

# Energy and Environmental Stewardship Initiative: 2010 Climate Action Plan

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## From the desk of President Michael K. Young

It has never been an easy task to meet the practical needs of the present without the risk of compromising our delicate relationship with the environment. The dramatic effects of climate on the world have forced us to reassess our way of living and come up with viable, sustainable solutions that will impact our collective future in sensible, positive ways.

The University of Utah is dedicated to setting the standard for responsible and sensible actions with a plan that promotes thoughtful environmental stewardship and reduces our own carbon footprint on campus. Through the U's Office of Sustainability, we are reaching that delicate balance between environmental care, economic development, and social responsibility by introducing and expanding programs such as increased energy efficiency, sustainability-focused curricula, renewable energy production, and decreased dependence on single-occupant vehicles. In addition, students have created the Sustainable Campus Initiative Fund, which allocates resources for meaningful campus sustainability projects and new awareness campaigns.

This Energy and Environmental Stewardship Initiative: 2010 Climate Action Plan will outline the University's efforts in laying out the scope of the challenge; defining goals, strategies and tactics; and creating a blueprint for that action. By bringing bright minds together and through thoughtful, decisive action, the University of Utah is leading the way in its commitment and response to key climate issues and working to create a more responsible, sustainable world in which to live and learn.

Sincerely,

A handwritten signature in blue ink that reads "Michael K. Young". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

Michael K. Young

President

The University of Utah



## Dedication

**T**he 2010 University of Utah Energy and Environmental Stewardship Initiative: 2010 Climate Action Plan (EESI) is dedicated to the memory of Dr. Craig Forster, founding director of the Office of Sustainability, who died tragically in a hiking accident in Zion National Park on November 28, 2008.

Dr. Forster was raised and educated in British Columbia and began his academic career as a hydrologist. He had a keen intellect and deep interest in many fields, leading to his active engagement in interdisciplinary research and teaching. At the time of his death, Dr. Forster retained a research faculty position in the College of Architecture + Planning with a focus on urban system dynamics and sustainability. He led the effort to establish a campus Office of Sustainability in 2007 and had recently been promoted from interim to full director at the time of his death. Dr. Forster also laid much of the groundwork for the University of Utah's participation in the American College and University Presidents' Climate Commitment (ACUPCC).

In addition to his professional accomplishments, Craig was a veritable Renaissance man who played in a Hungarian folk music ensemble with his wife, Bonnie Baty; enjoyed gardening, gourmet cooking, hiking, skiing, and cycling, among his varied talents. His many colleagues, students, friends, and family continue to mourn his loss.

In the wake of Dr. Forster's untimely death, President Michael K. Young pledged that the University would carry his work forward. This plan is one tangible demonstration of that commitment. Dr. Forster's legacy is also carried forward in the lives of the many students he influenced and in the Office of Sustainability, which he envisioned and helped build.

May all who undertake to implement this plan to achieve carbon neutrality at the University of Utah do so with Dr. Craig Forster's same passion, intellectual rigor, sense of purpose, ardor, energy, and commitment to creating a truly sustainable campus.



# 1: Introduction

*“Sometimes doing your best isn’t good enough; sometimes you have to do what is required.”*

– Winston Churchill

*The social, environmental, and economic changes of the 21st century will be among our society’s greatest challenges. These circumstances provide us with an opportunity to be leaders in the development of a bold, holistic, and creative vision that will address these challenges in new and innovative ways, serving as a model for the broader community.*

## What is this Plan?

On Earth Day 2008, President Michael K. Young signed the American College and University Presidents' Climate Commitment (ACUPCC) and joined the ranks of more than 650 leading academic institutions committed to developing an institutional plan to achieve net zero greenhouse gas (GHG) emissions and expand the University's research and educational efforts related to sustainability.

The Office of Sustainability sought participants from departments across campus as well as interested students, faculty, staff, and alumni. Participants were divided into five main task teams, with the President's Sustainability Advisory Board serving as the steering committee. The main topic areas considered were:

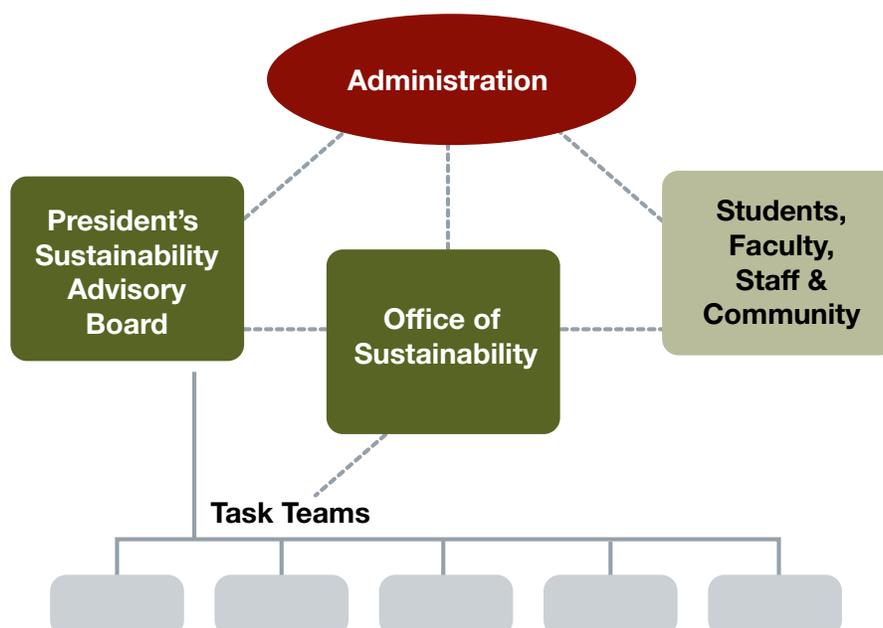
- **Education and Research**
- **Energy Efficiency and Conservation**
- **Renewable Energy and Offsets**
- **Transportation**
- **Water, Waste, Purchasing, Grounds, Food**
- **Communication**

Carbon neutrality encompasses conservation, the effort to reduce our reliance on nonrenewable resources. At the same time, it includes researching and implementing new renewable technologies and practices not currently part of the University's administrative or operational routine. It is about eliminating wasteful habits as well as providing a vision for practices, policies, and actions that will lead to a sustainable campus.

The Energy and Environmental Stewardship Initiative: 2010 Climate Action Plan (EESI) builds on the University of Utah's 2008 Campus Master Plan and extends the University's leadership by integrating the principles of social, economic, and environmental sustainability into campus planning, design, operations, administration, curriculum, and community engagement. This plan represents the desire, ability, and commitment of students, staff, faculty, and administration to dramatically reduce our greenhouse gas (GHG) emissions and achieve carbon neutrality as rapidly as practicable.

The University of Utah's efforts to become carbon neutral will address the potential risks associated with carbon emissions in a proactive way. First and foremost, the plan seeks to reduce and mitigate future threats to the University and by extension to the

### EESI Organization Graphic



*“ . . . the debate over comprehensive climate and energy policy often focuses on the costs of climate action, rather than on the serious economic and environmental consequences if we fail to act.”*

– Union of Concerned Scientists

greater community and the state of Utah. At its core, the plan examines how we obtain and use energy resources that power our campus and our modern amenities and mission-critical facilities. To their credit, University of Utah administrators have been taking steps over the past decade to slow the demand for energy and invest in efficiency and conservation when possible. They have laid the groundwork that can now be accelerated based on the strategies in this plan. A carbon-neutral campus will ultimately be highly efficient, resilient, and innovative.

This document is the outcome of the University’s first planning effort to achieve carbon neutrality. Participants have learned a great deal from this effort and recognize that it is an iterative process that will be repeated in the future as progress is made and new information becomes available.

### **Why should the University of Utah become actively engaged in these challenges?**

Universities are the centers from which new knowledge, cutting-edge research, and creative, thoughtful leaders emerge. The true leaders in this transformational time will have the skills to navigate complex systems and foster collaborative innovation. The University of Utah, consistent with its mission and position as the state’s flagship university, has stepped forward in its commitment to lead, with technology solutions, policy solutions, and human solutions.

To this end, the University of Utah will contribute to develop workable new strategies, systems, practices, and technologies that can be scaled up to the community and state levels. The goals of the ACUPCC are well-aligned with the mission of the University to foster active and responsible citizenship in the arenas of human health, environmental stewardship, social responsibility, and economic progress. Taking action on this issue is expected to hold further advantages in the quest to recruit top students, faculty, and staff; to attract new sources of funding and to maximize the support of alumni and local communities.



Your Choice

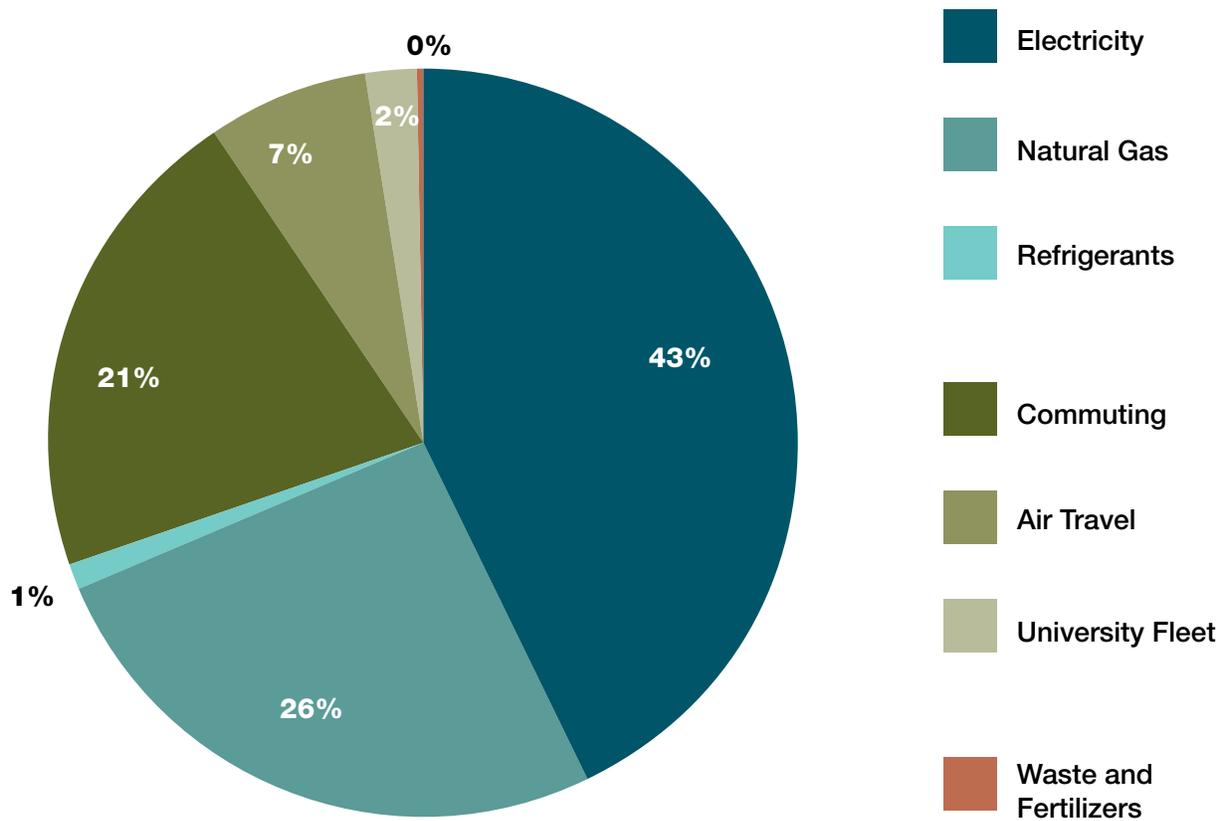
pm2.5 = 7 ug/m<sup>3</sup>  
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pm2.5 = 100 ug/m<sup>3</sup>  
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## 02: Understanding the University Of Utah's Greenhouse Gas Emissions

*Operating the University of Utah requires considerable energy resources that are currently derived predominantly from fossil fuel sources, which in turn cause significant greenhouse gas emissions. In order to achieve significant reductions, we needed to understand the sources of our emissions and their relative contributions before we could begin exploring how to reduce them. In 2007, a team of students and staff at the Office of Sustainability conducted a pilot inventory for 2006. Based on lessons learned from the study, a formal carbon inventory was conducted for calendar year 2007 and reported to the ACUPPC as the University's starting point for future reductions.*

# GHG Emissions CY 2007



Emissions organized in the following categories 1) **Built environment / Buildings** (Electricity, Natural Gas and Refrigerant use) 2) **Transportation** (Commuting, Air Travel, and University Fleet), and 3) **Waste generation and Fertilizers**.

