chapter 8
sustainability
The first rule of sustainability is to align with natural forces, or at least not try to defy them.

PAUL HAWKEN
Sustainability is a consistent theme of the LRDP that takes into consideration the long term social, environmental, and economic impacts of campus planning and design. Because sustainability can be applied to all campus systems, this chapter provides a comprehensive overview of sustainable practices found throughout campus. Through this review, this chapter provides an evaluation of the existing campus utility and infrastructure system, as well as the campus transportation system, and site and building design. Also included in this chapter is an analysis of campus waste management and materials purchasing, and a discussion of the long range economic impacts related to sustainable technology, planning, and design. The discussion of campus sustainability includes specific goals, recommendations and action steps to continuously measure the progress and success of the plan.
Sustainability Overview

In 1989, the World Commission on Environment and Development developed the widely accepted definition of sustainability as “[to meet] the needs of the present without compromising the ability of future generations to meet their own needs.” Since that time, the Kyoto Protocol governing international greenhouse gas emissions has been ratified, the U.S. Green Building Council’s LEED Rating System for green buildings has been adopted for construction projects from the municipal to federal level, renewable portfolio standards are beginning to be required for some states’ energy production, a national call for energy independence has risen, and greenhouse gases have been declared a pollutant by the U.S. Environmental Protection Agency. Closer to campus, the University of Wyoming received three million dollars in the spring of 2009 to research clean coal technology and President Tom Buchanan signed the American College and University Presidents’ Climate Commitment. Momentum has been building behind sustainability and has created economic opportunity as well as reshaped the way business is conducted.

In practice, most decisions are typically made based on short-term economics alone, not taking into account costs or benefits that accumulate over time or that are not easily quantifiable monetarily. This sometimes leads to distorted decision-making that can miss opportunities for mid- to long-term returns on investment, or to improve factors such as health or productivity, or that can create future liabilities such as polluted water and air or resource scarcity. In short, many decisions are made only to meet the needs of the present without consideration of “future generations.”

In order to achieve sustainability, a careful balance of social, environmental and economic concerns must be attained. While this calls for a renewed emphasis on society and environment, this shift does not have to sacrifice fiscal responsibility.
Many projects that benefit society and the environment also make economic sense. The comprehensive nature of sustainability planning helps to prevent underinvestment that leads to inefficiencies and wasted dollars.

The University of Wyoming has much to gain from this type of approach to its decision-making. As an educational institution, a more comprehensive, long-term evaluation of University practices, strategies and policies that internalizes a greater range of costs and benefits allows for more informed decision-making and should yield greater net gains monotonically and otherwise. Investments into energy efficiency can yield monetary returns competitive with or exceeding other areas in the market. Transportation improvements increase campus safety and productivity, help with community relations and development, and preserve valuable land for future development or natural habitats. Green buildings can increase productivity, reduce absenteeism and improve health. Materials purchasing and waste management create a market for local and regional products, improve health and create a resource stream instead of a liability. Altering behavior and culture through awareness and education will make the efforts for sustainability enduring.

The University of Wyoming has a strong history in energy and agricultural education. It is well-positioned to emerge as a leader in a new energy economy that utilizes diverse energy resources, accounts for the ecological and environmental impacts of resource use, and begins to manage carbon. University students, professors and graduates could be at the center of this transformation that is encouraging technological research and development, creating new economic instruments, and redefining business-as-usual.
OVERARCHING GOALS AND FRAMEWORK

This plan outlines a roadmap for the University of Wyoming to achieve sustainability by promoting a balance of economic, environmental and social considerations. Four overarching goals governed the development of this plan:

- Reduce environmental impact;
- Increase energy, water, and other resource efficiency;
- Improve health and productivity; and
- Promote community involvement and ownership.

These goals provided a foundation for evaluating the resource use practices and policies at the University and guided the development of action steps going forward. The plan is divided into five key areas:

- Environmental Literacy and Behavioral Change;
- Infrastructure and Utilities;
- Transportation;
- Site and Building Design; and
- Waste Management and Materials Purchasing.

UNIVERSITY OF WYOMING CLIMATE ACTION PLAN (CAP)

To achieve the aggressive long range sustainability goals established in this document and to fulfill the American College and University Presidents’ Climate Com-
Commitment of reducing carbon emissions a detailed action plan is necessary. The University of Wyoming Climate Action Plan (CAP) was created in 2009 by the Campus Sustainability Committee (CSC). The CAP establishes a comprehensive plan to achieve campus sustainability with the end goal of carbon neutrality. The plan is divided into three phases of greenhouse gas emission reductions:

- Phase I: Reduce GHG emissions 15% below 2005 levels by 2015;
- Phase II: Reduce GHG emissions 25% below 2005 levels by 2020; and
- Phase III: Achieving carbon neutrality by 2050.

The CAP includes seven main sections that parallel the five areas identified in this document. These sections are: (1) energy; (2) facilities; (3) grounds; (4) water; (5) transportation; (6) procurement and waste management; and (7) policy and behavioral change. The CAP enforces the goals established in this document and expands on the implementation and verification plan necessary to achieve each goal. It includes detailed action items to be completed and metrics that will be used to measure progress. The following sections provide an overview of the proposed goals, describing background information and current University efforts in each area.

Environmental Literacy and Behavioral Change

GOAL STATEMENT

Create a campus culture where the University of Wyoming students and staff together practice and advance sustainability. Empower the president, faculty, and staff to stand behind and promote sustainable principles. Educate each new student so he or she understands his or her role in conservation on campus and how to achieve this in life after graduation.

Background Information

Environmental Awareness

Environmental awareness has increased at the University of Wyoming and change has occurred for both campus operations and for everyday student practices. The campus operations have executed changes ranging from addressing energy and water use to changing 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. A recent survey indicated that only 2 in 30 students on campus were aware of sustainability concepts. Sustainability will
not be fully effective until it is engrained in the overall campus culture. Embracing this culture needs to occur at all levels, from the entering freshman to the highest levels of administrative policy makers. 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 students’ future communities.

**Student Involvement in Sustainability**

The University of Wyoming Energy and Natural Resource (ENR) Club recently merged with Students for Sustainability (SFS) to create a new student organization called Students for a Sustainable Environment. The ACRES (Agricultural Resources for Everyday Sustainability) Student Farm is growing vegetables for campus consumption and marketing. The Farm collects and composts food waste with future plans to expand to production of bio-fuels. There is also a Campus Sustainability Committee (CSC) which has some involvement with the Students for a Sustainable Environment. The CSC organization is made up of University faculty, staff and students and also includes representation from the Associated Students of the University of Wyoming (ASUW). The ASUW allocated nearly $25,000 to support the activities of the sustainability student groups for 2008–2009. The campus sustainability groups have promoted recycling programs throughout the campus along with establishing a University mug program to discourage the use of disposable cups. These programs have helped achieve the goal of integrating recycling and sustainable practices into the everyday lives of University students.

Other student groups have been established that focus more on implementing local conservation projects. The Wyoming Conservation Corps (WCC) was created by the State Legislature to introduce students to natural resource issues in the area. This group is funded by AmeriCorps with plans to move toward financial self-sufficiency. The WCC established a formal partnership with the Student Leadership and Civic Engagement (SLCE) program. Recently the WCC helped support a WCC Freshman Outdoor Experience where freshmen were involved in one-and-a-half day service projects.

