

University of Pennsylvania Climate Action Plan



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Meeting on College Green Takes on a Whole New Meaning These Days for the Red and the Blue

Environmental sustainability is a defining issue of the 21st century. Higher education can play a leadership role in addressing global climate change. Through its research, teaching, and operational practices, Penn is dedicated to promoting a sustainable culture and implementing environmentally-conscious policies. I signed the American College and University President's Climate Commitment in 2007 and pledged that Penn would develop plans to reduce our emissions of greenhouse gases. Our renewable energy purchases and our efficient operations have allowed us to exceed the Kyoto Protocol carbon reduction targets. Our Plan represents a new approach to how we think and behave. I am pleased to share with you this summary of our strategies, and I invite you to visit the Green Campus Partnership website.

Please join in our efforts to foster a more sustainable University community that raises environmental awareness and contributes to a healthier planet.

AMY GUTMANN
President

Acknowledgements

We would like to extend grateful thanks to the following listed people, who contributed to the development of the University of Pennsylvania's *Climate Action Plan* over the past two years. We are indebted to your good judgment, fair evaluations, and green conscience.

University of Pennsylvania Administration

Amy Gutmann	President
Craig Carnaroli	Executive Vice President
Vincent Price	Provost
Gregory S. Rost	Vice President and Chief of Staff
Anne Papageorge	Vice President, Facilities and Real Estate Services
Marie Witt	Vice President, Business Services
Daniel Garofalo	Environmental Sustainability Coordinator

Environmental Sustainability Advisory Committee (ESAC) Chairs

Andrew Binns	Co-Chair Academics, School of Arts and Sciences & Provosts Office
Marsha Lester	Co-Chair Academics, School of Arts and Sciences
Anthony Sorrentino	Chair Communications, Office of the Executive Vice President
David Hollenberg	Co-Chair Physical Environment, University Architect
Eric Weckel	Co-Chair Physical Environment, School of Medicine
Kyle Rosato	Chair Recycling, Environmental Health and Radiation Safety
Larry Bell	Co-Chair Transportation, Business Services Division
Vukan Vuchic	Co-Chair Transportation, School of Engineering and Applied Sciences
William Braham	Co-Chair Utilities and Operations, PennDesign
Joe Monahan	Co-Chair Utilities and Operations, Facilities and Real Estate Services

(A complete list of ESAC members and subcommittee participants is included in Appendix C)

Sustainability Team Associates

Sarah Abrams	2008-2009 Assistant Sustainability Coordinator, BA in Biology, 2008
Steve Belfiglio	Sustainability Communications Associate, BA in Communications, 2007
Brittany Bonnette	Sustainability Initiatives Associate, BA in Urban Studies, 2008
Sarah E. Fisher	Sustainability Associate, Master of City Planning, 2009
Lydia Nicole Hermo	Sustainability Associate, Master of Architecture, 2009
Kathy Lent	Sustainability Associate, Master of Architecture, 2007
Sarah-Jane Littleford	Assistant Sustainability Coordinator, BA in Sustainable Development, 2009

3 Executive Summary

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In 2007, University of Pennsylvania President Amy Gutmann signed the American College and University President's Climate Commitment (ACUPCC). This pledge committed Penn to developing plans for long-term reduction of its emissions of climate-altering greenhouse gases. The following *Climate Action Plan* lays out the strategies that will be adopted by the University of Pennsylvania to achieve this goal, as well as the means to track and communicate progress to the Penn community and external audiences.

Penn is well positioned to enhance its leadership in environmental sustainability and responsible use of resources. The University is already recognized by the US Environmental Protection Agency (EPA) as a leader in green energy purchasing, having received the *Green Power Award* for the past three years, as the number one purchaser of wind-power renewable energy credits among American colleges and universities.

As an institution dedicated to excellence in teaching and research, Penn benefits from a strong shared mission and interdisciplinary collaboration across its twelve liberal arts and professional schools. One of Penn's greatest strengths is its ability to assemble resources from both academia and its administration, to mobilize the enthusiasm, expertise, and dedication of its faculty, staff, and students to find solutions to complex societal issues. Penn's response to sustainability and to the threat of global warming presents just such a challenge.

"This is a defining issue of the 21st century, and I am proud to sign on and promote higher education as a leader in addressing global climate change through research, education and reduction of greenhouse gas emissions. At Penn, we must recognize the impact of a research institution of our size and acknowledge that our actions extend beyond our campus and have global consequences."

- President Amy Gutmann,
February 13, 2007

Development of the *Climate Action Plan*

Penn's *Climate Action Plan* builds on extensive experience in energy and resource management. The TC Chan Center for Energy and Simulation in Penn's School of Design was commissioned in 2006 by the Division of Facilities and Real Estate Services (FRES) to conduct a comprehensive environmental assessment of campus operations. This study, carried out in close collaboration with FRES staff, demonstrated expertise in assessing campus energy systems, and provided invaluable guidance for Penn's sustainability mission. Building on the capacity developed during this assessment, Penn now tracks campus carbon emissions, and has published carbon inventories for fiscal years 2007, 2008, and 2009 (Sections 5.2, 5.3, and 5.4).

While the work with the TC Chan Center provided a good foundation, the signing of the ACUPCC focused campus attention on the need to gain input from a broader set of campus constituencies. Penn created the Environmental Sustainability Advisory Committee (ESAC), made up of faculty, administrators, and students, and chaired by the Vice President of FRES, and charged this group to develop University-wide recommendations and implementation strategies for a *Climate Action Plan*. ESAC established six comprehensive themes and disciplines as the most significant avenues for reducing Penn's carbon footprint and enhancing overall sustainability; subcommittees were assembled to focus on these specific aspects of the broad ESAC goals. To manage the subcommittees and research the feasibility of specific recommendations, a Sustainability Team, under the Environmental Sustainability Coordinator, was established, consisting of a coordinator assisted by a

One of Penn's greatest strengths is its ability to assemble resources from both academia and administration, and to mobilize the enthusiasm, expertise, and dedication of its faculty, staff, and students in finding solutions to complex societal issues.

number of sustainability associates. Finally, an umbrella organization, the Green Campus Partnership (GCP), was created to develop initiatives across the University. The GCP is a virtual organization, made up of constituents from across the university, which facilitates communication and dialogue. The Green Campus Partnership is comprised of senior staff from across the university, and leaders from student groups, and is staffed by current students and recent graduates.

Over the course of 2009, the recommended goals and strategies of the committee were vetted with key stakeholder groups across campus such as:

- Council of Deans
- Faculty Senate
- Graduate and Professional Student Assembly
- Undergraduate Assembly
- Vice Provost Council for Research
- Senior Roundtable
- Penn Professional Staff Assembly
- University Council,
- Trustees of the University of Pennsylvania

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Conserve Energy

Design Green

Reduce Emissions

Minimize Waste

Learn Sustainability

ESAC Recommendations

The following recommendations from make up the *Climate Action Plan* and align with the carbon reduction action plan developed by the TC Chan Center (see Section 5.1), and fit into an overall campus strategy to reduce carbon emissions:

Utilities and Operations (Section 5.5): *The goals are to reduce energy usage by 5 percent from the 2007 baseline in fiscal year 2010, and a 17 percent decrease from the 2007 baseline by 2014.*

Strategies include:

- Eliminate the growth in energy use in existing buildings through education and management;
- Improve the efficiency of existing buildings' utility systems, and adopt conservation measures such as building re-commissioning, metering, and incentives for better energy performance; and
- Continue purchase of renewable energy credits (RECs).

Physical Environment (Section 5.6): *The goals are to create and maintain a sustainable campus by increasing green space, decreasing building energy consumption, and increasing education and awareness of sustainable design.*

Strategies include:

- Adopt LEED Silver Certification, with Penn-specific goals, as a minimum standard for new construction and major renovations;
- Provide training to Penn staff on sustainable design and construction practices; and
- Implement increasingly sustainable protocols for site planning and landscape maintenance.

Transportation (Section 5.7): *The goal is to emphasize and plan a quality pedestrian campus environment, encourage use of public transportation for commuting, and provide safe, efficient local transportation services for the University community.*

Strategies include:

- Investigate public transportation subsidy through partnership with SEPTA;
- Improve bicycle and pedestrian environments; and
- Improve the fuel efficiency of Penn's vehicle fleet.

Waste Minimization and Recycling (Section 5.8): *The goals are to double Penn's diversion rate of paper, cardboard, commingled recyclables to 40 percent by 2014, and reduce Penn's overall waste stream through improved purchasing practices, and by providing education to the Penn community.*

Strategies include:

- Institute a comprehensive waste minimization and recycling policy;
- Provide widespread education about why and how Penn recycles; and
- Ensure adequate provision of recycling and waste bins within campus buildings and public spaces.

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Academics (Section 5.9): *The goal is to make climate change and environmental sustainability a part of the curriculum and educational experience for all Penn students.*

Strategies include:

- Launch a new University undergraduate minor in Sustainability and Environmental Management, available in Fall 2009;
- Provide sustainability-related programs for faculty, staff and students, such as workshops, proseminar classes, and the focus of the 2010 Penn Reading Project; and
- Expand student participation in sustainability research.

Communications (Section 5.10): *The goals are to develop clear, concise, and accurate information about Penn's sustainability commitments, while encouraging Penn's community to participate in continued learning in this field.*

Strategies include:

- Establish and reinforce messages that individual behavior is critical in meeting the *Climate Action Plan* goals;
- Ensure that all communications are accurate, easily accessible, and provide valuable up-to-date information; and
- Create events that galvanize the campus community and bring attention to the University's sustainability campaign.

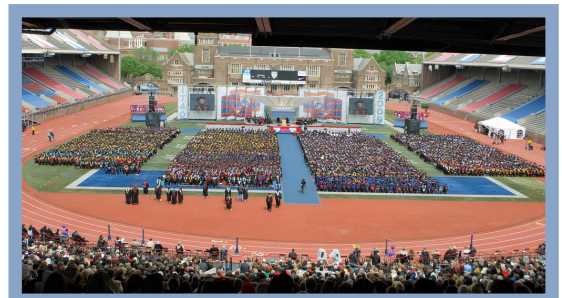


A plan which involves the entire Penn community in the effort to reduce campus carbon emissions



The recommendations of the *Climate Action Plan* are measurable, achievable, and consistent with the imperatives associated with Penn's sustainability aspirations. These recommendations contribute to meeting Penn's sustainability aspirations as follows:

- *The entire Penn community must contribute to the goal of energy conservation.* Energy consumption represents the largest environmental and financial component of Penn's operations;
- *Penn must invest in high-performance renovations and new construction, and ensure that buildings are maintained and operated to support Penn's sustainability mission.* A well-designed and well-built campus can minimize life cycle operation and utility costs, and maintaining a healthy indoor and outdoor environment for learning, teaching, and research;
- *Every effort should be made to embrace sustainable transportation to reduce emissions and congestion.* Vehicle use has a significant effect on local environmental quality and on Penn's livability;
- *Penn's community must minimize unnecessary consumption and recycle waste.* Individual consumer choices have an enormous impact on waste, handling costs, and energy use;
- *Penn must educate its stakeholders to meet the environmental challenges of the future.* A prepared citizenry is the best strategy to mitigate environmental threats.



3 Executive Summary

Responsibility

Implementation of an endeavor as large and complicated as a University sustainability plan depends on the support and endorsement of the Trustees and the University president and the senior administration, as well as enthusiastic participation of the institution's students, faculty, and staff. Penn's implementation strategy is designed to educate and motivate Penn's 40,000-person community to reduce campus carbon emissions, as well as to encourage Penn's expansive alumni network and external community to live more sustainably. Achieving this shared goal requires significant input and actions from each school and center on Penn's campus. Components of the strategy include:

- The GCP's continued outreach and education efforts, such as a strong website presence and the creation of a robust communications plan.
- The Sustainability Team, led by Penn's Environmental Sustainability Coordinator, will manage sustainability projects, and education and outreach programs. This office is anticipated to grow and take on expanded responsibilities to ensure the robust implementation of the *Climate Action Plan*.
- The Environmental Sustainability Advisory Committee will continue to meet, vet new ideas, and monitor progress of the plan. As ESAC is comprised of members from a variety of backgrounds and roles, these stakeholders serve as sustainability ambassadors to their constituencies and through them to the University community at large.
- Annual funding has been budgeted for key projects (see Appendix B), with proposed expenses currently under review. Senior administrators with budgetary authority are apprised of the *Climate Action Plan's* goals to ensure that future funding plans are developed to continue implementation into the future.
- Key metrics for success are monitored and reported regularly, and are easily available to every member of the Penn community through the GCP website (www.upenn.edu/sustainability).
- A robust communications plan, launching in Fall 2009, is designed to both motivate and educate the Penn community and report on the University's progress on its commitment.
- A dedicated Green Fund for sustainability projects will be launched in Fall 2009, to make available grants of up to \$50,000 to any member of the Penn community. A project will be selected for funding based on ability to change behavior, educate, or implement solutions that reduce campus emissions and improve sustainability.

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The University of Pennsylvania has a tradition of leading environmental management and scholarship, and is extremely well positioned to further enhance its excellence in the sustainable use of resources, academics, and local and global environmental engagement. Penn boasts a premier faculty in every field of academics and professional study, and equally important, the campus community – faculty, administration, and students – has a history of rising to meet important challenges to promote its dual mission of excellence in teaching and research.

During the era of great social and cultural change of the 1960s, Penn contributed leading scholarship in social work, education, and planning – including pioneering work in regional planning and design. Through the 1980s and 1990s, Penn’s challenge was to engage and revitalize its adjacent neighborhoods – addressing head-on the issues of blight, urban crime, and abandonment. The West Philadelphia Initiative to revitalize Penn’s neighborhood remains a model for strategic investment in urban communities. The benefits of this initiative include a pedestrian-oriented community, well-served by vast choices in

housing, public transportation, parks, local retail, and access to quality jobs and public education – the hallmarks of a sustainable community.

Today, President Amy Gutmann has identified environmental sustainability as a key challenge to today’s generation of leaders, and has committed the University to a robust program to meet this challenge. The American College and University Presidents’ Climate Commitment (ACUPCC) represents a nation-wide effort to improve environmental sustainability on college campuses and to address global warming in particular by focusing on reducing carbon emissions and accelerating research and scholarship to mitigate the effects of climate change. Key aspects of the Presidents’ Climate Commitment are:

- Completing an emissions inventory;
- Within two years of signing, setting a target date and interim milestones for carbon reductions;
- Implementing immediate steps to reduce carbon emissions by improving

“Certain places, through the peculiar combination of physical, cultural, and, perhaps, spiritual characteristics, inspire people to care for their community. These are the places where sustainability has the best chance of taking hold.” - Muscoe Martin, School of Design

operations, design, and construction, minimizing waste, and supporting sustainable transportation; and

- Ensuring that all members of the community are afforded an opportunity to learn and understand the issues of sustainability as an integral part of the curriculum and educational experience.

This *Climate Action Plan* responds to the aspirations of the ACUPCC by providing a roadmap and summary of Penn’s sustainability efforts. By posting this document online, Penn is publicly committing to meeting these goals and to making Penn’s inventory, goals, and progress reports publicly available.

Penn’s History and Culture

Among premier institutions of higher learning, Penn is America’s first University and is unique in hosting 12 diverse schools on one contiguous campus:

- The College of Arts and Sciences
- The Annenberg School for Communications
- The Graduate School of Education
- The School of Dental Medicine
- The School of Design
- The School of Engineering and Applied Science
- The School of Law
- The School of Medicine
- The School of Nursing

- The School of Social Policy and Practice
- The Wharton School of Business
- The School of Veterinary Medicine

Its physical density in a compact 180-acre urban setting creates an opportunity for interaction and exchange, as faculty and students from all of Penn’s disciplines share the same campus, streets, pathways, and gardens. In a profound way, Penn’s physical campus sets the stage for a commitment to sustainability.

As noted by architect Muscoe Martin of Penn’s School of Design, “The word *sustainable* has roots in the Latin *subtenir*, meaning ‘to hold up’ or ‘to support from below.’ ... Certain places, through the peculiar combination of physical, cultural, and, perhaps, spiritual characteristics, inspire people to care for their community. These are the places where sustainability has the best chance of taking hold.”

Penn is just such a place. Its two-year journey toward a cohesive expression of campus sustainability since President Gutmann signed the ACUPCC is a testament to this campus character, and to the nature of the Penn community who lives and works here.

The Penn Compact: President Gutmann’s Commitment

When Dr. Amy Gutmann became the tenth president of the University in 2004, the hallmark of her inaugural address was the unveiling of the Penn Compact: three overarching academic and administrative themes that would propel Penn from excellence in the core

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mission of teaching, research, and service to eminence as an institution of higher learning. Three principles inform the Penn Compact: increasing access for talented students of all incomes and backgrounds to Penn's premier education; integrating knowledge across disciplines; and engaging in service, education, and leadership locally and globally. Penn has a long-standing tradition of environmental stewardship, as outlined in Appendix A: *A Commitment to Teaching, Research, and Planning: Environmental Tradition at Penn*. However, recently, Penn has incorporated environmental sustainability in all aspects of the Penn Compact, and since 2004, Penn has used these themes as a lens to examine all of its activities. Several specific environmental initiatives took form concurrently in the first years of President Gutmann's administration:

- *The Report to the Trustees on Environmental Performance*: Responding to a Presidential and Trustee request, the new Vice President of FRES undertook a comprehensive review of ongoing sustainability work upon her arrival in 2006. This review documented much of the work described in Appendix A, and concluded that although not previously expressed as a core mission, Penn was already a leader in environmental operations and management, in engagement with external partners on these issues, and in integrating sustainability in learning, teaching, and research. The report presented to the Trustees Facilities and Campus Planning Committee in February 2007 summarized the ongoing work, was endorsed by the trustees as representing Penn's finest values,

and raised expectations for future performance at the University.

- *Campus Operations and Utility Infrastructure*: From the operational side, Penn has long been a leader in best practices to reduce the ecological footprint of campus. Energy efficiency through engineering improvements has produced dramatic savings. For instance, large efficiencies have been realized thanks to a centralized chilled water loop and the creation of centralized control center for some campus utilities. See Section 3.5 of this report for a background summary of the work Penn has carried out over the past two decades.
- The energy efficiencies and associated financial savings gained through energy efficiency programs and campus infrastructure improvements were applied to a ground-breaking investment in clean energy. Starting in 2001, Penn started purchasing wind Renewable Energy Certificates (RECs) and investing in a cleaner regional energy mix (See Appendix D for further discussion of RECs). In 2004, Penn entered into a ten year agreement with Community Energy, a local wind power company (now a part of Iberdrola Renewable, one of the largest wind power companies in the world). Penn's purchase commitment of 40,000 kilowatt hours annually allowed Community Energy to complete a 12-turbine, 24-megawatt wind energy plant at Bear Creek,

Pennsylvania in February 2006. Since that initial purchase, Penn has more than quadrupled its wind power purchases, and, at 193,000 kilowatt hours purchased annually, consistently has won the Environmental Protection Agency's *Green Power Partner* award as the nation's largest buyer of clean wind energy among colleges and universities in 2006, 2007, and 2008.

- *TC Chan Center for Energy and Simulation*: In light of the overall interest in environmental sustainability, FRES commissioned the TC Chan Center to undertake a comprehensive sustainability audit of Penn's West Philadelphia academic campus. The instruction to the TC Chan Center team was two-fold: to determine metrics for Penn's overall energy use and opportunities for savings, and to see how Penn compares with peer institutions in terms of practices, standards, and operational efficiencies. TC Chan Center also was commissioned to conduct a campus greenhouse gas inventory for every year since 2006.

The TC Chan *Phase I Sustainability Report* (2006) focused on six aspects of environmental performance – energy, water, waste, transportation, land use, and health and wellbeing – and developed a description of performance and benchmark standards for each criteria. Energy was quickly identified as Penn's key environmental impact in terms of global and local environmental impact. Because the cost of energy is

both high and unpredictable, energy use also has the greatest bearing on Penn's operational resources allocations. One key finding was that although the campus heating and cooling system achieved a high level of operational efficiency, there was not a corresponding efficiency at the individual building level.

A second finding was that although the campus has grown in size and complexity over the past several decades, due to Penn's large purchase of wind RECs and efficiency upgrades at Penn's steam provider, the University's adjusted carbon footprint was found to be smaller than it was in 1990. This put Penn in compliance with the targets of the Kyoto Protocols for carbon reduction.

After a review of these initial findings, the TC Chan Center was commissioned to produce *Phase II and III Sustainability Plans*, which addressed effective energy management at the building level, and provided an assessment of Penn's energy budgeting and utility cost allocation model.

The TC Chan studies documented that, with the diverse use of Penn's 182 buildings on the academic campus, there was not a consistent, easy, or equitable way to allocate energy costs across the twelve schools and centers on campus, nor was there any overt financial incentive for deans, administrators, or building managers to save energy.

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For Phase II of the plan, the TC Chan Center drew on its extensive expertise in modeling and energy simulation to create a unique computer construct: the Building Performance Assessment Tool (BPAT+). The BPAT+ was based on extensive surveys and assessments of every building on campus, carried out by Penn School of Design graduate students. These survey results were compared to the original construction documents, to create a simplified energy model of the design conditions of every building. Buildings were ranked in terms of efficiency and carbon emissions to help facilities teams determine where further investigations were warranted. Buildings that had higher than anticipated energy use profiles were selected for pilot re-commissioning projects. The study was presented in two phases to FRES in June 2007 and February 2008.

Implementation of a pilot, a two-building re-commissioning project, began in 2007 to demonstrate the effectiveness of the process and the potential campus energy savings. TC Chan Center completed the re-commissioning surveys and coordinated with FRES to identify the savings opportunities. FRES staff then coordinated with customers to implement these energy saving initiatives. With meters installed to document utility savings, a list of about 200 necessary repairs were prioritized and implemented by FRES staff over time. The first year's savings totaled

over \$500,000 for the two buildings – a total return on investment of less than six months. At the completion of the pilot, the facilities operations team made plans to scale up the project to eight buildings annually – a schedule that continues to be carried though 2009 and beyond.

- *Student initiatives:* Just as the trustees, staff, and faculty consultants engaged in sustainability investigations, Penn's student leadership was focused on the issues as well.
 - Founded as an outgrowth of an Academically Based Community Service class in 2004, the student organization *FarmEcology* has worked closely with Penn Dining Services to ensure that food providers on campus make local and seasonal foods available to students. The student group sponsors a local foods dinner once each semester and has worked with local non-profits and farms to bring a weekly local farmers market to the heart of campus. They also sponsor and staff "Winter Harvest," a student buying club for local produce during the winter months.
 - The *Undergraduate Assembly* and the *Graduate and Professional Student Association* have standing sustainability committees, where student input is gathered on all aspects of campus life for communication to the administration.

- *PennMOVES*: For the past two years, Penn's Business Services Division has conducted *PennMOVES*, a move-out recycling and reuse drive to reduce waste and prevent usable items from going to landfills. In 2009, over 45 tons of material was diverted, and more than \$30,000 in sales was donated to West Philadelphia charity agencies.
- The *Penn Environmental Group* (PEG) was founded in 1971 by students active in the inaugural Earth Day 1970 celebration. Students at Penn have been in the forefront of environmental activism ever since. Today, PEG continues student leadership by conducting student awareness campaigns, engaging with faculty and the administration, running a speaker series, and carrying out service programs such as compact fluorescent light bulb distribution in the College House residences. In November 2006, PEG student leaders identified a series of opportunities regarding Penn's sustainability performance, and acknowledging Penn's leadership on many environmental issues, presented their constituents' views to President Gutmann at a University Council meeting.
- On behalf of the administration, President Gutmann responded with enthusiastic encouragement of the students, pledging to continue to implement best practices where Penn's performance was strong, to emulate peer institutions where the University could improve, to look for new opportunities to demonstrate leadership in environmental sustainability, and challenging the administration to improve in other areas.



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Signing of the American College and University Presidents Climate Commitment (ACUPCC)

The student’s University Council presentation was timely; soon afterwards, the ACUPCC team contacted the Office of the President soliciting Penn’s support and involvement. Penn’s extensive sustainability activities over the previous years provided President Gutmann and her senior staff with the information needed to quickly evaluate the ACUPCC proposal and assess the challenges of participation. Penn had already carried

out a carbon inventory through the TC Chan Center, and was in compliance with several other pre-requisites of the ACUPCC. President Gutmann determined that signing the pledge and committing Penn to a comprehensive path to carbon reduction would enhance the University’s sustainability programs, and could be an effective way to reach even higher achievements in the future.

Environmental sustainability was the theme of President Gutmann’s commencement speech that following spring, in which she asked the graduating class to take up the challenge of sustainability leadership:

Each and every one of you leaves Penn better than you found it. Now, we ask you: are you ready to step up and become global stewards for a more sustainable and more humane world? ... We must cultivate respect for the values of science, which are too often distorted. We must demand respect for the dignity of every human being, which is too often denied. And we must learn to respect our earth by undoing the damage we have done to our soil, water, air, and biodiversity... Achieving sustainability will not come easy. Differences and disagreements over how best to pursue common goals will inevitably arise. We can't play down our differences—nor should we. That is part of the beauty of living in a free society.

While the world is waiting, our environment does not have the luxury of time. But the world has you. You have the power to sustain the planet just as you will be sustained by the strength of your Penn education and the love of your friends and family. Yes, we live in a beautiful world that deserves a longer lease on life. Make it happen!

Institutional Response to the Presidents' Climate Commitment

The signing of the ACUPCC and compliance with its requirements focused the University on the sequence of work that would be required to complete a *Climate Action Plan*. Faculty, staff, and students would each be asked to contribute expertise and resources to develop a plan for implementation in support of this University-wide presidential initiative.

Creating a Support Structure for Sustainability:
Prior to the President signing the ACUPCC

pledge, Penn was already engaged in numerous sustainability initiatives. The immediate challenge was to bring these efforts together in a coherent structure, develop metrics for evaluating success, and create a formal *Climate Action Plan*. At Penn, the three initial steps were: coordinate a guiding committee to develop recommendations to the Office of the President, create an Sustainability Team under the Environmental Sustainability Coordinator, with appropriate staff to oversee and direct efforts, and communicate the wide-ranging ongoing sustainability work at Penn in a coherent way.

