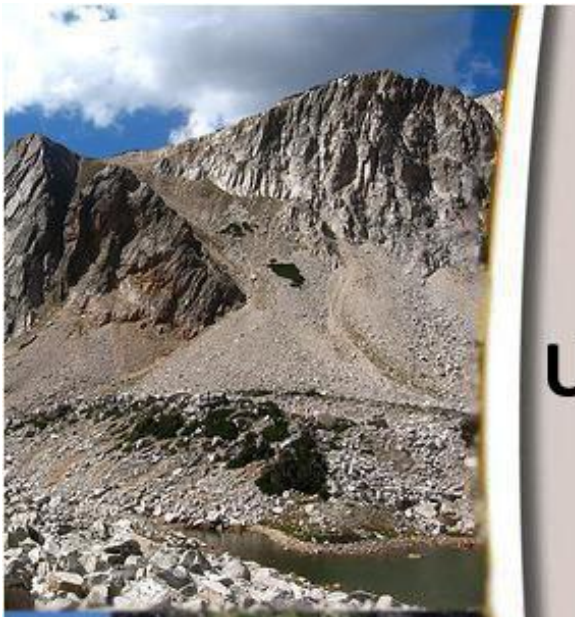
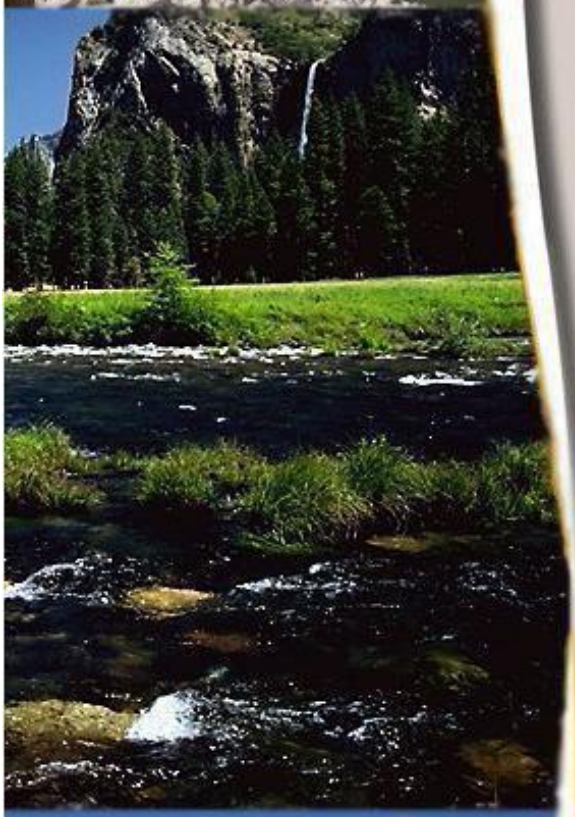




UNIVERSITY OF WYOMING

Climate Action Plan

September 15, 2009
Submission deadline to American College and University Presidents' Climate Commitment

UNIVERSITY OF WYOMING

TABLE OF CONTENTS

b. Facilities
    i. Goal Statement
    ii. Background Information
    iii. Current Programs and Accomplishments
    iv. Action Steps
    v. Metrics
c. Grounds
    i. Goal Statement
    ii. Background Information
    iii. Current Programs and Accomplishments
    iv. Action Steps
    v. Metrics
d. Water
    i. Goal Statement
    ii. Background Information
        1. Domestic Water Use
        2. Irrigation Water Use
    iii. Current Programs and Accomplishments
    iv. Action Steps
        1. Domestic Water Use
        2. Irrigation Water Use
    v. Metrics
        1. Domestic Water Use
        2. Irrigation Water Use
e. Transportation
    i. Goal Statement
    ii. Background Information
    iii. Current Programs and Accomplishments
    iv. Action Steps
    v. Metrics
f. Procurement and Waste Management
    i. Goal Statement
    ii. Background Information
        1. Ongoing Consumables
        2. Food Service
        3. Durable Goods
        4. Facility Alterations and Additions
    iii. Current Programs and Accomplishments
    iv. Action Steps
    v. Metrics
g. Policy
    i. Goal Statement
    ii. Background Information
    iii. Current Programs and Accomplishments
    iv. Action Steps
    v. Metrics

EXECUTIVE SUMMARY

Sustainability efforts at the University of Wyoming increased dramatically in 2005 with the formation of the Campus Sustainability Committee and the Students for a Sustainable Environment. In 2007, the University of Wyoming became a charter member of the American College and University Presidents' Climate Commitment. President Thomas Buchanan charged the Campus Sustainability Committee with administering the commitment's requirements. So for the committee has conducted campus greenhouse gas emissions inventories for 2007 and 2008 and performed a number of smaller tasks to move the institution toward more sustainable principles and practices. One requirement of the Presidents' Climate Commitment is the development of a Climate Action Plan to illustrate how the institution will reduce its carbon footprint. This document is the institution's plan to fulfill that commitment. It is intended to be a living document and will be updated periodically as new technology becomes available or budget opportunities change.

The University of Wyoming campus includes over seven million square feet of facility space on approximately 750 acres. The campus includes an 18-hole golf course and several large designated green spaces. There are over 3,000 coniferous trees and 1,000 deciduous trees on campus. The grounds are expertly maintained despite the northern climate conditions and 7,200 foot elevation.

As the only four-year institution of higher learning in the state, the University of Wyoming has a responsibility to provide high-quality opportunities for academic learning, teaching, and research about sustainability, climate policy, climate science, and energy.

Existing and new facilities have a significant impact on the land, air, ecology, and culture. Conserving energy and water has become increasingly important as resources decline, energy prices rise, and the effects on the environment and climate are better understood. Conservation can be enhanced by incorporating sustainable principles and by utilizing new technology in buildings, infrastructure, and transportation.

In addition to the physical environment, altering behavior and culture is critical to implementing truly sustainable change. The physical environment can contribute to cultural change by revitalizing areas and transforming experiences. It can also influence behavior by providing viable alternative transportation choices, areas of recreation, and desirable residential spaces with connections to places of work, school, and services. Education, awareness, outreach, and a clear vision are also crucial to creating true change.

Wyoming is rich in mineral and energy reserves. The university conducts a tremendous amount of energy research, positioning us to contribute to innovations and advances in sustainability on a national scale.

University greenhouse gas emissions are produced mainly from electric use and coal consumption. The campus purchases electricity from Rocky Mountain Power and natural gas from Source Gas. Steam heat and chilled water are produced at the campus Central Energy Plant. Electricity consumption accounts for 45 percent of UW's total greenhouse gas emissions, coal accounts for a little over 35 percent, and natural gas comprises 5 percent of total emissions. Transportation, including air travel, contributes another 13 percent to total emissions.

The Climate Action Plan is divided into three phases: (1) reducing greenhouse gas emissions to 15 percent below 2005 levels by 2015; (2) reducing greenhouse gas emissions to 25 percent below 2005 levels by 2020; and (3) achieving carbon neutrality by 2050. As illustrated by the above emissions statistics, achievement of these targets will require considerable reductions in electrical use and coal consumption.

Education, research, and public engagement initiatives are integral to the success of the plan and are presented early in the document. Research initiatives are an important component to the plan given Wyoming's prominent position as an energy state and its significance to the supply side of the energy equation. The plan for greenhouse gas emission reduction is divided into seven sections: (1) energy; (2) facilities; (3) grounds; (4) water; (5) transportation; (6) procurement and waste management; and (7) policy and behavioral change. The plan discusses potential barriers and solutions, presents projected costs and financial alternatives, and outlines an implementation plan. Finally, the plan proposes a tracking and measurement methodology to accurately monitor progress.

Phase I of the plan provides specific goals and action steps. Action steps in Phase II are more aggressive and build on Phase I initiatives and evaluations. Phase III action steps are more general due to unknown advancements in technology and uncertainty in cost and funding components. In general, Phase I will focus on education and reductions in energy use through behavioral change and facility upgrades, evaluation of alternatives, and limited implementation of promising initiatives. Phase II continues successful initiatives and long term projects. Infrastructure and alternative energy initiatives become more prevalent in Phase II and continue into Phase III on a larger scale.

President Buchanan has charged the Campus Sustainability Committee with coordination and measurement of progress for the Climate Action Plan. Data will be gathered each year and annual reports will be produced in conjunction with the annual greenhouse gas emissions inventory. Subcommittees will assist with prioritizing action steps and initiatives, developing schedules and targets for intermediate progress, and executing communication and outreach efforts on the committee's behalf.

It is the committee's intention to work closely with the Divisions of Academic Affairs, Student Affairs, Research and Economic Development, and the Physical Plant, Facilities Planning, and other key university units to execute this plan. We look forward to that opportunity and believe the Climate Action Plan will be significant to the future success of this university.

INTRODUCTION

In August 2007, President Thomas Buchanan positioned the University of Wyoming to be a leader in the sustainability initiative by signing the American College and University Presidents' Climate Commitment as a charter member.

Since signing the commitment, the University of Wyoming has created a Campus Sustainability Committee, conducted two yearly inventories of campus greenhouse gas emissions, and performed a number of smaller tasks to move the institution toward more sustainable principles and practices.

As the only four-year institution of higher learning in the state, the University of Wyoming has a responsibility to provide high-quality opportunities for academic learning, teaching, and research about sustainability, climate policy, climate science, and energy.

Existing and new facilities have a significant impact on the land, air, ecology. and culture. Conserving energy and water has become increasingly important as resources decline, energy prices rise, and the effects on the environment and climate are becoming more understood. Conservation can be enhanced in buildings, infrastructure, and transportation by utilizing new technology and by incorporating sustainable principles.

In addition to the physical aspects of sustainability, altering behavior and culture is critical to implementing true change. The physical environment can change the culture by revitalizing areas and transforming experiences. It can also influence behavior by providing viable alternative transportation choices, areas of recreation, and desirable residential spaces with connections to places of work, school, and services. In addition to providing the physical changes that encourage a cultural transformation, education, awareness, and a clear vision are crucial to creating true change.

This document outlines strategies for reducing the University of Wyoming's carbon footprint. Each section includes a goal statement, background information, current programs and accomplishments, a set of action steps to achieve the goal, and metrics for measuring the effectiveness of the actions. It is important to note that this document is only a portion of a much bigger energy-related goal for UW.

Information in certain sections of this document has been taken from the 2008 and 2009 greenhouse gas emissions inventories completed by Campus Sustainability Committee student interns, the draft Long Range Development Plan being developed by Moore Iacofano Goltsman, Inc. and various sub-consultants, the draft Utility Master Plan being developed by Affiliated Engineers, Inc. and various sub-consultants, and the Transportation and Parking Master Plan developed by Stantec. The Campus Sustainability Committee is appreciative of the detailed analyses and information that contributed to the development of this Climate Action Plan.

CAMPUS CLIMATE COMMITMENT

Goal Statement

The goal of the Climate Action Plan is to develop strategies and action steps to be used as a guide to minimize the institution's greenhouse gas emissions and climate impact by reducing campus energy consumption, obtaining energy from renewable and sustainable sources, and instituting a sustainable culture among students, faculty, and staff.

The most widely accepted definition of sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." This characterization was defined at the 1987 World Commission on Environment and Development and implies preservation of the natural environment and a stewardship responsibility to future generations. True sustainability requires a balance between financial, human, and environmental capital. It involves living with values and acting with integrity, responsibility, and generosity. Sustainable actions include those that preserve or rehabilitate natural resources, employ renewable energy, or avoid damage to the environment.

For purposes of this report, sustainability is defined as conducting ourselves in a manner such that the natural environment will be maintained for future generations.

The Climate Action Plan is divided into three phases: Phase I (2010-2015), Phase II (2015-2020), and Phase III (2020-2050). The Phase I target is to reduce carbon emissions to 15 percent below 2005 levels by 2015. The Phase II target is to reduce carbon emissions to 25 percent below 2005 levels by 2020. The Phase III target is to achieve carbon neutrality by 2050. Action steps for Phase I are specific and mostly quantifiable, action steps for Phase II are more general and somewhat quantifiable, and action steps for Phase III are less specific or quantifiable due to the unknown circumstances surrounding advancements in technology and cost factors.

Principles

Principles to guide the institution toward goal achievement will be followed throughout all phases of the implementation process. These principles include:

- Constructing new facilities, renovating existing facilities, and maintaining campus infrastructure to achieve reductions in energy consumption and use resources in a more sustainable manner.
- Practicing the efficient use of energy consumption in all institutional facilities across all types of energy systems.
- Conducting climate and energy research related to cleaner energy and alternate sources of energy.
- Contributing to the development and implementation of new technology to enhance the efficiency and viability of fossil fuel resources, including the university's potential contributions to the state of the art in CO_2 separation and sequestration
- Exploring and implementing new initiatives to provide continuous improvement in each identified primary category to achieve the stated goals.
- Acting with integrity and ethics in the performance of our responsibilities and stewardship for our environmental, physical, and financial resources.

CAMPUS GREENHOUSE GAS EMISSIONS

Overview

To assess the university carbon footprint, greenhouse gas emissions inventories were conducted by student interns for the University of Wyoming utilizing FY 2007 and FY 2008 data, as well as trend data from 1997 forward. These inventories yield estimates of total greenhouse gas emissions based on calculation results from the Campus Carbon Calculator developed by Clean-Air Cool Planet. The calculator is an Excel based workbook set up to receive input data by each user institution. The output measure of emissions is called carbon dioxide equivalents (CO_{2e}). Carbon dioxide equivalents are a metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential. Carbon dioxide equivalents are commonly expressed as "million metric tons of carbon dioxide equivalents" (MMTCDE). The inventories were conducted under the direction of the Campus Sustainability Committee. Summaries of each annual greenhouse gas emissions inventory are presented separately and then compared and contrasted.

Greenhouse Gas Emissions Inventory 2008

The breakdown of total estimated greenhouse gas emissions for FY 2007 by fuel source is depicted in Figure 1. The university's largest contributors to greenhouse gas emissions were electricity (44 percent) and coal (36 percent). Air travel contributed 11 percent, natural gas contributed 5 percent, and other sources such as commuting, waste, agriculture, and fleet service contributed smaller percentages of the total greenhouse gas emissions. In 2007, UW's greenhouse gas emissions were determined to be 134,392 metric tons of carbon dioxide equivalents.

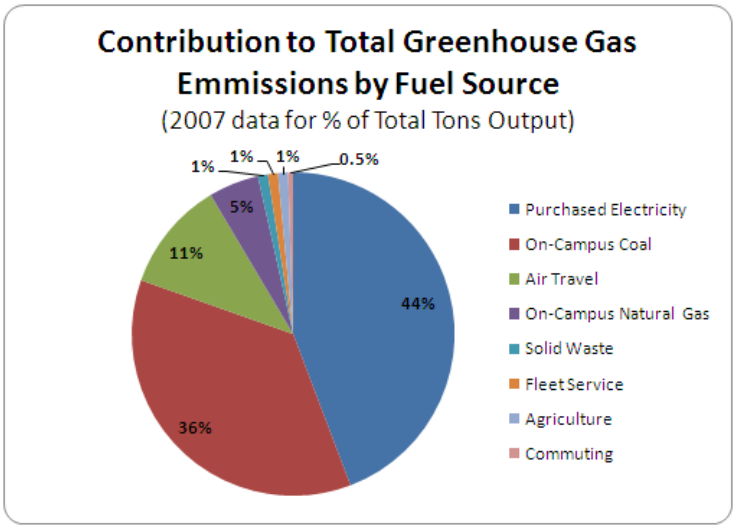


FIGURE 1. Total greenhouse gas emissions 2007 (Anderson and Wechsler (2008) "Greenhouse Gas Emissions Inventory for the University of Wyoming").

The 2008 greenhouse gas emissions inventory also included trending campus carbon dioxide emissions from 1997 to 2007, as shown in Figure 2. Since 1997, electricity, coal, and natural gas have been the university's main sources of carbon dioxide emissions. For the university to meet the goals in the

Presidents' Climate Commitment, considerable reductions in emissions from these two fuel sources must be made.

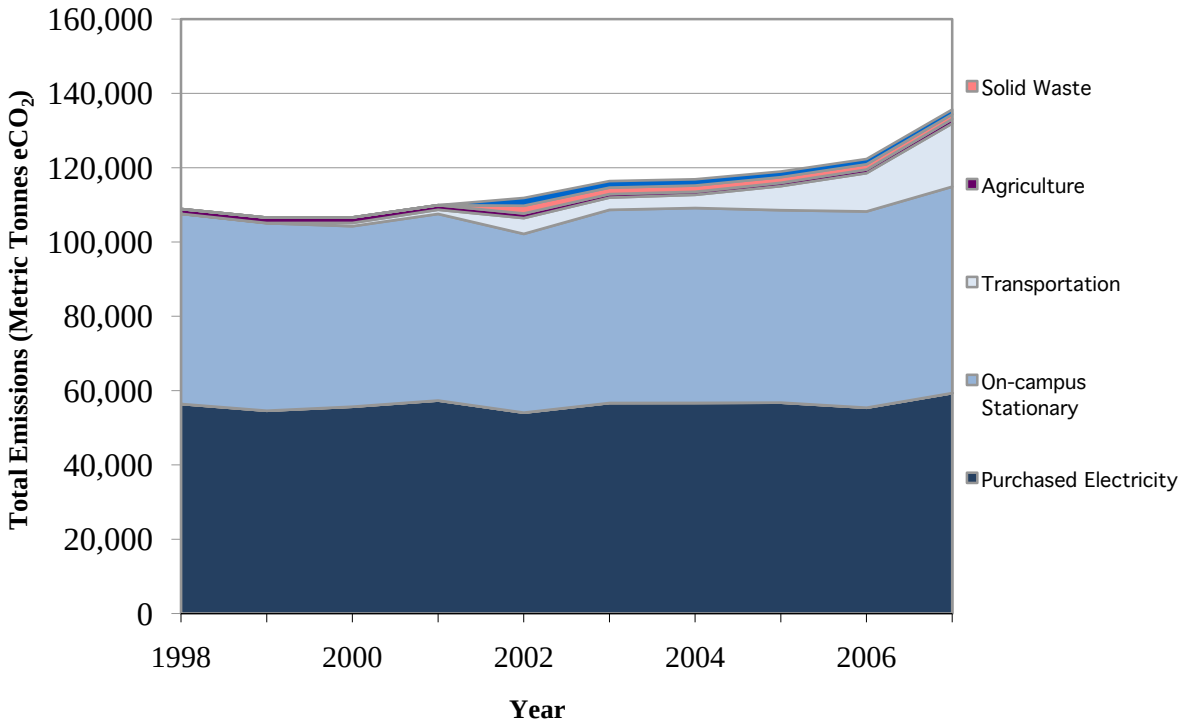


FIGURE 2. Total greenhouse gas emissions by source.

