2015 iCAP

Illinois Climate Action Plan

University of Illinois at Urbana-Champaign

2015 Illinois Climate Action Plan

Climate Action Plan for the University of Illinois at Urbana-Champaign

Contents

Contents, continued

Contents, continued

Contents, continued

Message from the Chancellor

Seven years ago, our campus signed the American College and University Presidents' Climate Commitment, recognizing the urgency of mitigating global climate change and committing as an institution to become carbon neutral as soon as possible.

The 2010 Illinois Climate Action Plan (iCAP) set specific targets for campus sustainability, and many of those targets have already been met, nearly met, or exceeded:

- Reducing existing building energy consumption by 20%;
- Reducing existing building greenhouse gas emissions by 15%;
- Purchasing 30% of food from local sources;
- Reducing potable water usage by 20%;
- Implementing a "no net increase in space" policy; and
- Obtaining 5% of electrical energy from renewable sources.

I am excited to present the 2015 Illinois Climate Action Plan, a document that builds on the successes of the past five years and looks ahead to the next five — and beyond. This new plan is ambitious, and it positions Illinois at the forefront of tackling the profound sustainability challenges that face humanity, including climate change and clean energy. We intend to serve as a model for campuses and communities across the world, while we also educate the next generation of sustainability leaders who can build on our campus's efforts. Our campus will move toward carbon neutrality and will also be a showcase for sustainability in terms of water use, recycling, transportation, and agricultural practices.

This plan will require the dedicated and continuing efforts of our faculty, students, and staff to identify and implement the best solutions for our campus. Many of these solutions will save money in the longer term, while requiring strategic up-front investments. We are committed to finding creative ways to implement such solutions. They are the right thing to do not only for our climate but also for the long-term financial sustainability of our campus.

Given the uncertain fiscal situation of both our state and our university, we have a responsibility to carefully weigh the costs and benefits of such solutions. But we cannot afford to discard them. The costs of inaction are tremendous, as climate change threatens not only the environment but also the very future of our students.

This is an action plan for reaching our sustainability goals. We are proud of the progress we have already made, but we are also both humbled and excited by the challenges that lie ahead. I am pleased to endorse this plan and I am confident that our great campus is ready to rise to these challenges.

Sincerely,

Barbara J. Wilson

Interim Chancellor, University of Illinois at Urbana-Champaign

Executive Summary

Overview of 2015 Illinois Climate Action Plan (iCAP)

In 2008, our campus signed the American College and University Presidents' Climate Commitment (ACUPCC), formally committing to become carbon neutral as soon as possible, and no later than 2050. The first Illinois Climate Action Plan (iCAP) was developed in 2010 as a comprehensive roadmap toward a sustainable campus environment. The 2015 iCAP was developed using the Procedure for Formulating and Evaluating Campus Sustainability Policies & Initiatives,[1] with many 2010 iCAP targets restated or revised and new targets added. Additionally, an updated nomenclature is used in order to provide consistency throughout the document.

- **Goals** are the long-term targets, including the primary goal for our campus to become a global model of sustainability by creating effective, positive change. These overarching goals may be specifically related to our previously defined Climate Commitment,[2] or they may be aspirational goals such as mitigating our contribution to the hypoxic "Dead Zone" in the Gulf of Mexico.
- **Objectives** are defined to be specific, measurable, achievable, relevant, and time-bound. iSEE, in collaboration with F&S and other campus units, will measure progress toward these objectives and work with campus and University budgetary authorities to identify funding to implement them,

1) http://sustainability.illinois.edu/wp-content/uploads/2014/10/Campus_Sustainability_Procedures_Final.pdf
2) http://icap.sustainability.illinois.edu/files/project/489/Climate_Commitment.pdf

while striking an appropriate balance with other mission-critical budgetary priorities. Generally, the objectives include short-term targets, such as to decrease energy consumption 30% by FY20.

- **Potential strategies** are methods that the campus could consider to aid in reaching the specific objectives, and many of these potential strategies were motivated by aspirational goals beyond the formal Climate Commitment.