**Sustainable Educational Programs and Research**

Many sustainable education programs and research opportunities are available at the University. With the College of Engineering and Applied Science, the College of Agriculture and Natural Resources, the School of Energy Resources, and the School of Environmental & Natural Resources, students wishing to focus on the environment have many programs from which to choose.
Research facilities and projects are also prevalent at the University of Wyoming. Currently the College of Engineering and Applied Sciences maintains a renewable energy field site to develop and demonstrate renewable energy systems. 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 ten researchers in academic departments and twenty-two research projects. Other research facilities on campus include:

- Enhanced Oil Recovery Institute (EORI);
- Coal Bed Natural Gas Center;
- Wyoming Reclamation and 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
- High Plains Gasification Advanced Technology Center (GE and UW to develop advanced gasification and “cleaner coal” solutions for Powder River Basin and other coals).

Recent opportunities have become available through grants and matching funds from the National Renewable Laboratory and the Clean Coal Technologies Research Fund. These new research projects will focus on the use of solar photovoltaic (PV) and wind energy, and the improvement of clean coal technologies.

**Community Sustainability**

The University of Wyoming is closely connected to the community of Laramie both by proximity and shared services and resources. Beyond Laramie, the entire state of Wyoming is part of the university community since UW is the only 4-year university in the state. UW is a community leader in several areas of sustainability. To truly foster the culture of sustainability and make environmental changes more far reaching, the surrounding community needs to increase their support of the principles and practices of sustainability.

Based on the information gathered, both the City and County are striving to increase sustainability but have made limited commitments to change. The City of Laramie has included a Conservation chapter in the Laramie Comprehensive Plan completed in 2007 which focuses on a broad range of sustainability objectives.
Currently, the City provides limited recycling at the local landfill and relies on two local companies for any additional services. The City currently promotes higher efficiency buildings by requiring all new construction to comply with the International Energy Conservation Code (IECC). Laramie participates in the national Tree City USA program along with local cleanup programs to promote sustainable lifestyles.

The Conservation chapter of the Laramie Comprehensive Plan also includes many opportunities to promote sustainability throughout Laramie. The opportunities presented include recycling, waste reduction, aggressive building standards, renewable energy and water conservation.

The City of Laramie has considered signing the U.S. Mayors’ Climate and Protection Agreement. The City decided to suspend signing the agreement in order to further develop a City policy on climate change and energy policies. The former city attorney, Peggy Trent, drafted the Laramie Climate Action Plan that called for a committee to be established in late 2007 to research the reduction in City carbon emissions.

Both the City and the County have taken the important first step of developing concepts and opportunities related to sustainability. It will now become important to begin implementation of sustainability practices. The current University sustainability practices are generally more aggressive than those in the surrounding community. As the University continues to expand their sustainability initiatives, there will be a valuable opportunity to help further the City, County and State practices to make an integrated sustainable community.

**Action Steps Overview**

There are many opportunities to increase environmental awareness in an educational environment. The Action Steps outlined in the CAP create a mindset that can create significant change at a minimal cost. Students can be formally educated on sustainability practices from their first days on campus and campus staff can enforce this culture with support and through leading by example. The CAP outlines the key steps that can be taken to foster behavioral change and awareness on campus through sustainability groups, student awareness and action, and research and course development. The following bullets highlight Action Steps from the CAP:

- Enhance current groups
- Freshmen sustainability orientation
- Green dorms/floors
- Awareness campaign
- Hands-on-activities
- Sustainability courses
• Multidisciplinary research and degrees

**Metrics**

Environmental literacy may be measured in a variety of ways. The metrics in the CAP focus on the education of students, staff and faculty. These metrics include tracking the number and size of events offered, number of seminars and panel discussions, and event participation. The CAP provides more detail into tracking the progress of Environmental Literacy and Behavioral Change goals and verifying their achievement. Additional behavioral goals are included in other sections such as energy, water, transportation and materials.

**Infrastructure and Utilities**

**ENERGY**

**Goal Statement**

Reduce campus carbon emissions and climate impact by lowering campus energy use and obtaining energy from renewable and sustainable sources, with the ultimate goal of reaching carbon neutrality.

**Overview**

The President of the University of Wyoming signed the American College and University Presidents’ Climate Commitment on August 6, 2007 which requires completion of a Greenhouse Gas Emissions Inventory and creation of a plan for emissions reduction with the ultimate goal of reaching carbon neutrality. The campus has established a Campus Sustainability Committee (CSC) to pursue actions and address other areas of sustainability on campus.

To assess the current campus carbon footprint, a Greenhouse Gas Emissions Inventory was created for the University of Wyoming by two students, Linse N. Anderson and Alyssa Wechsler. The University’s main fuel sources of coal and electricity produce the majority of emissions, along with a smaller portion of natural gas. Other activities such as commuting, waste and travel contribute smaller percentages of the total greenhouse gas emissions. In 2008, UW’s Greenhouse Gas (GHG) Emissions were determined to be 133,909 metric tons of carbon dioxide equivalents (MTCDE).

The Greenhouse Gas Emission Inventory also included trending campus carbon dioxide emissions from 1997 to 2008. Since 1997 electricity and coal have been the University’s main sources of carbon dioxide emissions. For the University to reach carbon neutrality, significant reductions in these two fuel sources need to be made.

This sustainability plan along with the University’s Climate Action Plan will create a framework for the reduction of carbon dioxide emissions with an end goal of carbon neutrality. Without a clearly defined strategy, carbon dioxide emissions are predicted to follow an increasing trend as new buildings are constructed on campus.
Background Information

Demand Side

The University’s energy demand can be attributed to conditioning and operating campus buildings and facilities. The Central Energy Plant (CEP) produces steam and chilled water for building conditioning and laboratory use. Additional buildings are being considered for connection to the central plant distribution system including an additional one million square feet in the southeast area of campus. With expansion, it is anticipated that the CEP will not have redundancy within 10 years.

There are a large 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 1800s to recent construction. The majority of the existing buildings utilize steam heating from the central coal-fired boilers, with a base year round steam use on campus of 12,000 lb/hr 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 heating systems including infrared radiators, fin-tubes, unit heaters, and air handling units. Natural gas is used for heating and hot water requirements for buildings not connected to the steam distribution system. End uses for natural gas also include residential, laboratory use and cooking. These buildings include residential as well as outlying laboratory, science buildings and animal facilities.

The majority of the approximately 180 existing buildings on campus are not cooled. There are (14) buildings with approximately 802,000 square feet that utilize chilled water from the 1,600 ton central chilled water plant. This plant contains two electric chillers along with a flat-plate heat exchanger to utilize free cooling via cooling towers. Large buildings are being added to the chilled water distribution as air conditioning upgrades are performed. A limited number of other buildings are
cooled with stand alone mechanical cooling or evaporative cooling. The remaining buildings have no cooling capabilities.

Buildings are not currently individually metered for steam, water, or electricity. The energy and water use for each building is therefore not known. A metering pilot program is expected to occur within the next 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.

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. Electronic 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.

Many of the older buildings have steam heating systems with older thermostats and control valves. Temperature control has been recently improved at the 8 and 12 story residence halls with the installation of heating control valves (Selmer, 2003). 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 likely many opportunities for occupant comfort improvements.

**Supply Side**

The University of Wyoming main campus purchases electricity from Rocky Mountain Power. The campus is fed from two substations with all distribution from these points owned by the University. In 2008 the University used approximately 65,000,000 kwh, 10,000,000 kwh/year higher than 1990 levels. This is assumed to be due to
additional building cooling and increased plug loads from computers and electronics. According to Forrest Selmer, Deputy Director of Facilities Management, in his utility presentation in 2000, the approximate end use break down of electricity is 55% motors, 25% lighting and 20% 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.