Greenhouse Gas Emissions Inventory 2009

During FY 2008, the University of Wyoming emitted an estimated net total of 133,766 metric tons of carbon dioxide equivalents, which consisted of 133,781 metric tons of carbon dioxide equivalents emissions less offsets of 15 metric tons. The small number of offsets was the result of purchased wind energy credits by student contributions. FY 2008's net total shows a slight decrease in emissions from FY 2007's net total of 134,392 metric tons of carbon dioxide equivalents. Figure 3 below shows the overall trend in UW's estimated net emissions, by source, from 1997-2008.

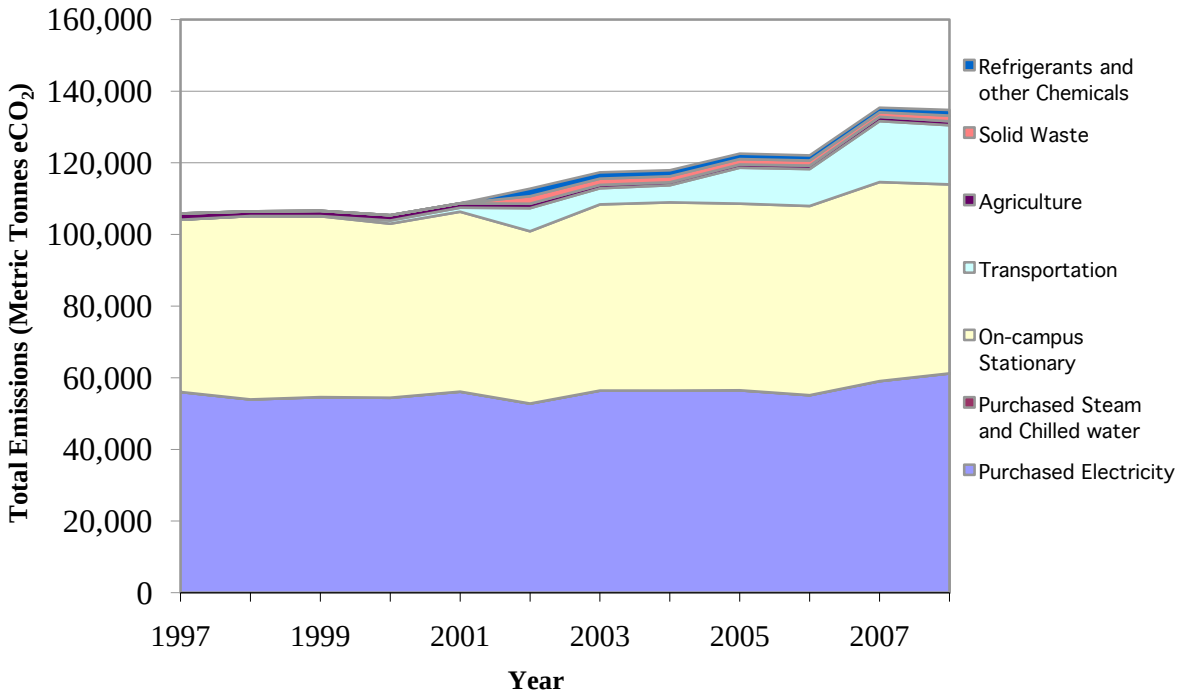


Figure 3. University of Wyoming greenhouse gas emissions by source, 1997 – 2008, reported as metric tons of carbon dioxide equivalents.

The percentage of emissions from each category source is shown in Figure 4 below to provide a visual breakdown of UW's contributions to greenhouse gases.

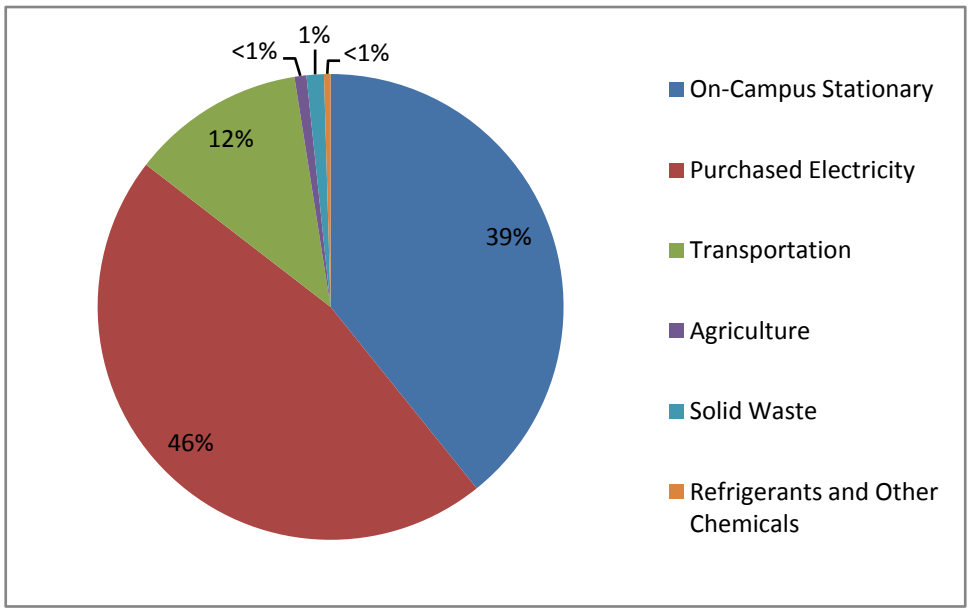


Figure 4. Fiscal year 2008 contribution to total greenhouse gas emissions for each source.

The estimated per capita emissions from 1997-2008 for the University of Wyoming community, including students, faculty, and staff, is displayed in Figure 5. Over that time period, the average emissions per UW community member have gradually increased by approximately 17 percent. Lower part time enrollment in 2007 as compared to surrounding years resulted in a spike in measurement between 2006 and 2007 on a per capita basis.

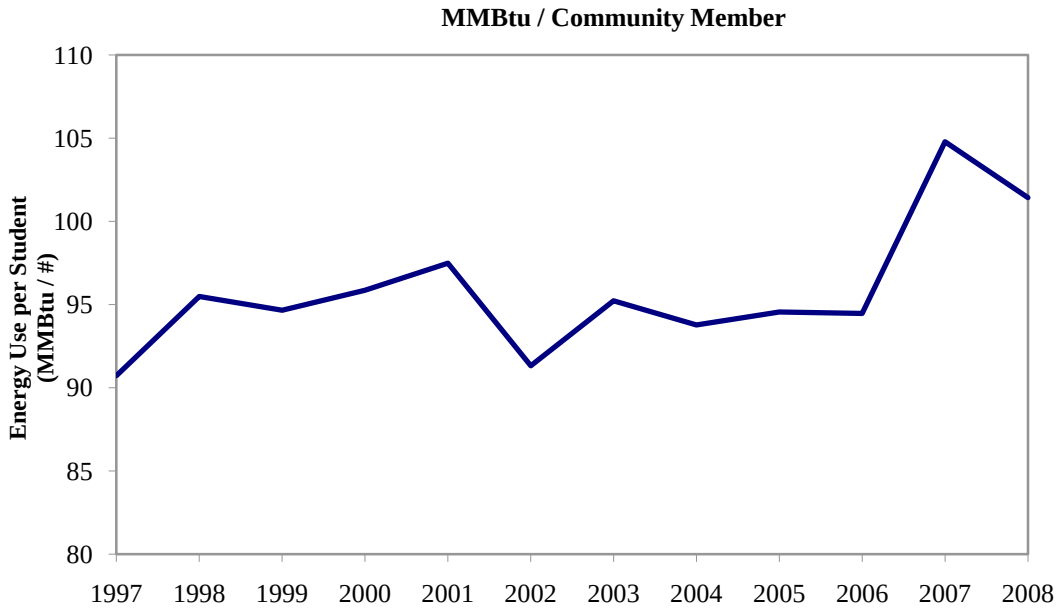


Figure 5. Per capita metric tons of carbon dioxide equivalents greenhouse gas emissions for the UW community, including students, faculty, and staff.

2008 and 2009 Comparison Emission Comparison

Overall university greenhouse gas emissions decreased less than one percent from the 2008 to 2009 inventory. The amount of purchased electricity increased by two percent, the on-campus stationary decreased by approximately two percent, and transportation increased by one percent. Other sources stayed relatively stable between FY 2007 and FY 2008. For data on number of students and employees, the square footage of facilities, and other details see the greenhouse gas emissions inventories at http://uwyo.edu/sustainability/.

The net decrease in emissions can be explained by yearly temperature variations rather than a change in behavior. However, during FY 2008, the university added over 300,000 square feet of new facilities, contributing to the increase in greenhouse gas emissions.

EDUCATION RESEARCH AND PUBLIC ENGAGEMENT

Goal Statement

Research, curriculum, and outreach can play a role in reducing carbon emissions at an institution of higher learning. We hope that by exposing students, faculty, staff, and administrators to sustainability

education, UW will experience advances in sustainability through participation at all levels of the university community. Providing academic opportunities in the areas of climate science, climate policy, and sustainability can prepare students for careers in rapidly growing fields related to sustainability.

The University of Wyoming intends to integrate academic efforts into advancing sustainability through the expansion of existing sustainability-related curricula and the development of new programs, engaging in ongoing and future research efforts, and reaching out to the public (described below and illustrated in Tables 1 and 2). All of these efforts will be at the desire and discretion of faculty and their departments.

Background Information

Environmental awareness has increased at the University of Wyoming, and change has occurred for campus operations and every day student practices. Campus operations have executed changes from addressing energy and water use to modifying purchasing practices. Changes in student practices include increased recycling and an increase in bicycle and pedestrian traffic. The sustainability groups and programs currently in place on campus are an important step in increasing awareness and encouraging change.

Although awareness has increased and many changes have been made, there is still much more to be accomplished. Sustainability will not be truly effective until it is ingrained in the overall campus culture. Embracing this culture needs to occur at all levels, from the entering freshman to the administration. A clear and consistent vision for the campus and a strong educational initiative are key elements to achieving awareness and change. As students leave the campus, this environmental culture and awareness can resonate into their future communities.

Academics

Faculty engagement and development and curricular development and expansion are important to creating, maintaining, and growing a strong, coordinated academic program around sustainability. The following is a description of how UW will use its academic strengths to achieve this goal.

Faculty

UW faculty will be integral in developing and implementing an interdisciplinary curriculum related to sustainability, as well as conducting high-level sustainability research across disciplines. We anticipate faculty having a central role in implementing the following action steps related to sustainability and climate science, as well as curriculum and research.

As shown in Tables 1 and 2, UW faculty already are engaging students in sustainability- and climate-related exploration through current course offerings by several departments. We expect this trend to continue at the desire and discretion of faculty and their departments and as teaching loads and faculty interest and expertise permit. It is our intention that the academic setting created by implementing these actions should act as a microcosm of the larger campus community and will involve rigorous academic considerations of sustainability across departments and colleges.

Research in wind power, clean coal technologies, carbon capture and sequestration, and other energy related areas are already underway at UW. We expect research in the fields of energy, sustainability, and climate will continue to expand at UW.

Curriculum

We propose a four-pronged approach to strengthen UW's sustainability and climate change curricula: (1) bundling existing courses into new certificate programs, minor options, and/or other offerings; (2) enhancing the breadth of the curriculum to expose as many students as possible to these issues; (3) strengthening outreach efforts to broaden the impact beyond students; and (4) expanding research (and the impact of that research) on climate change and sustainability.

Campus Sustainability Course Inventory. A survey of UW staff and faculty was conducted in March 2009 to determine what courses devoted to or containing an element of sustainability and climate change are currently offered or are planned to be offered. The frequency of offering was also determined for existing courses. A combination of electronic survey and contacting individual faculty members produced a more complete course list. This list identifies gaps and can be used in the justification for the creation of a new course, perhaps in the context of a new minor in sustainability. The full inventory results are displayed in the following Tables 1 and 2.

Completing the survey was voluntary. Twenty-six departments across all seven colleges responded; however, some departments did not respond and the table is not all inclusive.

Table 1 includes courses currently offered at UW with sustainability related content. Table 2 includes courses currently offered with climate change related content. Although not listed in the inventory, the Science and Mathematics Teaching Center's Math Science Partnership, funded by the Wyoming Department of Education, offers professional development to teachers across the state. One of the courses offered is Quantitative Reasoning in the STEM Disciplines, which addresses climate change issues in science, technology, engineering, and mathematics.

Additional courses may potentially include a sustainable planning course to be offered by Geography and a capstone course in the revised MBA program that would include sustainability principles.

The Campus Sustainability Course Inventory also demonstrated widespread departmental interest in offering courses emphasizing sustainability concepts within disciplines. Departments from all seven colleges responded favorably to sustainability- and climate-related offerings.

Table 1. Sustainability-related courses currently offered at UW.

Department prefix and course number	Course title	Aspect of sustainability addressed in course	% of course on sustainability	Frequency	Instructor
ACCT 4600	Professionalism and Ethics	employee Issues, environmental issues, long-term profitability	50	every fall and spring	Department Chair
EDCI 4000	Environmental Education for Teachers	curricula emphasizing sustainable practices	25	each spring	Buss or Medina-Jerez
ENR 4600	Campus Sustainability	miscellaneous	100	once per year	Paulson
ENR 4890 / 5890	The Land and Water Connection in Wyoming	Wyoming human, land and animal life	75	as needed	MacKinnon
FCSC 5101-02 (special topics)	Green Design	sustainability in house, community and other design	100	every other year	Sprout
GEOG 5060	Landscape Ecology	sustainable landscapes	100	once per year	Baker
LAW 6915-05	Topics in Law: Energy Law & Policy	renewable energy sources and climate change law and policy	25	once a year	Stickley
ME 4360 / ESE 4360	Nuclear Energy	renewable energy	100	every three semesters	Various ME faculty
ME 4460 / ESE 4460	Solar and Geothermal Energy	renewable energy	100	every three semesters	Various ME faculty
ME 4470 / ESE 4470	Wind and Tidal Energy	renewable energy	100	once every three senesters	Various ME faculty
MKT 4910-01	Marketing Ethics	economic and social	50	annually	Rittenberg
MKT 4910-02	Intro to Sustainable Business Practices	economic, environmental, social	100	annually	Arnould
MKT 4910-03	Alternative Value Chains	economic, environmental, social	90	annually	Press
MKT 4910-04	Services and Experience Marketing	environmental and economic	50	every other year	Baker
MKT 4910-06	Marketing and Society	economics and social	40	every other year	Hunt
Outreach Enrichment	Sustainable Living Series	home lifestyles	100	on a semester-by-semester basis	Community members
Outreach Enrichment	Alternative Energy: Living Off the Grid	alternative energy	100	on a semester-by-semester basis	Community member
PHIL 2330	Environmental Ethics	obligations to current/future generations	25	every other year	Goodin
PHIL 2345	Natural Resource Ethics	justice, future generations	33	every other year	Lockwood
PHIL 4340	Seminar in Environmental Ethics	varies: deep ecology, justice, etc.	50	every other year	Lockwood
REWM 3100	Principles of Wildland Water Quality	sustainable water supplies, hydrology	50	annually	Reddy
RNEW 2100	Forest Management	sustainable use of forests, harvest, disturbance	100	annually	Thurow
RNEW 3000	Tropical Ecology	biodiversity, extinction and conservation	90	every other year	Shaw
RNEW 4400	Invasive Plant Ecology	impact and ecology of exotic species on natural systems	50	annually	Collier
RNEW 4775	Forest Ecology	management and sustainability of forests	50	annually	Thurow
WMST 4500 (special topics)	Women and Sustainability	environment, livelihoods	100	to be offered 1 x per year?	Shea
WMST 4580	Women and Third World Development	livelihoods	Unknown	not in last three years	Jensen
WMST/SOC 4400	Women and Work	livelihoods	Unknown	once per year through outreach	Inman

Additional sustainability courses not listed by survey respondents

AECL 1000	Agroecology
AECL 4120 (PLNT 4120)	Organic Food Production
ANTH 4340 /4350 (INST 4350)	Culture Change
ARE 2410	Fundamentals of Building Performance
ARE 3600	Architectural Design I
ARE 4600	Architectural Design II
FCSC 4182 (FCSC 5182)	Textiles Industry and the Environment
GEOG 3030	Geography and Development
PHIL 3250	Global Justice
PLNT 4020	Alternative Agriculture
POLS 4350	Sustainable Development and Global Policy

Table 2. Climate change-related courses currently offered at UW.

