Climate Action

iCAP

# *A Climate Action Plan*

for the
University of Illinois at Urbana-Champaign

MAY 15, 2010

ILLINOIS

## MESSAGE FROM THE CHANCELLOR

Climate Action

Two years ago, the University of Illinois at Urbana-Champaign enthusiastically signed on to the American College & University Presidents' Climate Commitment. We agreed to create institutional structures to guide the development and implementation of strategies that fulfill the commitment. Our Office of Sustainability and Sustainability Council led the effort and completed their task thoroughly and expeditiously. For example, our greenhouse gas inventory was completed in just twelve months.

Now I am pleased to present our completed institutional action plan. This will eventually make the University of Illinois at Urbana-Champaign carbon neutral for the first time. We believe the following plan provides a realistic framework for these actions. The plan outlines a structure for which more detailed analysis, dialogue, and refinement will take place. In this plan you will find:

- A target date that achieves carbon neutrality as soon as possible

- Interim targets for goals and actions that will lead to carbon neutrality

- Actions that make carbon neutrality and sustainability a part of our overall curriculum and that will lead to a broad set of targeted educational experiences for our students

- Actions to expand research and other efforts necessary to achieve carbon neutrality

- Mechanisms for us to track progress on goals and actions.

We intend our plan to provide a macro-level, carbon neutral vision for the campus with stretch goals and strategies for their achievement. This is just the beginning to a greener future for sustainability on our campus. More detailed plans and micro-level implementation strategies will evolve in numerous ways within our organization in coming months and years.

Our intentions are clear and our goal remains ambitious: to be the model of sustainability for all universities in the nation.

**Robert A. Easter**
*Chancellor and Provost (Interim)*

May 15, 2010

## SUMMARY

In 2008, the University of Illinois at Urbana-Champaign (the University or Illinois) signed the American College & University Presidents' Climate Commitment. This action committed the campus to carbon neutrality by the year 2050. This Illinois Climate Action Plan (iCAP) describes a path toward the fulfillment of this commitment. As the flagship public university in the state of Illinois, the campus has a moral and ethical responsibility to lead, to set aggressive goals, to work to meet them, and to serve as a model for the community, state, and nation.

The Plan represents a roadmap to a new, prosperous, and sustainable future for the University. It outlines strategies, initiatives, and targets toward meeting the stated goal of carbon neutrality by 2050.

**Campus Vision**

The campus Strategic Plan from 2007 envisions an Illinois Sustainable Energy and the Environment Initiative that focuses on power generation and networks, transportation and portable energy, water supply and use, and landscapes and urban architecture. It envisions a learning laboratory for demonstration of sustainable technologies and curricula to prepare students with skills required to tackle the challenges of a sustainable society.

The Strategic Opportunity in Global Sustainability Challenges: A Vision for the University of Illinois at Urbana-Champaign document proposes a vision of the future for the campus in addressing two long-term global societal sustainability challenges: (1) To maintain or restore natural ecosystem function while providing essential human services; and (2) To sustainably raise the quality of life for the world's poor to acceptable levels.

This Climate Action Plan is the refinement of the first challenge into tangible actions and activities that lead directly to greenhouse gas (GHG) reductions.

**Emissions Inventory**

The total campus emissions inventory for fiscal year 2008 (the base year) was 570,000 Metric Ton Equivalent (MTE) of carbon dioxide ($CO_2$). Approximately 85 percent of these emissions are a direct result of the need to heat, cool, and operate campus buildings. Most of the energy produced for building operations comes from the combustion of coal and natural gas at Abbott Power Plant and the rest through purchases of electricity from outside sources. Other emission sources on campus are found in transportation systems and patterns (commuting, fleet, and air-travel), agricultural emissions from the south farms, water use, solid waste, and other fugitive sources. This Plan details specific strategies, reduction targets, and recommended actions for each contributing source toward directly reducing emissions and meeting the goal of carbon neutrality.

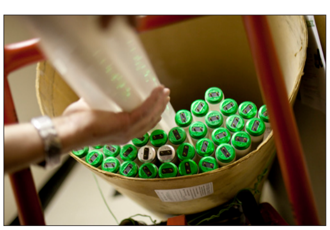
## Strategies

Energy is by far the largest contributor to the campus' emissions inventory. The iCAP focuses on a detailed strategy of building energy conservation, de-carbonizing generation systems, and the addition of renewable energy sources. This "conserve-and-load" approach is achievable, affordable, and implementable. The Plan calls for a reduction in building energy use of 40 percent by 2025. This requires comprehensive energy conservation efforts with contributions from a variety of sources including: building retro-commissioning (RCx), heating, ventilating, and air conditioning (HVAC) improvements, and lighting retrofits as examples. The intent of this aggressive conservation plan will allow campus to have a plan in place by 2012 that outlines how the University will eliminate coal combustion by 2017. The University also seeks to meet the state's Renewable Portfolio Standard of 25 percent renewable energy use by 2025.

The University seeks to significantly reduce emissions from transportation by 2025 (with a goal of 50 percent) by encouraging alternative modes of commuting to campus, exploring central campus movement and parking patterns, encouraging telecommuting and improving bicycling infrastructure. A "no net increase" in building square footage (after current planned projects are completed), aggressive energy and green standards for any new or renovation projects, and the elimination of some of the existing building stock, will help us achieve GHG emission neutrality. The Plan calls for increased recycling, sustainable agriculture on the University's South Farms, methane capture from livestock manure, and setting up local food and composting systems. It also calls for water conservation, a local carbon registry, the ability to purchase local carbon offsets, and the implementation of a carbon sequestration program. The implications of the power requirements of National Petascale Computing Facility are also analyzed. Finally, the cumulative effect of all the recommendations and strategies are captured in an emissions mitigation wedge chart that shows the campus' emissions trajectory declining to zero by 2050.

## Commitments

The targets and strategies detailed in this report represent a series of commitments the University is making in order to achieve its goal of carbon neutrality by 2050. The 11 core commitments outlined below are based on the campus emissions inventory, projections for future emissions, targets, and scenario strategies that were developed as part of a larger climate planning process for the campus.

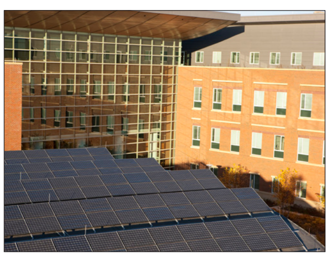


**Energy Conservation.** In the near term, the University will implement decentralized energy billing at the college level in 2011. The University will attain a 30 percent reduction in total building energy use (excluding Petascale; see Section 3.1.2) by fiscal year 2020 as compared to fiscal year 2008, and a 30 percent reduction in associated building related emissions. Appropriate maintenance levels will be allocated to ensure that energy reductions are sustained.

**Financing.** The University will establish a dedicated, centrally coordinated funding pool for energy conservation projects within the next three years. This "clean energy" fund will allow for both internal (student fees, faculty contributions, staff contributions, energy savings reinvestment, capital programs), and external (programs, rebates, donations, outside investors) participation. It will be established as a capital infusion and coordination mechanism aimed at physical energy and energy cost reductions that also allows for the sustained maintenance of these investments.

**Coal Use at Abbott Power Plant.** The University will cease all investments intended to extend the operating life of coal-fueled systems at Abbott Power Plant. A detailed study that examines campus energy generation and distribution systems will be made by 2012. The study will specifically identify the earliest possible date for the elimination of coal steam production. The study will also evaluate the potential for: 1) eliminating summer coal use in the near term; 2) eliminating all coal use by 2017; and 3) alternative means of generating and distributing thermal energy (hot water distribution, regeneration, geothermal looping) in the long term.

**Renewable Energy.** The University will satisfy at least 5 percent of all its electrical energy needs through renewable energy generation systems by 2015, and 25 percent by 2025 as targeted by the Illinois Renewable Portfolio Standards (ILRPS). At least one utility scale wind turbine will be installed by fiscal year 2011, with the goal of installing two additional turbines if feasible.



**Transportation.** The University will implement the campus bicycling master plan. A bike-sharing program will be created by 2012. By 2015, a Greenhouse Gas fee will be imposed on all automobiles registered or parked on campus.[1] The fee structure will be based on the relative efficiencies of the car make and model. The University will enact a system for purchasing local emissions offsets from air travel impacts, with a voluntary program beginning by 2012 and will recommend to the Board of Trustees to move to mandate a required program by 2016.

**Building Standards.** The University will require all new buildings and major renovations to meet the Leadership in Energy and Environmental Design (LEED) Gold Standards by 2011.[2] By 2015, these requirements will be raised to LEED Platinum, and applied to Urbana-Champaign property. Additionally, all currently planned new construction and major renovation projects will be required to demonstrate at least a 30 percent improvement in building energy performance over the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) 90.1 (latest year) standards for total building energy use.

**Campus Lands and Space.** The University will enact a "no net increase in space" policy for the entire campus by 2012, applicable to all space controlled by campus including auxiliary units and rental space. The University will develop and implement a sustainable landscape plan devoted to planning for and implementing sustainable landscapes and landscape maintenance practices. It will also implement a pilot methane capture project at the South Farms by 2015.

**Procurement and Waste.** The University will implement full-cost accounting and life-cycle analysis structures on all campus building projects of more than $1 million in fiscal year 2011 and on all major campus purchases (total exceeding $25,000) by 2015. The University will exceed the state local food procurement standards by making more than 30 percent of food purchases from local sources (within 100 miles) by 2015. The University will commit to a Zero Waste campus policy by 2012, a large-scale food composting project by 2012, and target an increase in the University's waste diversion rate to 75 percent by 2020.

**Water.** The University will ramp up water conservation efforts, with a potable water reduction target of 20 percent by 2015. Opportunities to utilize non-potable sources will be harnessed, including connecting the existing raw water system by 2020. Water costs will be included in the energy billing program.

**Planning.** The University will commission a detailed food and non-food consumption and waste study that outlines current data, future projections, and strategies for minimizing consumption and meeting those projections with locally derived resources. The University will also commission a detailed water use baseline and "true cost of water" study.

**Follow Through.** The University will assign specific individuals the task of developing detailed plans for achieving the above commitments. Individuals and units will also be tasked with implementing these plans. The University will integrate an annual review process that will track progress related to each commitment. This will be an integral part of the Campus Strategic Plan review process. The University will engage the University Community (students, faculty, and staff) in the data collection, analysis, and progress review process. The progress of the plan will be closely monitored and highly publicized.

## Educational and Research Opportunities

All the strategies, inventories, and initiatives in this iCAP present educational and research opportunities for campus. The conversion to a carbon neutral campus will be part of the University's core educational mission.

*As a world-class university, Illinois has the capacity and the obligation to assume a leadership role in climate destabilization research and action. We believe it can inspire a wide range of exciting and crucial scholarship, while developing cross-campus partnerships, and engaging our students. The emergence of climate destabilization as both a global and local issue offers a rare opportunity for the University community to unite around a common cause.*

## Next Steps

This plan provides a framework for action and a structure for which more detailed analysis, dialogue, and refinement will take place. It is intended to provide a macro-level, carbon neutral vision for the campus with stretch goals and strategies for their achievement. More detailed plans and micro-level implementation strategies will take place in numerous ways within our organization in the coming months and years. The Plan and related ideas and opportunities will no doubt evolve.

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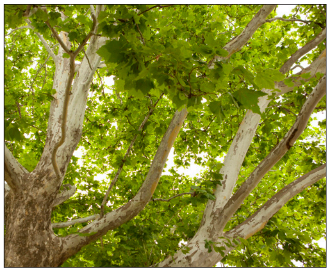
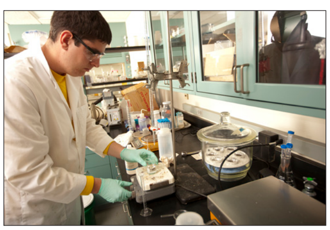
# 1 INTRODUCTION



Climate change is a real and significant threat to humankind (IPCC 2007). The campus response to this threat presents opportunities to create a more livable, equitable, and economically vibrant University community. By using energy more efficiently, harnessing cleaner and renewable energy to power buildings, enhancing access to sustainable transportation modes, conserving campus resources, recycling and composting campus waste, and developing vibrant local food systems, we can keep dollars in the local economy, create jobs, improve the quality of life, and lead the state in its resolution of this important issue.

This Illinois Climate Action Plan (iCAP) represents a roadmap to a new, prosperous, and sustainable future for the University. It outlines strategies, initiatives, and targets toward meeting the University's obligations to the American College & University Presidents' Climate Commitment (ACUPCC) and stated goal of carbon neutrality by 2050.

To accomplish this, the campus will build upon the University's rich history of environmental research, education, and service by developing innovative approaches to understanding, resolving, and engaging communities in the important issue of climate change. This Plan will enhance the University's reputation for providing high-quality talent and knowledge to the state of Illinois by preparing the next generations of Illinois graduates to confront future climate issues with confidence. The strategies for how campus proposes to achieve this are described below.



## 1.1 Background

The literature suggests that the impacts of climate change will be significant. And although the increase of GHG concentrations might be slowed and eventually reversed by reducing emissions, some of the impacts of climate change are irreversible. There is a trade-off between avoiding irreversible policy cost and irreversible damages. While it is not possible to change the irreversible nature of some damage caused by climate change, its cost to society can be lessened through efficient adaptation policies (PCAP 2008).

Because of the severe "lag-effects" in the atmospheric system, climate stabilization requires sustained action over several decades in order to achieve the necessary cuts in GHG emissions. There are various emissions targets for state, national, and international entities that are available to help guide us. These targets seek to stabilize a global equivalent[3] of $CO_2$ in the atmosphere at 450ppm. It is estimated that this is the level that will limit a global temperature rise of 2.0°-2.4°C (IPCC 2007). Long-term emissions targets usually seek a reduction of 80 percent or greater. According to the Intergovernmental Panel on Climate Change (IPCC), this means a cut in emissions by about 40 percent by 2020 (compared to 1990 levels[4]). The current target in the state of Illinois is to achieve a reduction to 1990 levels by 2020 although the state has also set Energy Efficiency and Renewable Energy Portfolio Standards that are more aggressive (asking that electric utilities in the state conserve and produce 10 percent of their energy from renewable sources by 2015 and 25 percent by 2025). The Presidents' Climate Commitment signed by Illinois encourages climate neutrality by 2050.[5]

## 1.2 Approach

The approach to planning for climate neutrality by 2050 requires that the University first establish a baseline emissions inventory from which to assess strategies and to measure success. This baseline represents the total emissions produced by each of nine sectors for 2008. This will establish the conditions from which scenario strategies can be tested. In this case, 2008 is the base year since it represents the maximum GHG emissions to date.[6]

Following the *Summary Document* and the *Introduction*, the iCAP is organized into eight subsequent sections. Section 2, *Carbon Inventory*, describes the state of the campus in the baseline year, estimating how many GHGs campus currently emits. Section 3, *Commitments* outlines goals for reaching neutrality. Section 4, *Strategies for GHG Reductions* is a detailed analysis of nine major component areas and some resultant strategies for GHG reductions in each: energy conservation, energy generation, transportation, agricultural emissions, water, space management, purchasing and recycling, sequestration, and other offsets. The results of implementing these strategies are outlined in Section 5, *Campus Scenario Results*. It shows generally how campus can achieve the desired 2050 goal of carbon neutrality. *Cultivating a Climate Culture* and *Committed to Change*, the titles of Sections 6 and 7, outline just a few of the many things that are already underway as they relate to climate issues alongside the University's education, research, and engagement missions. Section 8, provides *Conclusions,* and Section 9, *Appendices* contains much of the background information, references, and parallel information needed to complete the document.

## 1.3 Process

The process the campus has initiated for building the iCAP follows a classic "challenge" approach. Information is delivered that challenges some basic assumptions and provides the basis for discussion. In this case the information challenge was provided by the first draft of this Plan. It is followed by a public review process where the challenges can be addressed more directly. Once the review has been completed another version of the draft can be circulated for further refinement or review.

The first draft of the iCAP was publicly presented in February 2010 to approximately 50-60 persons. Smaller discussion groups were formed to discuss the Plan more specifically. Following the public exchange, teams were organized of potential reviewers to individually address specific sections of the Plan. Their feedback has been reviewed and implemented in subsequent versions.

The hope is that this version becomes the basis for future analysis, discussion, scholarship, and research. The University also encourages neighboring communities to engage in the process and together produce a more robust and communicative agenda for mitigating emissions at a regional scale.

