efforts to reduce emission activity. The growth rate is assumed to be one-percent and accounts for a number of new buildings becoming operational in 2015. Left unchecked, this represents a 12% increase in emissions by 2030.

- **CPS Phase I and II upgrades** (estimated cost: $101 million)- The next line shows an initial 10% decrease in Scope I and II emissions due to the major upgrades currently underway at the Central Power Station. This 10% is merely an estimate by the Office of Sustainability based on discussions with senior Facilities Services staff. A more detailed report on the GHG emission reductions has been ordered by Facilities Services. However, the positive effects of the upgrades do little more than neutralize the effects of expected growth.

- **Retro-commissioning** (estimated cost: $4.3 million)- The next line down represents the cumulative effects of the CPS upgrades ***and*** approximately an additional 7% decrease in Scope I and II emissions due to retro-commissioning and tightening operation schedules. Through these actions we can maintain our emissions at 2008 levels out to 2030 despite campus growth.

- **Conservation** (estimated costs: $20.7 million) - The University should be able to decrease its Scope I and II emissions another 7% through energy conservation improvements including upgrades to HVAC and lighting systems, and improvements to building envelopes. This line represents the cumulative effects of CPS upgrades, retro-commissioning, and conservation efforts. These data are all based on estimates made by McKinstry in their report to OUS. Details are provided in Appendix 5.

- **CPS conversion to biofuels** – This line is the most controversial. Phase II of the CPS upgrade includes plans to install duel fuel burners capable of handling biofuels. There could be significant emissions reduction should the UO Central Power Station burn biofuel instead of natural gas. Biofuels emit carbon when burned, but are re-captured during the growth of the new crop (corn, switch-grass, etc.). Depending on the type of biofuel, technology, and emissions accounting method, UO could achieve significant emissions reductions. Significant additional work needs to be done to produce a reliable estimate.

- **Scope III travel emissions** (estimated offset cost: $300K annually) As can be seen, no significant reduction solutions exist at this time. IT solutions like video-conferencing, reduced travel budgets, changes in faculty and staff travel priorities, and efficiency improvements undertaken by the airline industry will all contribute to Scope III emissions reductions, but it is not at all clear by how much. Purchasing carbon offset credits, and deducting them from our travel emissions is the only other viable and acceptable method of reducing and/or eliminating air travel emissions.

These potential actions and their estimated costs and impacts on emissions offer a starting point for discussion. It's important to note that UO School of Architecture faculty (including G.Z. Brown who directs the Energy Studies in Buildings Lab and is an internationally recognized expert on the subject) believe significant additional energy savings beyond what is discussed here could be achieved through conservation and efficiency measures. They further state that this is the simplest and most cost effective approach to energy and emissions reductions. While this may be true in theory, many of these strategies require significant behavior changes by faculty, staff, and students. It's not clear to what extent the campus community is willing to adapt or what the costs would be.

Achieving significant emissions reductions will require sustained commitment by the entire university community. Higher green building standards, fuel switching, changes in individual behavior and campus culture, and investments in new technologies need to be combined with an adaptive strategy that rewards experimentation. A monitoring and reporting system is needed to determine which actions are most successful and merit continued investment.

Significant assumptions were needed to produce this estimate. A detailed 40-year plan extending out to 2050 would be nearly useless. Instead, we'll revise the emissions reductions trajectories periodically as we move down the path to carbon neutrality.

commitments and goals

The University of Oregon and all schools within the Oregon University System (OUS) are bound by the statewide emissions reduction goals set out by Governor Kulongoski in July 2007. HB 3543 mandates the following targets for the state of Oregon ***but currently apply only to Scope I and II emissions:***

- 2010: stabilize and begin to reduce GHG emissions
- 2020: achieve GHG levels 10% below 1990 levels
- 2050: achieve GHG levels 75% below 1990 levels

Construction and renovation projects at UO are also required to comply with the State Energy Efficiency Design (SEED) program.[5] SEED was originally established in 1991 as a result of Oregon State law, ORS 276.900-915. This law directs state agencies to work with the Oregon Department of Energy (Energy) to ensure cost-effective energy conservation measures (ECMs) are included in new and renovated public buildings. It was revised in 2001 to require that all state facilities constructed on or after June 30, 2001 exceed the energy conservation provisions of the Oregon State building code by 20 percent or more.

In signing the ACUPCC the University of Oregon has committed to taking its GHG mitigation efforts a step further than the state-mandated requirements. The current targets for GHG reduction *which include air travel are*:

- **2010: stabilize and begin to reduce GHG emissions**
- **2020: achieve GHG levels 10% below 1990 levels**
- **2050: CLIMATE NEUTRALITY**

The ACUPCC also requires the University to fulfill two of a list of 'tangible actions' while developing the Climate Action Plan. The University of Oregon was already fulfilling three of these conditions:

- *Establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent. UO adopted this policy in 2005.*
- *Encourage use of and provide access to public transportation for all faculty, staff, students and visitors at our institution. UO provides free passes to the Lane Transit District bus system for all students, faculty and staff.*
- *Participate in the waste minimization component of the national RecycleMania competition, and adopt 3 or more associated measures to reduce waste.*

1) UO's comprehensive and award winning recycling program diverted 45% of total waste from the landfill which in 2005 equaled over 1500 tons of material.

2) UO annually composts 10,000 pounds of coffee grounds and other pre-consumer food discards produced by UO Housing and EMU Food Services.

3) Computer Harvest has processed over 5,400 unwanted computers through its reuse and recycling program.

4) The Re-use Chemical Database provides an easy way for researchers to share chemicals and thereby reduce unnecessary purchases

5) The Property Surplus Database allows departments to easily make available and/or source unwanted furniture, appliances, etc. to/from other campus units.

The full text of the ACUPCC is available in Appendix 4.

campus emissions

In 2009, a comprehensive greenhouse gas (GHG) inventory for the University of Oregon was conducted for the years 2004-2008 by Sightlines. To assist in estimating the footprint of the campus, Sightlines used the Clean Air Cool Planet Campus Carbon Calculator, v5.0.

The inventory took into account all major greenhouse gases, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), HFC-13A, HFC – 404A, and sulfur hexafluoride (SF_6). For ease of calculations and comparability, the different gases were all converted into Metric Tons of Carbon Dioxide Equivalent ($MTeCO_2$).

EMISSION SOURCES

The commonly accepted framework for classifying and quantifying GHG emissions has been developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The Protocol defines three "scopes" for carbon emissions accounting in order to distinguish between "direct" and "indirect" emissions, to promote transparency and consistency, and to ensure as far as possible that no two companies account for the same emissions.[6]

Under recommendations from the Environmental Issues Committee (EIC), the University of Oregon has modified this framework, further delineating Scope III emissions for greater specificity and accuracy.

Scope	Explanation	At UO
Scope I: Direct Emissions	Sources that are owned and controlled by the University, also called "stationary sources"	UO Central Power Station, vehicles owned by UO, and release of refrigerants
Scope II: Emissions from Purchased Electricity	Generation of electricity by another party that is consumed by the University, also called "purchased electricity"	PPurchased electricity, steam, and chilled water from local utility
Scope III: Indirect Emissions		
IIIa: Direct Transportation Emissions	Travel on behalf of, or sanctioned by the University	Auto travel for university business, faculty and staff air travel, athletic staff and student travel, travel to and from study abroad programs
IIIb: Indirect Transportation Emissions	Unofficial university travel	Daily commuting
IIIc: Embodied Emissions in Purchased Goods and Services	Emissions from the production and transport of goods and services consumed by the University	Food, paper, computers, construction materials, etc. [7]

BOUNDARIES

The boundaries for Scopes I and II encompass the entire Gross Square Footage (GSF) of University owned and leased buildings, and their associated fleet vehicles. Leased properties less than 10,000 square feet – which combined represent less than 1% of total UO owned and leased property – were omitted due the difficulty of collecting their utilities data in comparison to their relative significance.[8]

Data was not available to account for satellite campuses and off-campus student housing. Emissions arising from these properties was extrapolated using average energy consumption rates from the main campus and the athletics complex.[9] Future emissions inventories will attempt to capture actual emissions data from these properties buildings.

Scope III direct transportation emissions include all UO faculty and staff business air travel and athletic staff and student air travel. Indirect transportation emissions encompass all current Eugene-based employees and registered students attending classes at the main campus in Eugene. Future inventories will attempt to also include student travel to and from UO sanctioned study abroad programs. Daily commute emissions to and from satellite campuses are relatively small, difficult to measure, and therefore omitted. Estimation of the embodied emissions of goods and services is a much more complicated – though useful – undertaking. The boundaries for this category remain to be determined.[10]

MONITORING AND REPORTING

The UO's emissions profile will be updated annually. The Director of Sustainability may use his/her discretion to estimate emissions from buildings where obtaining actual utility data would be onerous, such as off-campus student housing. Estimation methods and the buildings that rely on estimates will be clearly documented. Emissions will be reported in absolute terms, per building square foot, and per full time registered student.[11]

At this time we do not have sufficient metering equipment to break emissions down by building or by activity such as research or athletics. Many experts see the value of enhanced monitoring and reporting. We will continue to work towards improved metering, recognizing that better feedback leads to better decision-making.

The data will be reported annually to the Association for the Advancement of Sustainability in Higher Education (AASHE) as per the ACUPCC, and will be publicly available on the AASHE website. The Office of Sustainability will be responsible for managing this process, and will also make the data available on UO's sustainability website – http://sustainability.uoregon.edu

SUMMARY FINDINGS

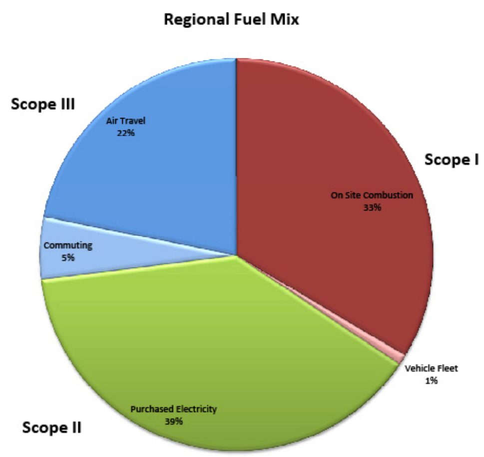
		FY2004	FY2005	FY2006	FY2007	FY2008
Scope I						
Utility Combustion	MTeCO_2	37,510	33,008	32,874	31,897	33,062
Vehicle Fleet	MTeCO_2	1,297	1,315	1,292	1,084	1,214
Agriculture	MTeCO_2	21	21	21	22	20
Refrigerants & Chemicals	MTeCO_2	-	-	-	-	-
Total Scope I	**MTeCO2**	**38,829**	**34,344**	**34,186**	**33,003**	**34,296**
Scope II						
Purchased Electricity	MTeCO_2	7,793	8,101	9,237	8,990	9,467
Purchased Steam	MTeCO_2	-	-	-	-	-
Purchased Chilled Water	MTeCO_2	-	-	-	-	-
Total Scope II	**MTeCO2**	**7,793**	**8,101**	**9,237**	**8,990**	**9,467**
Scope IIIa						
Air Travel	MTeCO_2	16,309	17,147	15,939	19,286	21,544
Scope IIIb						
Commuting	MTeCO_2	4,952	5,058	5,075	5,087	5,032
Scope IIIc						
Solid Waste	MTeCO_2	450	443	448	440	440
Total Scope III	**MTeCO_2**	**21,711**	**22,648**	**21,463**	**24,812**	**27,016**
Total Gross Emissions	**MTeCO2**	**68,333**	**35,092**	**64,886**	**66,805**	**70,778**

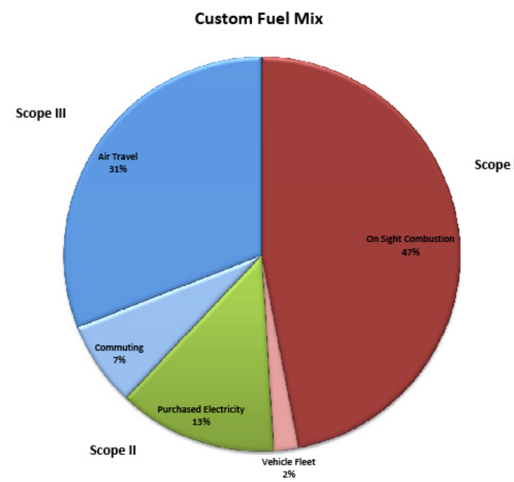
In 2008 UO's Gross Emissions per 1000 Gross Square Feet (GSF) was 11.60 MTeCO_2, as compared to an average of 21.39 for other schools in its Carnegie Class: Doctorate Granting Universities.[12] Gross emissions per FTE student were 3.67 MTeCO_2 in 2008, compared to the Class average of 8.81 MTeCO_2.[13]

1990 LEVELS

Governor Kulongoski's executive order sets 1990 as the base year. However, lack of reliable data makes an accurate measurement impossible. OUS agreed to hire Good Company (a Eugene-based consultant) to estimate its 1990 emissions and document the assumptions used. Using average energy consumption rates from the Energy Information Administration's ***Commercial Building Energy Consumption Survey (CBECS),*** Good Company provided a best guess. A full description of the methods can be found in Appendix 3.

It was estimated that the University of Oregon had Scope I & II emissions of 51,597 MTeCO2 in 1990. Compared to the 2008 Scope I & II emissions (43,762 $MTeCO_2$) this shows a significant drop. This can be attributed mainly to the fact that 1990 emissions for UO were estimated using a wood waste emissions factor in the generation of electricity it used. Emissions factors only takes into account "tailpipe" emissions resulting from combustion. They do not account for "life-cycle" emissions that include the raw material extraction, transportation and processing that occurs before consumption. As such wood has almost double the GHG emissions per million British Thermal Unit (MMBTU) compared to natural gas. This illustrates the powerful effect that fuel switching can have on the campus's emissions profile.





Note: GHG from agriculture (0.008%) and solid waste (0.04%) were not significant enough to include in these diagrams.

DISCUSSION OF RESULTS

In conducting this inventory, it became apparent that there is some level of unavoidable error involved with measuring emissions for a large decentralized university. Emissions tracking is still new and relies on accounting methods that are still evolving. (Note: a separate GHG inventory was completed for UO in 2007 that produced different results.) We have already discovered a few sources that will be accounted for more fully in next year's assessment. In the future, it is possible that ***the University may see as much as a 5% change in our campus emissions simply due to more thorough and accurate accounting.***

Despite some annual fluctuations between 2004 and 2008, emissions appear to be trending upwards.

Scope I

On-site utility combustion represents 47% of GHG emissions from the University of Oregon. The University purchases and burns natural gas in the Central Plant, generating steam which is distributed throughout the main campus to heat the buildings. The steam produced in the cogeneration system is used to generate a small amount of campus electricity demand – 7% of total usage in 2008.[14] The steam is then piped over to campus for heating purposes. However, the primary use of the Central Plant is for heating with natural gas, and as a result, a major focus of our efforts at emissions reductions should be in mitigation of heating demand.

One notable event in the data demonstrates the viability of this approach. A fairly significant decrease in overall emissions occurred between 2004 and 2005. While some of the other emissions sources saw an increase in this year, Scope I emissions were reduced by 4,500 $MTeCO_2$ which equal 12% of Scope I emissions or a 7% reduction in all UO emissions. 2004 marked the enactment of a very aggressive insulation and joint replacement upgrade to the heat distribution system across campus.[15] This clearly shows that well-targeted efficiency retrofits can make a large difference in the emissions profile of the campus.

The University-owned vehicle fleet comprises a rather small percentage of the total GHG emissions. UO will work with the public and private motor pools it contracts with to develop an appropriate data collection program and increase MPG requirements for motor pool vehicles. However, the fleet does not represent a major area of opportunity for mitigation.

Scope II

An important factor influencing the calculation of Scope II emissions is the mix of fuel sources used to generate the purchased electricity. The EPA gives standardized numbers for a "regional fuel mix," in this case for the Pacific Northwest. It is worth noting that the power grid in the Northwest is the cleanest in the nation, placing universities here in a favorable position due to the high percentage of renewable energy (mostly hydropower).[16] Furthermore, the University of Oregon purchases its supplemental electricity from the Eugene Water and Electric Board (EWEB), which happens to have a much cleaner fuel mix than even the Pacific Northwest regional standard. Using this "custom fuel mix" in calculations reduces UO's emissions profile significantly, due to the decrease in Scope II emissions. This custom mix provides much more realistic GHG profile and has been used for all the calculations in this report.

EWEB's relatively clean fuel mix puts our Scope II emissions at roughly 13% of the total GHG emissions from the campus and changes the relative percentages of the other categories. This tells us again that the most significant emissions reductions lie not in the conservation of electricity, but in reduced heating demand in our buildings and upgrades to our on-site Central Power Plant – in other words: Scope I emissions.