1. The *Environmental Sustainability Advisory Committee* (ESAC) was established once President Gutmann signed the ACUPCC. The Vice President of FRES, acting as chair of the new committee, invited selected faculty, staff, and student government leaders to the first meeting in Fall 2007. After an initial presentation by the co-chairs of the TC Chan Center and FRES staff to bring the committee members up to date about ongoing work, the committee determined that its key tasks were to:
 - Gain input from the entire University on strategies to improve campus sustainability and reduce carbon emissions;
 - Research best practices at peer institutions; and
 - Use this information to develop Penn's *Climate Action Plan* by Fall 2009 for submission to the ACUPCC.

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Six subcommittees – Utilities and Operations, Physical Environment, Transportation, Waste Minimization and Recycling, Academics, and Communications – were established to investigate and develop recommendations for inclusion in the *Climate Action Plan*. Over the course of 2007, 2008, and Spring 2009, the full committee met twice per semester, with the subcommittees meeting more frequently to formulate specific recommendations.

In May 2009, ESAC had completed its work and presented its recommendations to President Gutmann. With the original task now completed, ESAC and its six subcommittees will continue to meet and to respond to new ideas, review implementation plans, and provide feedback on progress.

2.

1. The *Sustainability Team* was established in the spring of 2008, with the appointment of Penn's first Environmental Sustainability Coordinator and an Assistant Sustainability Coordinator. For the first year, the key work of the office focused on managing the *Climate Action Plan*, preparing updates for the University president and senior staff, and promoting and supporting the extensive work underway across the University. As noted above, the office expanded greatly with the arrival of six sustainability associates (students and recent graduates from both Penn undergraduate and graduate schools) in the summer of 2008, three of whom stayed on for the following academic year to carry out specific research on and assist in the implementation of new initiatives in sustainable transportation, waste minimization and recycling, and

academic sustainability programs. During the summer of 2009, the Sustainability Team was again supported by six new summer associates, dedicated to:

- Preparing of the *Climate Action Plan*;
- Launching a pilot student and staff Eco-Reps program;
- Organizing the launch of the Green Fund sustainability loan program;
- Improving off-campus recycling and housing initiatives;
- Conducting research into electronic waste and universal waste and recycling;
- Providing sustainability training for FRES staff;
- Assessing the University vehicle fleet for sustainability; and
- Managing a pilot study to develop sustainability standards for renovation projects fewer than five million dollars.

As the ongoing work shifts to the implementation phase of the *Climate Action Plan*, the Sustainability Team will continue to serve to update the President on progress and coordinating activities across the University. The primary tasks will include monitoring and reporting on the *Climate Action Plan* recommendations, in particular the tracking and reporting of carbon emissions. Other tasks include management of the student and staff Eco-Reps program, the development of sustainability public events and activities, the publication of a bi-monthly sustainability newsletter known as "The Red and Blue: On College Green," and

the compilation of the results of the carbon reduction strategies under way by schools and centers. An annual sustainability report will be produced at the end of the 2009-2010 academic year and annually thereafter for distribution to the wider Penn community.

Although the implementation of the *Climate Action Plan* recommendations will require additional staff and resources equal to the broad scope and critical importance of this work, the work to date has been carried out by a minimum of full-time staff and temporary sustainability associates. The Sustainability Team continues to rely on and be advised by many divisions and individuals across the University, in particular the Business Services Division, FRES, the Office of the Executive Vice President, and the TC Chan Center.

3.

1. The *Green Campus Partnership (GCP)* grew out of a student-led initiative to champion environmental issues, and was established as the umbrella group to address environmental sustainability

and stewardship on campus soon after President Gutmann signed the ACUPCC. Comprised of self-selected parties from across the campus, the GCP functions as a virtual clearing house and repository of initiatives, providing a web presence and a comprehensive communications strategy to provide outreach and updates to the University. Participants and contributors to the GCP include representatives from the Office of the Provost, FRES, Penn Dining, Business Services Marketing and Communications, the Office of the Executive Vice President, Environmental Health and Radiation Safety, Deans and department Chairs, and student groups.

The GCP website was updated and redesigned over the summer of 2009, and launched in September. The website updates progress on the Presidents Climate Commitment, provides an ongoing calendar of campus sustainability events, and features the



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latest projects and initiatives of the Sustainability Team through links to the “Red and Blue: On Campus Green” newsletter.

The GCP implements the communications strategy laid out in the *Climate Action Plan*. In addition to the website, the GCP will advertise events, feature speakers and symposia on environmental topics, provide media coordination and outreach, launch frequent e-newsletters, and serve the Penn community as the first stop for information and updates.

Green Ribbon Panel: In addition to the work described above, there remain some issues the need to be resolved to institutionalize the *Climate Action Plan*. These include:

- Developing and publicizing metrics to measure progress on the recommendations;
- Determining the authorities within the University responsible for implementation;
- Budgeting the necessary resources; and
- Creating a management and review team to ensure that the *Climate Action Plan* is carried out.

In September 2009, at a meeting of the University Senior Roundtable, the Vice President of Facilities and Real Estate Services recommended the creation of a *Green Ribbon Panel*, with operational responsibility to monitor the progress of the *Climate Action Plan*,

ensure implementation of the recommendations and report to senior administrators and to the Provost on progress. This Panel will be similar to few other initiatives at the University, in that there will be shared implementation from both academic and administrative departments, with commitment from the highest level of University administration.

Twice annually, this Panel will receive a progress report on sustainability metrics, new initiatives, and other updates of the *Climate Action Plan* implementation by the Sustainability Team.

Future Supporting Activities:

The *Penn Green Fund* was launched at the start of the 2009-2010 academic year to provide financial support for selected sustainability initiatives from members of the Penn community. While rewarding creativity and innovation, priority will be given to projects with results that are able to demonstrate a quantifiable return on investment, secure additional funding, that will be applied across campus, engage multiple stakeholders within the Penn community, and are effective in educating or changing behavior. Each team awarded a grant will be required to submit a performance/status project report at midpoint and completion, and the final report will be published on the GCP website to demonstrate the environmental benefits.

The *Eco-Reps* program relies on peer education and group learning to generate enthusiasm among both students and staff populations. Self-selecting groups will receive once-a-month training on specific topics (energy use,



recycling, sustainable commuting, purchasing, etc.), and are charged with communicating these lessons to their peers across the University. In 2009, these programs will start with a pilot program in three College Houses and around 40 Eco-Reps, with the intention to expand to all College Houses in the 2010- 2011 academic year.

The *PennGreen Freshmen Pre-Orientation* program had its first full-scale run in August 2009, with 40 incoming freshmen participating in a four-day program prior to the start of formal new student orientation. Events included tours of campus and of urban farms, meetings with representatives from the City of Philadelphia's Office of Sustainability, meetings with the sustainability team at Penn, and lunch with faculty and staff working on the issue. PennGreen participants signed a pledge to commit to a sustainable lifestyle for four years while a student at Penn.

Collaborations with outside stakeholders: Penn's sustainability team has a number of important collaborations and partnerships outside of the institution:

- Penn participates in the *Ivy+ Sustainability Working Group*, made up of Sustainability Coordinators and Directors from the Ivy League schools plus Johns Hopkins, MIT, Stanford, Georgetown, the University of Chicago, and Duke. Weekly conference calls and an annual retreat allow for sharing of information and collaborations.
- *The Mayor's Sustainability Advisory Board:* The FRES Vice President was asked by the Mayor of Philadelphia to co-chair his sustainability advisory board, organizing the 25 members to provide advice and feedback on city operations and environmental initiatives as they launch a city-wide sustainability plan.

4 Introduction

- *The US Green Building Council (USGBC):* Penn is a member of the USGBC, and Penn's Environmental Sustainability Coordinator is the chair of the local chapter, the Delaware Valley Green Building Council (DVGBC). The DVGBC is the leading advocacy and education provider on green building policy and technology in the Delaware Valley.

Shared Mission

The goal of the *Climate Action Plan* – and the challenge to society as a whole as regards global warming – is to affect behavior change. The necessary actions at Penn will take many forms and all are critical to success, and mutually supporting:

- Academic research and teaching with an emphasis on sustainability;
- Large-impact, high-capital changes in the way Penn designs, builds, and operates campus buildings and infrastructure; and
- Small-scale individual changes – that are large in aggregate – in how each member of the Penn community uses resources.

As a learning institution, Penn has the tools to affect the behavior change necessary to reduce energy use and create sustainable lifestyles. This *Climate Action Plan* provides the implementation strategy to reduce carbon emissions and to create a more sustainable campus community. The key to success in this endeavor is not to be found in either technology or administrative directive, but in individual understanding and personal commitment.

Each member of the campus community is a stakeholder in this effort. To be successful the *Climate Action Plan* has to communicate the importance of reducing carbon emissions, why conservation of energy and resources matter, and how a more sustainable institution can be built. If successful, then the carbon reduction will follow.

The reduction of carbon emissions is not a matter of accounting, but a matter of insight, awareness, and appreciation. The scale of the challenge the community faces is evident; to succeed, the Penn community will have to rely on relationships and collaboration, have trust in its collective will, and believe that changes can be achieved in order to reach the shared goal of a sustainable University of Pennsylvania.

5 Mitigation Strategies

Mitigation Strategies

The following sections present the actions that Penn will take to reduce its carbon footprint over the long term. The Carbon Reduction Action Plan, which begins on page 37, summarizes the analysis of Penn's current carbon footprint completed for fiscal years 2007, 2008, and 2009, along with the proposed strategies to achieve the carbon reduction goals.¹ The recommendations of the *Climate Action Plan* begin on page 54, and are organized by area: Utilities and Operations, Physical Environment, Transportation, Waste Minimization and Recycling, Academics, and Communications. Each category is organized into a uniform format, addressing background, mission and/or target, recommendations, progress, responsibility, and funding. Together, the *Carbon Reduction Action Plan* and the *Climate Action Plan* recommendations provide the University with compelling mechanisms to reduce its carbon footprint.

1 A carbon footprint is “the total set of GHG (greenhouse gas, or carbon dioxide equivalent) emissions caused directly and indirectly by an individual, organization, event or product” (UK Carbon Trust 2008).

5.1 Carbon Reduction Action Plan

Campus Carbon Footprint

The current carbon footprint of the main campus was developed with a carbon calculator created for Penn, using the conventions and assumptions set out by the World Resources Institute and modeled on a similar calculator developed for Harvard.¹ The *Carbon Reduction Action Plan* includes the inventory of the main academic campus in West Philadelphia.

Institutional greenhouse gas (GHG) emissions are typically divided into categories based on the source and the institution's level of control of the emissions. The categories are referred to as "scopes." Scope 1 includes all sources of emissions that are released directly by the institution, such as natural gas and fuel oil combusted on campus, refrigerant leakage, and University-owned vehicles. Scope 2 includes indirect sources of emissions from the purchase of electricity, heat, or steam. Scope 3 includes all other indirect sources of emissions that may result from the activities of the University, but that occur from sources owned or controlled by other entities. Scope 3 emissions include commuter travel, solid waste disposal, and institutionally sponsored air travel.

The *gross* greenhouse gas emissions for fiscal year 2008 were 355,800 metric tons of carbon dioxide equivalent (MTCDE), a slight drop from the previous year. The *net* emissions of 250,500 MTCDE are considerably lower in fiscal year 2008 due to purchasing additional Renewable Energy Certificates (RECs)² that

1 <http://www.greencampus.harvard.edu/ggi/docs.php>

2 "Renewable energy certificates (RECs) represent the attributes of electricity generated from renewable energy

offset approximately 30 percent of the gross emissions. A colder winter in fiscal year 2009 led to an increase in demand. However, Penn's carbon emissions remained level. As with most universities, the largest share of campus emissions are related to energy use in buildings. In Penn's case, almost 90 percent of the carbon footprint comes from the production of electricity and steam. (Fig 5.1)

Carbon Footprint

Sources of Emissions

Over 86 percent of carbon produced by the University is from building-related sources. At present, steam, electricity, oil, and natural gas are all used in the operation of the University campus with steam and electricity accounting for the vast majority of emissions.

Unlike its peer institutions, the University does not own or operate a generating facility. It purchases the energy it needs from local utilities, acquiring steam for heating from a combined heat and power plant at Grays Ferry through TriGen Energy Corporation and electricity to run its chillers and other electric devices from Philadelphia Electric Company (PECO). The Trigen plant produces steam as a waste product from the generation of electricity, so it is a responsible way to achieve a low-carbon source of heat.

Air travel by students, faculty and staff is the next largest source, comprising eight percent

sources." (US NREL) By purchasing REC's that have zero carbon emissions, Penn can claim an indirect "offset" of its own emissions.

5.1 Carbon Reduction Action Plan

of emissions, although it should be noted that this total includes only travel that was arranged directly through the University. The balance of the emissions is from commuting, solid waste disposal, Penn-owned vehicles, refrigerant leakage and replacement, and landscape management. Using historical data, the GHG emissions of the University were calculated for the years 1990 to present day (Fig. 5.1).

Emissions from Buildings

As noted above, utility consumption in buildings constitutes the majority of carbon produced by the University. Therefore, much of the focus of this plan is on carbon

reductions in campus buildings. The reduction of utility consumption, and the associated carbon emissions, will require many kinds of improvements to buildings and their systems, as well as changes in the purchasing and use of the power consuming equipment within them. This area will be explored in more detail in the *Climate Action Plan's* recommendations.

In order to understand where energy is used and carbon produced, Building Performance Assessment Tool (BPAT+) audits are used to create a normalized and relative assessment of campus building performance. The BPAT+ audits are a way to provide strategic information on individual building

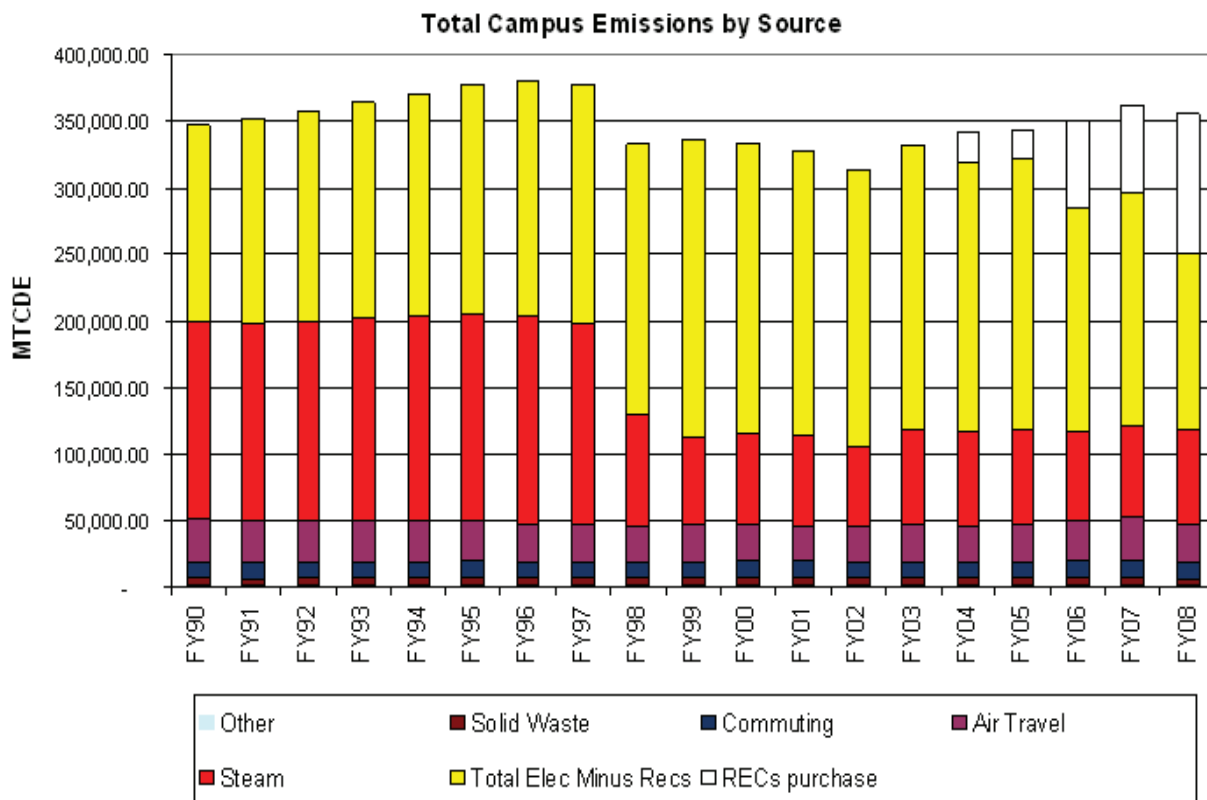


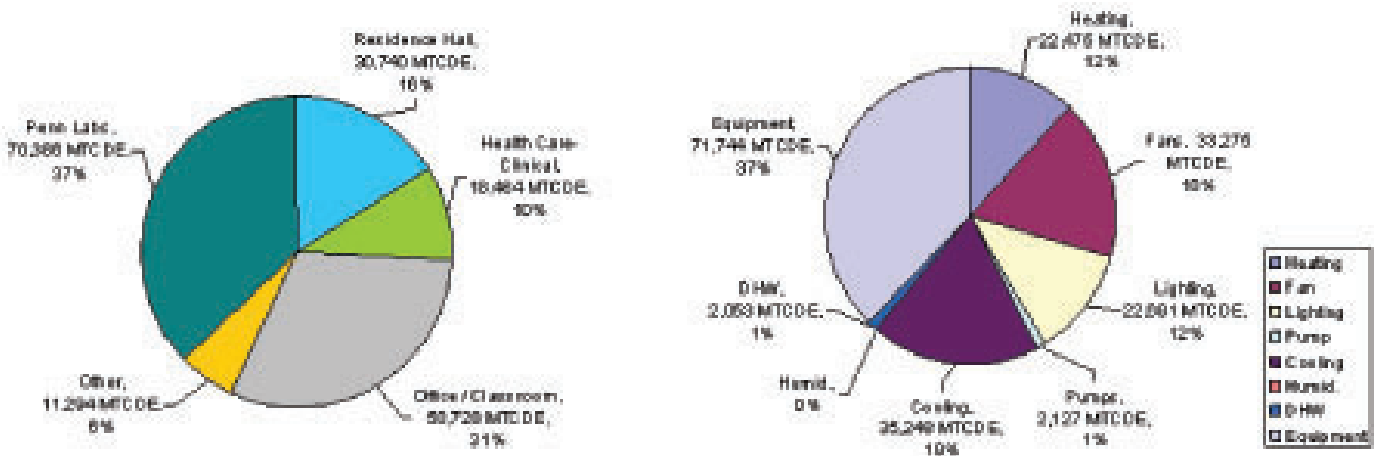
Figure 5.1 Annual Carbon Production Since 1990

performance but leave open the question of how much to reduce that energy consumption. To help answer that question, Penn’s buildings are compared to the EPA’s Energy Star performance data.

Drawing on the US Department of Energy’s Commercial Buildings Energy Consumption Survey, which provides average energy use data for classes of buildings across the nation, Energy Star measures annual energy consumption in thousands of BTUs per square foot (kBtu/SF) for specific building types and occupancies. This metric is the closest to a “miles-per-gallon” metric available for buildings. These consumption amounts are then

correlated to a percentile ranking on a scale of 1 to 100, with 50 representing the average energy consumption for that building size, type, occupation, and location. To actually obtain an Energy Star label or certification, a building has to rank at Energy Star 75 or above, meaning it has to perform better than 75 percent of the buildings of its type (www.energystar.gov).

To understand the potential carbon reduction opportunities in buildings, emissions were analyzed in two ways: by building type (Fig. 5.2) and by uses of energy across all campus buildings (Fig. 5.3). Of campus building types, laboratory buildings, residence halls, and medical facilities represent the largest



Figures 5.2 and 5.3 Emissions by Building Type and Emissions by Use

5.1 Carbon Reduction Action Plan

producers of carbon. In terms of energy uses, electrical equipment, cooling, fans, lighting, and heating make up the largest portions of carbon emitted by buildings on campus. These are the categories with the most potential for energy and emissions reductions.

Emissions Projections

Carbon Reduction Scenarios

Using the current carbon footprint and anticipated campus growth, a base-case was developed projecting Penn's future GHG emissions. Under this "business-as-usual" (BAU) scenario, assuming no carbon reduction strategies are implemented, Penn would nearly double its total carbon emissions by 2050.

With this BAU case as the starting point, a variety of alternate strategies were studied to develop scenarios for reducing the carbon footprint. The preferred scenario describes a variety of individual emissions reductions achieved through ambitious yet achievable strategies. This plan bases the short-term carbon reductions on realistic strategies that have been demonstrated through on-campus projects. The mid- and long-term strategies assumes progressively more aggressive reductions, anticipating advances in technology, improvements in economic feasibility and increased community awareness.

Using the assumptions described above, along with the continuing purchase of RECs at approximately the current level, Penn's plan for carbon reduction has the potential to achieve significant reduction in emissions. The scenarios

presented provide a framework for identifying a target date for significant carbon reduction.

The BAU-case scenario of projected emissions from the University assumes that no new carbon reduction strategies are implemented. This scenario started with the current carbon footprint extrapolated in tandem with estimates for campus growth. Based on data over the last 20 years, the rate of growth (building square footage and campus population) was assumed to be one percent per year.

A second significant growth factor for campus emission is derived from the historical analysis of energy use and campus size. These documents show a steady increase in *electrical intensity* (watts per square foot) over time: every year the University uses about 1.5 percent more electricity per building area. This growth rate is consistent with national trends, and is mainly due to the use of more devices demanding electric power: computers, printers, scanners, copiers, and cell-phone chargers.³ For the BAU base situation, it was assumed this trend would continue.

Using these two basic growth factors for campus size and electricity use, the projected increase of the University's emissions are shown in the BAU graph (Fig. 5.4). If recent patterns of growth continue and no efforts are made to reduce energy use, the University will add approximately 100,000 MTCDE to its emissions in 20 years, which would nearly double its total carbon output by 2050. There are significant limitations in this sort of long-term trend analysis and these are reflected in the fading colors of the graph after the 20 year

3 Energy Information Agency

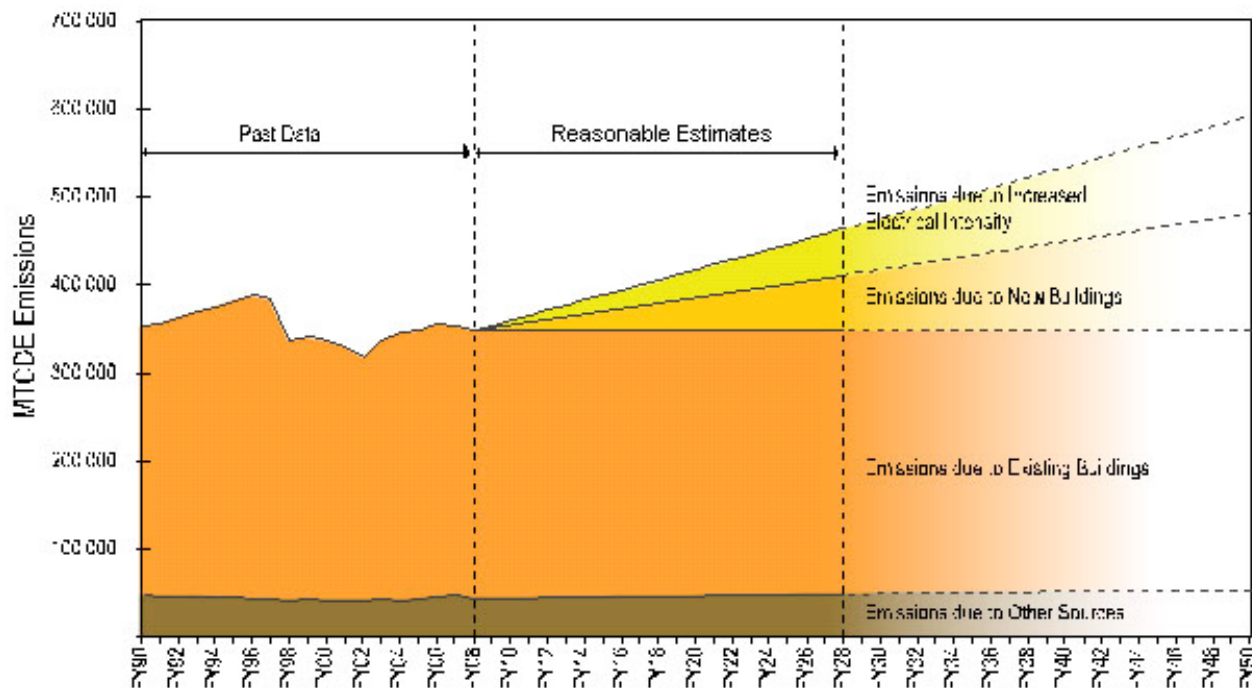


Figure 5.4 Base Case (Business-As-Usual)

mark. However, as the journey to a reduced carbon footprint will take many years, a long-term projection is needed to provide a target for carbon reduction scenarios.

Categories of Carbon Emissions

To understand and develop a scenario for significantly reducing the carbon footprint, Penn’s emissions over the next 40 years have been separated into four broad categories.

1. New emissions due to increased electric intensity;
2. New emissions due to the construction of *new* buildings;
3. Emissions from *existing* buildings; and
4. Emissions from non-building sources.

In Fig. 5.4, each of these categories of carbon emissions is illustrated as a colored area representing the total expected emissions in the BAU scenario. Each measure begins at fiscal year 2009, and is extrapolated to fiscal year 2050. Although this timeline is well beyond the range of reasonable prediction, these simple, linear projections allow for broad comparisons.

New emissions due to increased electric intensity

As noted above, the amount of electricity used per square foot of building has increased steadily at a rate of about 1.5 percent per year in excess of the growth in campus buildings. As this trend is projected forward, it describes a surprisingly large new wedge of carbon emissions and warrants immediate action. Since this form of growth is largely decentralized,

5.1 Carbon Reduction Action Plan

both in the purchase of devices and in their use and operation, it will require a range of measures to reduce or eliminate this growth (see Section 5.5: Utilities and Operations).

New emissions due to the construction of *new* buildings

Each year, new buildings are added to the campus. Each new building will require additional energy for its operations, and add more carbon to the University's emissions. As indicated in the previous section, that rate of growth has averaged about one percent a year, which defines the slope of the carbon wedge attributed to new buildings. To limit further growth of emissions, new buildings should be as energy efficient in their design and operation as possible (see Section 5.6: Physical Environment).