The campus Central Energy Plant (CEP), built in 1983, used an annual average of 17,900 short tons of coal over the last three years. Three multi-use boilers currently use coal as the fuel source, but can also be fired using natural gas or oil. A fourth boiler can be fired using natural gas or oil and is used for backup only. The CEP primary steam generation was converted many years ago to utilize more coal in lieu of natural gas due to the lower cost of coal. Combined coal and gas use has been relatively constant since 1990.

Energy efficiency projects have allowed the total energy use from these two fuels to remain fairly constant despite additions to campus square footage. Those buildings not connected to the steam distribution system have used an annual average of 109,000 MMBtu of natural gas for the last three years.

The CEP does not currently provide co-generation. A co-generation feasibility study was previously performed and it was determined that co-generation should be considered once electric costs exceed $50/MWh.

Energy Sources and Renewable Energy Potential
As a state, Wyoming has an abundance of natural resources including coal, natural gas, wind and solar. More information on UW’s history and natural resources can be found in the “UW Existing Conditions: Urban Design” section. According to the Energy Information Administration, Wyoming leads the country in coal reserves.
and production, both in general and low sulfur coal, and pays the lowest price. The closest coal mines, located at the Hanna site (about 90 miles northwest of Laramie) closed in 2001 and 2005. The University now uses other sources of coal such as Green River near Rock Springs, WY and Craig, CO (Selmer, 2000) to obtain fuel for the Central Energy plant.

According to the Energy Information Administration, Wyoming has the second largest reserves of natural gas in the country and has the 8th cheapest natural gas prices. The prices remain volatile despite going down nation-wide in 2007. Currently, natural gas is only used for backup at the central plant, for process loads, and for outlying buildings.

Wind resources consistent with utility scale production are available just to the west and east of Laramie (NREL, 2002). According to the American Wind Energy Association, 349 MW of wind turbines are currently in operation in the area and 109 additional MW are under construction. Faculty and staff were able to purchase wind energy credits from Rocky Mountain Power in 2007; however, there was limited participation.

According to the U.S. Department of Energy’s Energy Efficiency and Renewable Energy website, most of Wyoming receives 5,000 to 5,500W/hr/sq m/day of energy from the sun. Laramie also receives sun 250+ days per year. This makes Laramie a good candidate for flat plate collectors and other solar energy technologies.

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 American College and University Presidents’ Climate Commitment in 2007, the University was dedicated to reducing its energy use and exploring new opportunities. The campus facility departments have made significant efforts to evaluate opportunities to lower energy use and peak demand. They have implemented many of these opportunities over the last several years, which has made a noticeable difference in coal consumption and helped to keep electricity from rising as much as it would have otherwise. According to Selmer’s 2003 Utility Report, some of the larger projects completed include:

- Heat recovery systems installed at the Library Annex and Corbett Physical Education Buildings;
- Window replacements at various buildings;
- Expansion of the campus wide digital control network;
- Heating control valves installed at the 8 and 12 story residence halls;
• New boilers and better controls installed at Plant Science, Insect Soils facility (PSIS);
• Performance contracts with UW’s primary building control firm used at PSIS, State Vet Chem Lab and 951 N. Poplar St. (in Casper);
• Various motor replacements and VFD installations;
• Lighting improvements at the Coe Library, Corbett Gym and Pool, Science Library Annex, Classroom Building, A&S Building, Knight Hall corridors, Physical Plant, and other locations;
• Chiller replacement at the Ivinson Building; and
• Extension of the campus chilled water system to replace aging building chillers in Knight Hall, Coe Library, Law Building and Fine Arts Building.

In addition, the Physical Plant has started a campus-wide metering project that will allow for the opportunity to benchmark and track all existing buildings and target the worst performers. They have evaluated different options for the Central Energy Plant, from cogeneration to converting to biomass fuel. The Physical Plant is also responsible for a large reduction in the University’s use of City water by converting landscaping irrigation to well water.

To ensure that all new buildings on campus are energy efficient, the University has created a LEED new construction policy that all new buildings on campus must strive to meet or exceed the LEED Silver standard.

Along with energy efficiency, the University has a strong interest in renewable energy on campus. In recent years it has looked at costs and opportunities for both wind and solar energy. Solar panels have been installed on the south side of the Indoor Practice Facility.

Transportation accounts for a large focus of behavioral change on campus as a means to reduce environmental impact. The University is attempting to change the staff and student mindset of the “single driver” mentality. The University has designated parking in preferred areas for carpooling and is charging for parking on campus. The University is promoting walking and biking to campus, and the campus shuttle system has been greatly expanded.

**Action Steps Overview**

The University of Wyoming CAP provides detailed Action Steps on how to achieve target emission reductions. Projects are ordered into three phases: Phase I (2010-2015), Phase II (2015-2020), and Phase III (2020-2050). Projects with the highest yield on investment are introduced first. These “low-hanging fruit” options are included in Phase I. Projects with moderate paybacks and/or requiring more complex implementation are included in Phase II. Finally, projects requiring high initial investment with varying paybacks and/or
requiring in-depth analysis and planning are included in Phase III.

Phase I Action Steps focus mainly on reductions in demand side energy use. Energy efficiency upgrades to the campus Central Energy Plant and the incorporation of renewable energy on campus are also included in this phase. The following list highlights key steps to achieve Phase I goals:

- Building metering;
- Delamping, relamping, and lighting upgrades;
- Building Retro-Commissioning (RCx), Energy Saving Performance Contract (ESPC) Projects;
- Central plant RCx;
- LEED silver plus new construction;
- ZEV & hybrid University fleet;
- 1.5 MW wind energy farm; and
- Credit purchase: offset 5% total electric energy use.

Phase II Action Steps focus on the implementation of higher cost demand side reduction measures and increasing the use of renewable energy at the central energy plant and on campus. These Action Steps include:

- Building RCx, ESPC implementation;
- Explore central plant biomass or cogeneration systems;
- Building scale solar hot water, PV systems;
- LEED gold plus new construction; and
- Expand shuttle system.

Phase III Action Steps focus on achieving carbon neutrality on campus. The Action Steps in this phase include major improvements or changes to the Central Energy Plant and large scale renewable energy projects on campus including:

- Net zero energy new construction;
- Hybrid, electric buses;
- Replace central plant equipment;
- One MW solar PV system;
- Credit purchase: offset 1.5% total electric energy use; and
- Establish local carbon offset program.
Metrics

Metrics will be used to measure the reduction of energy use and carbon dioxide emissions by the University. This will primarily be in the form of utility and sub-meter data since most of the campus emissions come from buildings. Pounds of coal and units of electricity purchased will be the primary metrics. Additional metrics include the emissions associated with the gallons of fuel purchased for campus vehicles and the miles travelled by single passenger vehicle or airline.

To track progress and make it visible to the public, a University website should be established that will track building energy use and the University’s overall progress toward carbon neutrality. This site would also be the clearinghouse for all campus sustainability efforts. To effectively achieve energy reduction goals, the University should hire an energy manager to continuously track and analyze utility usage and direct energy reduction efforts.

Additional methodology may be used to track the progress of areas that are difficult to quantify such as the progression of behavioral change on campus. Specific energy-related metrics for student, faculty and staff energy use could include energy use of dorm/staff occupied buildings, number of students purchasing renewable energy credits, and number of people aware of the actions that can be taken to reduce energy consumption. More information on behavioral metrics can be found in the Environmental Literacy section.