Department prefix and course number	Course title	Aspect of climate change addressed in course	% of course on climate change	Frequency	Instructor
AGEC 4600 / ENR 4890	Community Economic Analysis	Energy policy and economics	100	annually	Coupal
EDCI 4000	Environmental Education for Teachers	GIS & remote sensing to investigate change and involve students in the GLOBE program	50	annually	Buss or Medina-Jerez
ENR 4890 / 5890	Policy Strat. for Clim. Change in WY: Mitig. & Adapt.	policy	75	as needed	MacKinnon
ENR 4900 / 5900	ENR Policy Practice	ENR policy	50	annually	Tinker and Lauenroth
GEOG 1010	Introduction to Physical Geography	multiple	25	every semester	Shinker and Legleiter
GEOG 3450	Weather and Climate	geologic and anthropogenic climate change	50	annually	Shinker
GEOG 3480	Environmental Change	multiple	30	annually	Orvis
GEOG 3550	Natural Hazards and Society	multiple with some sustainability content	40	annually	Shinker
GEOG 4880	Global Climate Variability	role of climate change on fires, hurricanes, drought and ocean circulation	60	every other year	Shinker
ME 3040 / ESE 3040	Thermodynamics II	combustion and associated pollution	50	once each year	Various ME faculty
ME 4330 / ESE 4330	Internal Combustion Engines	efficiency, carbon emissions, pollution, biofuels	50	every third semester	Two ME faculty members
ME 4340 / ESE 4340	Gas Turbine Engines	efficiency, carbon emissions, pollution	25	annually	One ME faculty member
PHYS 4050	Physical Principles of Pollution	global warming, pollution	Unknown	very rarely	Unknown
PHYS 4150	Energy in a Technical Society	global warming	Unknown	very rarely	Unknown
PHYS 4160	Energy Issues for Educators	global warming	Unknown	very rarely	Unknown
REWM 3500	Plant Ecophysiology	the response of plants to temperature change, CO2 increase, greenhouse gas, etc.	50	annually	D. Williams
REWM 47oo	Wildland Watershed Management	hydrologic cycle, drought, sustainable surface and groundwater supply	40	annually	T. Thurow
REWM4830	Ecological Applications	vegetation resposnse to drought, temperature, grazing use, disturbance	30	annually	T. Thurow
SOIL 4535	Soil Biogeochemistry	impacts of drought, altered temperature, precip and nutrient cycles on soils	20	annually	G. Vance
Additional climate change courses not listed by survey respondents					
ESS 1000	Wyoming in the Earth System				
ATSC 2100	Atmospheric Change: Composition and Climate				
ESS 3480	Environmental Change				
ATSC 4400 (ATSC 5400)	The Physical Basis of Climate				
ANTH 4310	Environmental Anthropology				

Depth - bundling existing and new courses. By bundling or packaging existing (and some new) UW courses into a minor or certificate program, students can explore sustainability or climate change in greater depth.

Climate affairs minor or certificate. Offer a minor or certificate program in climate affairs. The University of Montana, Columbia University, and other institutions provide examples of these types of programs.

Sustainability minor or certificate. Offer an interdisciplinary minor or certificate program in sustainability studies. The sustainability studies program would draw on courses from across campus and might be housed in the Haub School of Environment and Natural Resources. The first step is to meet with potential campus partners to assess interest and feasibility.

Breadth – imbedding themes throughout the curriculum. To reach as many students as possible, sustainability and climate change must be woven throughout the curriculum, regardless of discipline. While mandating these themes via a new University Studies Program requirement seems premature, voluntary, incentive-based programs to infuse sustainability and climate science more broadly throughout existing UW courses may be appropriate. Courses emphasizing sustainability, climate science, and/or policy are already being taught within disciplines by experts in those fields. We will encourage a continuation and expansion of these course offerings, as described below. Even small changes in course syllabi can make a large difference in student attitudes, especially when these changes have an incremental effect across the students' curricula. Champions from the Campus Sustainability Committee will work with faculty and their departments and colleges to lead this effort.

Sustainability across the Curriculum. Work with the Ellbogen Center for Teaching and Learning to host "Sustainability across the Curriculum" workshops, an incentive-based program to imbed sustainability (or climate change studies) into existing and new courses. UW representatives would be encouraged to attend "Sustainability Across the Curriculum Leadership Workshops," hosted by the Association for the Advancement of Sustainability in Higher Education (AASHE) (http://www.aashe.org/profdev/curriculum.php), which train key university representatives to work with faculty on their campuses. Under the "Sustainability across the Curriculum" model, faculty members would apply to participate in the on-campus workshop and would be provided a stipend to attend trainings, and ultimately to modify and execute a course syllabus with sustainability themes. Faculty from all disciplines would be welcome. Approximately half of the departments that responded to the Campus Sustainability Course Inventory expressed interest in such a model, including departments from all seven colleges.

The incentive-based portion of the "Sustainability across the Curriculum" program is often monetary at other institutions; however, UW may consider offering the workshops to interested faculty without incentive until funding becomes available, or offering a non-monetary incentive at the discretion of the Division of Academic Affairs and individual academic units.

Freshman Interest Group. Create a new climate science and/or sustainability Freshman Interest Group (FIG). Freshman Interest Groups are living/learning communities of freshmen who take a core set of classes (usually three) together and live in a dorm together. Global Sustainability (GEOL 1600) and Environment and Natural Resources Problems and Policies (ENR 1100) might be candidate courses for

the Freshman Interest Group. A third Freshman Interest Group course might focus on civic engagement or international issues, for example.

Climate Science Module. Create a climate science module, modeled after UW's "Science Posse," to be used in classes across campus and in the community. In collaboration with faculty members who choose to integrate the module into their classes, the module should be tailored to the specific disciplinary perspective of the course. After "field-testing" the module on campus for one year, the module could be modified for a K-12 audience and introduced into classrooms throughout the community.

Climate Issues Seminar. Create a seminar on climate, water, and energy that could be taken for credit by graduate students and upper-level undergraduates. A course to this effect has already been created by the Anthropology Department and could serve as a model for a permanent course. The seminar would also have a series of public lectures open to the community.

Research

Stimulating and promoting sustainability-related and climate science research at UW is an ongoing effort. UW is perfectly positioned for energy-related research, a tradition that spans decades of the university's history. With an increasing focus on carbon-based fuels, clean energy initiatives, and advances in alternative sources of energy, UW has the opportunity to be a leader nationally in energy innovation. The university currently has ongoing research in clean coal technologies, carbon sequestration, renewable energy resources, electric power conditioning and grid control, and water quality and conservation. Recent awards for climate change research total almost $1.3 million. The following are descriptions of ongoing or future research endeavors at UW.

Research and Applications in Climate and Energy. Research and Applications in Climate and Energy is an interdisciplinary group of UW faculty researchers and outside experts working on climate and energy issues. In the past, this effort has been funded by various entities on campus, including the President's Office, the Office of Research and Economic Development, the Program in Ecology, the Haub School of Environment and Natural Resources, and the School of Energy Resources. The goal of the group is to develop cross-campus synergies for new research endeavors and to share information on existing research. Pending the acquisition of sufficient and consistent funding, Research and Applications in Climate and Energy will produce on-line publications and briefs, easily accessible "broadsheet" publications on particular aspects of ongoing UW climate and energy research for campus and public information. These publications are an opportunity to reach a broader audience and for UW to be a recognized information source on climate and energy issues.

Clean Coal. The High Plains Gasification Advanced Technology Center is a partnership between GE Energy and UW established to develop advanced gasification and "cleaner coal" solutions for Powder River Basin and other Wyoming coals. The small-scale gasification center in Cheyenne will allow UW faculty and GE personnel to work on advancing clean coal technology. UW will own and operate the facility, and funding is provided by GE Energy and the state of Wyoming. The project will be governed by a board of directors.

Additionally, recent opportunities have become available through grants and matching funds from the National Renewable Energy Laboratory and the Clean Coal Technologies Research Fund. These new

research projects will focus on solar heating, photovoltaics, and the improvement of clean coal technologies.

Carbon Sequestration. Wyoming produces 40 percent of the nation's coal. As such, carbon capture and geologic sequestration is a strategic priority for the state. To prepare for sequestration within the state, the Wyoming State Legislature has passed legislation governing ownership of pore space, regulatory responsibility, assignment of liability, and dominance of the mineral estate over pore space owners.

The University of Wyoming is researching all aspects of carbon sequestration, including pre and post combustion capture scenarios, and disposal and use opportunities for the CO_2 or CO_2 containing by-product. In the area of carbon capture, research has focused in two areas. First, evaluation of the potential capture by mineralization of carbon from the flue gas stream is being conducted with a pilot project at Jim Bridger power plant funded by the Wyoming State Legislature through the Clean Coal Research Program administered by UW's School of Energy Resources. Secondly, other sorbents for carbon capture are being studied, funded by the same program. In the area of geologic sequestration, eleven groups of researchers from three UW colleges and the Wyoming State Geological Survey are working to characterize the geology and geochemistry of potential receiving formations in southwestern Wyoming, undertaking experiments to characterize rock-fluid reactions and carbon dioxide trapping mechanisms, and developing geophysical and numerical models for use in monitoring long-term carbon dioxide in the subsurface. This two-year research project is funded by the Department of Energy National Energy Technology Laboratory (DOE-NETL).

Further, the Enhanced Oil Recovery Institute, housed in the School of Energy Resources, is engaged in carbon-based enhanced oil recovery research. This technology provides environmental and economic benefit by injecting captured carbon dioxide into mature oil reservoirs. The advantage of this technology is that it can sequester CO_2 and produce additional oil from areas previously used for oil production without an impact on additional pristine land.

Electric Power Technology. Through the School of Energy Resources and the Electrical Engineering Department, current research is underway with various partners to enhance power grid stability and reliability. The Department of Energy's 2002 National Transmission Grid study called for real-time monitoring of the power system to permit the introduction of sophisticated automatic controls to prevent blackouts. The entire western United States and parts of Canada form one large power grid. A major event in one part of the West can affect the entire region. With modern electronics, the power utilities are able to collect an immense amount of measured information about the flow of electricity throughout the power grid. Advanced communication systems are used to relay all this information from all over the grid simultaneously back to control centers. The challenge is to determine at any given time how close the grid is to instability and take action to prevent a potential blackout.

Renewable Energy Research Center. Faculty from across campus are engaged in energy nanoscience research, particularly in solar cells, fuel cells, and energy storage.

Wind Energy. Wyoming, particularly southeast Wyoming where the University of Wyoming is located, is one of the best locations in the United States for wind energy resources. Wyoming is ranked 7th in total wind resource and is currently 13th in installed wind energy capacity (American Wind Energy Association, 2008). More important than total wind resource is the number of windier sites where wind energy is most profitable. It has been reported that Wyoming contains over 50 percent of the highest two

continental-based wind sites (class 6 and 7). In addition to this outstanding wind resource, Wyoming also has open space favorable for wind energy development and a market close by in the Front Range that would consume any electricity that is not used in Wyoming. Finally, Wyoming has a history of developing its energy assets.

The College of Engineering and Applied Science has conducted wind energy research for more than 10 years. The Wind Energy Research Center (WERC) at the University of Wyoming is quickly becoming one of the recognized academic centers for wind energy resource and wind turbine technology. There are 12 faculty members actively working on wind energy issues ranging over a diverse range of topics including wind resource measurement, estimation, and modeling; unsteady blade aerodynamics; blade materials; turbine dynamics and control; and wind turbine towers and foundations. The interdisciplinary nature of wind energy requires a team with such a diverse background. As a result of this history, UW formed the Wind Energy Research Center in December 2007 shortly after the announcement of a large gift from BP for wind energy research. Currently, there is almost $3 million of support for wind energy research projects in the center.

Water Quality and Conservation. The Department of Civil and Architectural Engineering participates in a federal-state-university research effort called the Wyoming Water Research Program (WRP). This program brings together the WRP and the National Institute for Water Resources (NIWR) at the University of Wyoming. The WRP supports faculty and students along with funding 10 researchers in academic departments and 22 research projects.

Climate Change. Recent grants totaling approximately $1.3 million have been received through federal stimulus funds to further climate change research at UW. Research projects have been awarded to the Department of Atmospheric Science to study various aspects of climate change which may lead to the first signs of ozone recovery in the Antarctic; to the Department of Geology and Geophysics for research in the Andes of South America; to the Department of Plant Science to advance the understanding of atmospheric ice nucleation; and to the Department of Botany to study how the timing of summer precipitation affects the responses of boreal forests to climate changes.

Facilities. Research facilities are prevalent at the University of Wyoming. Currently the College of Engineering and Applied Science maintains a renewable energy field site to develop and demonstrate renewable energy systems. Other research facilities on campus include the Enhanced Oil Recovery Institute, Coal Bed Natural Gas Center, Wyoming Reclamation & Restoration Center, Wind Energy Research Center, Renewable Energy Resources Center, Carbon Management Center, Uranium Research Center, Reservoir Characterization and Simulation Center, Clean Coal Technologies Center, and the new High Plains Gasification Advanced Technology Center.

Public Engagement

To broaden our influence beyond the traditional campus community, various units on campus will need to cooperate in a concerted outreach effort that will engage decision-makers, teachers, off-campus members of the public, and others. Possible engagement efforts are outlined below.

Summer Institute. Partner with the Science and Math Teaching Center (SMTC) to host a Summer Institute for teachers focusing on sustainability and climate science. This program would be similar to the summer institute currently offered by the School of Energy Resources (SER) and could be offered jointly with SER. If the National Science Foundation Experimental Program to Stimulate Competitive

Research (EPSCoR) proposal for Wyoming is funded, the Science and Math Teaching Center will host annual Global Climate Change in the Classroom (GC^3) summer institutes for high school and community college instructors from Wyoming and neighboring states during 2010 to 2014.

Speaker Series. Building on the work of the UW Climate Change Committee (C3) initiative, the School of Energy Resources speaker series, and the Haub School of Environment and Natural Resources speaker series, UW could support a campus and public speaker series on sustainability and climate science. The public lecture series would be imbedded in the Climate Issues Seminar as detailed above in the curriculum section.

Current Programs and Accomplishments

The campus is making an effort to promote environmental literacy on campus. The President of the University has taken a stance on climate change and the campus has formed a Campus Sustainability Committee to assist with sustainable initiatives. The Campus Sustainability Committee has facilitated completion of annual greenhouse gas emissions inventories, is developing this Climate Action Plan, and is communicating with the local community and other community organizations. UW's prominent position in the region allows it to serve as a leader in climate change and as an example for others to follow.

Many significant research projects on energy related and climate based topics are in progress. Curriculum enhancements and academic programs in environmental areas are ongoing, and more are being planned.

Action Steps

There are many opportunities to increase environmental education, awareness, and research in an academic environment. Students can be formally educated on sustainable practices from their first days on campus, and campus staff can enforce this culture with support and leading by example. Action steps for education, research, and public engagement are listed below:

Phase I

- Make the campus sustainability vision and goals clear and publicly available.
- Enhance the current sustainability campus groups, and set specific goals and targets.
- Expand sustainable and climate related classes when economically feasible.
- Develop minors in sustainability and climate change.
- Coordinate research projects for maximum effect.
- Promote problem-based learning opportunities to faculty across campus.
- Engage students in the measurement and monitoring process to assess progress toward meeting goals. Potential areas include measurement of energy and greenhouse gas reductions, assessment of behavioral change, and evaluation of budget and funding strategies.
- Establish sub-committees to focus on key areas and to promote student involvement.
- Incorporate awareness and outreach efforts into public engagement activities.
- Develop and conduct a peer-to-peer freshman environmental introduction program at residence halls so students are immediately aware of the sustainability vision and best practices.

Phase II

- Expand sustainable initiatives to include more students. One example is the Green Floors initiative which allows students to live on a residence hall floor that adopts sustainable practices.
- Consider including required introductory level environmental or sustainability classes in appropriate majors. Conduct other training sessions and workshops for students.
- Incorporate students from various departments to participate in the sustainability initiatives such as business, engineering, and the sciences.
- Continue to promote research in the areas of alternative energy, energy conservation, and water conservation through grants and involvement of faculty with specialties in these fields.

Metrics

The following statistics will be tracked and monitored by the Campus Sustainability Committee to evaluate progress in the areas of academics, research, and public engagement:

- Percentage of faculty participation in sustainable workshops.
- Percentage of freshmen enrolled in an environmental or sustainable class.
- Percentage of all students participating in an annual environmental or sustainable event outside of class.
- Number of students enrolled in and graduated from environmental or sustainable minors programs.
- Number and type of sustainable and climate related research projects ongoing at year-end.
- Number and type of sustainable or climate related events sponsored by the Campus Sustainability Committee, Student Sustainability Group, and other campus groups.
- Conduct an annual student, faculty, and staff survey to track sustainability awareness and involvement.