Emissions from *existing* buildings

Existing buildings are currently the largest contributors of carbon on campus (86 percent of total emissions) and will continue to be so for the foreseeable future. This category of emissions obviously represents the largest opportunity for emissions reduction (see Section 5.5: Utilities and Operations).

Emissions from non-building sources

Emissions due to non-building sources are primarily due to air travel at 8.2 percent, followed by commuting at 3.5 percent, and then by solid waste at 1.4 percent. Natural gas, fuel oil, landscape management, refrigerants, and fleet diesel and gasoline combined contribute a negligible amount of only 0.27 percent of

total emissions from 1990 to 2008 (see Section 5.7: Transportation and Section 5.8: Waste Minimization and Recycling).

Carbon Reduction Plan

Renewable Energy Certificates (RECs)

Reducing or eliminating energy consumption is the most direct method of reducing Penn's carbon footprint. The focus of this plan is a set of strategies to achieve significant reductions in energy use, although it will never be feasible for the campus to stop using energy completely. Even with substantial reductions in energy use, Penn will continue to have carbon emissions until the power supply is itself carbon-free. Renewable energy certificates provide a second-tier approach to reduce the campus' carbon footprint to near zero. These offsets can range from the on-site production of non-emitting sources of power, such as solar energy, or the purchase of green power generated elsewhere. In 2004, the University began to purchase a percentage of its annual electric power from wind generation through renewable energy certificates. Wind power purchases are considered a carbon offset as they have little or no carbon emissions associated with their production. These RECs are a major reason why the University's overall carbon emissions have declined over the past five years, as seen in Fig. 5.1.

A further consideration for carbon reduction is Act 213, signed into law by Pennsylvania Governor Edward Rendell in November 2004. This act, also known as the Alternative Energy Portfolio Standard (AEPS), requires that Electric Distribution Companies (EDCs)

provide a certain percentage of their energy from alternative systems, increasing from 5.7 percent in 2007 to 18 percent by 2021. Sources are classed as Tier 1 – traditional renewables such as biomass and wind, Tier 2 – alternative sources including waste coal and demand-side management, and S-RECS for solar energy. According to PECO, the largest electric and natural gas utility in Pennsylvania, the total environmental benefit of the alternative energy credit purchases will be the same as planting more than 33 million trees or not driving 428 million miles. For Penn, this act means that the amount of clean, emission-free power that supplies the University will increase, and the carbon footprint of the electricity available on the grid will be lower, with little effort on the part of the University. There is some pending legislation that could significantly increase the AEPS standards; however, since this is still tentative, the existing Act 213 regulations have been incorporated into the University's plans.

ESAC Subcommittees and Additional Carbon Reduction Initiatives

All six ESAC subcommittees contributed useful strategies to reduce Penn's carbon footprint. Implementing recommendations from the Utilities and Operations subcommittee can make the most significant and immediate carbon reductions. The Academics and Communications recommendations are unlikely to have direct carbon reductions; the Transportation and the Waste Minimization and Recycling recommendations can yield some smaller annual carbon reductions; and the Physical Environment group yields indirect carbon reductions through implementation of higher building standards. The explanations

below summarize the types of immediate initiatives recommended by the *Climate Action Plan*.

- 1. Utilities and Operations** (Section 5.5): Implement energy conservation programs, accelerate and re-focus facilities renewal, capital project renovations, and re-commission existing buildings.
- 2. Physical Environment** (Section 5.6): Develop new standards compatible with the LEED rating system, incorporate staff training, and improve landscape maintenance protocols.
- 3. Transportation** (Section 5.7): Promote use of alternative transportation, provide incentives for the use of public transit, improve bicycle and pedestrian campus infrastructure, and improve efficiency of the Penn vehicle fleet.
- 4. Waste Minimization and Recycling** (Section 5.8): Develop a comprehensive policy, University standards, and improved purchasing practices, and disseminate information across campus.
- 5. Academics** (Section 5.9): Enhance undergraduate, graduate, and faculty sustainability education opportunities.
- 6. Communications** (Section 5.10): Develop branding, implement website maintenance, standardize marketing and advertisement, and directly engage the target audience in order to encourage behavior change.

5.1 Carbon Reduction Action Plan

Long-term Reduction Targets

Reduction Measures

Starting with the emissions projections in the BAU base case, a number of possible scenarios were analyzed consisting of varying combinations of carbon and energy reduction strategies. The recommendations put forth in the *Climate Action Plan's* Utilities and Operations, Transportation, Waste Minimization and Recycling, and Physical Environment sections each have recommendations for carbon reduction measures that, combined, produce a scenario for significant carbon reductions by mid-century. These reductions, as dictated by the

Climate Action Plan's recommendations, were calculated using a carbon calculator created by the TC Chan with input for the World Resources Institute carbon calculator and one developed by Harvard University. The *Carbon Reduction Action Plan*, together with maintaining the current amount of RECs purchased each year, has the potential to make crucial reductions in Penn's carbon footprint.

The plan focuses on six targeted emissions reduction measures:

1. Reduction in electric intensity (watts/sf);
2. Adoption of higher performance standards for new buildings;

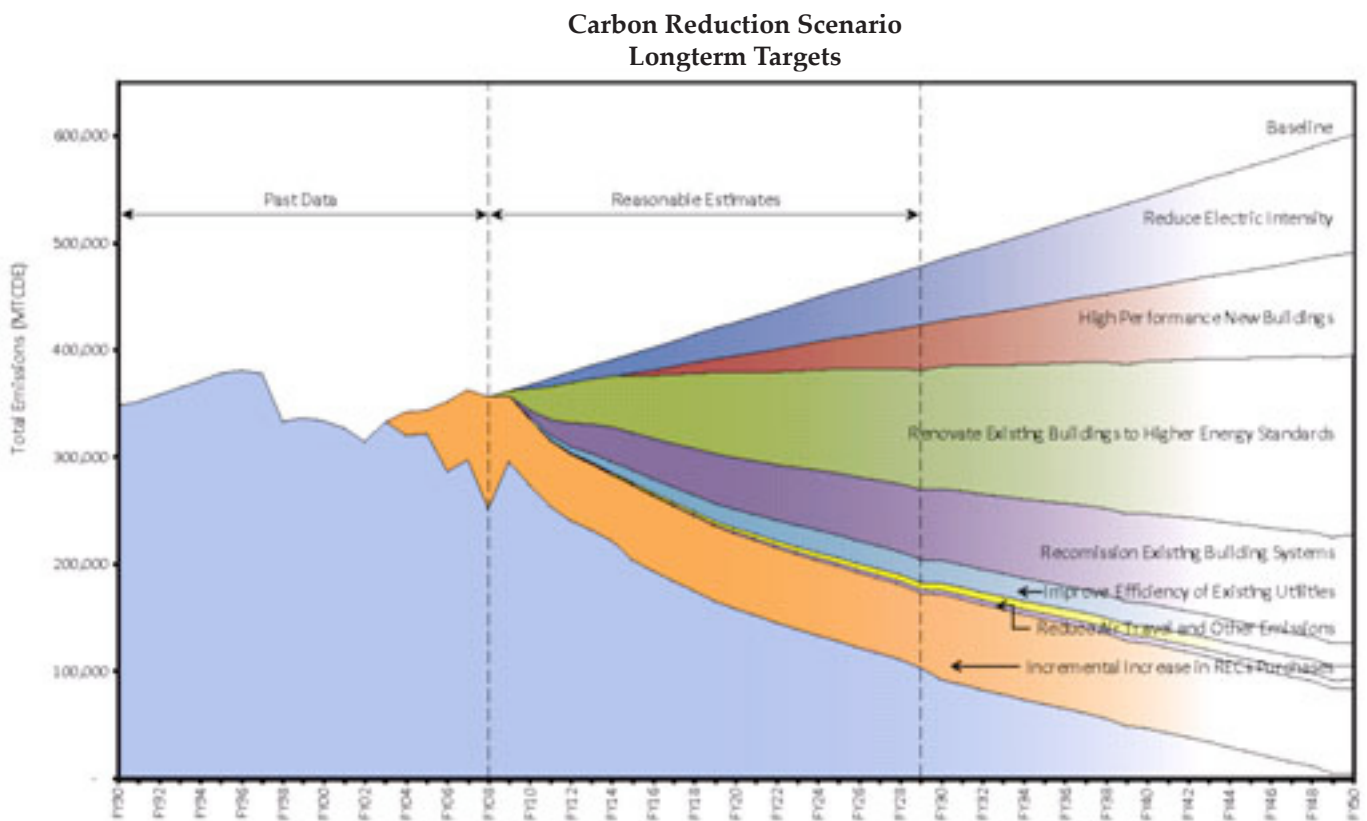


Figure 5.5 Long-term Carbon Reductions

3. Renovation of existing buildings to higher energy standards;
4. Re-commission existing building systems;
5. Improvement of the efficiency of existing utilities and infrastructure; and
6. Reduction of emissions from air travel, solid waste, University vehicles and other smaller sources.

Potential measures for reducing emissions are shown as wedge shaped areas in Fig. 5.5. The area of each wedge represents the amount of carbon that could be eliminated over time if the associated measures are undertaken.

Reduce Electric Intensity

This measure involves eliminating the current 1.5 percent annual growth in plug loads (electric intensity growth) and further reducing the current electric consumption of campus buildings. To achieve this, Penn will develop and implement educational programs that focus on occupant behavior modification, and will also modify the procurement process for equipment. This measure is estimated to yield an estimated carbon reduction of 3,000 MTCDE annually for the first two years. The amount of savings decreases to 67 percent of the original savings until fiscal year 2050.

Design High Performance New Buildings

By adopting energy efficiency standards similar to those set by peer institutions for new construction, substantial energy savings can be achieved with cost-effective investments. This measure assumes that any new campus buildings will be designed and constructed

to meet an equivalent of Energy Star 90, or 30 percent below American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) standard 90.1. This will yield an annual carbon reduction of 2,673 MTCDE which continues through fiscal year 2050.

Renovate Existing Buildings to Higher Energy Standards

This measure assumes that the existing buildings renovated each year are improved to a minimum standard of Energy Star 75 or equivalent (some recently renovated campus buildings have already met this goal). After the first few years of improvement to Energy Star 75, the standard would be raised to reach Energy Star 90 standards.

Renovating existing buildings and systems to an Energy Star 75 standard could yield up to a ten percent annual payback on the initial dollar investment and up to an annual estimated carbon reduction of 14,000 MTCDE for the first year or so. This annual payback decreases to around 5,500 MTCDE annually after the worst performing buildings have been renovated. The annual carbon reduction will continue to reduce in savings until it reaches about 1,500 MTCDE in fiscal year 2040 and levels off.

Re-commission Existing Building Systems

Re-commissioning involves adjustments and recalibration of the energy consuming systems so they will operate more efficiently. Anticipated carbon reductions in the plan, based on an initial sample of buildings that were re-commissioned, are 30 percent savings for specific buildings over the first three years

5.1 Carbon Reduction Action Plan

and a gradual decrease to level off at nine percent of those savings after the 80 worst performing campus buildings have been re-commissioned. This sequence will be repeated every ten years to keep buildings operating at optimal performance. The associated reductions assume that a minimum of 600,000 square feet (SF) of buildings is re-commissioned annually, with a higher SF in the first five years as the largest buildings are re-commissioned. With the recommended installation of meters in each campus buildings, accurate recording of each building's individual steam and electric consumption and subsequent savings will be possible.

Improve Efficiency of Existing Utilities

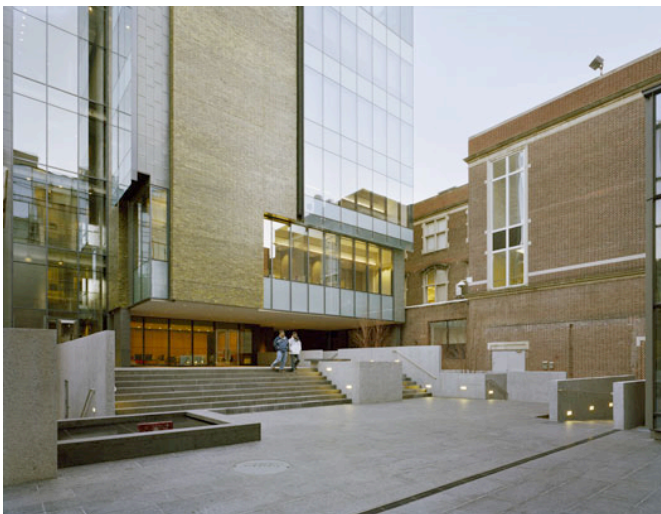
This measure encompasses a variety of infrastructure improvements to increase energy efficiency, including strategies to reduce system losses such as insulating steam lines and repairing system leaks. It has been assumed that after fiscal year 2009, the utility measures are increased to produce an annual carbon

reduction of approximately 2,000 MTCDE until fiscal year 2014, and then cut by half to produce an estimated annual carbon reduction of 900 MTCDE until fiscal year 2024. After the first 15 years, this measure assumes that all of the existing utilities will have been improved to a better energy standard.

Reduce Air Travel and Other Emissions

This measure assumes that the carbon emissions produced by both the University's air travel and by all emissions from commuting, fleet, solid waste, natural gas, and diesel generators, are cut by one percent annually. This carbon reduction is relatively small in the overall wedge scenario and is represented as a very small sliver in the graph.

In future years, Penn will investigate a local carbon offset program wherein carbon emissions generated by University-sponsored air travel are offset by donations from travelers into a fund used to renovate and weatherize local Penn-owned apartment buildings. The



reduced emissions from these more efficient buildings will be credited to the University.

Green Power RECs

This scenario assumes that the current rate of wind power REC purchases at 193,000 kWh per year would continue at the same level for the first five years of the Plan. Over the next 15 years, Penn will continue to have a similar level of commitment to green power in the future. This measure would reduce carbon emissions by approximately 3,000,000 MTCDE.

Individual Wedges or Pieces of the Plan

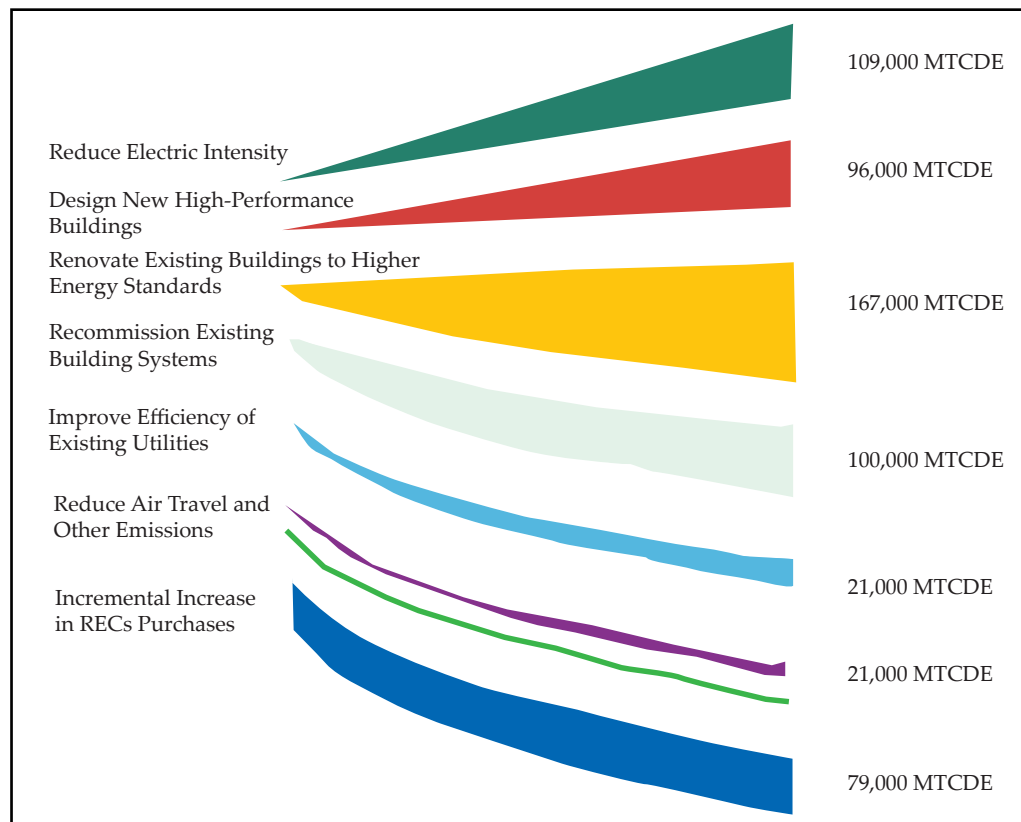
Each individual measure is a separate wedge in the chart (Fig. 5.6). In isolating each wedge

as an individual piece, it is evident how much impact each specific measure carries on its own.

Five-Year Reduction Targets

The previous scenario shows a long-term approach to achieving carbon reductions at Penn. Fairly significant carbon reductions are possible within the first five years of this plan, as seen in Fig. 5.7, and by fiscal year 2014, the net carbon footprint can decrease around 160,000 MTCDE or 43 percent from the BAU (the BAU line at 2014 is 300,000 MTCDE) case, assuming continued purchase of RECs. This is an actual reduction of approximately 108,000 MTCDE or 30 percent from 2008 levels, not including the effect of wind RECs. The first five

Figure 5.6 Isolated Wedge Carbon Reductions



5.1 Carbon Reduction Action Plan

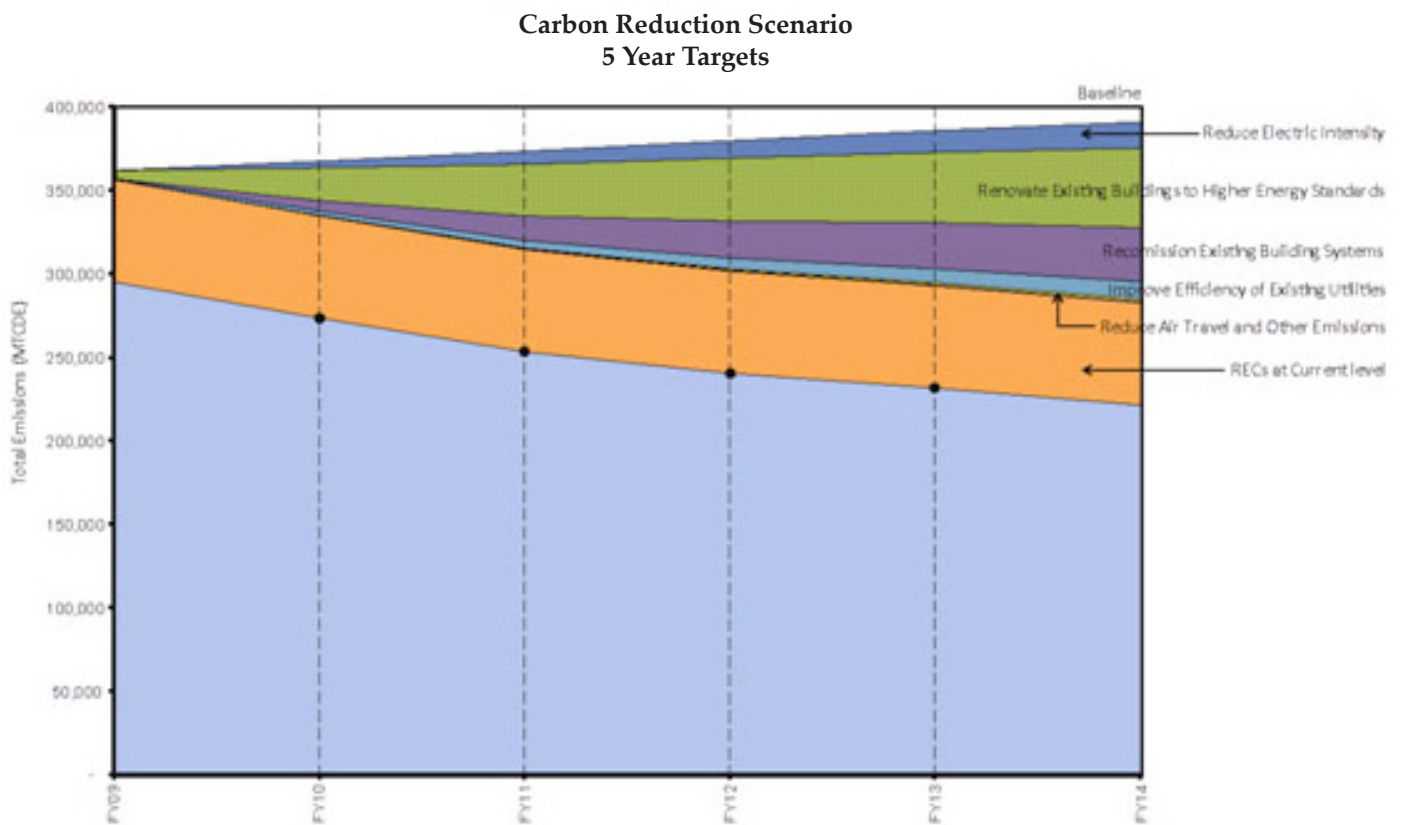


Figure 5.7 Five Year Short Term Targets

years are an indicator of what measures can occur immediately to start the University on a path to the reduction of the overall carbon footprint by fiscal year 2050. The following assumptions and projections relate to the 2009 to 2014 timeframe.

Reduce Electric Intensity

Reducing electric intensity involves eliminating the current 1.5 percent annual growth in plug loads (electric intensity growth) and reducing the current electric consumption in campus buildings by implementing two programs: educational programs that focus on occupant behavior modification, and a revised

procurement process for equipment. The first two years start off with higher initial carbon reductions to yield around 3,900 MTCDE each year. The next three years taper off the estimated amount of carbon savings to 2,600 MTCDE each year. The decrease occurs due to the inability to sustain the higher initial savings once the behavior modification programs have been in place.

Renovate Existing Buildings to Higher Energy Standards

Implementing higher energy standards assumes that the existing buildings renovated each year are improved to a minimum standard

of Energy Star 75. The first few years of renovation will yield a higher energy savings by selecting the worst performing campus buildings to renovate immediately. The first two years yield a 10 percent annual payback on the initial dollar investment. Following this, there will be an incremental decrease to five percent annual payback in fiscal year 2012 and a further decrease to three percent in fiscal year 2013 and fiscal year 2014.

Re-commission Existing Building Systems

To achieve the estimated carbon emissions reductions, the re-commissioning projects will tackle the systems of the worst eight performing buildings in the first year and will install meters to continue to track energy use. The first five years carry a possible 10 percent energy savings based on the average kBTU/SF of 210.40 for the worst 40 performing campus buildings surveyed in the BPAT+. These reductions assume re-commissioning eight buildings each year with FY2010 including re-commissioning the following buildings totaling 961,300 square feet:

- Levine Hall
- Skirkanich Hall
- Vagelos Laboratories
- Stellar Chance Laboratories
- Chemistry 1973 wing
- Veterinary Medicine Quadrangle
- Steinberg Conference Center
- Meyerson Hall

For the next four years—until fiscal year 2014—the reductions assume that another eight

buildings of a similar size of 961,300 will be chosen each year.

Improve Efficiency of Existing Utilities

Utility infrastructure programs are expected to increase energy efficiency in the overall system. The first five years of activity produces an estimated annual carbon reduction of 1,500 MTCDE. This measure yields a three-year payback on the initial dollar investment for the first five years of implementation.

Reduce Air Travel and Other Emissions

This measure assumes that the carbon emissions produced by the University's air travel is cut by one percent annually as well as all emissions from commuting, fleet, solid waste, natural gas and diesel generators are cut by one percent annually.

Green Power (RECs at current level)

This scenario assumes that the current rate of wind power REC purchases 193,000 kWh/yr would simply be continued over the first five years. This would yield an estimated annual carbon offset (or savings from the BAU baseline) of 60,000 MTCDE.

Cost Savings for Five-Year Plan

The initial five years of the *Climate Action Plan* have been projected in the University budget, and are shown in Appendix B. For each year, an initial implementation cost is determined along with the expected energy, carbon, and financial savings. The first five years of the plan will require a significant additional investment

5.1 Carbon Reduction Action Plan

with a relatively high cost savings potential and an estimated carbon reduction of 100,000 MTCDE. The savings figures for the first five years do not include the cost to purchase RECs or the carbon savings associated with RECs. See Appendix B for budget information.

Carbon Reduction Action Plan **Recommendations**

With this *Carbon Reduction Action Plan*, the University has taken an important step towards a serious and sustained reduction in energy consumption, avoiding future costs and reducing carbon emissions. The preparation of this Plan, and that of the *Climate Action Plan*, and the discussions in ESAC subcommittees have underlined the importance of extending this energy efficiency and conservation work in a way that engages the entire campus population. The leadership provided by the President and the administration have been instrumental in realizing these Plans and the successes achieved thus far—and will be necessary to realize additional energy savings.

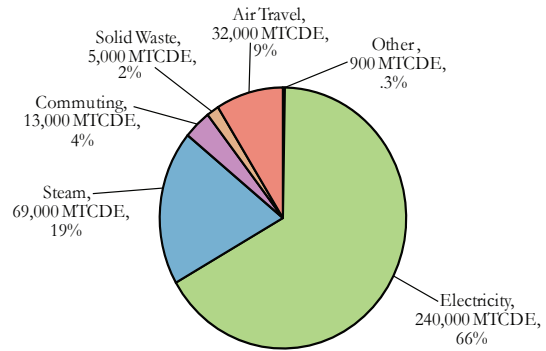
A central principle advanced in the first sustainability plan, *Phase I: Environmental Performance Indicators and Development of*

Campus Building Energy Management Decision Management Decision Making Tool (2006) is: “if you can’t measure it, you can’t manage it.” The BPAT+ building audits provided the first building-level energy consumption data on the campus and have proven essential to the preparation of this plan and future management of building energy assets at the University – but real consumption data is necessary for the next steps. While BPAT+ provides useful strategic data and can enable scenario testing, actual metered data is required to verify any reductions as commercial vendors begin to take part in energy reduction programs and achieve actual Energy Star operational ratings. Metered utility data also provides the material to more equitably distribute costs, share savings, and provide incentives to schools and centers. Staged metering will be part of an organized program of reforming the allocation of utility costs – a plan that prepares and protects the schools and centers from unexpected changes in costs (see Section 5.5: Utilities and Operations).