WATER

Goal Statement

Reduce water use at the University of Wyoming by educating students about water conservation, upgrading plumbing fixtures, and reducing the amount of water used for irrigation. Water use reduction goals in the University CAP are separated into two categories: 1) domestic water use and 2) irrigation water use.

Goals for this section are similar to those outlined by the United States Green Build-
Background Information

Domestic Water Use

The plumbing fixtures in the existing buildings on campus 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, so the usage by building is not currently known. A more detailed description of the University’s potable water distribution can be found in the previous Utilities and Infrastructure section. A metering project is currently underway to add individual meters to buildings.

From 2006-2007, total campus domestic water use, including residential living facilities, has been relatively constant at an average of 220,000 gallons per year. The domestic water needs on campus are expected to grow throughout the next 30 years, as additional education and residential buildings are constructed.

Irrigation Water Use

The University maintains approximately 90 acres of irrigated land. The well irrigation system is continually being expanded, resulting in a significant reduction in the annual cost of irrigating campus land. Well water is not currently used to irrigate athletic fields or the University golf course. The irrigation distribution can be found in the Utilities and Infrastructure section. The University peak water demand is currently during the summer months, indicating that some irrigation is still accomplished using potable water.

The demand for well water use for 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.

Current Programs and Accomplishments

The University has implemented several water conservation efforts to lower the potable water used in buildings as well as 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 middle of the day watering;
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 20-50% of the water consumption for irrigation; and all new construction projects utilize well water for irrigation.

**Action Steps Overview**

The University CAP provides defined Action Steps to achieve the water goals outlined in this section. Action Steps are divided into two categories: domestic water and irrigation water. An overview of these steps can be found below, with a further established implementation plan and timeline located in the University CAP.

Domestic Water Action Steps fall into one of 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. Action Steps from each of these categories are highlighted in the following list:

- Water conservation;
- Building metering;
- New construction low-flow fixtures;
- Replace existing fixtures with low-flow;
- Convert irrigation to well water;
- Reuse rain water;
- On-site filtration; and
- Gray water mechanical and non-potable uses.

Irrigation Water Action Steps fall into one of the following categories: 1) new landscaping requiring no irrigation, 2) converting existing landscaping to low water use vegetation, 3) upgrading controls and piping, and 4) upgrading athletic field turf. A summary of these steps is as follows:
- New landscaping will be low water use;
- Convert existing landscaping to low water use where appropriate;
- Convert existing landscaping to well water;
- Re-zone irrigation piping;
- Upgrade irrigation controls;
- Develop integrated campus water system; and
- Convert football practice field and golf course to well water.

**Metrics**

Metrics are outlined in the CAP to measure progress and verify achievement of the domestic and irrigation water goals. Metrics identified include the gallons of domestic and irrigation water reduced, the amount of new landscaping requiring no irrigation after establishment, and the amount of area converted to low water use vegetation. Additional metrics may count the number of low-flow plumbing fixtures per Assignable Square Foot (ASF) replaced in existing buildings, the number of low-flow fixtures installed in new buildings, or the number of gallons of rain water reused.

**STORM WATER AND SANITARY SEWER**

**Goal Statement**

Strive to increase ground filtration and gray water reuse to reduce the impact on natural hydrology and municipal waste water systems. Create a framework for storm water and sanitary sewer management. Strive to collect and reuse or evaporate precipitation on campus and use gray water for campus irrigation or domestic water needs.

Goals for this section are similar to those outlined by the United States Green Building Council (USGBC) in their Leadership for Energy and Environmental Design for Existing Buildings: Operation and Maintenance (LEED EB: O&M) rating system. By following the Action Steps defined in the University CAP, existing buildings on
campus should be able to meet many of the requirements needed to achieve points in the Sustainable Sites section of this rating system.

**Background Information**

With a large number of parking lots and other hardscape areas, storm water runoff management is a concern for the University. The city storm water system is currently being pushed to the limit with the available pipe sizes and runoff quantities. The Laramie River is receiving large amounts of storm water which can contain contaminants picked up from surface areas. There are some storm water detention areas that are not sufficient and there are several problem areas on campus.

The sanitary sewer system is a standard collection and treatment system that does not currently have significant known issues. There are opportunities to reduce sanitary sewer collection quantities which would lower the impacts on the city waste water treatment facilities and reduce water and energy use. The Infrastructure and Utilities section of the LRDP has more detailed information on the storm and sanitary systems.

**Current Programs and Accomplishments**

Currently the University maintains storm water detention areas that have native vegetation and local species. New construction often incorporates vegetated areas, reducing the amount of pavement on campus. As described in the water use section, some changes have been made within buildings to reduce water use, which in turn reduces sanitary sewer conveyance.

**Action Steps Overview**

Action Steps in the CAP create a framework for achieving the storm water and sanitary sewer goals. Through storm water system evaluation, hardscape reduction, sanitary system planning for new and existing buildings, and a comprehensive grey water and irrigation integration plan, the goals established in this section may be achieved.

The Action Steps for this section are separated into two categories: 1) storm water and 2) sanitary sewer. The Storm Water Action Steps focus on the evaluation of current storm water management and the implementation of enhanced management, retention and open space restoration. These steps are summarized below:

- Evaluate current storm water system;
- Identify underutilized hardscaped surfaces;
- Convert hardscape areas to permeable surfaces;
- Implement a storm water management plan;
- Increase the use of alternative surfaces;
- Design enhancements for storm water retention; and
• Identify areas for open space restoration.

The Sanitary Sewer or System Action Steps generally focus on new and existing buildings on campus. The following list is a summary of these steps:

• Utilize advanced technology, such as on-site filtration;
• Utilize advanced technology, such as water re-use;
• Use gray water systems for non-potable uses, such as irrigation or mechanical make-up requirements;
• Existing building fixture replacement;
• Utilize gray water systems for new building irrigation requirements; and
• Integrate new gray water irrigation systems with existing well water systems.

Metrics
The metrics in the storm water category include quantifying the reduction in storm water flow rates going to the City storm system, tracking the square feet of hard surface areas converted to permeable and tracking the number of improvements and repairs made to the storm water system. The metrics for sanitary sewer could include reduced number of waste water gallons going to the city and percentage of fixtures upgraded.

Transportation
Goal Statement
Increase the amount of multimodal transportation on campus. Reduce the “one person, one car” use of vehicles on campus by increasing the use of alternative means of transportation, such as mass transit (shuttles and buses), biking, walking and carpooling. Reduce the average distance travelled to campus with integrated mixed use development and living learning environments.

Enhance the transportation system operations to utilize more efficient vehicles, convert vehicles to alternative fuel sources such as biodiesel and offset the carbon generated by travel. Reduce the amount of fuel used for transportation and campus vehicle operations.
Background Information

In March of 2008, the University, in cooperation with 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 University of Wyoming Transportation and Parking Master Plan by Stantec, March 2008. The information from the Stantec report was used in the campus greenhouse gas inventory completed in August of 2008, to conclude that transportation contributes roughly 13% of campus greenhouse gas emissions.

According to the transportation plan, the University of Wyoming has 9,982 students, of which 2,053 or approximately 21%, live on-campus. There are also 2,445 faculty and staff members. Approximately 66% of students, faculty and staff commute to campus in individual vehicles, consuming 77,738 gallons of gasoline and 8,920 gallons of diesel fuel (Anderson and Wechsler, 2008). Nearly 25% travel by foot or bicycle, with 15% walking and 9% riding bikes (Stantec Consulting, 2008). There are currently seven shuttle services for public use on campus; however, less than 5% of faculty and staff members ride the campus shuttle.