REDUCTION OF INSTITUTIONAL GREENHOUSE GAS EMISSIONS

This section is divided into sub-sections for major areas of focus in UW's effort to reduce greenhouse gas emissions. Sub-sections are included for energy, facilities, grounds, water, transportation, procurement and waste management, and policy and behavioral change. Each section includes a goal statement, background information, current programs and accomplishments, action steps, and metrics.

Energy

Goal Statement

Reduce greenhouse gas emissions through modifications in energy use and demand, increased efficiencies in utility delivery systems, and supplemental use of renewable energy sources.

Background Information

This section is divided into sub-parts for demand side, supply side, and energy sources and renewable energy potential.

Demand Side

The university's energy demand can be attributed to conditioning and operating campus buildings and facilities. The Central Energy Plant produces steam and chilled water for building conditioning and

laboratory use. Additional buildings are being considered for connection to the district energy system in the future. With the planned expansion, it is anticipated that the Central Energy Plant will not have redundancy within 10 years.

There are a number of existing buildings on campus to service all of the various campus needs. The ages of the buildings vary from the original campus construction in the late 1880s to recently constructed buildings. The majority of the existing buildings utilize steam heating from the Central Energy Plant coal fired boilers, with a base year round steam use on campus of 12,000 pounds per hour for domestic hot water, laboratory use, and distribution losses. Heating is accomplished in approximately 20 older buildings with original steam radiators. Other buildings have various hot water heating systems with steam as their source of energy and include systems with infra-red and fin tube radiation, unit heaters, and air handling units. The electricity to power buildings with air handling units comes from the local electric utility.

Natural gas is used for heating and hot water requirements for buildings not connected to the district energy system. End uses for natural gas also include laboratories and cooking. These buildings include student apartments, as well as outlying laboratory and science buildings.

The Central Energy Plant also produces chilled water for building cooling. Present capacity of the plant is 1,400 tons, but a new chiller to be installed in the summer of 2009 will increase capacity to 2,000 tons. The plant contains two electric chillers along with two flat-plate heat exchangers to utilize free cooling. Chilled water is distributed to 23 campus buildings, totaling approximately 1,226,000 square feet. Evaporative cooling schemes are used on five other facilities and a portion of two others. The remaining buildings have no cooling capabilities. Existing buildings are being added to the chilled water distribution as air conditioning upgrades are performed if evaporative cooling cannot be used. Both methods of cooling are supported by utility provided electricity and city provided water. Not all buildings are planned to be cooled.

The following chart in Figure 6 shows the percentage of campus total energy use from the major fuel sources that contribute to building energy use. Buildings are not currently individually metered for steam, water, or electricity, and only a few are metered for chilled water. The energy and water use for each building is therefore not known. A metering pilot program is expected to occur during the 2009-2010 academic year to begin the process of adding steam, water, and electricity meters to each building. The addition of metering is critical to identify improvement opportunities and measure results of upgrades.

Distillate is only used as an emergency backup and is not considered a contributing factor to building energy use.

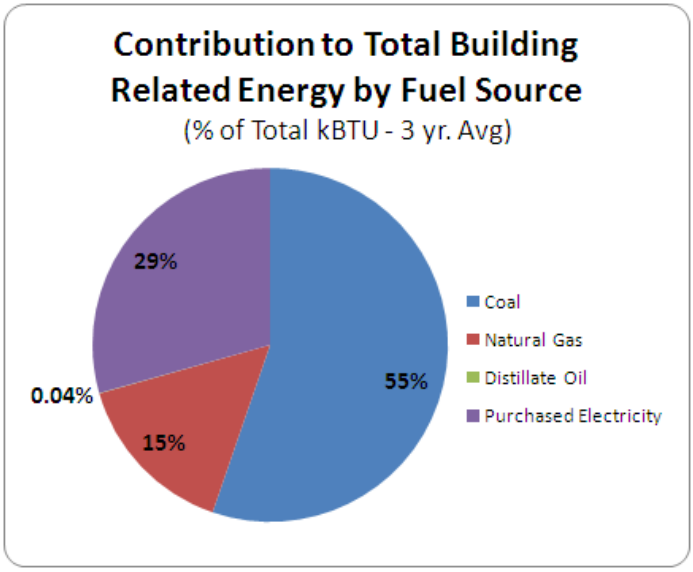


FIGURE 6. Total annual energy consumption (Anderson and Wechsler (2008), "Greenhouse Gas Emissions Inventory for the University of Wyoming").

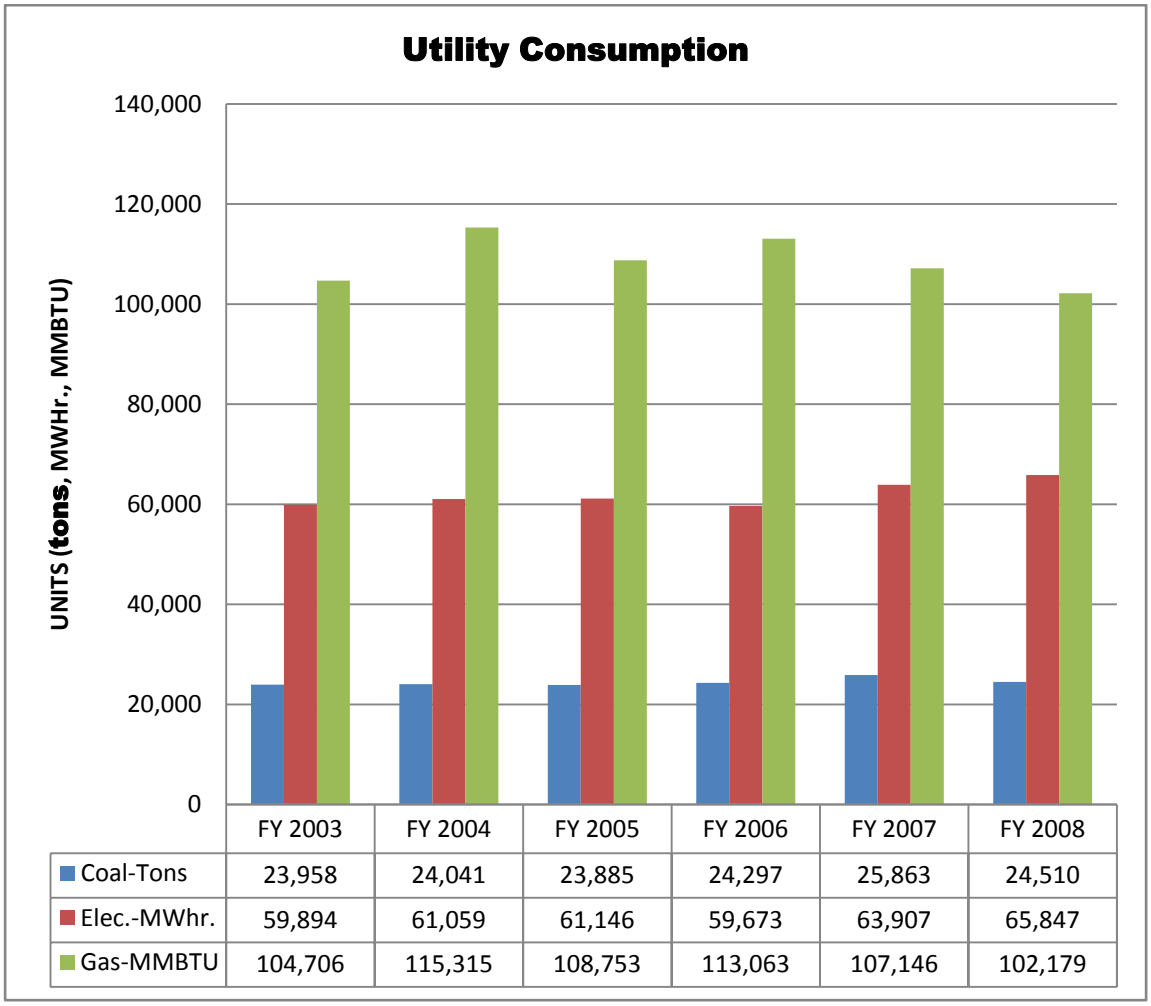
Limited control is currently in place for the majority of the building equipment on campus. Many of the building systems are not being turned off or set back during unoccupied hours. Computerized digital control has been added to the majority of the main building mechanical rooms but scheduling has not been implemented. Zone level systems are generally not on the central control system.

The existing building Indoor Environmental Quality (IEQ) for ventilation, occupant comfort, controllability of systems, and pollutant sources varies throughout the existing buildings on campus. This variation is inherent to a campus with many different building types and systems that have been installed at different points in time. The level of control available to the building occupants varies from operable windows, manual steam or water valves and manual light switches, to highly automated environments in recently constructed buildings. Minimum outside air ventilation in the various buildings is generally supplied through the air handling systems. However, in many older buildings air ventilation is accomplished with the use of operable windows. Indoor air quality at the Science Library, Corbett P.E., and Half Acre Infield has been improved through the installation of heat recovery systems. There are likely many other opportunities to improve building ventilation throughout the campus. Some of these improvements may have a negative impact on energy use but will improve the indoor environment for the occupants. Most new buildings now come with heat recovery systems, especially if evaporative cooled.

Many of the older buildings have steam heating systems with older thermostats, and some still have manual control valves. Temperature control has been recently improved at the eight and 12 story residence halls with the installation of heating control valves utilizing self powered integral thermostats. New control valves and thermostats could be used in other locations on campus to improve occupant comfort. With the variation in systems and configurations, there are many opportunities to reduce energy demand on campus.

Supply Side

The University of Wyoming main campus purchases most of its electricity from Rocky Mountain Power, which is connected to the Western Electricity Coordinating Council (WECC) power grid. Outlying areas are supplied through the particular electrical provider in that area. The core campus is fed from two substations with all distribution from these points owned by the university. Figure 7 below shows consumption amounts of the various energy supplies from FY 2003 through FY 2008.



	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
Coal-Tons	23,958	24,041	23,885	24,297	25,863	24,510
Elec.-MWhr.	59,894	61,059	61,146	59,673	63,907	65,847
Gas-MMBTU	104,706	115,315	108,753	113,063	107,146	102,179

FIGURE 7. Utility consumption by fiscal year and energy type.

In FY 2008, the university used approximately 65,800 megawatt hours (MWh) of electricity. Anticipated usage for FY 2009 will be over 66,000 megawatt hours. These amounts are over 10,000 megawatt hours per year higher than 1990 levels. This excess is assumed to be due to increased square footage, additional building cooling, and increased plug loads from computers and electronics. The approximate break down of electricity end use is 55 percent motors, 25 percent lighting, and 20 percent other plug loads. Renewable energy does not currently make a significant contribution to electricity supply; however, students do have the option to purchase wind energy credits to be applied to the Student Union electricity demand.

Buildings not connected to the steam distribution system have used an annual average of 107,500 MMBtu (one million British thermal units) of natural gas for the last three years for heating, hot water requirements, laboratory, cooking, and emergency generator use. Natural gas is also a back up for coal at the Central Energy Plant. Natural gas is supplied through Source Gas's mainline and local distribution systems.

Combined coal and gas use has been relatively constant since 1990. Projects have been performed to utilize more coal at the central plant in lieu of natural gas due to the lower cost of coal. Energy efficiency projects at both the Central Energy Plant and throughout the campus have allowed the total energy use from these two fuels to remain fairly constant despite additions to campus square footage. Coal is currently being supplied from a mine in Hanna, Wyoming, but over the years it has come from as far away as Decker, Montana (320 miles one way). Coal has always been transported by semi trucks. Ash disposal is typically done at the host mine or the local landfill. A feasible method to recycle this coal combustion by-product has not yet been found.

Energy Sources and Renewable Energy Potential

Wyoming has an abundance of natural resources including coal, uranium, natural gas, wind, and solar. According to the Energy Information Administration, Wyoming leads the country in coal reserves and production, producing both general and low sulfur coal and offering the lowest price in the county. The university's current coal contract receives coal from Hanna, Wyoming for fuel at the Central Energy Plant. Other potential suppliers are located in Decker, Montana; Green River, Thermopolis, and Rock Springs, Wyoming; and Craig, Colorado.

According to the Energy Information Administration, Wyoming also has the second largest reserves of natural gas in the country and has the eighth cheapest natural gas prices. Currently, natural gas is used only for backup at the Central Energy Plant, process loads, and outlying buildings.

Wind resources consistent with utility scale production are available just to the west and east of Laramie (National Renewable Energy Laboratory, 2002). According to the American Wind Energy Association, 349 megawatts of wind turbines are currently in operation in Wyoming, and 109 megawatts are under construction. Since 2007, students have had the option to purchase wind energy credits from Rocky Mountain Power to be applied to the Student Union; however, to date there has been limited participation. It is expected that Rocky Mountain Power, UW's electrical provider for the majority of its electricity, will improve its metric tons of carbon dioxide equivalents per kilowatt hour as it aggressively develops wind farms and reduces its coal based generation.

According to the U.S. Department of Energy, most of Wyoming receives 5,000 to 5,500 megajoules per square meter per day of energy from the sun. Laramie receives sun 250 plus days per year and is therefore a good candidate for flat plate collectors and other concentrating solar energies. The campus does have three photovoltaic arrays, initially set up for research and demonstration purposes, that the Physical Plant is now maintaining as part of the utility infrastructure. Total installed capacity of the three systems is 35 kilowatts with a peak output of approximately 20 kilowatts.

Current Programs and Accomplishments

Increasing energy efficiency and reducing environmental impact has become a priority on the University of Wyoming campus. Significant efforts have been in the areas of behavioral change, transportation, existing building efficiency, and new construction.

Even before signing the Presidents' Climate Commitment in 2007, the university was dedicated to reducing its energy use and exploring new opportunities. The Physical Plant has made significant efforts to evaluate opportunities to lower energy use and peak demand. Initiatives implemented over the last several years have made a noticeable difference in coal consumption and have helped to keep electricity use from rising as much as it would have otherwise. Some of the larger projects completed include:

- Installation of heat recovery systems in the Science Library, Half Acre, and Corbett P.E.
- Window replacements in several older buildings (Knight Hall, Health Sciences, Half Acre, Old Main, Hoyt Hall, Landmark Square, and Spanish Walk).
- Expansion of the campus-wide digital control network.
- Installation of heating control valves in the eight and 12 story residence halls.
- Installation of new boilers and better controls in the Plant Science Insect Soils facility.
- Performance contracts with UW's primary building control firm used at the Plant Science Insect Soils facility, State Veterinary Chemistry Lab, and the university's Casper facility.
- Numerous motor replacements and variable frequency drive installations.
- Lighting improvements at Coe Library, Fine Arts Building, College of Law, Corbett P.E., Half Acre Gym and Pool, Science Library, Class Room Building, Arts and Sciences Building, Knight Hall corridors, Physical Plant, and several other locations.
- Building renovations at Geology, Pharmacy, Health Sciences, Student Health, Knight Hall, Information Library and Learning Center, Student Union, Half Acre, Education, Washakie Cafeteria, McIntyre and Orr Halls, and other locations.
- Chiller replacement at the Ivinson Building.
- Window film on various buildings to decrease the cooling load.
- Extension of the campus chilled water system to replace aging building chillers in Knight Hall, Coe Library, College of Law, and Fine Arts.

In addition, the Physical Plant has started a campus-wide metering project to benchmark and track energy consumption for existing buildings and target the worst performers for improvements. Through the completion of the Utility Master Plan, different options for the Central Energy Plant are being evaluated, including cogeneration and converting to biomass fuel. The Physical Plant is also responsible for a large reduction in city water use by converting landscaping irrigation to well water.

The Physical Plant is also involved with Rocky Mountain Power's demand side reduction program which started in January 2009. The university is now receiving cash credits for energy efficient ballast, motor, variable frequency drive, or other electrical saving measures implemented.

To ensure that all new buildings on campus are energy efficient, the university has instituted the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) certification system as a new construction policy—all new buildings on campus must meet or exceed the LEED Silver standard. The latest building in the planning stages, the Visual Arts Facility, is striving to be a "net-zero" facility.

Along with energy efficiency, the university has a strong interest in renewable energy on campus. In recent years opportunities and costs for wind and solar energy projects have been evaluated. Solar panels and solar heating walls have been installed on the south side of the Indoor Practice Facility. This facility, along with the Hansen Teaching Arena, has light bands on the walls that provide enough lighting for typical operational needs.

To reduce environmental impact, transportation is a significant focus of behavioral change on campus. The university is promoting walking and biking to campus and the campus shuttle system has been greatly expanded. Designated parking areas for carpooling and increasing parking permit prices contribute to this effort.

Action Steps

To achieve the emission reduction goals outlined in this section, a comprehensive plan will be required. Action steps for each phase are divided into several major categories. The first phase includes planning, evaluation, and implementation of selected initiatives. The second phase includes continuance of phase one initiatives and implementation of higher capital cost measures.

Phase I

Action steps in Phase I focus primarily on four areas: (1) developing plans to reduce overall facility energy consumption; (2) evaluating Central Energy Plant upgrades and executing upgrades within defined payback range; (3) implementing infrastructure programs to reduce energy consumption and monitor energy usage; and (4) pursuing renewable energy alternatives.