5.2 Carbon Inventory Fiscal Year 2007

Summary of Emissions (MTCDE)

Scope 1 Emissions	900
Scope 2 Emissions	310,000
Scope 3 Emissions	50,000
Total Emissions (Scopes 1+2)	310,900
Gross Emissions (Scope 1+2+3)	360,000
Net Emissions (Minus RECs)	296,000



Scope 1, 2 & 3 Emissions by Source

Scope 1 Emissions (MTCDE)

Agriculture	0
Emissions from Natural Gas	500
Emissions from #2 Oil	60
Emissions from Refrigerants	n/a
Emissions from Fleet	200
Other (Scope 1 Total)	900

Scope 2 Emissions (MTCDE)

Emissions from Electricity	240,000
Emissions from Steam	69,000

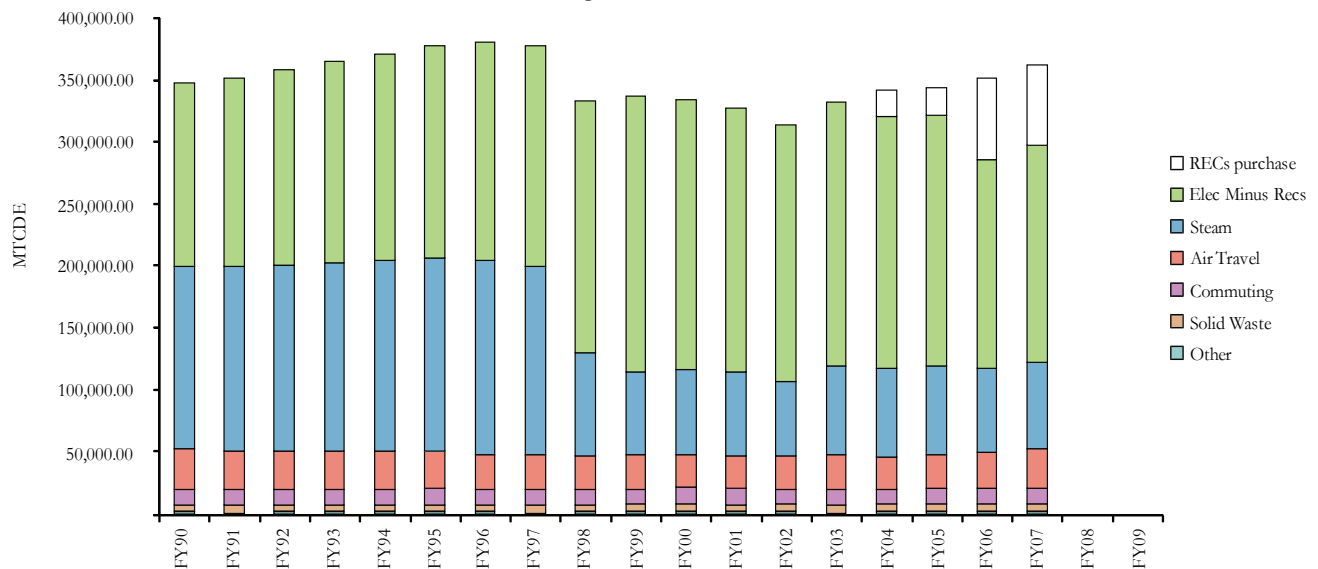
Scope 3 Emissions (MTCDE)

Emissions from Commuting	13,000
Emissions from Solid Waste	5,000
Emissions from Air Travel	32,000

FY07 At a Glance:

- President Amy Gutmann signed the American College & University Presidents Climate Commitment (ACUPCC)
- Start of Aircuity pilot program for energy conservation in Penn labs
- Start of Harnwell College House Utility Project for measuring daily residence hall energy usage
- Start of the Light Bulb Exchange Program to replace incandescent bulbs in residence halls with compact fluorescent bulbs
- Start of the Orth-Rodgers "Campus Circulation: A Study of Multi-Modal Access"

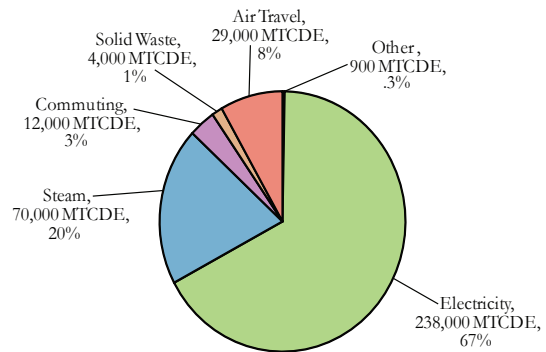
Total Campus Emissions Over Time



5.3 Carbon Inventory Fiscal Year 2008

Summary of Emissions (MTCDE)

Scope 1 Emissions	900
Scope 2 Emissions	308,000
Scope 3 Emissions	46,000
Total Emissions (Scopes 1+2)	309,900
Gross Emissions (Scope 1+2+3)	355,900
Net Emissions (Minus RECs)	250,000



Scope 1, 2 & 3 Emissions by Source

Scope 1 Emissions (MTCDE)

Agriculture	0
Emissions from Natural Gas	600
Emissions from #2 Oil	60
Emissions from Refrigerants	n/a
Emissions from Fleet	200
Other (Scope 1 Total)	900

Scope 2 Emissions (MTCDE)

Emissions from Electricity	238,000
Emissions from Steam	70,000

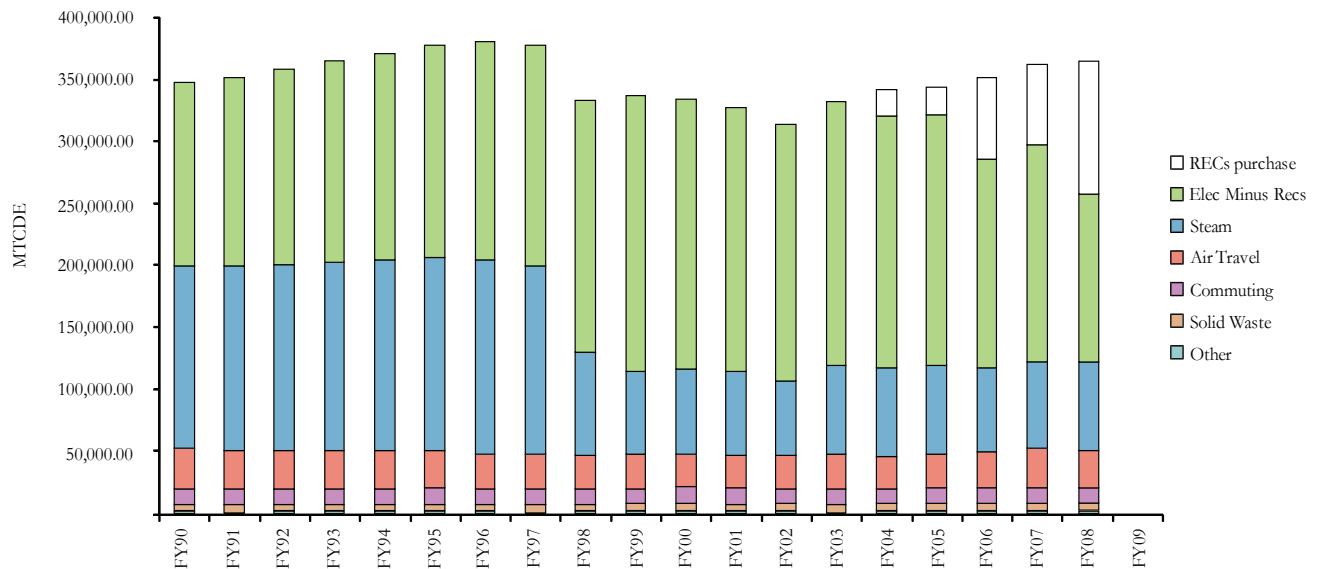
Scope 3 Emissions (MTCDE)

Emissions from Commuting	12,000
Emissions from Solid Waste	4,000
Emissions from Air Travel	29,000

FY08 At a Glance:

- Appointed the University's first environmental sustainability coordinator
- Start of RecycleMania, a competition among colleges and universities nationwide to have the highest recycling rate
- Pilot for a potential City of Philadelphia bike sharing program
- Completion of the first campus green-roof atop Kings Court /English House

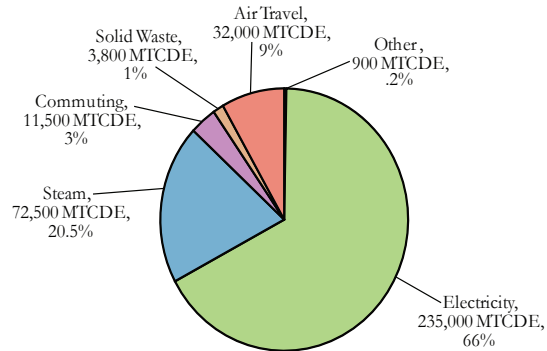
Total Campus Emissions Over Time



5.4 Carbon Inventory Fiscal Year 2009

Summary of Emissions (MTCDE)

Scope 1 Emissions	900
Scope 2 Emissions	307,700
Scope 3 Emissions	47,300
Total Emissions (Scopes 1+2)	308,700
Gross Emissions (Scope 1+2+3)	356,000
Net Emissions (Minus RECs)	294,400



Scope 1, 2 & 3 Emissions by Source

Scope 1 Emissions (MTCDE)

Agriculture	0
Emissions from Natural Gas	600
Emissions from #2 Oil	60
Emissions from Refrigerants	n/a
Emissions from Fleet	200
Other (Scope 1 Total)	900

FY09 At a Glance:

- Completion and launch of the Climate Action Plan
- Installation of Aircuity lab ventilation monitoring system in Fisher Translational Research Center
- Launch of the Green Fund, a sustainability project financing program
- Completed optimization of 9 campus buildings including: CRB, Van Pelt Library, Dietrich Library, Harnwell, Houston Hall, Huntsman Hall, Lynch Life Sciences, McNeal, and Shattner.

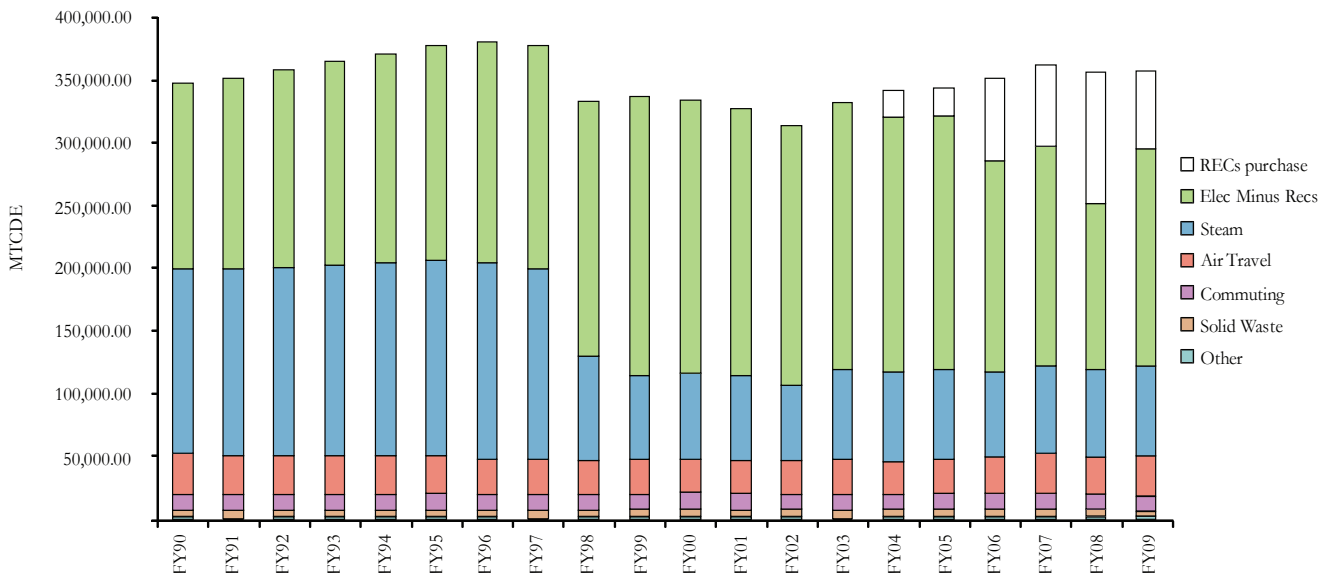
Scope 2 Emissions (MTCDE)

Emissions from Electricity	235,000
Emissions from Steam	72,500

Scope 3 Emissions (MTCDE)

Emissions from Commuting	11,500
Emissions from Solid Waste	3,800
Emissions from Air Travel	32,000

Total Campus Emissions Over Time



5.5 Utilities and Operations

Conserve Energy

Background

Throughout the history of the University of Pennsylvania, sustainable practices for building operations and utility management have been integrated into the planning and expansion of the campus. Sustainability planning has been extended to the present day with a host of measures to conserve energy and reduce the cost of campus utilities.

Chiller Plant

Recognizing the efficiency of centralized heating and cooling plants, Penn embarked on building a central chilled water and steam distribution system more than 20 years ago. The campus chilled water loop was completed in 2008: a circuit of over seven miles of underground piping delivering cooling to Penn's buildings across campus. The Module 6 Chiller Plant (Mod 6), built in 1995, uses a 4,000-ton ice tank to boost energy efficiency and cost savings. The plant freezes water at night when energy costs are low to provide supplemental daytime cooling capacity, reducing Penn's burden on the regional electrical grid while saving money. The plant provides enough cooling capacity to cool more than 4,500 houses.

In 1998, Penn completed the construction of an even larger remote facility – the Module 7 Chiller Plant (Mod 7) – to replace numerous smaller units and compressors scattered through the campus. Both Mod 6 and Mod 7 use cooler ambient air temperatures during varying seasons to cut the costs of cooling. Its completion improved efficiency of the chilled water operations considerably, and combined with the completion of the distribution loop, saves \$5 million annually in energy costs.

Operations Control Center

Penn's Operations Control Center (OCC), created in 2001 at the Facilities and Real Estate Services (FRES) offices, controls and monitors utilities for the entire campus. The OCC tracks over 130,000 heating, ventilation, air conditioning, and electrical use control points cross campus. From this central, constantly monitored location, FRES staff can regulate Penn's utility distribution, the operation of air handling units across campus, and temperature controls at most campus buildings. Sophisticated demand management practices allow Penn to avoid costly peak utility charges and conserve energy year-round.

Electrical power distribution on campus from six substations, also monitored from the OCC, allows supervisors to adjust the chiller plant and air handler operations in real time to meet Penn's designated target for electrical consumption.

Building Optimization Projects

Through the partnership with the TC Chan Center as noted in Section 4, a series of campus buildings were chosen to be studied for energy efficiency improvements, starting with a two-building pilot in 2006. Since then, a total of 15 campus buildings have been studied for possible energy improvements including laboratories, residential high rises, classroom buildings, and libraries. The TC Chan Center examined each building's heating, ventilating, and air conditioning (HVAC) system, took stock of lighting conditions and schedules, checked control systems for errors and improper set points, and determined the overall building's usage schedules. Information collected during these optimization studies was given to FRES Operations, who then coordinated with the customers to implement the suggested improvements, reducing energy consumption and utilities costs.

Mission

The mission of the Utilities and Operations subcommittee is to increase energy efficiency and reduce energy consumption on campus.

Target

- Establish a **fiscal year 2010 energy conservation goal of five percent** for the entire Penn campus relative to the fiscal year 2007 load. This conservation goal together with other campus-wide carbon reduction efforts, will contribute to a seven percent reduction in total carbon emissions.
- Establish a **fiscal year 2010 to 2014 energy conservation goal of 18 percent** for the entire Penn campus relative to the fiscal year 2007 baseline load. This conservation goal corresponds with a 23 percent reduction in total carbon emissions.

Recommendations

- A. **Eliminate the growth in electrical usage in existing buildings through education and management.**
 1. FRES is working with a consultant to develop training packages for building staff and building occupants; during the summer 2009, a sustainability associate with specific insight into the student body worked with the consultant to hone messages for the return of the student population;
 2. New Student Orientation messages will focus on energy and resource savings; and
 3. Education and management programs (such as staff and student

5.5 Utilities and Operations

Eco-Reps programs) will be developed to reduce energy use by between one percent and 1.5 percent annually from the fiscal year 2007 energy baseline.

B. Improve and enforce building performance standards.

Support development of an Energy Management Team (FRES staff with representatives from schools and centers), to evaluate and enforce the energy policy standards;

1. Adopt performance standards for all new buildings equal to Energy Star 75, with an anticipated increase to Energy Star 90 in the future;
 - The US Green Building Council's LEED Silver rating will bring new buildings close to the Energy Star 75 standard, but each building must be assessed individually to measure the Energy Star Rating; and
 - The Energy Star rating standard increase will be evaluated on a case-by-case basis for cost-benefit analysis to increase from Energy Star 75 to Energy Star 90.
2. Continue to renovate existing buildings to an equivalent of Energy Star 75.
 - This standard is achieved by Penn's typical energy related building renovations;
 - A higher Energy Star rating would bring additional marginal energy

savings, but the higher cost would mean that fewer renovations could be made annually; and

- It is recommended that more buildings are brought to the Energy Star 75 level first, which would result in greater energy savings, in addition to savings on future maintenance.

C. Improve the efficiency of existing utility and distribution systems.

1. Insulate all un-insulated campus steam pipes and replace inefficient insulation when found;
2. Improve campus water usage via repair and replacement to existing campus irrigation system; and
3. Improve ventilation rates in campus laboratory buildings to reduce overall campus energy usage;
 - Energy savings expected for all of the above measures are based on a three year or less payback upon initial investment.

D. Adopt basic conservation measures, implement and monitor building metering, and revise utility cost allocations to provide incentives for improvements.

1. Basic conservation measures include replacing bathroom and toilet room fixtures to save water, re-lamping projects to provide more efficient lighting, and installing occupancy sensors to gain day lighting benefits;



2. Sub-meter select campus buildings for electricity to track specific usage (such as server farms and laboratories); and
3. Increase sub-metering to eventually sub-meter the entire campus with remote meters to track individual building usage.

E. Re-commission eight buildings each year and add meters to an additional eight buildings.

1. This work is a continuation of the TC Chan building optimization projects; and
2. Anticipated energy and carbon reductions are based on a 10 percent energy savings in campus buildings once re-commissioning is completed.

F. Investigate alternative sources of local renewable energy to determine the most cost-effective type.

1. Explore the research carried out in 2008 on implementing a power-purchase agreement for a utility-scale installation of photo-voltaic panels on roofs and at the New Bolton Center; research micro-wind turbines on campus; and
2. Explore the installation of a hydrogen fueling station on campus.

G. Continue purchase of Renewable Energy Certificates.

1. Penn is currently the number one purchaser of wind power Renewable Energy Certificates (RECs) among institutions of higher education,

5.5 Utilities and Operations

at a rate of 193,000 kilowatt hours annually;

2. Determine the amount of RECs Penn will need to purchase over time and develop a long-term procurement plan; and
3. Evaluate the RECs that make the most positive impact for Penn and the environment.

H. Develop an incentive program for schools and centers that show a significant decrease in their environmental footprint.

1. Determine what practices have the greatest impact on energy reduction;
2. Determine what kind of credits/awards can be offered to schools based on which energy reduction practices they adopt; and
3. Propose alternatives and modifications to the current allocated cost model for utility expenses to capture annual energy savings as an incentive to continue energy reduction practices;

Progress

Once the above recommendations were accepted with support from Environmental Sustainability Advisory Committee (ESAC), work began immediately on implementing the proposed plan to improve the University's utility management and operations. FRES staff has updated energy standards for building renovations, initiated pilot studies

to test new energy-reducing technologies in campus buildings, installed new energy efficient products, and is piloting a behavior-change program – Greening FRES – at the facilities office to lead by example. Current implementation activities include:

TC Chan Center Building Optimization Projects

After the initial set of eight building optimization studies was complete, an optimization team within FRES was provided with the energy consumption data for each building and a list of control deficiencies or malfunctions found during the study. The repair items were prioritized according to potential energy savings and their cost.

In addition to the pilot buildings – Jon M. Huntsman Hall and the Robert Schattner Center - 14 additional buildings were studied in 2008 and 2009: Houston Hall, Clinical Research Building, Biomedical Research Building 2, Van Pelt Library, Carolyn Lynch Laboratory, Harnwell College House, McNeil Building, Pottruck Center, Skirkanich Hall, Hill Pavilion, Dietrich Graduate Library, Stellar Chance Laboratories, Vagelos Laboratories, and Levine Hall. The next buildings to be studied for optimization are Meyerson Hall, Chemistry Laboratories 1973 Wing, Ryan Veterinary Hospital, and the Towne Building.

Aircuity Pilot Program for Lab Safety and Ventilation

Laboratory ventilation is a prime candidate for energy reduction, as ventilation systems are typically designed to provide high air

change rates to keep occupants safe from the build-up of noxious or dangerous fumes that are often products of bio-medical or chemical research. Typical systems rely on high air change to maintain a safe environment, but are not capable of detecting a build-up of contaminants or varying the rate of air flow based on need or occupancy. This results in conditioned air exhausted very quickly, requiring reconditioning of fresh air at a high rate, with accompanying high electricity load of the pumps, fans, motors, and blowers. In addition, the use of fume hood systems in lab environments – again, to remove contaminated or potentially contaminated air from the lab space quickly - also contributes to heavy energy demand of the high volume ventilation systems. The result is a safe, but extremely costly to operate, lab environment.

To reduce the air changes per hour without sacrificing the indoor air quality, the University piloted the 'Aircuity' air monitoring system in 2007. This system is comprised of air sampling tubes within labs or vivaria with a centralized air quality monitoring systems located somewhere within the building. An automatically controlled vacuum pump draws air from each lab into the monitoring station, where the air is tested to determine concentrations of six key contaminants. If these contaminants are within set parameters, the air-flow rate is kept stable, but if a spike in concentration of one or more contaminants is detected, the system automatically ramps up the air exhaust system, flushing the lab with clean conditioned air. Instead of constant high volume, the lab is served with just as much air as needed, but retains the capacity to boost the air changes as required.

At Penn, the pilot study established the suitable locations for installation of the Aircuity system, evaluated the system cost, and assessed the potential carbon and energy savings. The pilot continued into 2008 with the installation of Aircuity systems in a vivarium suite in Hill Pavilion and a lab suite in Lynch Life Sciences Building.

Significant energy savings have already been realized in both buildings without any degradation of indoor air quality. From October 2008 to January 2009, there has been a 23 percent reduction in energy use in Lynch Life Sciences Building and similar savings in Hill Pavilion. The expected utilities cost savings for Hill Pavilion and Lynch Life Sciences combined is about \$40,000 annually. Since the installation of the pilot Aircuity system, significant energy savings have been realized with no deterioration in indoor air quality and estimated payback periods of less than two years. The pilot program is now being expanded to other vivaria as well as to the Fisher Translational Research Center, now under construction. The over \$650,000 investment will be recouped from energy savings in an estimated two years.

Installation of Zone Presence Sensors in Labs

To reduce energy associated with the exhaustion of conditioned air through fume hoods, Penn has installed Zone Presence Sensors (ZPS) on the face of fume hoods in several buildings. This device detects the presence of a technician at the fume hood: if there is no technician, the system lowers the airflow face velocity at the hood and reduces the exhaust rate. ZPS units have

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been installed in Vagelos Laboratories, with possible expansion of the project into other laboratory buildings in the near future. The savings expected from the ZPS units in Vagelos Laboratories are approximately \$115,000 annually if implemented across campus, with a reduction in carbon of around 100 MTCDE annually.

Remote Metering of Campus Buildings

Until recently, Penn's academic campus buildings have only had manual-read meters to measure electrical consumption on a building-by-building basis. In order to monitor energy consumption and provide a more accessible

remote meters are being installed to digitally transfer and archive electrical, steam, and chilled water data on a daily basis. Around 20 campus buildings have already had remote meters installed for electrical, steam, and chilled water. The remote meters are being installed first at the buildings that use the most energy and in conjunction with the building optimization projects.

Insulation of Existing Campus Steam Pipes and Manholes

Since the University is an older urban campus, the existing steam pipes and manholes range in age and level of insulation. In an effort to reduce steam system line losses, FRES Operations began identifying and replacing defective insulation and repairing aging manholes in 2008. The potential savings is about \$300,000 in the first year – an overall simple payback of three years or less.

Residential Hall Monitoring (Harnwell College House Utility Project)

In the fall of 2007, a Penn alumnus provided matching funds to begin a pilot program to measure and publicly display real-time utility



The Harnwell College House Utility Project allows students to witness firsthand how much energy savings are possible by making small behavioral modifications.

consumption information in the recently renovated Harnwell College House. The program enables students to understand how much energy is required to heat and cool their residences, and through voluntary reporting of energy use by 12 suites of students, compare the energy use of an individual suite with the entire 22-story college house.

Students living in the 12 study suites volunteered to download data from sensors and provide their data to the TC Chan Center for analysis. Real time energy use data for the building is available online or at a LCD touch screen in the lobby of Harnwell 24 hours a day. The intent of this project allows students to witness firsthand how much energy savings are possible by making small behavioral modifications such as turning off lights, shortening shower times, using less air conditioning in the summer months, and limiting the quantity of electronic devices they use daily.

Adopting Higher Performance Standards for Existing Building Renovations

As part of Penn's typical deferred maintenance program, the University has begun to raise the priority of energy-saving renovations. Energy-related projects have become one of the highest priority projects, and are now addressed first to meet Energy Star standards for building renovations. Also, to improve indoor air quality, the construction guidelines for interior renovation have now been revised to eliminate products that produce significant volatile organic compound (VOC) levels.

State Legislation

On October 15, 2008, Governor Rendell signed Act 129 which works in tandem with Act 213, the Alternative Energy Portfolio Standard (AEPS). In addition to the overall goal of reducing energy consumption and demand across the state, it expands the definition of Tier 1 alternative energy sources. Under Act 129, each of the seven major electric distribution companies (EDCs) in Pennsylvania (those with at least 100,000 customers) are mandated to develop and file an energy efficiency and conservation plan, detailing the achievement of a 1 percent reduction in consumption by May 31, 2011, and a 4.5 percent reduction in peak demand by May 31, 2013.

To achieve this reduction, energy companies have also been directed to provide energy efficiency and conservation tools and tips to their customers and provide energy efficiency and demand-side response programs. A large part of their programs will be the provision and installation of 'smart meters,' which will supply consumers with information about energy consumption patterns. Consumers are then able to alter their consumption patterns to take advantage of periods when power prices are lower, thus saving money and lessening overall peak demand. Act 129 requires that the utility companies provide their customers with smart meters within 15 years. Another significant tool is financial incentives that will be provided to large institutional consumers by energy companies to decrease their energy demand.