The full list of objectives is included in remaining pages of this Executive Summary. Chapter 1 provides a more thorough introduction to this 2015 iCAP. Chapters 2 through 7 present the goals, objectives, and potential strategies for six topical areas: Energy Conservation and Building Standards; Energy Generation, Purchasing, and Distribution; Transportation; Water and Stormwater; Purchasing, Waste, and Recycling; and Agriculture, Land Use, Food, and Sequestration. Chapter 8 discusses carbon reduction options through the use of carbon offsets. Chapter 9 outlines objectives for financing. Chapter 10 addresses our efforts to integrate sustainability into the education our students receive in the classroom, and Chapter 11 lists outreach efforts such as co-curricular student events and recurring major annual sustainability events. Chapter 12 discusses the span of sustainability research on our campus and describes the initiatives currently being undertaken by iSEE to spawn new interdisciplinary research themes. Chapter 13 offers a potential scenario for successfully reaching carbon neutrality, and concluding remarks.

With the approval of this 2015 Illinois Climate Action Plan, our campus recognizes the urgent need to dramatically reduce its greenhouse gas emissions in order to help mitigate the dangerous effects of climate change that are already becoming evident, and more generally to continually become better stewards of our environment. We reaffirm our commitment to become carbon neutral as soon as possible, and we look forward to the possibility of accelerating our climate efforts and setting a goal to attain carbon neutrality considerably sooner than 2050. In doing so, we aim to lay the groundwork for the continued excellence of the University of Illinois, for the next 150 years and beyond.

Energy Conservation and Building Standards objectives:

1. Maintain or reduce the campus gross square footage relative to the FY10 baseline.
2. Identify the highest achievable energy standards for new buildings and major renovations, and incorporate these into the campus facility standards by the end of FY16.
3. Strengthen centralized conservation efforts focusing on building systems to achieve a 30% reduction in total campus building energy use by FY20. This includes meeting LED Campus commitments.
4. Engage and incentivize the campus community in energy conservation, including a comprehensive energy conservation campaign, with at least 50% of units participating by FY20.

Energy Generation, Purchasing, and Distribution objectives:

5. The Energy Generation, Purchasing, and Distribution SWATeam, in collaboration with Facilities & Services and topical Consultation Groups, will lead an exploration of options for 100% clean campus energy during FY16 and submit recommendations through the formal sustainability process.
6. Expand on-campus solar energy production. By FY20, produce at least 12,500 MWh/year, and by FY25 at least 25,000 MWh, from solar installations on campus property. These targets represent 5% and 10% of our expected 2050 electricity demand, respectively.
7. Expand the purchase of clean energy. By FY20, obtain at least 120,000 MWh, and by FY25 at least 140,000 MWh from low-carbon energy sources. These targets represent 48% and 56% of our expected 2050 electricity demand, respectively.
8. Offset all emissions from the National Petascale Computing Facility (and other successor facilities) by the conclusion of the current period of National Science Foundation support.

Transportation objectives:

9. Reduce air travel emissions from a new FY14 baseline by 25% by FY20, 50% by FY25, and 100% by FY30.
10. Reduce emissions from the Urbana-Champaign campus fleet by 20% for departmentally-owned and

carpool vehicles by FY20.
11. Conduct a detailed study by the end of FY17 to develop scenarios for complete conversion of the campus fleet to renewable fuels.
12. Reduce the percentage of staff trips made using single-occupancy vehicles from 65% to 55% by FY20, 50% by FY25, and 45% by FY30.
13. Implement the Campus Bike Plan on the schedule noted in that plan. Notable deadlines include full implementation of new bikeway facilities by FY25, bike parking within 150 feet of every building in the core of campus by FY20, and bike rentals by FY20.
14. Appropriately staff sustainable transportation efforts, especially through the hiring of an Active Transportation Coordinator.

Water and Stormwater objectives:

15. Obtain and publicize more granular water use data by FY16, including water quantity and quality data where available.
16. Improve the water efficiency of cooling towers by limiting the amount discharged to sewer to less than 20% of water intake for chiller plant towers, and less than 33% for stand-alone building towers, by FY20.
17. Perform a water audit to establish water conservation targets — and determine upper limits for water demand by end-use — for incorporation into facilities standards by FY16.
18. Inventory and benchmark campus' existing landscape performance by FY17.
19. Through an open solicitation process, implement at least four pilot projects to showcase the potential of water and/or stormwater reuse by FY20, with the objective of implementing a broader program by FY25.
20. Investigate the water quality impacts of stormwater runoff and potential ways to reduce stormwater pollutant discharges by FY18.