# 2 CARBON EMISSIONS INVENTORY

Figure 1 describes the baseline Carbon (equivalent) Emissions Inventory for 2008. Emissions generated by energy production used in heating, cooling, and generating electricity for buildings are the main contributor to campus GHG emissions. The primary source of this production is the Abbott Power Plant, where steam is produced by firing coal or natural gas. This steam is used to both heat campus buildings directly (co-gen steam) and to produce electricity used for building cooling and electrification (co-gen electricity). Together they account for 63 percent of the total campus emissions. Electricity purchased from other sources (purchased electricity[7]) is responsible for another 21 percent of campus GHG emissions. These main emission contributors account for almost 85 percent of campus GHG emissions and need to be targeted aggressively in order to achieve carbon neutrality goals.

Based on currently available data, the total contribution of campus transportation systems and habits contributes around 10 percent of the total campus GHG emissions. Air travel is estimated to be about 7 percent of the campus total (or 70 percent of the transportation estimate). Campus owned vehicles and aircraft (through the Institute of Aviation) contribute about 1 percent, and transportation emissions from faculty and staff commuting patterns contribute approximately 2 percent of the total GHG emissions. Agriculture activities on the South Farms are responsible for another 1 percent of carbon emissions. Solid waste is responsible for an estimated 2 percent of emissions, mostly from methane released from wastes generated by campus activities. The impacts of refrigerants have not yet been assessed, although it has been found to be relatively minor in most other campus inventories. The impact of water use also has not yet been captured. It is fairly well known that certain energy efficient activities also can help reduce water consumption and its subsequent disposal and treatment. However, the embedded GHG emissions associated with the treatment of potable water and the treatment of wastewater are usually ignored. Since the University is a major water user and waste water generator, the significance of indirect GHG emissions associated with water use will be evaluated in future inventories.

To summarize, the Urbana-Champaign carbon emissions inventory reports on nine core sources that include:

1. Coal use at Abbott Power Plant
2. Natural gas use at Abbott Power Plant
3. Purchased electricity consumption
4. Agriculturally generated emissions
5. Air travel
6. University fleet and aircraft
7. Faculty and staff commuting
8. Solid waste
9. Other fugitive emissions

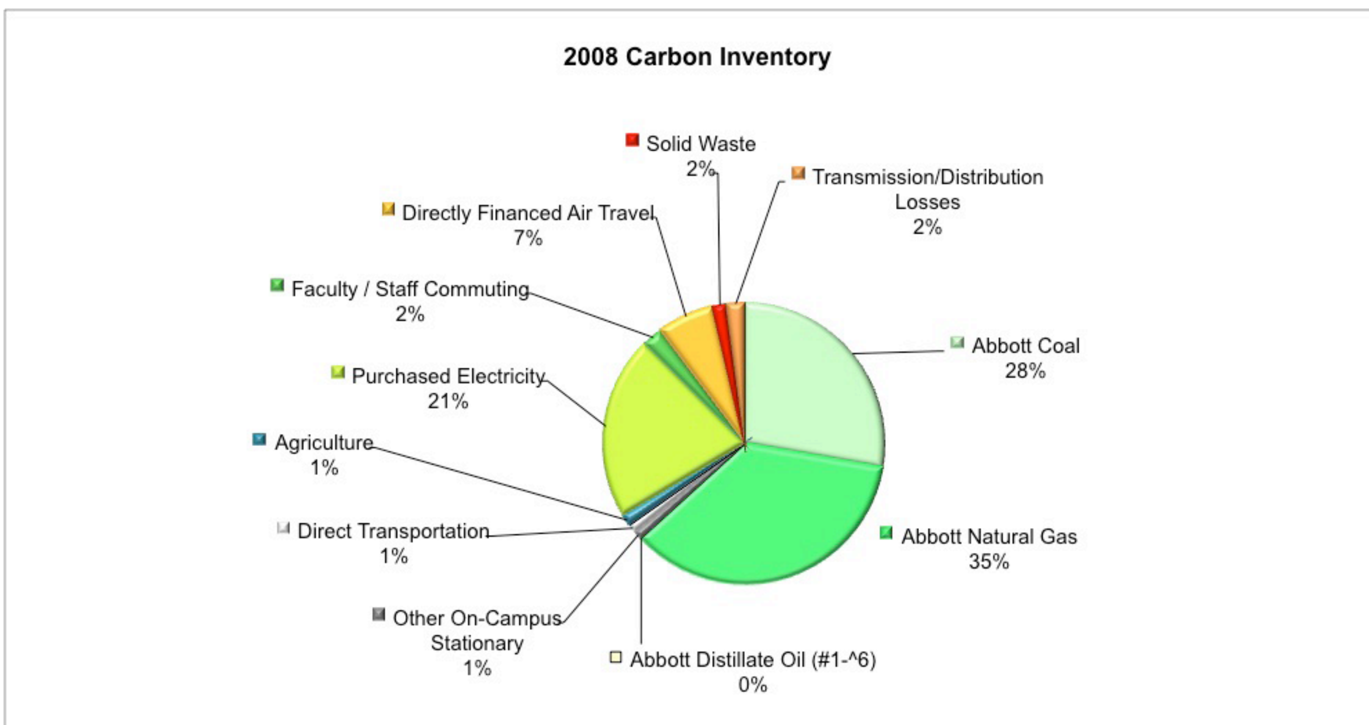



*Figure 1. 2008 University of Illinois Carbon Inventory. This is the baseline campus footprint by GHG emissions contributors.*

## 2.1 A Projection of Carbon Emissions

Campus carbon emissions have generally trended upward in the last decade and a projection based on this past performance would also describe a generally increasing slope (Figure 2). As described above, the campus source energy production has a profound impact on emissions (generally about 85 percent). But one difficulty in assessing a trends based projection is that energy consumption alone does not tell a complete story. In fact, even though a reduction in energy use would have a positive effect on emissions, because natural gas produces about half as much $CO_2$ (per energy output) as coal, adjustments in the campus source energy production fuel mix could easily overshadow these energy reduction effects.

Beginning in fiscal year 2007, the campus began an aggressive building energy conservation effort with a goal of reducing per square foot energy consumption by 10 percent in three years. From fiscal year 2008 to fiscal year 2009, source energy consumption (purchased electricity, Abbott Power Plant, and other on-campus stationary sources) was reduced by nearly 6 percent—an admirable one-year reduction. Campus carbon emissions, however, decreased only 2.2 percent. This disparity is due to the fuel mix used to produce energy in that time period (a 15 percent increase in coal use). Generally, decisions on fuel mix are based on price signals; when the price of natural gas is favorable, campus tends to burn more natural gas than coal and campus emissions are low. Likewise, when the price of coal is favorable (as it was in 2008-2009) campus emissions increase. Emissions from energy production through the combustion of coal and natural gas at Abbott can produce between 300,000 MTE of $CO_2$ per year for an all-natural gas mix to 540,000 MTE of $CO_2$ for an all-coal mix (if the University were able to completely source all campus steam needs from either fuel). In 2008, the baseline year, source energy production emissions peaked at 480,000 MTE of $CO_2$. Therefore, although controlling demand is an integral part of any climate action plan, the source energy supply can be equally critical in meeting carbon reduction goals.

Figure 2 describes campus emissions projected to 2050 based on a trends analysis of past and current inventories. Similar to the current inventory, it is dominated by source energy production (electricity, steam, and purchased power) with other emissions (transportation, agriculture, and solid waste) contributing to the total. The National Petascale Supercomputing Facility[8] is shown to begin contributing to emissions in 2011. The analysis assumes that the 2008 fuel mix remains constant,[9] along with a continued increase in demand (generally from a continued and constant rate of growth in building square footage). The dips and peaks in the graph describe actual emissions data from 2001-2009. Year-to-year differences are the result of yearly variability in both supply and demand. Demand varies as a very fundamental response to varying weather conditions (the need for heating or cooling energy differs year to year). Supply based fluctuations are due to differences in fuel mix.

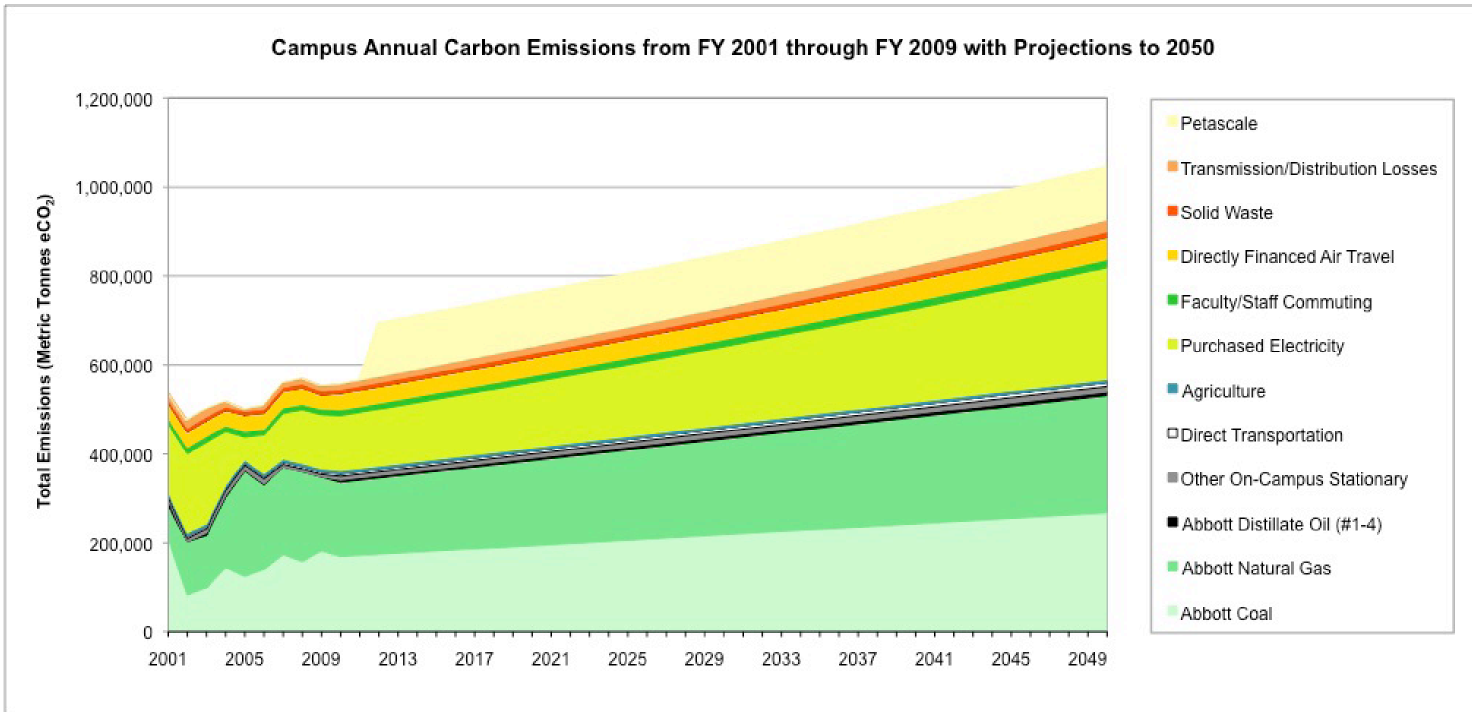



*Figure 2. Campus annual carbon emissions from fiscal year 2001 through fiscal year 2009 with projections to 2050.*

# 3 COMMITMENTS

The targets and strategies detailed in this report represent a series of commitments the University of Illinois at Urbana-Champaign is making in order to achieve its goal of carbon neutrality by 2050. The 11 core commitments outlined below are based on the emissions inventory, projections for future emissions, targets, and scenario strategies that were developed as part of a larger climate planning process for the campus.

## 3.1 Energy Conservation

In the near term, the University will implement decentralized energy billing at the college level in 2011. The University will attain a 30 percent reduction in total building energy use (excluding Petascale; see 3.1.2) by fiscal year 2020 as compared to fiscal year 2008, and a 30 percent reduction in associated building related emissions. Appropriate maintenance levels will be allocated to ensure that energy reductions are sustained.

### 3.2 Financing

The University will immediately establish a dedicated, centrally coordinated funding pool for energy conservation projects. This "clean energy" fund will allow for both internal (student fees, faculty contributions, staff contributions, energy savings reinvestment, capital programs), and external (programs, rebates, donations, outside investors) participation. It will be established as a capital infusion and coordination mechanism aimed at physical energy and energy cost reductions that also allows for the sustained maintenance of these investments.

### 3.3 Coal Use at Abbott Power Plant

The University will cease all investment in coal-fueled systems that extend the life of coal assets at Abbott Power Plant beyond operating expenses.[10] The University will commission a detailed study by 2012 that examines campus energy generation and distribution systems specifically tasked with planning for: 1) eliminating summer coal use; 2) eliminating all coal use by 2017; and 3) generating and distributing thermal energy more efficiently (through hot water distribution, regeneration, geothermal looping, etc.).

### 3.4 Renewable Energy

The University will satisfy at least 5 percent of all its electrical energy needs through renewable energy generation systems by 2015, and 25 percent by 2025 as targeted by the ILRPS. At least one utility scale wind turbine will be installed by 2011.

### 3.5 Transportation

The University will implement the campus bicycling master plan. A bike-sharing program will be created by 2012. By 2015, the University will impose a Greenhouse Gas fee on all automobiles registered or parked on campus.[11] The fee structure will be based on the relative efficiencies of the car make and model. The University will use this revenue to provide incentives to reduce transportation emissions. The University will also enact a system for purchasing local emissions offsets from air travel impacts, with a voluntary program beginning by 2012 and will recommend to the Board of Trustees to move to mandate a required program by 2016.

### 3.6 Building Standards

The University will require all new buildings and major renovations to meet LEED Gold Standards by 2011.[12] By 2015, these requirements will be raised to LEED Platinum and applied to all University of Illinois at Urbana-Champaign property. Additionally, all currently planned new construction and major renovation projects will be required to demonstrate at least a 30 percent improvement in building energy performance over ASHRAE Standard 90.1 (latest year) for total building energy use.

### 3.7 Campus Lands and Space

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### 3.9 Water

The University will ramp up water conservation efforts, with a potable water reduction target of 20 percent by 2015. Opportunities to utilize non-potable sources will be harnessed, including connecting the existing raw water system by 2020. Water costs will be included in the energy billing program.

### 3.10 Planning

The University will commission a detailed food and non-food consumption and waste study that outlines current data, future projections, and strategies for minimizing consumption and meeting those projections with locally derived resources. The University will also commission a detailed water use baseline and "true cost of water" study.

### 3.11 Follow Through

The University will assign specific individuals the task of developing detailed plans for achieving the above commitments. Individuals and units also will be tasked with implementing these plans. The University will integrate an annual review process that will track progress related to each commitment. This will be an integral part of the Campus Strategic Plan review process. The University community (students, faculty, and staff) will be engaged in the data collection, analysis, and progress review process. The progress of the plan will be closely monitored and highly publicized.

### 3.12 Long-Term Commitments

#### 3.12.1 Long-Term Energy

The University will reduce total building energy consumption by 40 percent (excluding Petascale) by fiscal year 2025 as compared to fiscal year 2008, and achieve 40 percent emissions reductions in the building sector from these demand-side measures. The University will meet or exceed the targets for renewable energy generation targets in the ILRPS—25 percent in 2025 with a focus on campus generation. By 2025, all new construction or substantial renovation projects will be net energy neutral or net energy providers. When the next contract is negotiated, the University will impose charges for the purchase of renewable energy at the National Petascale Computing Facility and on any new energy user of similar scope.

#### 3.12.2 Other Long-Term Commitments

By 2025, the campus will reduce water use and treatment to reduce its associated carbon emissions by 40 percent. All methane produced from the campus' South Farms operations will be captured and utilized for energy generation by 2020.

## 4 STRATEGIES FOR GHG REDUCTIONS

Following are the targets and scenario strategies that will enable the campus to satisfy its commitments and reach the stated 2050 goal of carbon neutrality.

### 4.1 Energy Conservation

Energy conservation is considered the easiest and most cost-effective way to achieve reductions in GHG emissions. Opportunities for conservation on campus are great.