Penn will benefit from these consumption reduction mandates, because the University will have additional tools to help meet energy

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reduction goals. Both the technology of smart metering and financial incentives to reduce consumption will play a role in allowing the schools and centers at the University to take ownership of their energy consumption, and support a broad-based conservation attitude throughout Penn.

Responsibility

Implementation will be carried out by FRES Operations, with the support of ESAC subcommittee members, staff and student Eco-Reps. Direction by and support from the Office of the President, the Executive Vice President's Office, and the Provost's Office will be instrumental to the success of these goals as well as help from every school, center, and division.

Metered Energy Usage Data

The main process of tracking utilities and operations energy reductions will be through the use of monitoring the manually read meters to track actual electrical usage, with eventual upgrades to the digital metering system. The monthly meter data will be recorded and archived on the Green Campus Partnership website to develop monthly and yearly trends, as public indicators on the progress

of the *Climate Action Plan* recommendations. As infrastructure and building upgrades are executed, and behavior modification programs impact energy consumption, the entire University community will be able to see the realized energy savings.

Tracking Sustainable Initiatives in Operations and Maintenance

FRES staff (Operations and the Office of the University Architect) will record all changes in energy standards including updates to ASHRAE and code standards referenced by the University that have energy and utilities impacts. Staff will record any sustainable initiatives implemented annually, such as capital improvements, renovations to Energy Star levels, and implementation of re-commissioning work.

Funding

FRES will finance the implementation of the Utilities and Operations energy reduction activities, with support from individual schools and centers where appropriate. Capital improvements will remain funded through the capital budget and the Facilities Renewal Fund. For further information on funding, see Appendix B.

5.6 Physical Environment

Design Green

Background

The University of Pennsylvania is a 96-acre, contiguous urban campus consisting of over 12 million square feet in 182 buildings, excluding the hospital complex. The structures range in age from the Civic House, built in 1850 to the present day.

Design Guidelines and Review of Campus Projects

Well before the advent of the *Climate Action Plan*, the University maintained a high standard for adaptive reuse, sustainable design, and the materials used for its building projects. Inherent in all of the planning and construction activities is the understanding that the University builds and manages its assets with long-term ownership in mind, and that decisions made today will commit the University to maintenance, utility, and operational costs for years to come. Life-cycle costing, or “total cost of ownership” analysis are implicit in Penn’s capital planning and renovation planning process. Penn also realizes the potential for substantial carbon emission reductions and cost savings associated with the operation of buildings as designed.

The “Design Guidelines and Review of Campus Projects,” approved by the Trustees in 2002, outlines the campus standards for design, construction, and the formal design review process consistent with this attitude. Included in this document is a section on “Responsible Use of Energy and Natural Resources.” According to the guidelines:

Each project should undertake a comprehensive analysis to diminish the use of energy and reduce the use of non-renewable resources. The University intends to be a leader and champion of environmentally sensitive design, demanding innovation and creativity from our design consultants and helping to educate our community. The University is committed to creating a campus environment that moves beyond merely sustainable, to one that actively improves the quality of life and the environment for its users.

Goals set out in the 2002 guidelines include:

- Siting new structures mindful of orientation, shading and the effect on adjacent buildings and spaces;
- Reducing dependence on non-renewable resources by using appropriate recycled materials and by promoting adaptive reuse of existing structures;

- Reducing marginal energy costs by promoting selection of locally manufactured or fabricated products and materials;
- Using landscape design to create healthy and ecologically appropriate spaces, provide pleasant outdoor environments, reduce exterior lighting demand and minimize stormwater runoff;
- Minimizing maintenance and operating costs by employing whole-systems life-cycle evaluation to determine the true project costs, and by integrating innovative daylighting and building engineering solutions at project inception;
- Improving indoor environmental quality;
- Adopting monitoring, measuring, and feedback systems to establish baselines of energy usage and building performance, against which the University can evaluate improvements and set goals for future projects;
- Maximizing building flexibility to satisfy the varied demands of current and future users and residents; and
- Reducing energy consumption of building and site systems (HVAC, hot water, and lighting) through the use of appropriate mechanical and construction technology (natural cooling, light recovery, passive solar design, etc.).

Since good initial design practices promote a longer building lifespan, most construction on campus is renovation work. Through a rigorous maintenance program, the University has been

able to preserve the majority of its structures, investing on average over \$100 million annually in renovations, equipment, and facilities renewal over the last decade.

The 2002 Design Guidelines specifically address this commitment to “Responsible Renovation and Upgrades to Existing Buildings”:

...encourage responsible stewardship of all existing University buildings. Each renovation project, therefore, should include an investigation of all aspects, systems and features impacted by the specific intervention. Conditions discovered during project evaluation, design or construction that are in need of improvement cannot be ignored. Even in cases where budgetary or schedule constraints necessitate only a partial remediation, any building deficiencies brought to light are to be examined and documented so that they may be addressed at a future time.

Such proactive management reflects the University’s commitment to maximizing the efficiency of its built environment. In working to sustain its existing capital investments, the University proves the principle that “the greenest building is the one you do not have to build.”

Livable Community Initiatives and Neighborhood Investment

As noted in the introduction, Penn has partnered with its surrounding community to create neighborhoods that are safe, livable, and walkable, furthering sustainability efforts in transportation, utilities and operations, and waste minimization and recycling. With the

5.6 Physical Environment

founding of the University City District (UCD) in 1997 and investment in key commercial and residential development projects, Penn has demonstrated its commitment to sustainable urban development: dense, transit-accessible, mixed-use and mixed-housing, with well-designed and well-maintained streets that promote quality of life in the city.

UC Green: UC Green is a non-profit tree-planting and community beautification organization in the University City neighborhood, founded in 1999 by Penn and a consortium of local institutions. The mission of UC Green is to promote, coordinate, and support volunteer community greening in University City and the surrounding West and Southwest Philadelphia neighborhoods. Through partnerships, UC Green builds community, endorses sustainable practices, and champions environmental stewardship. The organization has engaged more than 4,000 volunteers in planting and maintaining over 1,000 trees since its inception, bringing a host of environmental benefits, as well as increasing property values and reducing stormwater runoff in the neighborhood.

The Agatston Urban Nutrition Initiative (AUNI): AUNI is run through the Barbara and Edward Netter Center for Community Partnerships and provides hands-on learning about food, nutrition, and cooking at Penn's community schools. The focus is on healthy eating and building healthy lifestyles for students as they enter adulthood. AUNI focuses on gardening by maintaining several acres of community gardens at neighborhood schools and preparing food. AUNI works to improve community nutrition and health (particularly obesity and

nutrition-related diseases such as diabetes) through service-based learning and community engagement.

Other Penn-led neighborhood sustainability initiatives include the following:

- UC Brite, which has partnered with homeowners and apartment buildings to install exterior lighting fixtures at more than 1,300 residences throughout University City. UC Brite funds half of the cost of lighting fixtures, provided that over half of any given block participates in the program – thereby bringing communities together and encouraging dialogue around issues of safety and physical improvement;
- Penn Home Ownership Services provides home ownership resources and favorable closing costs as an incentive for faculty and staff to own homes in the West Philadelphia community;
- Rehabilitation of local housing stock, sometimes by brokering deals among outside parties, and more rarely by direct purchase, rehabilitation, and sale; and
- Construction in the Sadie Tanner Mossell Alexander/University of Pennsylvania School as well as investments in other local elementary schools through subsidies and grants.

Such efforts help to stabilize the community and enhance West Philadelphia's reputation as a desirable place to live, and improve the sustainability of both Penn and its immediate environs.

Mission

To create and maintain a sustainable built environment on campus and the adjacent neighborhoods by incorporating standards and best practices in design and operations into Penn's campus plan, decreasing building energy consumption; increasing education and awareness of sustainable design among professional staff; and engaging in outreach to both the campus and neighboring communities.

Recommendations

- A. **Adopt LEED Silver Certification, with Penn-specific goals, as a minimum standard of new building construction.**

The Leadership in Energy and Environmental Design green building rating system promotes and certifies sustainable practices through independent, third-party verification.

1. Empirically evaluate the LEED credits and establish priorities regarding environmental issues important to Penn;
2. Modify Penn's existing design criteria to achieve sustainability objectives and LEED certification without changing the mechanism of enforcement; evaluate ways in which guidelines or practices not enforceable can be best encouraged in line with the intent of the Penn Trustees 2002 Guidelines; and



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3. Develop guidelines for determining the appropriate scale (dollar value, building area, etc.) for when LEED certification is appropriate, and when simply higher environmental design and construction standards are appropriate.

B. Adopt LEED CI (Commercial Interior), with Penn-specific goals, as a minimum standard for renovations.

1. Prioritize and select LEED CI credits appropriate for each project category and empirically evaluate criteria that comprise the LEED review;
2. Compare this system with other relevant and international standards;
3. Solicit suggestions and action items from the primary stakeholders related to each selected LEED CI credit;
4. Determine cost impact of implementing each action item and the training requirements for the corresponding departments;
5. Conduct a pilot study to determine the effectiveness of LEED CI certification at the University; and
6. Develop guidelines for determining the appropriate scale for when LEED CI certification is appropriate, and when simply higher environmental design and construction standards are appropriate.

C. Adopt LEED Existing Buildings: Operations and Maintenance (EB: OM), with Penn-specific goals as a minimum standard for building maintenance and operations and ensure that adequate resources are budgeted for appropriate levels of preventative maintenance and facilities renewal.

1. Prioritize and select available LEED EB: OM credits appropriate for each category within the LEED EB: OM purview;
2. Solicit suggestions and action items from the primary stakeholders related to each selected LEED EB: OM credit;
3. Identify vendors or sources of qualifying products and services that can be used to meet LEED EB: OM criteria;
4. Determine cost impact of implementing each action item and the training requirements for the corresponding departments;
5. Establish a committee to design and manage the implementation and continuation of the LEED EB: OM policies, compliance, and processes;
6. Conduct a pilot study to determine the effectiveness of LEED EB: OM certification at the University; and
7. Use the LEED EB: OM protocols as a tool to evaluate and prioritize deferred maintenance and facilities renewal projects in order to maximize energy savings, reduce resource use,

and improve indoor environmental quality and performance of teaching, research, living, and working spaces across campus.

D. Encourage the achievement of campus-wide goals, modify the existing Capital Needs Statement to incorporate a sustainability agenda.

1. Draft modified form and information to requesters and review with Vice President of Facilities and Real Estate Services (FRES), the Capital Advisory Group, and Capital Council reviewers; and
2. Provide information and education to FRES Design and Construction Project Managers.

E. Incorporate sustainable practices into Penn's Instructions to Design Professionals and construction guidelines.

1. Review and evaluate sustainability practices as they currently appear in Instructions to Design Professionals and construction guidelines;
2. Establish a periodic review process for these guidelines to ensure that Penn maintains the most up-to-date standards in the Instructions to Design Professionals and construction guidelines policies;
3. Create a policy to track project progress and ensure quality assurance for each project as it is completed; and

4. Educate University personnel, both directly and indirectly involved in the project process, on the importance of these policies and what they mean to the University as a whole, as well as updates when these policies are modified. Ensure that small projects and typical renovation projects are critically evaluated by University personnel for opportunities to raise project environmental performance, both in terms of design and implementation.

F. Provide training to Penn staff regarding sustainable practices in building design and operations/maintenance.

1. Identify groups who need training within FRES, schools and centers, and among contractors and consultants to determine objectives and content required by each group. Ensure that staff is aware of the long-term cost savings associated with adequate preventative maintenance and proper building commissioning;
2. Obtain buy-in from schools regarding training requirements for School facilities staff;
3. Identify expertise required for trainers or for content developers;
4. Identify relevant conferences and associations;
5. Identify informal/optional training material and information that can be distributed via email or through University publications such as the

5.6 Physical Environment

Almanac, brochures, posters or the Green Campus Partnership website; and

6. Determine what references/resources need to be posted on the FRES website regarding LEED criteria.

G. Develop and implement sustainable protocols/practices for site planning, open-space design and landscape maintenance.

1. Establish a timeline and authority structure to review these practices and ensure that the most up-to-date standards are being utilized;
 - Create a committee of related professionals within FRES to discuss, review and evaluate existing practices, with support of consultants if required;
 - Complete all irrigation repairs recommended in the 2008 audit of the current system;
 - Improve snow removal methods for minimal waste and damage to plants and landscape (using brine instead of salt for snow melting);
 - Recycle more landscape waste material;
 - Provide more efficient campus lighting;
 - Develop a more comprehensive tree appreciation program;
 - Improve landscape maintenance procedures and protocols;

- Improve maintenance and requirements for donor gardens and projects; and
- Evaluate the new Sustainable Sites Initiative for possible implementation on campus.

2. Create a policy to maintain quality assurance for each of these general practices; and
3. Educate University personnel, both directly and indirectly involved in the project process, on the importance of these policies and what they mean to the University as a whole, and provide updates as required.

Progress

In many respects, the University has adopted and is operating as if the *Climate Action Plan's* Physical Environment recommendations were already in place. Penn works to ensure the optimization of its current building stock, as evidenced by TC Chan Center and Facilities and Real Estate Services work. The University recognizes the need to maintain and operate buildings to their highest performance level in order to achieve significant carbon emission reductions and cost savings. The US Green Building Council's LEED system has been used by a number of schools and centers to guide the design and construction process and set achievement goals. As recommended by the *Climate Action Plan's* Physical Environment section, Penn is expanding the use of other metrics and standards to benchmark buildings in design and renovation, such as the latest American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)

standards for ventilation, heating, and air conditioning, and uniform energy metrics (such as annual consumption of KBTUs/square foot for new construction).

As the University begins to employ more robust life-cycle analyses to guide capital project decisions, schools and centers will shift from a strategy of managing cost through a sequence of annual capital budgets to one that takes into account the needs of the University's entire asset and landscape portfolio over time. The goal of such a transition is to evaluate the success of Penn's capital and maintenance budgets by how well they support Penn's missions of teaching, research, and service. Because resources are not infinite, Penn's schools and centers must demonstrate excellence in decision-making to meet the needs of today's generation, and of future generations of students, faculty, researchers, and staff.

Implementing better life-cycle cost decision-making will:

- Gradually reduce and manage the deferred maintenance backlog;
- More clearly prioritize projects;
- Better predict future budget needs;
- Reduce carbon emissions; and
- Improve the overall condition of campus assets.

Penn Connects and Penn Park

Penn Connects, the campus masterplan launched in 2006, recommends sustainable development for all new projects. Every new

Penn Connects respects Philadelphia's traditional dense and pedestrian-friendly urban-scale development, and tends to orient buildings along east-west walkways and streets to take advantage of this optimal solar orientation.

building currently under design is registered with the US Green Building Council and is targeting LEED Silver rating or higher. Penn Connects concentrates mixed-use dense development near existing transportation hubs, allowing the academic functions to remain in the core of campus. The plan respects Philadelphia's traditional dense and pedestrian-friendly urban-scale development, and tends to orient buildings along east-west walkways and streets to take advantage of this optimal solar orientation. Improved opportunities for daylighting and natural ventilation will reduce energy demand and improve building efficiency.

The centerpiece of the Plan is the addition of Penn Park in 2011 which add around 22 acres of recreational and green space. The park will replace asphalt and concrete with pervious pavements and open fields that can capture over 13,000 cubic feet of stormwater during a rain event and reduce the burden on the City's combined sewer/stormwater system to keep Philadelphia's rivers cleaner. The park will also provide additional landscape waste composting facilities and pilot the installation of "dark sky,"

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energy-efficient LED light fixtures to reduce ambient light pollution.

Staff LEED Training

Sixty-five facilities staff from three schools and centers have received education in the newest LEED 2009 green building standards. This training establishes the University's relationship with US Green Building Council (USGBC) instructors, streamlines the planning of future workshops, and prepares staff for "Green Associate" LEED accreditation. Facilities managers will receive specialized LEED training and accreditation as required in areas such as New Construction, Operations and Maintenance, and Commercial Interiors. The increased level of awareness among facilities staff will pave the way for involvement in future LEED projects.

Pennification of LEED

The "Pennification" of LEED standards is an ongoing effort to help the University streamline its project submissions process by cataloging the "free" points it could attain by continuing to build as it has been, and identify the points that have the maximum environmental benefits for Penn. As a dense urban campus well-served by public transportation, with a sophisticated district energy systems and high standards for design and construction, any new Penn building would qualify for LEED certification with a minimum of effort by the design team.

FRES staff has already completed analysis for the LEED New Construction, Commercial Interiors, and Existing Building standards under the previous version of LEED (2.2), and

will update these assessments under the new LEED version 3.0 point systems to accurately gauge the challenges of the LEED Silver and Gold certification. FRES sustainability associates will research the LEED "portfolio" program and new LEED Existing Buildings: Operations and Maintenance (EB: OM) to determine how Penn can adopt the *Climate Action Plan* recommendations and requirements into University maintenance and operations standards and guidelines.

LEED Projects in Design and Construction

USGBC states that: "LEED is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, carbon dioxide emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts." The number of points a project earns in seven LEED categories determines its level of achievement, from "Certified," for meeting baseline criteria for good green building practices, to Silver, Gold, and Platinum, for buildings which exemplify increasing levels of sustainability and innovation.

The **Music Building**, an existing historic 1892 structure, is being renovated and modernized, with double the number of practice rooms, upgraded wiring and basic systems, and improved lighting and soundproofing. Exterior work will restore the building's distinctive terra cotta and front porch, while construction of a new addition will nearly double the size of the

building. The project will serve an important role in the University's eastward expansion by enhancing the connection between College Green and buildings to the east of 34th Street. The Music Building renovation has been registered with the USGBC and is targeting LEED Silver certification. Some of the key features include an infiltration basin to filter rainwater and reduce load on the sewer system; high efficiency fixtures to reduce water use by up to 30%; high performing building systems and envelope that will optimize energy performance by 22.5%; diversion from landfills of 95% of demolition and construction waste by salvaging, reusing and recycling; the purchase of GreenGuard certified furniture; and the implementation of a Green cleaning plan using green cleaning products and methods.

The **Fisher Translational Research Center** is an eight-story medical facility containing 300,000 square feet devoted to basic, clinical, and translational research. Targeted for completion in the fall of 2010, the facility will be physically integrated with the recently opened **Perelman Center for Advanced Medicine** and the **Roberts Proton Therapy Center**, a 500,000-square-foot outpatient cancer facility, creating one of the largest academic medical centers in the country and one of the first health care facilities in the Philadelphia region constructed using LEED principles. The Perelman Center and Roberts Proton Therapy Center are registered with LEED as a single project, which is targeting LEED Certification. The Fisher Translational Research Center is however targeting a LEED Silver rating.

More than 90 percent of the debris from the buildings demolished to make way for this

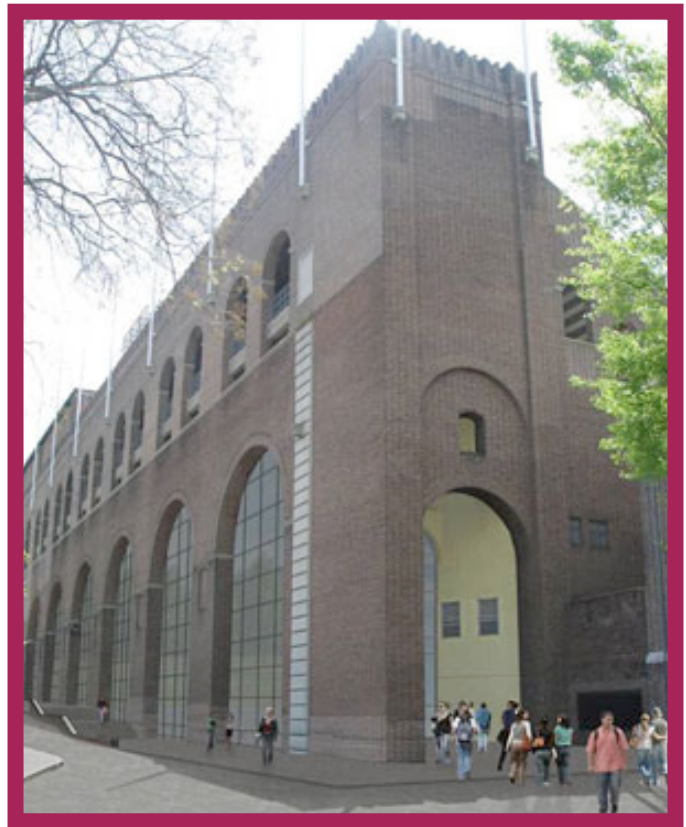
state-of-the-art medical complex — over 20,000 tons — was salvaged or recycled. Other green features include construction with materials and mechanical systems that are projected to consume 15 percent less energy than a conventionally-designed building (saving approximately \$350,000 and 3,700 metric tons of carbon dioxide emissions per year); a state-of-the-art AirCuity air-monitoring system to enhance lab and vivarium safety while cutting energy costs; establishing green housekeeping protocols that require non-toxic cleaning agents and resource-efficient paper and mopping products; using recycled and locally manufactured materials; incorporating low-VOC interior finishes to improve indoor air quality; specification of sustainably harvested wood products; providing bicycle racks and changing rooms to promote non-auto commuting; integrating underground parking with 21 electric charging stations promote the use of electric vehicles; and specifying landscaping with native plants to reduce irrigation needs. In addition to providing an environmentally conscientious and healthy place to visit and work, the new Center also improves the economic health of the city by creating new jobs, and has received funding from federal, state, and local government support.

The new **Horticultural Center at Morris Arboretum** is Penn's most comprehensive assay into sustainable design and construction. The new \$20 million complex is targeting Platinum LEED certification. A selection of the key features include: preferred parking for fuel efficient vehicles; a stormwater management plan that utilizes green roofs, rain gardens, and cistern storage; a grey water system that makes

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use of harvested rainwater stored in a dedicated cistern as well as utilization of high efficiency fixtures; state-of-the-art energy management systems that will reduce energy consumption by 45%; a ground-source heating and cooling system; generation of onsite renewable energy from both a PV array and a solar hot water heater; and the harvesting and manufacturing of over 20% of building materials from within a 500 mile radius of the project.

The **George Weiss Pavilion** renovation will infill the arcade on the northern side of Franklin Field stadium with a new weight training and fitness center. The \$25.7 million project, will entail approximately 55,000 square feet of construction, and is slated for completion in 2010. The Center inhabits the space underneath two levels of supporting arches and connects the interior concourse space under the stadium bleachers with a new pedestrian promenade. The project will connect training facilities and retail space with a planned outdoor park, **Shoemaker Green** (due for completion in 2012 or 2013). The project anticipates LEED Gold certification, and will be the first renovated sports facility project in the nation to attain this level. A few of the major features include: reduction of impervious cover and increasing on-site infiltration; high efficiency fixtures that will reduce water use by up to 30 percent; the diversion from landfills of 95 percent of demolition and construction waste through salvage, reuse and recycling; an increase in outdoor air ventilation by 30 percent; the purchase of GreenGuard certified furniture; and the implementation of a green cleaning plan using green cleaning products and methods.



The **Singh Nanotechnology Center**, currently in the design phase, will house molecular research in the areas of engineering, medicine, and the health sciences, and is being designed to receive a LEED Silver rating. The building will be located in the 3200 block of Walnut Street and will be funded in part by a \$20 million gift from Krishna Singh, an alumnus of Penn's School of Engineering and Applied Science. Its sustainable design includes locally sourced construction materials, a green roof, low flow water fixtures, solar-heated hot water, natural ventilation and design for daylight harvesting.

LEED Existing Buildings (EB) Pilot Project: Huntsman Hall

The Wharton School is undertaking a research project to assess the feasibility of certifying Huntsman Hall under LEED 2009 for Existing Buildings: Operation and Maintenance.

Analysis will include a survey of attainable credits under existing building conditions, a list of any physical modifications needed to earn additional credits, operational changes to Penn's cleansing, maintenance protocols, and associated submittal documentation and expected costs. The goal of this study is to determine the obstacles, energy savings, and feasibility of certification for other buildings on campus, and to provide a case study for future LEED EB: OM projects.

LEED Commercial Interiors (CI) Pilot Project: Towne Building

The Office of the University Architect and the School of Engineering and Applied Science are embarking on a feasibility study to explore the costs and complexity of "greening" a 7,000-square-foot mechanical system upgrade and office renovation in the Towne Building. A consulting firm will work with the renovation project's architect and cost-estimator to develop projections for identifying the cost "premium" of implementing options typical for a LEED CI Silver Certified renovation. This project will serve as a pilot study to identify the obstacles, opportunities, efficiencies, and benefits of carrying out a small renovation project with sustainability as a principle goal, in comparison to a typical "baseline" renovation that meets Penn's standard requirements. A secondary intent of this evaluation is to help the University

evaluate whether LEED CI is an appropriate metric for small renovations and to inform the development of guidelines for similar future projects.

Sustainable Landscape Practices

The University Landscape Architect, within the Office of the University Architect, oversees landscape initiatives across the urban campus including routine maintenance of the grounds, installation of improvement projects and the review of major capital improvements. Routine projects, such as ongoing tree and shrub care, turf and planting bed programs and flower planting, are managed in conjunction with the Urban Park Manager of Facilities Operations.

In response to the American College and University Presidents' Climate Commitment (ACUPCC) and the City of Philadelphia's new stormwater management regulations, the University's landscape practices have become even more sustainable by incorporating pervious paving and more responsible stormwater management. Test areas of pervious brick paving have already been installed on campus walkways. Pilot projects to test the feasibility of below-grade water retention and recharge large impervious areas are underway, with the intent of decreasing both installation costs and the impact of the University's runoff on Philadelphia's wastewater infrastructure.

Other state-of-the-art environmental management practices include using native landscape plantings on several campus gardens (Civic House entry, the Quadrangle College House grounds, Penn Press garden, and the Class of 1972 Reading Garden) to prevent

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invasive species from competing with and harming plant and animal communities. In alignment with the Sustainable Site Initiative's mandate to reduce waste water and in response to a 2008 consultant's audit of the current irrigation system, repairs to stop leaks in the irrigation heads are nearly complete, and are resulting in a 40 percent decrease in irrigation water use. A study to evaluate the implementation of a new "smart" irrigation system, which would incorporate moisture sensors and climate responsive controls for increased water efficiency, will be undertaken. Composting of leaf waste continues, and a new yard waste composting facility completed in 2008 will expand composting to include grass clippings and wood chips, in addition to all of the leaves that fall on Penn's campus.