Purchasing, Waste, and Recycling objectives:

21. By FY17, environmental standards will be applied to purchases of office paper, cleaning products, computers, other electronics, and freight/package delivery services. At least 50% of purchases in these categories will meet campus standards by FY20, and 75% by FY25.
22. Reduce municipal solid waste (MSW) going to landfills. This involves reducing nondurable goods purchases, effectively reusing materials, and recycling. In the latter category, campus will increase the diversion rate of MSW to 45% by FY20, 60% by FY25, and 80% by FY35, while also increasing the total diversion rate to 90% by FY20 and 95% by FY25. MSW sent to landfills should decline to 2,000 tons annually by 2035.
23. Utilize landfills with methane capture.
24. Appropriately staff Zero Waste efforts through the hiring of a full-time Zero Waste Coordinator.

Agriculture, Land Use, Food, and Sequestration objectives:

25. Perform a comprehensive assessment of GHG emissions from agricultural operations, and develop a plan to reduce them, by the end of FY16.
26. Design and maintain campus landscapes in a more sustainable manner; expand the specification of sustainable plantings in campus landscaping standards, and develop and implement a tree care plan by FY16 and an integrated pest management program by FY17.
27. Incorporate sustainability principles more fully into the Campus Master Plan.
28. Implement a project that examines the food service carbon footprint for Dining and other on-campus food vendors, while increasing local food procurement to 40% by FY25.
29. Increase carbon sequestration in campus soils by determining the sequestration value of existing plantings and identifying locations for additional plantings, with a specific objective of converting at least 50 acres of U of I farmland to agroforestry by FY20.
30. Reduce nitrates in agricultural runoff and subsurface drainage by 50% from the FY15 baseline by FY22.

Carbon Offsets objectives:

31. By the end of FY16, conduct a Request for Proposals process for verified carbon offsets — and undertake the first campus purchase of offsets.
32. By the end of FY17, develop an administrative mechanism to enable campus units to voluntarily purchase carbon offsets.
33. By the end of FY18, develop a program of local or regional mission-linked verified carbon offsets, so that our purchases of offsets will also support our institutional missions.
34. By FY20, utilize offsets to meet all iCAP emissions targets that have not been met by direct emission reductions.

Financing objectives:

35. By the end of FY16, develop criteria and a review process for the iCAP Working Group to allocate funding for feasibility studies of SWATeam-recommended sustainability projects and initiatives, using funds provided by campus administration and other sources.
36. By the end of FY16, increase the size of the Revolving Loan Fund (RLF) to a level commensurate with our aspirational peers, expand the reach of the Fund, and increase the use of Energy Performance Contracting.
37. By the end of FY16, identify the amount of funds that are available across campus for projects that do not offer a rapid financial payback, but which are nevertheless important for improving campus sustainability, and identify options to increase that amount annually.
38. By the end of FY16, evaluate the feasibility of internally putting a price on carbon emissions.

Curricular Education objectives:

39. Offer an undergraduate minor in sustainability, starting with about 20 students in FY16, that will provide in-depth learning about the three dimensions of sustainability and enable students to make connections between the different disciplines to solve problems related to sustainability.
40. Provide opportunities for undergraduate students to obtain research and practical experience by participating in independent study projects on sustainability topics.
41. Add at least five new sustainability-focused courses by FY20.

Outreach objectives:

42. Support and communicate about co-curricular student sustainability programs.
43. Strengthen and communicate about sustainability outreach programs. Specifically, at least half of the full-time campus staff will be participating in the Certified Green Office Program by FY20.
44. Organize and promote three major sustainability events on campus each year: Earth Week, Campus Sustainability Week, and the iSEE Congress.

Research objectives:

45. Create a hub for the sustainability community: to develop a comprehensive online gateway for faculty, staff, students, potential donors, and all interested parties to find information about sustainability research, education, outreach, initiatives, and operations.
46. Build connections: to bring together scholars from across campus to encourage collaboration, and to enhance research endeavors.
47. Foster "actionable" research: to encourage and support research that provides real-world solutions to society's grand challenges in sustainability, energy and the environment. iSEE research themes are broken into five categories: Climate Solutions, Energy Transitions, Secure and Sustainable Agriculture, Sustainable Infrastructure, and Water and Land Stewardship.