**Conservation Strategies**

A recent evaluation of potential energy conservation measures on campus was performed by the international consulting firm Science Applications International Corporation (SAIC). The subsequent report described conservation strategies with the potential to reduce campus energy use by about 32 percent, resulting in a 114,500 MTE $CO_2$ reduction (this is about 22.5 percent of current emissions). According to SAIC, these energy and emissions reductions require a capital investment of $151 million, with an annual return of $9.8 million in the form of avoided energy expenses (this represents about a 15-year simple payback). As a starting point, the University will commit to carrying out all of the SAIC-prescribed energy conservation measures with a target date for completion of 2022.

The SAIC report breaks down the potential energy savings in the following way:

- Lighting – 1.65 percent of total energy consumption (5.6 percent of total electricity consumption)
- Envelope – 4.1 percent of total energy consumption
- Retro-commissioning (RCx) – 8.4 percent of total energy consumption
- Other HVAC – 12.4 percent of total energy consumption
- Fume Hoods – 0.75 percent of total energy consumption
- Hot Water – 4.4 percent of total energy consumption
- Computing – 0.06 percent of total energy consumption.

Using the SAIC report as a starting point, additional energy savings were identified in the following areas: lighting, envelope, building commissioning, fume hoods, behavior, and information technology (IT).[13]

**Lighting:** The campus is in the process of retrofitting older T12 fluorescent lighting fixtures by replacing them with more energy-efficient T8 (or T5) fixtures and electronic ballasts. The lighting retrofit proposed in the SAIC report would reduce campus energy consumption by ~1.6 percent; a very small amount of this is due to the use of occupancy sensors and day lighting controls. Extending this retrofit to smaller campus buildings, replacing other lighting fixtures (besides T-12s), and a wide deployment of both occupancy and daylight sensors (which can reduce lighting use by 20 percent to 80 percent depending on location) should be able to provide significantly more energy savings than predicted in the SAIC report. The campus target for lighting is 2 percent.

**Envelope:** The SAIC report derives most of its envelope-related savings from window replacement and roof insulation, assuming that only 1 percent of campus energy can be saved by weatherization. The report did not consider changes such as entry-way retrofits to reduce heat loss during entry and exit or improvements in insulation in areas besides roofs. Additionally, the report made no estimation of chilled water savings due to either weatherization or wall insulation, or any potential savings from decreasing heat gain through roofs due to improved reflectivity or vegetative roofs. Improvements to building envelope, weatherization, improving insulation levels in roofs and other areas, and tightening building infiltration and exfiltration would offer a 4 percent reduction in campus energy use, though more is highly likely. The campus target for envelopes is 1 percent.

**Building (Retro) Commissioning:** Commissioning for existing buildings (sometimes referred to as retro-commissioning or RCx) is a systematic process for investigating, analyzing, and optimizing the performance of building systems by improving their operation and maintenance to ensure their continued performance over time. This process helps make the building systems perform interactively to meet current facility requirements. The campus RCx teams have found a 29 percent average reduction in energy use and emissions for the 14 existing buildings (2,347,170 sq. ft.) they have examined. This success rate shows that there is enormous potential for this reduction strategy. Campus RCx activities have included: repairing and recalibrating sensors, valves and dampers, upgrading control systems, demand control ventilation, and implementing scheduling for air handling units, among others. The current RCx program is being augmented by several Energy Service Company (ESCO) contractors. A plan to revisit every building on a 5- to 8-year basis should also be instituted in order to maintain these savings. A direct-digital control command center to monitor temperature control and alarms to determine when systems fail or inappropriate temperature settings are being utilized will be constructed by the end of calendar year 2012. Based on the campus RCx program performance to date, savings proposed by SAIC for this section can be increased. The new target for RCx is 12 percent.

**Fume Hoods:** The campus is estimated to have between 1,700 and 1,800 fume hoods in operation at the present time. The majority of these are constant air volume (CAV) hoods without heat recovery that operate continuously. Several hundred variable air volume (VAV) hoods also exist, which are in operation only when the hood sash is raised. These hoods, however, are often operated continuously. Based on a Trane TRACE energy model for a typical fume hood on campus, the cost of conditioning air to replace the air vented by a CAV fume hood over the course of a year is estimated to be approximately $5,500 per year. The energy model also predicts an energy usage for VAV hoods, CAV hoods using heat recovery, and VAV hoods using heat recovery to cost about $2,100, $3,200, and $1,500, respectively. Fewer than 200 of the campus' 1,700 fume hoods are VAV. These figures provide an opportunity to significantly reduce fume hood energy consumption. If the campus takes into account some portion of fume hoods that utilize VAV or heat recovery, the University can conservatively assume the average cost of hood operation to be $3,750 per year. Using this average cost, the total energy cost that can be attributed to campus fume hoods is roughly 9 percent of the campus total. The University believes the physical number of fume hoods in operation can be reduced by 20 percent to 25 percent. This is based on the fact that many rooms have multiple hoods that do not require simultaneous use, and that many of these fume hoods are currently used for chemical storage and cannot be removed. The remaining fume hoods should all be converted to VAV systems with heat recovery—these can reduce a CAV hood's energy consumption by 70 percent. This strategy will also require an educational component. Groups and individuals will need to be educated on operating hoods correctly and to shut the hood sashes when not in use. The above actions can reduce campus energy consumption by at least 2 percent. Our new target for fume hoods is 2 percent.

**Information Technology (IT) and Electrical Equipment:** The SAIC report assumes very little potential for savings from the purchase of ENERGY STAR® equipment such as computers and printers. Thin client computers being deployed on campus today offer the potential for a 90 percent reduction in energy use compared to desktop computers. A broad deployment of low-energy computing equipment, server virtualization, consolidation of IT facilities (web servers, file servers, terminal servers) and reduction in the total number of server instances can all yield significant savings on both costs, equipment purchase expenses, and campus IT costs. Use of standards more aggressive than ENERGY STAR® for all equipment purchases (i.e. washers and dryers in residence halls, etc.) can yield substantial savings. Students are becoming increasingly independent of campus computer labs, preferring to remotely access campus computing resources as needed. Campus' decentralized IT status results in a disparity of these and other practices. For example, many IT groups discourage users to enact computer power management settings or turn off their computers in the evening and the weekends to allow for security upgrades. However, technologies such as Wake or LAN can allow computers to be powered down and reactivated for upgrades. The target for IT and other electrical equipment is 1 percent.

**Behavioral Changes and Incentives:** Although the SAIC report describes the potential energy savings from behavioral changes in its section on metering, it does not include it in its analysis. The University believes a well designed incentive and education program can reduce campus energy consumption by at least 5 percent. Such a program should seek to ensure that cost savings from energy conservation measures benefit building users (e.g. "energy rebates" to students in high-performing departments, or energy-driven reductions in overhead rates for faculty). In addition, adding real-time energy displays in campus buildings and via electronic media can help promote awareness and incentive for improvement. Many buildings have limited or no control over their thermostat settings. However, the departments that occupy these spaces do get a substantial influence in setting building temperatures and enacting more reasonable settings. This will require behavioral change from the academic units and the building occupants. The target for behavioral changes is 5 percent.

**Other HVAC:** This category includes conversion from constant air volume reheat to variable air volume, eliminating summer steam usage (reheat), heat recovery, variable speed drives for fans and pumps, and steam system maintenance (including trap replacement and pipe insulation). The target for other HVAC is 12.5 percent.

**Hot Water:** This category includes using instantaneous and semi-instantaneous hot water heaters, increasing insulation on hot water tanks, utilizing recovered heat from chiller condensers and other sources, and temperature setbacks. The target for hot water is 4.5 percent.

Given improvements in the above areas, the revised set of targets for energy conservation is the following:

- Lighting – 2 percent of total energy consumption
- Envelope – 1 percent of total energy consumption
- RCx – 12 percent of total energy consumption
- Other HVAC – 12.5 percent of total energy consumption
- Fume Hoods – 2 percent of total energy consumption
- Hot Water – 4.5 percent of total energy consumption
- IT and Electrical Equipment – 1 percent of total energy consumption
- Behavioral Changes – 5 percent of total energy consumption.

These new energy conservation targets represent the potential to reduce energy consumption on campus by 40 percent by 2025. Carbon emissions reductions lag behind energy use reductions since the largest proportion of savings are expected from reductions in steam and chilled water use, with electricity savings lagging behind. Since campus power generation is based on steam production and not electrical power demands, this means that a greater fraction of power will need to be purchased off campus. This may cause emissions to be slightly higher than expected because by co-generating the steam, the on-campus power generation footprint is generally lower than that of the purchased power.

Continued savings will require larger-scale renovations or replacements of the existing building stock. This measure is shown in the University's mitigation chart (Figure 6) as a "Green Building" wedge. Adopting new low-energy building standards for these large-scale projects is critical. This is a far better tool than mandating specific projects.

One more note on conservation: The success of the RCx team has been partially enabled by a significant shortfall in maintenance funding through the years. RCx is able to capture the potential energy savings of years of deferred maintenance in one swoop. This makes it look much more attractive than it might otherwise. In order to continue on the path that RCx has established, an increase in support for maintenance with an emphasis on energy conservation needs to occur to sustain these savings. Several of the energy conservation strategies previously mentioned will require ongoing maintenance to sustain the level of expected savings. Continuing to defer maintenance will cost us several years of energy savings opportunities. Many of these activities, like replacing steam traps, fixing hot water valves, and cleaning ductwork, have tremendously short, simple paybacks (some less than one year). Furthermore, it is essential that campus begins to manage buildings as whole systems and train Facilities & Services staff to do so. One recommendation from a facilities manager was to have a staff member responsible for overall building maintenance for several buildings, responsible for keeping an eye on the individual's buildings, ensuring air-handler settings are not tampered with, and holistically managing maintenance issues. This type of paradigm shift for building management is critical to retaining savings. Some decentralization of building controls to local users may also be necessary, especially if staff levels at Facilities & Services are not restored.

**Building Energy Conservation Targets and Strategies**

*Targets*

The University will meet the following goals compared to fiscal year 2008 energy and emissions levels for existing buildings:[14]

1) Reduce building energy consumption by:
   a) 20 percent by fiscal year 2015
   b) 30 percent by fiscal year 2020
   c) 40 percent by fiscal year 2025.

2) Reduce building related GHG emissions by:
   a) 15 percent by fiscal year 2015
   b) 30 percent by fiscal year 2020
   c) 40 percent by fiscal year 2025.

These targets will be constantly re-evaluated based on performance measures and changes in technology on at least an annual basis. Campus has already shown that it is capable of successfully taking on the energy problem, achieving a 9.6 percent reduction in energy consumption per square foot during the past two years. In order to achieve these targets, campus investment in energy conservation will need to increase above current levels. Additionally, individual colleges will need to be incentivized so that they seek to reduce their consumption, buy efficient research equipment, and invest their own funds.

*Strategies*

1) Complete all SAIC-prescribed energy conservation measures by 2022.

2) Implement decentralized energy billing at the college level by 2011.

3) Immediately establish a dedicated, centralized funding pool for energy conservation projects. This "clean energy" fund will allow for both internal (student fees, faculty contributions, staff contributions, energy savings reinvestment, capital programs), and external (programs, rebates, donations, outside investors) participation in the fund. It will be established as a capital infusion and coordination

mechanism aimed at physical energy and energy cost reductions that also allows for the sustained maintenance of these investments.

4) Allocate proper maintenance funds to ensure that the energy reductions are sustained, and reorganize building maintenance procedures to support long-term energy savings.

### 4.1.1 National Petascale Computing Facility

The National Petascale Computing Facility is a National Science Foundation (NSF) funded supercomputing facility. The Facility is substantially complete; however, the supercomputers will not come online until July 2011. The Petascale Computing Facility has been developed to high-energy efficiency standards; the building is likely to achieve LEED Gold or possibly LEED Platinum certification. The Blue Waters supercomputer is housed in the Petascale Computing Facility. Blue Waters is water-cooled and directly powered with high-power alternating current to reduce power conversion losses. Once complete, it is likely that this supercomputer will be the most energy efficient in the world.

The primary facility load is due to the Blue Waters supercomputer (14 to 16 MW), though the facility is also expected to host additional smaller supercomputers. By December 2012, the Facility will draw ~18 MW of electrical power for the supercomputers and other equipment, running continuously with at least 95 percent uptime. This will increase campus electricity consumption by about 30 to 35 percent. The Facility will also require a cooling capacity of 5,400 tons, provided through a combination of chilled water by campus chiller facilities or by on-site cooling towers. The overall chilled water usage is 263,061 MMBtu. Campus intends to purchase all the electricity for the Facility and for its chilled water needs from the Midwest Independent Standards Operator (MISO) grid. The University can estimate from the MISO fuel mix that the facility will have annual carbon emissions of ~120,000 MTE $CO_2$. Even though the NSF will pay for the electricity it requires to operate the Facility, it does not pay for externalities and emissions increases.

The campus contract to operate the supercomputer is effective through September 30, 2016, though the Facility will likely continue to operate. In 2016, the NSF will entertain requests for proposals to replace Blue Waters. The next iteration of supercomputer is likely to draw an additional 30 MW of electrical power (for a total of ~50 MW).[15]

Due to the difficulties in predicting the fate of the Facility, the University assumes that it will contribute a fixed amount of 120,000 MTE $CO_2$ to campus emissions from 2012 to 2050. Since the Facility itself has been built to high efficiency building standards, and most of its power consumption is mission driven, additional opportunities for reduction do not seem available at this time. However, any future possibilities to reduce the Facility's power consumption should be investigated. The campus will include charges for the purchase of renewable electricity when competing for the next supercomputer.

**National Petascale Computing Targets and Strategies**

*Targets*

1) Offset the GHG impacts of the National Petascale Computing Facility when the next contract is negotiated.

*Strategies*

1) Impose charges for the purchase of renewable energy at the National Petascale Computing Facility at the earliest opportunity and on any new energy user of similar scope.

## 4.2 Energy Generation

The goal of campus carbon neutrality cannot be achieved without addressing both demand- and supply-side strategies. As discussed earlier, annual campus carbon emissions are very sensitive to the fuel mix utilized at Abbott Power Plant. Both coal-fired and gas-fired boilers are utilized to meet the steam demand for campus, producing co-generated electricity as a byproduct. Since coal combustion generates over 200 lbs of $CO_2$ per MMBtu of energy released, and natural gas generates about 120 lbs of $CO_2$ per MMBtu, the campus should consider emphasizing a larger role for natural gas in the near term. An easy transition to natural gas in the short term will substantially lower GHG emissions and act as a bridge to more intensive use of renewable energy systems in the long term.

**Reduce Coal Dependence**

Abbott Power Plant is a cogenerating facility that burns both coal and natural gas, in coal boilers, gas boilers and gas turbines, producing steam and electricity. The coal system represents some of the oldest and higher maintenance equipment at the plant, but is used due to coal generally being available at a lower price per MMBtu as compared to natural gas.

In Figure 3, campus fossil fuel energy use is plotted since 1990, as well as campus steam consumption. Despite continued growth in campus square footage, steam consumption has fallen 25 percent below its fiscal year 2006 peak almost to the level used in 1990, and further decreases are expected. The natural gas use peak is in fiscal year 2005, when the new gas turbines were being run at peak capacity for failure testing. In fiscal year 2009, about 40 percent of Abbott Power Plant's fuel input energy was derived from coal; the five-year average was 32 percent.

A financial analysis conducted by SAIC showed that Abbott Power Plant can only be operated economically for the production of steam for campus, generating electricity as a byproduct, and is unable to cost-effectively generate electricity. Abbott's electricity and steam outputs and efficiencies since 1990 are plotted in Figure 4.