Scope III

Emissions in this category – particularly air travel – make up a significant portion of the institution's GHG profile. Unfortunately, this is an area over which the University has little control. Due to its nationally recognized alternative transportation initiatives, only 49% of faculty and 11% of students drive to and from campus alone, resulting in low commute emissions. Mandating how professors and athletics teams travel to conferences, meetings, and sporting events is a significantly more difficult task. Therefore, Scope III emissions will remain a major challenge to the University's efforts towards carbon neutrality, and perhaps one that can only be addressed through purchase of offsets.

It is important to note that the formula used to estimate air travel emissions converts dollars spent to miles travelled to emissions. Flights out of Eugene typically cost 10-20% more than flights from Portland resulting in inflated air travel emissions estimates. Changes in data collection and/or estimators that factor in increased travel costs for those flying from regional airports should reduce our estimated air travel emissions.

mitigation strategy

The University of Oregon will need to implement aggressive reduction strategies to meet its goal of net zero emissions. In order to achieve the most meaningful reductions and receive their full benefit in the local context, UO will seek to implement as many direct mitigation measures as possible, only pursuing offsets when absolutely necessary. This is the generally accepted strategy employed at ACUPCC signatory institutions nationwide.

The University will need to pursue these measures in a flexible, opportunistic manner. As the campus changes and grows, and volatile external factors such as swings in fuel costs, changing regulations, and new technology come into play, this adaptive strategy will prove strongest. ***As such, this Climate Action Plan is intended to establish general guidelines that will inform the process, rather than prescriptive policies.***

PRIORITIZING PROJECTS

It must be recognized that while the University is taking responsibility for mitigating its emissions, it is dependent on a number of external factors over which it has little control. These factors can positively influence our goals (such as unexpected breakthroughs in clean technology), or negatively influence them (such as the inability to curtail air travel, or dictate campus user behavior). The following table shows a range of actions. Each is evaluated for both its likely impact on emissions reduction and the degree of control that UO has over implementing them.

impact versus control for greenhouse gas emission reductions

	Low Control	High Control
High Impact	• Reduce air travel • Individual energy conservation efforts	• Insulate steam pipes • Alternative fuels for heating • HVAC upgrades • Purchasing offsets
Low Impact	• Increased use of alternative commuting programs	• Window replacement • Lighting upgrades

This table illustrates a method of evaluating projects. A source with a large potential impact and a high degree of control would be the first selected. One with a smaller impact and a low degree of control would be assigned a lower priority. On the low end, an extreme in either category (minimal impact or no control) could render a project undesirable.

This method will be further informed by the costs and paybacks associated with each measure.

Additionally each project would be evaluated for its educational value. Many projects provide excellent learning and research opportunities for students and faculty. For example a student group in the Center for Sustainable Business Practices at the Lundquist School of Business could design and manage a program for purchasing and managing the University's carbon offsets. Students in PPPM might help design incentives to reduce air travel. Psychology students could design behavior change campaigns.

One additional factor weighing in on decision-making is the potential for major breakthroughs in technology. For example, the University might decide to delay a planned CFL lighting upgrade in hopes of leapfrogging straight to hyper efficient but as yet unproven LED lighting. A possibility also exists for a technological innovation to be a total game-changer – for example a new clean and renewable fuel source for our boilers. This type of technology could change our entire strategy, and while the University should not wait around for one to emerge, the University should remain open to the possibility.

There is no way to accurately predict these unknowns in our Climate Action Plan. The UO is dependent on developments in technology in the private sector, as well as on the regulatory framework in which we operate. Given all these potential factors, the University's policy in writing and implementing the CAP is to stay flexible, setting incremental goals and constantly revisiting our strategic plans, so as to remain open to what may come.

ADAPTATION

Increasingly, those in the climate response research community recognize that a complimentary mix of mitigation and adaptive strategies is appropriate.This makes sense given that some amount of climate change is, at this point in time, inevitable. Adaptive strategies fall into three subcategories: resistance, resilience, and facilitation. Resistance involves actions that attempt to prevent impacts of climate change, resilience improves the capacity to maintain the status-quo, and facilitation works to ease the transition to new climate conditions. The following example helps clarify the differences. Given that the Pacific Northwest can expect to see hotter, drier summers one can imagine a resistance strategy of turning up the air conditioner, installing a green roof as a resilience strategy, and an urban forest plan whose trees are adapted to the new conditions and shade nearby buildings.[17]

This climate action plan primarily focuses on mitigation strategies. Future releases will include adaptive strategies as well.

CAMPUS GROWTH

As facility expansion is the single biggest driver of rising carbon emissions and energy use campus-wide, several planned new facilities will have a significant impact on the emissions profile of the University of Oregon. According to the July 2009 Capital Projects Plan, there are currently 638,000 GSF of buildings in various stages of design and construction.[18] Using the 2008 factor of 11.6 $MTeCO_2$/1000 GSF / year, this represents an additional annual 7,400 $MTeCO_2$ that will need to be addressed. Left unmitigated, this would represent a 10% growth in total annual emissions over a six-year period.

Fortunately, in reality the lower energy use of the modern, LEED- and SEED-compliant buildings will result in a significantly smaller increase in emissions. This greater efficiency will hopefully be accompanied by a rise in energy conscious user habits. We are assuming a 20% reduction in emissions from these new buildings relative to current averages, giving us a projected annual emissions increase of 5,900 $MTeCO_2$. This equals an 8% increase in total carbon emissions by 2015. As a consequence, planned upgrades to the Central Power station will not reduce emissions relative to 2008 levels; they will only mitigate the emissions related effects of growth. Thorough discussion and thoughtful, decisive action will be required to balance the somewhat-opposing desires of an expanding campus, and a zero-emissions campus.

direct reductions: demand side

SCOPES I & II EMISSIONS

Demand management is the direct reduction of electricity and/or natural gas required to power our campus. These reductions can be achieved through modifications in end-user behavior, upgrades to building envelopes, lighting, appliances, and/or HVAC systems, or through increasing the efficiency of our Central Power Station (CPS).

Recent and current actions

UO has already implemented many of the "low-hanging fruit" energy saving actions across campus. From 2001 to 2003, the University spent $540,000 on energy efficiency upgrades to the CPS and in campus buildings. These included occupancy sensors, heat pumps, time clocks, valve replacements, and lighting upgrades from T12 to T8 fluorescent lighting. Currently over 80% of campus fluorescent lights have been changed to T8. These upgrades save approximately 1.7 million kWh annually, enough electricity to power 140 average Eugene homes.[19]

Since 2000, the campus Sustainable Development Plan has mandated that all new construction meet LEED certification standards (although not necessarily undergo certification). In 2004 this policy was reinforced by the Oregon Department of Administrative Services which requires all state-owned buildings to meet a slight modification of LEED silver design standards. University buildings also must comply with the State Energy Efficiency Design (SEED) program. According to Campus Planning and Real Estate, the University met SEED requirements on all construction projects during the 1991-2001 period which required performance 10% better than code. In 2001 SEED began requiring state buildings to perform 20% better than code. Campus Planning and Real Estate reports that the UO has completed and occupied approximately a dozen projects since 2001. All have met the required SEED design criteria. Eight have passed post-occupancy energy tests. Post-occupancy data for the remaining four buildings are still being collected.[20]

Central power station

The CPS is currently undergoing a major, two-phase upgrade whose estimated cost is $100M. Phase One, which was recently completed, involved a complete overhaul of the campus chilled water facilities. The four older chillers were replaced with five new 1500 ton/hr chillers and associated cooling towers. The new system is expected to be significantly more efficient than the old system, resulting in lower electricity use for the chillers. This phase also involves a replacement of all the existing switchgear and an upgrade to the electrical substation.[21]

Phase Two, currently in the design and planning stage, involves switching to newer, more efficient boilers, an upgrade to the steam delivery system, and associated landscaping and site work. This should result in an estimated 20% decrease in natural gas consumption. Conservatively, the ***UO can expect to see a 10% decrease in campus emissions due to these CPS upgrades***. A more accurate calculation of improvements is expected sometime in the near future when the more detailed engineering report ordered by the Facilities Services is completed.

The CPS upgrade will also accommodate alternative fuels in the event they become available and more economically viable in the future.[22] Switching from natural gas to an algae-based or switch grass derived biofuel may dramatically reduce our emissions. However, significant breakthroughs in technology and changes in public policy and farming practices would first have to happen. Therefore, it is impossible at this time to predict the likely impact of biofuels on UO's emissions. Nevertheless, planning to accommodate biofuels makes a great deal of sense given current focus on developing these fuels and the likelihood that large swaths of the Willamette Valley may someday be dedicated to growing them. Additional fuel options also increase our options to deal with supply interruptions caused by extreme weather events, reductions in oil availability, and price volatility.

Campus facilities assessment

In 2009, McKinstry was hired by the Oregon University System (OUS) to conduct an analysis of the existing building energy use and GHG emissions. The purpose of the study was to identify and quantify the energy conservation and GHG reduction opportunities in the campus building stock. McKinstry conducted facility energy audits and an on-site analysis of eleven representative buildings and extrapolated their results across the entire campus. It is important to note that the resulting carbon reduction estimates and costs is considered a 'rough order of magnitude' study and therefore is not investment grade. While the analysis results are within +/- 25% confidence, it is recommended that UO evaluate each measure further before implementing the projects. McKinstry produced two emissions reduction scenarios defined below:

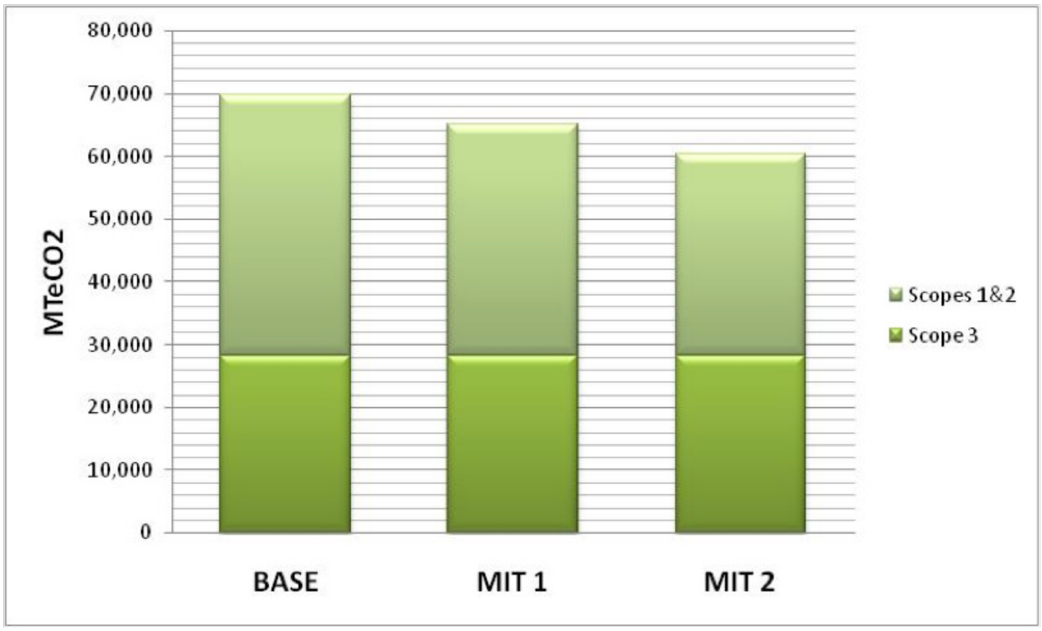
mitigation scenario one

- <u>Low- or no-cost projects</u>: retro-commissioning and consolidation of operations to reduce run times during partial use periods

mitigation scenario two

- <u>Conservation projects that require capital investment</u>: modern controls, variable frequency drives (VFDs), lighting retrofits, new equipment, etc.

CAMPUS LEVEL EMISSIONS SAVINGS



**Due to the structure of McKinstry's analysis, the above graph includes emissions from the vehicle fleet and agriculture within Scope 3.*

Mitigation scenario one involves low- or no-cost strategies that can be implemented immediately. Retro-commissioning is a systematic investigation process for improving or optimizing a building's operation and maintenance. The retro-commissioning process most often focuses on dynamic energy-using systems with the goal of reducing energy waste, obtaining energy cost savings, and identifying and fixing existing problems. This process should be combined with a tightening of building operation schedules, and consolidation of activities during times of reduced occupancy (nights, weekends, vacations, summer term). These actions would require some time spent on logistical consideration, but overall represent a direct savings in money and emissions.

Mitigation scenario two involves energy conservation projects in our buildings that require upfront capital investment. McKinstry recommended the installation of variable frequency drives on pump and fan motors where there currently are none, lighting retrofits for the remaining T-12's and incandescent lamps and select building envelope improvements. The projects that increase campus heat efficiency promise significant emissions reductions. These actions simultaneously prepare us for higher energy costs and the warmer weather projected for the Eugene area. While these projects do require an initial investment, they will result in savings in the long-run.

McKinstry estimates 9,500 MTeCO_2/year or ***approximately 13.5% of the existing carbon emissions can be easily reduced through retro-commissioning and energy conservation projects (MIT 1 & 2)***. The cost in today's dollars to implement these projects across the campus is approximately $25.8 million, with an annual energy savings of $2 million. With an average project life of 15 years, this results in a net customer cost savings of $35 million (assuming a 3.5% utility cost escalation) over the life of the projects.

It's important to report that experts from the UO's School of Architecture believe significant additional reductions can be achieved through conservation and efficiency upgrades. Some of their suggested strategies would require sacrifices in convenience, changes in behavior, and other forms of community support/buy-in that we may not have a sufficient reserve of.

The following table summarizes these findings. For a more detailed look at energy conservation projects in the sample buildings, a full list of potential actions, their costs and carbon savings is included in the McKinstry tables located in Appendix 5.

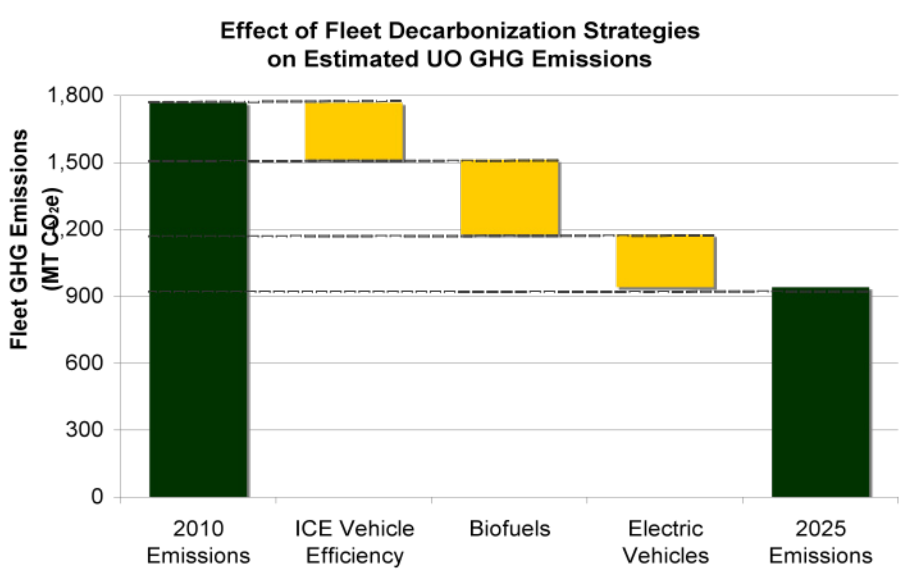
summary findings by building - mitigation scenarios one & two[21]

Building Type	Total UO Sq.Ft. for building type	% Total Sq.Ft.	Energy Use Index (kBtu/ ft2/yr)	Estimated Cost	Average Simple Payback	MTCDE Reduced/yr
Academic	1,786,682	32%	93	$5,109,911	17	2,882
Science/Research	389,392	7%	224	$5,287943	12	1,120
Residential	923,396	16%	98	$4,930935	40	2,352
Administrative	591,483	11%	121	$2,572,951	35	838
Library	392,275	7%	108	$1,086,602	23	296
Athletic	1,038,042	19%	108	$5,5532,764	*	1,120
Student Life/ Union	438,328	8%	150	$1,267,645	*	569
Campus Total	**5,585,034**	**100%**	**122**	**$25.8M**	**18**	**9,576**

**Project cost estimates are based on proxy data from Portland State University. Simple Payback cannot be calculated without further investigation.*

FLEET VEHICLES

Good Company analyzed the UO's fleet. Technological changes and changes in fuels and procurement decisions could ***reduce UO's fleet emissions by an estimated 827 MT CO_2e by 2025*** – a 50% reduction over 2008 fleet emissions. The analysis considers vehicle efficiency improvements, lower emissions from emerging low-carbon fuels, and the large-scale introduction improvements, lower emissions from emerging low-carbon fuels, and the large-scale introduction of electric vehicles. Some of the emissions reduction will come as a result of regulation and market forces that originate outside of OUS. However, there will be opportunities to reinforce and accelerate these trends. The analysis provides a planning framework for the universities to support these trends in their fleets.[24]



SCOPE III EMISSIONS

Scope III air travel emissions make up a significant portion of our total emissions. The UO is currently taking aggressive actions to address solid waste emissions through recycling and composting programs. In future assessments the embodied emissions in purchased goods and services (Scope IIIc) will be estimated. For now, commuting and air travel emissions will remain the focus of our efforts.