Chapter 1. Introduction

History

As we approach the sesquicentennial of our campus, it is vital that we focus on our role as stewards of the University's future. We have clearly thrived over the past 150 years, but we cannot take for granted that the next 150 years will be smooth sailing. One linchpin of our future success is that our campus operations must be environmentally sustainable; that is to say we must be able to sustain them indefinitely (or at least another 150 years) without substantial degradation of the environment we depend on.

As the flagship institution of higher education in Illinois and one of the world's leading research institutions, it is imperative for the campus to practice responsible stewardship of the natural resources it uses.

The sustainability of our campus involves many important considerations, including water use, decreasing biodiversity, and a declining resource base. Clearly, however, the biggest challenge to our environmental sustainability is the climate change that is caused by our emission of greenhouse gases such as carbon dioxide (CO_2).[3] The mounting evidence of the profound impacts of climate change prompted our Chancellor in 2008 to join many of our higher education colleagues in the American College and University Presidents' Climate Commitment (ACUPCC), formally committing to become carbon neutral as soon as possible, and no later than 2050.

3) Appendix A is a list of acronyms and the associated definitions.

"We believe colleges and universities must exercise leadership in their communities and throughout society by modeling ways to minimize global warming emissions, and by providing the knowledge and the educated graduates to achieve climate neutrality. Campuses that address the climate challenge by reducing global warming emissions and by integrating sustainability into their curriculum will better serve their students and meet their social mandate to help create a thriving, ethical and civil society." — excerpt from American College and University Presidents' Climate Commitment

In 2010, our campus developed the Illinois Climate Action Plan (iCAP)[4] following an inventory of greenhouse gas emissions. The 2010 iCAP provided a roadmap to a sustainable future. Since 2010 we have made remarkable progress on many fronts, especially in the areas of energy and water conservation. As a result, our campus has been recognized in many ways for its sustainability efforts, for example by achieving Gold Level honors in the Sustainability, Tracking, Assessment, and Rating System (STARS)[5] and being ranked the top in the Big Ten Conference by the Sierra Club "Cool Schools" program.[6]

The 2010 iCAP set aggressive goals for reaching carbon neutrality. These goals were organized into 10 themes: Education, Energy, Funding, Land and Space, Outreach, Procurement and Waste, Reporting Progress, Research, Transportation, and Water.[7] Many of these themes included interim targets for completion by FY15. For example, the FY15 target for energy use per square foot was a reduction of 20% from the FY08 baseline, and campus has exceeded this target in FY14 with a reduction of 24.2%. Similarly, the FY15 target for water consumption was a 20% reduction from the FY08 baseline, and campus has exceeded that in FY14 with a 23% reduction.

Targets for education included the development of learning outcomes, measuring sustainability literacy, developing a course inventory to identify gaps in offerings, and integrating sustainability throughout the curriculum. A multidisciplinary task force succeeded in the development of six sustainability learning outcomes. The course inventory conducted in 2010 revealed approximately 250 courses related to sustainability. Today, that number is nearly 400. A teaching workshop for faculty and instructors designed to aid them in integrating sustainability into their courses resulted in the modification or development of about 75 courses to include sustainability. Additionally, efforts are underway to increase the volume and impact of sustainability research at Illinois. Seed funds have been made available to fund the most promising actionable research in the areas of climate solutions, energy transitions, sustainable infrastructure, water and land stewardship, and secure and sustainable agriculture.

In late 2011, the Chancellor commenced the Visioning Future Excellence[8] initiative, a collaborative and comprehensive process that gathered input from more than 3,000 individuals in order to identify the areas in which the University can best contribute to society's most pressing needs. One of six major themes that emerged from this process was "Energy and Environment." In the outcomes report, released in mid-2013, the first new strategic initiative was the creation of the Institute for Sustainability, Energy, and Environment (iSEE)[9] in order to coordinate and elevate the recognition of sustainability efforts across campus, in the areas of campus sustainability, education and outreach, and research.