- Complete the campus metering project, allowing energy and water use to be determined by building. Reductions in energy consumption will be the priority.
- Conduct retro-commissioning of existing control systems and optimize their performance, including tuning and enhanced scheduling.
- Complete the recently started digital control system upgrade, including setting up processes to best use the system and implementing the system throughout campus, beginning with replacement of the oldest systems.
- Implement a wider range of temperature set points (72 degrees for heating and 78 degrees for cooling) and seek feedback on any issues.
- Once building metering is in place, create an overall assessment of all buildings on campus. Use Energy Star to benchmark building performance. Identify the worst performing buildings to prioritize the need for improvements.
- Complete a campus-wide light lumen level assessment to determine areas where light levels are too high and delamping is applicable.
- Evaluate the efficiency and sustainability aspects of biomass burning opportunities at the Central Energy Plant for energy conservation opportunities. This may include:
    - Testing burning biomass in the existing coal boilers to determine the best biomass fuel and ratio to use.
    - Replacing ageing coal handling equipment that would better facilitate both non-stoker grade coals and future biomass fuels.
    - Further investigating the addition of a fourth coal/bio-mass boiler that could burn ¼ inch and smaller coal plus alternative bio mass fuels and possibly cogenerate, producing electricity.
- If the biomass burn is successful and sustainable, begin burning biomass fuel ratio in the existing Central Energy Plant boilers as practicable and economical.
- Complete implementation of recommended improvements at the Central Energy Plant.
- Evaluate the campus distribution system for energy saving opportunities such as leaks, piping changes, sources of heat losses/gains, and heat exchange effectiveness.
- Evaluate campus process loads for potential opportunities.

- Implement electrical distribution system and process load recommended improvements from the Utility Master Plan.
- Install wind data gathering towers at strategic locations owned by the university.
- Utilizing the first year's wind data, investigate and pursue opportunities to develop this resource through both institutional and/or outside sources.
- Investigate other wind turbine supplied electricity options.
- Investigate the possibility of participation in renewable energy programs such as Rocky Mountain Power's "Blue Sky" program to determine if it will prove cost effective and will count towards reducing the university's carbon footprint.
- Further investigate the feasibility of using Western Area Power Administration-Bureau of Reclamation's hydro power for the core campus.
- Investigate low cost lighting controls for larger areas.
- Install "Vending Mizers" on beverage machines throughout campus.
- Incorporate sustainable concepts and practices into the campus vending contracts.
- Evaluate the feasibility of instituting a "net zero" construction concept for new facilities.
- Add solar domestic hot water heating to any facility with constant water heating demands, such as gymnasiums or food service facilities.
- Investigate and implement integration of renewable energy sources, such as solar photovoltaics, solar hot water, or building integrated wind, in new facilities to offset a portion of the building energy.
- Investigate the cost and feasibility of offsetting 15 percent of campus electricity with renewable energy credits.

Phase II

Phase II continues to focus on the reduction of energy use, the expansion of alternative energy projects, and the purchase of carbon offsets as feasible. This phase focuses on the following areas: (1) implementing Central Energy Plant and infrastructure upgrades with higher capital costs; (2) increasing renewable energy use and possible generation; and (3) possible purchasing of Renewable Energy Credits and Carbon Offsets as needed and able to achieve target reductions.

- Complete expansion of the digital controls system to encompass the mechanical systems in all buildings on campus.
- Begin the process of incorporating cogeneration in the Central Energy Plant.
- Begin planning for larger scale central solar and/or wind generation.
- Purchase offsets as possible to achieve reduction targets.
- Raise enough funds to offset the energy use of the Student Union through purchasing Renewable Energy Credits.

Phase III

Phase III focuses on large reductions in the amount of non-renewable energy used to operate the campus. This phase focuses on the following areas: (1) net zero new construction; (2) upgrading the Central Energy Plant; (3) campus supply side large scale renewable energy projects; and (4) purchasing renewable energy credits and carbon offsets.

Due to the uncertainties in future technologies and fuels, this phase is not broken down in the same level of detail.

- Recommend that new buildings are constructed to net zero specifications if funding can be secured. This requires that buildings produce as much energy as they use throughout the year to have net zero energy use and emissions.
- Upgrade the Central Energy Plant to match capacity with the upgraded campus buildings and replace the central equipment. Convert the existing boiler system to cogeneration and change the fuel source to a biomass product or other options that still may use fossil fuels, but have substantially reduced CO_2 production.
- Convert the Central Energy Plant cooling system to the most efficient cooling method available.
- Complete the installation of a one megawatt or larger solar photovoltaic system on campus.
- Consider the installation of a wind energy farm either solely owned by the university or in conjunction with another organization.
- Continue to purchase renewable energy credits and carbon credits from third parties as possible to achieve reduction targets.

Metrics

Metrics for energy use are primarily based on reductions in consumption for each utility type and the cost efficiency achieved from conditioning campus facilities. Specific information will be gathered and analyzed by:

- Tracking and monitoring consumption annually for coal, electricity, natural gas, gasoline, and diesel through the greenhouse gas emissions inventory process to determine progress in reduced energy consumption and reduced carbon emissions.
- Accumulating and analyzing costs by utility type per each 10,000 square foot of gross facility space.
- Tracking of energy related projects implemented for the Central Energy Plant, energy infrastructure, alternate energy sources, controls, and other campus-wide energy consumption systems.

Facilities

Goal Statement

Reduce energy demand and increase sustainability for campus facilities by constructing energy efficient and sustainable new buildings and by renovating existing buildings with energy efficient building systems as economically feasible.

Background Information

Buildings are a significant part of the daily lives of people and of the economy. It is estimated that people spend 90 percent of their day indoors (Environmental Protection Agency, 2003), making the indoor environment incredibly important to the health and well-being of individuals.

Enhanced indoor environmental quality strategies typically include integrated day-lighting and task-lighting design, prioritized occupant comfort, and good air quality. Each of these strategies has been shown to increase productivity, improve attendance and performance, and save health-related costs. Well-designed day-lighting strategies have resulted in 15 percent less absenteeism, 18 percent higher test scores, and 40 percent increased sales revenues (Green Buildings Alliance, 2002). Good ventilation strategies have contributed to seven to eight percent higher test scores and a 3.2 decrease in

absenteeism (Green Buildings Alliance, 2002). Essentially, environmentally comfortable buildings create pleasant, healthy, and desirable spaces.

Materials that buildings consume are not just those used during construction. Carpeting, floors, furnishings, cabinetry, and equipment are replaced repeatedly over the life of the building. Increasing the life of these products includes modular furnishings that can be moved and redesigned as building needs change and carpet tiles that allow individual sections to be replaced as needed. Their embodied energy is being reduced by the increased use of recycled and rapidly renewable content.

With over 250 days of sun, long winters, and relatively cool summers, University of Wyoming buildings can benefit greatly from taking advantage of solar gains with minimal risk of overheating. New university buildings can use proper orientation and thermal mass to maximize solar access. On existing structures, overhangs can be used to manage solar gain. Incorporating passive solar principles is the current practice for new building design on campus.

The University of Wyoming campus is comprised of several facilities over 100 years old. The institution has maintained its architectural integrity through the use of local and regional materials and has maintained building quality through standards that have remained fairly consistent over the years. The campus has a collegiate ambiance and a familiar feel from building to building.

The institution faces two noteworthy challenges in operating and maintaining sustainable facilities. The first is renovating existing facilities to be technologically functional and energy efficient without sacrificing the character and historical significance of the structures. The second is to operate and maintain facilities within the financial limitations of a cyclical state economy.

Current Programs and Accomplishments

The University of Wyoming has adopted the requirement that all new construction and major renovations will strive to meet the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Silver standard. The planned renovation of the Kendall House and the renovation and expansion of the College of Business will pursue LEED Silver certification. Three more construction and renovation projects will aim to achieve the LEED Silver standard or better. While the university has not formally established its own sustainability guidelines or goals beyond the LEED rating, many practices that are part of the LEED process are already in place, including:

- Providing opportunities for the public to purchase and relocate smaller structures though the Facilities Planning Office and the Real Estate Office.
- Recycling/reusing building materials from buildings being demolished.
- Diverting construction waste from landfills.
- Using passive solar design in new buildings including east-west orientations, appropriate window design, shading, and thermal mass.
- Incorporating day-lighting in new designs to improve indoor environmental quality and lower electric lighting energy use.
- Locating major sidewalks above steam distribution tunnels to the extent possible.
- Achieving at least 20 to 30 percent energy use reduction below code requirements for all new construction.
- Utilizing energy modeling to assure energy reductions will be met.
- Implementing low energy heating and cooling systems in new designs.

- Commissioning all new buildings to confirm that building systems are installed and operating as intended.
- Incorporating materials that have recycled content or are regionally located where possible.
- Implementing cool roofs strategies, low-flow water fixtures, and low-emitting materials.
- Providing bicycle storage and changing areas.
- Reducing light pollution.

Some of the practices listed above have been utilized in the Indoor Practice Facility—natural lighting, natural ventilation, active solar heating and photovoltaic panels were installed on the south exterior. Achieving LEED Silver standards for new buildings should not be a far reach with the practices that are currently in place.

The Physical Plant has instituted design practices and guidelines to work toward consistency and efficiency in existing building systems across campus. Special efforts are being made in upgrades to lighting, window, roofing, and entry systems. With legislative support through major maintenance appropriations, the Physical Plant has been able to fund a phased building automation controls system upgrade, facility envelope upgrades, mechanical system improvements, interior lighting system replacements, and exterior lighting enhancements. All of these initiatives have contributed to increased occupancy comfort, a safer campus environment, and savings in energy consumption.

Action Steps

Phase I

Phase I action steps build on facility initiatives planned or in progress and set guidelines and priorities for additional initiatives.

- Review preventive maintenance procedures with emphasis on extending equipment life and improving operational efficiency and modify as needed.
- Develop sustainable building guidelines for new and existing facilities that express a clear vision for sustainability across the campus and incorporate them into the university's "Instructions to Architects and Engineers."
- Set a goal for low energy use intensity for new and existing buildings by type.
- Continue to utilize energy modeling to achieve performance goals in early design stages.
- Set percentage targets for energy performance, renewable energy production, water efficiency, and material resources used or consumed by facilities.
- Establish a green cleaning policy for all buildings.
- Locate and orient future buildings along east-west axis to maximize solar opportunities to the greatest extent possible. Consider microclimates created by building orientations in the Wyoming climate.
- Develop a local source for native stone.
- Conduct a waste audit, including solid waste, wastewater, and heat, to identify opportunities to reduce waste and to allow buildings to complement each other.
- Complete a campus-wide lighting fixture upgrade that includes converting any T-12 lamps to T-8 or T-5 lamps and any incandescent lamps to compact florescent lamps.
- Install occupancy sensors for lighting in all intermittently occupied areas.
- Conduct facility evaluations for campus data centers and labs. Implement recommended improvements with acceptable paybacks.
- Begin energy saving performance contract projects for identified buildings and systems with five year or less paybacks.

- Implement building envelope upgrades including replacing windows, adding insulation to roofs, and sealing all sources of excessive infiltration with a Phase I target of 25 percent of existing buildings.
- When feasible, install or replace roofs with a light colored roofing material.
- Integrate sustainable building concepts into the educational curriculum.

Phase II

Phase II action steps expand facility initiatives to include those with longer paybacks or higher up-front costs.

- Continue the campus wide envelope upgrade with a Phase II target of 60 percent of existing buildings.
- Introduce LEED Existing Buildings Operations and Maintenance or a plan with similar strategies to address ongoing building operations.
- Require new construction projects to meet or exceed a LEED Gold rating.
- Establish formalized processes for integrated and sustainable design early in the project delivery process, preferably during schematic design.
- Develop a comprehensive habitat restoration plan both campus-wide and for microclimates.
- Implement building efficiency measures with a 10 year payback or less.
- Implement remaining efficiency measures in data centers and labs utilizing a 15 year payback or less.
- Complete Energy Saving Performance Contract projects for applicable buildings including relevant equipment replacement and major controls upgrades.
- Identify synergies with Laramie to share resources.

Phase III

Phase III action steps are more general and include flexibility for changes in strategy, technological innovation, and cost.

- Continue with aggressive upgrades and improvements in existing buildings such as aggressive envelope renovations, large equipment replacement, and incorporation of renewable energy generation.
- Implement building efficiency measures with a 15 year payback or less. Design new systems to promote thermal comfort, user control, and natural ventilation with strategies including radiant heating and cooling panels, chilled beams, under floor air distribution, evaporative and free cooling, and natural/displacement ventilation.
- For buildings not on the central heating and cooling systems, design new systems for enhanced efficiency, incorporating low energy use central heating and cooling plants such as condensing boilers, evaporative cooling or variable frequency drive chillers with free cooling, and use of natural ground water tables, ground source heat pumps, subsurface thermal mass, and passive and active solar.
- Integrate renewable/reclaimed energy in new building design.

Metrics

The following metrics are suggested to measure progress toward sustainability:

- Track amounts directly expended on projects resulting in building energy reductions each year.

- Monitor energy use by utility type attributable to specific facilities.
- Record all new building projects meeting LEED Silver standards or higher.
- Verify building energy performance as outlined in LEED.
- Track the percentage of total campus square footage using green cleaning concepts.

Grounds

Goal Statement

Strive to build and develop in ways that reduce impact on the campus and community ecosystem. Establish sustainable development plans to protect and restore open spaces and build in areas with existing infrastructure. Create a framework for pest management, erosion control, storm water management, and landscaping management.

Background Information

The University of Wyoming is the only four-year higher education institution in Wyoming. It is located in south-central Wyoming, within the heart of Laramie, the third largest city in the state (population 25,688). The population density of Laramie is 2,442 persons per square mile, which is comparable to Montana State University in Bozeman, Montana (2,183 persons per square mile) and Colorado State University in Fort Collins, Colorado (2,550 persons per square mile).

UW is located in the Laramie Valley, a high plain nestled between two mountain ranges, the Snowy Range and the Laramie Range. The area is not in a moderate or special flood area as defined by the Environmental Protection Agency. There are several hazardous waste locations near the university and two regulated air emission locations, one of which is the Central Energy Plant on campus. There are no known endangered or threatened species currently living on the university property; however, according to the United States Department of the Interior, there are 10 endangered or threatened species that live within or can be affected by projects in Albany County. There are some areas on campus with native vegetation and wildlife.

When the University of Wyoming was founded in 1886 as a land grant institution, it began with a commitment to improving agriculture and military programs (University of Wyoming American Heritage Center). Today, most of Wyoming is considered to be rural, with mining and ranching as significant industries in the state. Maintaining and improving open spaces and creating a positive connection with the local environment fit naturally with Wyoming's history.

The UW campus size is approximately 750 acres including an 18-hole golf course. In addition to the golf course, approximately 90 acres are maintained landscape. The campus landscape includes approximately 1,000 pine trees, 2,000 spruce, 600 deciduous trees (mostly cottonwoods), 600 shrubs, and a number of ornamentals. Physical Plant operates a campus greenhouse and maintains the majority of campus grounds.

The campus has developed further east over time primarily due to available space. The cemetery on the north-central part of campus has further pushed the university expansion to the east. The density of the east campus is lower than the west campus. Eastward expansion has created a relatively long and narrow campus with long distances between residential areas in the east and academic buildings toward the west.

Goals for this section are similar to those outlined in LEED for Existing Buildings (LEED-EB). By following the Action Steps defined in the sections below, existing buildings on campus should be able to meet the requirements needed to achieve points in the Sustainable Sites section of LEED for Existing Buildings.

Current Programs and Accomplishments

The campus has many key open spaces that give the users of the campus a connection with the outside environment. Several of the larger areas are protected from development by charter. Some undeveloped areas remain with native vegetation such as the open spaces around the new Wyoming Technology Business Center and east of the golf course, and there are storm water retention areas that have native vegetation and local species. Many large trees provide shade especially in the older areas of campus, and several plazas with granite boulders have been created to replicate mountainous areas east of campus. Community and campus connectivity is an ongoing focus of the university during future development.

Current programs include an annual campus beautification program to improve rights of way by planting trees and adding landscape, and a tree spraying program to protect pine and spruce trees from pine beetle infestation.

Action Steps

Phase I

- Create a plan to protect or restore campus open spaces for natural habitats and connection to the environment.
- Consider the Wyoming climate and building locations when determining placement of open spaces.
- Create a management plan that integrates pest management, erosion control, and landscape management (including the golf course).
- Evaluate options for capturing and using groundwater and roof runoff for irrigation (including the golf course).
- Continue the campus beautification program as possible through annual funding from the Physical Plant operational budget.
- Reduce light pollution by shielding all fixtures greater than 50 watts.

Phase II

- Evaluate the current storm water system and implement a storm water management plan that collects and reuses or evaporates at least 15 percent of the precipitation on campus.
- Convert hard surfaces to permeable surfaces to allow storm water to drain into the ground water system.
- Use native or adapted vegetation to cover a minimum of 25 percent of the campus area, excluding the building footprints. This cover may include native trees and vegetation for wind break, shading, carbon sequestration, and storm water control.

Phase III

- Reduce heat islands by installing and maintaining a vegetated roof covering for at least 25 percent of the roof area.

Metrics

- Track number of trees planted on campus or in the surrounding community each year.
- Track acreage converted to native landscaping.

- Track square feet of hard surface converted to permeable.
- Track campus habitat inventory, including acres of natural habitat, number of contiguous acres, habitat type, and identification of pressured species.
- Conduct annual light surveys to monitor light levels, identify areas for improvement, and maintain a safe and secure exterior environment.