Commuting

UO has already made significant progress in this area, which is measured as Scope IIIb in our GHG inventory. The 2009 Transportation Survey showed that only 11% of students currently drive alone to campus, most choosing to walk, bike, or take public transportation. Of University employees, 49% drive alone to campus. Oregonians consume only 7.3 gallons of gas per week compared to 8.2 gallons consumed a week by the average American[25] , demonstrating that students and employees are part of an already informed community of commuters.

In order to support alternative commute modes and discourage the use of vehicles, the University provides over 4,000 secure bicycle parking spaces on campus, enough for one-sixth of the entire population. The University also has one of the lowest ratios of vehicle parking spaces to campus users in the nation. [26]

Since 1988 the University has made available free bus passes to the entire campus population, with the ability to ride anywhere in the service district. The Associated Students of the University of Oregon (ASUO) paid $888,000[27] for students and the University paid $210,000 for faculty and staff to receive this benefit for the 2009 calendar year.[28] Financial and priority parking incentives for carpoolers and a guaranteed ride home program for faculty and staff who ride the bus to campus have been in effect for several years.[29]

Overall, this is an area where the University has already made great strides. Maintaining these alternatives to driving are important, though significant additional emissions reductions are unlikely. UO will continue to support these programs and expects to see a rise in their popularity due to external factors such as rising gas prices and an increased sense of climate responsibility.

In the next update of this Climate Action Plan, we plan to include a model developed by Good Company that estimates reductions in commute emissions based on increased MPG and introduction of electric cars to the market.

Air Travel

Air travel is estimated to account for nearly a third of UO's emission profile. This is also not an area where emissions can be easily reduced. Travel is fundamental to university life. Faculty and staff travel to conferences, athletics teams to their sporting events, and students will – and should – participate in study abroad programs. While some progress could be made in this area through administrative suggestions, educating faculty and staff on efficient travel techniques like choosing non-stop flights and encouragement of alternatives such as videoconferencing, this is not an area the UO can make significant changes given the realities of university life.

As mentioned earlier in this report, a more accurate model for converting dollars spent on air travel to air travel emissions will itself lower our estimated air travel emissions. Flights from Eugene cost more than flights from Portland, for example, but don't emit any more per air mile travelled. Future emissions calculators will take the additional cost to fly out of a regional airport into consideration.

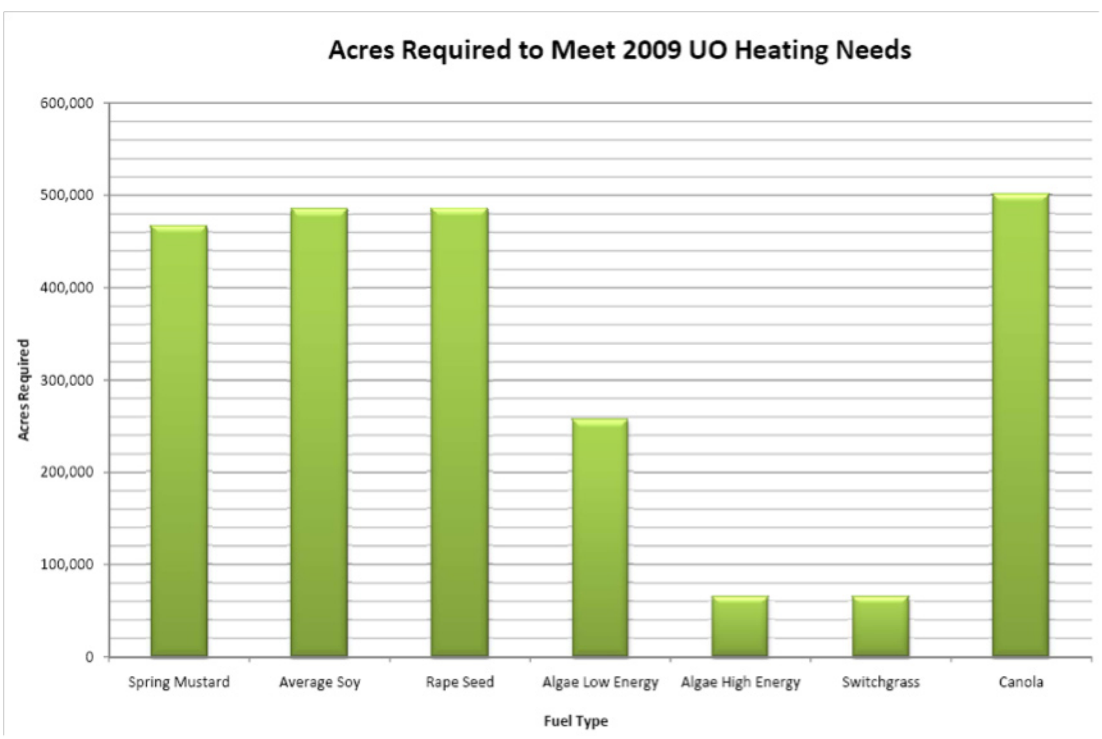
The University expects to see a reduction in air miles traveled due to increased expense of flying and tighter university budgets. There is also a promising possibility that airplanes themselves will become less carbon intensive. Great improvements in fuel efficiency of aircraft, streamlining of ground operations, and the potential for the use of renewable biofuels all show promise in the mitigation of GHG emissions associated with air travel. For example, Virgin airlines is purchasing several new Boeing 787 aircraft which use 20% less fuel than similar airplanes and is setting a goal of 30% improvement in fuel efficiency for its entire fleet by 2020.[30] It is expected that external developments like this will have a beneficial impact on our campus GHG profile.

direct reductions: supply side

The Pacific Northwest is rich in renewable energy resources such as solar, wind, geothermal, and particularly biomass.[31] While developing the facilities to harness these resources will require significant investment, given the rising cost of fossil fuels and the imminent possibility of cap-and-trade regulations requiring carbon offsets, this technology will pay off in the long run. Additionally, the University cannot achieve its emissions reduction goals with demand management strategies alone. A successful and sustainable strategy requires that the University transition away from fossil fuels for heating and replace them with renewable energy sources. The most promising renewable energy resource for the University of Oregon is biofuel. However, a creative proposal being developed by the Oregon University System could capture wind, wave, and solar power on its properties which are distributed widely across the state, and wheel the power back to the UO and its sister campuses.

BIOFUELS

Renewable energy from biomass – commonly plant matter – can generate electricity and/or produce heat. Forest residues from logging (such as dead trees, branches and tree stumps), wood chips and other biodegradable wastes may be burned as fuel in a specialized facility. This technology creates a market for local crops and some waste streams from nearby industry. UO is well located for this approach.The National Renewable Energy Laboratory estimates the Willamette Valley can produce over 500,000 tons of biomass/yr.[32] The campus annually consumes 625,000 MMBtu of energy in the central heating plant.[33] Studies show that Oregon produces enough crop residues to meet UO fuel needs 43 times over[34]. According to Prout Institute, the Willamette Valley has over 800,000 acres of land in agricultural production of which nearly 500,000 are used to grow ornamental grass.[35] The graph below shows the acreage needed to meet UO's heating needs given different crop types.



McKinstry estimates ***that the University could eliminate approximately 25% of its total GHG emissions by converting to a biofuel fuel stock.*** Based on the commodity cost difference between natural gas and woodchips, fuel savings are estimated at $2.9 million/yr. This project will mitigate emissions of approximately 17,500 $MTeCO_2$/yr. This claim is based on the fact that some researchers consider biofuels to be carbon neutral. Their reasoning follows along these lines: in one year carbon is absorbed to create the plant. The plant is then used as fuel stock and carbon is released into the atmosphere. The following growing season the carbon released by combustion is reabsorbed, resulting in a zero net carbon emission. However, recent life-cycle analysis of certain biofuels show significant emissions associated with using certain biofuels. The carbon-cycle is not clearly understood so these debates will continue in the future. Additionally, the calculations associated with biofuel-stock missions will be highly dependent upon the availability of particular fuel-stock, the distance necessary for transportation of the fuel and the energy content of the stock. We must conclude that the technology associated with biofuels and their availability is unpredictable at this time. However, the Office of Sustainability feels that this is an area which the University should continue to monitor.

Solar

Efficiency gains and production line advances have reduced the cost of solar photovoltaics from approximately $300 per watt in 1956 to less than $5 per watt in 2009. The Energy Information Administration *Annual Energy Outlook* 2009 projects that, by 2030, costs for new generating plants using solar photovoltaics will be 37 percent lower than the 2009 costs, making solar a viable alternative to fossil fuel burning technologies.[37] While not all climates and sites are ideal for solar installations, a 2009 BacGen study commissioned by OUS has identified several viable solar installations for each OUS campus. The various projects, if implemented, promise to provide a total of over 25% of the Oregon University System's energy needs.[38]

The University of Oregon currently has two demonstration-scale solar projects, providing a very small percentage of its energy usage. BacGen identified a few additional projects for UO, which would provide 870 kW of electricity (two percent of campus energy needs.) UO is not an ideal site for photovoltaics. Instead, OUS is considering a plan to develop 22 megawatts of solar power at the Oregon Institute of Technology and wheel it to the other institutions.

OUS Renewable Energy Cooperative

The Oregon University System is currently developing a plan to build six renewable energy projects. Together, they have the potential to generate over 50% of OUS's current electrical demand. Many also provide cutting edge research and educational opportunities for faculty and students.

The OUS Renewable Energy Cooperative will identify the best renewable sites, pool systems resources to finance projects, leverage additional funds through innovative public/private partnerships, and distribute energy credits evenly to all seven institutions. Current pilot project descriptions are given below. Plans are evolving quickly however. Updated information will be presented in subsequent versions of this document.

The following six projects have been proposed in the 2007-2009 and 2009-2011 OUS Capital Budget Requests:

University of Oregon, Central Power Station Phase III: The project includes installation of gas fired turbines and boilers designed to accommodate alternative fuels. This could enable the main campus to eliminate Scope I emissions in the future. Additionally, the complete build-out of the co-generation units will provide an average electrical output of approximately 17 megawatts (MW). The campus electrical load is 15 MW with a projected growth to 24 MW by 2029. When an alternative fuel source is identified to fire the co-generation turbines, the bulk of the campus electrical load will also be provided by a carbon neutral energy source. Emissions reduction could reach 60% of the 2008 campus total with a full implementation of this plan.

Solar Power: OUS recently completed a solar feasibility study to determine near-term generating capacity on buildings and land, and to facilitate OUS' net zero energy goal. The potential generation capacity is almost 25% of the energy consumed by the entire Oregon University System. Although each campus has at least one solar-ready site, most of the generation will be developed at a 125+ acre south facing hill on the OIT campus.

Oregon Institute of Technology (OIT), GeoSolar Electric Generation: OIT is uniquely positioned in Klamath Falls to take advantage of exceptional local geothermal resources. Currently the entire campus is heated using 192-degree water pumped from three geothermal wells. OIT plans to build a one-megawatt, low-temperature geothermal power plant that receives a boost from solar troughs. The plant will provide 100% of campus electricity demand, saving approximately $500,000 annually. Excess electricity will be sold into the grid through a net metering system that could earn OIT $200,000 annually. The research and technology transfer related to this project will be led by OIT's Geo-Heat Center. Students will be able explore the development of direct heat utilization of geothermal and solar energy and demonstrate its potential as a renewable energy resource in Oregon. Upon completion of the project, OIT will become the first geothermally heated and powered campus in the world.

Oregon State University (OSU), BioEnergy Research Center (BERC): The Center will serve as a prototype facility that demonstrates advances in biofuels science and technology, utilizing local and regional biomass and other available feedstocks. An in-plant analytical laboratory capable of managing ASTM and European testing techniques will provide proof of concept results. The BERC will develop public-private partnerships to integrate proven conversion technologies with cutting edge research and development conducted by a multi-disciplinary team of OSU researchers. The center will generate electricity and heat by fueling a new, LEED Platinum combined heat and power plant adjacent to the BERC site.

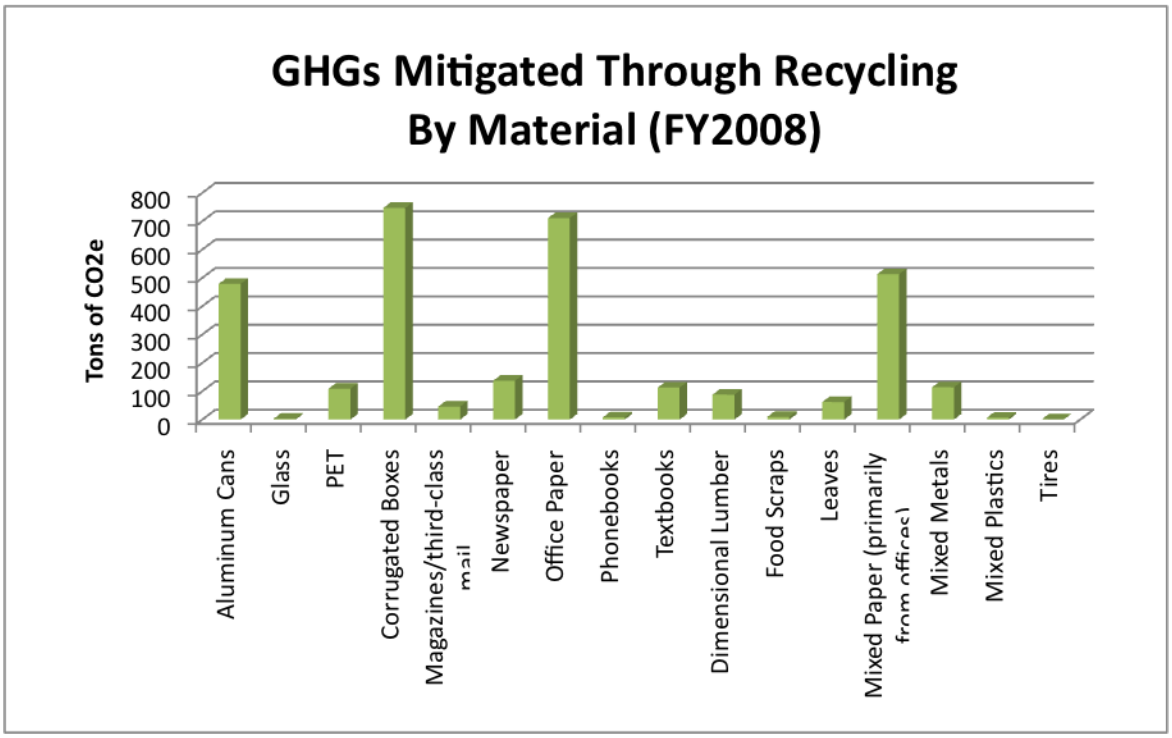
Urban Wind Project: The project includes the development of urban wind generation at the Portland State University Campus. The scope of this project is to design, build and install a rooftop ballast mounting system, suitable for existing urban structures. The final design must employ a flexible, durable, modular ballasting mechanism that reduces noise and vibration. Power generated from the wind turbines will be net metered to the building's existing electrical service.

Oregon State University, National Wave Energy Research Center: The energy from Oregon's coast is available 80% of the time, compared to 35% of the time for wind power. OSU's College of Engineering is seeking to build this Center to test ocean wave energy designs. This project will place the required infrastructure to create approximately 6 test bays off the coast of Newport, allowing OSU researchers to transmit power to the grid.

other emissions reductions

SOLID WASTE AND RECYCLING

Based on data received from the Campus Recycling Program, the University recycled 1,451 tons of the 3,071 tons of solid waste (47%) created through University activities in FY2008. Annual recycling rates are based on the total amount of waste recovered via recycling and composting divided by the total amount of all collected materials including material disposed in the landfill[39]. These materials would have been landfilled if they had not been diverted from the waste stream. According to the US EPA's WARM program,[40] UO's recycling and composting efforts mitigated over 3,000 $MTeCO_2$. The Campus Recycling Program believes it can further increase recycling rates and thereby mitigate even more emissions. Ideally the University will develop purchasing and conservation policies that will lower the volume of waste generated while encouraging more solid waste recycling.



TREES

According to information from the Campus Facilities Exterior Team, there were 3,997 standing trees on campus in the year 2009. Based on the "Method for Calculating Carbon Sequestration by Trees in Urban and Suburban Settings," a workbook by the US Department of Energy[42], published in 1998, the Office of Sustainability estimated the total annual carbon sequestration from campus trees. These trees sequestered an estimated 91 $MTeCO_2$ in 2009.

CARBON OFFSETS AND RENEWABLE ENERGY CREDITS

Carbon offsets are obtained by financing emissions reduction projects elsewhere in the world. Markets exist to exchange credits between organizations initiating the projects and organizations seeking to offset their emissions. One offset credit represents one metric ton of carbon dioxide equivalent ($MTeCO_2$).