In addition to commuter transportation on campus, 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. Over 19 million miles were travelled by plane in 2007 (Anderson and Wechsler, 2008).

The seven campus shuttle routes are open to students, faculty and the public. Beginning in the fall of 2009, students are assessed a transit fee and staff and faculty must purchase a transit pass to use the campus shuttle system. There are five lines that run regularly on University business days, generally from 6:00 or 7:00 am until 6:00 or 6:30 pm with two lines offering service until 10:00 pm. There are also two on-call services for night and weekend service or for those with disabilities during business days. According to the University of Wyoming Transpark...
Current Programs and Accomplishments
Transportation has been a major priority for the University. The University has begun to implement many of the recommendations from the Stantec study, as well as other measures. The University is attempting to change the employee and student “single driver” mentality. The University now has designated parking areas for carpooling and is charging for parking on campus. Walking and biking to campus is being promoted. Improvements to mass transit can include leasing additional buses for expanded routes, installing bike carriers to the front of buses, and sponsoring a bike library that loans bikes for a small fee. With the increased pedestrian and bicycle use on campus, safety and connectivity are primary concerns and improved signage, way finding, intersection traffic controls and other measures have been introduced to protect the safety of all travelers on campus.

Additional investigation has been performed including an evaluation of an interior loop for the shuttle system, reducing the wait time between shuttles, and working with the city to improve traffic on 9th Street. More information on the existing transportation systems can be found in the transportation section of the LRDP.

Action Steps Overview
The Action Steps in the CAP provide a detailed plan to achieve the sustainable transportation goals. These steps are divided into the following categories: multi-modal transportation and system operations. The Multi-Modal Transportation Action Steps focus on the development and improvement of alternate commuting options. Systems Operations Steps focus on the transportation operated by the University including the University fleet and shuttle buses. Action Steps are highlighted in the following lists:

**Multimodal Transportation**

- Add bike lockers and shelters around campus;
• Enforce parking restrictions;
• Improve walking paths, biking paths, and roadways;
• Encourage telecommuting and web courses;
• Increase shuttle service to the two main residential areas, south of Grand Avenue and west of campus;
• Extend shuttle service downtown and integrate with City services; and
• Implement rideshare programs to encourage people to carpool or take mass transit to campus.

System Operations
• Compile information for all campus vehicles including fuel type, gas mileage, and Greenscore rating;
• Prioritize vehicles and equipment for replacement;
• Replace campus vehicles, buses, and shuttles with fuel efficient and zero emission vehicles;
• Use biodiesel blends to fuel existing buses;
• Purchase carbon offsets for air travel; and
• Adopt more stringent vehicle purchasing policies to transition fleet from fuel efficient to zero emission vehicles.

Metrics
Direct and indirect metrics are suggested for measuring progress toward the transportation goals outlined in the University CAP. These metrics may include the increased percentage of faculty, staff and students living within walking and biking distance of campus and the percentage of campus users utilizing alternative transportation based on transportation surveys and shuttle counts. The number of avoided travel trips due to alternative meeting approaches (e.g. video conferencing) may also be tracked, along with the pounds of CO2 offset with carbon offsets purchased for air travel.

Above:

Figure 8.7 Commuter Transportation Mode Choice
Site and Building Design

SITE DEVELOPMENT

Goal Statement
Strive to build and develop in ways that reduce impact on the campus and the 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.

Buildings are an integral part of their environment. They directly impact the surrounding microclimate by taking up habitat space, increasing runoff, introducing pollutants including oils, light, and pesticides, and by changing the local temperature and solar exposure. These impacts have real consequences for the local plant and animal life, the energy the building consumes, and water and air quality. The LEED rating system, with its increasing popularity, is probably the single best consolidated effort to abate these effects.

Goals for this section are similar to those outlined in the Sustainable Sites section of LEED Building Development and Design (LEED BD+C) and LEED for Existing Buildings Operations and Maintenance (LEED EB: O&M).

Many of the goals outlined above and those detailed in the CAP compliment the other elements of the LRDP. Sustainability is considered throughout the LRDP and these standards are specifically developed and incorporated within the site planning and design standards. To capture the most opportunity, the elements of the site and building design should be looked at as an opportunity for integration with the surrounding environment. For example, buildings that are sited and placed within the water table should consider the opportunities this water could provide. The ground water could be utilized during the irrigation season to provide water to the site landscaping. It could also be used year round for general non-potable water needs within the building. Eventually, a campus approach could be achieved.
linking adjacent building inputs and outputs together and tying them in with the existing environment.

**Background Information**

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 (American Heritage Center website). The University has roots in a tradition tied to the land and the people who have used the available resources to meet their needs. 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.

**Environmental Conditions**

The University is located in the Laramie Valley, a high plain nestled between two mountain ranges, the Medicine Bow and the Laramie Mountain. This area is not in a moderate or special flood area as defined by the FEMA, although some areas along Spring Creek and Laramie River within the city limits are delineated as a 100-year floodplain. 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 ten 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.

Wyoming receives over 250 days of sun, has long winters and relatively cool summers. University buildings can benefit greatly from taking advantage of solar
gains in this climate, with minimal risk of overheating. Similar to the Ancestral Puebloans who inhabited cliff dwellings in neighboring states, the University has begun incorporating passive solar principles for new building design on campus. New buildings can use proper building orientation and utilize thermal mass and shading to maximize solar access and control solar gain. On existing structures, overhangs can be used to manage heat gain. Having dark colored solid surfaces, such as black pavement and dark roofs, can increase the ambient temperature which is known as the heat island effect. In general, heat islands can affect communities by increasing peak energy demand in the summer, raising air conditioning costs, and increasing air pollution and greenhouse gas emissions. Using light colored reflective surfaces or more vegetation on ground and roof surfaces will reduce this effect.

**Density and Community Connectivity**

The University of Wyoming is the only public four-year higher educational institution in the State of Wyoming. It is located in south-central Wyoming, within the heart of Laramie, the third largest city in the state with approximately 25,688 residents. The population density of Laramie is 2,442 persons per square mile, which is comparable to the densities of cities with universities of the same size in neighboring states. According to the U.S. Census Bureau and university websites, Bozeman, MT (Montana State University) has 2,183 persons per square mile and Fort Collins, CO (Colorado State University) has 2,550 persons per square mile.

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.

According to the City of Laramie website, the City and surrounding area has 11 museums, 22 city parks, over 75 dining locations, a ski area and an airport. The campus is only six blocks from historic downtown Laramie. There are two shuttle services that connect the University with the City; one is student-initiated and the other is for the disabled. Albany County also offers numerous outdoor activities ranging from skiing and snowshoeing to hiking, fishing and camping.

**Current Programs and Accomplishments**

The campus has many key open spaces that give the users of the campus a connection with the outside environment. There are some areas with native vegetation such as the open spaces around the new Wyoming Technology Business Cen-
ter development. Many large trees provide shade especially in the older areas of campus. Community and campus connectivity is an ongoing focus of the University for future development.

**Action Steps Overview**
The Action Steps in the CAP provide detailed implementation instructions and a defined timeline for achieving the site development goals established in this section. These steps reduce site impact on the ecosystem, integrate open spaces, incorporate native vegetation, utilize optimum building siting, and improve community connectivity. The following Action Steps are included:

- Reduce heat islands by installing vegetated or light colored roofs;
- Reduce light pollution by shielding exterior fixtures;
- Create a management plan that integrates pest management, erosion control and landscape management;
- Create a plan to protect or restore campus open spaces;
- Use native or adapted vegetation;
- Utilize parking garages to minimize large surface parking lots;
- Consider the Wyoming climate and building locations when determining placement of open spaces;
- Incorporate mixed-use development in East and Northwest Campus;
- Connect East and West Campus with future planned development;
- Enhance connection with downtown with shuttle changes; and
- Increase density with infill development.