Water

Goal Statement

Reduce water use at the University of Wyoming through educating students, staff, faculty, and administrators about water conservation, upgrading plumbing fixtures, and reducing the amount of water used for irrigation. Water use reduction goals are separated into two categories: (1) domestic water use, and (2) irrigation water use. This plan outlines the following reduction goals in university domestic water use as compared to 2006 levels: (1) 15 percent by 2015; (2) 25 percent by 2020; and (3) 40 percent by 2030. The plan outlines the following reduction goals in university irrigation water use as compared to 2006 levels: (1) 5 percent by 2015; (2) 20 percent by 2020; and (3) 30 percent by 2030.

Goals for this section are similar to those outlined in LEED for Existing Buildings. By following the action steps defined in the sections below, existing buildings on campus should be able to meet many of the requirements needed to achieve points in the water efficiency section of LEED for Existing Buildings.

Background Information

Domestic Water Use

The plumbing fixtures in existing buildings have varying levels of water efficiency. Some fixtures have been replaced over time but many are still older fixtures with high water use. For new buildings, specifying and installing efficient plumbing fixtures is a practice currently in place in response to the requirement for LEED Silver equivalent buildings. The buildings are not currently individually metered and therefore the usage by building is not currently known.

Figure 8 shows the water use by campus buildings, including athletic facilities and the Central Energy Plant. This figure excludes residential living facility or dorms. From 2006 to 2007, total campus domestic water use, including residential living facilities, has been relatively constant at an average of 220,000 gallons per year.

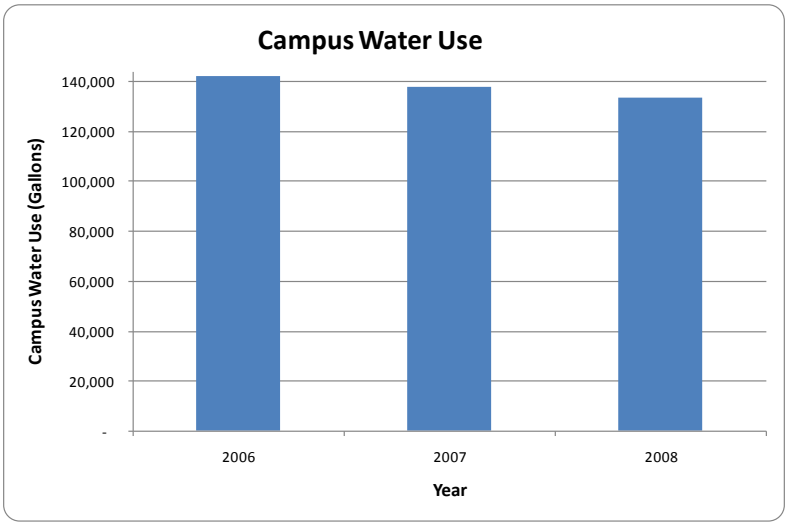


FIGURE 8. Campus building water use excluding residential living.

The domestic water needs on campus are expected to grow throughout the next 30 years as additional buildings are constructed. The estimated demand increase is shown by the business as usual (BAU) line in Figure 9 which estimates the trend if no changes were made to domestic water use. Steps to achieve the 2020 and 2030 goals are shown by the reduction trend line in Figure 11.

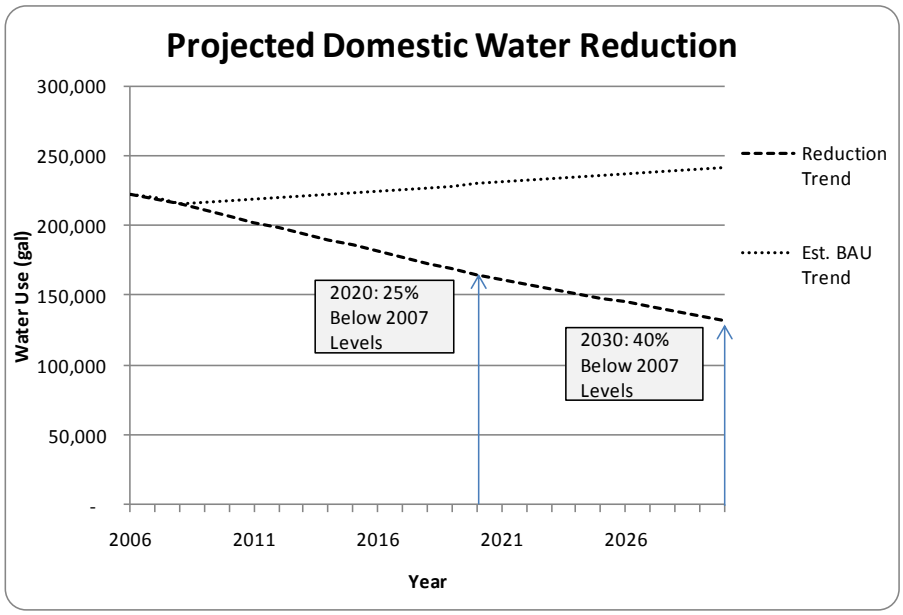


FIGURE 9. Projected domestic water use trends.

Irrigation Water Use

The university maintains approximately 90 acres of irrigated land in addition to the golf course. The university operates two on-campus wells for irrigation. As possible, additional acreage is converted from City water to the well system to reduce water costs and provide a more sustainable irrigation system. In terms of irrigation, it is more sustainable to use untreated water pumped from on-campus wells. Using city water is less sustainable because it has to be pumped to a treatment plant, treated

with chemicals, and pumped back to the point of use—all of which require energy use. It costs the university more to use city water and untreated water is better for the turf, plants, and trees.

Well water is not currently used to irrigate athletic fields or the university golf course. The university peak water demand is currently during the summer months, indicating that some irrigation is still accomplished using potable water. Figure 10 illustrates the number of gallons of well water used annually to irrigate campus grounds.

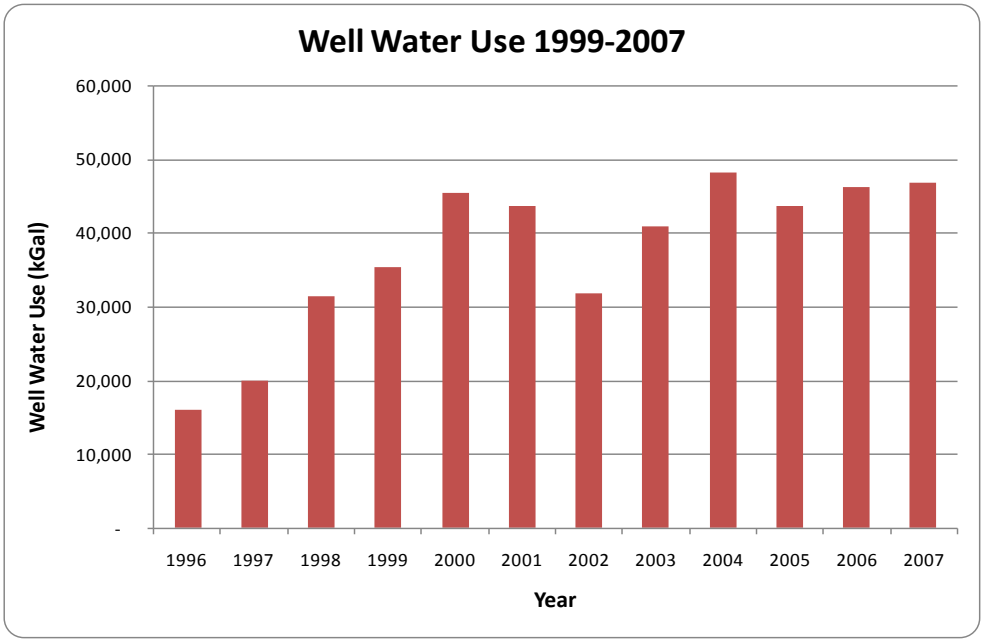


FIGURE 10. Campus well water use.

The demand for well water irrigation will continue to rise as landscaping is removed from the city water system and high water use facilities such as the athletic fields are converted to well water systems. The projected increase is shown by the business as usual (BAU) line in Figure 11, along with the goals for reducing irrigation water use.

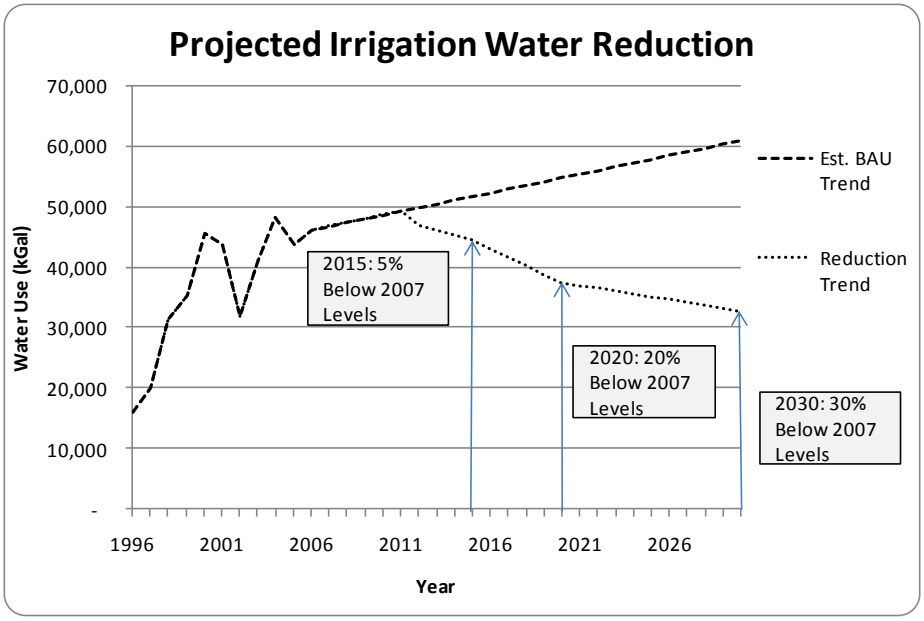


FIGURE 11. Projected irrigation water use trends.

Current Programs and Accomplishments

The university has implemented several water conservation efforts to lower the potable water used in buildings and the water used for irrigation. The list below highlights a few of these accomplishments:

- All plumbing fixtures for new construction projects are required to be low-flow fixtures.
- Irrigation currently takes place during morning or evening hours to prevent watering during the middle of the day.
- Starting in 1995, the majority of the campus irrigation systems have been converted from potable to well water.
- Many of the well irrigation systems have been upgraded to include automated controls which were estimated to save between 20 to 50 percent of the water consumption for irrigation.
- All new construction projects utilize well water for irrigation.

Action Steps

Action steps are outlined below and are broken into two groups: (1) domestic water use, and 2) irrigation water use.

Domestic Water Use

The action steps below outline a plan to achieve the aggressive domestic water reduction goals. These steps include the following categories: (1) existing plumbing fixture efficiency; (2) new construction plumbing fixtures; (3) converting irrigation to well water; (4) water conservation; and (5) the use of gray water systems. Figure 12 depicts the effects of implementing these steps.

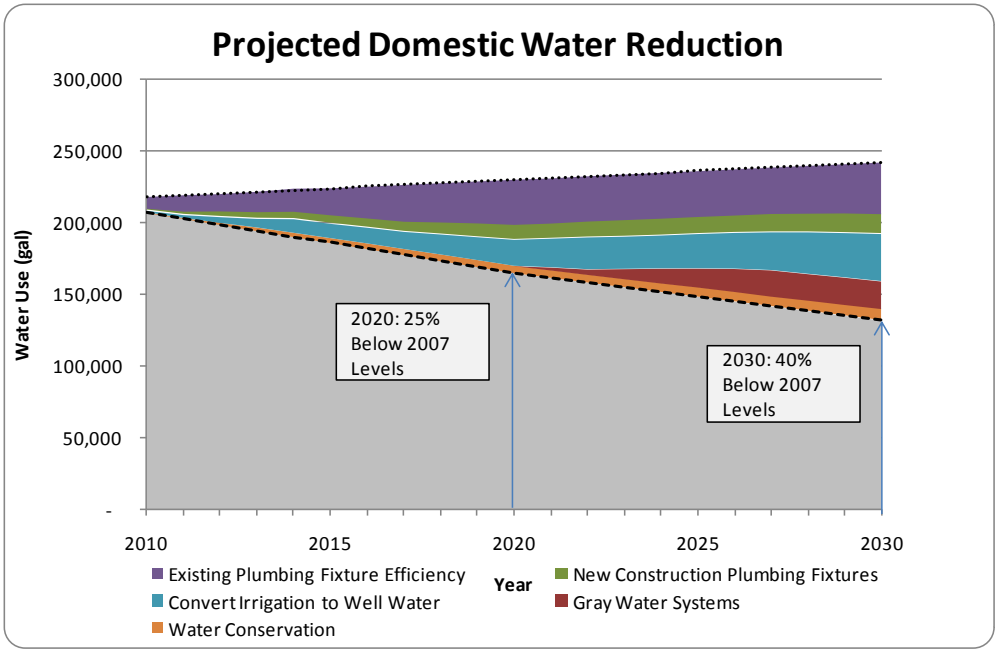


FIGURE 12. Domestic water use reduction.

Phase I

- Complete the building metering project to identify buildings with high water usage. Metering will help identify priority projects and allow for verification of savings when efficiency improvements are made.
- Create awareness among students about water use and water conservation.
- Convert all existing irrigation to well water.
- Require all new construction projects to meet LEED water requirements as part of the campus prototype credits.
- Institute the campus-wide water reduction initiative that includes replacing existing non-compliant plumbing fixtures with new low flow and occupancy sensor controlled fixtures.

Phase II

- Begin to sub-meter any equipment with high water use, such as cooling towers.
- Complete comprehensive upgrade of all fixtures on campus.
- Utilize advance technology in new buildings such as on-site filtration and water re-use to minimize building water use.
- Collect and reuse rainwater when possible.
- Begin a more comprehensive domestic water system upgrade to integrate water supply, treatment, and reuse in all buildings on campus.

Phase III

- Begin a more comprehensive domestic water system upgrade to integrate water supply, treatment, and reuse in all buildings on campus.
- Expand initiatives with rainwater, gray water, and other advanced technology-enabled initiatives.

Irrigation Water Use

Reductions in irrigation water use will be met by the action steps outlined below. These steps fall in to the following categories: (1) new landscaping requiring no irrigation; (2) converting existing landscaping to low water use vegetation; (3) upgrading controls and piping; (4) utilizing groundwater and roof runoff water; and (4) upgrading athletic field turf. Figure 13 shows the effects of implementing these strategies.

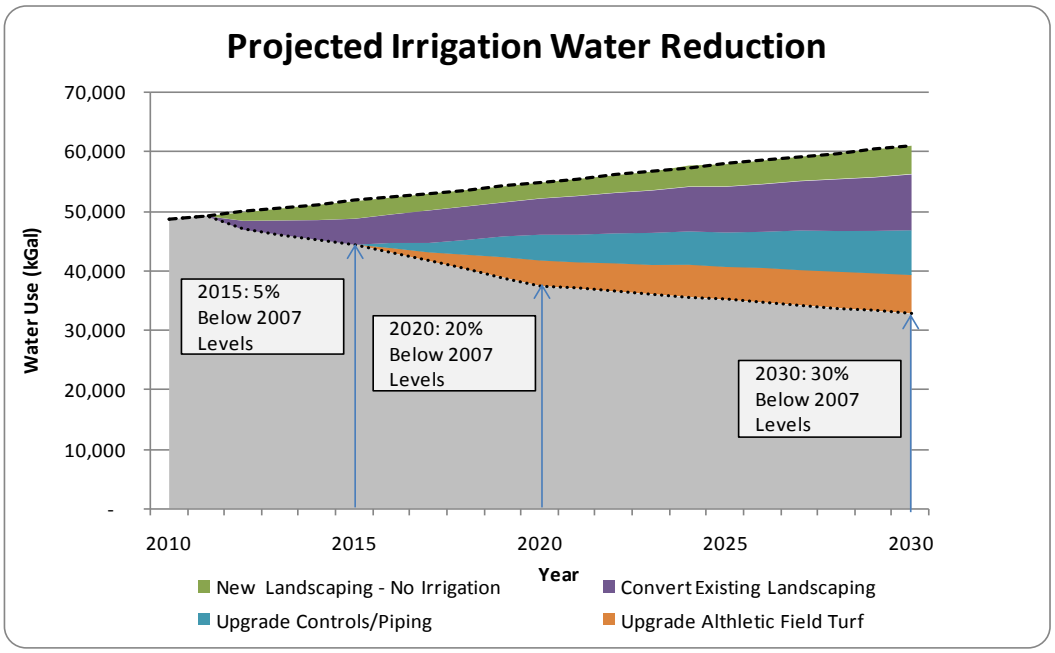


FIGURE 13. Irrigation water use reduction.

Phase I

- Meet LEED requirements by utilizing only low water-use and drought-resistant native vegetation for all new building landscaping. For playing fields or recreation areas that require turf, install grasses that reduce the water needs for these areas.
- Develop a plan to re-zone irrigation piping systems to provide different levels of watering to low water-use areas or replace normal water-use vegetation with low water-use or drought-resistant vegetation.
- Upgrade individual automated irrigation controls system by installing a central control system with more capability. This system will be capable of utilizing local weather conditions and ground moisture readings to determine amount of irrigation required.
- Utilize groundwater and roof runoff water to supplement well water for the campus irrigation system.

Phase II

- Convert existing areas to low water-use landscaping.
- Create a more integrated campus water system that integrates building gray water, storm water, and irrigation needs.

- Convert recreation area and golf course to well water systems. Replace recreation area turf with alternative material or grasses.