The University of Oregon currently purchases very small quantities of offsets. In 2009, the student body purchased 540 $MTeCO_2$ worth of carbon offsets from Native Energy at $14/ $MTeCO_2$[43]. From 2005 - 2008 students purchased 2,280 renewable energy credits (RECs) to offset emissions from the student union. RECs are distinct from offsets in that they represent proof that electricity was generated from a renewable energy resource, thus promoting low-carbon technologies. Since the campus's source of electricity is already fairly clean, it was decided in 2008 that money would be better spent purchasing offsets. These purchases were made using the Environmental Issues Committee's purchasing protocol developed in 2009. This protocol can be seen in Appendix 3.

Since it would be nearly impossible to eliminate all GHG emissions, offsetting will remain a necessary part of our strategy to reach climate neutrality. After reducing all the University can through direct actions, the University will need to purchase offsets equivalent to the remaining emissions. ***After completing all recommended actions, UO will still need to offset a significant amount of emissions annually to reach zero GHG emissions.***

Oregon-based Climate Trust – which is ranked in tier one companies in Consumer Guide to Carbon Offsets – prices offsets at $12/MTeCO$_2$[44]. Experts assume the price could climb as high as $50/MTeCO$_2$, in the future due to increased government regulation of and higher demand for carbon emissions.

Note: the UO has decided not to offset faculty, staff, and student commute emissions. Doing so creates a perverse incentive for campus users – if they were told their commute emissions were being offset by the institution, perhaps they wouldn't worry about the environmental impacts of driving to campus. Rather, the UO will continue to provide a wide array of alternative transportation options, and leave the responsibility to mitigate commute carbon emissions to individuals.

CARBON REDUCTION SUMMARY

These emissions reductions activities amount to 3,785 MTeCO2 in FY 2008 which equals 5% of total UO emissions. However, we are not currently subtracting them from UO's total emissions because the standards of accounting are not yet clear. It is our hope that the ACUPCC will credit these reductions in the future.

Carbon Reductions		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
Trees, Offsetting	MTeCO$_2$	-3,941	-3,537	-3,555	-2,939	-3,785

financing

Achieving climate neutrality is largely a financial challenge. Technologies exist to eliminate all UO's Scope I and II emissions, but it's not clear how to pay for it. The University of Oregon, working with the Oregon University System, will aggressively pursue a variety of financing options described below. Success largely depends on creative public/private collaborations and the legislature's appetite for emissions reduction and renewable energy projects.

- OUS is currently negotiating performance contracts to finance retro commissioning and conservation projects recommended by McKinstry. McKinstry estimates it would cost approximately $153 million to address Scope I and II reductions across the Oregon University System. The University of Oregon's share is $28.5 million.[45]
- $20 million is currently available to OUS institutions to support energy efficiency and building safety projects. A committee to review proposals is being organized. Proposals that effectively leverage additional funds will be most competitive.[46]
- OUS requests funding to support deferred maintenance and energy efficiency projects from the Oregon legislature each biennium. Recent successes include:
  - Straub Memorial Hall $13.3 million
  - Fenton Hall $8 million
  - Heating and Power Plant $13.2 million
- The University of Oregon is currently evaluating a revolving loan fund structure similar to the Green Campus Fund at Harvard University. Funds would support first costs of energy efficiency and conservation projects and be paid back through utility bill savings and reduced operation costs.[47]
- The University of Oregon is currently evaluating a revolving loan fund structure similar to the Green Campus Fund at Harvard University. Funds would support first costs of energy efficiency and conservation projects and be paid back through utility bill savings and reduced operation costs.
- The proposed OUS renewable energy cooperative calls for six alternative energy projects. Projects are matched to the most effective campus location. For example, solar panels would primarily be built at the Oregon Institute of Technology rather than at UO. This visionary project would move the whole system to energy independence at a cost of approximately $840 million.[48]
- The University of Oregon plans to continue upgrading its Central Power Station. Phase II improvements include a heating system capable of burning locally sourced biofuels. The estimated cost is $54 million.[49]

There are also a number of energy efficiency and alternative energy tax incentives offered at the federal, state and local levels that are being investigated.

Payback Period

The decisions of many institutions are constrained by strict payback period policy. Under these circumstances any project with a payback period exceeding that established by the institution does not get approved, and this greatly limits the options available for mitigating emissions, especially in regards to efficiency upgrades requiring capital investment.

Fortunately, the University of Oregon does not use a hard-and-fast payback period, but makes its decisions on an ad hoc basis. Many of the energy conservation measures identified by McKinstry have reasonable payback periods under 20 years (see Appendix 2, column marked SPB), and some do not. ***However, when bundled together as a package, the payback for all the identified energy conservation projects is 18 years.***

education, research, and outreach

This Climate Action Plan is not simply a facilities plan to be implemented by staff while the rest of campus carries on with its business. Rather, this plan represents a major new goal for our entire learning community, one that can be reflected in the curriculum, in faculty research, and in how the University relates to its neighbors.

The University community should view this massive undertaking as an opportunity to leverage a powerful educational experience for our talented students and faculty. Many possibilities exist for this sort of partnering: getting psychology students working on behavior modification campaigns, architecture classes calculating energy savings from building retrofits and business faculty and majors managing the UO's carbon offset portfolio just to name a few. Ultimately, a Climate Action Plan facilitating this type of involvement will result in more effective actions and a rich educational experience for our campus community.

Over the next three years the University will work with faculty to develop plans that offers basic sustainability literacy to all students. The recent BIG Ideas process identified five major multi-disciplinary themes to be developed at the University of Oregon. Three have distinct sustainability connections. Global Oregon in particular aims to develop curriculum that supports global awareness. This could become a vehicle to develop basic sustainability literacy for all students as well as specialized opportunities for advanced students.

CURRENT ACTIONS[50]

To its credit, the University of Oregon has already embarked on the path towards carbon neutrality. The UO is consistently ranked as one of the greenest schools in the nation[51] due to the range of green operational and educations programs offered. These actions should be further encouraged and their successes built upon as the University moves forward.

Research

There are at least ten major research institutions and centers at the University that focus in part on sustainability: 1) Institute for a Sustainable Environment, 2) Solar Energy Center, 3) Center for Ecology and Evolutionary Biology, 4) Oregon Institute of Marine Biology, 5) Center for Advanced Materials Characterization in Oregon, 6) Materials Science Institute, 7) Center for Housing Innovation, 8) Oregon Transportation Research and Education Consortium (OTREC), 9) the Center for Sustainable Business, and 10) Energy Studies in Buildings Laboratory.[52] These institutes and centers conduct diverse research related to sustainability. For example, the Institute for a Sustainable Environment houses the Climate Leadership Initiative, which conducts research on the impact of climate change on Oregon's forest resources and provides a technical assistance program.[53] OTREC involves researchers from several Oregon University system schools and was federally mandated 2005.

Two major science laboratories focus on sustainability research at the University of Oregon, the Green Chemistry Program and the Solar Radiation Monitoring Laboratory.[54] The Green Chemistry Program has gained international attention and more than one hundred educators from all over the world have attended "Green Chemistry in Education" workshops at the University of Oregon.[55] The Solar Radiation Monitoring Laboratory collects data on solar radiation in the Pacific Northwest and makes these data accessible to the public. These data can then be used for projects such as passive solar design.

In addition, numerous faculty members, graduate students, and undergraduates conduct research on environmental and/or social sustainability who may not be affiliated with a specific research organization.

Curriculum

Students at the University of Oregon can engage with environmental sustainability issues from a wide array of disciplinary and interdisciplinary perspectives. Of the eight colleges and professional schools comprising the University of Oregon, six offer courses in environmental sustainability. Of the forty-six undergraduate majors offered within the College of Arts and Sciences, twenty-two (48%) included courses related to environmental sustainability in the 2005-06 academic year. Two of those majors, Environmental Studies and Environmental Science, are designed specifically to help students develop an interdisciplinary understanding of environmental issues. The Environmental Studies Program also offers a minor in Environmental Studies, as well as Masters and PhD programs in Environmental Studies.

The School of Law is well known for its expertise in environmental law, offering an Environmental and Natural Resources Law Program and an Environmental Law Clinic. The College of Business is emerging as a leader in sustainable business practices and the School of Architecture focuses much of its curriculum around sustainability. The architecture program states its first objective as "the promotion of broad inquiry into the integrative nature of environmental issues and design."[56] This year (2010) Architectural Record magazine ranked the Department of Architecture as #1 in Sustainable Design Practices and principles.[57]

Student Culture

The University of Oregon has a long history of student involvement in sustainability issues. Currently, sixteen student groups on campus focus on sustainability issues. The most recently formed student groups are the Environmental Club, Environmental Policymakers and Planners, Design Bridge, and LiveMove.[58] Other recently formed student groups include: Sustainable Business Group, Coalition Against Environmental Racism, Ecological Design Center, and the Center for the Advancement of Sustainable Living.

Students are also training and building job skills in the field of sustainability through internships and graduate teaching fellowships for a variety of departments and institutes on campus. For example, students work with the Institute for a Sustainable Environment, the Energy Studies in Building Laboratory, the Green Chemistry department and Center for Sustainable Business Practices among many others.

The ASUO is a non-profit organization funded by student fees and functions as the student government of the University of Oregon. The ASUO provided funding for twelve sustainability-oriented student groups in 2005-06. The ASUO also annually supports numerous sustainability projects on campus. Of their total 2009-10 budget of $11.6 million,[59] ASUO provided $888,000 to Lane Transit District to provide free bus passes for all students[60]. ASUO also contributed $296,700 to the Campus Recycling Program in 2009-10. Many other sustainability-related programs receive ASUO funding[61]. In summary, the ASUO spent $1.3 million or 11% of its budget for 2009-10 on twelve sustainability-related student groups and three campus programs, including Campus Recycling and bus passes.[62]

In addition to these annual programs, a one-time $100,000 over-realized fee allocation went to the Ecological Design Center in 2001 to install solar panels on the Erb Memorial Union and the Student Recreation Center. A similar over-realized fee allocation process was recently completed in April 2007 with nearly $200,000 going toward the purchase of three biodiesel vans for Campus Recycling and the building of a biodiesel processor.[63]

There are also a number of major student publications that cover sustainability produced at the University of Oregon, including *Ecotone, Journal of Environmental Law and Litigation, The Student Insurgent* and the campus newspaper, the *Oregon Daily Emerald.*

Engagement

The University of Oregon provides a wide variety of opportunities for public service and outreach. Many programs and projects help students connect with their community. Eleven programs specialize in community outreach focused on environmental sustainability.[64] For example, the Community Planning Workshop (CPW) has provided planning assistance to communities, agencies, and organizations throughout Oregon since 1977. Graduate students have the opportunity to work on planning and public policy problems for CPW clients. CPW projects include Natural Resource Policy, Land Use Policy, and Sustainable Development[65].

The Environmental Leadership Program gives students the opportunity to work with government agencies, nonprofit organizations, and local businesses on environmental and sustainability issues. Projects in 2006-07 examined issues of restoration stewardship, environmental education, and corporate sustainability, among others.[66]

Community members also have an opportunity to learn more about sustainability issues through the University's Continuing Education Division, which offers sustainability leadership workshops and a certificate program.[67]

In addition to public service and outreach programs, conferences held at the University provide opportunities for students, faculty and staff to interact with the surrounding community on sustainability issues. Currently four major student-organized sustainability conferences occur at the University of Oregon annually. These include: 1) Sustainable Advantage Conference, 2) Holistic Options for Planet Earth Sustainability (HOPES), 3) Public Interest Environmental Law Conference, and 4) the Environmental Justice Conference. The total funding for sustainability conferences in 2005-06 was $50,875 (2005 dollars).

Conference, 2) Holistic Options for Planet Earth Sustainability (HOPES), 3) Public Interest Environmental Law Conference, and 4) the Environmental Justice Conference. The total funding for sustainability conferences in 2005-06 was $50,875 (2005 dollars).

implementation

OUS LEVEL

The Oregon University System (OUS) supports these emissions reduction goals. Many of the actions, particularly building efficiency upgrades and renewable energy projects, will be coordinated across all seven campuses. Already a centralized coordinator has been supporting planning efforts by funding consultancies and increasing communication between institutions. OUS has also convened a central, board-level sustainability committee to develop a shared academic and operational vision and identify corresponding funding.[68] This cooperation and coordination will remain a key part of our activities.

STRATEGIC PLANNING

All efforts must be made to ensure that the actions taken as part of this CAP harmonize with the mission of the University, as this describes the primary purpose of the institution. Each potential action should be evaluated against the criteria set forth in the UO Mission Statement.[69]

The CAP must also integrate with existing strategic plans for the University. There are a wide range of policies and guidelines that have been established and agreed upon by various units within the campus community. For this plan to be effective it must not conflict with the goals and trajectories already set forth, but rather seek to encourage shared ideas and language. For example, the OUS Green Development Goals recommend that all campus Master Plans and policy documents include an energy plan[70]. The University of Oregon expects to develop a process to cultivate this participation and cooperative planning.

Fortunately, the UO already uses a very progressive framework for planning purposes. The ***Campus Plan*** (2005) establishes a framework of patterns and policies that guides all campus development. Special effort will be made to ensure that this CAP is well coordinated with the ***Campus Plan’***s policies and patterns related to the UO’s long-standing environmental commitment. Of particular relevance is:

- ***Campus Plan*** Policy 10: Sustainable Development (one of the twelve primary ***Campus Plan*** policies), and
- the Sustainable Development Plan (a separate document containing a series of patterns related to sustainable development).

The planning framework stems from the principles set forth in Christopher Alexander’s book The Oregon Experiment, which call for the direct involvement of campus users and the use of a shared language in the development of planning practices. Planning decisions are made by following a process rather than relying on an established image of the campus. ***Campus Plan*** provisions go well beyond what is typical for meaningful input from students, faculty, staff, and others. In addition, the ***Campus Plan*** integrates Alexander’s “Pattern Language” to provide a non-technical vocabulary of design principles (known as patterns) that allow building users to communicate effectively with the planners and designers of those buildings. Patterns are design statements that describe and analyze design issues and suggest ways to resolve them. Thus, individual projects are not mandated to accomplish goals in specific ways, but rather held to the pattern, leaving each project open to finding the best way to fulfill the criteria.[71]

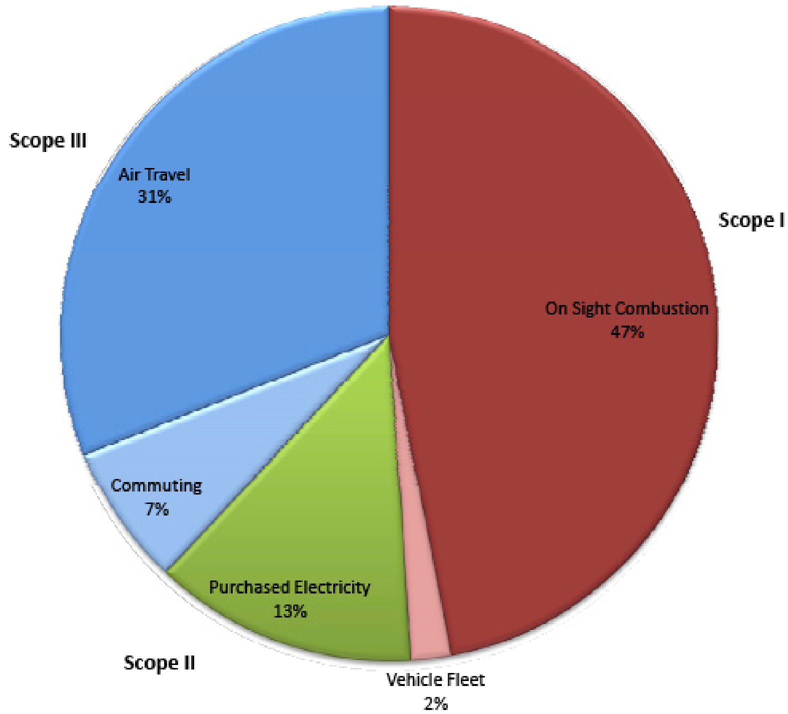
One example applicable to the CAP is establishing the pattern that building designs will maximize use of passive systems and take advantage of the interactions between separate building elements, such as windows, lighting, and mechanical systems.