## What are greenhouse gases?

Greenhouse gases (GHGs) are chemical compounds that absorb infrared radiation and keep the Earth’s temperature in a range that is hospitable for sustaining life as we know it. However, scientists now recognize that excessive build-up of additional human-caused greenhouse gas pollution is trapping heat in the Earth’s atmosphere and causing changes that result in an overall warming trend (IPCC, 2007). The primary greenhouse gas is carbon dioxide but there are also several others that need to be considered for the inventory (see appendix). For comparative purposes, the relative contribution of each gas is converted to metric tons of carbon dioxide equivalent, or MTCO<sub>2</sub>e, and then totaled to give an overall emissions rate per year.

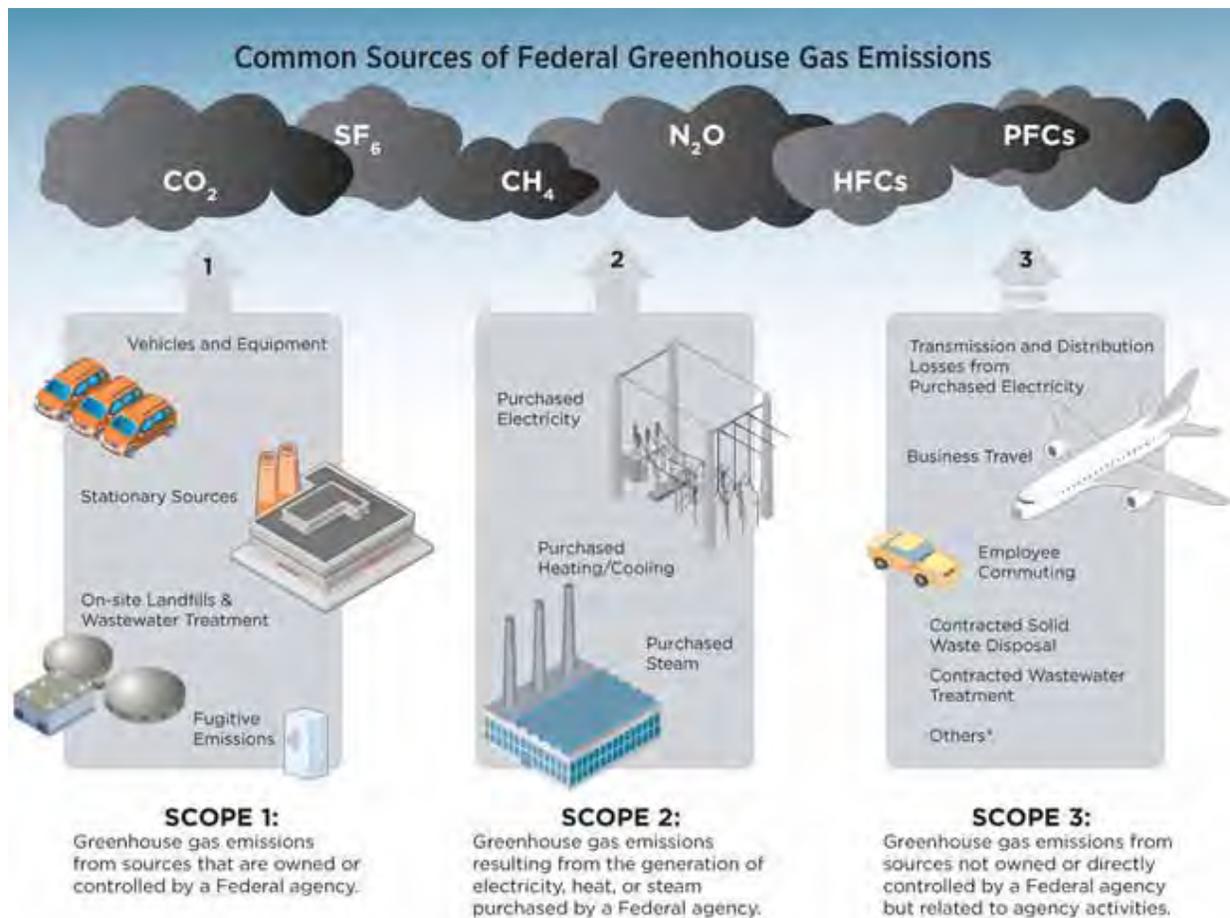
## How did we measure?

The 2007 baseline inventory was completed using the Climate Registry General Reporting Protocol (the Protocol), which has been adopted by many campuses, institutions, and corporations. This gave us the “rules of the road” for determining what and how to count our emissions sources. For the data tracking and calculations, we used the Clean Air-Cool Planet Campus Carbon Calculator™, a free custom spreadsheet tool that was developed specifically for college and university campuses.



## What did we measure?

To establish the University's organizational boundaries, a carbon accounting "control method" first had to be selected, based on definitions in the protocol. The University chose the financial control approach as the best suited for the institution. This requires us to include all wholly owned buildings and land area of the University and its subsidiaries but excludes leased facilities.



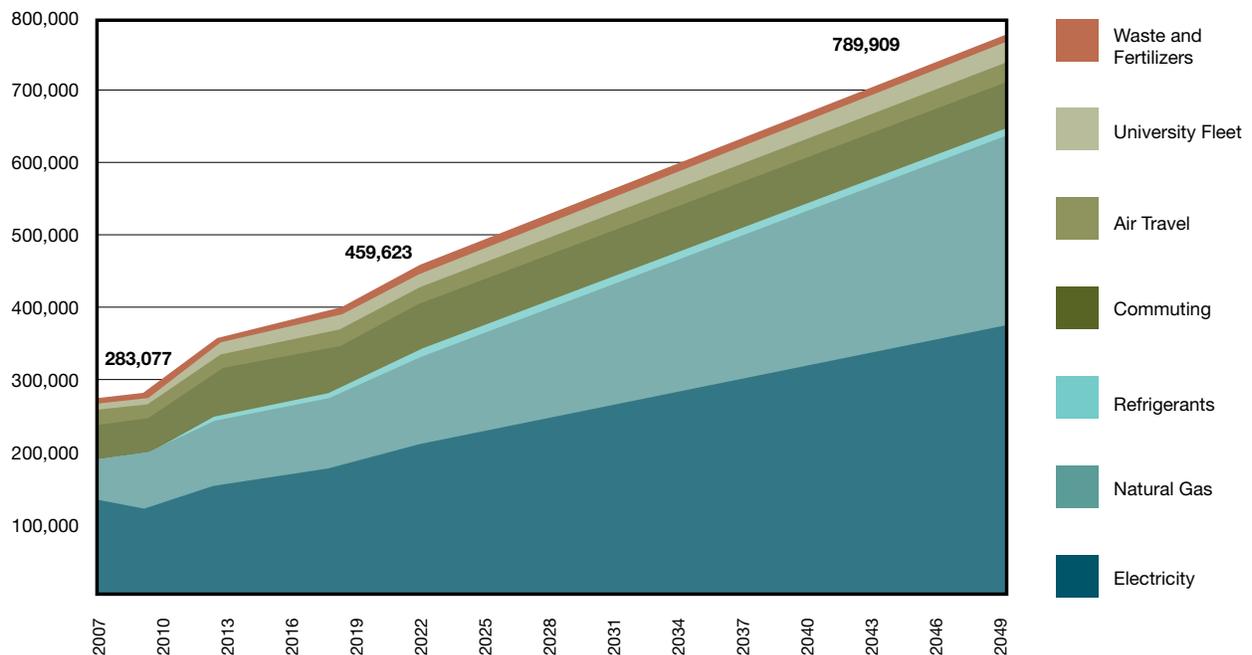
\*Additional, significant Scope 3 emission sources exist beyond the examples provided

## What we found

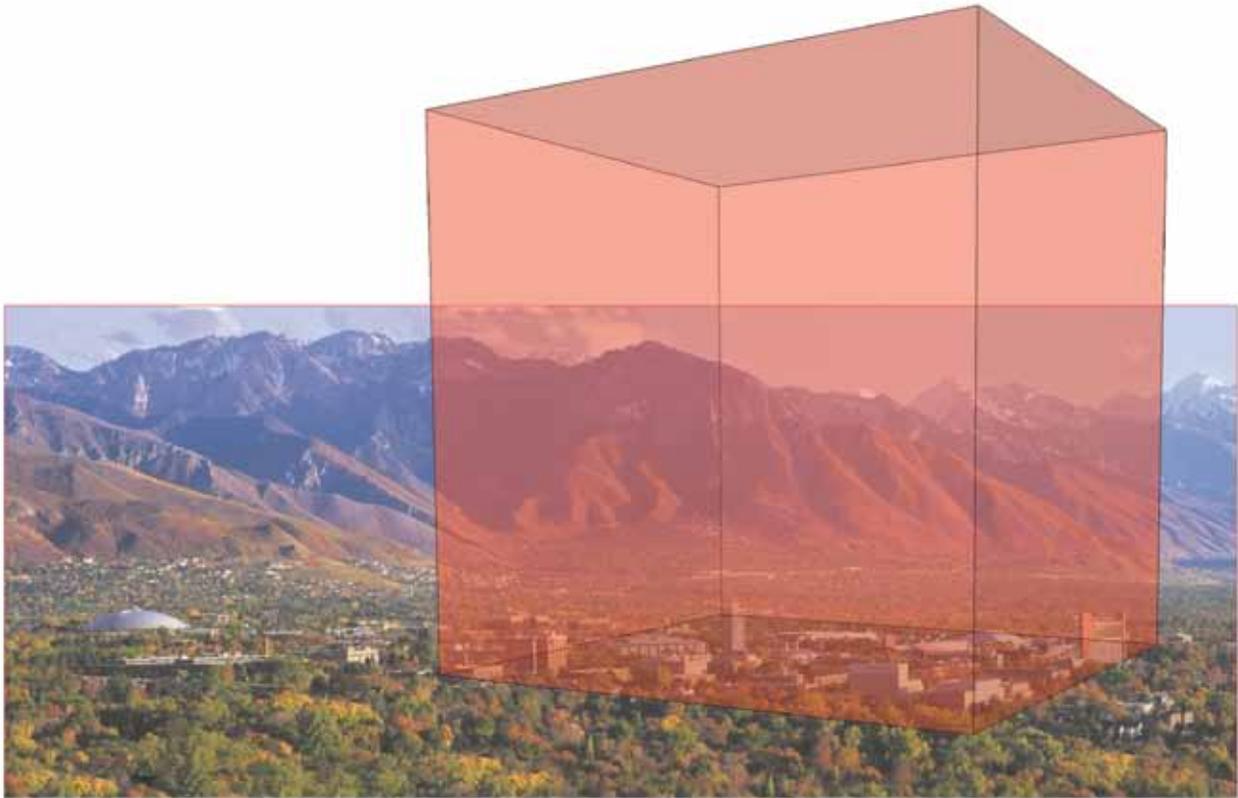
For the purposes of emissions inventories, emissions sources are divided into categories, or scopes, (see graphic on previous page). These are divided by how directly the emissions are generated. Scope 1 includes all the fuels and chemicals that are burned or released within campus boundaries; the main component is natural gas burned at the central heating plants. Scope 2 includes emissions produced at the utilities from which we buy electricity. Scope 3 emissions are those generated indirectly due to University activities and operations. For the ACUPPC, we must report business air travel, daily commuting, and waste disposal.



## GHG Emissions Projections BAU 2007-2050



In this "business as usual" projection, the U will more than double its GHG emissions over the next 40 years due to increasing enrollment, increased building area, and the increased impacts of research and clinical energy use.



The total annual greenhouse gas emissions for the University of Utah in 2007 = 283,077 Metric Tons of CO<sub>2</sub> equivalent. At sea-level pressure and temperature, the current annual contribution to the atmosphere is a cube of greenhouse gases, 533 meters, 1748 feet or 0.33 miles, per side.

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## Moving forward

The CY2007 reportable emissions for the University of Utah totaled 283,077 MTCO<sub>2</sub>e. According to the United States Environmental Protection Agency Equivalencies Calculator (EPA, 2009), this is equivalent to the annual emissions due to energy use of approximately 24,000 average United States homes. Emissions by other comparable university campuses in the United States range from fewer than 200,000 MTCO<sub>2</sub>e to more than 500,000 MTCO<sub>2</sub>e. Making direct comparisons between the emissions of different campuses is complicated by differences in size, scope, activities, demographics, local climate (heating and cooling degree days), and fuel source mix for power generation. In particular, major scientific research and health sciences centers such as the University of Utah tend to be more energy-intensive.