Green Roofs on Campus

Penn has installed green roofs on five buildings: Hill Pavilion of the Vet School, Koo Plaza at Huntsman Hall, Claire Fagin Hall courtyard at the Nursing School, Kings Court-English College House, and at the Radian apartment complex above street-level shops. A variety of environmental and cost effective benefits to the University include:

- Capturing rainwater and absorbing it slowly over time, Penn's green roofs lessen the burden on the West Philadelphia sewer system;
- The soil-and-plant roofing system reduces Penn's utility costs by reducing rooftop temperature during hot months and insulating the building during the winter, making the building below easier to heat and cool;
- The green roof systems extend the life of the roof waterproofing membrane by protecting it from UV light and extreme temperatures swings;
- Green roofs can provide a habitat for insect and bird species, increasing urban biodiversity; and
- Green roofs provide visual relief and delight for residents of neighboring buildings, and in certain instances create additional green space for campus residents to enjoy.

Neighborhood Sustainability Initiatives

In the summer of 2009, the Sustainability Team began research on several potential neighborhood sustainability initiatives such as:

- Working with Penn Home Ownership Services (PHOS) to make energy audits available as part of Penn's services to staff and faculty;
- Investigating city, state, federal, and non-profit agencies funding for residential improvements related to energy performance;
- Liaising with the Energy Coordinating Agency, a leading Philadelphia energy conservation non-profit, to work on strategies to deliver winterization and energy efficiency improvements to neighborhood residents; and
- Researching local carbon offset programs and apply for grants to implement the program.

As a direct result of these studies, beginning in the fall of 2009, PHOS in collaboration with the Energy Coordinating Agency, will offer a new use for the *Enhanced Forgivable Loan Program*, targeting energy efficiency home retrofits. In addition to the \$7,500 forgivable loan available through PHOS's *Enhanced Forgivable Loan Program*, a number of state and federal grants and rebates are available to homeowners pursuing energy efficiency home retrofits. This initiative demonstrates the University's commitment to promoting sustainability by encouraging homeowners and buyers to reduce their carbon footprints.

Several new lighting initiatives are building on the success of UC Brite in making neighborhoods more active, safe, and desirable for dense urban development. In the summer of 2009, UCD installed 71 new pedestrian lights on Baltimore Avenue neighborhood commercial corridor, from 45th to 50th streets. In the summer of 2009, the University launched a Neighborhood Lighting Initiative that will partner with local landlords to install new pedestrian lights between Chestnut and Baltimore and 40th and 43rd streets. These lights will replace older incandescent bulbs housed in weaker plastic casing with high efficiency compact fluorescent bulbs housed in durable cast aluminum casing. These new pedestrian lights are not only longer-lasting in their construction, but the bulbs themselves will endure for longer and will consume less energy.

Responsibility

FRES in collaboration with BSD will be responsible for carrying out the *Climate Action Plan's* Physical Environment recommendations,

including staff training and research tasks performed by the Sustainability Team. The facilities and operations staff in the various schools and centers will also be responsible for implementation.

The following metrics were created to ensure that Penn achieves its goals in terms of the *Climate Action Plan's* Physical Environment recommendations:

- Document the number of LEED registered new and renovation projects;
- Document the number of LEED Green Associates and Accredited Professionals on administrative and facilities staff to help retain institutional knowledge as Penn builds its portfolio of certified projects;
- Track the area of permeable surfaces as a percentage of total land area of campus, as a means to evaluate stormwater runoff percentage decrease;
- Track the weight of composting in tons of collected and saved waste material; and
- Track the number of energy efficient retrofits conducted.

Funding

The attached five-year budget has been created to support the Physical Environment recommendations of the *Climate Action Plan* incorporating sustainability into many institutional aspects of the University such as engineering guidelines and the Capital Needs Statement. See Appendix B for budget information.

5.7 Transportation

Reduce Emissions

Background

Penn is a compact, urban campus that is well-served by a variety of modes of alternative and public transportation. The core campus is entirely pedestrian, and the campus as a whole is situated in a dense network of public bus and trolley routes, with subway, regional rail, and Amtrak's Philadelphia 30th Street Station within a five-block walk. Penn provides an ideal setting for the use of multi-modal and alternative transportation.

Nonetheless, the Penn community has only a moderate percentage of alternative transportation users among faculty, students, and staff. The current estimated breakdown is 60 percent individual automobile commuters and 40 percent alternative transportation commuters (walk, bicycle, train, and carpool).

The Southeastern Pennsylvania Transportation Authority (SEPTA) services the city and region extensively with subway, buses, trolleys, and regional rail. To support the staff and faculty who use this mode, the University provides a pre-tax, 10 percent discount for all public transit in Philadelphia. This "Compass Program" was used by about 2,200 people – over 10 percent of the workforce – in fiscal year 2007, and

provides a strong incentive to reduce auto use, congestion, and air pollution by encouraging public transit commuting.

For the Penn community who use SEPTA less routinely or who live outside of SEPTA's service area, Penn offers an additional pre-tax purchase option called "Transitcheks". These are available in set denominations and can be redeemed for tickets or passes through a number of public transit agencies, including NJ Transit, the interstate Delaware Port Authority Transit Company (which runs the PATCO high-speed rail from suburban New Jersey counties to Camden and Philadelphia), and Amtrak.

The vast majority of the student body of about 20,000 graduates and undergraduates live on campus or in the immediate neighborhood, and campus housing is provided for around 5,500 students. These students rarely bring cars to campus – a testament to Penn and Philadelphia's walkability. However, for students who live outside the immediate area, PennPass is an affordable means to reduce reliance on auto usage. PennPass allows students to take unlimited local rides on all days and unlimited regional rides on weekends and holidays.

Closer to home, Penn provides excellent transportation around campus in order to reduce the number of cars driven by students, staff, and faculty.

- LUCY, the Loop through University City, shuttles passengers between 30th Street Station (the stop for regional rail, Amtrak, and the local subway and trolley lines) and campus. Two routes run continuously in opposite directions, making stops at Penn's main campus as well as two local hospitals operated by the University of Pennsylvania Health System. The loop also serves the Veterans Administration Hospital and the Children's Hospital of Philadelphia and is free for all members of the University community.
- Penn also runs several overlapping passenger routes (the Penn bus and the Penn shuttle) around campus between 5 p.m. and 12:30 a.m., with an on-call basis all night until 7 a.m. These routes provide free transit within a roughly 20-block radius of campus and provide reliable, safe local transit. In 2008, Penn purchased new buses which use ultra-low sulfur diesel fuel and have the capacity to change to biodiesel should a supplier become available.
- In 2008, Penn partnered with PhillyCarShare, a local non-profit founded by Penn alumni, to become the largest North American university car share partnership. With over 30 cars within a ten-block radius of campus, these cars, rented by the hour, offer students, faculty, and staff the

mobility of their own car without the cost. The membership of this service reports owning 10,000 fewer cars than they would otherwise. As part of this partnership, Penn staff receives discount rental rates, allowing for a reduction in fleet size.

Mission

The subcommittee's mission is to emphasize a quality pedestrian environment with safe, efficient transportation services for the University community and neighbors through the provision of:

- Safe, convenient, and reasonably priced access to and from campus;
- Convenient access within the campus area; and
- Enhanced accessibility and mobility with respect to the environment.

Target

The Transportation recommendations support the goal of having over half of the University population using alternative transportation in their daily commute.

Recommendations

- A. Encourage intermodal transportation use (easy transfers among all modes, such as walk and bus, park and ride train) through better services, communication, and resources.**

5.7 Transportation

1. Encourage use of SEPTA passes as well as Penn Transit Services and LUCY;
 2. Publicize all alternative transportation services supported by Penn on all websites and publications:
 - PennTransit
 - Car-sharing organizations such as PhillyCarShare
 - Carpooling services AlterNet and Share-A-Ride from the Clean Air Council.
 3. Develop enhanced marketing to further popularize intermodal transportation use.
- B. Increase accessibility and usage of public transportation.**
1. Determine the current levels of public transportation use among the Penn community on all providers (SEPTA, PATCO, NJ Transit, etc.);
 2. Create a partnership with SEPTA to:
 - Allow students to use University identity cards as SEPTA passes;
 - Provide introductory daily passes for new students and staff, along with information about SEPTA.
 - Increase visibility of token/pass purchasing locations on and near campus.
 - Increase subsidies for Transpasses and Trailpasses.
 - Improve campus signage;
 3. Study Penn Transit Bus service to underserved local neighborhoods, such as Fairmount District, Art Museum, east of Broad, and south of South Street.
- C. Decrease Penn's dependency on automobiles and reduce congestion.**
1. Determine exact profile of parking permit holders and other automobile users on campus;
 2. Incentivize use of alternative modes;
 3. Ensure that on-street parking is consistent with the University's interests;
- Negotiate with SEPTA increased frequency and reliability of bus, trolley, and regional rail services in the campus area;
 - Identify the subway and subway surface stations in close proximity to the campus as a "University of Pennsylvania Station";
 - Coordinate with Penn Police and SEPTA police to improve the attractiveness and safety of subway and subway-surface stations;
 - Daylight and make attractive underground subway and subway-surface stations in the campus area; and
 - Identify neighborhoods underserved by public transit, and work with SEPTA to improve access.

4. Revise parking rate structures to discourage commuting by car; and
5. Review pricing strategy for campus parking garages and lots.

D. Improve bicycle safety, environment, and discipline at Penn.

1. Determine the number of bicyclists within the Penn community;
2. Encourage University City residents and institutions to vocally support a citywide bike-sharing system;
3. Coordinate and install more bike racks/bike lockers, especially at areas sheltered by buildings or overhangs;
4. Install two bike corrals per year, remove single bike racks;
5. Work with the City to install bike lanes on key corridors;
6. Coordinate a bi-annual Share-the-Road campaign that includes enhanced enforcement and education;
7. Coordinate activities with the Bicycle Coalition of Greater Philadelphia; and
8. Improve networks for bicycles connecting with the regional bikeway network.

E. Commit to maintaining a “human-scaled” campus by valuing the pedestrian environment and safety.

1. Determine the number of pedestrian

commuters; and

2. Improve intersections with high pedestrian volume, specifically but not limited to:

- 33rd and Smith Walk,
- 34th and Locust Walk, and
- 38th and Spruce Streets.

F. Review operational protocols of the PennTransit’s fleet management.

1. Determine environmental impacts of University’s fleet; and
2. Promote more energy efficient management of the University’s fleet, including expanded use of alternative fuels.

G. Consider other modes of transportation that are potentially beyond Penn’s control and implement sustainable policy.

1. Determine overall impact and numbers for freight deliveries (long distance) and local deliveries;
2. Create a policy for non-peak hour deliveries;
3. Institute a “no-idling” policy;
4. Investigate methods of decreasing Penn’s reliance on air travel by video conferencing and use of rail services where possible; and
5. Provide air travelers with information on how to decrease their carbon footprint.

5.7 Transportation

H. Evaluate University transportation objectives and programs to better align with the needs and goals of the University City area.

Progress

Parking/Circulation

- **Orth-Rodgers' Campus Circulation: a Study of Multi-Modal Access:** The University has completed a comprehensive transportation and traffic study, with a focus on developing a 30-year plan for multimodal transport to and within campus. Currently, about 40 percent of faculty and staff commute to Penn via public transit, bike, or walking. The study has generated recommendations to raise this level of sustainable travel to 60 percent and these recommendations have been incorporated into the *Climate Action Plan*. **Transportation Survey:** In October 2009, a transportation survey of the Penn Community will be carried out. The intent is to establish accurate baseline data about commuter habits, preferred modes of commuting, commuters' awareness of other options, the feasibility of proposed sustainability projects, and what commuter choices are unavailable that the Penn community would like to see offered.
- **South Street Bridge:** The Division of Public Safety (DPS), Business Services Division (BSD), and the University of Pennsylvania Health Systems brought together key Penn and external stakeholders over the course of six

months to coordinate services and response leading up to the Fall 2008 closure of the South Street Bridge, a key access point and main artery on campus.

- **30th Street/Station Square Taskforce:** Facilities and Real Estate Services (FRES) has been involved in the restructuring/planning of a new pedestrian square around 30th Street Station to improve pedestrian safety and accessibility.

Alternative Transportation

- **AlterNet and Share-A-Ride:** Business Services Division (BSD) has teamed up with these two carpooling service providers to encourage Penn commuters to consider carpooling.

Public Transportation

- **PennTransit GPS:** Real-time information on bus arrivals for the Penn transportation services make traveling by bus and van much more convenient thanks to GPS installed on the shuttles and buses.
- **Commuter Transit Fairs:** BSD brought together key transit agencies and mobility organizations in an extremely well-attended and highly successful effort to educate commuting staff and faculty on how to use public and alternative transportation to travel to and from work. Plans are in place to repeat this effort annually.
- **LUCY (Loop through University City) Extended Hours:** SEPTA and University City District worked together to extend service frequency for the LUCY Green

and Gold routes.

- **SEPTA:** BSD and FRES have established an open dialogue with SEPTA management regarding important changes requested by Penn.

Bicycles

- **Bike Parking:** Bike parking has been installed in two University garages for covered, secure parking. Two pilot corral projects were installed on the exterior of campus.
- **Bike racks on PennTransit shuttle buses:** To expand accessibility and encourage intermodality, Penn installed bike racks on the front of all shuttle buses in 2008.
- **Bike Share Feasibility Study:** In coordination with the Mayor and City Council of the City of Philadelphia, Penn is supporting a city-wide bikeshare program. Currently, the city is conducting a trip demand study to investigate locations for the bicycle sharing stations. Penn anticipates being a major participant and beneficiary of this program and looks forward to the positive impacts it will have on the campus' and the city's sustainability initiatives.
- **Bike-share demonstration project:** In September 2008, Penn sponsored a very successful bikeshare demonstration project with 18 bicycles, generating over 55 one-way trips between campus and Center City Philadelphia.

- **Share-the-Road Campaign with DPS:** DPS has implemented a biannual motorist and cyclist education campaign with outreach events, educational classes, and safety check-ups, etc.
- **Coordination with Bicycle Coalition and Bicycle Ambassadors:** Penn has reached out to local advocacy groups in order to educate local bikers on rules and rights.



5.7 Transportation

Pedestrians

- **Weave Bridge:** The Weave Bridge over the Amtrak rail lines that run through the southeast corner of Penn's athletic fields, was completed in the spring of 2009, and provides a bicycle and pedestrian connection for two important sections of Penn's campus. The bridge was initially conceived as a connector during the reconstruction of the South Street Bridge, which had provided the span over the train tracks, but is currently under reconstruction. The Weave Bridge has become an integral part of the Penn Park plan, providing increased access for both members of the campus and city communities alike.

Fleet

- **Fleet inventory analysis:** A comprehensive review of the current University fleet makeup will allow for investment in a more appropriate mix of vehicles, including more hybrids and smaller, more efficient vehicles.
- **California Clean Idle trash truck:** Penn has purchased clean idle vehicles which decrease emissions while the trash truck operates.

Responsibility

FRES and BSD will coordinate the implementation of the above recommendations. Both divisions currently coordinate transportation activities, fleet services, parking, transit services, transportation subsidies, and campus planning. These divisions

will track progress on the specific goals of the subcommittee: to increase alternative transportation use to over half of the University's community. This will be measured by a yearly survey, administered to faculty, students, and staff, where mode choice will be the key metric. The Green Campus Partnership will promote options to the Penn community for sustainable commuting travel practices.

Funding

The majority of transportation activities, such as the SEPTA subsidy and fleet costs, are the responsibility of BSD. It will be necessary to coordinate with local and state agencies to prioritize and allocate available funding. Infrastructure improvements, such as crosswalk and intersection upgrades, bicycle parking, pedestrian signalization, etc, are handled in FRES. Investments in these transportation recommendations, while beneficial to the University as a whole, tend towards significant cost and a small quantitative emissions benefit.

The one large potential reduction in emissions can be found in reducing air travel. The responsibility for this cost resides entirely with each individual school and center. See Appendix B for budget information

5.8 Waste Minimization and Recycling

Minimize Waste

Background

The City of Philadelphia became the first major US city to establish a mandatory recycling law in 1987. Public and private schools, including colleges and universities, are now required to recycle and to report recycling data to the city.

Penn's recycling efforts, however, beginnings date back to the early 1970s, long before municipal requirements. Initiatives include the creation of a landscape materials yard to store paving and landscape stonework, composting all landscape leaf litter on campus for use as compost in campus gardens, and the provision, through Penn's Morris Arboretum, of free garden waste drop-off and composting services for the entire municipality of Springfield Township. Recycling programs at the University have evolved considerably since their inception and have yielded steady improvements in results. In the early 2000s, the Facilities and Real Estate Services (FRES) Operations Department collaborated with the University Landscape Architect to install custom designed outdoor triplet recycling and waste containers. The triplets were deployed in high traffic areas to make it easier to recycle waste materials in the outdoor campus environment.

Further efforts by FRES and the Business Services Division (BSD) have helped to create an increasingly transparent collection system that provides more effective feedback and communication with the Penn community.

Currently, the University recycles about 20 percent of its municipal waste stream, diverting over 1,500 tons of mixed paper, cardboard, and commingled (glass, plastic, and metal) materials from landfills annually. FRES is responsible for the collection of municipal solid waste (trash) and recyclables from Penn buildings and outdoor receptacles on campus. Penn Environmental Health and Radiation Safety (EHRS) collects computers, electronic devices, batteries, and fluorescent light bulbs for recycling. Although a Philadelphia-area food and organic waste composting facility has yet to be established, the University will carry out pilot studies to identify how composting could be carried out in its cafeterias and will document the amount of compostable waste generated.

In November 2008, the nation's struggling economy caught up to the recycling market, and Philadelphia witnessed plummeting resale values for materials such as glass, plastic, metal, cardboard, and paper. Before this collapse of the recycled materials market, municipal solid waste was being hauled off campus at

a rate of about \$68 per ton, while Penn was able to dispose its recyclables at no cost at a local Philadelphia recycling facility. For the remainder of fiscal year 2009, recycling costs increased significantly from an initial rate of \$25 per ton to \$61 per ton, which resulted in about \$45,000 in new disposal costs to Penn's Operations budget. Fiscal year 2010 projections for disposal cost are even higher, underscoring the importance of improved purchasing practices, composting efforts, and waste minimization initiatives.

Starting in 2008, Penn participated in the Environmental Protection Agency's *RecycleMania*, a competition and benchmarking tool for colleges and universities to promote more sustainable behavior among students. The competition has effectively raised awareness of Penn's recycling program and highlighted the increased efforts of schools and centers across the campus. Penn competed in *RecycleMania* again in 2009 and showed improvements in the categories of diversion rate and waste minimization, with Penn leading all Ivy League schools in the latter.

In March 2008, FRES retained Niche Recycling, Inc. to perform an assessment of all Penn's waste removal practices, including a regulatory review, an "On-Route Survey" of the campus collection system, and a waste audit to determine an accurate estimate of Penn's potential recycling rate. The "On-Route Survey" documented consistent high performance of FRES waste management, but the survey analysis revealed that more attention is required to ensure in-house management of recycled materials and to improved communication between waste generators and collectors.

Over the past few years, Penn has shifted its focus toward overall waste minimization to complement its recycling efforts. Penn's Purchasing Services is committed to environmental stewardship through green purchasing, conservation, and construction designed to conserve natural resources and preserving the environment, in support of President Gutmann's ACPUCC commitment. Purchasing's environmental sustainability initiatives have included recycled content products, environmentally preferable products and services, bio-based products, energy and water-efficient products, alternative fuel vehicles, products using renewable energy, and disposal of solid waste. Purchasing Services also created an annual performance metric for green purchases; purchase activity for fiscal year 2008 was tracked and will be utilized as a baseline to measure performance in future fiscal years.

Suppliers featured in the Penn Marketplace are encouraged to include products that promote environmental stewardship in their online product catalogues and Penn faculty and staff members are empowered to select environmentally friendly products from preferred contract suppliers and manufacturers. All University-branded stationary is printed on 30 percent PCR chlorine-free paper, FSC and Green Seal certified, and the electricity used to manufacture this paper is offset with 100 percent Green-e certified wind certificates.

Furthermore, the University is committed to purchasing Energy Star qualified products such as printers, computers, and appliances. Penn Computing Green Information Technology (IT) program has established recommended

5.8 Waste Minimization and Recycling

guidelines for IT purchases that include Energy Star 4.0 compliant desktops, replacing CRT monitors with LCD monitors, and encouraging the purchase of small form factor or all-in-one desktops instead of mini-towers or towers. Beyond its purchasing guidelines, Green IT provides resources to help users throughout the University improve the sustainable aspects of their computing operations by reducing energy consumption and producing less e-waste.

While recycling and waste minimization do not represent a significant amount of Penn's carbon footprint, they are both highly visible actions that all individuals directly associate with sustainability. Gaining the trust of skeptical Penn audiences will prove to be

an effective method of promoting behavior change in other aspects of sustainability. In addition, the savings yielded from successful waste minimization through the establishment of a comprehensive campus policy, revising purchasing strategies, and development of an education and awareness campaign, can fund waste minimization and recycling initiatives in future years.

Mission

Decrease the amount of municipal waste generated on campus, and increase environmental awareness and recycling participation throughout the Penn community.



Target

Establish a framework for a centralized University Recycling Program that increases Penn's diversion (recycling) rate of paper, cardboard, and commingled recyclables from 20 percent in 2008 to 40 percent by 2014.

Recommendations

The *Climate Action Plan* recommendations for Waste Minimization and Recycling are consistent with those of the Niche Recycling Survey and Analysis prepared for FRES in January 2009.

A. Institute a comprehensive waste minimization and recycling policy.

1. Develop expectations of performance and recommended practices that will impact the entire University community:
 - Designate a point person and set up a committee to develop a campus-wide recycling plan, using the city's requirements as guidelines.
 - Develop and adopt a common language and standards for labeling on designated in-house containers, material pick-up site compactors, dumpsters, "toter" carts, balers, and commingled container collection pods.
2. Provide direction to address:
 - Municipal solid waste;
 - Residual waste;
 - Computer and electronic waste;
 - Universal waste;
 - Purchasing policies consistent with minimizing the generation of waste materials;
 - Best practices for copiers and printers;
 - Contract language with vendors to minimize packaging and promote "take back" programs.
3. Include specific waste minimization and recycling goals:
 - Increase diversion rate for recyclable paper, cardboard and
 - Develop in-house collection protocols with accompanying written materials and an orientation presentation for recycling collection and waste disposal at each campus facility.
 - Review, and where necessary, revise personnel manuals, job descriptions, and contractor agreements to provide for proper handling and placement of recycled materials.
 - Develop a training and orientation program for FRES and contracted housekeeping managers and their staffs to assure proper in-house management of recycled materials set aside for collection.

5.8 Waste Minimization and Recycling

commingled recyclables from 20 percent to 40 percent by 2014;

- Ensure that at least one recycling bin is available on every floor of every building on campus by 2011; and
- Establish aggressive targets for overall waste minimization as interim recycling goals are achieved.

B. Create a campus-wide mechanism for communication and feedback between various Penn constituents (generators, collectors, and implementers).

1. Using the student Eco-Reps model, recruit a member from each School and center as initial members;
 - Members will meet regularly for education, information and to share best practices for waste minimization, recycling, and energy conservation;
 - These Eco-Reps will be responsible for communicating information throughout their respective schools and centers.
2. Encourage Building Administrators to promote interaction between building occupants, administrators, housekeepers, and Operations and Maintenance staff, and develop a system for housekeeping and Operations and Maintenance staff to provide feedback on building occupants (and vice versa) in order to cultivate a collaborative environment among all constituents in each

building.

C. Develop a campus-wide waste minimization and recycling education and awareness campaign.

1. Collaborate with the Green Campus Partnership Communication Committee's larger Sustainability Awareness campaign to develop a waste minimization and recycling awareness campaign for the internal Penn community;
2. The campaign will draw upon lessons learned through the ESAC process, facilities operations, and the waste minimization and recycling policy;
 - Create a clear and consistent message – visual and textual – to promote to the Penn community through on-campus advertisement and the Green Campus Partnership website;
 - Update signage and distribute educational marketing materials that explain correct recycling practices at Penn;
 - Use the Green Campus Partnership website to publish materials that illustrate the life-cycle of the University's waste and recycling and include education about the benefits of recycling in terms of environmental health/risk and the individual's carbon footprint;
 - Identify recycling collection points

and educate the individuals responsible for maintaining them;

- Seek feedback from building administrators, housekeepers, students, staff and faculty to measure the effectiveness of the communication materials and use this information to establish points of contact in the Penn community;
- Explain and emphasize the importance of the “zero-waste” aspect of recycling to improve purchasing practices throughout the University;
- Direct audiences to the Green Campus Partnership website to learn more; and
- Provide recycling resources online and create a feedback system that allows the Penn community to offer opinions and insight on recycling issues.
- Publish recycling and municipal waste data on a quarterly basis through the website.

D. Establish the function of a University Waste and Recycling Coordinator.

Charge coordinator with responsibility to document existing recycling practices on campus, current building and campus program costs, cost avoidances and identify opportunities for improvements, staying current with the existing market conditions that affect the cost of operating a comprehensive recycling program. This position will:

1. Establish and maintain relationships with building administrators, FRES Operations (housekeeping, urban park), Office of Design and Construction, and Environmental Health and Radiation Safety (EHRS);
2. Maintain compliance with the recycling rules and regulations of the City and Commonwealth;
3. Work closely with Sustainability Team to raise awareness throughout the Penn community by supporting education and outreach programs, and student projects focusing on recycling issues;
4. Develop a comprehensive construction waste management program for all capital projects and renovations across campus; and
5. Work with University Landscape Architect and landscape contractors to manage landscape waste management and recycling of landscape materials.