COMMUNICATIONS

In order to make this effort highly visible, participatory, and exciting across campus, a well-coordinated communications campaign must be launched and sustained. Such a strategy will make our Climate Action Plan more effective overall, and help the University gain the recognition it deserves for undertaking such a commitment. Key elements should include:

- A strong statement from senior leadership to make it known that carbon neutrality is an institutional priority
- Internal directives and encouragement from vice presidents and deans to their units
- Development of an emissions monitoring and reporting plan that offers reliable, sufficiently granular, and frequently updated emissions data for UO buildings and air travel
- A widely-known and user friendly outlet for faculty and students to link research and course work into emissions reduction and monitoring efforts
- Broad-based educational campaigns to inform campus users of important behavior changes to reduce individual carbon footprints
- External communications to achieve recognition of UO’s commitment with potential students, alumni, and donors, as well as to encourage similar efforts in other institutions, municipalities, etc.

personal commitment



As demonstrated by the emissions pie chart, there is a significant need for each of us to change our behavior. Success at all scales depends on it. There are many important actions individuals can take to reduce institutional emissions. Reduce air travel wherever possible, riding a bike or using public transportation rather than driving to campus, wearing a sweater and turning down the office thermostat, and of course turning lights and appliances off when leaving the room. For more ideas see the EPA's Individual Emissions page: http://www.epa.gov/climatechange/emissions/individual.html.)

Departments/units interested in learning more about what they can do to reduce their emissions, please contact the Office of Sustainability.

TIMELINE

McKinstry recommends that the retro commissioning, operations consolidation, and conservation projects be implemented first, over the next five years. These projects provide the best opportunity for cost-effective implementation, and will generate immediate energy and carbon savings, while improving operations and addressing maintenance needs and occupant comfort. Upgrades to the Central Power Station are already underway, and UO is in a unique position to realize a large-scale renewable project in the near future. Preliminary budgeting and design has started on this project and it will most likely be competed in the next five to ten years.

Communications regarding CAP implementation and results will commence immediately. An annual report will be produced and made publicly available on the UO Sustainability website.

appendix 1: definitions of key terms

American College and University Presidents Climate Commitment (ACUPCC) is an effort to encourage commitments from institutions of higher learning to neutralize greenhouse gas emissions and prioritize the research and education efforts aimed at stabilizing earth's climate.

Carbon dioxide (CO_2) means the chemical compound containing one atom of carbon and two atoms of oxygen.

Carbon dioxide equivalent (CO_2e) represents the quantity of a greenhouse gas multiplied by a Global Warming Potential (GWP) factor, relative to CO_2. This is the "standard unit" used to quantify various greenhouse gasses. Also represented as $MTeCO_2$ or metric ton of CO_2e.

Global Warming Potential factor (GWP) means the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of carbon dioxide over a given period of time. For instance, methane (CH_4) has a GWP of 23, meaning that every gram of methane will trap 23 times as much solar radiation as a gram of CO_2.

Greenhouse gas (GHG) is any gas that contributes to anthropogenic global warming including, but not limited to, carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

Intergovernmental Panel on Climate Change (IPCC) is a scientific body established to provide policymakers with an objective source of information on climate change. The IPCC performs no research nor does it monitor climate data; it instead offers analysis of research and climate data as an objective body with a broad range of views, expertise and wide geographical coverage.

Metric ton, tonne, or metric tonne (mt) means one metric tonne (1000 kilograms) or 2204.62 pounds.

Net emissions is the calculated sum of GHGs emitted minus renewable energy certificates, composting activities and carbon offsets.

Renewable Energy Credit (REC) is a tradable certificate that represents a unit of energy produced by renewable energy sources. The owner of a REC can claim that they are using renewable energy equal to the amount of RECs owned.

Renewable energy source means any source of energy that is replenished rapidly by natural processes. Renewable sources may include, but are not limited to, wind, solar, hydroelectric, biomass, geothermal, tidal or sea currents etc.

Total emissions or Gross emissions is the calculated sum of GHGs emitted due to University of Oregon activities.

appendix 2: office of sustainability GHG calculation methods

TRAVEL

The data for the air travel GHG emission was gathered through interviews with the travel coordinator on the University. Data were either provided as a total cost line item or in the form of total air miles. In order to calculate the GHG emissions from total cost the following steps were taken:

- The website: http://www.airlines.org/economics/finance/PaPricesYield.htm was used.
- This site calculated the average cost per air mile for the given year (not including taxes).
- The total cost was divided by the average cost per air mile, resulting in the total air miles.

To calculate GHG emissions from total air miles:

- The website (http://www.carbonfund.org/site/pages/carbon_calculators/category/Assumptions) was used.
- Their calculations revealed the average amount of carbon emissions produced by a single air mile averages 0.21 kg/mi, the equivalent of 0.463 lbs/mi.
- The total air miles were then multiplied by 0.463 lbs/mi resulting in the total amount of carbon emissions produced.

Note: Radiative Forcing

According to the Intergovernmental Panel on Climate Change (IPCC), air travel's actual contribution to climate change is potentially several times higher than would be captured by looking at carbon emissions alone. This is because other effects of air travel, including upper atmosphere emissions of NOx and the formation of contrails, also contribute to climate change. To account for this extra contribution many institutions multiply their carbon emissions from air travel by what is known as a radiative forcing factor. The Clean Air-Cool Planet Campus Carbon Calculator incorporates a radiative forcing factor of 2.8, which is derived from IPCC's best estimates of the ratio of total radiative forcing from air travel to that from CO_2 emissions alone.

To calculate radiative forcing, simply multiply the total carbon emissions by a factor of 2.8.

RECYCLING

Recyclable material is collected and sorted by students and staff around the campus. The material is then sent to various sources including Sanipac, Lane County Waste Management, BRING Recycling, OBRC and International Paper. The Recycling Center is then given receipts that include the tons of materials recycled. This data was then input into the United States Environmental Protection Agency's WAste Reduction Model (WARM) which calculates the amount of GHG emitted.

COMPOST

All organic debris from around campus is collected and stored. This includes branches, leaves, prunings, sticks, weeds, and even trees that have been removed where the wood cannot be milled and recycled. The material is amassed over a couple of months then ground up and moved to a compost pile. The tonnage is calculated by using a cubic yard measurement with a density multiplier.

TREES

Campus trees data was obtained from Facilities Management. The trees were sorted by type, the age was calculated and then a growth rate was determined based on US Department of Energy (DOE) data. Then using the DOE's calculators the amount of carbon and then carbon dioxide sequestration were determined for each tree. The sum of the individuals was then calculated. Some important information was missing from the data so all estimations were based on the most conservative calculations available. Additionally, Facilities Management does not have accurate planting records for most trees planted before 1993. All trees that do not have a planting date were calculated at the age of 15 years old providing a conservative estimate.

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To calculate radiative forcing, simply multiply the total carbon emissions by a factor of 2.8.

appendix 3: carbon offset purchase guidelines

The University of Oregon is a signatory to the American College and University Presidents Climate Commitment (ACUPCC). As such, the University is responsible for neutralizing carbon emissions from the campus energy plant, purchased electricity, all university funded air travel, and emissions resulting from faculty, staff and students' daily commute.

The University may find it necessary to purchase carbon offset credits on the free market to reduce these greenhouse gas emissions. When this occurs, the University will follow the current ACUPCC Voluntary Carbon Offset Protocol (see appendix).

Additional guidelines for purchasing carbon offset credits and the situations that will trigger the need to purchase offset credits are given below:

I. Given the status of the University of Oregon as a public institution of higher education in the state of Oregon, the following additional guidelines are important considerations for the selection of carbon offset credits to be purchased. The offset projects should meet as many of the following guidelines as possible prior to consideration of cost:

(i) The projects offer educational benefits to UO faculty and/or students in the execution, impact, or monitoring thereof.

(ii) The carbon offset projects are based in Oregon.

(iii) The projects are public in nature, with ancillary beneficiaries being the broadest public possible.

II. The following situations may trigger the decision to purchase carbon offset credits:

(i) There are greenhouse gas emissions due to campus activity for which current technologies offer no means of elimination; or

(ii) The university exhausts all opportunities to reduce emissions directly, including switching to carbon free sources of energy, efficiency upgrades, and conservation initiatives, yet needs to further reduce its emissions under the ACUPCC; or

(iii) Interim carbon reduction goals are not being met through direct emissions reduction initiatives; or

(iv) The point at which the cost of further eliminating greenhouse gas emissions for which the University has accepted responsibility are substantially higher when compared to the costs of reducing emissions by purchase of equivalent carbon offsets; or

(v) ACUPCC changes policy to allow signatories to buy offsets in the current year and credit them to a future year (i.e. a banking system). These offsets can only be credited when one of the above situations occurs.

appendix 4: text of the American College & University Presidents' Climate Commitment

We, the undersigned presidents and chancellors of colleges and universities, are deeply concerned about the unprecedented scale and speed of global warming and its potential for large-scale, adverse health, social, economic and ecological effects. We recognize the scientific consensus that global warming is real and is largely being caused by humans. We further recognize the need to reduce the global emission of greenhouse gases by 80% by mid-century at the latest, in order to avert the worst impacts of global warming and to reestablish the more stable climatic conditions that have made human progress over the last 10,000 years possible.

While we understand that there might be short-term challenges associated with this effort, we believe that there will be great short-, medium-, and long-term economic, health, social and environmental benefits, including achieving energy independence for the U.S. as quickly as possible.

We believe colleges and universities must exercise leadership in their communities and throughout society by modeling ways to minimize global warming emissions, and by providing the knowledge and the educated graduates to achieve climate neutrality. Campuses that address the climate challenge by reducing global warming emissions and by integrating sustainability into their curriculum will better serve their students and meet their social mandate to help create a thriving, ethical and civil society. These colleges and universities will be providing students with the knowledge and skills needed to address the critical, systemic challenges faced by the world in this new century and enable them to benefit from the economic opportunities that will arise as a result of solutions they develop.

We further believe that colleges and universities that exert leadership in addressing climate change will stabilize and reduce their long-term energy costs, attract excellent students and faculty, attract new sources of funding, and increase the support of alumni and local communities. Accordingly, we commit our institutions to taking the following steps in pursuit of climate neutrality.

1. Initiate the development of a comprehensive plan to achieve climate neutrality as soon as possible.
    a. Within two months of signing this document, create institutional structures to guide the development and implementation of the plan.
    b. Within one year of signing this document, complete a comprehensive inventory of all greenhouse gas emissions (including emissions from electricity, heating, commuting, and air travel) and update the inventory every other year thereafter.
    c. Within two years of signing this document, develop an institutional action plan for becoming climate neutral, which will include:
        i. A target date for achieving climate neutrality as soon as possible.
        ii. Interim targets for goals and actions that will lead to climate neutrality.
        iii. Actions to make climate neutrality and sustainability a part of the curriculum and other educational experience for all students.
        iv. Actions to expand research or other efforts necessary to achieve climate neutrality.
        v. Mechanisms for tracking progress on goals and actions.
2. Initiate two or more of the following tangible actions to reduce greenhouse gases while the more comprehensive plan is being developed.
    a. Establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent.
    b. Adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist.
    c. Establish a policy of offsetting all greenhouse gas emissions generated by air travel paid for by our institution.
    d. Encourage use of and provide access to public transportation for all faculty, staff, students and visitors at our institution.
    e. Within one year of signing this document, begin purchasing or producing at least 15% of our institution's electricity consumption from renewable sources.
    f. Establish a policy or a committee that supports climate and sustainability shareholder proposals at companies where our institution's endowment is invested.
    g. Participate in the Waste Minimization component of the national RecycleMania competition, and adopt 3 or more associated measures to reduce waste.

3. Make the action plan, inventory, and periodic progress reports publicly available by providing them to the Association for the Advancement of Sustainability in Higher Education (AASHE) for posting and dissemination.

In recognition of the need to build support for this effort among college and university administrations across America, we will encourage other presidents to join this effort and become signatories to this commitment.

Signed,

The Signatories of the American College & University Presidents Climate Commitment

appendix 5: detailed building proxy analysis

U of O Building Description

Campus	U of O	U of O	U of O	U of O	U of O	U of O	U of O
Building Name	Klamath	Cascade	Straub	Millrace 1	McKenzie	PLC	Condon
Building Proxy Category	Science/ Research	Science/ Research	Academic	Academic	Academic	Academic	Academic
Construction Year	1967	1988	1929, 2002	1986	1970	1963, 1968	1925
Renovation Year	-	-	-	-	-	-	-
Square Feet	166,969	50,950	82,472	8,669	82,797	108,887	42,269
# Levels	4	3	4	2	2	9 in main 4 in south 1 story auditorium	3
Construction Type	Brick Facade	Brick Facade	Brick Facade	Wood Frame, Wood Siding, Shingle Roof	Steel and Concrete Frame, Brick Facade	Steel Frame, Glass and Tile Facade	Brick Facade
Lighting Systems	T-8	T-8, T-12, CFL	T-8, T-12, Various	T-8, Various	T-8, T-12, Various	T-8	T-8, T-12
Air Handling Systems	VAV AHUs	VAV AHUs	CV MZ AHUs	Stand Alone DX Split AC for Computer Labs	CV MZ AHUs, VAV AHUs, DD CV AHU	MZ AHUs, VAV VFD AHUs	New: DD VAV VFD AHU*, Old: VAV? AHU
Heating Source	Central Steam to HW	Central Steam to HW	Central Steam to HW	Electric Baseboard	Central Steam to HW	Central Steam to HW	Central Steam to HW
Cooling Source	Central CHW	Central CHW	Central CHW Independent DX AC	None	Central CHW	Central CHW	Central CHW
Controls	Pneumatic, DDC Siemens	Pneumatic, DDC Siemens	Pneumatic, Stand Alone DDC	Stand Alone	Pneumatic, DDC Siemens	Pneumatic, DDC Siemens	Pneumatic, DDC Siemens
Hours of Operation	Assume 18hrs of Operation per Proxy Age	Fans 1, 2,4: 6am-10pm 7 days. 24/7 Fans 3, 5, 6	Assume 18hrs of Operation Per Proxy Avgs	Assume 18hrs of Operation Per Proxy Avgs	Assume 18hrs of Operation Per Proxy Avgs	Assume 18hrs of Operation Per Proxy Avgs	M-F: 7am-10pm, S-Su: 7am-5pm
Use	Classrooms, Lab	Classrooms, Lab	Classrooms, Office	Art Studios, Classrooms	Classrooms	Library, Classrooms	Classrooms
Orientation	NSEW	NSEW	WNS	NS	EWNS	EWNS	EWNS
Climate Zone	2 - Willamette Valley	2 - Willamette Valley	2 - Willamette Valley	2 - Willamette Valley	2 - Willamette Valley	2 - Willamette Valley	2 - Willamette Valley
Comments			MRI Area has Own Chiller and AHU		Poorly Insulated		*Custom Setup

U of O Building Description Continued

Campus	U of O	U of O	U of O	U of O	U of O
Building Name	Knight Law	Carson	Earl	Campbell	Klamath
Building Proxy Category	Academic	Residential	Residential	Administrative	Science/Research
Construction Year	1999	1949	1954	1921	2009
Renovation Year	-	-	-	-	-
Square Feet	148,611	96,174	80,178	20,284	62,421
# Levels	4	5 story main 2 story Dining Hall	4	3	3.1
Construction Type	Steel Frame, Concrete & Brick	Brick Facade	Brick Facade	Brick Facade	Brick Facade
Lighting Systems	T-8, Various	T-8, T-12, Various	T-8, T-12, Various	T-8, T-12	T-9
Air Handling Systems	VAV VFD AHUs	VAV AHUs, RTUs	CV MZ AHU for Common Areas Only	None, Operable Windows	VAV AHUs
Heating Source	Central Steam to HW	Central Steam to HW	Central Steam to HW	Central Steam to HW	Central Steam to HW
Cooling Source	Central CHW	Electric Chiller for Kitchen/Commons	None	None	Central CHW
Controls	Pneumatic, DDC Siemens	Pneumatic, Stand Alone DDC	Pneumatic	Pneumatic, DDC Siemens	Pneumatic, DDC Siemens
Hours of Operation	Assume 18hrs of Operation per Proxy Avgs	Assume 18hrs of Operation per Proxy Avgs	Assume 18hrs of Operation per Proxy Avgs	7am-6pm M-F Year Round	Assume 18hrs of Operation per Proxy Avgs
Use	Classrooms, Library	Dormitory, Dining Hall	Dormitory	Office	Classrooms, Lab
Orientation	EWNS	NSEW	ENS	NSEW	NSEW
Climate Zone	2-Willamette Valley	2-Willamette Valley	2-Willamette Valley	2-Willamette Valley	2-Willamette Valley
Comments		Major Kitchen			

The following tables provides a list of all measures identified in the buildings surveyed for U of O.