A “business as usual” scenario has been developed to help visualize impacts into the future and to track potential improvements over time. To project annual emissions, we used growth projections for population and built space from the 2008 Campus Master Plan. We then calculated baseline average emissions per person and per square foot from our inventory results and estimated how our footprint would grow without any changes. We now have greenhouse gas inventories for 2008 and 2009 to compare against our original estimates. In 2008, total emissions were 286,817 MTCO<sub>2</sub>e and in 2009, 288,785. By comparing actual versus business as usual emissions over time, we can track progress and test our assumptions.



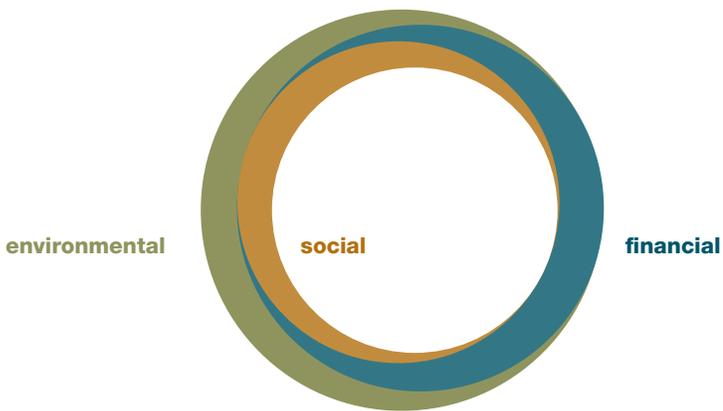
## 3. Guiding Principles

*The following guiding principles will steer the strategies and initiatives within this Energy and Environmental Stewardship Initiative: 2010 Climate Action Plan (EESI). Furthermore, they provide a framework for the University of Utah on its path towards greater overall sustainability in the coming decades.*

**Start “Seeing Green”:** All members of the University of Utah community (faculty, students, staff, visitors, and administration) will view themselves as active participants in the creative effort to become a model for efficiency and resilience. Everyone will be expected to look for transformative opportunities in everyday activities and longer-term planning to become sustainable.

**Campus as Living Laboratory:** While looking for opportunities to create a sustainable campus, the University of Utah will promote an environment that encourages on-site experimentation and applied research by students, faculty, and staff.

**Triple Bottom Line**



**Triple Bottom-Line Approach:** The University of Utah will consider relevant environmental, social, and economic impacts (the triple bottom-line) in operational, administrative, and educational decision-making.

**Invest & Reinvest:** The University of Utah will aggressively seek to fund initiatives that reduce dependence on fossil fuels. Additionally, programs and financial accounting mechanisms will be created to capture and reinvest net savings into additional projects and to create the incentives and intrinsic motivations that will foster participation.

**Think Beyond the Barriers:** The University of Utah will provide encouragement, support, and guidance to overcome traditional operational and institutional barriers that impede progress. This requires systems-thinking and recognition that issues are all part of a greater whole.

**Internalize the Mitigation Costs:** For each contract, practice, or activity the University of Utah will seek to create mechanisms that embed the price of associated carbon mitigation within the cost of that activity to the extent possible.



**Localize the Strategy:** The University of Utah will work to develop and promote campus-based and local programs for efficiency and renewable energy to offset unavoidable emissions and diversify the portfolio of offsets over time.



# Who are we?



Professor David Orr of Oberlin College reminds us that any change in the way we live our lives will require a change first in our loyalties, affections, and basic character and that only then will we change our intellectual priorities and paradigms. It is essential for students to contemplate what it means to be human and how that meaning has been interpreted in history, literature, philosophy, and art. Technology alone cannot answer the question of how we have come to assume that material progress is our right or even the question of what it is we should seek to sustain: Our present way of life? Power over nature? A living and diverse planet? Technology and science must be informed by contemplations of how we can imagine ourselves in a different way—as members of a community embedded in a biosphere and, consequently, how we answer the question, **“What will it require of us?”**



## 4. Strategies

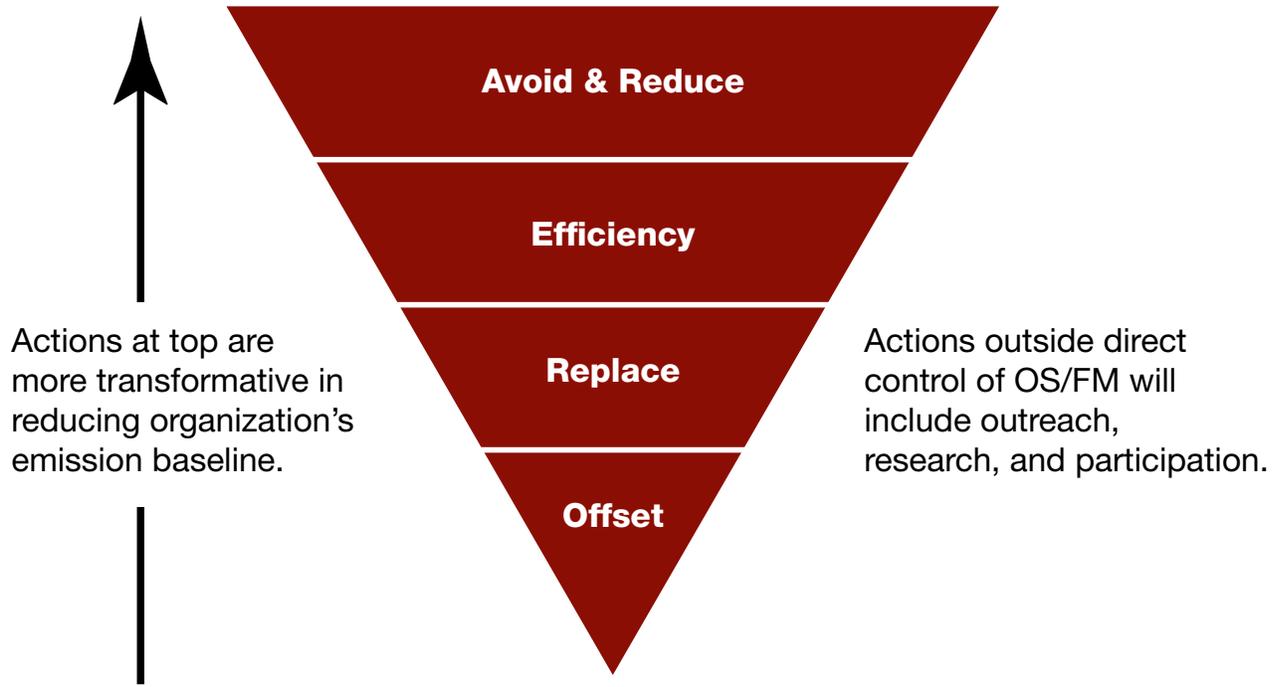
### How were strategies developed?

Strategies for mitigating the impacts of carbon were developed by a team of over 80 students, faculty, and staff. These volunteers studied the potential to impact campus operations, education, and administration through mechanisms such as policy change, behavioral change, investment in efficiency, potential for clean fuels and educational opportunities.

Strategies were then categorized by the following time frames:

<b>On-going:</b>	current programs or strategies to be continued or expanded
<b>Short-term:</b>	strategies to be initiated by 2015 (five years)
<b>Mid-term:</b>	strategies to be initiated by 2020 (ten years)
<b>Long-term:</b>	strategies to be initiated after 2020

## Decision-making criteria for Carbon Reduction



### How will decisions be made?

This plan provides numerous strategies for reducing the net production of carbon associated with University of Utah operations and will prioritize the strategies in the following descending order of importance:

**Avoid and Reduce:** Typically referred to as conservation measures, this group of measures prioritizes the elimination of wasteful practices or the avoidance of new consumption of carbon-based fuels. Strategies in this category typically provide the highest return on investment.

**Maximize Efficiency:** This category includes energy-efficiency measures and infrastructure upgrades. They are a means to reduce demand for energy of any type, generally through substituting more advanced technological equipment, while providing the same (or better) quality products and services. These strategies can also provide a return on investment.

**Replace:** This group of measures includes the option to re-evaluate the fuel source or means of operation. Switching from diesel fuel shuttles to natural gas or bio-diesel to reduce carbon-emissions and substituting video conferencing for business travel are two examples of these strategies. Additional opportunities include on-campus solar energy production and electric vehicles.

**Offset:** Despite our best efforts to eliminate or reduce our carbon footprint and become sustainable, we may still find that some activities are essential to the mission of the University and must continue. These emissions can be mitigated by establishing financial instruments that help pay for projects that reduce emissions elsewhere. Offsets should be the last step taken to meet reduction targets and will be largely voluntary for the near-term.

## How can we reduce our impact?

This plan is organized around five central themes: education, efficiency, renewable energy, transportation, and waste (including grounds, food, and other related issues). By implementing the strategies outlined in this document, the University will be on the path towards carbon neutrality. Since many of today's technologies are changing rapidly, this document prioritizes measures that can be implemented over the next five years and which provide recognized benefits to the University (including internal rate of return for efficiency, increased educational benefits, and risk avoidance for escalating energy costs). Future versions of this plan will update the programs and measures based on the available technology and information to maximize the positive impacts.

Committing to carbon-neutrality by 2050 also requires intermediate goals so that progress can be measured, evaluated, and maintained. The president's Sustainability Advisory Board determined a range of acceptable possibilities for mid-term targets. Because greenhouse gas emissions have a cumulative and long-term effect, the ideal goal based on current climate science (see appendix) is to create 50 percent (50%) reductions from 2007 baseline within five years (2015). Since that goal was considered difficult to achieve by some, a reduction of twenty-five percent (25%) from 2007 baseline levels by 2020 will be set as the minimum threshold for this plan. For more discussion and a summary of greenhouse gas reduction strategies, see Section 5 *Implementation*.



# 4A: Curriculum, Education, and Research

## Introduction

Unlike other topics addressed in this plan, the strategies proposed in the Curriculum, Research, and Community Education section may not have a directly attributable effect in reducing the University of Utah's carbon footprint. Instead, they recognize the central role of education in providing society with a core understanding of global systems and the tools to solve critical problems now and in the future. These strategies present a framework that incorporates a balanced social, environmental, and financial philosophy to develop and distribute content and research. In addition, these strategies recognize that the University's community is broad and its perspectives diverse. Among this community, we include our students and faculty, administration and staff; our neighbors, alumni, and financial supporters. This breadth and diversity is our greatest resource. Through a renewed emphasis on trans-disciplinary intra-community conversations and engagement in the public policy process, we will be able to fulfill our mission.

## Curriculum

Universities have a critical responsibility to educate citizens by organizing knowledge and learning about sustainability. It is through the curriculum that we envision and implement what knowledge and values are most important and through the curriculum that we can demonstrate the intersections all disciplines have with the environment. Human interdependence with the natural world can be put at the center of all the disciplines and redirect education toward experiential learning and systems thinking. Most important, the integration of sustainability into curriculum helps create the civic-minded and collaborative leaders of tomorrow.

### Strategies

#### Near-term:

- Work with the Council of Academic Deans to develop and implement a Sustainability Certificate.
- Review existing "Student Credit Hours" (SCH) structure and develop strategies to support and fund trans-departmental integrated sustainability course offerings.

Students, faculty, and staff participate in an open house discussion about potential carbon-reduction strategies for the University.





Traditional landscaping on campus is being replaced with native and adaptive species. These design concepts help inform our campus community about the regional climate and how best to live within the limits of available water and resources.

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- Incorporate sustainability efforts in both departmental reviews and faculty activity reporting.
  - Create a University Professorship in Sustainability.
  - Create a robust faculty support system to develop a broader understanding of sustainability concepts and “Social Learning,” and develop sustainability course materials.
  - Develop and provide release time and other opportunities for faculty for professional development, trainings, and other activities to help faculty broaden and deepen sustainability curriculum. Work with administration to assure that participation in sustainability curriculum and research is rewarded during performance and tenure track reviews.
  - Encourage the Council of Academic Deans to support and incorporate the sustainability curriculum (both sustainably focused and sustainability-related) at a trans-disciplinary scale.
  - Work with the campus libraries in building collections, licensing and creating resources, and providing services that fully support the sustainability curriculum.
  - Work with Center for Teaching and Learning (CTLE), Technical Assistance Center (TAC) and other campus entities to further integrate sustainability into existing coursework.
- Mid-term:**
- Evaluate opportunity to create a Sustainability Degree Program at the undergraduate and graduate levels.

## Sustainability University Professorship

For the 2011 academic year, the Office of Undergraduate Studies will fund a special University Professorship with a unique emphasis on sustainability. This professorship builds upon an existing program that has resulted in permanent curriculum changes.