Phase III

- If water supply is an issue, convert the majority of all outdoor areas to non-irrigated landscaping.
- Complete an upgrade of campus irrigation piping and controls system to reduce the amount of over-watering for different vegetation areas.
- Convert all remaining irrigation to well water systems.

Metrics

Reduction in water consumption will be tracked and monitored annually from city water billings for domestic water and from flow meter readings for well water.

Domestic Water Use

Phase	% Reduction from 2007 Levels	Gallons Reduced
PHASE I: 2015	10%	21,975
PHASE I: 2020	25%	54,939
PHASE II: 2030	40%	87,902

Irrigation Water Use

Phase	% Reduction From 2007 Levels	kGal Reduced
PHASE I: 2015	5%	2,336
PHASE II: 2020	20%	9,344
PHASE III: 2030	30%	14,016

Transportation

Goal Statement

Reduce the institutional carbon footprint from transportation through expanding the mass transit system, increasing bicycle and pedestrian traffic, replacing fleet vehicles with more fuel efficient vehicles, increasing alternative fuel and hybrid vehicles, and implementing alternate modes of transportation with fewer carbon emissions.

Background Information

In 2008, the university, the city of Laramie, and the Wyoming Department of Transportation undertook a study evaluating transportation and parking conditions on campus and in the surrounding community.

The results of this study are found in the March 2008 University of Wyoming Transportation and Parking Master Plan by Stantec. The information from the Stantec report was used in the campus greenhouse inventory completed in August of 2008 to conclude that transportation contributes approximately 13 percent of total campus greenhouse gas emissions.

Mass transit opportunities in Laramie were limited prior to 2008, contributing to the high transportation demand component. In addition, the university fleet consumed nearly 100,000 gallons of gasoline and 35,000 gallons of diesel in 2007. The university also owns two planes and sponsors travel on commercial airlines. In 2007, UW employees traveled over 19 million miles by plane (Anderson and Wechsler, 2008).

According to the transportation plan, 9,982 students attend the University of Wyoming, of which 2,053, or approximately 21 percent, live on campus. The university also employs 2,445 faculty and staff. Approximately 66 percent of students, faculty, and staff commute to campus in individual vehicles, consuming 77,738 gallons of gasoline and 8,920 gallons of diesel fuel per year (Anderson and Wechsler, 2008). Nearly 25 percent travel by foot or bicycle, with 15 percent walking and 9 percent riding bikes (Stantec Consulting, 2008). Figure 14, adapted from the Transportation and Parking Master Plan, shows this breakdown:

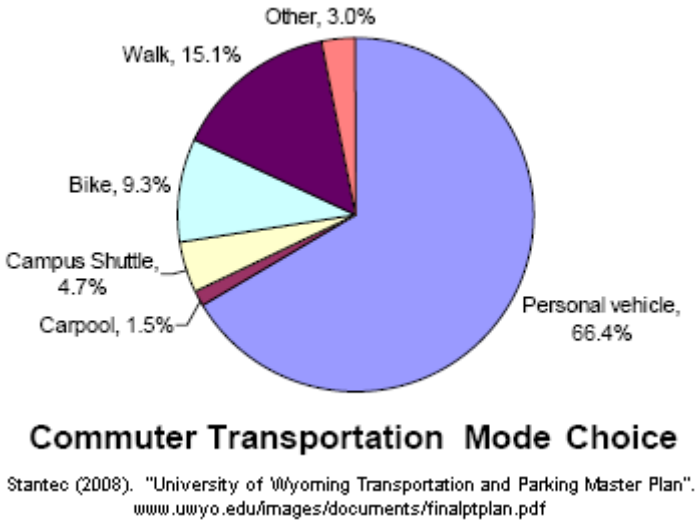


FIGURE 14. Commuter transportation modes.

The shuttle system is partially funded through student fees and bus passes purchased by faculty and staff. Currently, less than five percent of faculty and staff currently ride the campus shuttle regularly. There are five shuttle lines serving campus on business days from 6 a.m. to 6:30 p.m., with two lines offering service until 10 p.m. There are also two on-call services for night and weekend demand or for those with disabilities during business days. Two shuttle lines run at five minute intervals, two at 10 minute intervals, and one at 24 minute intervals. There are two additional services that provide access to off campus areas within Laramie.

Current Programs and Accomplishments

The university has expanded its mass transit system significantly in the last year and has plans to further expand the system in the next year. Mass transit improvements already implemented include leasing

additional buses for expanded routes and sponsoring a bike library that loans bikes for a small fee per semester. Plans are in place to purchase more fuel efficient buses for the mass transit system and to track riders to improve system efficiency.

A bicycle and pedestrian program has been developed including designated bike and pedestrian paths and expanded bike rack locations. Over 500 bike rack spaces were added to campus last year, and a campus map was created showing bike paths, bike racks, and dismount zones. Additional signage was installed to identify accessible paths and enhance way-finding.

Action Steps

The University of Wyoming commits to the following steps to reduce carbon emissions associated with its transportation systems:

Phase I

- Continue shuttle system and parking improvements to reduce the number of single passenger vehicles driven to campus.
- Improve biking and walking routes to encourage more pedestrian transportation within campus.
- Compile information for all campus vehicles including fuel type, gas mileage, and Greenscore rating.
- Prioritize vehicles and equipment for replacement, and create lists of preferred vehicle/equipment types for purchase.
- Replace campus vehicles with electric and hybrid vehicles where appropriate and feasible.
- Evaluate the feasibility of purchasing hybrid/electric buses and shuttle vehicles.
- Adopt policies to purchase the most efficient campus vehicles practicable.

Phase II

- Explore the availability and possibility of converting existing vehicles and equipment to use compressed natural gas as a primary fuel source.
- Purchase and use alternative vehicles and other modes of transportation as applicable for on-campus transportation.
- Conduct an annual transportation survey to evaluate mass transit ridership, alternate modes of travel, and perceptions of campus transportation to assist in measuring Climate Action Plan effectiveness.

Metrics

The following metrics will be used to measure achievement of the transportation goals and accomplishment of the action steps:

- Track cumulative vehicle statistics annually from the vehicle list.
- Track gasoline and diesel quantities consumed on an annual basis.
- Monitor the number of hybrid vehicles and percentage of hybrids as a total of the fleet.
- Monitor the number of alternative fuel vehicles and percentage as a total of the fleet.
- Track annual rider counts monthly for the campus mass transit system.
- Track the number of bicycle registrations annually.

Procurement and Waste Management

Goal Statement

Set a baseline for current sustainable purchases of materials and increase those purchases 50 percent by 2015 and 75 percent by 2020 as measured by cost.

Set a baseline of current waste volume and reduce waste from materials and food on campus 50 percent by 2015 and 70 percent by 2020 as measured by volume or weight.

Goals for this section are broken into two parts: (1) procurement, and (2) waste management. The goals are similar to those outlined in LEED for Existing Buildings. By following the action steps defined in the sections below, existing buildings on campus should be able to meet many of the requirements needed to achieve points in the materials and resources section of LEED Existing Building standard.

Figure 15 depicts the effect of projected waste reduction targets.

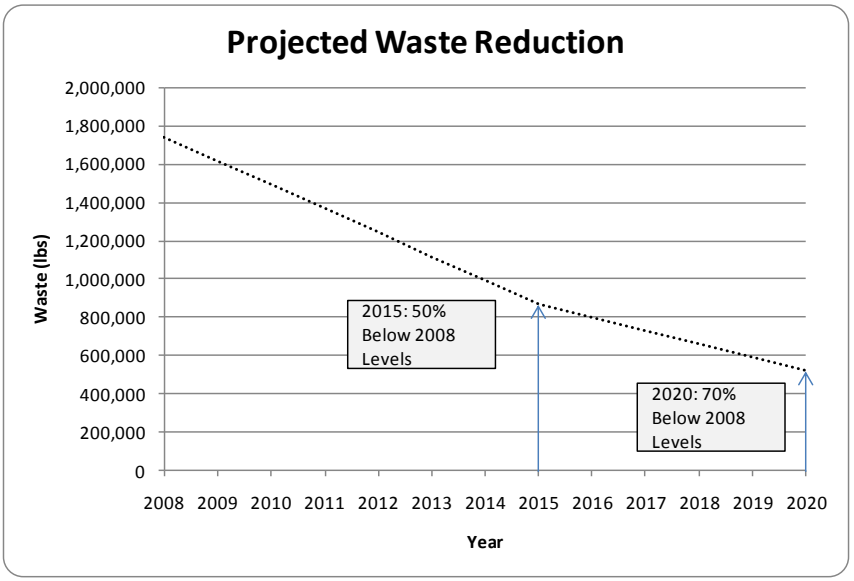


FIGURE 15. Projected waste reduction.

Background Information

Procurement and waste management are broken into the following subcategories: (1) ongoing consumables; (2) food service; (3) durable goods; and (4) facility alterations and additions. Ongoing consumables, according to LEED Existing Building, covers materials with a low cost per unit that are regularly used and replaced, such as paper, binders, and batteries. Food includes both its production as well as its transportation. Durable goods refer to items that are a higher cost per unit and are replaced infrequently, such as electric–powered equipment or furniture. Facility alterations cover renovations, demolitions, and new construction additions.

Ongoing Consumables

The university purchases ongoing consumables through the procurement department or individual university departments. The procurement department has made an effort to purchase 30 percent post-consumer products and 100 percent recyclable materials and requires campus vendors to look closely at the environmental aspects of their products. The three largest suppliers include this information with

their product offerings. The procurement department also has made a significant effort to promote environmentally friendly material purchasing among other university departments; however, each individual department is in charge of its own budget and purchasing. Implementation of a purchasing policy should be considered to require all departments to follow the same guidelines.

The campus recycling program includes several ongoing consumables. Receptacles for paper and plastic are located in almost all buildings, and exterior bins are located across campus for other items. The bins in newly renovated buildings are large, well marked, and have good placement. The recycling efforts currently include co-mingled containers such as cans and bottles, paper, and printer ink cartridges. Recycling efforts to reduce waste have increased with participation in the national RecycleMania competition. As part of this competition, the university targets paper, corrugated cardboard, bottles, and cans.

Food Service

The majority of dining services at the university are provided at the Washakie Dining Center. Elements, Book and Bean, and a few other on-campus dining facilities at the Student Union are also available. These facilities offer a number ways to reduce waste, from a reusable mug program to corn-based compostable containers. Some food scraps are sent to the recently established campus student farm (ACRES) to be composted; however, based on discussions with campus staff, only a small portion of food waste is currently composted due to the limited number of locations that will accept this material. Dining Services currently purchases sustainable goods such as organic, fair trade coffee and some recycled materials.

Durable Goods

Durable goods are purchased by departments through the procurement office. The property department takes care of disposal of most durable goods. Currently, unneeded equipment is offered for sale to departments, students, and the public, and anything left over is recycled if possible. A program through the Division of Information Technology allows for lab computers to be sold to other departments after three years at a discounted price. Desks and various other pieces of equipment are recycled at the local recycling facility, and computers are taken to Denver. When reuse or recycling is not possible, items are sent to waste. Even with these practices in place, some items are sent to waste before they can be sold for reuse due to the lack of storage space at the university and resources available to administer this activity.

A significant effort has been made by the university to purchase sustainable durable goods. A campus policy is currently in place to purchase energy-efficient appliances with an Energy Star certification.

Facility Alterations and Additions

Purchasing and waste management for new construction or major facility alterations are currently guided by LEED Silver requirements, including the recycling or reuse of building material waste, along with purchasing recycled content materials, regional materials, rapidly renewable materials, certified wood, and low-emitting materials.

Facility alterations and smaller renovations are performed by the Physical Plant. The Physical Plant has created a website dedicated to sustainable purchasing, complete with an extensive database of products that will help achieve a sustainable campus (see http://uwadmnweb.uwyo.edu/pplweb/sustainability/Index.html). The database can be used to search

for acceptable green products such as custodial items and outdoor products and includes a list of local vendors to promote the purchase of local materials. Links are also included for Energy Star and Green Seal products. The Physical Plant has recently explored using environmentally friendly cleaning chemicals campus wide.

Current Programs and Accomplishments

Sustainable practices are taken into consideration in procurement and waste operations across campus. Individuals from these departments are active on the Campus Sustainability Committee, and thought has been given to the potential improvement opportunities in these areas. Recycling has increased and has been provided in new areas. The recycling operation is part of Physical Plant. It is funded primarily through a student fee of eight dollars a semester (effective July 1, 2009). Additional funding comes from sales of recyclable materials. Efforts are being made to divert durable goods and construction materials from the landfill, and sustainable purchasing initiatives are in place. Several of the current programs and accomplishments are outlined in the background information above. Highlights of these efforts include are outlined below:

- Sustainable purchasing practices are currently in place for new construction and major renovations. These practices correlate with the requirement that all new construction and major renovations at the university will strive to meet LEED Silver standards.
- Sustainable purchasing is being utilized in some departments for both ongoing consumables and durable goods.
- The university has adopted an Energy Star purchasing policy.
- The university participates in the annual national RecycleMania competition.
- The Student Sustainability Committee has distributed additional recycling containers throughout campus.
- Local metal recycling is being utilized. Computers and electronics are being recycled in Denver.
- Collections for recycling have increased from 300 tons in 2005 to 400 tons in 2008.
- The student body has approved an increase in the recycling fee that will fund one additional employee to allow expansion in pick up and drop off recycling locations on campus.
- If possible, durable goods are sold for reuse prior to disposal.

Action Steps

This section is broken down into action steps that will create a framework for achieving the waste management and materials purchasing goals.

Phase I

- Ongoing consumables – develop a plan to reduce paper use by 20 percent.
- Ongoing consumables – ensure purchases contain 10 percent post-consumer materials or 50 percent rapidly renewable resources.
- Food service – ensure purchases are 25 percent sustainable by cost, including Unite States Department of Agriculture (USDA) certified organic or fair trade products.
- Durable goods – ensure furniture purchases contain 10 percent post-consumer materials.
- Conduct an initial waste audit in 2010 and continue with an annual audit each year after.
- Expand and promote the campus recycling program to achieve a 20 percent increase in recyclables.

- Expand recycling operations by adding one full time employee and one additional truck to facilitate increases in and frequency of in pick up and drop off locations (funded through a student recycling fee effective July 1, 2009).
- Implement a drop off location for recyclables with drive through capabilities.
- Expand the property depot to include additional items and promote reusing more items on campus. This endeavor would be controlled by the property office and utilize student volunteers or organizations.
- Revise the web page for the depot to include items for sale, hours of operation, and directions to the facility.
- Allow students to donate unwanted and reusable items to the depot. With the help of student volunteers, create multiple drop-off sites during student move-out.
- Ongoing consumables – reuse or recycle 70 percent by weight or volume.
- Food service – compost 25 percent by weight or volume.
- Durable goods – reuse or recycle 50 percent by weight or volume.
- Facility alterations and additions – divert 70 percent of waste from landfills.
- Promote recycling and sustainability at all athletic events.

Phase II

- Expand the paper reduction initiative to reduce paper by an additional 30 percent.
- Expand the collection and processing of recyclables by an additional 30 percent.
- Ongoing consumables – ensure purchases contain 20 percent post-consumer materials and 50 percent harvested within 500 miles.
- Food service – ensure purchases are 50 percent sustainable by cost, including United States Department of Agriculture (USDA) certified organic or Fair Trade products.
- Durable goods – ensure furniture purchases contain 20 percent post-consumer materials.
- Food service – ensure compost is 50 percent by weight or volume.
- Durable goods – reuse or recycle 70 percent by weight or volume.
- Partner with Laramie to develop a composting site.

Metrics

Set a baseline of current waste volume and reduce waste from materials and food on campus 50 percent by 2015 and 70 percent by 2020 as measured by volume or weight.

Waste reduction will be measured by tracking the number of landfill loads made on an annual basis. Recycling effectiveness will be measured by tons of recyclables processed each year.

Purchases of sustainable products will be monitored and controlled by procurement services. Durable goods reuse will be tracked through property depot records.

Phase	Reduction From 2008 Levels	Pounds of Waste Reduced
PHASE I: 2015	50%	870,000
PHASE II:2020	70%	1,218,000

Policy

Goal Statement

The university will execute policies and procedures to support climate change and sustainability initiatives outlined in this document when appropriate and feasible. Policies will be applied consistently across divisions and departments.

Background Information

Implementing sustainable practices across the institution ultimately requires policy decisions. To formalize sustainability initiatives through policy, the university president or appropriate vice presidents will enact policies to require all departments and units to follow the same guidelines.

Current Program and Accomplishments

A policy has been enacted for the purchase of Energy Star machinery and appliances. Guidelines for recyclable content in ongoing consumables have also been specified.

Sustainable practices are currently in place for new construction and major renovations. These practices correlate with the requirement that all new construction and major renovations at the university will strive to meet LEED Silver standards. These are practices, however, and there is no policy currently in place.

Action Steps

Phase I

- Propose a campus-wide policy to purchase paper with at least 30 percent post-consumer material.
- Propose a campus-wide policy that ongoing consumable purchases must contain 10 percent post-consumer materials or 50 percent rapidly renewable resources.
- Propose a campus-wide policy that furniture purchases will contain 10 percent post-consumer materials.
- Propose that all new construction and major renovations be constructed to LEED Silver standards.
- Propose that the Energy Star guidelines be applied to department purchases.