Building	FIM	Measure Desc	Therm Savings	kWh Savings	Total Cost Savings	Project Cost	SPB	Measure Life	Annual lbs. CO_2e Reduced	Annual MTCDE Reduced	Project Life MTCDE Savings	Measure Life Cost Savings	First Cost per MTCDE Reduced	First Cost/ Measure Life MTCDE Reduced	$50/ MTCDE Off-Set Purchase Cost
Campbell	9.13-CAM	Lighting Throughout	0	15,352	$611	$7,302	12	15	2,763	1	19	$9,160	$5,824	$388	$940
Campbell	9.12-CAM	Lighting Occupancy Sensors	0	18,615	$740	$18,252	25	15	3,351	2	23	$11,107	$12,006	$800	$1,140
Campbell	1.11-CAM	Steam Trap repairs	317	0	$257	$1,002	4	10	3,709	2	17	$2,570	$596	$60	$841
Campbell	13.02-CAM	Roof Insulation	456	715	$398	$14,909	37	24	5,469	2	60	$9,548	$6,008	$250	$2,978
Campbell	13.12-CAM	Windows	609	715	$521	$46,800	90	24	7,250	3	79	$12,509	$14,228	$593	$3,947
Totals			1,382	35,397	$2,527	$88,265	35		22,542	10	179	$44,894	$8,630	$448	$9,847

Building	FIM	Measure Desc	Therm Savings	kWh Savings	Total Cost Savings	Project Cost	SPB	Measure Life	Annual lbs. CO_2e Reduced	Annual MTCDE Reduced	Project Life MTCDE Savings	Measure Life Cost Savings	First Cost per MTCDE Reduced	First Cost/ Measure Life MTCDE Reduced	$50/ MTCDE Off-Set Purchase Cost
Carson	8.01-CAR	Premium Efficiency Motors	0	3,099	$120	$8,884	74	5	558	0	1	$601	$35,102	$7,020	$63
Carson	9.01-CAR	Add exterior lighting photocell	0	5,055	$196	$600	3	15	910	0	6	$2,940	$1,453	$97	$310
Carson	3.06-CAR	Install VFD on Fan motors	0	18,332	$711	$29,019	41	18	3,300	1	27	$12,793	$19,382	$1,077	$1,347
Carson	3.33-CAR	Insulate Piping	112	0	$91	$2,998	33	20	1,312	1	12	$1,818	$5,037	$252	$595
Carson	4.05-CAR	Demand Control Ventilation	556	0	$451	$7,200	16	15	6,505	3	44	$6,762	$2,439	$163	$2,214
Carson	25.05-CAR	Manage Building Level Operations Based on Seasonal and Day of the Week	968	21,629	$1,624	$1,200	1	5	15,220	7	35	$8,118	$174	$35	$1,726
Carson	4.07-CAR	Retro-Commis-sioning	2,494	1,996	$2,098	$57,600	27	15	29,528	13	201	$31,470	$4,299	$287	$10,048
Carson	13.02-CAR	Roof Insulation	3,990	393	$3,250	$66,960	21	24	46,750	21	509	$78,001	$3,157	$132	$25,454
Totals			8,119	50,475	$8,540	$174,461	20		104,083	47	835	$142,503	$3,694	$209	$41,757

Building	FIM	Measure Desc	Therm Savings	kWh Savings	Total Cost Savings	Project Cost	SPB	Measure Life	Annual lbs. CO_2e Reduced	Annual MTCDE Reduced	Project Life MTCDE Savings	Measure Life Cost Savings	First Cost per MTCDE Reduced	First Cost/ Measure Life MTCDE Reduced	$50/ MTCDE Off-Set Purchase Cost
Cascade	9.12-CAS	Lighting Occupancy Sensors	0	13,390	$526	$7,642	15	15	2,410	1	16	$7,888	$6,988	$466	$820
Cascade	8.01-CAS	Premium Efficiency Motors	0	26,876	$1,042	$41,364	40	18	4,838	2	40	$18,758	$18,843	$1,047	$1,976
Cascade	3.18-CAS	Pump VFDs on CW / HW loop	0	27,844	$1,079	$44,040	41	18	5,012	2	41	$19,431	$19,367	$1,076	$2,047
Cascade	1.11-CAS	Steam Trap repairs	675	0	$547	$4,009	7	10	7,898	4	36	$5,473	$1,119	$112	$1,792
Cascade	25.05-CAS	Manage Building Level Operations Based on Seasonal and Day of Week	1,071	54,992	$3,000	$1,200	0	5	22,424	10	51	$15,000	$118	$24	$2,544
Cascade	25.02-CAS	Retro-Commis-sioning	2,821	75,889	$5,229	$48,912	9	5	46,661	21	106	$26,146	$2,310	$462	$5,293
Cascade	13.02-CAS	Roof Insulation	4,929	4,072	$4,154	$81,518	20	24	58,399	26	636	$99,698	$3,077	$128	$31,796
Totals			**11,807**	**237,477**	**$19,790**	**$277,596**	**14**		**1176,557**	**80**	**991**	**$213,453**	**$3,465**	**$280**	**$49,547**

Building	FIM	Measure Desc	Therm Savings	kWh Savings	Total Cost Savings	Project Cost	SPB	Measure Life	Annual lbs. CO_2e Reduced	Annual MTCDE Reduced	Project Life MTCDE Savings	Measure Life Cost Savings	First Cost per MTCDE Reduced	First Cost/ Measure Life MTCDE Reduced	$50/ MTCDE Off-Set Purchase Cost
Condon	8.01-CON	Premium Efficiency Motors	0	6,932	$269	$7,044	26	18	1,248	1	10	$4,838	$12,442	$691	$510
Condon	9.12-CON	Lighting Occupancy Sensors	0	7,954	$312	$4,544	15	15	1,432	1	10	$4,686	$6,996	$466	$487
Condon	1.11-CON	Steam Trap repairs	321	0	$260	$1,002	4	10	3,755	2	17	$2,602	$588	$59	$852
Condon	25.02-CON	Retro-Commis-sioning	472	20,937	$1,194	$18,161	15	5	9,288	4	21	$5,971	$4,310	$862	$1,054
Condon	25.05-CON	Manage Building Level Operations Based on Seasonal and Day of Week	472	26,172	$1,397	$1,200	1	5	10,230	5	23	$6,986	$259	$52	$1,160
Condon	4.07-CON	Control System Upgrade	770	39,325	$2,149	$36,000	17	15	16,093	7	110	$32,240	$4,930	$329	$5,476
Condon	4.05-CON	Demand Control Ventilation	1,310	0	$1,062	$7,200	7	15	15,327	7	104	$15,932	$1,035	$69	$5,216
Totals			**3,345**	**101,320**	**$6,644**	**$75,152**	**11**		**57,372**	**26**	**295**	**$73,254**	**$2,887**	**$255**	**$14,754**

Building	FIM	Measure Desc	Therm Savings	kWh Savings	Total Cost Savings	Project Cost	SPB	Measure Life	Annual lbs. CO_2e Reduced	Annual MTCDE Reduced	Project Life MTCDE Savings	Measure Life Cost Savings	First Cost per MTCDE Reduced	First Cost/ Measure Life MTCDE Reduced	$50/ MTCDE Off-Set Purchase Cost
Earl	8.01-EAR	Premium Efficiency Motors	0	9,580	$371	$2,115	6	18	1,724	1	14	$6,686	$2,703	$150	$704
Earl	3.33-EAR	Insulate Piping	112	0	$91	$2,169	24	20	1,312	1	12	$1,818	$3,644	$182	$595
Earl	1.11-EAR	Steam Trap repairs	450	0	$365	$1,503	4	10	5,265	2	24	$3,649	$629	$63	$1,194
Earl	25.05-EAR	Manage Building Level Operations Based on Seasonal and Day of Week	1,100	24,588	$1,845	$1,200	1	5	17,300	8	39	$9,227	$153	$31	$1,962
Earl	25.02-EAR	Retro-Commis-sioning	1,834	34,423	$2,822	$48,107	17	5	27,659	13	63	$14,110	$3,833	$767	$3,137
Earl	13.02-EAR	Roof Insulation	2,495	164	$2,029	$48,108	24	5	29,216	13	66	$10,145	$3,629	$726	$3,314
Earl	3.29-EAR	Retrofit AHU with VAV & DCV	2,935	6,557	$2,634	$504,000	191	20	35,517	16	322	$52,675	$31,275	$1,564	$16,115
Earl	13.12-EAR	Windows	3,326	328	$2,709	$159,538	59	24	38,974	18	424	$65,028	$9,022	$376	$21,220
Totals			**12,252**	**75,640**	**$12,867**	**$766,739**	**60**		**156,967**	**71**	**965**	**$163,337**	**$10,766**	**$795**	**$48,242**

Building	FIM	Measure Desc	Therm Savings	kWh Savings	Total Cost Savings	Project Cost	SPB	Measure Life	Annual lbs. CO_2e Reduced	Annual MTCDE Reduced	Project Life MTCDE Savings	Measure Life Cost Savings	First Cost per MTCDE Reduced	First Cost/ Measure Life MTCDE Reduced	$50/ MTCDE Off-Set Purchase Cost
Klamath	9.12-KLA	Lighting Occupancy Sensors	0	21,071	$824	$20,874	25	15	3,793	2	26	$12,130	$12,130	$809	$1,291
Klamath	3.06-KLA	Ilnstall VFD on Fan motors	0	22,228	$862	$17,341	20	18	4,001	2	33	$15,512	$9,553	$531	$1,634
Klamath	9.13-KLA	Lighting Throughout	0	35,109	$1,373	$16,699	12	15	6,320	3	43	$20,595	$5,824	$388	$2,151
Klamath	1.11-KLA	Steam Trap repairs	1,800	0	$1,459	$2,505	2	10	21,060	10	96	$14,594	$262	$26	$4,778
Klamath	25.05-KLA	Manage Building Level Operations Based on Seasonal and Day of Week	3,995	149,418	$9,033	$1,200	0	5	73,646	33	167	$45,164	$36	$7	$8,354
Klamath	25.02-KLA	Retro-Commis-sioning	6,658	209,032	$13,502	$133,597	10	5	115,522	52	262	$67,512	$2,549	$510	$13,104
Klamath	3.29-KLA	Retrofit AHU with VAV & DCV	10,121	11,148	$8,638	$10,800	1	20	120,421	55	1,093	$172,764	$198	$10	$54,637
Klamath	13.02-KLA	Roof Insulation	13,494	11,148	$11,374	$187,871	17	24	159,892	73	1,741	$272,965	$2,590	$108	$87,056
Klamath	3.26-KLA	Replace old hoods with new hoods and controls	39,640	457,083	$49,861	$594,636	12	20	546,063	248	4,955	$997,225	$2,400	$120	$247,760
Totals			**75,709**	**919,239**	**$96,926**	**$985,525**	**10**		**1,050,717**	**477**	**8,415**	**$1,618,690**	**$2,067**	**$117**	**$420,763**

Building	FIM	Measure Desc	Therm Savings	kWh Savings	Total Cost Savings	Project Cost	SPB	Measure Life	Annual lbs. CO_2e Reduced	Annual MTCDE Reduced	Project Life MTCDE Savings	Measure Life Cost Savings	First Cost per MTCDE Reduced	First Cost/ Measure Life MTCDE Reduced	$50/ MTCDE Off-Set Purchase Cost
Knight Law	25.05-KLW	Manage Building Level Operations Based on Seasonal and Day of Week	2,055	69,012	$4,342	$1,200	0	5	36,469	45	227	$21,710	$26	$5	$11,338
Knight Law	25.02-KLW	Retro-Commis-sioning	2,885	96,617	$6,085	$89,167	15	5	51,149	64	318	$30,426	$1,403	$281	$15,884
Totals			**4,941**	**165,629**	**$10,427**	**$90,367**	**9**		**87,618**	**109**	**544**	**$52,136**	**$830**	**$166**	**$27,223**

Building	FIM	Measure Desc	Therm Savings	kWh Savings	Total Cost Savings	Project Cost	SPB	Measure Life	Annual lbs. CO_2e Reduced	Annual MTCDE Reduced	Project Life MTCDE Savings	Measure Life Cost Savings	First Cost per MTCDE Reduced	First Cost/ Measure Life MTCDE Reduced	$50/ MTCDE Off-Set Purchase Cost
Knight Library	9.02-KLB	Day Lighting Controls	0	2,062	$80	$7,200	90	15	371	0	3	$1,204	$42,759	$2,851	$126
Knight Library	16.01-KLB	Vending	0	15,685	$611	$8,340	14	5	2,823	1	6	$3,054	$6,511	$1,302	$320
Knight Library	8.01-KLB	Premium Efficiency Motors	0	47,112	$1,827	$87,747	48	18	8,480	4	69	$32,878	$22,806	$1,267	$3,463
Knight Library	1.11-KLB	Steam Trap repairs	450	0	$365	$1,915	5	10	5,265	2	24	$3,649	$802	$80	$1,194
Knight Library	9.17-KLB	Bi-Level Lighting	0	272,157	$10,597	$77,766	7	15	48,988	22	333	$158,959	$3,499	$233	$16,670
Knight Library	4.07-KLB	Control System Upgrade	5,418	78,452	$7,434	$432,000	58	15	77,507	35	527	$111,512	$12,284	$819	$26,375
Knight Library	13.02-KLB	Roof Insulation	6,587	15,690	$5,949	$235,366	40	24	79,897	36	870	$142,786	$6,493	$271	$43,501
Knight Library	25.02-KLB	Retro-Commis-sioning	4,941	435,843	$20,903	$235,365	11	5	136,256	62	309	$104,517	$3,807	$761	$15,456
Totals			**17,396**	**867,001**	**$47,767**	**$1,085,700**	**23**		**359,588**	**163**	**3,231**	**$558,558**	**$6,655**	**$336**	**$161,551**

Building	FIM	Measure Desc	Therm Savings	kWh Savings	Total Cost Savings	Project Cost	SPB	Measure Life	Annual lbs. CO_2e Reduced	Annual MTCDE Reduced	Project Life MTCDE Savings	Measure Life Cost Savings	First Cost per MTCDE Reduced	First Cost/ Measure Life MTCDE Reduced	$50/ MTCDE Off-Set Purchase Cost
McKenzie	3.33-MCK	Insulate Piping	37	0	$30	$739	24	20	437	0	4	$606	$3,727	$186	$198
McKenzie	8.01-MCK	Premium Efficiency Motors	0	17,332	$672	$23,263	35	18	3,120	1	25	$12,095	$16,435	$913	$1,274
McKenzie	3.17-MCK	Pump VFDs on CW / HW loop	0	20,883	$810	$21,674	27	18	3,759	2	31	$14,573	$12,708	$706	$1,535
McKenzie	25.05-MCK	Manage Building Level Operations Based on Seasonal and Day of Week	462	25,633	$1,368	$1,200	1	5	10,019	5	23	$6,842	$264	$53	$1,136
McKenzie	3.29-MCK	Retrofit AHU with VAV & DCV	968	8,374	$1,109	$39,600	36	20	12,827	6	116	$22,182	$6,842	$340	$5,820
McKenzie	13.02-MCK	Roof Insulation	1,056	1,066	$898	$42,809	48	24	12,552	6	137	$21,549	$7,517	$313	$6,834
McKenzie	1.11-MCK	Steam Trap repairs	1,125	0	$912	$2,375	3	10	13,163	6	60	$9,122	$398	$40	$2,986
McKenzie	13.12-MCK	Windows	1,198	1,333	$1,023	$67,372	66	24	14,253	6	155	$24,546	$10,418	$434	$7,760
McKenzie	4.07-MCK	Control System Upgrade	6,037	53,316	$6,962	$324,000	47	15	80,226	36	546	$104,424	$8,901	$593	$27,300
McKenzie	3.16-MCK	Install DCV for AHU	15,409	136,094	$17,770	$7,200	0	20	204,782	93	1,858	$355,399	$77	$4	$92,914
Totals			**26,292**	**264,030**	**$31,554**	**$530,232**	**17**		**355,137**	**161**	**2,955**	**$571,338**	**$3,291**	**$179**	**$147,758**

Building	FIM	Measure Desc	Therm Savings	kWh Savings	Total Cost Savings	Project Cost	SPB	Measure Life	Annual lbs. CO_2e Reduced	Annual MTCDE Reduced	Project Life MTCDE Savings	Measure Life Cost Savings	First Cost per MTCDE Reduced	First Cost/ Measure Life MTCDE Reduced	$50/ MTCDE Off-Set Purchase Cost
PLC	3.33-PLC	Insulate Piping	150	0	$121	$2,958	24	20	1,749	1	16	$2,424	$3,727	$186	$794
PLC	3.34-PLC	Condensing Gas Furnace	326	0	$264	$6,560	25	15	3,815	2	26	$3,966	$3,789	$253	$1,298
PLC	1.11-PLC	Steam Trap repairs	450	0	$365	$4,009	11	10	5,265	2	24	$3,649	$1,678	$168	$1,194
PLC	25.05-PLC	Manage Building Level Operations Based on Seasonal and Day of Week	810	33,710	$1,964	$1,200	1	5	15,546	7	35	$9,819	$170	$34	$1,763
PLC	25.02-PLC	Retro-Commissioning	1,215	53,936	$3,076	$65,332	21	5	23,926	11	54	$15,382	$6,018	$1,204	$2,714
PLC	13.02-PLC	Roof Insulation	1,985	1,753	$1,677	$55,260	33	24	23,537	11	256	$40,252	$5,175	$216	$12,815
PLC	4.07-PLC	Control System Upgrade	1,985	35,058	$2,968	$72,000	24	15	29,532	13	201	$44,526	$5,373	$358	$10,049
PLC	13.12-PLC	Windows	3,176	3,506	$2,711	$151,123	56	24	37,785	17	411	$65,056	$8,815	$367	$20,573
Totals			**10,096**	**127,963**	**$13,147**	**$358,442**	**27**		**141,154**	**64**	**1,024**	**$185,073**	**$5,597**	**$350**	**$51,200**