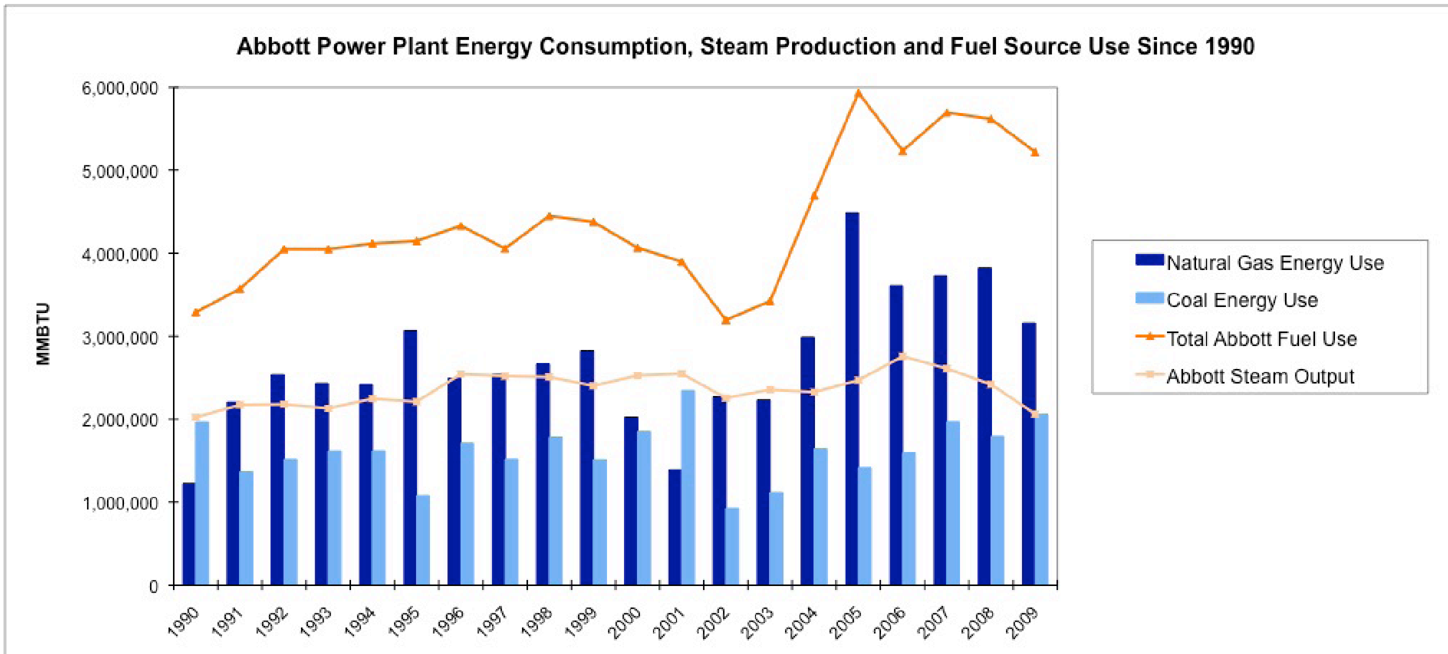



*Figure 3. Abbott Power Plant energy consumption, steam production, and fuel source use since 1990.*

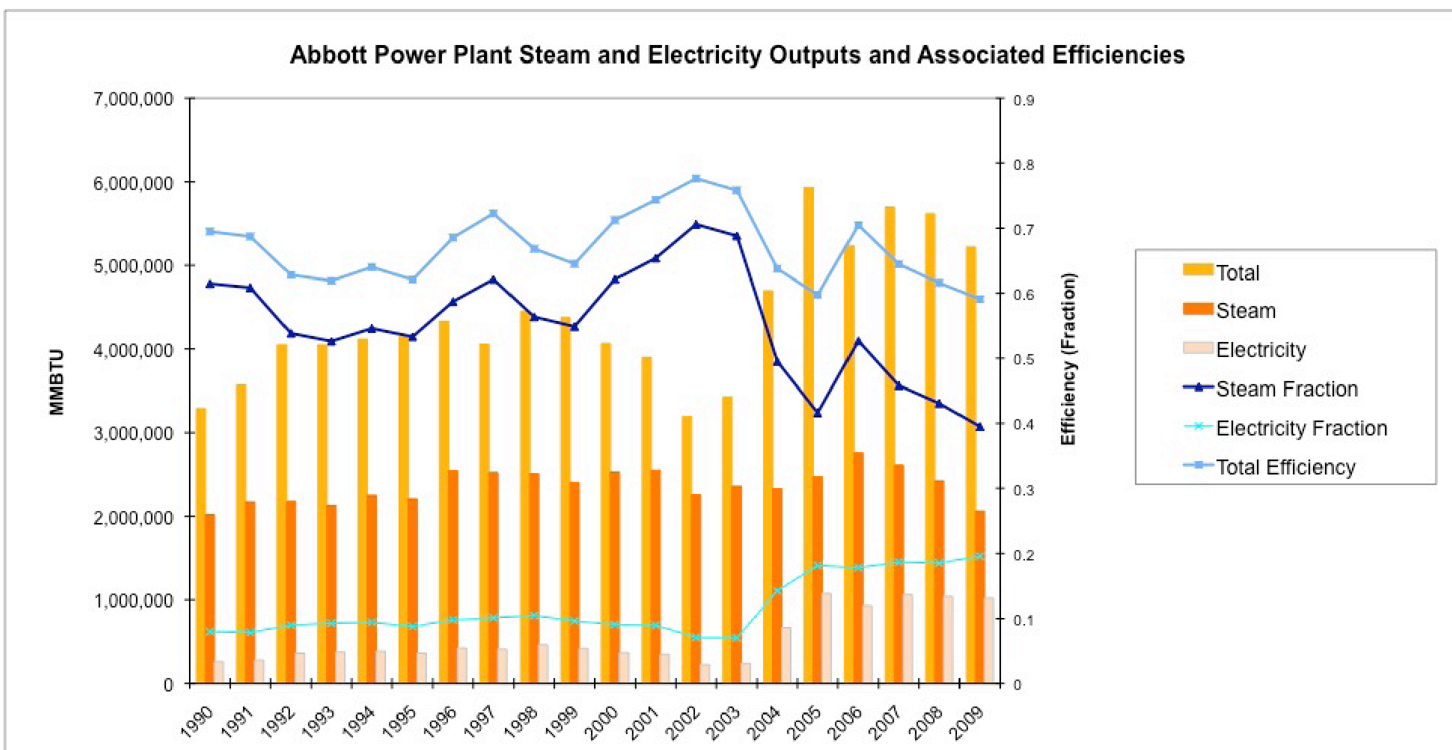



*Figure 4. Abbott Power Plant steam and electricity outputs and associated efficiencies.*

Aggressive energy conservation to reduce steam demand, and investments to reduce losses in the steam distribution system can allow the campus to reduce peak demand sufficiently to abandon the coal system. Campus fuel input energy to Abbott from February 2009 to January 2010 (the last dates for which data was available) was down to 4.89 million MMBtu, whereas the one-year peak natural gas use period was 4.53 million MMBtu (June 2004 to May 2005). Just operating at peak historical natural gas levels would allow campus to cut coal use to 7.5 percent of total fuel energy use, and continuing the current conservation trajectory would allow for its elimination within a year or so.

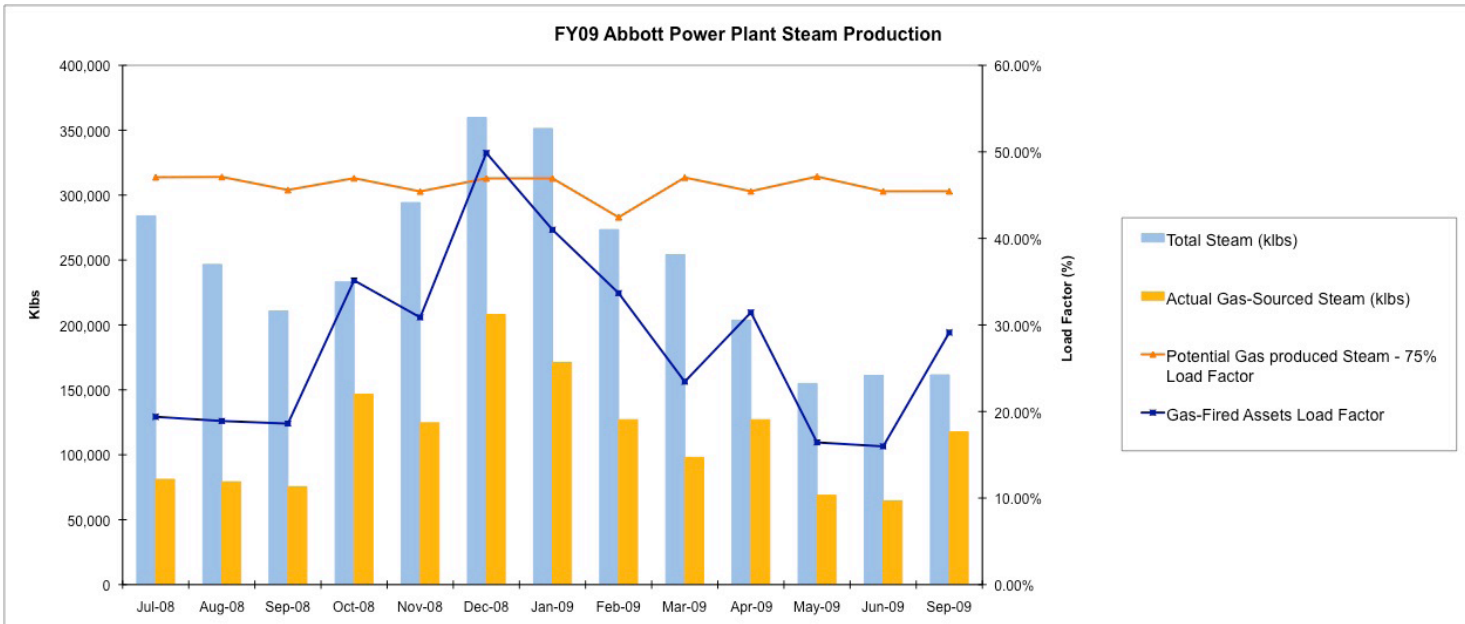



*Figure 5. Fiscal Year 09 Abbott Power Plant steam production, fraction sourced from natural gas, theoretical amount available from natural gas and gas systems load factor.*

Figure 5 shows that monthly steam demand in fiscal year 2009 could have been met by the natural gas systems operating at a 75 percent load factor 10 months out of the year, with demand on a declining trend.

However, additional work would be needed to ensure that the campus winter steam demand is still able to be met; the peak steam demand during fiscal year 2009 was on December 12, 2008, for 650 klbs/hour of steam. The average steam demand in winter is 470 klbs/hour of steam. Between 15 percent and 20 percent of this steam is lost in the distribution system of steam pipes in underground tunnels that carries the steam to various campus buildings. The gas turbine systems (which operate in combined cycle and are optimized for electricity generation) are capable of operating at 240 klbs/hr whereas the two gas boilers—Erie Boiler #2 and Erie Boiler #3 (which are optimized for steam production, and produce low pressure steam with very low electricity cogeneration) can produce 350 klbs/hr of steam.

The total rated steam production capacity of the campus' gas-fired assets is 590 klbs/hour of steam. During normal operation, these units are de-rated; estimates of the average total gas-fired steam production capacity range from 540 klbs/hour to 470 klbs/hour of steam.

Conservation strategies targeted toward peak-shaving, steam loss reduction, and demand response (thermostat setbacks on extremely cold days) can ensure the ability to meet demand. Currently, a single coal boiler could be kept operating during the winter period at low levels to act as backup for the gas system when high demand is anticipated.

Transitioning off of coal has several benefits. First, the coal-fired boilers and steam turbines are 50-60 years old; the gas fired system is much newer. Due to the age of the equipment and the maintenance investment needed to continue operating the plant, the present value of Abbott Power Plant is estimated to be negative $77 million. Next, the SAIC report estimates that investment of $172 million to $233 million will be needed over the next 15 years to keep the plant in operation—mostly directed toward the coal-fired systems. A transition from coal to natural gas will allow us to avoid much of these costs (capital that will be better spent on energy conservation investments that provide a net positive return). Reduced costs as a result of such a transition will also help repay the University's $90 million utilities deficit. Natural gas costs and coal costs have both shown the same rates of increase the past four years; however, the impact of the recession led coal to become more expensive than natural gas during the fall of 2009. While an unlikely medium-term state of affairs, coal and natural gas price divergence should be more than compensated for by maintenance savings.

Abandoning coal-fired assets in-place will also eliminate a substantial legal and regulatory risk that is associated with making large investments in coal-based assets without running afoul of the Clean Air Act. This transition from coal strategy will also allow the campus to reduce its exposure to federal- or state-imposed charges on carbon emissions.

**Move to Renewables**
Carbon mitigation efforts also need to introduce substantial amounts of clean, renewable energy. Possibilities include on-campus wind, solar, and biomass, as well as off-campus offsets. At a minimum, campus should meet the State of Illinois' Renewable Portfolio Standards that ComEd and Ameren must adhere to. This dictates a 25 percent contribution from renewable energy by 2025. An effort to install three wind turbines on the South Farms has been ongoing for several years, though it is currently on hold due to the economic situation. If this project proceeds, it could displace approximately 3 percent of total electricity use. Significant opportunities for smaller wind projects exist in the South Farms area of campus. Conversations with corporate and community partners about creating a large-scale renewable energy farm for the University have begun.

A full study for solar electric or thermal energies has not yet been conducted. Estimates of the built campus area of ~5 square kilometers can likely accommodate 5 percent solar photovoltaic (PV) array coverage as rooftop solar—or about 250,000 square meters, with peak generation capacity of 25 MW, and generating 45 million kWh of electricity. This has the potential to displace 10 percent of current campus electricity usage. Potential for larger tracking arrays on the South Farms also exists.

Biomass provides another important source of emissions reductions. In order to meet the net-zero commitment, a large-scale biomass facility will need to be pursued. Upgrading Abbott Power Plant to be able to co-fire with biomass, possibly with a circulating fluidized bed boiler, must be given serious consideration.[16] The fuel stock could come from a variety of sources including agricultural waste or an energy crop, such as *Miscanthus giganteus*. The campus should also explore waste-to-energy plants for electricity and steam generation.

Since the current purchased electricity mix has negligible amounts of renewable energy, the University should seek out power contracts that include substantial contributions from renewable energy sources, but at a lower priority than installation of on-campus renewables. Student environmental fees could contribute to such an endeavor, but would need to be raised three-fold to provide a 1¢ subsidy per kWh purchased, at current usage levels. There are several wind farms in the area under development that present opportunities to purchase green power directly from these projects. The creation of public/private partnerships to develop renewable energy resources directly on University property is also a way to facilitate a more aggressive switch from fossil energy systems. These entities can raise substantial amounts of capital while taking advantage of federal and state incentives that may not be available to tax-exempt entities.

**Additional Generation Opportunities**

Other generation and distribution efforts for the district power systems should also be investigated. During significant periods in the year, campus operations require both heating and cooling. New building projects are considering incorporating building level heat recovery chillers that would provide heat and generate chilled water as a byproduct. Excess chilled water could be returned to the district system. While this is beneficial, the hundreds of existing buildings on campus will not reap the benefits from such a system. Incorporating heat recovery in some manner at the central level can provide a similar benefit. One such option would be a regeneration system in place of the existing cogeneration system. This would require conversion from a steam distribution system to a hot water system.

Advantages of hot water heat distribution include significantly reduced system energy losses as compared to steam distribution. Hot water systems also provide the potential for capturing waste heat more effectively. A current estimate of the annual overlap between heat generated by fossil fuels and distributed to buildings and heat collected by the chilled water system and rejected through cooling towers is 36 percent on campus (see Table 1). Hot water systems enable this thermal overlap to be used much more effectively. A hot water distribution system would also allow for the implementation of a geothermal loop system for heating and cooling—which is most effective as a district system rather than on a single building basis.

| | Campus Steam Use (klbs) | Campus Steam Use (MMBtu) | Chilled Water Use (million ton-hours) | Chilled Water Use (MMBtu) | Thermal Overlap (percent)(%) |
|---|---|---|---|---|---|
| August 2007 | 190,000 klbs | 227,000 MMBtu | 13.5 million ton-hours | 162,000 MMBtu | 71% |
| February 2008 | 285,000 klbs | 340,000 MMBtu | 2.25 million ton-hours | 27,000 MMBtu | 8% |
| FY 2008 Total | 2,419,000 klbs | 2,888,000 MMBtu | 87.8 million ton-hours | 1,053,600 MMBtu | 36% |

*Table 1. Regeneration potential at the University of Illinois (Derived from the SAIC Energy Report)*

In combination with conservation efforts and a moratorium on new growth (see Section 3.6), the installation of on-campus renewable energy systems, major central system improvements, and specification of renewable energy for purchased electricity, can eliminate a significant portion of campus buildings' carbon footprint. This aggressive and forward-thinking vision can open up additional opportunities for grants.