Phase II

- Propose a campus-wide policy to purchase paper with at least 80 percent post-consumer material.
- Propose a campus-wide policy that ongoing consumable purchases must contain 20 percent post-consumer materials and 50 percent harvested within 500 miles.
- Propose a campus-wide policy that furniture purchases will contain 20 percent post-consumer materials.
- Propose that all new construction and major renovations be constructed to LEED Gold standards.

Metrics

Policy execution will be evidenced by including a sustainable policies section on the Campus Sustainability Committee website with links to the policies. Policy compliance will be monitored by departments or units responsible for enforcement in specific areas.

Behavioral Change

Goal Statement

Encourage incremental change and culture shifts to increase awareness of climate change and sustainability concepts; provide tools and resources to facilitate behavioral change among students, faculty, and staff toward more climate friendly and sustainable actions; and create a culture of sustainability across the institution.

Background Information

A foundation is in place for behavioral change at the University of Wyoming through our commitment to the Presidents' Climate Commitment, the establishment of the Campus Sustainability Committee, and the creation of a student sustainability organization. Additionally, the Physical Plant and Facilities Planning have implemented initiatives to create more energy efficient and sustainable facilities, and Auxiliary Services has expanded the mass transit system to serve a growing desire to reduce on campus travel in single occupancy vehicles. Designation of pedestrian and bicycle pathways has increased bicycle use and pedestrian access on campus. Recycling has been expanded and become more prominent, and dining locations are using more sustainable practices for food delivery and waste management.

These changes have led to an increased awareness of sustainability and environmental stewardship among the campus community. This awareness is a first step toward meaningful behavior change. Although awareness has increased, and many changes have been made, there is more to be accomplished. Widespread and enduring ehavioral change will require acceptance and participation at all levels of the university community. The Campus Sustainability Committee, through implementation of this Climate Action Plan, will communicate a clear and consistent vision for campus sustainability, and lead the charge for true culture change. As students leave the university, the goal is to have this environmental culture and awareness resonate into their future communities.

Current Programs and Accomplishments

The institution has made progress in raising awareness of sustainability on campus and of climate change effects on our local and regional environment. Smaller strides in changing behavior have also taken place. Annual Earth Day events, campus cleanups, seminars and panel discussions, student projects and presentations, and informal sustainability related events have been held on campus for the last two or three years. This category holds great potential for improvement: the Campus Sustainability Committee, Students for a Sustainable Environment, and the Associated Students for UW (ASUW) plan to cooperate in effecting behavioral change through promotion and outreach efforts.

Action Steps

Encouraging interest and promotion in all areas of sustainability throughout the university community requires strategic marketing and concerted effort. The following action steps relate to (1) education; (2) culture; and (3) ethical behavior. The following steps will encourage interest and promote participation in all areas of campus sustainability throughout all levels of the campus community:

Phase I

- Communicate campus sustainability visions and goals to the public through the Campus Sustainability Committee website.
- Communicate and promote education on sustainability concepts including life cycle analysis, closed loop recycling, and cradle to cradle process methodologies.

- Modify behavior through cultural changes including energy use and conservation, waste minimization, and environmental stewardship.
- Promote behavior change related to sustainability and climate change by instilling positive principles and values in our students, faculty, and staff.
- Propose that the new Summit Orientation program include a sustainability section where students are introduced to energy saving practices and other sustainability initiatives.
- Post literature and permanent signage in dorms and dining facilities reminding students of conservation and recycling efforts on campus.
- Encourage students to participate in one sustainable or environmental hands-on activity each year. This activity might include a university tree planting event or annual trash cleanup around campus.
- Develop a central brand and logo that symbolizes the university's efforts in advancing sustainability.
- Promote student involvement in sustainability by enhancing opportunities and funding for student projects through the Campus Sustainability Committee and student government.
- Communicate campus environmental practices, recent improvements, and the resulting environmental benefits through the Campus Sustainability Committee website.
- Continue to promote research in the areas of alternative energy, energy conservation, and water conservation.
- Challenge students, faculty, and staff to adopt a personal sustainability initiative from a list of initiatives posted on the Campus Sustainability Committee website.
- Propose a peer-to-peer freshman environmental introduction program at residence halls to introduce students to sustainability vision and best practices.

Phase II

- Continue successful programs and initiatives.
- Develop new programs and initiatives to sustain momentum.
- Require incoming students to take one course focused on sustainability or the environment during the first year of enrollment (see section 5: Education, Research and Public Engagement for class details).

Metrics

The effectiveness of behavioral change efforts will be measured annually by tracking and monitoring:

- Event participation.
- Number and size of events offered.
- Number of seminars and panel discussions.
- Responses to campus wide surveys.

POTENTIAL BARRIERS AND SOLUTIONS

Certain barriers to significant reduction in the carbon footprint at the University of Wyoming exist and must be understood and addressed before and during implementation of the action plan to ensure success. The following describes some of these barriers and offers potential solutions.

Barriers

While universities are developer-owners of the projects they build, budgeting can divide capital investment monies from the ongoing operations and maintenance budgets for buildings. Budgeting affects decision-making, often sacrificing long-term cost-effectiveness for short-term savings. Total cost calculations will take into consideration all of the costs required to run a building, including hard and soft costs, as well as utility, maintenance, service, remodeling, and end-of-life costs. This internalizes many of the consequences design decisions have over the life of the building, including those relating to sustainability. This approach to project cost and analysis is called life cycle costing, and it is a valuable metric to analyze and justify most projects.

A second metric useful in analyzing barriers to sustainable projects is payback. Often, projects will require a five-year simple payback for energy savings measures. This short payback requirement constrains many energy related projects and thus becomes a barrier to obtaining approval for competing resources. Accepting longer payback terms or incorporating a variety of characteristics related to sustainability may lead to better decision making on sustainable projects.

<u>Education, Research, and Public Engagement</u>

Some of the proposed action items associated with education, research, and public engagement come with initial costs. For example, hosting "Sustainability across the Curriculum" workshops could include the following expenses:

- ¼-time faculty effort (possibly a buy-out of teaching) - $20,000 -25,000
- Travel and registration for two at Greening the Curriculum workshop - $2,500
- If five faculty members participate annually, each paid a $3,000 financial incentive, five years of the program would cost $75,000.
- Anticipated total is $102,500.

The incentive-based portion of the "Sustainability across the Curriculum" program is often monetary at other institutions; however, UW may consider offering the workshops to interested faculty without incentive until funding becomes available, or offering a non-monetary incentive at the discretion of the Division of Academic Affairs and individual academic units.

Developing a "Climate Science Module" to be used in classrooms and communities across Wyoming could cost $40,000:

- ¼-time faculty effort (possibly a buy-out of teaching) - $20,000 - 25,000
- One graduate assistantship per year - $15,000

A speakers series on climate science and policy and/or sustainability may run about $15,000 per year if it includes travel and honoraria for six speakers each year, publicity costs, and an undergraduate student worker (10 hours/week).

The Research and Applications in Climate and Energy program may cost $30,000 per year ($15,000 for a graduate assistantship and $15,000 for publication).

<u>Reduction of Institutional Greenhouse Gas Emissions</u>

Other than beneficial results from behavioral change, most action steps in this plan require some cost. The costs include one-time costs associated with facility system upgrades, infrastructure improvements,

or academic enhancements, or recurring costs including costs for transportation maintenance and fuel, using natural gas instead of coal, and purchasing carbon offsets. Action items must be prioritized to make the most effective use of resources.

Limitations of the existing infrastructure may reduce viable options for energy use and conservation. Some infrastructure is aged and outdated and expensive to upgrade or replace. These limitations may have to be mitigated through implementation alternatives, or projects may need to be timed according to potential infrastructure upgrades.

Allocation of labor resources may present operational difficulties for managers. With varying workloads and priorities, it may be difficult to allocate the appropriate labor resources to projects with long term paybacks.

Changing culture in any organization can be a long and difficult process. Changing culture when it may involve inconvenience and compromise in work environments could prove difficult. This is especially true when the potential savings from implemented initiatives are not received by those making the sacrifices.

A barrier especially applicable at UW is how to reduce energy use and carbon emissions in a campus growth period. In the last three years, UW has expanded facility space by approximately 300,000 square feet. In the next three years, facility space is projected to increase by another 200,000 square feet. Additionally, advances in technology and intensity increases in use of facility space create challenges to reducing energy consumption for existing facilities on a per square foot basis. Climate change has resulted in the desire for more conditioned facility space, which demands more energy and maintenance requirements.

Another barrier for sustainable projects is that they have to compete against other institutional projects for available resources. In Wyoming, the economy depends on raw materials used as energy. Coal, natural gas, oil, and other mined minerals generate a significant portion of state revenues. Since UW receives the majority of its funding from the state, economic fluctuations affecting these energy sources directly impact available resources. As demand for energy from fossil fuels decreases, Wyoming will produce fewer of these materials and will receive less revenue from them. Because Wyoming is an energy producer, some energy types are less expensive here than in other parts of the country. When decisions are made based on financial impact, paybacks for energy related projects become longer and projects become less attractive than in other geographical locations.

Solutions

Fortunately, solutions exist to mitigate or offset many of these barriers. Many of the action steps follow good business practices and would likely be the chosen course of action for reasons other than reductions in greenhouse gas emissions. These synergistic relationships must be explored and prioritized.

<u>Education, Research, and Public Engagement</u>

Some of the costs associated with education, research, and public engagement activities could be offset or paid for through private donors and grants. For example, “Sustainability across the Curriculum” workshops could be funded through a combination of private grants and donations. Several private foundations routinely fund sustainability education programs, such as the Geraldine R. Dodge

Foundation, Rockefeller Brothers Fund, Pew Charitable Trusts, and the William and Flora Hewlett Foundation, to name a few. Various units on campus have established relationships with some of these foundations and could help facilitate funding for "Sustainability across the Curriculum."

A Climate Science Module to be used in classrooms throughout Wyoming might be of interest to a statewide funding organization, such as the Wyoming Community Foundation, which funds educational efforts in Wyoming.

Finally, Research and Applications in Climate and Energy could be funded through research grants sought by faculty involved in the program. The National Science Foundation may be one resource for this kind of effort.

The Campus Sustainability Committee will works towards forming partnerships and alliances with foundations and programs that would facilitate funding.

Reduction of Institutional Greenhouse Gas Emissions

Life cycle costing and payback guidelines are two methodologies useful in justifying sustainable or energy saving projects. These two methods should be part of a cost/benefit analysis including both direct financial benefits and sustainability-related benefit factors.

Projects of the same type or within the same building should be evaluated together to determine if there are synergistic relationships or economies of scale that would make a project more viable. For example, combining window replacements, overhangs, and expenditures on preventative maintenance may result in a shorter payback than if the projects were done separately and allow for more predictable budgeting.

It can be difficult to quantify less tangible benefits such as improvements to health, productivity, comfort, and environmental quality and therefore it is challenging to evaluate measures that would improve these aspects through a life-cycle cost analysis. However, a well designed cost/benefit model could account for these benefits if they are quantified through priority or defined standard practices.

The Physical Plant plan to separately meter each building could also contribute to justification for sustainable projects by providing actual data indicating energy costs and potential savings.

Use of major maintenance appropriations will allow for prioritization of sustainable projects, and specific allocations to energy related initiatives will protect funding from other uses. Benchmarking energy use by square foot may increase support for sustainable projects by showing savings at a level understandable to most groups and by normalizing the data from growth, cost fluctuations, and other varying cost factors.

Through standard setting and policy enactments applicable to all divisions, it may be possible to achieve progress in inter-departmental or university-wide projects.

Administrative Actions

Administrative actions can strengthen the sustainability effort by demonstrating support from the highest levels of the university. Examples of administrative measures include developing guidelines and setting priorities that promote sustainability principles.

PROJECTED COSTS AND FINANCIAL ALTERNATIVES

The projected cost of proposed action steps and program initiatives is difficult to quantify due to the long time frames and uncertainty surrounding developments in technology. Projects to be funded will be reviewed and selected based on their level of economic sustainability, technological feasibility, and operational viability.

The university is fortunate to have state and institutional support for implementation of energy saving initiatives, construction of new capital facilities, and renovations to existing facilities. More traditional financial alternatives include allocation of a portion of major maintenance funding to energy saving initiatives, infrastructure improvements, and building system upgrades; exploration of performance contracting projects to leverage available funding; and innovative use of operational funds. Revenues generated from recycling operations can be returned to the operation to fund expansion, new containers, and outreach expenses.

Other opportunities to be explored include reinvestment of energy savings to fund ongoing projects and generating funds through the UW Foundation. Finally, through research projects, opportunities may exist for alternative energy production that can be used to provide power to a specific building or to sell back to a power company through power grid connections.

IMPLEMENTATION

The Campus Sustainability Committee will assist and advise the coordination and implementation of activities described in UW's Climate Action Plan. Specific action steps will be carried out by the responsible campus departments and units. Cooperation from key units on campus will be critical. For example, Facilities Planning and the Physical Plant must be in frequent communication and collaboration with the Campus Sustainability Committee. Various academic units must also be closely involved to ensure follow-through on curricular and research action steps. Involvement with students and student organizations are integral to the plan's success, and support from the President's Office is important to set the tone and demonstrate support. The following outlines how implementation will occur.

Structure

This document has outlined a structure for implementation of the Climate Action Plan. Each area of emphasis in section five (education, research, and public engagement) requires input from other departments or organizations. It is the Campus Sustainability Committee's intent to facilitate these leadership roles and provide support as needed to complete action steps and achieve goals. The Campus Sustainability Committee will partner with the university community to create working groups and project teams. These groups and teams will assume responsibility for special projects and ad hoc or ongoing initiatives. Event planning, report development, and public outreach are examples of initiatives these groups could organize.

Updates

The Climate Action Plan will be revised as necessary. Reports, surveys, research, and technological innovation will be analyzed to determine if updates are warranted. The Campus Sustainability Committee will discuss and propose suggested updates to the President and affected units for consideration and approval.

Communication
Progress reports, updates, press releases, projects, research, surveys, feedback, and current events will be communicated to campus constituents and others. The Campus Sustainability Committee website will serve as a central place for information and communication. Files and documents will be posted on the site, announcements and events will be published, and contact information for feedback and assistance will be provided. The web site has been developed and is located at: http://www.uwyo.edu/sustainability.

In addition to the Campus Sustainability Committee website, presentations and panel discussions will be organized through campus organizations and academic channels, and surveys will be conducted for students, faculty, and staff. The Climate Action Plan is a public document and input from all stakeholders is encouraged. Two-way communication and feedback loops with positive issue resolution processes are essential components of the communication structure.

TRACKING AND MEASUREMENT

Measuring progress is critical to achieving intermediate greenhouse gas emission reductions goals and, ultimately, to sizable reductions in the institution's carbon footprint. Because this effort reaches across campus and beyond and continues over the course of several decades, accurate tracking through all action steps will be a significant undertaking.

Annual Greenhouse Gas Emissions Inventory
UW will continue to monitor its progress through an annual greenhouse gas emissions inventory. Data collection techniques continue to become more accurate. It is anticipated that student interns, supervised by a member of the Campus Sustainability Committee, will continue to complete the inventory update each year using the Campus Carbon Calculator, an Excel-based calculator used by most climate commitment signatories. The annual greenhouse gas emissions inventory will be submitted to the Presidents' Climate Commitment annually and made public on the Campus Sustainability Committee website.

Reporting Structure
Reports will be completed each year by the committee to track and measure progress toward goal achievement. The annual reports will compare actual progress to target measurements and provide statistical information useful for trend and historical reporting. Report data will include financial and statistical information, as well as charts and graphs to reach a broad audience.

All reports will be posted on the Campus Sustainability Committee website and made available for viewing by the campus community.

Climate Action Plan Updates
Analysis of the annual reports and the greenhouse gas emissions inventory data may result in needed adjustments to the institution's Climate Action Plan. Periodically, the Campus Sustainability Committee will review and revise the Climate Action Plan to incorporate these adjustments. It is anticipated that changes will be primarily to action steps in sections that have been affected by economic conditions, technological advancements, or unforeseen conditions. Any Climate Action Plan updates will be prepared by the Campus Sustainability Committee and approved by the President prior to publication.

Campus Sustainability Committee Role

While operational responsibility for implementation of specific action steps rests with the appropriate departments and units, the Campus Sustainability Committee will communicate the implementation plan to the campus community, offer assistance for sustainable programs and projects, provide technical assistance as needed, and publicize reports and updates.

The Campus Sustainability Committee will accumulate data to track, measure, and analyze against goals and targets, monitor progress toward goal achievement, and make recommendations for adjustments to the plan.

CONCLUSION

Institutions and universities worldwide are in a position to educate on sustainability and climate change and to positively influence behavioral change in a meaningful way. The University of Wyoming has embraced sustainability through charter membership in the Presidents' Climate Commitment, and the Campus Sustainability Committee has been charged with assistance and oversight of the Climate Action Plan implementation for the institution. This is a responsibility taken seriously and with commitment.

This Climate Action Plan presents many challenges to the university. But these challenges should be embraced and faced head-on for the long term sustainability and viability of the institution. Successful Climate Action Plan implementation will help solidify the sustainability of future generations.

RESOURCES

Greenhouse Gas Emissions Inventory 2008, Campus Sustainability Committee Student Interns.

Greenhouse Gas Emissions Inventory 2009, Campus Sustainability Committee Student Interns.

Transportation and Parking Master Plan 2008, Stantec.

Long Range Development Plan draft 2009, MIG.

Utilities Master Plan draft 2009, AEI.