Building	FIM	Measure Desc	Therm Savings	kWh Savings	Total Cost Savings	Project Cost	SPB	Measure Life	Annual lbs. CO_2e Reduced	Annual MTCDE Reduced	Project Life MTCDE Savings	Measure Life Cost Savings	First Cost per MTCDE Reduced	First Cost/ Measure Life MTCDE Reduced	$50/ MTCDE Off-Set Purchase Cost
Straub	3.17-STR	Pump VFDs on CW / HW loop	0	8,886	$345	$11,010	32	18	1,600	1	13	$6,201	$15,171	$843	$653
Straub	3.33-STR	Insulate Piping	224	0	$182	$4,437	24	20	2,624	1	24	$3,636	$3,727	$186	$1,190
Straub	1.11-STR	Steam Trap repairs	675	0	$547	$2,505	5	10	7,898	4	36	$5,473	$699	$70	$1,792
Straub	25.05-STR	Manage Building Level Operations Based on Seasonal and Day of Week	920	51,064	$2,726	$1,200	0	5	19,960	9	45	$13,630	$133	$27	$2,264
Straub	13.02-STR	Roof Insulation	1,654	1,328	$1,392	$49,483	36	24	19,586	9	213	$33,412	$5,568	$232	$10,664
Straub	13.12-STR	Windows	1,804	2,655	$1,566	$89,779	57	24	21,583	10	235	$37,573	$9,168	$382	$11,751
Straub	3.29-STR	Retrofit AHU with VAV & DCV	1,804	26,554	$2,492	$65,723	26	5	25,885	12	59	$12,460	$5,596	$1,119	$2,936
Straub	25.02-STR	Retro-Commis-sioning	3,068	71,490	$5,259	$49,483	9	5	48,762	22	111	$26,295	$2,237	$447	$5,531
Totals			**10,149**	**161,978**	**$14,509**	**$273,620**	**19**		**147,897**	**67**	**736**	**$138,682**	**$4,078**	**$372**	**$36,782**

Totals			**181,487**	**3,003,149**	**$264,697**	**$4,706,099**	**18**		**2,659,633**	**1,276**	**20,188**	**$3,761,919**	**$3,689**	**$233**	**$1,009,425**

appendix 6: good company 1990 estimates

1990 GHG BASELINE FOR BUILDING ENERGY USE IN THE OREGON UNIVERSITY SYSTEM

DRAFT VERSION DATE: September 6, 2009

OVERVIEW AND RESULTS

This memo provides an estimate of 1990 building energy use and the associated greenhouse gas (GHG) emissions for Oregon University System's seven institutions. This GHG calculation or "carbon footprint" is accompanied by a sensitivity analysis to scale the uncertainty in the calculation.

The Oregon University System, as part of its climate action planning process, seeks to put its current GHG inventory in the context of past emissions. In particular, Governor Kulongoski has issued an executive order that asks for reductions relative to 1990, the base year for consideration by the Kyoto protocol. While institutions and the system as a whole are free to pursue other more binding goals, there is a pressing need to establish this baseline to ensure compliance with the governor's stated intent. Specifically, there is a focus on building energy use, the single largest source of direct emissions and electricity-related emissions.

Establishing such a baseline is difficult. In the intervening twenty years, few institutions have maintained comprehensive records of facilities operations at this granular level. Many institutions did not, at that time, track energy use in the detail necessary to perform these calculations. Indeed, there have been data-related challenges simply in establishing data for 2004 to the present, much less for 1990.

This memo combines complete recent data, incomplete 1990 data, and a multi-year building energy survey for the Western United States, the Commercial Buildings Energy Consumption Survey (CBECS). In brief, the method assesses the value of CBECS as a proxy for current energy use by OUS institutions, then estimates 1990 use with the resulting proxy values. Energy use corrections are made for changes in building square footage. The energy use data is used to calculate GHG emissions. Corrections are made for the changes in the electricity generation mix (and modest increase in carbon intensity) of the regional grid since 1990.

As a last but crucial step, there is extensive sensitivity analysis to provide a sense of the scale of uncertainty in the estimates. The large range is driven by the lack of complete data for 1990 energy use, as well as the challenges in using CBECS to estimate energy use for specific contexts. This final section indicates potential improvements to the data that are likely to be high-leverage opportunities for narrowing the uncertainty. For more, please see the source spreadsheets that contain all original data, estimated data and calculations.

In highest-level summary, the resulting emissions were calculated as follows:

Table 1: Comparison of 2008 GHG emissions to estimated 1990 emissions baseline with uncertainty range.

2008 Building Energy Emissions	1990 Baseline Building Energy Emissions	1990- High Estimate	1990 - Low Estimate
188,779 MT CO_2e*	153,187 MT CO_2e	(17% above point estimate)	(23% below point estimate)

**values include natural gas and electricity emissions (regional emissions factor) taken from Sightlines GHG inventory.*

Greenhouse gas emissions from building energy use in 2008 were about 23% higher than the 1990 baseline. In other words, OUS institutions must, in aggregate reduce 2008 emissions from building energy by about 19% to get back to 1990 levels.

Over the same period, total square footage of the six institutions covered here (excluding WOU) rose 15.4%, from 16.369 million to 18.895 million gross square feet (GSF).

The estimated emissions calculated for each institution are as follows:

Table 2: Summary of 1990 GHG baseline, by OUS institution, with uncertainty range.

OUS Institution	1990 Estimate MT CO_2e	Low Estimate MT CO_2e	High Estimate MT CO_2e
Eastern	6,014	4,484	8,830
Portland State	23,342	20,773	30,394
Southern	10,710	7,969	11,742
Western	9,523	7,098	10,440
U of O	51,537	36,867	56,556
Oregon State	49,855	39,359	58,130
OIT	2,146	1,826	2,436
Totals	**153,187**	118,375	178,528

DESCRIPTION OF METHODS

This method of estimating the 1990 baseline for energy consumption and associated greenhouse gas (GHG) emissions required two primary pieces of information: the average energy intensity (energy use per square foot) of university buildings in 1990 and the emissions factor for electricity produced in the Northwest Power Pool (NWPP).

1990 ENERGY CONSUMPTION BASELINE

Average electricity and natural gas intensity (energy consumed / square foot) statistics are available in the Energy Information Administration's *Commercial Building Energy Consumption Survey (CBECS)*[1]. The survey has been conducted in 2003, 1999, 1995, and 1992. The surveys provide average electricity and natural gas intensities by principal building use for the western census region (everything west of the Rockies from the northern to southern US borders). The principal building types included in the survey, that fit university activities include: education, food service, health care, lodging, office, public assembly and warehouse and storage.

The CBECS statistics were assigned to each university building, by primary building type (as assigned by Sightlines), to estimate electricity and natural gas consumption for 1990, using the intensities reported in the 1992 CBECS survey. Building inventories were assembled for Sightlines' work that included the construction year for all institutions. The CBECS statistics were assigned to buildings constructed prior to 1990 (so building constructed in 1989 were included but those constructed in 1990 were not) to estimate electricity and natural gas consumption.

The CBECS building type classified as "health care" was assigned to those buildings classified by Sightlines as "scientific research" buildings. The CBECS statistics do not capture the function of a university scientific research building in any of their primary building categories. McKinstry recently measured energy consumption for scientific research buildings on a number of OUS campuses; when averaged, these measured EUI values are most comparable to the CBECS statistics for the "health care" category.

1990 EMISSIONS FACTORS

Electricity - The factors needed to calculate the emissions factor for the electricity produced in the Northwest Power Pool (NWPP) subregion are provided in a Washington State - Department of Community, Trade & Economic Development (CTED) report titled *Methodology for Estimating 1990 Electricity Load-based Emissions for Washington State*[2]. The report provides the NWPP's 1990 total electricity generation and the associated emissions with that generation. The total 1990 NWPP emissions are divided by the total 1990 electricity generation to determine the 1990 emissions factor (MT CO_2 / MWh). This method results in a 1990 emissions factor of 0.3179 MT CO_2 / MWh. For comparison, the most recent eGRID value for the NWPP is 0.4093 MT CO_2 / MWh.

The 1990 emissions factors for methane (CH_4) and nitrous oxide (N_2O) are not estimated in the CTED report, so these emissions are estimated using the 2006 U.S. EPA eGRID values. It is acknowledged that these values may differ from actual 1990 values, but will still be very small compared to the CO_2 emissions factor.

[1] The Commercial Buildings Energy Consumption Survey (CBECS) is a national sample survey that collects information on the stock of U.S. commercial buildings, their energy-related building characteristics, and their energy consumption and expenditures. Commercial buildings include all buildings in which at least half of the floor space is used for a purpose that is not residential, industrial, or agricultural, so they include building types that might not traditionally be considered "commercial," such as schools, correctional institutions, and buildings used for religious worship. The CBECS website is accessed at: http://www.eia.doe.gov/emeu/cbecs/

[2] The CTED report may be accessed online at: http://www.ecy.wa.gov/climatechange/TWGdocs/ene/1990WALoad-basedElectricitysectoremissions.pdf

Table 2: Comparison of CBECS electricity and natural gas statistics for 1992 and 2003.

Principal Building Activity	1992 - Electric Energy Intensity kWh / ft²	2003 - Electric Energy Intensity kWh / ft²	1992 - Natural Gas Energy Intensity ft³ / ft²	2003 - Natural Gas Energy Intensity ft³ / ft²	1992 - Energy Use Intensity kBTU / ft²	2003 - Energy Use Intensity kBTU / ft²
Education	10.9	10.2	36.6	39.6	74.5	75.2
Food Sales	49.8	**49.8**	N/A	N/A	N/A*	N/A*
Food Service	45.3	31.9	189.1	**189.1**	347.4	301.7
Health Care	19.7	22.5	59.8	86.1	128.2	164.6
Lodging	28	14.7	90.4	56.6	187.7	107.9
Retail (other than mall)	10.8	14.8	38.2	18.3	75.8	69.2
Office	17.4	15	28.2	23	88.1	74.6
Public Assembly	12.7	16	41.5	32.4	85.7	87.6
Public Order and Safety	N/A	N/A	N/A	N/A	N/A	N/A
Religious Worship	2.5	3.6	17.2	18.1	26.1	30.7
Service	**11.4**	11.4	N/A	N/A	N/A*	N/A*
Warehouse and Storage	6.3	7.3	14.5	**14.5**	36.3	39.7
Other	15.6	**15.6**	N/A	N/A	N/A*	N/A*
Vacant	6.8	**6.8**	28.6	**28.6**	52.4	23.2
Parking Garage	6.5	**6.5**	N/A	N/A	N/A*	N/A

Note: Bold values on the table indicate where 1992 data was substituted for a value that was missing from the 2003 survey. Values for some categories (in this case some principal building types) are not reported for some surveys due lack of data. * Indicates that N/A means Not Applicable, where elsewhere it indicates that the data was not collected during the survey.

Natural Gas – The emissions factors are taken from The Climate Registry's General *Reporting Protocol (version 1.1)*[3]. The emissions factors used in this analysis were published in 2008. It is used for this analysis with the assumption that the heat and carbon content of natural gas is not significantly different from 1990. The carbon dioxide (CO_2) emissions factor is a weighted U.S. average based on the heat and carbon contents of the natural gas (page 74). The methane (CH_4) and nitrous oxide (N_2O) emissions factors are for a commercial-sector boiler (page 80). The GHG emissions factor used in this analysis for natural gas is 53.36 kg CO_2e / MMBTU.

Wood and Wood Waste (12% moisture) – The University of Oregon used wood waste as fuel in 1990 which as since been replaced by natural gas. Based on interviews with the operations staff, it is assumed that 100% of the 1990 heat content as estimated by CBECS for natural gas was actually produced by wood waste. UO was not the biggest estimated user of natural gas in 1990, but the usage made up 18% of the total estimated 1990 energy consumption.

Emissions for UO were calculated using a wood waste emissions factor. This emissions factor only takes into account "tailpipe" emissions, not life-cycle emissions, and as such is almost double the GHG emissions per MMBTU compared to natural gas. This method is being used per California Climate Action Registry's *Power Generation/Electric Utility Reporting Protocol*. As of this writing, policy consensus on the net impact on climate from the combustion of biofuels has not yet been reached. In the absence of detailed information on the sources of the wood waste, it is inappropriate to make assumptions about the forest practices that led to this energy feedstock. Accordingly, this analysis draws on default emissions factors from high-consensus protocols.

The emissions factors for wood and wood waste are taken from The Climate Registry's *General Reporting Protocol (version 1.1)*[3]. The emissions factors used in this analysis were published in 2008. It is used for this analysis with the assumption that the heat and carbon content of wood and wood waste is not significantly different from 1990. The carbon dioxide (CO_2) emissions factor is a based on the heat and carbon contents of the wood and wood waste (page 74). The methane (CH_4) and nitrous oxide (N_20) emissions factors are for a commercial-sector technology (page 80).The GHG emissions factor used in this analysis for wood waste is 93.22 kg CO_2e / MMBTU.

[3] The Climate Registry, General Reporting Protocol may be downloaded at: http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/

DESCRIPTION OF CALCULATIONS

The following equations represent the proposed method of estimating 1990 energy consumption for the OUS system and the associated GHG emissions. Figure 1 shows this method for in general terms for total energy consumption (electricity and natural gas). Figures 2 shows the specific equations used for electricity and natural gas respectively.

Figure 1: General formula and description of variables used to estimate 1990 emissions.

$$\text{GHGs}_{\text{total energy use}} = \frac{\text{GHGs}}{\text{units of energy}} \times \frac{\text{unit of energy}}{\text{ft}^2} \times \text{ft}^2$$

Variable	Variable Description
GHGs	An estimate of greenhouse gases generated from total energy consumption during the 1990 fiscal year.
GHGs/ unit of energy	This term represents the emissions factor for all energy consumed regardless of type. In practice a separate emissions factor will be used for electricity and natural gas.
Unit of energy / square footage	This term represents the CBECS statistics used to estimate 1990 energy consumption (for electricity and natural gas) for each campus.These statistics are specific to the western census region and the primary building type. For more information see the 1990 Energy Consumption Baseline section of this report.
Square footage	Existing building data provided to Sightlines by each institution will be used to determine 1990 building square footage by primary building type.

Figure 2a: Formula and description of variables to estimate electricity emissions.

$$\text{GHGs}_{\text{electricity use}} = \frac{\text{GHGs}}{\text{kWH}} \times \frac{\text{kWh}}{\text{ft}^2} \times \text{ft}^2$$

Variable	Variable Description
GHGs	An estimate of greenhouse gases generated from electricity during the 1990 fiscal year.
GHGs/ kWh	This term represents the emissions factor for all electricity. The 1990 emissions factor for the Northwest Power Pool (NWPP) is taken from a CTED report. See the Emissions Factors section of this memo for more detail.
kWh / ft^2	This term represents the CBECS statistics used to estimate 1990 electricity consumption for each campus.These statistics are specific to the western census region and the primary building type. For more information see the 1990 Energy Consumption Baseline section of this report.
ft^2	Existing building data provided to Sightlines by each institution will be used to determine 1990 building square footage by primary building type.

Figure 2b: Formula and description of variables to estimate natural gas emissions.

$$\text{GHGs}_{\text{natural gas/wood waste use}} = \frac{\text{GHGs}}{\text{ft}^3} \times \frac{\text{ft}^3}{\text{ft}^2} \times \text{ft}^2$$

Variable	Variable Description
GHGs	An estimate of greenhouse gases generated from natural gas or wood waste during the 1990 fiscal year.
GHGs/ ft^3	This term represents the emissions factor for natural gas. The 1990 emissions factor for natural gas and wood or wood waste is taken from The Climate Registry *General Reporting Protocol (version 1.1)*. These emissions factors are not specific to 1990, but the current value for both are assumed to be equal to the 1990 value. We assume the current heat and carbon content of natural gas and wood in 2009 is very similar to 1990.
ft^3 / ft^2	This term represents the CBECS statistics used to estimate 1990 natural gas consumption for each campus. These statistics are specific to the western census region and the primary building type. For more information see the 1990 Energy Consumption Baseline section of this report.
ft^2	Existing building data provided to Sightlines by each institution will be used to determine 1990 building square footage by primary building type.