**Energy Generation Targets and Strategies**

*Targets*

1) Strive to meet the requirements for renewable energy generation in the ILRPS both on-campus (priority) and off-campus (if necessary) as follows:
   a) 5 percent of total campus energy from renewable sources by fiscal year 2015
   b) 17.5 percent of total campus energy from renewable sources by fiscal year 2020
   c) 25 percent of total campus energy from renewable sources by fiscal year 2025.

2) End coal usage at Abbott Power Plant by 2017.

*Strategies*

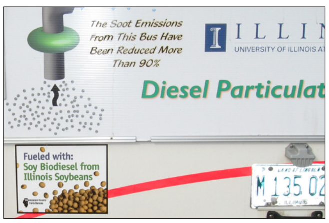
1) Install at least three utility-scale wind turbines on the south campus, with a minimum of one to be installed by fiscal year 2011, and a goal of two additional turbines if feasible.

2) Increase the amount of solar photovoltaic and thermal projects.

3) Purchase off-site green energy if on-site renewable projects are not sufficient to meet the ILRPS.

4) Cease all investment that will increase the lifetime of the coal-fueled systems at Abbott Power Plant.

5) Commission a detailed study by 2012 that examines campus energy generation and distribution systems, specifically tasked with eliminating coal by 2017 and distributing thermal energy more efficiently (e.g. hot water distribution, regeneration, geothermal use, etc.).



## 4.3 Transportation

Transportation emissions account for about 10 percent of the total emissions generated on campus. Generally, this includes commuter, air travel and fleet emissions, some of which are difficult to quantify.[17] The target for this section is to reduce transportation emissions by 50 percent by 2025. This aggressive target will require strategic thinking in all components of transportation-based emissions.

There are already a number of alternative transportation modes available to students, faculty, and staff. A combination of student fees and University funding allows all students and permanent employees free access to the Champaign-Urbana MTD buses. In 2009, the University also contracted with Zipcar to provide fuel-efficient vehicles for short trips in and around campus. To date, there are more than 500 members signed up and currently using the Zipcar alternative. In addition, street traffic has been rerouted and bike lanes are being redesigned and added to help create a safer and more attractive environment for pedestrian and bicycle traffic. But in order to have a sizable impact on transportation emissions, campus will need a multi-faceted program that encourages and educates the entire University community on alternative transportation options.

Successful transportation demand management programs incorporate incentives for commuters to switch from Single Occupancy Vehicles (SOVs) to active transportation modes. A reduction of SOVs driven on campus, which translates into fewer vehicle miles traveled, is one metric for success in reducing transportation emissions. There are a number of opportunities the campus might undertake to affect this change. Options for vanpooling and carpooling along with incentives for their use should be implemented. A "Guaranteed Ride Home" in cases of emergency would help to alleviate the concerns of campus citizens with children and families that utilize these alternative commuting choices. A revision of the parking permit system that allowed employees to purchase short-term, monthly, or parking permits that offer a specified number of days of parking per academic year have been proven to reduce driving to and from work on other campuses. Incentives like a specified number of free parking passes per year for the times when people must have their cars (for those who do not purchase parking permits), has also proven effective at other institutions.

The campus needs policies that not only incentivize staff and faculty away from driving, but that work to discourage students from having a vehicle on campus as well. These policies should be presented with education about the numerous transportation options available to students on campus, i.e. MTD, Zipcar, bike-sharing, etc. The current parking fee structure does not encourage keeping cars at home. Parking fees were recently reduced for most non-academic staff. The purchase of a semester- or year-long parking pass does not encourage alternative modes of transportation to and from campus as users feel they have to use parking every day in order to get the most from the purchase of a parking pass. Pay-per-day or seasonal parking would encourage leaving the car at home. Campus could require student parking permits to be only located on the outskirts of campus, and their vehicles could be prohibited from parking at meters within the University district during weekdays. This would require unique identification of student vehicles to make them recognizable to the parking enforcement officers. Commuters who drive fuel-efficient vehicles could be offered preferred parking, although there are concerns that incentivizing parking spaces sends a message that parking is rewarded.

Flexible scheduling and/or telecommuting are options that could also be explored. The University recognizes that there are supervisors who are uncomfortable with the idea of telecommuting. It would be important to work with Human Resources to roll out a program that provides training sessions for supervisors on how to effectively manage performance and productivity. It would also be best to have standard, objective criteria in place for supervisors to evaluate whether a telecommuting arrangement is a good fit for each position and each employee.

Transportation Demand Management has drafted a Campus Bike Master Plan that should be approved and implemented. This is in the process of evaluation by the CUATS bike plan subcommittee. There is severe lack of funding in this area on campus. The Student Sustainability Committee has partially funded a Campus Bike Project initiative that provides a place, tools, and supplies for minor repairs of bicycles on campus, and has been providing some bicycle parking funding as well. Research is also being conducted on the feasibility of implementing a bike-sharing program on campus. A substantial increase in convenient and safe bicycle parking on campus would also encourage more biking, as would convenient locker and shower facilities at places of study and work.

To affect a reduction in fleet emissions, the campus should commit to purchasing only vehicles that are in the top fuel-efficient categories. Bio-diesel options should be enhanced. Electric vehicles should also be considered as campus moves toward renewable electricity generation. Charging stations for many vehicles would then be a more realistic venture. Strategies should also be developed to reduce fuel emissions due to campus-owned aircraft at the Institute of Aviation. A cap for business miles could be imposed. Air travel should have a cap, be charged carbon fees, and/or require locally purchased offsets. Business travelers could be rewarded for taking bus or rail rather than air. Support should be given to high-speed rail projects proposed for travel through Champaign-Urbana.

A system for purchasing voluntary local emissions offsets for air travel will be instituted. The University will recommend to the Board of Trustees that these offsets become required by 2016 to address the major source of transportation emissions. The purchase of offsets directed at local projects on campus could become a valuable funding stream for funding bio-restorative projects while simultaneously reducing carbon emissions.

**Transportation Targets and Strategies**

*Targets*

1) Reduce carbon emissions related to transportation (including air travel, commuting, and fleet vehicles) from fiscal year 2008 baseline

   a) 30 percent by 2015
   b) 40 percent by 2020
   c) 50 percent by 2025.

*Strategies*

1) Impose a GHG charge on cars purchasing parking permits based on their relative efficiencies by 2015. Assess a similar fee for students bringing cars to campus but not purchasing parking permits. Revenue will be used to reduce transportation emissions.

2) Immediately begin to implement the Campus Bicycle Master Plan and improve bicycling infrastructure. Work with cities to improve bicycle feeder routes to campus. Provide campus investment and supplement with revenue from GHG emissions charge on cars.

3) Create and subsidize a bike sharing program by 2012.

4) Enact a system for purchasing local emissions offsets from air travel impacts, with a voluntary program beginning by 2012 and recommend to the Board of Trustees to move to mandate a required program by 2016.

## 4.4 Agricultural Emissions

It is becoming increasingly clear that food systems have a major impact on climate change. Fields are sprayed with fertilizer, animals have to be fed and food is flown across the world to be processed and then shipped to a local grocer. The combined effects of all the stages of the food system can be a large source of GHG emissions from consumption by households. Because of these important influences, more work should be done in terms of planning to reduce the climate impact of campus food consumption and agricultural production.

Campus emissions associated with agriculture and food systems can be thought of in several different ways, from production to processing, transportation, marketing, and consumption. This report will focus on the resident population and research facilities that engage in food production, delivery, and related enterprises. In addition to considering the land use and agricultural production and processing facilities that support campus research, the campus plan must address the campus food system directly.

Areas for improvement include reductions in food waste and the energy required for food processing, preparation and transportation. Campus dining services currently serve about 38,000 meals per day. Because of the sheer volume of meals served, they plan meals and secure vendors through competitive contract bids. Liberalization of the bidding process has proven to be a critical part of improving institutional buying to promote local foods. In addition to this, campus is striving

to reduce waste and has taken a number of steps, including trayless service and a switch to the use of compostable materials, to reduce associated emissions.

The University of Illinois South Farms represent a large part of the production side of the food equation. They cover a contiguous area of 4,600 acres, 3,609 of which are planted to crops and pasture. The farm produces a variety of crops for research and feed, and supports livestock production at the feedlot scale. Overall, the South Farms produce 7,130 MTE $CO_2$ equivalent. Methane from livestock manure and digestion comprises 44 percent of the $CO_2$ equivalent GHG emissions produced by the South Farms. Nitrous oxide derived from manure and commercial fertilizer comprises 6 percent and 22 percent of $CO_2$ equivalent GHG emissions, respectively.

Most of the bovine manure is land applied, while much of the swine manure is treated in Champaign's municipal sewage treatment facility at a cost to the University. If manure produced by all animals on site were converted to methane in a digester and routed to Abbott Power Plant, GHG emissions from the South Farms could be reduced by 90 to 95 percent. In addition, the remaining digested material would provide a treated (composted) fertilizer that could be used to replace fossil energy-based nitrogen and phosphorus fertilizer, further reducing GHG emissions. Since more than 90 percent of GHG emissions from the South Farms can be remedied through a methane digester, this will be a priority.

GHG emissions aren't the only environmental contaminants on the South Farms. Extensive tile drainage on 3,609 acres of farmland delivers more than 100 metric tons of nitrate-N to the Embarras River and ultimately to the Gulf of Mexico, where it contributes to gulf hypoxia. Nitrogen, whether in the form of manure or commercial fertilizer, causes atmospheric contamination forming nitrous oxide through nitrification and partial denitrification in the soil, and surface water contamination as nitrate-N leaches into streams. One of the most promising management practices for the removal of nitrate and the elimination of nitrous oxide from agricultural surface waters is the establishment of constructed tile-drainage wetlands. Tile-drainage wetlands built at a 5 percent wetland-to-watershed ratio could remove nearly 50 percent of the nitrate-N that otherwise would enter the Embarras River (Kovacic 2007). In addition, wetlands would provide fish and wildlife habitat on the South Farms, flood reduction through increased water retention, aesthetics, and areas for new research opportunities.

Food miles are now talked about by everyone from shoppers to retailers and the media. Crops and animals are shipped, driven, and flown to factories, food is transported to shops, and then people drive to the supermarket for purchases. The range of journeys and vehicles involved mean that estimates of the impact of food miles are extremely varied: estimates of emissions range from 1.8 to 3.5 percent of the total campus GHG emissions.[18] Although the current impact of food transport on climate change is low in comparison to other parts of the food system, the system is currently growing. The Leopold Center for Sustainable Agriculture's estimates on the average number of miles that food travels has doubled in the last 30 years. To reduce the problem of food miles and its related emissions, the campus needs to close the loop in food production, use, and waste recycling. This will

require a shift to more sustainable agriculture and animal production practices, providing a support infrastructure of a local foods network, and a large-scale food-composting project to eliminate unnecessary food waste.

The University currently has a small (~3 acres) produce garden, the Sustainable Student Farm. The produce is sold and used in the University dining halls – meaning the farm could sustain itself while providing local (less than 7 miles) food. The farm also does not use any chemicals on its land. With the implementation of passive solar greenhouses, the growing season can be extended into November and could start as early as January. The slower production times can be supplemented by preserved food from the summer when food abundance is great but there are fewer students.

**Agricultural Targets and Strategies**

*Targets*

1) Reduce directly related agricultural emissions by 50 percent by 2020.

2) Exceed the state local food procurement standards by purchasing more than 30 percent of food purchases from local sources (within 100 miles) by 2015.

*Strategies*

1) Install a methane capture process for additional energy generation by 2020, with a pilot project by 2015.

2) Incentivize sustainable and organic agricultural practices on campus (and campus owned or leased) agricultural lands.

3) Implement a biofuels initiative to transform agricultural waste into energy production, beginning with the planned miscanthus boiler at the College of Veterinary Medicine by fiscal year 2011.

4) Incorporate a large-scale food composting project by 2012.

5) Investigate the role of biochar to create fuel from agricultural and livestock waste, improve soils, reduce nutrient runoff, and sequester carbon in the soil.

6) Develop and promote a campus "local foods network" and innovative production options.

7) Incorporate carbon costs into food products sold on campus.

## 4.5 Water

Water and energy are intricately linked. The challenge of reducing campus GHG emissions should involve looking at the importance of water in at least two ways.

The first is to understand the significance of indirect GHG emissions associated with the use of treated water and the discharge of wastewater to the sanitary sewer. Another way to look at water in this context is as further incentive for improving energy efficiency. This section addresses both of these topics. In fiscal year 2009, campus used 1,202,497 kgal (1,000s of gallons) of water. In fiscal year 2008, campus used 1,312,492 kgal. In fiscal year 2007, campus used 1,262,491 kgal. The costs associated with these amounts of water use were $2,287,351 in fiscal year 2009, $1,762,819 in fiscal year 2008, and $1,661,137 in fiscal year 2007. Another 50 percent rate increase is expected in the next fiscal year.

Since the University of Illinois is a major water user, the baseline GHG emissions study should include an effort to determine the significance of indirect emissions due to water use. Significantly reducing campus water use will require greater understanding of how water is used on campus. Current water use categories include:


- Major Labs – 22 percent
- Chiller Plants – 19 percent
- Abbott Power Plant – 14 percent
- University Housing Facilities – 14 percent
- Irrigation – 7 percent
- Campus Recreation – 1 percent
- Other (Domestic Use - Classroom, Office, etc.) – 23 percent.

The second major way to look at water in the context of reducing GHG emissions is to account for the fact that certain energy efficiency improvements reduce water use. In other words, the economic value of energy efficiency is often greater than just the economic value of the energy saved. For example, energy efficiency improvements that reduce cooling loads will save a proportional amount of cooling tower water. When cooling towers use less water, they require proportionately fewer chemicals, maintenance, etc. Therefore, a cooling efficiency improvement will result in savings in the cost of energy, the cost to purchase water, the cost to discharge water to the sanitary sewer, the cost of cooling tower chemicals, and the cost of cooling tower maintenance. Economic justification is easier when all of these cost savings are captured. The Illinois Sustainable Technology Center has performed true cost of water accounting for Ford and Caterpillar, and the results have shown that the actual cost to use water can be 5 to 20 times greater than the cost of the water alone.

Campus has begun to utilize efficient water fixtures, including low-flow aerators for faucets, dual-flush and high efficiency toilets, high-performance low-flow showerheads, and pint urinals. These fixtures will continue to be utilized in new buildings and retrofits, and newer technologies to improve upon these efficiencies will be researched and harnessed. Non-potable sources of water will also be utilized when appropriate, including untreated raw water, sump pump discharge, cooling tower wastewater, stormwater, and graywater. The University has a raw water system across campus that has yet to be activated. This would allow campus to purchase lower cost, non-treated raw water from the water company. The Business Instructional Facility is already plumbed in a way that would allow for raw water to be used for toilet and urinal flushing when available. Campus will connect to the raw system and explore ways to use other non-potable sources in this system.

A next step would be to conduct an analysis to account for the true cost to use water on campus.

### Water Targets and Strategies

*Targets*

1) Reduce potable water usage and its associated emissions from a fiscal year 2008 baseline:
   a) 20 percent by 2015
   b) 30 percent by 2020
   c) 40 percent by 2025.

*Strategies*

1) Commission an internal, student-assisted study to determine a detailed water use baseline, the "true cost of water," and the related emissions.

2) Include "true cost of water" charges with the energy billing program.

3) Begin utilizing non-potable water, including untreated raw water, sump pump discharge, cooling wastewater, stormwater and graywater.

4) Connect the raw water system by 2020.

## 4.6 Space Management and Growth

The projected carbon emissions for a business-as-usual scenario show significant increases in emissions due to additional square footage. The University will pursue strategies that slow the amount of increased square footage by judiciously examining existing space. The business-as-usual projection also presumes energy efficiency at historic levels. The University has implemented green building requirements that should improve performance levels, including a LEED Silver certification requirement for major new buildings and renovations. Results by the Rocky Mountain Institute show that there is no correlation between the level of LEED achieved by a building project and the project cost.[19] Further, federal, state and local codes, ASHRAE, and AIA are targeting widespread deployment of net-zero commercial buildings by 2030, and the Department of Energy is seeking to make net-zero buildings financially viable by 2025. A net-zero building is one that generates as much energy as it uses over the course of an average calendar year. Projects that seek to do better than meet minimum campus standards should receive campus support or credit for the improvements compared to the baseline.