The professorship offers faculty the opportunity to launch a new project in the area of campus sustainability that presents the challenge of understanding complex adaptive systems in a world of increasing interdependency and that will have a continuing impact on the University's general education curriculum or bachelor's degree requirements.

## Sustainability Certificate

Sustainability is an interdisciplinary field of study that examines the dynamic interaction between many different aspects of culture and society. The Sustainability Certificate Program will provide students with knowledge regarding sustainability's focus on balancing the relationship between environmental stewardship, economic development, and social responsibility. Through a combination of coursework and hands-on learning, students will engage issues that lead to environmental and social change.

## Community Education

Inherent to the University of Utah's mission is the creation, accumulation, and dissemination of knowledge and research discoveries. Community Education builds upon the vision of the University of Utah as a leader in higher education in environmental, social, and financial sustainability, aspiring to engage all members of our community: students, faculty, administration, staff, and community.

### Strategies

- Implement "*Re-Imagine The Campus*" by fall semester 2011.
- Create enhanced orientation for students, faculty, and staff to include principles of sustainability in existing policies and programs, as well as participatory opportunities like Green Teams and campus organizations.
- Enhance involvement with high school "Fast Track" curriculum development to include sustainability.
- Create "Learning Clouds," or Internet-based, shared learning toolkits composed of courses, digital assets, and resources to engage the faculty, students, and staff in conversations across epistemic communities.



Professor Mira Locher leads a design-review with students studying the impact of urban design, social networks, and sustainable building practices on the community fabric.



Andrew Revkin, blogger and former environmental reporter for The New York Times, gives his lecture “9 Billion People + 1 Planet” at the Sutherland Moot Courtroom in the College of Law.

This presentation was made possible by a partnership with Environmental Studies Program, Environmental Humanities Program, Institute for Clean and Secure Energy, S.J. Quinney College of Law; and the Wallace Stegner Center for Land, Resources, and the Environment; and the Office of Sustainability.

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- Develop academic and research real-life opportunities for students to work with Facilities Management and allied professionals in the planning, design, and construction of the campus’ built environment.
  - Expand the “Focus the U on Climate Change Teach-In.”
  - Foster a culture of sustainability through our visible campus outreach efforts—from libraries and museums to theater and athletic events—to become a community model for sustainability.

## Research

Focused, high-quality sustainability research will inspire University and community leaders to provide

## Re-Imagining the Campus 2028

Re-imagining the Campus 2028 will build on and advance the goals of the 2008 Campus Master Plan and the University’s Carbon Neutrality Action Plan 2010.

Re-imagining the Campus 2028 will develop an interdisciplinary service-learning opportunity for students, faculty, and staff to work together on the real-world problem of how to transform the University into a sustainable and resilient campus. The centerpiece of this approach will be a two-semester cohort of interconnected, system-based practica. Proposed systems include energy, food, landscape, supply-chain, waste, building, water, transportation, human resources, social justice, and public health. Ideally, each class would have a cross-disciplinary student demographic and would work both independently and collaboratively. Active participation by the administration, staff, and the public would be expected to help define existing conditions and review transformational proposals. Collaboratively, the classes will develop a vision of our campus in the year 2028. Communication methods will be designed to reach the broadest audience including, but not limited to, the campus, the local community, and academia.

## Sustainability Research Center

The Sustainability Research Center (SRC), headed by Kent Udell, is an incubator for creating a cadre of researchers, citizens, educators, business and community leaders who can play key collaborative roles in transforming how we use the Earth's resources and share them with both current and future generations. Through cooperation across disciplinary boundaries, SRC affiliates will tackle the challenges of the 21st century through a systemic understanding of critical problems, while developing a capacity to disseminate solutions to others around the world. In other words, the SRC mission is to foster a more sustainable future through interdisciplinary research, education, and outreach.

The SRC will play an important research role in reducing the University of Utah's carbon footprint. The obstacles the University of Utah faces in moving to a carbon-free infrastructure are found at all governmental, industrial, and community levels. As the SRC's affiliates develop sustainability-related research programs, their findings will likely apply to University operations as well. Further, as attention is focused on changes that will accompany the University's commitment to reaching carbon reduction goals, the campus itself will serve as a research vehicle, allowing testing of ideas, technologies, methodologies, and strategies.

the long-term support for initiatives that prove to be effective in meeting the goal of carbon neutrality. As part of its research and teaching mission, the University of Utah must create the knowledge required to meet its goal of carbon neutrality. Faculty, staff, and students with passionate interests in sustainability will be enrolled in this research effort through funded research, internships, community outreach, and scholarly work. Because this research will consider energy and material flows, and policy and human behavior in each community sector, the work will bridge all disciplines, support choices and operations across departments, and help to direct resource allocations as appropriate in all colleges and in the campus libraries.

### *Strategies*

- Identify sustainability-related research by University of Utah investigators to identify areas that may attract funding and campus researchers.
- Promote sustainability-related research incentives such as funded research programs, fellowships, financial support, and formal mentorship.
- Promote sustainability-related in-class research such as class research papers, capstone projects, Undergraduate Research Opportunities Program (UROP) projects, master's theses and doctoral dissertations.
- Strengthen the foundation for sustainability research by supporting library resources and services focused on sustainability.
- Encourage interdisciplinary sustainability research in tenure and promotion considerations and implement procedures for faculty under promotion and retention consideration to report and highlight interdisciplinary sustainability research.
- Create an active interface between the Sustainability Research Center and the Technology Commercialization Office to foster technology transfer and accelerate commercialization of technologies within the University of Utah.
- Create integrated academic exercises based in the architecture, planning, and engineering schools that tie to ongoing projects managed by Facilities Management, Campus Planning, and Campus Design and Construction departments.



## Sustainability Practicum for the Sutton Building

In 2007, Professors Steve Burian (Engineering), William Johnson (Geology and Geophysics), and Fred Montague (Biology) launched a new interdisciplinary sustainability practicum course. Twenty students learned sustainability and green design principles and then applied them to the new Frederick A. Sutton Building, which was already under construction. The local architectural firm CRSA welcomed and assisted the student designers. Five projects were integrated into the final building design, including tubular skylights, a building energy dashboard, perimeter landscaping, and a xeriscaped green roof. These elements helped the building achieve LEED<sup>TM</sup> Gold certification, the first on campus.

## 4B. Energy Efficiency

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The total annual greenhouse gas emissions related to buildings for the University of Utah in 2007 = 196,704 Metric Tons of CO<sub>2</sub> equivalent. At sea-level pressure and temperature, the current annual contribution to the atmosphere is a cube of greenhouse gases 472 meters, or 1548 feet per side.

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### Introduction: “You Can’t Manage What You Don’t Measure”

More than 69 percent of campus greenhouse gas emissions are as a result of activities within our buildings such as heating, cooling, lighting, and equipment needed to conduct the business of administration, teaching, and research. This section addresses the opportunity to reduce emissions associated with buildings by addressing three important components: comprehensive metering of facilities to understand current use patterns, behavioral and administrative programs to address the human aspects of energy use, and changes to infrastructure and equipment in order to reduce the use of fossil-fuel based energy.

### Metering and Monitoring

Reducing energy emissions requires baseline data as a foundation for setting goals and targets and measuring progress toward those goals. Conducting the assessment of campus facilities and interpreting the

data are areas in which stakeholders will likely look to campus facilities professionals to provide leadership. Meters and monitors for equipment and buildings provide the tools needed to measure and gain a sense of the scope of the problem, the opportunities and the constraints for our institution in moving toward carbon neutrality.

The University of Utah will implement a comprehensive plan to baseline current campus-wide energy use accurately and to establish a method for ongoing assessment.

### Strategies

#### On-going:

- Install and automate all required power, gas, water, high temperature and chilled water meters necessary to assess individual building usage within five years.
- Implement a comprehensive commissioning program for both new construction and retro-commissioning for existing buildings.

### Near- & Mid-term:

- Perform comprehensive energy audits, modeling, and assessments of all campus buildings to prioritize and implement energy-efficiency work scopes within five years.
- Upgrade outdated or inadequate building control systems and implement a plan for upgrading to Direct Digital Control (DDC).
- Optimize existing building control systems to provide capacity for tracking key system components to initiate corrective action of poor-performing buildings in a timely manner.
- Layer a meter map into the existing geographic information systems (GIS) database to help identify areas in need of more extensive and sub-level metering. Incorporate historical meter data to support the building benchmarking database.

## Behavioral and Administrative

Once existing energy use is understood and being tracked comprehensively, the University will begin to expand current programs to address the behavioral aspects of energy reduction. In some building types, human actions alone can reduce energy use by over 20 percent of the total.

The University of Utah will increase faculty, staff, and student outreach programs about actions individuals can do to minimize the use of electricity and natural gas generated from fossil fuels.

## Strategies

### On-going & Near-term:

- Implement the campus energy standard to require all new capital improvement projects to provide a minimum of 40 percent savings beyond the required energy code.
- Create senior administrative support for the establishment of a Green Team in every campus department to act as the liaison between the department and the Energy Team and increase participation over time. Develop a feedback system to measure the success of campus awareness programs.
- Increase communication regarding the importance and benefits of turning off unused lights and equipment by expanding the Conservation Awareness Program's annual campaign in each department.
- Implement a space heater swap-out program to minimize inefficient and unsafe energy use while addressing the comfort needs of building occupants.
- Expand green information technology (IT) and computer management software to reduce unnecessary computer operation.
- Create energy efficient data center(s) and consolidate facilities where appropriate.
- Create a task force to develop space utilization standards to maximize efficiency of space throughout the campus and throughout the academic calendar.



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The U.S. Department of Energy estimates that by tracking a buildings performance and making energy saving modifications on an ongoing basis, up to 20 percent on annual energy costs can be saved. In addition, real-time feedback about current energy use helps building occupants reduce additional waste by alerting them to potentially wasteful patterns.

## Green Computing

The Information Technology department at the University of Utah has developed a website dedicated to educating the campus community on the best practices for green computing. These practices will result in a reduction in overall operating costs by reducing power use, using shared hardware resources, reusing similar systems, and reducing supplies such as toner, ink, and paper. Information about power-save settings and equipment consolidation can be found at [www.it.utah.edu/leadership/green](http://www.it.utah.edu/leadership/green).



- Create enhanced sustainability workshops for all new capital building projects to review all possibilities for minimizing energy use beyond required standards and include all necessary personnel.

### **Near- & Mid-term:**

- Establish a University policy for all building renovations and retrofits to meet a minimum efficiency standard. Maximize opportunities during construction by utilizing the energy conservation loan fund and Sustainable Campus Initiative Fund for exceeding typical energy efficiency upgrades and methods.
- Install building dashboards and feedback systems, enabling building occupants and facilities' staff to monitor and improve the energy usage of buildings.
- Utilizing sub-level meters at the departmental level, initiate energy conservation competitions among users. Encourage conservation through a reward program.
- Initiate a certification program for participating campus units to reward outstanding conservation behavior and initiative. Provide minimum standards similar to the Salt Lake City Corporation's e2 Business program.
- Develop education and training programs for all faculty, students, administrators, and staff on energy conservation issues.
- Initiate a campus program to provide integrative analysis and assistance for sustainable lab practices.
- Systematically review and adopt campus-wide purchasing policies and guidelines for the procurement of energy-efficient equipment. (See the Solid Waste, Purchasing, Food Systems, Water, and Grounds section for more details.)



Mark St. Andre, assistant dean of Undergraduate Studies, shows off the Sill Center's new dashboard console, which displays the energy harvested daily from the sun from their rooftop solar photovoltaic (PV) array.

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## Infrastructure

The University of Utah will upgrade and replace existing inefficient and outdated energy systems and equipment in order to reduce energy consumption.

### Strategies

#### On-going:

- Retrofit and replace existing lighting in buildings, exterior walkways, and parking lots to maximize efficiency levels. Use latest efficiency guidelines to set appropriate lighting standards and for information on appropriate technology.
- Replace worn-out or inefficient heating, ventilation, and air conditioning (HVAC) equipment with new, high-efficiency models.

#### Near-term:

- Convert buildings using steam heat to a more efficient high-temperature hot water system.
- Create a methodology to inventory and identify inefficient free-standing equipment and implement a program to reduce plug loads.

#### Mid-term:

- Complete a feasibility study to review the potential for a second combined heat and power (CHP) plant for the University Hospitals and Clinics central plant.
- Recover waste heat from stack exhaust at central high temperature plants and lab exhaust systems.