**Metrics**
Metrics should be used to track progress over time and to verify that goals have been achieved. Specific metrics for site and building design can be found in the University of Wyoming Climate Action Plan. These metrics may include the number of trees planted on campus or in the surrounding community each year, the area of land converted to native vegetation, square footage of buildings with optimum siting and orientation, or revenue generated from campus users accessing downtown Laramie services.
GREEN BUILDINGS

Goal Statement
Create healthy and pleasant interior spaces that will positively influence productivity and protect the health of building occupants. Implement life cycle costing and operations and maintenance practices that protect the longevity of the building and its equipment, as well as the integrity of the local environment. Support local economies and reduce the impact on the environment by reducing the embodied energy in building materials and furnishings. Reduce the need for virgin materials and energy by utilizing recycled material or waste as a product in other processes.

As described previously, sustainability is considered throughout the LRDP. The site planning and design guidelines incorporate these principles by addressing optimal building placement on campus, building orientation, and design elements. The building site can affect many aspects of sustainability ranging from the impacts on building heating and cooling to the modes of transportation used by the occupants. The building and system design is not only critical to minimizing energy use; it can create a healthier environment, providing long lasting results for the students and the University as a whole.
Background Information

Green Buildings take into account all of the ways in which a structure interacts with the environment and its occupants, from the initial design through operation and maintenance. Building green has grown in popularity in recent years and is expected to more than double by 2013 (McGraw Hill Construction, 2009). Higher education has been a big part of this movement. The American College and University President’s Climate Commitment has over 600 signatories, including the University of Wyoming. Many institutions, such as University of Colorado, require new construction and major renovations to achieve U.S. Green Building Council’s LEED Silver rating or greater.

It is estimated that people spend 90% of their day indoors (EPA 2003), making the indoor environment incredibly important to the health and well-being of individuals. It has also been demonstrated that the salaries of the people within a building easily dwarf the original construction costs, energy expenditures, maintenance costs and taxes for a building (ASHRAE, 2008; RMI 2004), demonstrating that the most valuable asset is not the structure, but the people within it.

This could be even more significant for a University. While there may be relatively few salaried employees per square foot of developed space, students represent not only paying customers, but also the institution’s product.

The importance of building occupants makes a compelling argument for green buildings. By enhancing the indoor environmental quality (IEQ), green buildings increase occupant well-being. Enhanced IEQ strategies typically include integrated daylighting and tasklighting design, prioritized occupant comfort and control, and good air quality. Each of these has been shown to increase productivity, improve attendance and performance, and save health related costs. In short, green buildings that are designed well and integrate the various active and passive systems create pleasant, healthy and desirable spaces.

Buildings are also significant consumers of resources, using 40% of raw materials globally (Worldwatch Institute, 1995), in addition to the energy consumed in the processing and transport of the material to the site. There is also the labor and fuel used to construct the building. This energy consumed to construct the building is generally referred to as “embodied energy.” It can be roughly estimated that the first 12 years of energy used by a higher education building is equal to the amount of energy consumed to construct the building (Hannon, 1978; EIA, 2007). Thus, it is often preferred, from a resources viewpoint, that existing buildings are reused, rather than be demolished and rebuilt, albeit more efficiently. Saving embodied energy also encourages good maintenance plans that extend the life of the building and its equipment and furnishings.
However, construction materials are not the only materials that buildings consume. Carpeting, flooring, furnishings, cabinetry and equipment are among materials that are not just part of the initial construction, but are also replaced repeatedly over the life of the building. Increasing the life of these products is being accomplished through modular furnishings that can be moved and redesigned as building needs change and carpet tiles that allow individual sections to be replaced as needed rather than the whole carpet. Embodied energy in these finishes can be reduced by the use of reclaimed, recycled and rapidly renewable products and by buying locally.

The ultimate goal of sustainability, though, is to close resource loops, where the waste from one process is a resource for another. Some higher education institutions have begun to experiment with this idea. The Living Machine in Oberlin College’s Adam Joseph Lewis Center mimics a natural wetland to clean the building’s wastewater for reuse. This has become a multidisciplinary educational demonstration of not only wetland ecology and water treatment science, but also life cycle valuation of building systems. This theory could also be implemented by capturing waste heat from laboratory fume hoods to heat make-up air or by using spent vegetable oil from dining halls for biodiesel to fuel the trucks that deliver the food. The loops can be contained within one building or extend into the surrounding buildings or community. The goal is to identify ways in which each building can be a resource as well as a consumer, creating self-sustaining systems on campus.

**Current Programs and Accomplishments**

**New Construction**

The University of Wyoming has adopted the requirement that all new construction and major renovations at the University will strive to meet USGBC LEED Silver standards. The planned renovation of the Kendall House and the remodel and expansion of the College of Business will...
pursue LEED Silver certification. Three more construction and renovation projects will aim to achieve LEED Silver standards or better. While the University has not formally established its own sustainability guidelines or extensive goals beyond the LEED rating, it has begun and continues many practices that should be included in such a document and/or are rewarded by LEED:

- Providing opportunities for the public to purchase and relocate smaller structures that would otherwise be demolished through the Facilities Planning Office of the University and the Real Estate Office;
- Recycling/reusing building materials from buildings being demolished;
- Diverting construction waste and other wastes from landfills;
- Using passive solar design in new buildings including east-west orientations, appropriate window design, shading and thermal mass;
- Incorporating daylighting in new designs to improve indoor environmental quality and lower electric lighting energy use;
- Achieving at least 20-30% 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 with recycled content or regionally located where possible;
- Implementing cool roof strategies, low-flow water fixtures and low-emitting materials;
- Providing bicycle storage and changing areas; and
- Reducing light pollution.
Outside of those buildings pursuing LEED, these practices can be seen in the Indoor Practice Facility that has utilized natural lighting, natural ventilation, active solar heating panels on the south exterior and photovoltaic panels. Achieving LEED Silver standards should not be a far reach with the practices that are currently in place.

**Existing Buildings**

There are a large number of existing buildings on campus ranging in age from the original campus construction in the late 1800’s to recent construction. The energy systems of these buildings and recent efforts to improve their energy efficiency are outlined earlier in this chapter.

While sustainable design is being implemented for new construction and renovations, not all existing buildings are currently being renovated. The IEQ of existing buildings varies by building type and age. The level of control available to the building occupants varies from operable windows and manual light switches to highly automated environments in recently constructed buildings. Temperature control in some of the older buildings with steam heating systems has been limited, requiring windows to be open in the middle of winter to prevent overheating. Heating control valves have been installed in 8 and 12 story residence halls to upgrade control. Ventilation is generally supplied by operable windows in many older buildings and from the heating systems in the newer ones. Indoor air quality could likely be improved in many locations on campus. The use of a system like the heat recovery units installed at the Science Library Annex and Corbett Physical Education Building (Selmer, 2003) should be considered to mitigate the energy penalty.