E. Continue to research possible improvements to the University recycling program.

1. Determine current baseline data for all recyclable materials in order to measure future progress;
2. Interface with peer institutions to compare waste minimization and recycling strategies and establish best practices to be employed at Penn;

5.8 Waste Minimization and Recycling

- Connect with other local colleges and universities to learn their methods for reducing waste and increasing recycling rates in a similar environment;
 - Continue collaboration with Ivy Plus Sustainability Group.
3. Perform a cost-benefit analysis for the installation of automated scales on trucks to weigh and radio information after each pick-up to track recyclables by location on an on-going basis;
 4. Continue to research existing opportunities for recycling and composting food residuals and other organic materials and establish a campus food waste and compost collection system when a local hauler and composter demonstrate a successful business model; and
 5. Research opportunities to collaborate with the City and the University City District to extend Penn's recycling program to the neighboring community.

Progress

Belly Solar Compactors

In late April 2009, FRES installed ten new BigBelly solar-powered trash compactors with attached recycling bins on public sidewalks at the periphery of campus. The BigBellies, each capable of holding four to five times

the amount of a conventional trash can, were installed in high-traffic areas to provide the Penn community with public recycling bins while reducing labor costs and carbon emissions associated with running vehicles to empty trash receptacles.

CFL and Battery Recycling

Since December 2008, FRES and EHRS have worked with College Houses and Academic Services to establish a new College House recycling program for universal waste, those products that contain trace amounts of mercury or other low-level hazardous materials. College House residents and members of the Penn community can now conveniently recycle their compact fluorescent light bulbs, old cell phones and batteries by placing them into specially-labeled bins located at each College House information desk that for collection by EHRS.

Greek Recycling Pilot

In late March 2009, seven fraternity and sorority houses kicked off an eight-week pilot recycling program with the help of FRES, the Office of Fraternity and Sorority Affairs and University City District. The seven houses diverted over four tons of materials from landfills. Additional interest has been generated among the Penn Greek community to expand the program during the 2009-2010 academic year.

RecycleMania 2009

Penn's second year of participation in the ten-week national college and University recycling competition showed improvement in the University's recycling program:

the campus' diversion rate for traditional recyclables increased from 18 percent to 20 percent. FRES, BSD and the student-run Penn Environmental Group coordinated several events across campus, including Greenfest, a Valentine-themed "Love Your Planet" event, and "Trash Talk" – a discussion panel on recycling at Penn. The School of Design also organized "Rethinking Recycling," an in-house competition to improve one of the aspects of the recycling system in Meyerson Hall, the department's main building.

PennMOVES 2009

Now in its second year, PennMOVES, the University's spring semester move-out recycling and re-use drive, was able to coordinate the diversion of over 45 tons of materials from landfills thanks to the efforts of BSD. Volunteers helped to collect student cast-offs after move-out from the College Houses across campus. The items were then valued and sold to the

public during a two-day sale in June 2009. Proceeds from the sale amounted to \$30,000 which was donated to the United Way to provide funding to West Philadelphia charity agencies. This event has developed into a new sustainable tradition at Penn.

Bon Appétit

The University augmented its commitment to sustainable and local food by partnering with Bon Appétit Management Company to deliver Penn's Dining program. Bon Appétit is committed to providing socially and environmentally responsible food. A program called "Farm to Fork" will provide the Penn community with food from nearby farmers, while students, faculty, and staff can take part in educational opportunities about healthy lifestyle choices, sustainable agriculture, and a low-carbon diet. Providing organic and local food options is yet another way Penn continues to show its commitment to sustainability.



Success depends on the participation and compliance of the entire Penn community

5.8 Waste Minimization and Recycling

Responsibility

Responsibility for the implementation of the recommendations set forth by *Climate Action* will mostly fall upon FRES and BSD, with assistance from the Green Campus Partnership Communications committee and the Office of the Executive Vice President to develop an effective education and awareness campaign. Success depends on the participation and compliance of the entire Penn community – students, faculty, and staff – and requires each person to make an individual effort to make sustainable purchasing decisions in order to reduce his or her own waste and increase the potential to recycle materials.

FRES and EHRS will perform the data tracking and analysis and will collaborate to produce an annual report that assesses waste management and recycling practices. The report will measure progress towards specific waste minimization and recycling goals, and provide updates on interim targets. Progress will be measured using the following metrics:

- Diversion rate of traditional recyclables (paper, cardboard and commingled)
 - Municipal solid waste (tons) vs. recycling (tons)
 - Municipal solid waste (percent) vs. recycling (percent)
 - Cost savings from diversion

- Diversion rate of electronic waste and universal waste
 - Batteries (tons, \$)
 - Fluorescent lights (tons, \$)
 - Computers, televisions, monitors and other electronic waste (#, \$)
- Waste Minimization
 - Overall tons reduced
 - Overall percentage reduction
 - Cost savings from waste minimization

Funding

Disposal of municipal solid waste and recyclables will continue to be funded by FRES. Purchasing new recycling bins for a building is the responsibility of the specific Building Administrator. If funding for recycling bins is unavailable, Building Administrators will consult with the respective Area Manager or FRES Director of Operations for funding assistance. Budgets for waste minimization and recycling events and promotions such as *RecycleMania* will be determined by FRES and BSD. For further information on funding, see Appendix B.

5.9 Academics

Learn Sustainability

Background

As America's first University, the University of Pennsylvania has always been attuned to the responsibility to educate students, faculty, and staff on the world's most pressing issues. The University has long realized the importance of sustainability and the necessity to equip its students, faculty, and staff with the tools to assess and improve the health of the planet. Sustainability is integrated into the Penn experience through coursework, research, and scholarship: Penn's interdisciplinary educational opportunities reflect the inherent nature of sustainability. Many schools and centers are involved in the quest for sustainability, with coordination between faculty, consultancies, research centers, students, and divisions throughout the University.

Curriculum

The undergraduate major in Environmental Studies, one of the country's first, was launched in 1972, followed soon thereafter by the companion Masters in Environmental Studies (MES) program. Today, Penn offers dual-degree programs that allow students to combine the MES degree with graduate degrees from

Wharton, Penn Law, or the School of Design. Courses included in the combined Masters of Business Administration/MES program, such as *Environmental Sustainability and Value Creation*, demonstrate how businesses can implement "triple-bottom line" goals of environmental sustainability, economic prosperity, and social equity. Students majoring in Science, Technology and Society can concentrate in energy and environment courses. The School of Design offers myriad courses that teach students how to restore and/or enhance the environment through Masters programs in Architecture, Landscape Architecture, City and Regional Planning, and Historic Preservation, and a new Masters in Ecological Design. The School of Design also coordinates efforts with the TC Chan Center, which offers certain faculty and graduate students the opportunity to work on real-world problems focusing on sustainability. Graduate students in the Master of Science in Applied Geosciences program learn technical expertise in hydrogeology, geochemistry, engineering geology, and geophysics to assess today's environmental problems.

The Program on Law, the Environment, and the Economy

PennLaw brings scholars, regulators, and policymakers to campus, through *The Program on Law, the Environment, and the Economy*, to engage and encourage research opportunities for students and faculty on such topics as global warming and natural hazards. The diverse compilation of speakers affords a comprehensive view of environmental issues.

Terra Pass

TerraPass is a leading carbon offset system that was developed by Penn Professor Karl Ulrich and his 2004 Wharton MBA class. Since then, TerraPass has enabled individuals and businesses to reduce over 1 billion pounds of carbon dioxide worldwide.

Initiative for Global Environmental Leadership

Wharton's Initiative for Global Environmental Leadership draws influential executives to Penn to discuss and research the nexus of business and the environment. Students often partner with this research giving new perspectives and learning from experts in the field.

Penn Environmental Group

Established in 1971, the Penn Environmental Group was created by students energized by the first Earth Day in 1970. The Group provides a forum to discuss environmental issues at the local, national, and international level. As an extracurricular activity, PEG is an avenue for members of the Penn community to increase

their environmental engagement. Past events hosted by the group have included a compact fluorescent light bulb exchange, tree planting, and a sustainability-related speaker series.

Institute for Environmental Studies

Housed within the Department of Earth and Environmental Studies, the Institute for Environmental Studies aims to foster a discussion of economic, scientific, and political related to environmental management. Urban environmental issues and watersheds are two of the Institutes' priority areas.

Penn Engineers Without Borders (PennEWB)

The University's Engineers Without Borders provides sustainable development assistance locally and abroad. PennEWB pairs technical assistance with educational opportunities to provide development assistance, focused primarily on basic infrastructure provision. Previous projects have included water supply work in rural Cameroon and the construction of a biodiesel processor at an agricultural high school in Philadelphia.

Organizational Dynamics

The Organizational Dynamics program, in the School of Arts and Sciences, will offer a new concentration in sustainable development through a partnership with Rohm and Haas Company. Rohm and Haas is an international leader in cutting-edge technology for specialty materials industry. The \$100,000 gift from Rohm and Haas to the program will not only support the new concentration but will fund the

5.9 Academics

creation of a sustainable development graduate certificate program. This innovative partnership forges the way for academic intuitions and corporate firms to work together on issues and best practices of sustainability. In addition, the Rohm and Haas gift will fund efforts to draw a diverse student body which will aid in enriching the entire Organizational Dynamics program and the broader sustainability agenda at Penn.

Mission

To make climate change and sustainability part of the curriculum and educational experience available to all students.

Recommendations

- A. **Update existing University undergraduate minor in *Organizations and Environmental Management to Sustainability and Environmental Management*.**
 1. Identify and receive a commitment of faculty members from each undergraduate school (Wharton, Engineering, and Arts and Sciences) to assist in restructuring this minor, with one faculty member from each participating school to be the management liaison and provide advising services;
 2. Determine the process by which minor students will be guaranteed admittance to the core required courses; and
 3. Advertise this minor.
- B. **Ensure that courses related to sustainability in the course register have *sustainability* as a keyword and ensure that faculty has online syllabi posted on *Course in Touch*.**
 1. Determine which courses and faculty need to be contacted to remind and instruct them on how to update their description and post online syllabi through the hire of a student intern; and
 2. Contact all faculty who teach sustainability related courses and recommend that they highlight sustainability in their course description or other advertisement of the course.
- C. **Coordinate with Center for Teaching and Learning (CTL) to hold sustainability workshops for faculty to find ways to incorporate sustainability into their courses, and for graduate students to learn more about green jobs.**
 1. Ask for faculty and graduate student involvement;
 2. Develop the curriculum for the sustainability workshop;
 3. Use this workshop to help determine the types of courses that are missing from the current list; and
 4. Involve Facilities and Real Estate Services (FRES) intern participation to coordinate volunteer faculty, students, and staff members to assist with the workshops.

D. Develop Sustainability Research in Action courses.

1. Solicit and evaluate proposals from faculty for the creation of these courses, to be overseen by the Academics subcommittee;
2. Recruit a leader of government, non-profit, or industry to present a class problem;
3. Assign class to research the topic, evaluate current literature, interpret data, and develop reports;
4. Report findings and recommendations at the conclusion of the course;
5. Research funding could include travel funds for recruited leader, student field research, or equipment and supplies for research purposes;
6. Possible funding shared between schools and centers; and
7. Look for potential outside funding opportunities (stimulus package, donors) to support the development of more sustainability related courses.

E. Provide community engagement opportunities for students through existing community outreach programs at Penn, including pro-seminar programs and summer internships.

1. Develop an inventory of the currently offered pro-seminars and summer internships that relate to sustainability;

2. Investigate expansion of current programs;
3. Find faculty to develop a course to help students engage with the community around sustainability issues; and
4. Continue support of the PennGreen Freshmen Pre-Orientation Program.

F. Develop Seminars/Guest Lectures of visiting scholars.

1. Develop a coordinated and focused seminar series related to sustainability, broadly defined; and
2. Set up a series of two to three high-profile seminars per semester that would be designed so that guest speakers give two lectures: one a research seminar and the second a presentation in an introductory or intermediate level undergraduate course in which the speaker would discuss her or his research in the context of the course content.

G. Make the Penn Reading Project a sustainability related subject, such as water or energy, for the academic year 2010-2011.

1. Compose a letter of support from the Environmental Sustainability Advisory Committee (ESAC) Academics subcommittee for a sustainability related subject as the academic year theme to David Fox, the director of the Penn Reading Project; and

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2. Vet and select appropriate book or other pertinent publication.

H. Enhance publicity regarding seminars, conferences, and other special programs through coordination with the Communications subcommittee and the Green Campus Partnership.

1. Post websites of specific departments, centers, or programs that sponsor sustainability related seminars;
2. Market the central source of event information to the Penn community;
3. Periodically monitor these sites for special events;
4. Develop email lists for seminars and special programs;
5. Create and maintain an events calendar for all sustainability seminars, conferences, and other special programs; and
6. Use the e-newsletter to promote these events.

I. Expand student participation in research.

1. Create an inventory of current student research around sustainability topics to create a sample list of research opportunities;
2. Work with Center for Undergraduate Research and Fellowships and Weiss Tech House and other schools and centers to support undergraduate research;

3. Support University Scholars for sustainability research; and
4. Get approval from faculty to allow their research to be classified as sustainability-related and advertised on the website.

Progress

Eager to implement the *Climate Action Plan* recommendations, the University has already begun to weave sustainability into curriculum and educational opportunities. Currently, each of Penn's 12 schools offers coursework focused on environmental sustainability, producing remarkable benefits for the campus and beyond.

Curriculum

As noted in the Introduction, a new minor, Sustainability and Environmental Management, is available to students starting in the fall semester 2009. The minor is a partnership between the School of Arts and Sciences, the Wharton School, and the School of Engineering and Applied Science, and provides students not only with a scientific and environmental understanding of sustainability but also with a keen ability to assess risk and change associated with environmental issues.

The School of Design's new two-year Masters of Ecological Design program will launch in 2009. This program focuses on the dynamic relationship between the natural and built environment, and is available to students studying architecture, landscape design, planning, urban design, and historic preservation.

In 2007, Penn began offering *Toward Environmental Sustainability on Penn's Campus*, an innovative class that culminates with student presentations to senior administrators on ways to advance the University's sustainability goals and reduce the University's carbon footprint. This course provides students with an opportunity to apply their work in the classroom to real world problems, is co-taught by the University's Environmental Sustainability Coordinator, and includes a presentation to senior administrators of final projects.

PennGreen

PennGreen is a pre-orientation program offered to 40 incoming freshmen to provide students with an environmental introduction to Penn and Philadelphia while building their capacity to engage in environmental activism and learning.

Responsibility

The Office of the Provost and the Sustainability Team will oversee the implementation of the *Climate Action Plan's* Academic recommendations. Regular updates and progress briefings will be provided to the Provost on a schedule determined by the office. A set of metrics have been created to monitor Penn's progress on the recommendations related to academics and the overall academic mission:

- Number of people enrolled in sustainability courses
- Number of sustainability courses offered
- Number of students enrolled in the Sustainability and Environmental Management minor, Masters of Ecological Design program and Masters of Environmental Science.



5.9 Academics

Funding

While the recommendations related to academics will not necessarily see a financial return in the short term, the long-term effects of including sustainability in the curriculum and other educational opportunities at Penn will be far reaching. Updating the existing University minor and ensuring that sustainability courses are coded for easy searching will be carried out in the Office of the Provost. FRES and the Office of the Provost will allot equal resources for the implementation of many of the recommendations, such as the Sustainability Research in Action programs, Undergraduate University Scholars sustainability research, and sustainability guest seminars/lectures. The Provost will contribute to the PennGreen orientation program. For further information on funding, see Appendix B.

5.10 Communications

Background

The Communications subcommittee was the first intra-campus communication on the issue of planning a sustainable campus, crossing over the boundaries of teaching, research, and operations in order to collaborate on behalf of one common goal—to effectively portray the efforts of the *Climate Action Plan* to a variety of audiences in a diverse array of media.

Under the banner of Penn’s Green Campus Partnership, the Communications subcommittee is the steward of the University’s commitment to reducing its carbon footprint and enhancing its overall sustainability practices using the *Climate Action Plan* as its foundation. A long-range strategy to reduce Penn’s carbon footprint, the Plan strives to build and maintain a culture that integrates sustainability practices into the operational and academic planning of the University and generates participation among the students, staff, faculty, and vendors doing business with Penn.

Mission

A campaign has been developed to communicate clear, concise, and accurate public information that informs the broad internal Penn community and key external

Penn stakeholders about the goals of the *Climate Action Plan* and the objectives of the Green Campus Partnership. The campaign will educate and motivate Penn stakeholders to help to meet the stated goals of the *Climate Action Plan* through individual participation. The campaign will also regularly provide updates on the progress being made, so as to build confidence and credibility among the Penn community about its commitment to operating a sustainable institution.

The communications goals include:

- Educate Penn stakeholders about the value and benefits of energy conservation, and motivate them to reduce consumption of electricity and other utilities;
- Educate Penn stakeholders about the value and benefits of minimizing waste and increasing recycling, and motivate them to participate in recycling programs and events;
- Educate Penn stakeholders about the value and benefits of using public transit, walking, bicycling or carpooling, as opposed to single-use auto-transit, and motivate them to try new, more sustainable methods of commuting;

- Promote to Penn stakeholders the outlets and opportunities for educating themselves about the myriad aspects of environmental sustainability, and motivate them to take courses and/or participate in programs, lectures and events; and
- Educate Penn stakeholders about the value and benefits of constructing and maintaining a campus of high performance sustainable buildings and landscapes, and reinforce the sustainability aspects of the Penn Connects campus plan.

Recommendations

A multitude of communications tactics have been planned as the recommended methods for most effectively communicating the University's sustainability commitment, goals, and aspirations, which include the following elements:

- **Branding:** Apply Green Campus Partnership identity on all relevant materials from brochures, to websites, to recycling bins -- to establish and communicate Penn's campaign
- **Messaging:** Develop messages and talking points to be used University-wide in collateral materials, web communications, media relations, and speeches/presentations; identify University spokespersons and support with message development training.
- **Executive Leadership:** Arrange for executive leadership to speak on the *Climate Action Plan* and Penn's Green Campus Partnership to faculty, students, and staff, and tour campus projects (buildings, classes, and research projects) that illustrate investment in sustainability as a core value of Penn; capture with photos of students, post online, etc. to show consistent interest and support.
- **Print Collateral:** Produce a signature piece of collateral that is the executive summary of the *Climate Action Plan*
- **Direct E-Mail Newsletter:** Design a new Green Campus Partnership e-newsletter for University-wide distribution six times annually that includes key messages on Penn's actions, information on the Plan's progress, helpful tips on how people can participate, and profiles of faculty, students and staff contributing to the Plan's success.
- **Web Communications:** Ensure that the Green Campus Partnership website is an up-to-date, accurate, user-friendly repository of valuable information for reducing campus carbon emissions. Establish a new section of the site that tracks progress of the *Climate Action Plan*. Create a presence in social media such as Facebook and Twitter.
- **Events and Promotions:** Work with student, faculty, and staff groups to produce events that galvanize the campus community and bring attention to the goals of the *Climate Action Plan* and the Green Campus Partnership in general.

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- **Training and Learning:** Promote opportunities for education and training to the broad University community regarding the goals of the *Climate Action Plan* by providing content to schools and centers related to the goals of the *Climate Action Plan*. Target high priority groups that represent faculty, students, and staff to give presentations that describe the major goals, targets, and initiatives; and recruit people to get involved representing their dorm, office, or lab; create and promote a pledge and leave behind at each meeting, or direct individuals to an online pledge form.
- **Advertising:** Create a series of both online and print media advertisements that brand the Green Campus Partnership, promote the goals of the *Climate Action Plan*, and educate audiences about the critical role of personal behavior, while also driving audiences to the website, and to attend special events.
- **Presentations:** Develop presentations to carry key messages directly to targeted audiences within the Penn community and to externally.
- **Point of Contact:** Enhance the campus tours managed by the Admissions Office to feature sustainability at Penn. Generate content for video welcome screens and posters in buildings that promote the sustainability aspects of that building, or more broadly, the goals of the campaign, helpful tips and advice in sustainable practices, etc.
- **Media Relations:** Continue to generate positive media by pitching stories and fielding inquiries. Develop a press list of journalists that cover sustainability, higher education for broadcast, web, and print for trade, international, national, regional and local outlets. Identify opportunities at national, local and industry outlets to communicate Penn's campaign, the success of its efforts, and profile individual scholars and administrators. Leverage milestones in the sustainability campaign by writing and issuing press releases to keep media informed, and generate coverage. Press conferences and/or media events will be produced for major milestones such as announcing the *Climate Action Plan*, the ribbon cutting or ground breaking of new buildings to promote their LEED characteristics, visiting lecturers and speakers, etc.

Climate Action Plan Announcement

On September 16, 2009, President Gutmann is scheduled to announce the completion of the *Climate Action Plan*, and kick off a multi-year commitment to enhance Penn's overall sustainability practices. This included a campus-wide event to which all members of the community were invited by the President, via an University-wide email notification; a press release and a media advisory announcing the *Climate Action Plan* kickoff event to generate local and national press attention; an open letter from the President in campus publications, laying out goals of the *Climate Action Plan* and its importance to Penn; launch

a new home page for the Green Campus Partnership website; distribute copies of an executive summary of the plan and providing promotional and educational materials for attendees.

Progress

Much progress has been made over the past several years in generating positive press coverage to national, trade, and local media outlets about Penn's commitment to the environment from an academic and operational perspective. Penn is regularly featured for its innovative work in energy management, purchasing and procurement strategies, recycling and support of local farmers.

Middle Class Task Force Event

In February 2009, Penn hosted Vice President Joe Biden as he presided over the Obama Administration's inaugural "Middle Class Task Force" meeting on the green collar economy. Penn was featured prominently for its dedication to energy management and greening the built environment.

Green Power Award

In addition, Penn has for several years been recognized by the EPA with its Green Power Award as the largest consumer of wind energy among institutions of higher education. Penn has won this award in 2006, 2007, and 2008.



5.9 Communications

Penn Future Award

Citizens for Pennsylvania's Future (PennFuture) awarded Penn the Penn Future "Green Power" Award. Alongside 25 individuals, private industries, government agencies, and public interest organizations that have helped to build Pennsylvania's renewable energy market.

***Scientific American* Green Leader Award**

In 2009, *Scientific American* ranked Penn nineteenth on its list of the country's "Top 25 Green Leaders", the only higher-education institutions alongside other environmentally-conscious companies and municipalities. Penn was recognized for its wind power purchases. Community Involvement

Penn's sustainability leadership extends far beyond its campus borders. Many of Penn's staff and faculty are resources for community organizations, local government, and non-profits in Philadelphia. Through community collaboration, Penn can affect a diverse set of sustainability goals.

- Penn's Executive Vice President is the chairman of the University City District, a special services district dedicated to improving the quality of life in Penn's adjacent neighborhoods
- The Vice President of FRES was appointed by Philadelphia Mayor Michael Nutter to serve as the co-chair of the City's Sustainability Advisory Board; she works closely with the City's Sustainability Director in developing Philadelphia's sustainability framework

- Penn's Environmental Sustainability Coordinator is a founder and current chair of the Delaware Valley Green Building Council, a nonprofit group working to transform the region through sustainable and environmentally responsible planning, design, construction and operation.

Responsibility

The ESAC Communications subcommittee was formed in 2007 to write the communications plan and exists as both the strategic and implementation arms of this effort. The committee, now known as the Green Campus Partnership Marketing and Communications committee, is comprised of marketing, communications, and public affairs staff as well as student representatives from various areas across Penn, with various degrees of expertise and perspective such as media relations, marketing, web communications, special event management and promotions to advance the goals of the campaign.

Funding

Expenses for the campaign's kick off and first year are \$180,000 funded from general operating resources, as well as leveraging existing marketing budgets already allocated to support sustainability. For more information on funding, see Appendix B.

6 Conclusion

6 Conclusion

Few people today are aware of the connection between the University of Pennsylvania and the Lewis and Clark Expedition. When President Thomas Jefferson commissioned his most trusted aide, Captain Meriwether Lewis, to lead the Corps of Discovery to the newly purchased Northwest Territories, he wanted the captain to be as well prepared as possible for whatever he might find in the unexplored lands up the Missouri River. In 1803, a year before Lewis and Clark's departure from St. Louis, Jefferson sent Lewis to the University of Pennsylvania to study with America's most prominent scientists: Benjamin Barton for botany and natural sciences, Benjamin Rush for medicine and biology, Caspar Wistar for comparative anatomy, and Andrew Ellicott and Robert Patterson. Penn, founded by Benjamin Franklin over 50 years earlier, was the foremost center of research and study of the practical arts. Lewis spent about three months in Philadelphia learning and preparing for his trip.

A good metaphor for culture's appreciation of the challenges of sustainability is captured in Lewis' journal two years into the journey up the Missouri.¹ Scouting along a ridge far ahead of his men, Lewis had his first glimpse of the

snow-capped Montana Rockies. His journal entry reflects both pride of accomplishment and trepidation for the hardships ahead:

...while I viewed these mountains, I felt a secret pleasure in finding myself so near the head of the heretofore boundless Missouri; but when I reflected on the difficulties which this snowy barrier would throw in my way, ... it in some measure counter-balanced the joy I had felt in the first moments in which I gazed on them.

This is where American society stands in its relation to sustainability: at the edge of great opportunity. Penn has seen the landscape change dramatically. In the coming years, the University – and our culture as a whole – will have exciting opportunities to effect changes in behavior, choices, and direction. The intent of Penn's *Climate Action Plan*, and the goal of this overall effort, is to make the sustainable choices the default choices for the campus community. To build the future envisioned by Penn's leaders, the University must continue to lead. Like Meriwether Lewis on the Missouri, it is only in having come so far, and having learned so much that one can see the enormity of the challenges ahead. Penn is ready to accept these challenges – and looks forward to continued discoveries.

¹ This reference was noted by Harvard Sustainability Director Leith Sharp in her GreenBuild Master Speakers lecture in Boston, November 2008

7 Glossary

7 Glossary

ACUPCC: American College and University President's Climate Commitment

This pledge committed Penn to developing plans for significant reduction of its emissions of climate-altering greenhouse gases.

AEPS: Alternative Energy Portfolio Standard

Act 213, signed into law by Pennsylvania Governor Edward Rendell in November 2004, requires that electric distribution companies provide a certain percentage of their energy from alternative systems, with a gradual increase from 5.7 percent in 2007 to 18 percent by 2021.

ASHRAE: American Society of Heating, Refrigeration, and Air Conditioning Engineers

ASHRAE is an international organization of 51,000 persons, with a mission to promote sustainability through research, standards writing, publishing and continuing education in the areas of heating, ventilation, air conditioning and refrigeration.

AUNI: Agatston Urban Nutrition Initiative

AUNI works to improve community nutrition and health in Philadelphia, particularly obesity and nutrition-related diseases such as diabetes, through service-based learning and community engagement.