## Behavioral Program Success: Department-Based Green Teams

The University of Utah's Behavioral Energy Program works closely with individual departmental and facilities' staffs to develop an understanding of the needs and usage patterns for every building. Having that knowledge helps University of Utah occupants make better-informed decisions in building scheduling and usage.

People are often uncertain if they have permission to turn off machines, heat, lighting, and other energy-consuming equipment. This program is designed to identify areas where energy is being wasted and educate building occupants about reducing that waste.

Awareness, responsibility, and autonomy are key components for success. The program uses positive peer pressure to encourage an atmosphere of conservation. There are clear instructions for specific practices, participant commitments, and goal setting, and continual follow-through on conservation measures identified for each building. Regular building reviews provide feedback for participants so they can see how well they are meeting their goals.

To date, the program has had tremendous success by saving an average of over \$1 million annually in each of the last six years in energy costs. According to the Energy Information Agency, this savings is equivalent to the amount paid to power, cool, and heat over 680 average Utah homes.

## 4C. Renewable Energy and Offsets

### Introduction

Thanks to a special student fee program and individual donors, the University of Utah currently purchases Green-e™ certified renewable energy credits to compensate for about 11 percent of its electricity through renewable energy sources. Since 2008, the Energy Management Office has installed two 3-kilowatt (KW) solar photovoltaic (PV) systems on main campus. These installations are anticipated to be the first of many as the University strives for climate neutrality. As opportunities are explored to incorporate more renewable energy technologies into the portfolio, several strategies will be emphasized:

- Regularly search for joint funding opportunities such as grants and donations to help offset the initial cost of alternative energy technologies.
- Prioritize technologies and projects that reduce carbon emissions while factoring in cost-effectiveness and efficiency.
- Be actively engaged in on-campus and campus-sponsored renewable energy research, including Net-Zero buildings, Seasonal Energy Storage, carbon capture, and storage and innovative financing mechanisms.
- Seek out mutually beneficial partnerships with local governments, nonprofits and companies to create opportunities for ownership sharing.

By 2050, the University of Utah will source the majority of its energy from clean renewable sources such as solar, geothermal, and combined heat and power. Much of the power will be generated on site. Energy purchased from local power companies will be generated through a diverse mix of low-carbon and renewable energy sources. Students, faculty, and staff will actively participate in the existing renewable energy campaigns and other credit and offset programs that promote local reductions. In 2050, mitigation efforts will have resulted in 100 percent reduction in carbon emissions.

### Strategies

#### Solar Photovoltaic (Pv)

##### Near-term:

- Seek matching funds to support roof- and/or ground-mounted solar installations. Continue to monitor installed cost of PV systems and proceed when full life-cycle cost analysis meets University criteria.
- Within one year, create criteria for photovoltaic mounting system evaluation and require all new building projects to have “PV-ready” infrastructure. The criteria should be flexible in order to meet rapidly changing technology.

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Combined Heat and Power: The cogeneration steam system supplies about 5 to 10 percent of the U's electricity needs and produces heat for most of lower campus and will reduce CO2 emissions by 63,000 tons annually.



- Explore issues and possibilities for electric vehicle (EV) charging stations and develop a plan for implementation of campus EV infrastructure.

**Mid-term:**

- Explore building-integrated photovoltaic systems for all major renovations and new campus construction.
- Create a campus standard for minimum percentage of renewable energy on all major capital development projects and tie to LEED Energy and Atmosphere credit 2 “On-Site Renewable Energy.”
- Create a pilot program and develop financing strategies with Commuter Services for a special parking permit to install PV parking structures.

**Solar Thermal**

**Near-term:**

- Research and identify opportunities to supplement domestic hot water in buildings with high summer hot-water demand (e.g., kitchens, residence halls, hospitals/clinics, laboratories, pools, etc.), and initiate projects with life-cycle analysis benefits.
- Analyze Building 093 (HPER) pool heating opportunities and initiate project if the life-cycle analysis and funding warrants action.
- Require all new capital development projects to investigate opportunities to use solar thermal and storage as a source for building heat.

**Mid-term**

- Conduct a study to determine opportunities for the collection and storage of solar hot water to preheat at the Central Heating Plant.

**Energy Storage**

**Near-term:**

- Research opportunities for diurnal, seasonal, and intermittent energy storage (e.g., interior building mass, fuel cells, compressed air, flywheels, and seasonal energy) and initiate as possible.
- Monitor success of Sill Center Ice Storage project. (See SIDEBAR.)

## V. Randall Turpin University Services Building Solar Array

The photovoltaic (PV) array on the V. Randall Turpin University Services Building is a 10-KW system. The project was completed November 21, 2008, and was funded in part by a \$30,000 grant from the State Energy Program. The system produces roughly 19,400 KWh annually, or approximately five percent of the power for the building—enough energy to power half of its computers.

This array acts as a living laboratory for students, faculty, and staff, and demonstrates the future of clean-energy technology. It is also visible to the general public from the South Campus TRAX station. The array is the first of many solar installations planned for the University of Utah campus.



## Seasonal Energy Storage for Carbon-Free Heating and Air Conditioning

A new technology that uses seasonal energy for building heating and cooling is being developed on campus. The idea is to chill soils in the winter to provide carbon-free air conditioning in the summer and eventually to store the heat of the summer in underground soils to provide carbon-free heat in the winter. Heat is inexpensively and effectively transferred to and from the soils with a patent-pending technology called Smart Thermosiphons.

The installation of a Smart Thermosiphon array at the Sill Center to demonstrate the use of chilled subsurface soils for carbon-free summer air conditioning is an example of an opportunity to reduce fossil fuel energy use through innovation and research. System performance monitoring and data analysis will be the thesis research of graduate students. The site will become an operating laboratory, allowing graduate and undergraduate engineering education opportunities for years to come.

### ***Fuels/Other***

#### **Near-term:**

- Evaluate potential applications and technologies of alternative fuel sources (e.g., jet fuel for Air Med, shuttle fuels, central boilers, and peak load-shaving generators).

### ***Combined Heat and Power (CHP)***

#### **Near-term:**

- Investigate opportunities and study the life-cycle cost implications of adding additional combined heat and power plants. Compare costs, greenhouse gas reduction, and energy savings from new CHP to load-reduction strategies in individual buildings to ensure the most effective approach.

### ***Renewable Energy Credits (REC) and Offsets***

#### **Overall goal: Increase Overall REC Purchases by 5 Percent Per Year**

#### **Near-term:**

- Evaluate and expand the campus portfolio of certified renewable energy credits (RECs) and offsets. Within two years, develop a promotional campaign to increase participation and contributions by 10 percent.
- Seek opportunities to establish a transparent, local program to mitigate on-campus emissions that cannot be directly reduced or eliminated through avoidance or efficiency.
- Create web-based opportunities for voluntary contributions to carbon-offset programs through air travel, vendors, and others.
- Regularly evaluate electricity purchase options and change as appropriate.
- Work with Rocky Mountain Power and campus administration to evaluate potential for purchasing Blue Sky credits with a portion of the voluntary fund for renewable energy credits.

#### **Mid-term:**

- Investigate option for programs and activities to require internalized carbon mitigation costs by offsetting energy use (air travel, vendors, etc.).

# Carbon Capture and Storage



A scientist participating in an International Energy Agency Greenhouse Gas R&D Program (IEAGHG) conference at the University of Utah stands next to the Crystal Geyser wellbore outside Green River, Utah. Crystal Geyser is a cold, CO<sub>2</sub>-driven geyser that erupts periodically throughout the day.

Because humankind has a responsibility to reduce CO<sub>2</sub> in the atmosphere, carbon capture and storage (CCS) is one possible method to use to achieve this goal. The simple idea is to capture CO<sub>2</sub> emissions from coal-fired power plants and other sources and store them deep underground, just as nature has stored natural gas and other gasses for millennia. Such CCS can buy us time to develop other technologies needed to move away from carbon-based energy.

Geologic CCS is much closer to being ready for “prime time” than many other solutions that can have a significant impact on reducing carbon emissions. The technology for injecting CO<sub>2</sub> into the deep subsurface is mature.

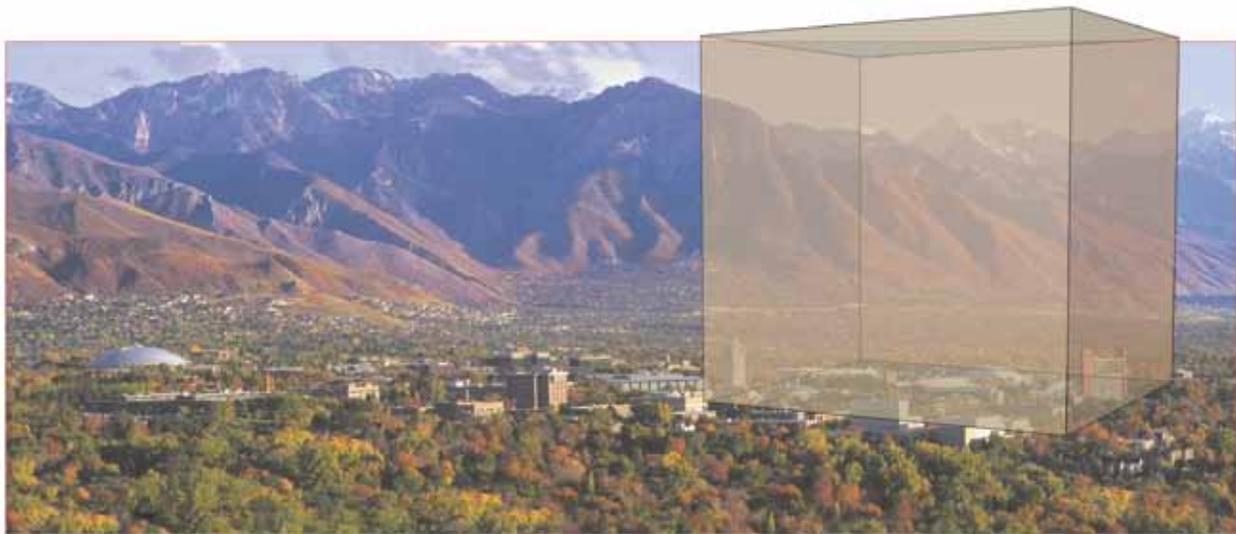
Evaluation of CCS feasibility is ongoing at the University of Utah. Dr. Brian McPherson, associate professor of Civil and Environmental

Engineering, is the principal investigator of the Southwest Regional Partnership on Carbon Sequestration, one of seven regional partnerships funded by the U.S. Department of Energy to evaluate the science and technology of storage of atmospheric carbon in underground geological formations and in surface soil and vegetation. More information about the project is accessible at <http://southwestcarbonpartnership.org> and <http://CO2.civil.utah.edu>.

If University of Utah research demonstrates that CCS is feasible, this technology will have enormous benefits for Utah. For one, it will allow the many thousands of Utahns who are employed in the energy sector to continue to earn a living, while new technologies and jobs can be created. Likewise, Utah’s geology provides excellent storage opportunities, which can bring revenue to the state, especially given that nearby states, like California, have fewer carbon storage options. And, most important, CCS can give innovators working on renewable (and there are many such innovators in Utah) time to develop the technology we need to break our dependence on fossil fuels while maintaining the quality of life we have all come to expect.



## 4D. Sustainable Transportation



The total annual emissions related to transportation for the University of Utah in 2007 = 85,914 Metric Tons of CO<sub>2</sub> equivalent. At sea-level pressure and temperature, the current annual contribution to the atmosphere is a cube of 358 meters or 1,175 feet per side.

In 2050, personal mobility and accessibility to services at the University of Utah will not be dependent on the automobile. Most people will rely on walking, bicycling, transit, and carpooling rather than driving alone. The various academic, research, administrative, clinical, athletic, artistic, and public venues of campus will connect by internal and regional public transit, bikeways, sidewalks, and greenways. When people do need to drive, vehicles will be highly efficient and run on low-carbon and renewable fuels. By 2050, a combination of direct reduction and mitigation efforts will have resulted in a 100 percent reduction in net carbon emissions from transportation.

### University-related Transportation Emissions and the ACUPCC

Under this plan, the University of Utah must quantify, track, and reduce net emissions for several components of transportation which contribute nearly 40 percent of total University emissions. Components of the plan include commuter-generated emissions (21 percent), business air travel (17 percent) and University fleet sources such as shuttles, vehicles, equipment, and AirMed helicopters (two percent).

Providing a functional and sustainable transportation system will require cooperation and coordination

among the University, and state, local, and regional government agencies and decision-makers. Efforts to reduce carbon emissions will also greatly benefit efforts to improve local and regional air quality by reducing regional criteria air pollution, especially fine particulates and ozone. The University's single occupant vehicle SOV trip reduction strategies, if successful, will help address both problems.