Figure 2c: Formula for CBECS-based estimate of 1990 emissions for electricity and natural gas.

$$\text{1990 Electricity and Natural Gas Estimate}_{\text{university } i} = \frac{\text{CBECS 1990}_i}{\left(\frac{\text{CBECS 2004}}{\text{Actual 2004}}\right)_i}$$

DATA SOURCES, DATA ISSUES AND SOURCES OF UNCERTAINTY

This method has significant sources of uncertainty, but it is currently the only defensible process for estimating building energy consumption. The only truly accurate method to establish a 1990 consumption baseline is digging into facilities records and / or determining if your utilities retain records from 1990.

The first source of uncertainty is the assumption that electricity and natural gas are consumed at every building included in the Sightlines building inventories. Having a knowledgeable representative from each institution conduct a line-by-line review of the estimation spreadsheet could significantly reduce this source of uncertainty.

A second source of uncertainty is that CBECS statistics are based on averages from the Western region. This means the average energy intensity statistics are most likely skewed by mixing dramatically different climate zones. For example the heating needs of Phoenix or Los Angeles are dramatically different than those in Eugene or Corvallis, which may result in an underestimate of CBECS natural gas intensity statistics when applied to Oregon.

The third source of uncertainty is the inability of the CBECS statistics to account for on-site electricity, steam or chilled water generation. On-site generation could affect the consumption of both electricity and natural gas, depending largely on the extent of co-generation by a campus power plant.

A fourth source is that CBECS provides energy intensity values for electricity and natural gas, but no other sources of fuel. For example, it is known that the University of Oregon consumed hog fuel in 1990 at its campus power plant. With the CBECS statistics it is not possible to estimate the quantity of hog fuel consumed. This is especially significant when calculating emissions. The emissions factor and generation equipment efficiency could be significantly different, but are difficult to account for using this method.

A fifth source of uncertainty lies in the lack of good data for *any* of the institutions, for 1990 or for a nearby proxy year. The estimates for PSU and OSU are based on partial data; those datasets have limitations, but even the limitations are not entirely clear. For example, Oregon State was able to provide 1990 electricity and natural gas consumption, but is currently unable to determine if these values are based on use records or some method of estimation. There is therefore some question about what activities these values actually cover. Second, Portland State provided utilities information for FY1993 that is partial in facilities scope (only 22 buildings out of 50+ buildings in the portfolio in that year) and in time (for certain buildings, several months were missing and had to be interpolated from surrounding months).

Figure 3: Building inventory and energy consumption data availability, by OUS institution.

OUS Institution	1990	2000
Eastern	Data Not Available	Data Complete
Portland State	Partial Data	Data Complete
Southern	Data Not Available	Data Complete
Western	Data Not Available	Partial Data
U of O	Data Not Available	Data Complete
Oregon State	Partial Data	Data Complete
OIT	Data Not Available	

SENSITIVITY ANALYSIS

This section provides an attempt to scale the uncertainty associated with the estimated values for energy use and resulting GHG emissions, by institution and by fuel (electricity or natural gas).

The figures below present the estimated range of uncertainty for electricity use and natural gas use, by institution. The high and low values are based on *the widest observed diversion from the CBECS benchmark for all institutions*. In other words, the high values (for electricity and for natural gas) assume that all institutions are at the same ratio of the CBECS benchmark, the highest observed for any one institution. Similarly, the low values assume that all institutions are at the lowest ratios for any one institution. This method is probably quite cautious, as it assumes that each institution could, in 1990, fall along the spectrum experienced in 2004 (relative to CBECS) for *all institutions*. Since the institutions are likely to be more similar to themselves over time rather than to each other, this method probably overstates the likely plausible range.

Figure 4: Sensitivity analysis for electricity consumption in 1990, by OUS institution.

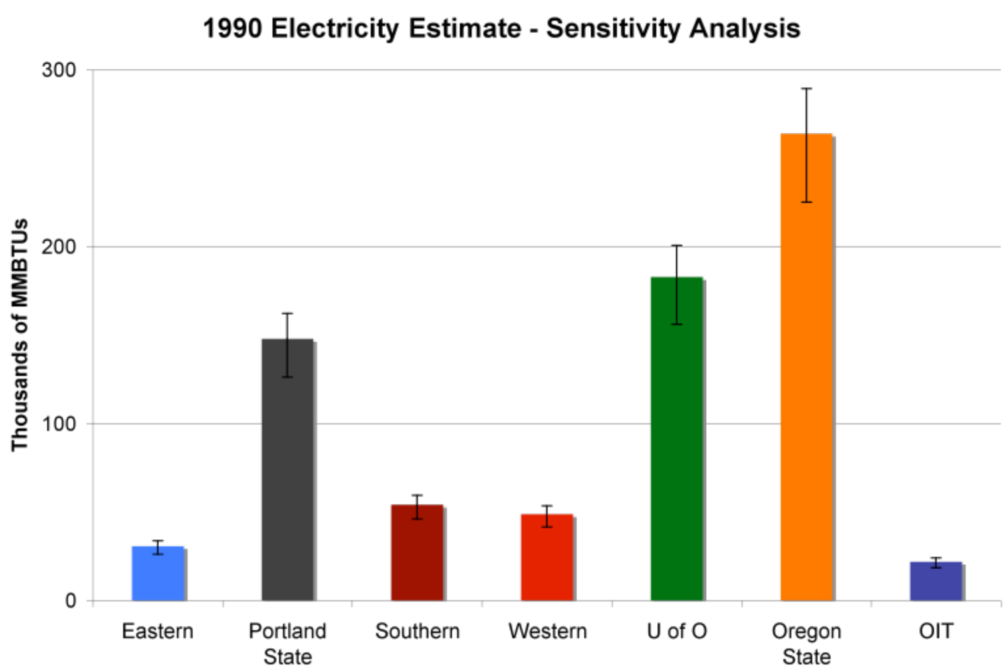

Figure 5: Sensitivity analysis for natural gas consumption in 1990, by OUS institution.

Note: OIT is excluded from the natural gas calculations because its consumption is negligible (as a result of its geothermal resource). Therefore, its consumption relative to the CBECS benchmark provides no guidance regarding to the other institutions' consumption.

There is no additional sensitivity analysis necessary in translating electricity and natural gas consumption into greenhouse gas emissions. Thus, the range of estimates of energy consumption *is*, with appropriate unit conversions (to MT CO_2e), the range of GHG calculations. Tables 3 and 4 below show the GHG conversions from the underlying data used to generate the graph above.

Table 3: 1990 estimates of GHG emissions from electricity by OUS Institution.

OUS Institution	1990 point estimate MT CO_2e	Low estimate MT CO_2e	High estimate MT CO_2e
Eastern	**2,884**	2,462	3,164
Portland State	**13,797**	11,760	15,135
Southern	**5,061**	4,321	5,552
Western	**4,557**	3,891	4,999
U of O	**17,062**	14,568	18,717
Oregon State	**24,606**	21,009	26,994
OIT	**2,054**	1,754	2,253
OUS Emissions:	**70,020**	59,785	76,814

Table 4: 1990 estimates of GHG emissions from natural gas (or wood waste), by each OUS institution.

OUS Institution	1990 point estimate MT CO_2e	Low estimate MT CO_2e	High estimate MT CO_2e
Eastern	**3,130**	2,021	5,666
Portland State	**9,545**	8,993	15,259
Southern	**5,650**	3,648	6,190
Western	**4,966**	3,207	5,441
U of O	**34,535**	22,299	37,838
Oregon State	**25,249**	18,350	31,136
OIT	**92**	72	183
OUS Emissions:	**83,167**	58,590	101,713

Note: University of Oregon emissions are estimated using the wood and wood waste emissions factor and should be considered and reported as biogenic GHG emissions per California Climate Action Registry Power Generation/Electric Utility Reporting Protocol.

The sums of these ranges provide the overall range for the 1990 GHG baseline, as presented on the first page of this memo. To recap:

Table 1: Comparison of 2008 GHG emissions to estimated 1990 emissions baseline with uncertainty range.

2008 Building Energy Emissions	1990 Baseline Building Energy Emissions	1990- High Estimate	1990 - Low Estimate
188,779 MT CO_2e*	153,187 MT CO_2e	(17% above point estimate)	(23% below point estimate)

**values include natural gas and electricity emissions (regional emissions factor) taken from Sightlines GHG inventory.*

The following tables provide electricity, natural gas and total energy use in tabular form.

Table 6: Estimates of 1990 electricity use, actual data and CBECS benchmarks.

OUS Institution	1990 / 1993			2004	
	1990 Estimate	Constructed Actual	CBECS Benchmark	Actual	CBECS Benchmark
	(thousands of MMBTUs)			(thousands of MMBTUs)	
Eastern	31	-	39	32	33
Portland State	148	101	185	158	171
Southern	54	-	68	38	59
Western	49	-	61	33	53
U of O	183	-	229	156	262
Oregon State	264	215	330	287	309
OIT	22	-	28	24	25

Table 7: Estimates of 1990 natural gas / wood waste use, actual data and CBECS benchmarks.

OUS Institution	1990 / 1993			2004	
	1990 Estimate	Constructed Actual	CBECS Benchmark	Actual	CBECS Benchmark
	(thousands of MMBTUs)			(thousands of MMBTUs)	
Eastern	59	-	36	63	32
Portland State	261	97	158	120	153
Southern	106	-	64	81	56
Western	93	-	56	74	51
U of O	360	-	218	493	249
Oregon State	533	414	322	564	305
OIT	2	-	27	1	23

Note: The Sightlines-reported value for PSU's FY2008 natural gas consumption was substituted for the 2004 consumption. This change was necessary because the 2004 value reported in the Sightlines GHG inventory is implausibly low, in addition to known accounting changes due to changes in PSU's service providers for building management and energy.

Table 8: Estimates of 1990 total building energy use, actual data and CBECS benchmarks.

OUS Institution	1990 / 1993			2004	
	1990 Estimate	Constructed Actual	CBECS Benchmark	Actual	CBECS Benchmark
	(thousands of MMBTUs)			(thousands of MMBTUs)	
Eastern	90	-	74	95	65
Portland State	409	198	343	278	323
Southern	160	-	132	119	115
Western	142	-	118	107	104
U of O	543	-	447	649	510
Oregon State	797	629	653	852	614
OIT	24	-	54	25	48

Note: Values for the CBECS benchmarks in Table 8 are merely the sums from the previous two tables.

endnotes:

[1] President Frohnmayer's Earth Day speech – April 18, 2008
[2] The University's Carnegie Class is Doctoral/Research Universities—Extensive
[3] Created by author based on McKinstry *CAP Facilities Assessment Report*
[4] State of Oregon, *House Bill 3543: Global Warming Actions*, http://oregon.gov/ENERGY/GBLWRM/HB3543.shtml and HB 3543
[5] State of Oregon, *State Energy Efficiency Design (SEED) Program*, http://oregon.gov/ENERGY/CONS/SEED/index.shtml
[6] 2008 DRAFT Environmental Issues Committee Final Report
[7] Created by author based on McKinstry *CAP Facilities Assessment Report*
[8] University of Oregon, Environmental Issues Committee, Final Report, 2009
[9] Sightlines, *Environmental Stewardship: Measure*, Monitor, Benchmark. April 2009
[10] University of Oregon, Environmental Issues Committee, Final Report, 2009
[11] Ibid.
[12] American Colleges and Universities President's Climate Commitment, *Average Gross Emissions per 1,000 sq ft by Carnegie Class* http://acupcc.aashe.org/ghg-scope-statistics.php
[13] Ibid.
[14] Calculated from Sightlines, *Environmental Stewardship: Measure, Monitor,* Benchmark. April 2009
[15] Phone conversation with Jeff Madsen 8.25.09
[16] From the Sightlines Excel document *"OUS GL FY08 v3.2"*
[17] Letter from David Hulse, Professor in UO Department of Landscape Architecture. January 25, 2010
[18] University of Oregon, *Major Capital Projects*, July 2009 from Chris Ramey
[19] Campus Sustainability Assessment, University of Oregon, May 2007
[20] Email from Fred Tepfer, Campus Planning. 10.28.09
[21] Phone conversation with Jeff Madsen 9.4.09
[22] Ibid.
[23] Chart created by author using data from McKinstry *CAP Facilities Assessment Report*
[24] Good Company, Fleet Transition Framework for the Oregon University System, September 29, 2009
[25] Sightline, *Easing off the Gas: Northwesterners Using Less Gasoline* http://www.sightline.org/publications/reports/northwesterners-driving-less-using-less-gas/gasoline-FINAL-web.pdf
[26] Campus Sustainability Assessment, University of Oregon, May 2007
[27] ASUO website, *ACFC Budget Summary*, http://asuo.uoregon.edu/docsmanuals.php?a=39
[28] Phone interview with Stuart Liang, October 2, 2009 conducted by Steve Mital
[29] Ibid.
[30] Virgin Atlantic, *Carbon Footprint*, http://www.virgin-atlantic.com/en/us/allaboutus/environment/carbonfootprint.jsp
[31] NREL slideshow
[32] National Renewable Energy Laboratory, *The Vision: Zero Carbon Campus* PowerPoint, March 23, 2009
[33] McKinstry *CAP Facilities Assessment Report*
[34] *The Sustainability of Biomass Energy in the Pacific Northwest: A Framework for the PNW Region of the Sun Grant Initiative*, Clark,C and Yin,Y, Oregon State University, 2007
[35] The Prout Institute, *Sustainable Agriculture in the Willamette Valley*, http://www.proutinstitute.org/pdfs/Sustainable_Agriculture_in_the_Willamette_Valley.pdf
[36] Chart created by author using data from McKinstry *CAP Facilities Assessment Report* and various energy content sources
[37] Energy Information Administration, *Solar Photovoltaic and Solar Thermal Electric Technologies*, http://www.eia.doe.gov/oiaf/ieo/solar.html
[38] BacGen Technologies, OUS Priorities -- Solar Grant Request Facilities
[39] Based on an email conversation with Jeff Ziglinski on November 13, 2009.
[40] See http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html for more information
[41] Chart created by Mark Nystrom based on data collected from Karyn Kaplan using EPA's WARM calculations.
[42] ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/sequester.pdf
[43] Bill of Sales, Native Energy, 7/14/2009

[44] National Renewable Energy Laboratory, *The Vision: Zero Carbon Campus* PowerPoint, March 23, 2009
[45] McKinstry *CAP Facilities Assessment Report*
[46] Conversation with Bob Simonton, October 6, by Steve Mital
[47] Harvard University, *Green Campus Loan Fund*, http://www.greencampus.harvard.edu/loan-fund
[48] Simonton Eco-Campus Project: *Oregon University System ECO-Campus Project Funding Summary*
[49] Phone conversation with Jeff Madsen 9.4.09
[50] Campus Sustainability Assessment, University of Oregon, May 2007
[51] Several rankings place the University high, see: Sustainable Endowments Institute (http://www.greenreportcard.org/report-card-2010/schools/university-of-oregon-eugene), Princeton Review (http://www.princetonreview.com/UniversityofOregon.aspx), National Wildlife [6] Federation (http://www.nwf.org/), Sierra Club (http://www.sierraclub.org/sierra/200909/coolSchools/allrankings.aspx), Greenopia (http://www.greenopia.com/LA/colleges_listing.aspx?ID=3&input=Name%25or%25product&Listpage=1)
[52] Data from a search in the University Bulletin of research institutions with a focus on sustainability, http://www.uoregon.edu/~uopubs/bulletin/research_institutes_a.shtml
[53] University of Oregon Climate Leadership Initiative, http://climlead.uoregon.edu/
[54] University of Oregon, Department of Sustainability, *Sustainability Database*, http://sustainability.uoregon.edu
[55] Ibid.
[56] University of Oregon Course Catalogue, http://www.uoregon.edu/~uopubs/bulletin/architecture.shtml#curriculum
[57] Architecture Record, 2010 America's Best Architecture School, http://archrecord.construction.com/features/0911BestArchSchools/0911BestArchSchools-2.asp
[58] Because these students are so new, they have not yet received University funding and are therefore not included in the budget analysis.
[59] ASUO website, *ACFC Budget Summary,* http://asuo.uoregon.edu/docsmanuals.php?a=39
[60] Ibid.
[61] Steve Mital, personal communication, 2007.
[62] ASUO website, *ACFC Budget Summary*, http://asuo.uoregon.edu/docsmanuals.php?a=39
[63] ASUO Budget Book, 2006-2007
[64] Data from a search of the University of Oregon's *Sustainability Database for Public Service*, http://sustainability.uoregon.edu/search/index.php
[65] University of Oregon, *Community Planning Workshop,* http://cpw.uoregon.edu/
[66] University of Oregon, *Environmental Leadership Program,* http://www.uoregon.edu/~ecostudy/elp
[67] University of Oregon, *Sustainability Leadership,* http://sustain.uoregon.edu.
[68] Oregon University System, *Climate Action Plan Summary* – July 2009
[69] University of Oregon, *University of Oregon Mission Statement,* http://www.uoregon.edu/~uosenate/UOmissionstatement.html
[70] Oregon University System, *Climate Action Plan Summary* – July 2009
[71] From the documents referenced and from conversations with Christine Thompson
[72] McKinstry *CAP Facilities Assessment Report*