**Action Steps Overview**

The detailed plan for creating sustainable new construction and existing buildings is presented in the CAP. The plan contains specific Action Steps to develop a Campus Sustainability Guideline, develop LEED requirements for new and existing buildings, and integrate green buildings into the education curriculum. The list below gives an overview of the Action Steps:

- Establish Energy Use Intensity (EUI) targets for building types;
- Create a campus storm water plan;
- Create a campus exterior lighting plan;
- Green cleaning policy;
- Wastewater treatment and reuse;
- Preventative maintenance plan;
- New construction Leadership in Energy and Environmental Design (LEED) Gold Plus; and
- Leadership in Energy and Environmental Design Existing Building Operations and Maintenance (LEED EB: O&M) for building retrocommissioning (RCx).
Metrics
Metrics should be used to measure progress toward sustainability. Metrics for green buildings may include tracking the percentage of buildings and campus building square footage that are LEED certified and/or in compliance with campus sustainability standards. Monitoring building energy use intensity by building type is also a good indicator of building efficiency. The building energy monitoring may be coupled with displays in each building to provide real time energy consumption data and goals to building users.

Waste Management and Materials Purchasing

Goal Statement
Reduce the waste from materials and food on campus, measured by volume or weight, through behavioral change and policy on reuse and recycling. Create a sustainable campus by achieving sustainable purchasing of materials measured by cost.

Goals for this section are broken into two parts: 1) waste management and 2) materials purchasing, and are similar to those outlined in Goals by the United States Green Building Council (USGBC) in their Leadership for Energy and Environmental Design for Existing Buildings: Operation and Maintenance (LEED EB: O&M) rating system. By following the Action Steps defined in the University CAP, existing buildings on campus should be able to meet many of the requirements needed to achieve points in the Materials & Resources section of this rating system.

Background Information
Waste management and materials purchasing 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 EB: O&M, covers materials with a low cost per unit that are regularly used and replaced, such as paper, binders, and batteries. Food includes the production of food 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 renova-
tions, demolitions, and new construction additions.

**Ongoing Consumables**
The University currently operates a recycling program for many ongoing consumables. Receptacles for paper, plastic and other items have been placed inside and outside buildings and exterior bins for other items have also been installed. The bins in newly renovated buildings are large, well-marked and have good placement. The recycling efforts currently include comingled containers such as cans and bottles, paper, and printer ink cartridges. Recycling efforts have been increased with the participation in the national RecycleMania competition to reduce waste. For this competition the University has chosen to target paper, corrugated cardboard, bottles and cans. The curbside waste collection provider in Laramie is also attempting to increase recycling by offering an opportunity for clubs and organizations to receive $10 per new participant signed up for the recycling collection service. Car or electronic batteries are recycled at local Laramie stores and two local facilities accept scrap metal.

Ongoing consumables are purchased through the Procurement department or individual University departments. The Procurement department has made an effort to purchase 30% post-consumer products and 100% recyclable materials and requires campus vendors to look closely at the environmental aspects of their products. The three largest suppliers have been including this information with their product offerings. The Procurement department has also 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. A purchasing policy would need to be in place from the University President to require all departments to follow the same guidelines.

**Food Service**
A majority of the dining services at the University are provided at the Washakie Dining Center. The Ross Hall Dining Room along with Elements, Book & Bean and a few other on-campus dining facilities are also available for students. These facilities offer a number of ways for students to reduce waste, such as a reusable mug program and corn-based compostable containers. Some food scraps are sent to the recently established campus farm 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. The dining services currently purchase sustainable goods such as organic, fair trade coffee and some recycled materials.
**Durable Goods**

The Property department inventories and tracks most durable goods purchased, along with their disposal. Currently, unneeded equipment is first sold to students or the public for reuse and then recycled if possible. Currently a program through the IT division allows for lab computers to be sold to other departments after three years at a discounted price. Desks and various other pieces of campus equipment are recycled at the local ARK recycling facility and computers are taken to GRX in 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. The University does not have a program in place for recycling electronics and computers, with the closest recycling location for these items being located in Ft. Collins.

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**

Waste management and materials purchasing for new construction or major facility alterations are currently guided by LEED Silver requirements. This includes 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. More details can be found in the Green Building section.

Small scale facility alterations are taken care of 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 them achieve a green campus. The database can be used to search for acceptable green products from custodial items to outdoor products. The database 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**

Overall, sustainability is currently being considered for waste and purchasing throughout the campus. Many people from the applicable 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, an effort is being made to divert durable goods and construction materials from the landfill, and sustainable purchasing efforts are being made. Several of the current programs and accomplishments are outlined in the background information above. Highlights of these efforts include the following:

- 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 Procurement department currently purchases recycled paper and duplex printers;
- The University has adopted an Energy Star purchasing policy;
- The University student body participates in the annual national RecycleMania competition;
- The Student Sustainability Committee has distributed recycling containers throughout campus;
- Local metal recycling is being utilized. Computers and electronics are being recycled in Denver; and
- Durable goods are sold for reuse prior to disposal.

**Action Steps Overview**

Waste management and materials purchasing goals will be achieved by the Action Steps presented in the CAP. Goals will be achieved by benchmarking waste, reducing ongoing consumables, reusing durable goods, and diverting waste from facility alterations and additions. Additional policies will make materials purchasing more sustainable. Waste Management Action Steps are provided in the list below:

- Conduct an annual waste audit;
- Promote recycling in residential buildings and on campus;
- Increase RecycleMania goals;
• Promote food conservation on campus;
• Purchase a campus on-site food composter;
• Create a University green store or second hand store; and
• New construction should follow LEED ND guidelines for waste diversion.

Steps for materials purchasing are divided into the following categories: ongoing consumables, food service and durable goods. An overview of these measures is as follows:

• Implement a campus-wide policy to purchase post-consumer material
• Compile a list of all consumables purchased on campus
• Identify which items can meet post-consumer and rapidly renewable requirements
• Implement a policy that food services department purchases sustainably grown and local foods
• Implement a policy that the Procurement department purchases furniture containing post-consumer materials

**Metrics**

Metrics will be used to determine the progress and achievement of the goals within the University CAP. Waste, recycling and reuse of materials may all be measured by volume or by weight to determine a baseline and track annual progress. Materials purchasing goals may be measured based on the percentage of sustainable materials purchased for ongoing consumables, food services and durable goods.
Economics

The Sustainability Plan has outlined a path to achieve carbon neutrality and sustainability. Many of the investments have a first cost, but would provide both quantifiable paybacks and other less tangible benefits. The plan elevates the importance of energy savings, carbon emissions, environmental impact and human well-being, introducing the need to evaluate project costs and benefits in terms of more than just dollars. Thus, it becomes imperative that the University develop a decision-making tool that encompasses cost savings over time, carbon emissions reductions, and less easily quantifiable benefits.

LIFE-CYCLE COST ANALYSIS

While universities are developer-owners of the projects they build, sometimes budgeting divides capital investment monies from the ongoing operations and maintenance budgets for buildings. This distorts decision-making, often sacrificing long-term cost-effectiveness for short-term savings. Incorporating life-cycle cost analysis (LCCA) early into the project delivery process captures the ongoing costs and benefits that occur over the life of the project and are affected by the initial design. This allows the design team to plan a project to be the most cost-effective over time.

Life-Cycle Cost Analysis Metrics

There are two recommended metrics for the life cycle cost analysis: net present value of total cost and payback. Total cost 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. The second metric, payback, is distinct from simple payback, which does not account for the time value of money affected by inflation and opportunity cost. Often, projects will require a 5-year simple payback for energy savings measures. This translates to over a 15% Internal Rate of Return (IRR) when the project life extends to 10 years and to nearly 20% at 15 years or longer. When this rate is compared to the current cost of money or even to other places in the market where money is invested, it is clear that projects are under-investing into cost saving projects.