In addition, neighborhoods adjacent to campus or in heavy commuter corridors will benefit from the implementation of this plan.

### Strategies

Strategies to reduce carbon emissions from the transportation sector fall into several inter-related categories for each sector (commuting, air travel, and fleet).

- Improve data collection, measuring and monitoring methods for benchmarking, tracking, and assessment of progress.
- Promote behavior change strategies to influence the use of alternative modes of transportation.
- Continue to integrate the principles of environmental, social, and economic sustainability into campus planning and the design of the campus infrastructure.

- Develop offset programs to mitigate emissions that cannot be directly reduced or eliminated in the transportation sector.
- Fleet specific strategy: Consider fuel type, fuel efficiency, emissions, and life-cycle costs in all vehicle purchasing decisions.

For the near-term, the University will expand proactive and positive strategies, largely under the administrative authority vested in Commuter Services. However, if SOV reduction goals are not on track by 2012–2014, a more comprehensive strategy will be considered. These strategies will likely require significant administrative leadership in efforts to gain the support of affected community members and decision-makers.

## Commuting

### Assessment

#### Near-term:

- Capitalize on University of Utah research and teaching resources to develop best practices, pilot studies, applied research projects, and statistically valid assessment methodologies.
- Develop a pilot hand-held, device-based system to track and evaluate campus shuttle ridership information.
- Conduct enhanced biannual Commuter Transportation Survey to track commuting patterns, needs, and methods of travel.
- Create a user-managed “transportation profile” for students, faculty, and staff within the Campus Information Service (CIS).
- Track and evaluate UTA ridership information collected using Ed-Pass Tap On/Tap Off, and other available data.

### Behavior Change / Mode Shift

#### Near-term:

- Promote all modes of alternative transportation, including carpooling, vanpooling, car sharing, bicycling and walking.
- Develop marketing campaign(s) aimed at reinforcing positive benefits of using alterna-

tive modes of transportation; promote making a sustainable choice the norm.

- Educate new students, faculty, and staff regarding alternative transportation options and benefits.

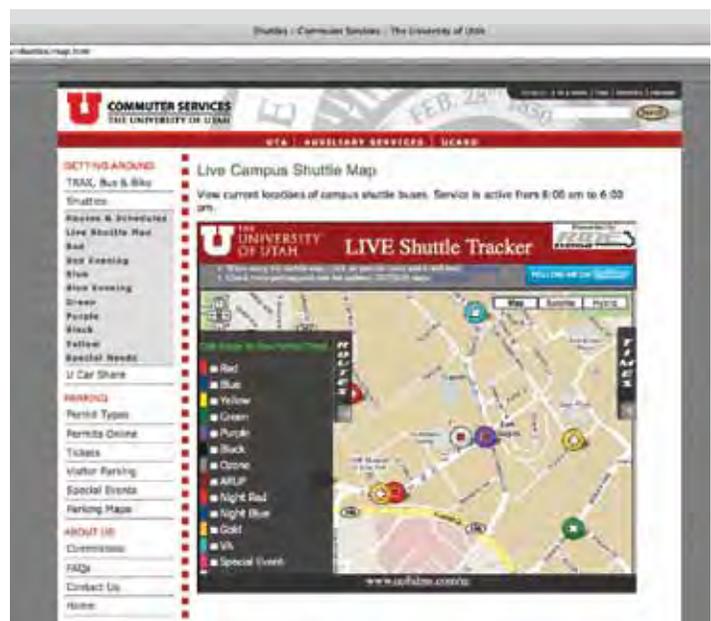
#### Mid-term:

- Increase on-campus employment opportunities available to students to help minimize the number of trips to and from campus.
- Re-evaluate parking permit fees through the lens of price sensitivity, fairness, and an auxiliary unit self-funding business model to seek optimum fee levels to meet SOV plan reduction goals.

## Trip Reduction

#### Near-term:

- Promote and expand support for flextime and telecommuting for staff and faculty as appropriate to job duties and work environment.
- Encourage faculty to utilize web-based technologies and innovative teaching methods to reduce the number of class meetings that take place on campus.
- Reintroduce van pooling and better promote both van and car pooling.



Shuttle Tracker: The U's shuttle fleet is equipped with GPS tracking devices, enabling them to be displayed on-line in real time (<http://www.uofubus.com/>), which allows the campus community to know when a shuttle is expected to arrive.

### **Mode Shift Promotion:**

- Investigate ways to encourage people to live near convenient public transit (bus/rail) service hubs.
- Re-institute and promote the Guaranteed Ride Home program (requires renegotiation of agreement with UTA and/or Commuter Services policy change).
- Work with Salt Lake City, Salt Lake County, and UTA to improve public transit service, routes and access to and from campus continually, including those areas where working students are employed.
- Promote TRAX use by students, staff, and faculty.
- Evaluate ways to expand eligibility for the Ed-Pass program in fiscally sound ways.
- Continue to look for ways to improve Campus Shuttle routes, including Research Park routes and UTA connecting service.
- Work with ASUU, UTA, and Salt Lake City to upgrade and expand the U-Bike share/rental program.

### **Infrastructure / Systems / Planning**

#### **Near-term:**

- Work with Campus Planning and Campus

- Design & Construction to implement applicable aspects of LEED-Neighborhood Development, “Complete Streets,” and other policies for all new construction projects and major building renovations and additions.
- Improve walkability and universal access through environmental design. Work with the Center for Disability Services, the Parking Committee Bicycle Subcommittee and Campus Planning to create accessible and safe routes throughout campus for all non-motorized users.
- Complete new bicycling master plan in fiscal year 2011 and improve bicycle routes to campus by integrating campus bicycle routes with Salt Lake City routes and improving gateways to campus.
- Design and construct new buildings with good bicycle parking and storage and bicycle rider amenities, and assess the need for new bicycle parking and secure storage at existing campus buildings using LEED-Neighborhood Design as a general guide.
- Utilize technology to provide more information, maps, trip-planners and other transportation tools for users.
- Work with Salt Lake City to develop plans for an urban streetcar system that would add another transit connection option for commuters.



Landscape Maintenance recently purchased three electric vehicles to support repair and maintenance of campus irrigation systems. Dump beds carry landscaping materials around campus.



Electric vehicle (EV) charging stations like these may soon be available on campus to help facilitate low-emission vehicles in use by the campus community.

- Investigate opportunities for Electric Vehicle (EV) charging stations on campus and create fiscal model for reimbursement and internalizing GHG offsets during use.

**Mid-term:**

- Increase on-campus housing options for students, faculty, and staff.
- Enhance connectivity between major campus destinations and on-campus intermodal hubs, including pedestrian, bicycle, and shuttle routes.
- Construct one or more intermodal hubs on campus that will facilitate easy transfers between routes and from one mode of travel to another.

**Long-term:**

- Study needs and potential solutions to develop more efficient and cost-effective transportation option between major campus destinations and transit hubs.
- Work with Salt Lake City and the Wasatch Front Regional Council to encourage high-density development within walking/biking distance of campus and at UTA transit nodes.

## The University Of Utah: A Leader In Sustainable Transportation

Since 1991, the University of Utah has actively promoted options for commuting to campus that enhance the efficiency and accessibility of travel. The campus is situated on more than 1,300 acres on the northeast bench of Salt Lake City. While this provides a beautiful setting, it also poses some challenges due to sheer size, relatively low building density, and elevation changes from across campus. Commuter Services has worked steadily to enhance transit services in partnership with the Utah Transit Authority. For intra-campus travel, it operates a free shuttle service. Commuter Services also promotes bicycling, walking, and carpooling. Thanks to its dedicated efforts for more than two decades, the University of Utah is a model employer in the region regarding transportation choice. Our successes provides a strong foundation for meeting the challenges and goals of this plan.



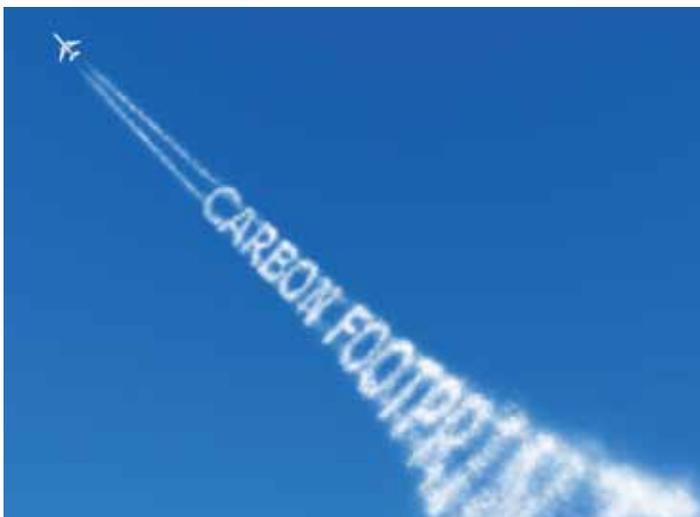
# The Ed-Pass Program and Transit Use—A Success Story

The University of Utah has actively partnered with the Utah Transit Authority (UTA) since 1991 to improve transit service to campus. One crucial component has been a universal transit pass, known as the Ed Pass, available on an annual basis to all qualifying students, faculty, and staff. The Ed Pass allows users unlimited transit access to the entire UTA regional transit network. (The sole exception is seasonal bus service to area ski resorts.) Ed Passes are funded through a combination of dedicated student fees and a portion of parking fees, and there is no direct charge for users to obtain a pass. The Ed Pass contract also provides a predictable and consistent source of funding for UTA as a part of its overall passenger revenue stream.

Overall transit service improvements have included new bus routes; improved

express service at peak times; the construction of the University light rail line from downtown Salt Lake City; the introduction of commuter rail (Frontrunner) from Salt Lake to Ogden; and a new city transit hub to connect light rail, commuter rail, bus, and intercity bus service. Additionally University of Utah Commuter Services regulates parking, charges permit fees campus-wide, and provides a free campus shuttle-bus system. As a result, mass transit ridership has grown from approximately 2,000 trips a day to more than 13,000. In 2009, almost 34 percent of the campus population commuted via mass transit.





### ***Business Air Travel***

#### **Near-term:**

#### ***Assessment***

- Upgrade University travel accounting system to streamline reporting and increase accuracy for tracking miles traveled.
- Develop an Air Travel Calculator (similar to Cool Climate Calculator) to enable travelers to calculate the emissions generated by their air travel. The calculator should include a voluntary option to purchase carbon offsets.

#### ***Behavior Change***

- Actively encourage University departments and employees to reduce air miles traveled, including choosing direct flights wherever possible.
- Encourage the use of alternatives to air travel such as high definition video conferencing and webinars.
- Promote ground transportation for shorter distance trips where time- and cost-effective.

#### ***Mitigation***

- Develop and implement a locally focused carbon offset program for air travel by faculty, staff, and students.

#### **Mid-term:**

#### ***Infrastructure / Systems / Planning***

- Construct high-definition custom video conference room facilities at key locations on campus.

## **University Of Utah Parking Services Director Improves Health Through Bicycle Commuting**

Alma Allred, director of Parking Services for the Commuter Services Department, has always been a cyclist, but not necessarily a regular bicycle commuter. Recently, however, Alma's physician encouraged him to increase his activity levels in order to improve his cardiovascular health; as a result, he decided to make the switch to bicycle commuting from his home several miles south of campus. This would allow him to incorporate his workouts into his daily transportation routine rather than finding time to hit the gym. He mapped out a good cycling route to campus on city streets, and a nearby bus route provided back-up transportation if necessary. He discovered that bike commuting was easy and very enjoyable. And a year later, his physician is pleased to see that Alma has met his goals and vastly improved his health without the need for other interventions.



## Supply Constraints, Global Markets, and Commuting

One key variable that affects how the students, faculty, and staff commute to campus is entirely outside the control of the University: the cost of various transportation fuels. In 2008, when the cost of gasoline rose to \$4 per gallon, Commuter Services and UTA noted a dramatic increase in transit ridership and a corresponding decrease in single occupant vehicle (SOV) trips. When the price of gasoline fell, the mode shift partially reverted back toward SOV trips. Given likely global crude oil supply constraints in the future, price increases are difficult to predict but likely to occur. Fuel cost increases also create a significant burden on fleet operators, skewing budgets for shuttle and campus fleet operations as well as for transit agencies. During the 2008 price spike, UTA imposed transit pass fee increases tied to the cost of fuel, which in turn resulted in a parking permit cost increase to cover this surcharge. Actions taken now to increase fleet efficiency and shift to lower-carbon and lower-cost fuels (principally compressed natural gas) will reduce institutional risk and operational costs over time.