BAU: Business-As-Usual

Assuming no carbon reduction strategies are implemented.

BPAT+: Building Performance Assessment Tool

A tool which uses steady state equations to determine the performance and energy consumption of a building without the need to install meters or develop complex simulation models.

BSD: Business Services Division

BSD provides the leadership, business practices, residential and parking services needed to develop and maintain a hospitable, community-friendly, and service-oriented campus environment.

CRT: Cathode Ray Tube

Cathode ray tubes were originally used in computers, but are large, heavy, and use great amounts of electric energy, making them less desirable.

CTL: Center for Teaching and Learning

CTL supports teaching at the University of Pennsylvania. CTL works to help standing faculty, adjunct faculty, and teaching assistants develop and improve their teaching, to promote valuable conversations about teaching among those groups, and to enhance the quality of education at Penn.

DVGBC: Delaware Valley Green Building Council

DVGBC is a nonprofit membership organization whose mission is to transform the Delaware Valley through sustainable and environmentally responsible planning, design, construction and operation of the region's buildings, landscapes, cities and communities, mindful of the legacy left for future generations

EDCs: Electric Distribution Companies

There are seven major EDCs in Pennsylvania, each with at least 100,000 customers.

EHRS: Environmental Health and Radiation Safety

The mission of EHRS is to promote health safety and environmental protection in teaching, research, health care, and administrative activities, and ensure compliance with federal, state, and local regulations to achieve optimal control or reduction of hazards and exposures which are detrimental to people, property, and the environment.

ESAC: Environmental Sustainability Advisory Committee

ESAC, made up of faculty, administrators, and students, and chaired by the Vice President of FRES, was established to gain input from a broad set of campus constituencies regarding Penn's *Climate Action Plan*.

FRES: Facilities and Real Estate Services

FRES, as stewards of Penn's physical environment, strives to provide innovative and cost-effective solutions that embrace Penn's rich past and enhance the quality of the University's living and learning experience. FRES does the University's planning, design, construction, maintenance, operations, and real estate services.

FSC: Forest Stewardship Council

The FSC was created to promote the practice of sustainable forestry throughout the world. The FSC has developed a set of principles and criteria for forest management that are applicable to all FSC-certified forests throughout the world and ensure that forests and forest products are handled in a sustainable manner.

GCP: Green Campus Partnership

GCP is the umbrella group that addresses environmental sustainability and stewardship, and advocates for enhanced sustainability policies at Penn. It includes ESAC as well as faculty and student groups. The GCP was formed after President Gutmann signed the ACUPCC in February 2007, the first Ivy League president to do so.

7 Glossary

GHG: Greenhouse Gases

These are gases which allow sunlight to enter the atmosphere freely; some occur in nature, such as water vapor, carbon dioxide, and methane, while others are exclusively human-made. In the United States, greenhouse gas emissions are primarily the result of combustion of fossil fuels in energy use.

Green IT: Green Information Technology

Green IT is the environmentally responsible use of computers and related resources, encouraging use of both environmentally friendly manufacturers and sustainable computer practices from the user.

HVAC: Heating, Ventilating, and Air Conditioning

The main purpose of an HVAC system is to help maintain good indoor air quality through adequate ventilation with filtration and provide thermal comfort.

IEMI: International Environmental Management Initiative

IEMI provides a forum for interdisciplinary solutions to environmental issues. IEMI was started by professors from Penn's Wharton School, School of Design, and College of Arts and Sciences. IEMI's research and teaching address environmental issues through the lenses of business and policy.

IGEL: Initiative for Global Environmental Leadership

IGEL brings together a network of leading experts in relevant fields in both business and at Wharton and other Schools at Penn, to discuss and research selected topics concerning business and the natural environment. IGEL's 2009 conference was entitled: "Integrative Thinking about Life-Cycle Analysis: Promises and Limitations."

kBTU/SF: Kilo British Thermal Units per Square Foot

Penn measures annual energy consumption in thousands of BTUs per square foot (kBTU/SF) for specific building types and occupancies. This metric is the closest to a "miles-per-gallon" metric available for buildings.

LAMP: Landscape Architecture Master Plan

This 1976 plan created intersecting brick walkways and the lawn of today's College Green at the heart of campus. The 1876 statue of Benjamin Franklin set in front of College Hall amid the grass and slate-colored paving of College Green sets the iconic image for the campus. In 2000, the LAMP was refined and upgraded by a team led by Penn School of Design faculty member Laurie Olin; the heart of campus was dedicated to teaching and learning activities, where faculty and students could meet to exchange ideas.

LCD: Liquid Crystal Display

An LCD monitor consists of five layers: a backlight, a sheet of polarized glass, a layer of colored pixels, a layer of liquid crystal solution, and a second polarized sheet of glass. LCD monitors are brighter, take up less space, and are less heavy than CRT monitors. Moreover, they use only one-third to one-half of the electricity of CRT monitors.

LEED: Leadership in Energy and Environmental Design

LEED is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, CO₂ emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

LEED EB: OM: LEED for Existing Buildings: Operations and Maintenance

LEED CI: LEED for Commercial Interiors

LUCY: Loop through University City

LUCY is a shuttle service that operates between 30th Street Station (the stop for regional rail, Amtrak, and the local subway and trolley lines) and campus.

MES: Masters in Environmental Studies

Penn's MES program offers a multidisciplinary approach to the study of the environment.

MTCDE: Metric Tons of Carbon Dioxide Equivalent

This is a standard unit to measure amount of greenhouse gases release into the environment; emissions are typically expressed in a common metric to allow for ease of comparison.

MWH: Megawatt hour

A megawatt hour is a measure of electricity use – it is the amount of power used if one million watts are used for one hour.

OCC: Operations Control Center

Penn's OCC tracks over 8,200 heating, ventilation, air conditioning, and electrical use control points cross campus. From this central, constantly monitored location, staff can regulate Penn's utility distribution, the operation of air handling units across on campus, and temperature controls at most campus buildings.

PATCO: Port Authority Transport Corporation

PATCO is a rapid transport line running between Philadelphia and South Jersey.

7 Glossary

PCR: Post Consumer Recycled Paper

Waste paper that has served its intended purpose and has been separated from solid waste to be recycled into new paper.

PEG: Penn Environmental Group

PEG was founded in 1971 and continues today to provide a forum to discuss and take action on environmental issues at the local, national, and international levels.

PennEWB: Penn Engineers Without Borders

PennEWB provides sustainable development assistance locally and abroad, pairing technical assistance with educational opportunities to provide development assistance, focused primarily on basic infrastructure provision.

Penn IUR: Penn's Institute of Urban Research

Penn IUR studies the sustainability of cities and the interaction of urban and natural systems. As a campus-wide institute, Penn IUR sponsors a number of initiatives, stimulates research, provides opportunities for collaborative instruction and engages with the world of practitioners and policymakers.

PHOS: Office of Penn Home Ownership Services

PHOS offers eligible employees the opportunity to apply for financing for home purchases in West Philadelphia. The department also offers home improvement

grants, loans, educational workshops, and a variety of other resources.

RECs: Renewable Energy Certificates

Renewable Energy Certificates are issued by a government agency to a power company that produces electricity in an environmentally friendly manner.

SEPTA: Southeastern Pennsylvania Transportation Authority

SEPTA is a regional public authority that operates the public transit — through bus, subway, elevated rail, regional rail, light rail and electric trolley bus — in and around Philadelphia.

UC Brite: University City Brite

UC Brite partners with homeowners and apartment buildings to install exterior lighting fixtures at residences in University City.

UCD: University City District

UCD is a neighborhood improvement organization whose mission is to “build effective partnerships to maintain a clean and safe environment” while planning and advocating for the region’s “diverse, urban community.”

UC Green: University City Green

UC Green is a non-profit tree-planting and community beautification organization in the University City neighborhood, founded

in 1999 by the Penn and a consortium of local institutions.

USGBC: United States Green Building Council

The US Green Building Council is a non-profit organization that certifies sustainable businesses, homes, hospitals, schools, and neighborhoods and is dedicated to expanding green building practices and education.

VOC: Volatile Organic Compound

A VOC is any organic compound that participates in atmospheric photochemical reactions.

ZPS: Zone Presence Sensors

This device detects the presence of a technician at the fume hood: if there is no technician, the system lowers the airflow face velocity at the hood and reduces the exhaust rate.

Appendix A: A Commitment to Teaching, Research, and Planning: Environmental Tradition at Penn

Environmental planning, thinking, collaboration, and implementation have been an important part of Penn's culture for many years. Prior to President Gutmann's signing the ACUPCC or before atmospheric carbon was thought of as a threat to a stable climate, the University had institutionalized a host of progressive sustainability programs and practices.

Academic Programs: Penn has a rich history in sustainability and environmental sciences. Hayden Hall, home of Penn's Earth and Environmental Science Department, is named for Ferdinand Vandiveer Hayden, who led early scientific surveys of the Valley of the Yellowstone River in Wyoming, and played a large role in the creation of Yellowstone National Park. Hayden was a professor at Penn in the early 1860s in the Department of Geology, prior to his long and distinguished career in public service.

Penn's undergraduate major in Environmental Studies, one of the country's first, was launched in 1972, followed soon thereafter by a professional-oriented Masters program. The PhD in Earth Science has been granted for over a century, with current dissertations focusing on climate change and global sea level rise.

Beginning in fall 2009, a new undergraduate minor will be offered in Environmental Management and Sustainability, with opportunities for engineering, arts and sciences, and business students to enroll in the

curriculum. In addition, consistent with President Gutmann's goal of integrating knowledge across disciplines, each of Penn's 12 academic and professional schools offers coursework in environmental sustainability. Curriculum options range from an Arts and Sciences course on the politics of food to classes on sustainable animal husbandry in the Doctor of Veterinary Medicine program.

Other examples include:

- The *TC Chan Center for Energy and Simulation* within the School of Design (co-located in Beijing in collaboration with China's Tsinghua University) is one of the world's leading centers of energy and fluid dynamics computer modeling. The TC Chan Center has built a close relationship with leading faculty and graduate students participating in energy consulting projects for the Penn. This continues a long history of collaboration with premier Chinese universities, especially Tsinghua University. In the 1920s, Penn's Graduate School of Fine Arts accepted several students from Tsinghua into its Masters of Architecture program. Five of these students would later return to China to assume leading academic positions in preservation and architectural design, one of whom later returned to Beijing to carry out the first systematic structural analysis and documentation of ancient countryside temples and the historic Palace in Beijing's Tiananmen Square.

The modern version of the inter-University collaboration was resumed seventy years later by Penn's School of Design, which invited faculty and graduate students from Tsinghua to partner with the TC Chan Center on research and consultancy projects. TC Chan Center's current work ranges local to international: from writing a national energy and building code for the nation of Qatar to collaboration with the City of Philadelphia's Office of Sustainability on research of distributed energy generation in southeastern Pennsylvania. The TC Chan Center has been integral to Penn's efforts to reduce campus energy use, and has carried out several key consultancies for the University over the past five years.

- A new Masters in Ecological Design in the School of Design prepares students in Architecture, Planning, Historic Preservation and Landscape Architecture to meet the need for greener, more sustainable planning, design, and construction. Included among the new faculty is the City of Philadelphia's first sustainability director.
- The Wharton School of Business launched the *Institute of Global Environmental Leadership* in 2008, to bring together faculty, students, and representatives from businesses to discuss pressing environmental issues. For example, a three-day conference

held in May 2009 focused on life-cycle assessment and environmental impact analysis, and their use as decision-making tools for businesses and institutions.

- The Fels Institute of Government convened a roundtable discussion during the spring of 2009 on the economics of sustainable agriculture in Pennsylvania, bringing together farmers, national leading non-profits such as the Food Trust, experts in urban nutrition, and leaders in farmland preservation.
- Penn's Institute of Urban Research (Penn IUR) studies, along with other disciplines, the sustainability of cities, and the interaction of urban and natural systems. As part of the Penn IUR activities, the chair of Penn's Urban Planning Department edited a timely book, *Rebuilding Urban Places after Disaster: Lessons from Hurricane Katrina*, published in 2006.
- In 2002, Penn sponsored six graduate research fellows from the Robert Wood Johnson Foundation to study the health effects of environmental issues, including climate change and environmental toxins.

Campus Design and Planning: Penn consciously dedicated to creating an environment that supports premier teaching and learning by affording the entire community the full benefits of interdisciplinary intellectual exchange. From its original configuration of individual

Appendix A: A Commitment to Teaching, Research, and Planning: Environmental Tradition at Penn

buildings along public streets, successive generations of Penn leaders have invested in place-making to create a compact pedestrian campus: a series of landscaped courts and lawns linked by leafy walkways. The public realm – the gardens, lawns, and plazas shared by all members of the Penn community – is a democratic setting for spontaneous interaction, impromptu meetings, and public participation in dialogue across disciplines.

The investment in a historical, pedestrian campus encourages renovation and reuse of valued buildings by each successive generation, saving resources while creating a fine-grained, richly detailed environment. Investment in Penn’s green open space has afforded the enjoyment of a carefully cultivated landscape, bringing greater biodiversity, lower summer temperatures, and opportunities for restorative environmental effects, such as natural rainwater infiltration. Penn’s sustainable campus unites the present community with past generations of scholars and students by expressly valuing the long-term goals of the community over the needs of an individual group or a single generation: the very essence of sustainability.

These shared, sustainable values have made possible increasingly sophisticated master planning projects. The most recent projects include:

- In 2000, Penn’s Landscape Architecture Master Plan (LAMP) was refined and upgraded by a team led by Laurie Olin,

Penn School of Design faculty member and focused on the quality of open space on campus. Known as the “Green Plan,” the Olin team’s designs reduced the amount of parking near the center of campus, converting small lots into vest pocket parks and sitting areas. The heart of campus was dedicated to teaching and learning activities, where faculty and students could meet to exchange ideas.

- With the acquisition of 14 acres adjacent to Penn’s campus from the US Postal Service in 2006, a new planning effort, *PennConnects*, was launched. The award-winning masterplan, led by the Executive Vice President’s Office, the Provost’s Office, the Office of the University Architect, and consultant Sasaki Associates, provides much-needed recreational space, enhances Penn’s connection to Center City Philadelphia, and introduces state-of-the-art stormwater management, storage, and reuse systems. By 2011, the former postal lands parking lots and adjacent recreation fields will be transformed into Penn Park: over 22 publicly accessible acres of tightly interwoven athletic facilities, formal and informal playing fields, and tree-lined biking, walking, and jogging trails. Penn Park will increase Penn’s open green space by 24 percent, and is truly a transformative urban campus amenity.

Landscape and Water Management: Water conservation is growing in importance to Penn, as natural and potable water systems are increasingly recognized as a critical component of livable cities, and water scarcity is identified as a limit to urban growth and economic viability. Water consumption has historically received little attention at the University, as in the past the costs for water were low, based solely on consumption, and not carefully documented. Stormwater runoff management was externalized to the City because the University had no practical way of reducing stormwater runoff, and because there was no incentive for private entities to manage local rainwater.

Fortunately, these conditions are now changing. The University is more thoroughly metering water use, has completed (in the summer of 2009) installation of more efficient showerheads and faucets in all College House student residences, and is in the midst of a three-year upgrade of campus irrigation systems to reduce water waste. The University Landscape Architect specifies only drought-resistant and native landscape species for gardens and plantings to reduce irrigation and maintenance needs. Penn is planning an upgrade to a state-of-the-art smart-irrigation system (in accordance with the *Climate Action Plan's* Physical Environment recommendations) that has the capacity to monitor soil conditions and provide the right amount of irrigation on a weekly basis.

The City of Philadelphia's new stormwater regulations require that any new development manage on-site the first inch of rainfall, without any additional water entering the city's combined sewer and stormwater system. The net effect of the new regulations is a dramatic reduction of "combined sewer overflows," which flush raw sewage into the Schuylkill River and Delaware River systems. Penn is doing its part: five new green roofs to capture and hold rainwater, a sophisticated stormwater management system at Penn Park, porous walkways and parking lot paving, and a rigorous regime of street tree planting on and off campus.

The Penn landscape management team employs best practices to enhance the environmental quality of open space in other ways as well. Pesticides and herbicides are not used except in response to specific infestations, and all leaves are collected, mulched, and used as topping in campus gardens. These sustainable practices extend beyond the West Philadelphia campus to Morris Arboretum and the New Bolton Campus. Excellent campus landscape and sustainable management practices demonstrate Penn's commitment to sustainability in an overt and teachable way, providing clear evidence to the Penn community of the administration's dedication to sustainability.

Business Services and Administrative Initiatives: Penn's Business Services Division (BSD) administers and manages such diverse

Appendix A: A Commitment to Teaching, Research, and Planning: Environmental Tradition at Penn

activities as student dining and housing, transit services, Penn's bookstore, conference planning, purchasing services, Penn's ice rink, and hotels. As part of the BSD's efforts to employ best practices and cost effective services, a number of important sustainability initiatives have been put in place over the years.

- *Purchasing Services* has implemented best practice standards for printing and office supplies to ensure that environmental concerns were considered by business administrators across campus. Examples of innovations include:
 - In a test pilot for one district of campus, office supplies were delivered in reusable boxes to cut down on cardboard waste;
 - The online purchasing website used by business officers across the University was reconfigured to direct users to more sustainable choices (recycled content paper, bulk purchasing, and recyclable products); and
 - Campus-wide preferred purchasing agreements were made with providers such as Quench water filters, which replaced bottled water in many offices across campus, reducing waste, and cutting costs.
- *Penn Dining* expanded the purchase of local foods through its collaboration

with the student group *FarmEcology* (see below), and also facilitated the use of Penn student dining plans at the weekly local farmers market on Penn's campus. In addition, Penn Dining partnered with a local non-profit start-up to turn Penn's trap grease into biodiesel, and participated in a month-long study to use the product in two of Penn Facilities' trucks. Starting in the fall of 2008, Penn's dining halls eliminated trays, saving over 110,000 gallons of water annually and achieving the reduction of greenhouse gases generated by heating water for dishwashing.

- *PennTransit* provides discounts and incentives to reduce the need for single-automobile commuting among Penn students, faculty, and staff. These include public transit subsidies and operating alternative transit options around campus, including local buses and door-to-door late night van service. See Section 5.7, the *Climate Action Plan's* Transportation recommendations, for a complete list of Penn's sustainable transportation activities.

The West Philadelphia Initiative: Of all Penn's initiatives, the West Philadelphia Initiative has probably had the greatest environmental impact. Penn has always embraced the challenge of existing within an urban space—seeking to combine University and city life, rather than exclude it. Whereas many

institutions have sought to separate themselves from their adjacent communities, Penn was founded on the vision that an education should be greatly enhanced by the surrounding city. Penn leaders and presidents throughout the University's history have worked to integrate the campus within the Philadelphia area, taking into account Penn's complex institutional needs and those of the neighboring community.

The University's investment in the revitalization of West Philadelphia during the mid-90s continued Penn's commitment to the urban condition, despite potential hardships. At the time, West Philadelphia was faced with soaring crime rates, a fleeing middle class, decaying properties, commercial vacancies, and the migration of faculty and students to other parts of the city or Philadelphia's suburbs. President Judith Rodin, however, was determined to rejuvenate Penn's urban environment. Taking into account the expressed desires and concerns of the community, Penn launched a series of initiatives aimed at restoring West Philadelphia as a bustling commercial, cultural, and academic hub. The University invested heavily in improved safety and cleanliness throughout the area, converted property at the edge of campus from parking lots into a lively retail and mixed-use space, provided homeowner benefits to University employees, supported local businesses and professionals, and – most importantly – founded the local Penn Alexander public school, to create a first-rate educational opportunity for area residents' children from kindergarten to eighth grade.

This comprehensive approach to investing in the surrounding neighborhood proved a huge success for Penn and the community, mitigating many of the problems formerly facing West Philadelphia. By thoughtfully integrating Penn's own interests with those of neighboring residents, the University managed to bring unprecedented social and economic change throughout the region. Crime rates have dropped significantly, Penn's students, staff, and faculty actively participate in neighborhood activities, home values have risen dramatically, artistic and cultural life is vibrant, and the West Philadelphia area is regarded as one of the region's most dynamic social, cultural, and economically successful neighborhoods. All over the world, urban planners and designers are trying to create what West Philadelphia already is: a dense, walkable, transit-oriented, diverse, and beautiful community, with good access to jobs, retail services, entertainment, and a first-rate primary education system.

Appendix B: Climate Action Plan: Budget & Carbon Reduction Estimates

2010-2014 ESAC Committees - Summary of Carbon Emissions Reductions

Item	Activity	2007 Baseline (MTCDE**)	362,142	Savings
		Five Year Emissions reductions by activity (MTCDE**)	Five Year Percentage reduced from FY07 baseline	
1	Utilities and Operations	86,478	23.88%	\$13,684,487.4
2	Physical Environment	TBD	TBD	TBD
3	Transportation	TBD	TBD	TBD
4	Waste Minimization and Recycling	TBD	TBD	TBD
5	Academics	+++++	+++++	N/A
6	Communications	+++++	+++++	N/A
7	Penn Green Fund	TBD	TBD	TBD
Totals=		86,478	23.88%	\$13,684,487.4

Key** MTCDE- Metric Tons of Carbon Dioxide Equivalents

Appendix C: Environmental Sustainability Advisory Committee (ESAC) Membership

ESAC Members:

ESAC Chair:

Anne Papageorge Vice President, Facilities and Real Estate Services

ESAC Leadership Team:

Dan Garofalo Environmental Sustainability Coordinator, Facilities and Real Estate Services
Laurie Cousart Director, Business Services
Sarah Abrams Assistant Environmental Sustainability Coordinator, Facilities and Real Estate Services
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Andy Huemmler Faculty, College of Liberal & Professional Studies
Marsha Lester Faculty, Chair of the Department of Chemistry, School of Arts and Sciences
Noam Lior Faculty, School of Engineering and Applied Sciences
Ali Malkawi Faculty, School of Design
Muscoe Martin Faculty, School of Design
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Vukan Vuchic Faculty, School of Engineering and Applied Sciences

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Kyle Rosato Environmental Manager, Environmental Health and Radiation Safety

Ramin Sedehi	Vice Dean, School of Arts and Sciences
Sara King	School of Arts and Sciences Facilities Planning and Operations
Anthony Sorrentino	Executive Director of Public Affairs, Office of the Executive Vice President
Khaled Tarabieh	Director of Project Management, Facilities and Real Estate Services
Eric Weckel	Director of Space Planning & Operations, School of Medicine

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Cassandra Giombetti	Doctoral Candidate, Graduate School of Education
Jonathan Lane	Graduate Student, School of Law
Kevin Levy	Undergraduate, School of Arts and Sciences
Mike Poll	Undergraduate, School of Arts and Sciences
David Slifka	Representative, Graduate and Professional Student Assembly
Wilson Tong	Undergraduate, Chair of Undergraduate Assembly, School of Arts and Sciences
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Appendix C: Environmental Sustainability Advisory Committee (ESAC) Membership

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Key

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Appendix C: Environmental Sustainability Advisory Committee (ESAC) Membership

Sustainability Team: Summer Interns 2008 & 2009

Bradley Dakake	Energy and Solar Power (Wharton MBA)
Maura Goldstein	Communications and Dining (BA in International Relations Candidate)
Brandon Gollotti	Energy Monitoring and Conservation, Eco-Reps Training (BA in Urban Studies Candidate)
Julian Goresko	Waste and Recycling and Community Initiatives (Master of Environmental Studies Candidate)
Rachel Heiligman	Transportation and Carbon Offsets (Master of City Planning)
Kara Medow	Carbon Footprint (Master of Architecture)
Chau Nguyen	Carbon Footprint and Building Metering (Master of Architecture)
Rebecca Popowsky	LEED Analysis (Master of Architecture & Landscape Architecture Candidate)
Alberto Tecce	AirCuity Laboratory Monitoring System (BSc in Electrical Engineering, Widener University)

Appendix D: Renewable Energy Certificates (RECs) Background

What is a REC?

A REC (pronounced: rĕk) represents the property rights to the environmental, social, and other nonpower qualities of renewable electricity generation. A REC, and its associated attributes and benefits, can be sold separately from the underlying physical electricity associated with a renewable-based generation source.

RECs provide buyers flexibility:

- In procuring green power across a diverse geographical area.
- In applying the renewable attributes to the electricity use at a facility of choice.

This flexibility allows organizations to support renewable energy development and protect the environment when green power products are not locally available.

How do RECs work?

All grid-tied renewable-based electricity generators produce two distinct products:

- Physical electricity
- RECs

At the point of generation, both product components can be sold together or separately, as a bundled or unbundled product. In either case, the renewable generator feeds the physical electricity onto the electricity grid, where it mixes with electricity from other generation sources.

Since electrons from all generation sources are indistinguishable, it is impossible to track the physical electrons from a specific point of generation to a specific point of use.

As renewable generators produce electricity, they create one REC for every 1000 kilowatt-hours (or 1 megawatt-hour) of electricity placed on the grid. If the physical electricity and the associated RECs are sold to separate buyers, the electricity is no longer considered “renewable” or “green.” The REC product is what conveys the attributes and benefits of the renewable electricity, not the electricity itself.

RECs serve the role of laying claim to and accounting for the associated attributes of renewable-based generation. The REC and the associated underlying physical electricity take separate pathways to the point of end use (see diagram). As renewable generators produce electricity, they have a positive impact, reducing the need for fossil fuel-based generation sources to meet consumer demand. RECs embody these positive environmental impacts and convey these benefits to the REC owner. The following is a list of the inherent primary and derived attributes that a REC can convey to an owner:

Primary REC Attributes

- Renewable fuel source
- Emissions of the renewable generation
- Geographic location of the generator
- Vintage of the generator
- Eligibility for certification or RPS

Derived REC Attributes

- Avoided emissions
- Eligibility for emission reduction credits or offsets
- Price stability
- Eligibility for certification or RPS

There are two approaches to verifying REC ownership and the right to make environmental claims:

- REC contracts and an audit of the chain of custody
- REC tracking systems (such as PJM GATS in Pennsylvania)

Both of these approaches help buyers avoid double counting and double claims and ensure against fraud. Of the two, REC tracking systems provide greater transparency when tracking RECs from their point of creation to their point of final use.

US EPA, Green Power Partnership, "Renewable Energy Certificates"

<http://www.epa.gov/greenpower/gpmarket/rec.htm>

(Accessed 08/28/09)