The campus will implement a freeze on new buildings and building additions once current planned projects are completed. Any new space must take an existing space of equal or greater size (or of equal or greater energy usage) out of commission. Furthermore, any building retrofit will be required to “do no harm”; that is, it should not increase the energy consumption of a building—if necessary by packaging together additional energy conservation and renewables as part of a project. New building projects will be net-zero or replace an existing building. These can be facilitated by a marketplace for space. All projects currently in planning require at least a 30 percent improvement in the proposed building performance rating compared with the baseline building performance rating, as calculated using the latest version of ANSI/ASHRAE/IESNA Standard 90.1.

Finally, the campus space market will include the demolition of certain buildings with poor energy performance, high deferred maintenance burdens, and low historical value. Campus buildings that are seen as approaching a deferred maintenance deficiency value that is higher than their current replacement value will be considered for removal or renovation.[20]

**Space Management and Growth Targets and Strategies**

*Targets*

1) Incorporate a "no net increase in space" policy for the entire campus by 2012, including auxiliary units and rental space.

2) Any new buildings or major renovations should be net energy neutral or a net energy provider by 2025.

*Strategies*

1) Implement a space marketplace to enable rewards for space reduction and swaps.

2) Move LEED certification requirements from Silver to Gold for new buildings and major renovations by 2011, and LEED Platinum by 2015.

3) Apply LEED Gold construction standards without certification for all other construction projects.

4) Currently planned projects should be required to demonstrate at least a 30 percent improvement in building performance over the latest ASHRAE Standard 90.1 baseline for total building energy.

## 4.7 Purchasing/Waste/Recycling

Materials consumption contributes directly to climate change. It requires energy to mine, extract, harvest, process, and transport raw materials, and more energy

to manufacture, transport and, after use, dispose of products. This is a throw-away society. Waste prevention and recycling are important components in the University's effort toward carbon neutrality.

According to Bill Sheehan of the Recyclers Network, a growing international Zero Waste Movement, is calling for radical resource efficiency and eliminating – rather than managing – waste. Zero Waste is a goal for how campus should responsibly manage materials and the energy required to make them. Zero Waste requires a "whole system" approach to resource management that implicates purchasing, maximizes recycling, minimizes waste, reduces consumption and ensures that products are made to be reused, repaired, or recycled back into the system. Zero Waste systems—including waste prevention and recycling—reduce greenhouse gases by:

- Saving energy – especially by reducing energy consumption associated with extracting, processing, and transporting raw materials and waste

- Reducing and eventually eliminating the need for landfills and incinerators.

The U.S. Environmental Protection Agency estimates that by cutting the amount of waste campus generates back to 1990 levels, the University could reduce greenhouse gas emissions by 11.6 million MTE. Increasing the national recycling rate from its current level of 28 to 35 percent would reduce greenhouse gas emissions by 9.8 million MTE, compared to land filling the same material. These same strategies have the potential to similarly affect campus GHG emissions.


Although the University has a Waste Transfer Station that collects and separates substantial amounts of recyclables, opportunities to improve collection rates can be harnessed. Non-construction and demolition waste is already recycled at nearly 50 percent. However, there are still opportunities to improve the capture rate and recycle additional items, such as glass and more plastic categories. While construction and demolition waste recycling has improved on campus for LEED projects, these standards will also need to be applied to smaller projects. Food waste composting should also be implemented across campus. Reuse of durable goods also needs to be expanded. Current state law does not allow the University to resell used goods to the public. Efforts to reverse this law and improvement of internal reuse programs should be implemented.

**Purchasing/Waste/Recycling Targets and Strategies**

*Targets*

1) Develop a long-term Zero-Waste campus policy by 2011.

2) Increase waste diversion to 75 percent by 2020.

*Strategies*

1) Make campus purchasing entities (all units and departments with purchasing privileges) responsible for costs of the disposal of the products consumed.

2) Use carbon and other environmental indicators for purchasing to avoid environmentally irresponsible products and corporations. Coordinate this effort with other universities.

3) Develop a campus incentive for reducing trash with the possibility of charging for waste.

4) Consider a campus-wide bottle or can deposit program.

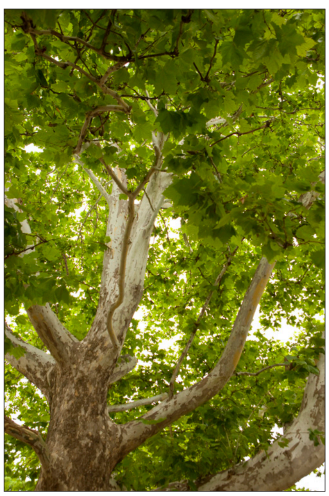
5) Identify opportunities for an increase in reuse and recycling of materials.

6) Implement full-cost accounting and life-cycle analysis structures for major purchases exceeding $25,000 by 2015.

7) Set and enforce minimum recycled content standards.

8) Develop a durable goods reuse cataloguing system.

9) Work for legislation to enable the resale of campus goods to the general public.



### 4.8 Sequestration

Carbon sequestration is the process through which land management practices absorb and sink carbon dioxide ($CO_2$) from the atmosphere. Sequestration activities can affect climate change by enhancing carbon storage in trees and soils, preserving existing tree and soil carbon, and by reducing emissions of $CO_2$, methane ($CH_4$), and nitrous oxide ($N_2O$). The modification of agricultural practices (proposed in Section 2.5) is one method of carbon sequestration in soil. Reforestation on marginal crop and pasture lands transfers atmospheric $CO_2$ to new biomass. For this process to be successful it is important to either manage such forests in perpetuity or use the wood from them for biochar, bio-energy with carbon storage, or durable products.

There may be opportunities to sequester carbon dioxide through several means on campus. First, landscape with plants that are native; native plants generally require less maintenance. Converting turf grass and other shallow-rooted plants to natural prairies or wooded areas can also increase the amount of carbon capture. Students in the Department of Natural Resources and Environmental Sciences have started the process of developing a local carbon registry for the local purchase of carbon offsets. This and related efforts on campus should be studied and incentivized.

**Sequestration Strategies**

1) Incentivize the establishment and use of a local carbon registry for purchasing local carbon offsets.

2) Develop and implement a sustainable landscape plan devoted to planning for and implementing sustainable landscapes and landscape maintenance practices.

### 4.9 Other Offsets

Purchased offsets should have a low priority compared to other mitigation strategies that will have a more direct and transparent impact on campus emissions levels. In certain sectors however, it may become necessary to purchase offsets. For example, campus will not be able to completely eliminate emissions from air travel or commuting. In order to achieve carbon neutrality, the remaining contributions from these sources will need to be addressed through the use of purchased or locally derived offsets.

The issue of what qualifies as a bona fide offset and why, largely boils down to a concept called additionality. Usually phrased as the question, *Is the project reducing emissions in a way that is business as usual, or is it beyond business as usual?* Additionality reflects whether or not a project is reducing emissions regardless of the prospect of offset revenues.

Locally derived offsets that improve the community should be prioritized when on-campus opportunities have been exhausted. Student groups are already involved in energy efficiency projects in the community, including weatherization for low-income homes and energy efficiency for private apartments. These efforts should be encouraged and supported by the University to capture their potential.

## 5 SCENARIO RESULTS

Based on the 2008 baseline data and the scenario strategies described above, the following mitigation wedges were generated to show how campus might achieve the University's overarching goal of carbon neutrality by 2050. The iCAP scenario approach differs from other approaches in three ways. First, it is more comprehensive. The iCAP represents a wide berth of potential climate action scenario strategies, some not considered in other plans. Next, it is more aggressive. In order to be a leader in this arena, campus must proactively pursue ambitious targets. It provides the long-term targets for which new ideas and strategies can be generated and tested. Finally, this approach differs from its predecessors by its inclusion of agricultural strategies. As a land-grant, agriculture-based institution, it is critical to include agricultural strategies in the goal for neutrality.

### 5.1 Mitigation Wedges

Figure 6 displays a set of possible mitigation wedges and rough levels of effectiveness in reaching carbon neutrality by 2050.

- The conservation efforts wedge indicates energy conservation work on the existing building stock, as well as improvements to the campus thermal energy distribution system.

- The space management wedge represents the main strategic "no net increase in square foot" policy.

• The green building wedge indicates an improvement in energy efficiency for replacement and major building renovations.

• Generation side efforts are detailed through two wedges: a renewable energy wedge composed of on-campus renewable energy generation and off-campus renewables purchases, and a fossil fuel mix wedge that represents the impact of the replacement of coal by natural gas.

• The petascale offsets wedge details the impact of the purchase of renewable energy for the National Petascale Computing Facility starting in 2016-2017.

• The transportation measures wedge includes the set of strategies described above to reduce the impacts of air travel, commuting, campus-owned transportation, and other transportation activities.

• The methane recovery wedge targets the primary GHG contributor from the South Farms.

• The zero waste wedge indicates efforts to eliminate landfill waste generation from the campus through composting and increased recycling efforts.

• The offsets wedge indicates purchased credits for carbon mitigation projects off campus.

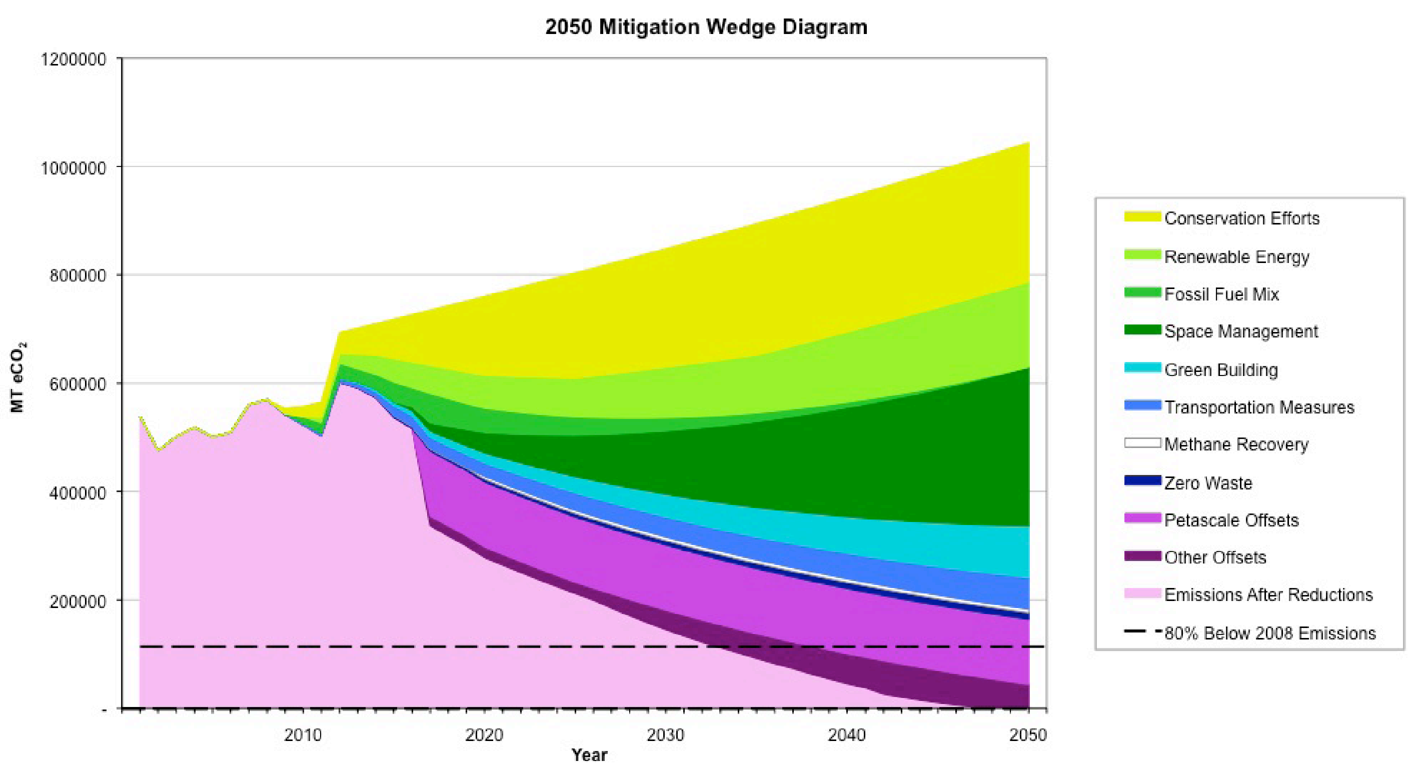



*Figure 6.*

### 5.2 Funding Opportunities for Mitigation

Funding is a core challenge of realizing the iCAP goals. Fortunately, many GHG reduction strategies are no-cost, low-cost, or will pay back investment costs over time. New funding and tracking mechanisms are needed to verify cost savings and recycle a portion of those savings into other initiatives and projects.

The institutional culture needed to evaluate, fund, and verify the costs and GHG reductions for the actions in the iCAP is only partially in place. Achieving iCAP goals will require operational and accounting changes that affect all departments and units.

A host of funding opportunities exist for these efforts including:

- American Recovery and Reinvestment Act (ARRA)
- Energy Service Companies (ESCOs)
- Revolving Loan Fund
- Improved Fundraising efforts (U of I Foundation involvement)
- Academic Facilities Maintenance Fund Assessment (AFMFA)
- Student Sustainability Committee
- Energy Billing Savings
- Corporate Partnerships
- Public/Private Partnerships.

A more concerted effort for financing and funding the long-term commitment needed by the University will require additional resources. Approaches to "offset" these monetary needs include:

**Establish a dedicated, centrally coordinated funding pool for iCAP projects.** This "clean energy" fund should allow for both internal (student fees, faculty fees, staff contributions, energy savings reinvestment, air-travel offsets, capital programs), and external (programs, rebates, donations, outside investors) participation in the fund. It should be established as a capital infusion and coordination mechanism aimed at physical energy and energy cost reductions that also allows for the sustained maintenance of these investments.

**Create a revolving climate loan fund.** A revolving loan fund is an effective way to initiate and sustain key components of the iCAP. A successful revolving loan fund will require initial capitalization, strategic loans, effective cost tracking, and verification to confirm projected cost savings and GHG reduction benefits are realized. The loan fund would provide capital for high-performance, energy efficient campus design, operations, maintenance, and occupant behavior projects.

**Pursue grants that reduce GHG emissions.** An area of specific interest is grant opportunities for implementing iCAP goals associated with building projects, and for reducing peak campus steam demand.

**Faculty and staff green commitment.** This fee would help the University achieve ambitious climate action goals and also give faculty and staff a sense of parity and shared commitment with students. Create an internal donations strategy and process for faculty and staff to contribute to the student green fee or centralized pool.

**Assess GHG fees on vehicular traffic.** Impose a GHG charge on cars purchasing parking permits based on their relative efficiencies by 2015. Assess a similar fee for students bringing cars to campus but not purchasing parking permits. Revenue will be used to reduce transportation emissions.

**Develop an integrated donations strategy.** Moving to a low GHG economy is swiftly emerging as the defining issue of this time. Donors will want to support iCAP efforts especially if they see the University taking a leadership role. Involving the U of I Foundation is essential to ensure clear messaging and a comprehensive, integrated approach. Furthermore, campus needs to establish a priority list of sustainability projects and assign a high-level liaison to support fundraising and implementation of such projects.

**UI green marketing.** Establishing the University as a leader in climate response and implementation has significant marketing value that should not be overlooked. Money follows good projects that are visible and easily understood. Sustainability is becoming a core value of the institution and continuing to build this reputation, supported by a good marketing program, is key to gaining financial support for this effort.

### 5.3 Future Climate Action Planning

The future of such climate plans is as important as this initial response. How does campus keep the process moving? Operationally, campus will use the President's Climate Commitment to provide a basis for regular review and critique. Specific actions steps will also be assigned to specific departments and ask them to create a detailed plan and report on progress. The Campus Strategic Plan tracking system will provide a basis for monitoring and accountability.

During the next year, the campus hopes to build on this Plan as a focal point activity—to create a community of scholarship around the Plan. The aim is to

develop an interdisciplinary research seminar for graduate students, who will be exposed to the entire breadth of this Plan—and by extension the physical realities of the campus—empowering them to contribute to an evolving plan through their own scholarship and research. Graduate students will be required to enroll in a two-semester research seminar. During the first semester, campus will host seven biweekly sessions that invite on- and off-campus speakers to discuss specific topics related to the Plan. These will be lectures open to the University community. Between these sessions, specific readings and student-led discussions will facilitate an interdisciplinary engagement on the topic presented in the previous week. These seminar discussions will provide the necessary resources to help students identify a basis from which to build a research topic, and to improve the Plan. Over the course of the year, students will find a relevant topic, conduct research on it, provide literature for participant discussions, and present intermediate products to the group. The intention is that this process helps students identify future dissertation or thesis topics and funding proposal concepts, and ultimately develop publishable work, while helping to improve and evolve the campus climate plan.