The Ultimate Icebreaker: The Department of Public Safety's Segway electric vehicles not only lessen the carbon footprint, they promote positive interactions with the campus community.

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### **Vehicle Fleet**

#### **Near-term:**

#### **Assessment**

- More closely monitor and track fleet fuel consumption and emissions data. Evaluate campus fleet vehicle utilization and needs annually to determine the number of fleet vehicles needed.

#### **Procurement And Policy**

- Promote current no-idling policy to the entire campus.
- Encourage departments to consider moving away from cars and trucks to low-carbon alternatives such as golf carts, electric vehicles (EV), bicycles, etc. for intra-campus needs.
- Replace at least two standard-sized, diesel-powered shuttle buses with compressed natural gas (CNG) powered buses annually. Capture savings and reinvest in cleaner fuel fleet enhancements over time and complete the phase-in of compressed natural gas-fueled shuttle buses by 2018.
- Increase fuel economy by purchasing smaller, more fuel efficient fleet vehicles. Consider life-cycle vehicle costs, not just direct purchase costs, in procurement decisions.

## 4E Solid Waste, Water, Grounds, Purchasing, and Food Systems

Buildings and transportation emissions account for over 98 percent of the University's greenhouse gas footprint. This section deals with the remaining practices that directly affect carbon emissions but also indirectly impact the resources that sustain our quality of life. These practices include solid waste, water use, landscaping and grounds maintenance, purchasing for equipment and supplies, and food systems. Although they are small in overall greenhouse emissions scope, activities in these areas can also have a profound impact on how our campus community understands and participates as global citizens.

### Solid Waste

We seek to achieve a 25 percent waste reduction in five years by implementing a more efficient and comprehensive record of all campus-based waste flows, improving education, and forging steps towards a zero-waste campus.

#### Strategies

The University will enhance waste-reduction programs by adopting efforts that leverage supply-

chain sustainability practices related to purchasing, policy decisions, and service. The University will also reduce its waste-stream volume through avoidance, durability and reuse, diversion, and aggressive recycling.

#### Policy/Procedure/Purchasing

##### Near-term:

- Implement "Solid-Waste Engineering Principles" to prioritize waste minimization and source reduction. Remove procedural and administrative barriers that discourage the donation and re-sale of surplus products.
- Prioritize reuse and renovation of existing buildings to avoid demolition. If removal is required, develop standards to deconstruct rather than demolish buildings.
- Implement an Environmentally Preferred Purchasing (EPP) Policy to minimize the generation of waste by procuring products with re-usable packaging, and that feature enhanced durability and long-term use.



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The University of Utah seeks to avoid waste production at all levels of operations. When the FAMB business building was deemed unsuitable for current needs, it was deconstructed carefully in order to minimize the demolition waste sent to the landfill. Most building materials were separated and sent to appropriate facilities to be reused where possible (rather than downcycled).



## Marriott Library Waste Pod Solution

In 2008, Director Joyce Ogburn of the J. Willard Marriott Library convened a staff task force to develop recommendations for enhancing sustainable practices in the library. The report led to the formation of a standing Green Committee and many positive changes. In the spring of 2010, the library expanded its recycling program by implementing centralized waste stations in its staff areas. These waste pods make it convenient for staff and faculty to deposit and sort all waste from workspaces into separate containers for aluminum, cardboard, papers, and plastics. Additional drop-off points were also designated for battery recycling in both public and staff areas. Waste pods and additional drop-off points make recycling easy and encourage staff to throw away less and recycle more. The library continues to recycle, re-purpose, and re-use items such as furniture, Styrofoam, packing materials, and telephone books.

### ***Systems & Infrastructure***

#### **Near-term:**

- Maintain the existing comprehensive waste management job position and provide staff sufficient to manage an integrated waste management system campus-wide.
- Optimize the use of electronic technologies and innovations to reduce paper usage.

#### **Near & Mid-Term:**

- Consolidate waste-collection and recycling programs campus-wide (and across business units) offering a more consistent collection program to enhance efficiency and consistency and increase program participation.

### ***Education and Awareness***

#### **On-going & Near-term:**

- Re-establish a campus-wide recycling core committee and expand integrated education and awareness program.



## Electronic Waste

The University of Utah will work towards achieving a more efficient, responsible, and comprehensive electronics waste collection program. This program will offer e-waste collection services to the community at large, with collection facilities created at strategic locations to enhance participation.

### Strategies

#### General

- The University will implement strategies to expand existing electronic waste, create standardized policies for electronic waste disposal, and provide opportunities to educate the campus community about responsible electronics recycling.

#### Policy/Procedure/Purchasing

##### Near-term:

- Reinforce and strengthen University Policies to send used and unwanted equipment to University Surplus and Salvage for appropriate processing, recycling, and salvaging.

##### Near-term:

- Process all computers through a central campus IT department for servicing of re-sellable machines and the destruction of sensitive information.
- Create policies to require that all electronic waste be handled by certified recyclers through e-Stewards Initiative or similar program.

##### On-going

- In 2010, the University sends only batteries and monitors to a certified e-steward recycling company. The University will seek to expand processing of e-waste to include all electronic items.

##### Mid-term & Long-term:

- Increase public access to the campus Surplus and Salvage operation by providing adequate transit access and vehicle parking.
- Evaluate the feasibility of a surcharge on University-funded electronics or computer purchases to cover increased recycling processing fees.
- Create a single, consolidated processing center to increase efficiency and effectiveness of the program.

## “What Goes Around Comes Around” Campaign

Since 2008, students living on campus at the Residential Halls have had the opportunity to reduce their end-of-the-year waste totals through a student-led initiative called “What Goes Around Comes Around.” At the end of spring semester, student volunteers in partnership with the Office of Sustainability, ASUU, and The Lowell Bennion Community Service Center collect reusable, quality pre-owned goods including clothes, electronics, lamps, couches, and pillows. All items are donated to the local charities.



## Campus Recycling

The U of U has already implemented a number of initiatives to reduce solid waste sent to the landfill. It has done so by enhancing the recycling programs and broadening the capture of plastic, paper, cardboard, aluminum, and scrap metal waste.

### Campus initiatives include:

Recycling at campus events such as athletic competitions, concerts, and graduation ceremonies.

Recycling bins are distributed throughout campus. (There are over 10,000 bins of various sizes and types.)

Facilities Management has installed scales to keep a monthly record of waste as well as materials destined to be recycled.

Plant Operations conducts a biannual waste analysis for a more comprehensive understanding of waste flows and efficient management and reduction practices.



## Education and Awareness

### On-going

- Continue to offer e-waste collection once a year for the campus community in partnership with the city's own e-waste recycling campaign. Evaluate opportunities to move forward on biannual collection basis.

### Near-term:

- Raise awareness of electronic waste principles and campus resources through public information/education sessions, lectures, electronic media, and public service announcements.

## Purchasing

Sustainable purchasing demonstrates the University's commitment to buying goods, materials, and services in a manner that reflects the core values of fiscal responsibility, social equity, community, and environmental stewardship. We will implement a comprehensive and environmentally preferred purchasing policy.

### Strategies

The University of Utah will decrease waste generated through purchasing by implementing strategies and policies that track purchases, educate students, faculty, and staff about sustainable purchasing practices and prioritize sustainability in purchasing.



### ***Policy/Procedure/Purchasing***

**Near-term:**

- Implement a comprehensive and environmentally preferred purchasing policy based on federal standards.

### ***Systems/Infrastructure***

**Near-term:**

- Create a centralized tracking system to account for purchases made by the campus community and to enhance opportunities for sustainable purchasing compliance.

### ***Education/Awareness***

**Near-term:**

- Create an education team to reach out to the campus community and provide guidance on sustainable purchasing.

## **Food Systems**

All campus-based food vendors and members of the campus community will seek to close food waste cycles by 25 percent by reducing food waste, enhancing energy-efficient technology, and purchasing more local foods between 2010-2015.

### **Dining Services:**

#### ***Strategies***

### ***Policy/Procedure/Policy***

**Near-term:**

- Revise vendor contracts to implement stricter sustainability practices and delineate incentives for waste minimization.

### ***Systems & Infrastructure***

**Near-term:**

- Replace existing dining preparation equipment with energy-efficient upgrades when life-cycle cost assessment analysis shows effective alternatives.

### ***Education and Awareness***

**On-going**

- Increase education efforts to promote behavioral change to healthy and sustainable food choices.

## **Taking A Watershed Perspective Towards A Water-Neutral Campus**

The campus rests in a high desert grassland eco-system along the foothills of the Wasatch Mountains. With only 15 inches of water falling every year, the University of Utah must be conscious of and responsible for use of this limited resource. In addition, water processing and transportation is tremendously energy intensive. While the carbon footprint from water use is not included in our greenhouse gas inventory, we still must be conscious of the impact. In light of an ever-increasing population demanding more resources, increased urbanization pressures, and increased trends of drought due to climate change, our limited water sources have the potential to become severely stressed, demanding more sustainable water conservation measures. To this end, the Facilities Management Division is assessing the feasibility to achieve “water neutrality” in the future, so that the campus would consume on an annual basis the equivalent of the average rainfall volume estimated to fall on campus.

- Initiate collaborative efforts with on-campus food service vendors, College of Health and other campus and community groups.
- Support and develop additional opportunities to integrate Project Clean Plate to measure and conduct weekly food waste audits
- Fully Integrate Project Green Thumb initiative to promote waste minimization. Sustain waste reduction and elimination and look for additional opportunities to expand incentives.

**Near-term:**

- Initiate “Bring Your Own Plate” campaign to promote the elimination of disposable dinner ware wherever possible.
- Increase purchases of local/organic food.

**Campus Food Production:**

**Strategies**

**Policy/Procedure/Purchasing**

**Near-term:**

- Establish written principles with adaptable policies and procedure for maintaining the campus gardens.

**Systems/Infrastructure**

**Near-term:**

- Expand and maximize production of existing gardens.
- Apply winter gardening strategies to create year-round interest and build soil quality.
- Collect base numbers of food grown and develop harvest management strategies to record amount harvested.
- Recruit and hire a campus garden coordinator to facilitate a year-round harvest of crops.
- Institute a market garden program in which a portion of produce is sold directly to dining services and U Farmers Market, with the remaining portion donated to local pantries.



The primary dining services provider, Chartwells, makes good on its corporate commitment to supporting local suppliers through the Farm to Fork program in the cafeterias as well as at their booth at annual campus farmers market.

**Education/Awareness**

**On-going**

- Create educational tools to promote urban agriculture and generate neighborhood and community interest in urban agriculture initiatives.
- Engage students, offer internships, and incorporate various disciplines into the context of the garden.
- Emphasize service learning component.

**Water and Grounds**

By 2020, the University of Utah seeks to achieve water neutrality and to minimize waste from grounds operations through composting. The University of Utah will implement strategies that use the latest technologies and innovative approaches for water conservation and grounds maintenance with an emphasis on place-based solutions.

**Water:**

**Strategies**

**Policy/Policy/Purchasing**

**Near-term:**

- Revise and enhance purchasing policy to include water-efficient appliances and tools.

## **Systems/Infrastructure**

### **Near-term:**

- Develop a plan for water capture and conservation, seeking to reduce the volume of annual storm water runoff beyond campus boundaries by 50 percent within five years and by more than 75 percent within 10 years.

### **Near-term & Mid-term:**

- Create and implement a 10-year plan for enhanced water conservation efforts. Plan to include interior water-conserving fixtures and potential for re-use, design standards for landscaping to minimize high water-use ornamental plantings, opportunities for non-potable irrigation water, and efficient irrigation methods.

## **Education/Awareness**

### **Short-term:**

- Create and sustain a general education campaign for water conservation campus-wide.
- Establish an administrative structure to facilitate campus-wide water-conservation and reuse.

### **Mid-term:**

- Explore opportunities to integrate water-efficient landscaping and technologies into course work and provide opportunities for students, faculty, and staff to be involved in maintenance of those projects.

## **Grounds:**

### **Strategies**

## **Policy/Procedure/Purchasing**

### **Mid-term:**

- Revise landscaping policies to promote more water efficient turf, landscaping and irrigation policies. Evaluate various design standards (such as LEED and Sustainable Sites Initiative) for applicability on campus.

## **Systems/Infrastructure**

### **Mid-term:**

- Explore alternatives to ice-melting salts on sidewalks and roads while maintaining safety and

evaluating life cycle costs of material, personnel, and unintended consequences of ice-melting salts.

- Explore alternatives to reduce synthetic fertilizer and herbicide use for lawns.