The Stanford Life Cycle Cost Analysis Guidelines utilize payback with the time value of money and require projects with a less than 10-year payback to implement the option, though allowing for an exemption for options with a 6-10 year payback upon approval from the Vice Provost for Land and Buildings. Paybacks exceeding ten years are discretionary. For projects that have a longer useful life, such as new construction, the IRR for options with a 10- to 20-year payback remains competitive with other market returns. Uncertainty is captured qualitatively, where minimal differences are ignored.
The Stanford LCCA also established a number of parameters for the evaluation: 1) the study life by project type (new construction, remodel, and labs); 2) time-value-of-money rates for short term and long term; 3) escalation rates for energy and water utilities; and 4) maintenance and labor. It also requires that each project establish an operations and maintenance baseline cost.

Renewable Energy Credits
It is important that the analysis include the option of achieving the same amount of carbon reductions through both renewable energy credits (RECs) and carbon offsets. In many cases RECs and offsets may be less-expensive, short-term measures, but provide no return on investment in the long term. They do provide an upper limit for carbon reduction measures, identifying a stopping point for investment. These measures are best applied where achieving carbon neutrality for a project is cost prohibitive. RECs and carbon offsets can be attained from any number of private providers and some utilities. The University of California, Berkeley, assigns a dollar value to the tons of carbon saved as a tool for comparison of different measures. However, while this establishes an order for measures, it does not provide guidance for how many of the measures should be implemented.

Energy Modeling to Establish Annuities
The life-cycle cost analysis does utilize energy modeling to develop the annuities, or annual savings, as inputs into the analysis. The University will need to identify which areas of a project design will most benefit from a life-cycle cost analysis and define a reasonable number of alternatives that will both allow for creative and aggressive options to be proposed and keep the project manageable. It is recommended that measures addressing the same energy savings be modeled together, since they could either create diminishing returns (upgraded windows and overhangs) or reduce upfront capital costs (increased insulation in walls, roof, windows, and lower floor-to-floor heights resulting in downsized mechanical equipment).

Unexpected Savings and Unquantifiable Benefits
It is important to point out that savings can be attained from unexpected areas. Expenditures on preventative maintenance could also provide cost savings in reactionary and planned maintenance areas and allow for more predictable budgeting. Some sustainability efforts such as diversifying landscaping species could have reductions in pest-management costs. However, it can be difficult to quantify less tangible benefits such as improvements to health, productivity, comfort and environmental quality and therefore make it chal-
lenging to evaluate measures that would improve these aspects through a life-cycle cost analysis. There are three approaches to this that the University could employ as appropriate. The first is identifying areas of highest priority where the benefit, though unquantifiable, is deemed necessary. This would apply to areas affecting health and, to some extent, productivity. In this case the benefit would be assumed to be infinite and the measure would be employed. Second, if a cost for a measure is deemed insignificant over the study life of the project, the measure would be employed. Lastly, the measure could fall under University defined standard practices outlined in campus sustainability and/or design guidelines.

FUNDING

While a life-cycle analysis provides an excellent decision-making tool, it does not identify a source of funds. In the cases where measures will generate cost savings, they can be evaluated parallel to other University investment strategies. There are two types of funds that need to be considered: those that the University would spend and keep the payback (general funds) and those that individual schools or departments could invest and keep the savings. There is also a hybrid scenario where both types of money can be mobilized.

General Funds and Recycling Savings

Under the general funds scenario, cost-saving sustainability investments could be evaluated on par with monies that the University would invest in its endowment or otherwise. Here, the life-cycle cost analysis would prove especially beneficial, identifying which measures are competitive with other University investments. It is recommended that some percentage of investment (endowment-type) funds go into these types of measures. If greater security is required for the University, Energy Savings Performance Contracts (ESPC), where energy savings are guaranteed, could be employed. However, for an ESPC to occur, the energy savings must be “bankable,” that is, the project must be able to use the energy savings to repay the first costs.
If the University has an initial budget for sustainability investments, these funds/grants could be first invested in the higher yielding energy cost-saving measures. The eventual profits from these measures would create a “sustainability” fund through which additional projects could be funded. Depending upon the success of this program, the sustainability fund could distribute some portion of its monies to measures that will not have a quantifiable return on investment or to renewable energy credits and carbon offsets. Some of this type of “recycling of funds” is being implemented by other institutions such as the University of California, Berkeley.

Recycling of funds could be possible even if budgets are awarded on a yearly basis and savings cannot be banked from year to year, insomuch as some latitude is given in the creation of the budget. In this case, the energy savings from an implemented project would be predicted for the budget year. Then, RECs or offsets equivalent to these predicted savings would be added to the budget with the goal of not exceeding the previous year’s allotment (after adjustments for fuel pricing and potentially seasonal differences). This is a somewhat crude method, but could be used if fiscal rules governing the University budget set by the State of Wyoming cannot be changed.

School or Building Level Funds
Another scenario is dependent upon the University installing individual meters by building. In this case, schools or buildings could use their own funds to implement sustainability projects. The ideal structure would be similar to an endowed chair, where the school/department would raise funds for an “Endowed Green School” or “Endowed Green Building.” Here, funds raised from alumni or others would be invested into cost-saving sustainability projects and the payback would be the “endowment” to be further invested in sustainability projects – necessarily cost-saving – or would just create revenue for the school.

This would also provide an opportunity for a hybrid scenario where the University and schools/departments are able to trade funds. Here the University could lend funds, even at a cost, to the smaller entity to invest in projects. Interest would be comparable to returns on income investments. Any profit after payback would belong to the school/department to invest further into sustainability projects.
CAMPUS CARBON TRADING

One catalyst that could be used to motivate participation in the University’s sustainability goals and to find the most cost-effective means of reducing emissions is a campus carbon trading system. The system would also be dependent upon instituting the metrics described in previous sections. A carbon cap-and-trade is unique from a carbon tax and does not require one to be assessed. Thus, it is not dependent upon legislation or any policy outside of the University.

Carbon trading allows the University to be autonomous if it chooses. The number of carbon permits is determined by the University and distributed to emitters based on a reduction goal. One scenario could have the University reduce the number of credits distributed each year and emitters would be responsible to cover utility costs in excess of the credits.

For example, if a school emits 100 carbon equivalents each year and the goal is to reduce this number by 15% by 2015, the University might give that school 100 permits each year for 2010-2012, but only 95 in 2013, 90 in 2014 and 85 permits in 2015. Emitters would be allowed to buy and trade permits so the least-cost method of reducing emissions would be achieved.

Funds for investing in measures that would reduce greenhouse gas emissions would be attained by methods outlined above. It is important, however that the individual emitters are allowed to bank (carry from one year to the next) both carbon and monetary savings. The business college, economics department and energy-related departments could be enlisted to develop the system. Aside from the ability of a cap-and-trade system to achieve reductions cost-effectively, it would also serve as an incredible educational tool for students and faculty.
Summary

Achieving a comprehensive approach to sustainability will require creative efforts that will utilize a combination of different funding and execution methods. It will be important to maintain both a broad reaching outlook to integrate sustainability throughout campus and a focused effort to achieve specific and measurable goals. Sustainability should be addressed in a comprehensive manner from the major tangible items such as reducing energy use down to behavioral change and campus culture.

The University’s Climate Action Plan will continue to be updated with appropriate goals and specific action items to set targets and track progress. With a specific and measurable approach, the University will achieve real benefits with long lasting results.