## 6 CULTIVATING A CLIMATE CULTURE

Implementing the strategies previously outlined will require a major shift in culture both on and off campus. Efforts underway in the overall sustainability initiative will help to address this needed change. As noted, the 2007 Campus Strategic Plan identified sustainability as a new core initiative. In response, and with the strong advocacy of student groups, the University formed an administrative Sustainability Council, an Office of Sustainability, and several related task forces on specific sustainability issues to assist in the investigation and implementation of opportunities to integrate sustainability into the campus culture. These opportunities include the campus response to the climate crisis. Significant efforts are underway in addressing each of the University's core components of its mission—education, research, and public engagement, along with campus operations, as they relate to this core initiative.

### 6.1 Education

Several opportunities have been identified to integrate sustainability into the University’s educational mission, including a preliminary set of learning outcomes requiring each graduating student to obtain a core competency on sustainability. These competencies, such as knowledge of how food, water, energy, and material goods affect human societies and ecosystems, are designed to prepare students for leadership roles as society prepares for the climate challenge.

In the next year, an assessment of current course offerings that include these outcomes will be prepared to examine the possible gaps in course offerings. The campus faculty has already begun to respond to the challenge. A number of first year discovery courses have been proposed on the topic and this summer the campus will be offering its first curriculum workshop (The Prairie Project) for faculty aimed at improving or developing new courses that include climate and sustainability.

The School of Earth, Society, and Environment has developed an online certificate program in environmental sustainability and plans a future degree program. In addition, the College of Engineering has recently announced the Energy and Sustainability Engineering graduate option, designed to involve students from both Engineering and other colleges in the pursuit of sustainable and climate related education.

In spring 2010, the Scholarship of Sustainability Series was made available to faculty, staff, students, and the public. It is modeled as public lectures, follow-on discussions and debate, and a deeper examination by students in the classroom. Faculty, staff, and students from across campus participated in the series.

Educational opportunities are evident throughout the iCAP. For example, in terms of life cycle assessment and waste reduction, Professor William Bullock of Industrial Design developed and implemented an e-waste project that included both education and outreach components. One hundred and sixteen tons of electronic waste were collected from the community at large and recycled and/or reused in a class design competition.


## 6.2 Research

Research is central to the sustainability of the University and the region. Already a world leader in sustainability and climate research, Illinois is developing opportunities for researchers from diverse disciplines to come together to explore new frontiers in discovering solutions to the challenges ahead. Innovative research collaborations focused on creating knowledge and new technologies are being developed to discover, analyze, and implement new approaches for meeting the "long emergency." For example, a new collaboration with the University of California, Berkeley on the development of bio-energy solutions recently formed. A Memorandum of Understanding with the Center for the Advancement of Sustainability Innovations in the U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center, has been established to pursue several areas of collaboration revolving around food, water, and energy.

## 6.3 Outreach/Engagement

The University of Illinois is working to enhance its engagement activities in the arena of sustainability. Champaign County Network (CCNet) is an effort to engage the campus and the surrounding community in a shared discourse on the critical sustainability and climate issues ahead. The University's Office of Corporate Relations is working to enhance collaborations with corporations in sustainability activities.

The iCAP provides an opportunity to engage the outside community in a dialogue on the University's role in helping to resolve community climate responses. For example, the Smart Energy Design Assistance Center (SEDAC) is designed to provide assistance to public and private interests in reducing and conserving their operational energy use in buildings. This type of information is an important step in developing meaningful solutions to climate change.

# 7 COMMITTED TO CHANGE

Illinois has a rich history in proactively addressing challenges. In the past several years, the University has created policies and taken action to address issues of energy use and carbon reduction. Illinois has an array of passionate students and enterprising faculty and staff. There is significant enthusiasm on campus and in the community to develop solutions to the most pressing issue of this time. People from every corner of campus have taken steps to express their commitment, including administrators, personnel from Facilities & Services, University Housing, colleges and departments, and of course, Illinois students.

## 7.1 Administration

In 2007, the Illinois Board of Trustees implemented an Energy Use Policy. The policy covers many components of energy use that includes: personal responsibility, guidelines for computer use and IT equipment, space management, and education and awareness. Through mass communication, the Chancellor requested the cooperation of the entire campus community in achieving reduced energy consumption. All faculty, staff, and students were asked to turn off lights and electronic equipment, raise or lower the thermostat during peak seasons, and report wasteful practices. General guidelines for space temperatures have been set, and space heaters are not allowed in campus facilities. Individuals using window air-condition units are asked to operate them only when the space is occupied. Many departments have worked with Facilities & Services to institute temperature schedules, further reducing energy consumption.

The Guidelines for Energy Conservation and Computing Equipment, developed by the Campus Information Technologies and Educational Services division, include making sure all computers are turned off or are in a "power saving" mode when not in use. They also serve to encourage units to purchase laptop computers, which draw significantly less amounts of power than desktop systems.

In June 2008, the Chancellor directed a 10 percent cut in per-square-foot energy use to be achieved over the next three years using fiscal year 2007 as the base year. Campus has nearly met this goal within two years since the effort began with a 9.6 percent reduction. The iCAP commits campus to a 40 percent energy reduction by 2025. Accurate metering measures the true benefit of completed conservation projects and guides future investments in energy reduction. Accordingly, the University has repaired, replaced, or upgraded utility meters in approximately 85 campus buildings through a series of projects. As a result, dependable utility metering exists in campus buildings comprising 90 percent of the annual energy consumption.

The University will soon implement a unit-based energy billing system. The new billing system represents a major shift in responsibility for utility expenses, shifting the opportunities for conservation from the campus to campus units. Illinois has also begun a process to install the first wind turbine on campus.

Illinois is committed to sustainable building design. The University's Facility Standards and Design Guidelines require all new construction and major renovations over $5 million be certified at a minimum Silver level building under the U.S. Green Building Council's LEED rating system. All projects less than $5 million are asked to design to Silver standards, but are not required to be certified.

The University has completed construction on the Business Instructional Facility, which received Platinum LEED certification. The facility is expected to consume 75 percent less energy than the average older campus buildings. The University Student Dining and Residence Hall project is the next one to pursue LEED certification. Eight other projects are in the planning stages and will pursue LEED accreditation. Even the new Petascale Computing Facility is expected to exceed LEED Silver certification.

Additionally, the University is a member of the U.S. Green Building Council. Facilities & Services engineers, planners, project managers, and inspectors have undergone LEED training. Twenty-five are LEED Accredited Professionals. An additional 18 students and staff members at the University are LEED accredited.

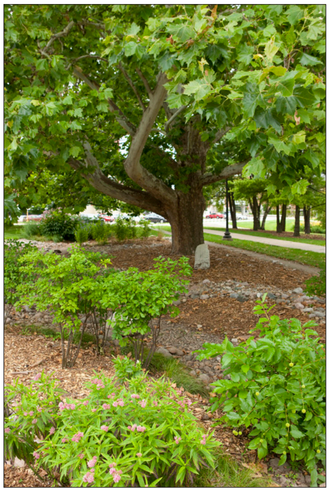
Several units across campus have established sustainability committees, or green teams, to encourage more earth-friendly initiatives and behavior. For example, the College of Fine & Applied Arts has established an intra-collegiate committee to discuss environmentally conscientious and sustainable issues and solutions. The Vice Chancellor for Student Affairs has created a green team with representatives from each of its units to develop a plan to implement sustainable practices.

### 7.2 Facilities & Services

Facilities & Services is a large organization of 1,400 staff supporting the facility and service needs of the campus community. Such a large operation is composed of many buildings on campus. Generally, the organization offers maintenance, construction, custodial, parking, engineering, printing, car rental, mailing, equipment and supply acquisition, and utility services to campus. The organization is divided into divisions headed by a director reporting directly to the executive director.

The Energy Management Division of Facilities & Services initiated an Energy Liaisons program in 2008. Departments, colleges, and other units across campus have designated Energy Liaisons to promote energy conservation and share ideas and suggestions. In fiscal year 2009, Facilities & Services hosted several workshops with the Energy Liaisons to discuss energy conservation opportunities. These Energy Liaisons serve as grassroots contacts for campus initiatives.

The University's RCx teams have had great success in the last few years, completing work in more than two million square feet of building space. They have seen an energy reduction of about 29 percent in these buildings, reducing campus energy costs by an estimated $3.1 million per year. Illinois also has a large-scale lighting retrofit project in full swing, replacing T12 linear fluorescents and magnetic ballasts with Super T8 linear fluorescents and electronic ballasts. The current phase will retrofit about 35 buildings, with the next phase retrofitting another 20 buildings. Facilities & Services has begun an occupancy sensor program funded by the Student Sustainability Committee. They have completed sensor installation in 11 buildings and are looking to expand the program.



Further, Facilities & Services personnel have also been working on water conservation. Low-flow aerators have been installed on lavatory faucets in 130 buildings across campus. The University is installing other water conserving fixtures in new buildings and remodels, including pint urinals and dual flush toilets.

The campus' first rain garden was completed in 2007. This garden was planted with native species and reduces flooding by capturing and filtering storm water, which then recharges the aquifer. Prior to the addition of the garden, the area frequently flooded, obstructing pedestrian walkways and threatening the adjacent red oak tree's vitality. Students in Campus Restoration Ecology classes designed and installed the rain garden with assistance from Facilities & Services, the City of Urbana, and in cooperation with the campus.

### 7.3 Purchasing and Recycling

As a state-funded institution, the University is bound by the Illinois State Procurement Code. This procurement code allows several opportunities for sustainable purchasing to include soybean oil-based ink, recycled supplies, recyclable supplies, environmentally preferable supplies, vehicle purchases, and locally grown foods.

The Purchasing Division specifies and purchases products with recycled material content whenever comparable to products without recycled content. The Division also identifies frequently purchased items for which recycled content items can substitute. Examples of reviewed items include: office supplies, paper products, building materials, lubricants, reprocessed chemicals, remanufactured parts, landscape products, and pavement materials. To ensure that a larger percentage of the University's waste stream can be recycled, the procurement policy will seek to eliminate the purchase of non-recyclable materials when suitable substitutes exist.

Other purchasing policies include energy efficient electronic equipment and appliances. ENERGY STAR® rated items are required unless justified economically. While it is difficult to track all appliance purchases on campus, campus has seen an increase of 10 percent in the purchase of ENERGY STAR® computers. Other improvements can be seen in fiscal year 2009, when approximately 35 percent of paper purchases were of recycled content and approximately 20 percent of cleaning materials and equipment were Green Seal certified.

#### 7.3.1 Recycling

The Waste Transfer Station recycles or diverts from landfill nearly 50 percent of the University's waste. In fiscal year 2009, the Waste Transfer Station recycled 1,852 tons of paper and cardboard, 38 tons of aluminum cans, 899 tons of scrap metal, 38 tons of plastic, 1,300 tons of landscape waste, and 325 tons of pallets. In addition to the Waste Transfer Station's efforts, the Campus Garage and Carpool recapped 25 tires rather than replacing them. Over the years, the University has recycled approximately 2,500 semi loads of materials. This effort kept 53,000 tons out of the landfill and generated $3.5 million in revenue. The University also recycles equipment, both electronic and non-electronic. In fiscal year 2009, the campus recycled more than 118 tons of electronic equipment and nearly 300 tons of non-electronic equipment.


University Construction Services demolished a dining facility and captured 77 percent of the material for recycling. Material included copper, aluminum, glass, baling material, and structural steel. This project was completed on time and well within budget. By utilizing recycling of this demolition, the University kept more than three million pounds of material out of the landfill. This is the model for future demolition projects.

Facilities & Services initiated the Rechargeable Battery Recycling Corporation (RBRC) program in October 2005. This is a free cell phone and rechargeable battery recycling program that is easy to use and environmentally friendly. RBRC supplies the collection boxes and shipping labels. If rechargeable batteries are not recycled on campus, they are considered hazardous waste and must be disposed of according to EPA regulations. To date, the University has recycled 49 boxes, resulting in savings of more than $3,000.

The Labor Electrician's shop has operated a fluorescent bulb recycling program since 2000. They properly recycle 99.9 percent of all University light bulbs. The Maintenance Electrical Repair shop has also been successful at recycling ballasts and removing copper wiring.

Nearly 100 percent of campus landscaping waste is composted or mulched. Any tree removals are chipped and reused; all collected leaf debris is stored and composted for use on campus; grass clippings are returned back to the lawn. The clippings are not bagged, except for rare instances of long grass in high-profile areas.


The University has identified and implemented seven No Mow Zones across campus. Benefits from this effort include lower maintenance costs, fewer emissions from mowers, and attracting wildlife to campus. Eventually some of these areas may be restored to a true prairie. In June 2009, two small prairie plantings (1/4th acre total) were installed at the College of Veterinary Medicine. Another 2.5 acre No Mow Zone is in the planning stages for prairie restoration in spring 2010.

## 7.4 Transportation

The University has two e-ride utility trucks in the service fleet. Powered by nine eight-volt batteries, the all-electric trucks produce none of the ozone-depleting emissions of gas powered trucks and don't require hazardous chemicals such as antifreeze and oil. All-electric vehicles are not a new concept for the Car Pool, which has had eight Global Electric Motorcars (GEMs) in its fleet since 2004. However, the e-ride trucks are designed specifically for utility tasks (GEMs are not) and can haul about 1,200 pounds of cargo. Campus Mail, the Paint Shop, the Locksmith Shop and several other units have been test driving eight Mini Trucks from several different manufacturers to gauge their suitability and durability as service vehicles. Although the Mini Trucks are gas-powered, they have smaller engines than full-size utility trucks and offer better fuel economy, with gas mileage in the 20-30 miles per gallon range. Some vehicles in the campus fleet have been switched to E85. Additionally, a new fuel system that interfaces with modules inside 95 vehicles in the service fleet is enabling Facilities & Services to download, by wireless connection, detailed data about each vehicle's fuel consumption and the amount of time the engine spends idling. Foremen have been asked to work with their crews to reduce the amount of time that service vehicles spend idling whenever possible to help conserve fuel.

The Garage and Carpool purchases automobiles according to State of Illinois guidelines. These vehicles are certified under the Federal Clean Air Act. As required by the state, new passenger vehicles are either hybrid, flex fuel, or biodiesel compatible vehicles. The Garage currently dispenses a 2 percent biodiesel blend. This percentage is expected to increase as a student project to produce 100 percent biodiesel fuel from used vegetable oil nears full-scale operation.

In addition to improvements of the fleet, Illinois is making strides toward providing alternative transportation to the campus community. Illinois employs a Transportation Demand Management Coordinator who has been actively seeking ways to increase alternative methods of transportation. The campus has just completed a comprehensive bicycle plan and survey of existing bicycle parking on campus. Through a partnership with Champaign-Urbana MTD, University employees ride the bus for free; students are also provided unlimited access by paying a mandatory fee each semester.

Eighty-nine percent of students use an alternative means of transportation to get around the community, such as walking, biking, or mass transit. In January 2009, the University provided yet another form of alternative transportation, the Zipcar, a membership-based car sharing program with cars available by the hour. Car sharing reduces trips and each car share vehicle is expected to take 15 personal vehicles off the road. There are currently 10 Zipcars in Champaign-Urbana with more than 500 members.

The Department of Kinesiology and Community Health has a pilot bike sharing program where members of the department can borrow a bicycle to use around campus. There are studies underway to examine the feasibility of expanding the program campus-wide. Funded by the Student Sustainability Committee, the University has opened up a bike repair shop, to be managed by students and volunteers. Many students are asking for additional bike racks, particularly with roofs for weather protection. In conjunction with LEED certification, a pilot preferred parking program for low emission vehicles has been instated near the Business Instructional Facility.

## 7.5 University Housing/Dining Services

The Dining Services Division of University Housing has made great strides in sustainable practices. They purchase food from more than 17 local growers or processors. They also purchase dairy products that are produced at the University's dairy farm. In addition, three out of seven dining facilities operate trayless dining programs. The implementation of trayless dining has saved 194,145 gallons of water per academic year, 817 pounds of dish detergent, and 50 pounds of rinsing additive. Through a partnership with Engineers Without Borders, Dining Services donates 100 percent of its waste vegetable oil for conversion to biodiesel for use by the campus fleet.