### **On-going:**

- Plant more poly-culture gardens to enhance diversity of plantings that offer multiple benefits such as food, pest resistance, enhance soil fertility and provide shade.

### **Mid-term:**

- Compost 100 percent of garden waste. Investigate potential for composting and the use of vermiculture (worm husbandry) throughout the campus community.
- Investigate the opportunity for students to provide maintenance through academic credit or service hours

## **Education/Awareness**

### **On-going**

- Create an education campaign about sustainable landscaping practices among grounds staff and the campus community.

### **Near-term & Mid-term:**

- Explore opportunities to integrate grounds maintenance into the curricula of select classes.



The Sill Center Organic Garden is one of two gardens at the U. The gardens not only produce nutritious food, but are used as living laboratories for teaching students the skills and benefits of organic gardening methods. Through hands-on application of various organic gardening techniques, students learn the basics of how to feed themselves, about healthy nutrition and most importantly recognize the imperative for growing our food more sustainably and locally.

## 4F Carbon Neutrality Action Plan Return On Investment Strategies

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The majority of the strategies contained in the CNAP provides a net financial return on investment or are cost-neutral in the long term. In addition, many provide a hedge against the future risk of fluctuating energy prices, potential for carbon tax or other operational unknowns. While many of these strategies can be completed without monetary resources, some may require up-front financing to initiate the potential for future paybacks.

To meet its goal of climate neutrality, the University of Utah will require significant internal commitment. However, financing carbon-neutrality should not require tremendous strain on internal budgets as many of the initial strategies have the potential to be financed through the savings created. In order to gain internal financial commitment to this approach, the University will need to implement the use of direct measurement devices for metering and monitoring to verify savings capture and payback.

Two actions will be essential to financing the Carbon Neutrality Action Plan.

Convene a task team to examine CNAP financing options and barriers; prepare a funding plan.

Study the potential to create an internal financing mechanism capable of receiving corporate, staff, and faculty contributions with the intent to finance investment in energy efficiency and renewable energy.

Investigate the potential to reinvest paybacks from investments in additional campus projects.

### Financing Options

The finance task team should consider the following possible financing strategies (and others) in order to maximize CNAP funding

### Donations

Students, faculty, staff, and alumni express growing interest in dedicating donations towards sustainability-related investments and programs. The University of Utah already has in place a Renewable Energy Campaign established for individual contributions.

### Institutional Budgets

Many of the strategies in the plan may be paid for directly through the University's operating budget since they involve basic maintenance and operations. In addition, energy efficiency and renewable energy projects have a quantifiable payback, low risk and provide a predictable income flow.

### Revolving Loan Fund

A revolving loan fund uses interest and principal payments on outstanding loans to issue new loans. This

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*“To make progress, a climate action plan needs to be embedded in sound business logic and a policy environment that removes obstacles that raise risk and thwart success.”*

– Wendell C. Brase (NACUBO Critical Path Issues on the Way to Carbon Neutrality)

option is a primary source of funding for projects with a quantifiable and measureable payback. The Energy Performance Contract and SCIF utilize a similar structure but should be deemed an entirely separate strategy from a revolving loan fund.

## Energy Performance Contracts

An energy performance contract (EPC) is a vehicle for procuring energy-related equipment and services through an energy service company (ESCO). Energy Conservation Initiatives executed by the University of Utah have already resulted in considerable savings from large Energy Performance Contracts, a behavioral program, and Energy Office retrofit projects. Currently, the ESCO provides an annual savings of more than \$300,000 and 1.2M KWh per year. ESCOs provide some of the best opportunities for funding large-scale, energy-efficiency projects.

## Power Purchase Agreements

The University will explore opportunities for power purchasing agreement partnerships. A power purchase agreement (PPA) is an agreement between the owners of a power-generating facility and a power purchaser, whereby the purchaser agrees to purchase energy and/or capacity at a specified price for a specified term. Through the use of power purchase agreements, the University can capitalize on incentives that are otherwise only available to commercial entities. PPAs will provide the University with the opportunity to expand renewable energy technologies such as solar, wind, biomass, and geothermal.

## Utility Incentives & Rebate Programs

Both Rocky Mountain Power and Questar Gas provide financial incentives for energy saving projects. Many of the projects proposed in the Carbon Neutrality Action Plan may qualify for rebates and incentives. The University of Utah can also get rebates from Questar by purchasing energy efficient appliances and equipment. In the future, the University of Utah will work to identify all rebates and incentives through Rocky Mountain Power and Questar Gas in order to maximize savings for new projects and purchases.



## Sustainable Campus Initiative Fund

Approved in the spring of 2009, the Sustainable Campus Initiative Fund (SCIF) collects a \$2.50 student fee per semester to go towards projects in sustainability. Seventy percent of the fund is directed towards projects with a monetary payback and the other 30 percent is dedicated to grants. SCIF has already funded several projects on campus and will continue to be a source for strategies in the future. SCIF will be up for re-approval in the spring of 2012.



## 5. Implementation

### Assessment

The strategies in the plan will be implemented by appropriate departments and campus entities respective of each individual strategy. The Office of Sustainability will assist and support campus departments as needed in order to ensure implementation success. Ultimately, the Office of Sustainability will be responsible for monitoring the progress of the plan. The University of Utah recognizes the need for an aggressive target for climate neutrality. By creating a reduction target of climate neutrality by 2050, the University of Utah assumes that the Carbon Neutrality Action Plan will be regularly re-evaluated and that

goals will be readjusted as necessary. Since the effects of greenhouse gases are long-term, the President's Sustainability Advisory Board has also emphasized the importance of interim targets. Consequently, the minimum goals to be achieved are real reductions of 25 percent by 2020 and 50 percent by 2030, with the optimal goal of 50 percent reductions by 2020. This report should be viewed as a "living document," progressing with improvements in technology, changes in energy costs, and other factors. This plan will be tracked annually and a new plan will be developed every three years. Future plans will take into consideration updated emissions projections and campus growth.

The 2007 Greenhouse Gas Inventory Baseline used in the 2010 Carbon Neutrality Action Plan is only as accurate and comprehensive as the data available to generate it. Future inventories may be expanded to include additional Scope 3 emissions from sources previously omitted in the 2007 inventory such as indirect supply-chain emissions from food, solid waste, water delivery and use. While these new additions may contribute to a higher carbon footprint, we feel it is our responsibility to be as comprehensive as possible in on our path to carbon neutrality.

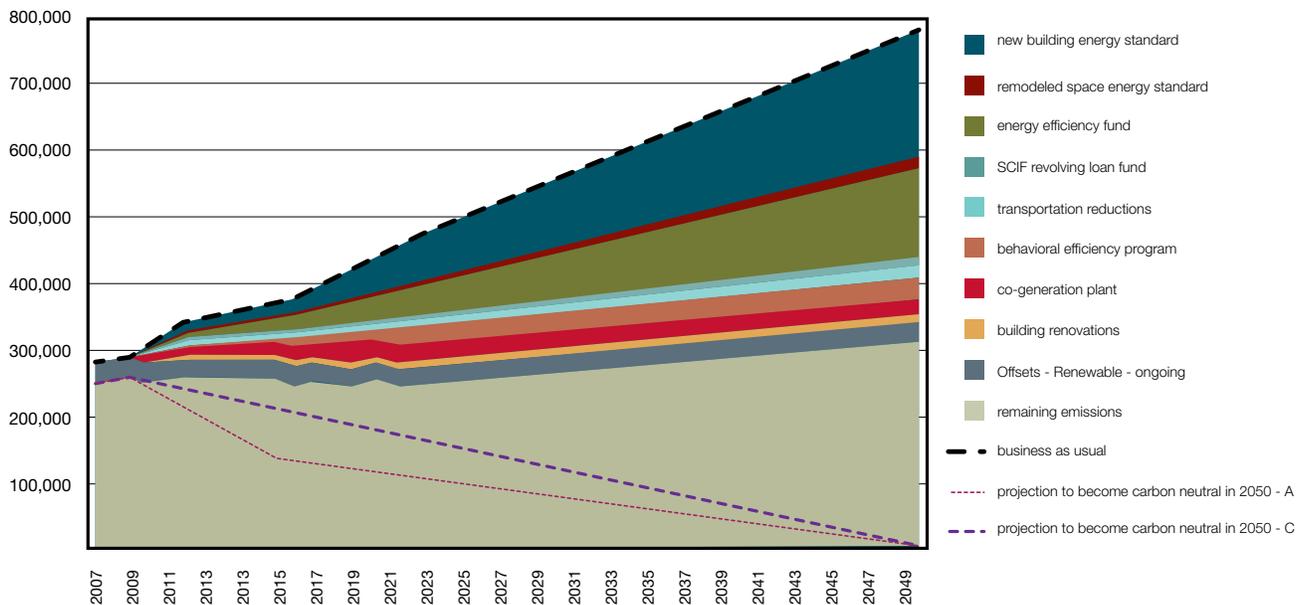
## Oversight and Reporting

The ACUPCC requires that institutional structures be in place to guide the development and implementation of the plan. The Office of Sustainability, along with the President's Sustainability Advisory Board, will provide oversight, direction, tracking, and reporting and will meet regularly to ensure continued progress.

Together, these groups will conduct periodic reviews. An annual progress report will be prepared and circulated throughout the campus community with open houses held for community input and response. The annual report will include the current GHG inventory, and projects and strategies that were accomplished in the previous year.

Each year, the Office of Sustainability will host a Climate Action Summit centered on climate change awareness, education, and University efforts. At the summit, the Office of Sustainability will deliver progress reports and provide an opportunity for the campus community to ask questions and comment on the plan.

## GHG Emissions Strategies 2007-2050



Greenhouse Gas Reduction Wedges: This graphic shows the impact of current programs' effectiveness in reducing the University's GHG footprint. By growing these programs where possible and implementing additional strategies in this document, the path to carbon neutrality will be realized.



photo by Lawrence Boye

## CONCLUSION

President Michael K. Young's pledge to meet the Presidents' Climate Commitment has resulted in a multifaceted and comprehensive process, bringing together the best and brightest students, faculty, administration, and staff in a dynamic and evolving process. Not only has a path been identified to reduce carbon emissions, but implementation of this plan will also help mitigate financial risks associated with rising energy costs.

The Energy and Environmental Stewardship Initiative: 2010 Climate Action Plan integrates the principles of social, economic, and environmental sustainability into campus planning, design, and operations, administration, curriculum, and community engagement. A carbon-neutral campus will ultimately be highly efficient, resilient, and innovative.

Although this plan represents much work and analysis, it must be restated that each of the strategies is

an abstract idea and needs full analysis and a set of actions to move forward and be fully implemented. It is a vision for practices, policies, and actions that will lead to a sustainable campus.

The University of Utah is embracing these new challenges with thoughtful and sophisticated strategies that will adequately prepare Utah's forthcoming technologists, policymakers, and leaders for a transformational future. In following its mission as a resourceful and cutting-edge research institution for the state of Utah, the University is taking this opportunity to chart a sensible and enduring path. The University is preparing world citizens to comprehend complex systems and to value sensible economic progress through collaborative innovation. While continuing its commitment to new research, new technologies, and enrichment of human health, the University is also reaffirming its responsibility toward environmental stewardship and keeping local communities thriving and resilient.

# Appendix A: Contributors and Preparers

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## Contributors

The Energy and Environmental Stewardship Initiative: 2010 Climate Action Plan represents the work of many dedicated members of the University of Utah community. Formal members of the planning teams are listed below. Many others contributed expertise and ideas over the course of the year, but they are too numerous to name individually. We would like to thank all participants for their contributions to the development of this plan.

## Office of Sustainability

Office staff coordinated the overall planning effort, supported the individual teams, and assembled the final plan draft.

**Jennifer Colby**, *Sustainability Coordinator, Office of Sustainability*  
**Marie Martin**, *Outreach & Education Coordinator, Office of Sustainability*  
**Whitney Williams**, *SCIF Coordinator, Office of Sustainability*  
**Myron Willson**, *Director, Office of Sustainability*

## President's Sustainability Advisory Board

The President's Sustainability Advisory Board guided the plan's development, reviewed plan drafts, and made recommendations to the president regarding key decision points and overall direction.

## Members

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**Chair: Dr. David Chapman**, *Professor, Geology & Geophysics, College of Mines and Earth Sciences*  
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## Task Teams

Teams of faculty, staff and students from a wide range of campus departments met over the course of the 2010 academic year. They worked together to brainstorm, refine, and research action item ideas and write their sections of the plan.

## Communication

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**Jeff Juip**, *Design Architect, MHTN Architects*