A new student farm has also been initiated and has been providing fresh produce to Dining Services. A pilot composting program has also begun. Also, at the end of the year when students move out of the dormitories, Housing donates many of the items left behind to local charities. Additionally, they annually donate approximately 16,000 pounds of clothing and other goods to charity.

## 7.6 Student Commitment

Student groups at Illinois are very active in the campus' sustainability efforts. There are more than ten environmentally oriented registered student organizations on campus. Students for Environmental Concerns (SECS) hosts a number of events throughout the academic year, including Live Green Week and Earth Week. In the spring and fall of each year, they host Environmental Action Night, where all environmental groups across campus are invited to exchange information and share with students. They are also currently partnering with the Sierra Club on a campaign to end coal use at the campus' power plant.

Other student organizations doing environmental work include Red Bison (involved in prairie restoration and stewardship), Engineers Without Borders (engaged in international development engineering projects), the Illinois Biodiesel Initiative (generating biodiesel from campus waste vegetable oil), Emerging Green Builders (interested in sustainable building practices), Ecological Design Consortium (interested in green design), Roots and Shoots (interested in conservation), the Wildlife Society, the Environmental Law Society, and UIUC Net Impact. Several additional student organizations incorporate environmental activities, including American Society of Mechanical Engineers (ASME), Alternative Spring Break, Students in Free Enterprise, and the Office of Technical Consulting Resources, to name a few. The Illinois Student Senate has established a Committee on Environmental Sustainability.

The Student Sustainability Committee explores the options for the use of the student fees for sustainability and alternative energy generation. The committee reviews and recommends projects to be funded from two student fees, a $5 Sustainable Campus Environment Fee and the $2 Clean Energy Technology Fee. In spring 2010, the student body voted to increase the Sustainable Campus Environment Fee to $14 per semester. By annual revenue, Illinois will have the largest student environmental fee pool in the country. Some projects of note include: an on-campus farm whose produce will be sold to the dining halls, two prairie installations, occupancy sensors, and a large LED lighting installation in the lobby of the Krannert Center for the Performing Arts. They also funded the green roof and half of the solar panels at the Business Instructional Facility. They have begun to provide zero-interest loans to colleges and departments for short payback projects and have provided the seed capital to bring the first wind energy generator to campus.

## 8 CONCLUSIONS

Our campus Strategic Plan from 2007 envisions an Illinois Sustainable Energy and the Environment Initiative that focuses on power generation and networks, transportation and portable energy, water supply and use, and landscapes and urban architecture. It envisions a learning laboratory for demonstration of sustainable technologies and curricula to prepare students with skills required to tackle the challenges of a sustainable society. Climate planning provides just such a laboratory for research, learning, and acting.

The Office of Sustainability Vision document proposes two grand sustainability challenges: (1) To maintain or restore natural ecosystem function while providing essential human services; and (2) To sustainably raise the quality of life for the world's poor to acceptable levels. The University considers the 'long emergency' of climate destabilization to be a major component of the first grand challenge for campus.

In 2008, the University signed the American College & University Presidents' Climate Commitment. This action committed the campus to reduce emissions of greenhouse gases from current levels to zero by the year 2050. This Illinois Climate Action Plan (iCAP) describes a path toward the fulfillment of this commitment. It represents a roadmap to a new, prosperous, and sustainable future for the University of Illinois.

# 9 APPENDICES

## 9.1 Data Sources

1) SAIC Report
2) Energy consumption data
3) Transportation survey
4) David Kovacic, “South Farms Report”
5) Clean Air-Cool Planet Carbon Calculator
6) Water consumption data
7) Sanitary sewer consumption data
8) Personal interviews

## 9.2 A Glossary of Acronyms

AASHE – Association for the Advancement of Sustainability in Higher Education

ACUPCC – American College & University Presidents’ Climate Commitment

AFMFA – Academic Facilities Maintenance Fund Assessment

ANSI – American National Standards Institute

ARRA – American Recovery and Reinvestment Act

ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers

ASME – American Society of Mechanical Engineers

CAP – Climate Action Plan

CATS – Campus Area Transportation Study

CAV – Constant Air Volume

CBECS - Commercial Buildings Energy Consumption Survey

$CO_2$ – Carbon Dioxide

ECE – Electrical and Computer Engineering

EPP – Environmentally Preferable Purchasing

ESCO – Energy Service Company

EUI - Energy Use Intensity

GEMS – Global Electric Motorcars

GHG – Greenhouse Gas

GSF – Gross Square Foot

HR – Human Resources

HVAC – Heating, Ventilating, and Air-Conditioning

IESNA – Illuminating Engineering Society of North America

ILRPS – Illinois Renewable Portfolio Standard

IPCC – Intergovernmental Panel on Climate Change

ISTC – Illinois Sustainable Technology Center

IT – Information Technology

Klbs – thousand pounds

kWh – kilowatt hours

LEED – Leadership in Energy and Environmental Design

MISO – Midwest Independent Standards Operator

MMBTU – One Million British Thermal Units

MTD – Mass Transit District

MTE – Metric Ton Equivalent

MW – Megawatt

PACE – Property-Assessed Clean Energy

PCAP – Presidents' Climate Action Plan

PV – PhotoVoltaic

RBRC – Rechargeable Battery Recycling Corporation

RCx – Retro-Commissioning

RPS – Renewable Portfolio Standard

SAIC – Science Applications International Corporation

SECS – Students for Environmental Concerns

SOV – Single Occupancy Vehicle

SSC – Student Sustainability Committee

VAV – Variable Air Volume

### 9.3 Bibliography

American College and Universities President’s Climate Commitment. (2007-2010) Retrieved from www.acupcc.org

Arizona State Climate Action Plan. (2009)

Association of the Advancement of Sustainability in Higher Education. (2005-2010) Retrieved from www.aashe.org

Climate action plan workshop. (2009)

Creating a climate-friendly campus, University of Colorado at Boulder. (2004)

Growing green, becoming a carbon neutral campus: Duke University climate action plan. (2009)

Hoyle, Cynthia. miPlan – Champaign-Urbana MTD. (2009)

Johnston, Morgan. (Ed.). University of Illinois campus bike plan, draft. (2009)

Kovacic, David. Agricultural plan. "South Farms Report." (2009)

Parking Department, University of Illinois. (2009)

Presidents Climate Commitment Implementation Committee. (2009)

Climate Action Plan Summary Report, Cornell University. Office of Publications and Marketing at Cornell University.

The Presidential Climate Action Project. (2008)

Rocky Mountain Institute. (1990-2010). Retrieved from www.rmi.org

Simpson, Walter. (2009). Cool campus. Retrieved from www.aashe.org

Student Sustainability Committee. (2009)

University of Illinois at Chicago Climate Action Plan. (2009)

University of North Carolina at Chapel Hill Climate Action Plan. (2009)

Cornell University: David Skorton, President of Cornell University, talks about the school's plans to move beyond coal. (This week on Sierra Club Radio)

## 9.4 Targets and Strategies

### 9.4.1 Building Energy Conservation Targets and Strategies

*Targets*

The University will meet the following goals compared to the fiscal year 2008 energy and emissions levels for existing buildings:

1) Reduce building energy consumption by:
    a) 20 percent by fiscal year 2015
    b) 30 percent by fiscal year 2020
    c) 40 percent by fiscal year 2025.

2) Reduce building related GHG emissions by:
    a) 15 percent by fiscal year 2015
    b) 30 percent by fiscal year 2020
    c) 40 percent by fiscal year 2025.

These targets will be constantly re-evaluated based on performance measures and changes in technology on at least an annual basis. Campus has already shown that it is capable of successfully taking on the energy problem, achieving a 9.6 percent reduction in energy consumption per square foot throughout the past two years. In order to achieve these targets, campus investment in energy conservation will need to increase above current levels. Additionally, individual colleges will need to be incentivized so that they seek to reduce their consumption, buy efficient research equipment and invest their own funds.

*Strategies*

1) Complete all SAIC-prescribed energy conservation measures by 2022.

2) Implement decentralized energy billing at the college level. Immediately establish a dedicated, centralized funding pool for energy conservation projects. This “clean energy” fund will allow for both internal (student fees, faculty contributions, staff contributions, energy savings reinvestment, capital programs), and external (programs, rebates, donations, outside investors) participation in the fund. It will be established as a capital infusion and coordination mechanism aimed at physical energy and energy cost reductions that also allows for the sustained maintenance of these investments.

3) Allocate proper maintenance funds to ensure that the energy reductions are sustained, and reorganize building maintenance procedures to support long-term energy savings.

#### 9.4.1.1 National Petascale Computing Targets and Strategies

*Targets*

1) Offset the GHG impacts of the National Petascale Computing Facility when the next contract is negotiated.

*Strategies*

1) Impose charges for the purchase of renewable energy at the National Petascale Computing Facility at the earliest opportunity and on any new energy user of similar scope.

### 9.4.2 Energy Generation Targets and Strategies

The University of Illinois at Urbana-Champaign will implement the following energy generation targets:

*Targets*

1) Strive to meet the requirements for renewable energy generation in the ILRPS both on campus (priority) and off campus (if necessary) as follows:

  a) 5 percent of total campus energy from renewable sources by fiscal year 2015
  b) 17.5 percent of total campus energy from renewable sources by fiscal year 2020
  c) 25 percent of total campus energy from renewable sources by fiscal year 2025
  d) End coal usage at Abbott Power Plant by 2017.

*Strategies*

1) Install at least three utility-scale wind turbines on the south campus, with a minimum of one to be installed by 2011.

2) Increase the amount of solar photovoltaic and thermal projects.

3) Purchase off-site green energy if on-site renewable projects are not sufficient to meet the ILRPS.

4) Cease all investment that will enhance or increase the lifetime of the coal-fueled systems at Abbott Power Plant.

5) Commission a detailed study by 2012 that examines campus energy generation and distribution systems; specifically tasked with eliminating coal use and distributing thermal energy more efficiently (hot water distribution, regeneration, geothermal use).

### 9.4.3 Transportation Targets and Strategies

*Targets*

1) Reduce carbon emissions related to transportation (including air travel, commuting, and fleet vehicles) from a fiscal year 2008 baseline

  a) 30 percent by 2015
  b) 40 percent by 2020
  c) 50 percent by 2025.

*Strategies*

1) Impose a GHG charge on cars purchasing parking permits based on their relative efficiencies by 2015. A similar fee for students bringing cars to campus but not purchasing parking permits will be explored. Revenue will be used to reduce transportation emissions.

2) Immediately begin to implement the Campus Bicycle Master Plan and improve bicycling infrastructure. Work with cities to improve bicycle feeder routes to campus. Provide campus investment and supplement with revenue from GHG emissions charge on cars.

3) Create and subsidize a bike sharing program by 2012.

4) Enact a system for purchasing local emissions offsets from air travel impacts, with a voluntary program beginning by 2012 and a required program by 2016.

### 9.4.4 Agricultural Targets and Strategies

*Targets*

1) Reduce directly related agricultural emissions by 50 percent by 2020.

2) Exceed the State local food procurement standards by making more than 30 percent of food purchases from local sources (within 100 miles) by 2015.

*Strategies*

1) Install a methane capture process for additional energy generation by 2020, with a pilot project by 2015.

2) Incentivize sustainable and organic agricultural practices on campus (and campus owned or leased) agricultural lands.

3) Implement a biofuels initiative to transform agricultural waste into energy production, beginning with the planned miscanthus boiler at the College of Veterinary Medicine by fiscal year 2011.

4) Incorporate a large-scale food composting project by 2012.

5) Investigate the role of biochar to create fuel from agricultural and livestock waste, improve soils, reduce nutrient runoff, and sequester carbon in the soil.

6) Develop and promote a campus "local foods network" and innovative production options.

7) Incorporate carbon costs into food products sold on campus.

### 9.4.5 Water Targets and Strategies

*Targets*

1) Reduce potable water usage and its associated emissions from a fiscal year 2008 baseline:

    a) 20 percent by 2015
    b) 30 percent by 2020
    c) 40 percent by 2025.

*Strategies*

1) Commission an internal, student-assisted study to determine a detailed water use baseline, the "true cost of water," and the related emissions.

2) Include "true cost of water" charges with the energy billing program.

3) Begin utilizing non-potable water, including untreated raw water, sump pump discharge, cooling wastewater, stormwater and graywater as soon as possible.

4) Connect the raw water system by 2020.

### 9.4.6 Space Management and Growth Targets and Strategies

*Targets*

1) Incorporate a "no net increase in space" policy for the entire campus by 2012, including auxiliary units and rental space.

2) Any new buildings or major renovations should be net energy neutral or a net energy provider by 2025.

*Strategies*

2) Implement a space marketplace to enable rewards for space reduction and swaps.

3) Move LEED certification requirements from Silver to Gold for new buildings and major renovations by 2011, and LEED Platinum by 2015.

4) Apply LEED Gold construction standards without certification for all other construction projects.

5) Currently planned projects should be required to demonstrate at least a 30 percent improvement in building performance over the latest ASHRAE Standard 90.1 baseline for total building energy.

### 9.4.7 Purchasing/Waste/Recycling Targets and Strategies

*Targets*

1) Adopt a long-term Zero Waste campus policy by 2011.

2) Increase waste diversion to 75 percent by 2020.

*Strategies*

1) Make campus purchasing entities (all units and departments with purchasing privileges) responsible for costs of the disposal of the products consumed.

2) Use carbon and other environmental indicators for purchasing to avoid environmentally irresponsible products and corporations. Coordinate this effort with other universities.

3) Develop a campus incentive for reducing trash with the possibility of charging for waste.

4) Consider a campus-wide bottle or can deposit program.

5) Identify opportunities for an increase in reuse and recycling of materials.

6) Implement full-cost accounting and life-cycle analysis structures for major purchases exceeding $25,000 by 2015.

7) Set and enforce minimum recycled content standards.

8) Develop a durable goods reuse cataloguing system.

9) Work for legislation to enable the resale of campus goods to the general public.

#### 9.4.8 Sequestration Strategies

1) Incentivize the establishment and use of a local carbon registry for purchasing local carbon offsets.

2) Develop and implement a sustainable landscape plan devoted to planning for and implementing sustainable landscapes and landscape maintenance practices.

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## ENDNOTES

1 This includes students that do not purchase a parking permit but that bring cars to campus and seek to use University lots during nights and weekends (currently free).

2 Only projects above $5 million will need to pursue certification, but all projects will have to meet the standards.

3 This is the total amount of GHGs that represent an "equivalent" amount of $CO_2$. It is useful for ease of measurement and comparison.

4 For developed countries.

5 Neutrality in this case means having a net zero carbon footprint, or achieving net zero carbon emissions by balancing a measured amount of carbon released with an equivalent amount sequestered or offset.

6 Figures and projections in this plan have been generated using the Clean Air–Cool Planet Carbon Calculator (www.cleanair-coolplanet.org).

7 In this case, campus purchases electricity from the Midwest Independent Transmission System Operator (MISO).

8 A more detailed description of the Petascale project is below.

9 This assumes a constant fuel mix for the convenience of this analysis. Most probably, co-generation will become a decreasing proportion of the total with purchased electricity becoming increasingly important.

10 Any investment that will enhance or increase its lifetime.

11 This includes students that do not purchase a parking permit but that bring cars to campus and seek to use University lots during nights and weekends (currently free).

12 Only projects above $5 million will need to pursue certification, but all projects will have to meet the standards.

13 SAIC targets in the Other HVAC and Water Heating categories remain.

14 New buildings are dealt with in the following sections.

15 This is a very large number and the campus should consider this carefully when crafting this or any agreements with similar sponsoring agencies (to make sure campus gets green power, efficient facilities, etc).

16 Peer institutions, including the University of Iowa, University of Wisconsin-Madison and Eastern Illinois University, already have the capability to burn biomass or have begun the process of building such a facility.

17 Total emissions due to transportation are still being updated, calculated, and verified.

18 Food, Fuel, and Freeways: An Iowa perspective on how far food travels, fuel usage, and greenhouse gas emissions. 2001. The Leopold Center for Sustainable Agriculture.

19 www.rmi.org

20 The University acknowledges that the variables involved in any decision to reduce campus space are complex. Nevertheless, space removal should be considered as a potential emissions reduction strategy, and the activities of the campus space reduction taskforce should be coordinated with emissions reduction efforts.

*Climate Action*