Other outcomes from the Visioning Future Excellence initiative include strategic new faculty hires and educating future leaders to effectively address societal challenges. In the Energy and Environment theme, campus administration approved a faculty cluster hiring program that may result in as many as seven new hires to build capacity among our faculty.

4) http://icap.sustainability.illinois.edu/files/project/36/iCAP_FINAL.pdf
5) https://stars.aashe.org/institutions/university-of-illinois-urbana-champaign-il/report/2015-03-17/
6) http://www.sierraclub.org/sierra/2014-5-september-october/cool-schools-2014/full-ranking
7) http://icap.sustainability.illinois.edu/goals
8) Visioning Excellence at the University of Illinois at Urbana-Champaign http://oc.illinois.edu/visioning/energy.html
9) http://sustainability.illinois.edu/

Further, a new approach for education, Grand Challenge Learning,[10] is being piloted to allow students to select courses with respect to an issue they care about, for example energy and environment.

Sustainability Process

One of iSEE's first major steps was to spearhead the creation of a process for developing and implementing policies and initiatives in the area of campus sustainability.The Procedure for Formulating and Evaluating Campus Sustainability Policies & Initiatives[11] was prepared in collaboration with Facilities & Services, the Office of the Vice Chancellor for Research, and the Office of the Provost, and was approved by the Chancellor in June 2014.

The heart of this process is a set of six topical Sustainability Working Advisory Teams (SWATeams), each of which consists of two faculty, two staff members, and two students, engaging with topical Consultation Groups of experts and stakeholders from around the campus and community. These SWATeams are charged with reviewing iCAP progress and proposing new sustainability procedures and initiatives. Recommendations from the SWATeams are transmitted to the iCAP Working Group, which consists of midlevel administrators as well as faculty and student representatives. The iCAP Working Group is charged with evaluating SWATeam recommendations, transmitting those with small or medium budgetary or policy impact to the appropriate campus units, and transmitting high-impact recommendations to the Sustainability Council. The Council is chaired by the Chancellor and contains the top-level decision-makers on our campus, as well as faculty and student representatives. Appendix B lists the members of the SWATeams, iCAP Working Group, and Sustainability Council during the period in which this document was formulated.

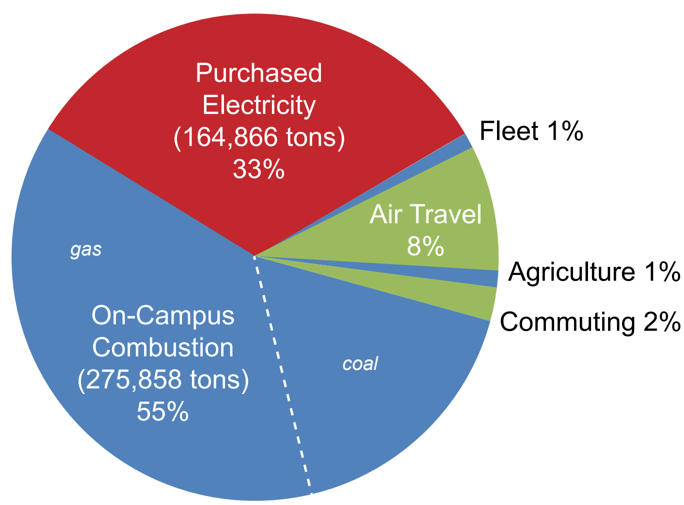


Figure 1: Scope 1, 2, and 3 Emissions. Scope 1 (on-campus) emissions are colored in blue, scope 2 (purchased electricity) are red, and scope 3 (off-campus)are green.

The present revision to the iCAP has been developed with a similar process. The SWATeams prepared recommendations and shared them with the campus community at the iCAP Forum in October 2014. They then provided drafts of the six topical chapters, which the iCAP Working Group revised and synthesized into a draft climate action plan. That draft was in turn commented on by the SWATeams, and again reviewed and edited by the iCAP Working Group. The resulting version was then shared with the entire campus community for a public comment period in May 2015, and a revised version was approved by the Sustainability Council in May 2015, and signed by the Chancellor in October 2015.

10) http://strategicplan.illinois.edu/goals.html#goal2
11) http://sustainability.illinois.edu/wp-content/uploads/2014/10/Campus_Sustainability_Procedures_Final.pdf

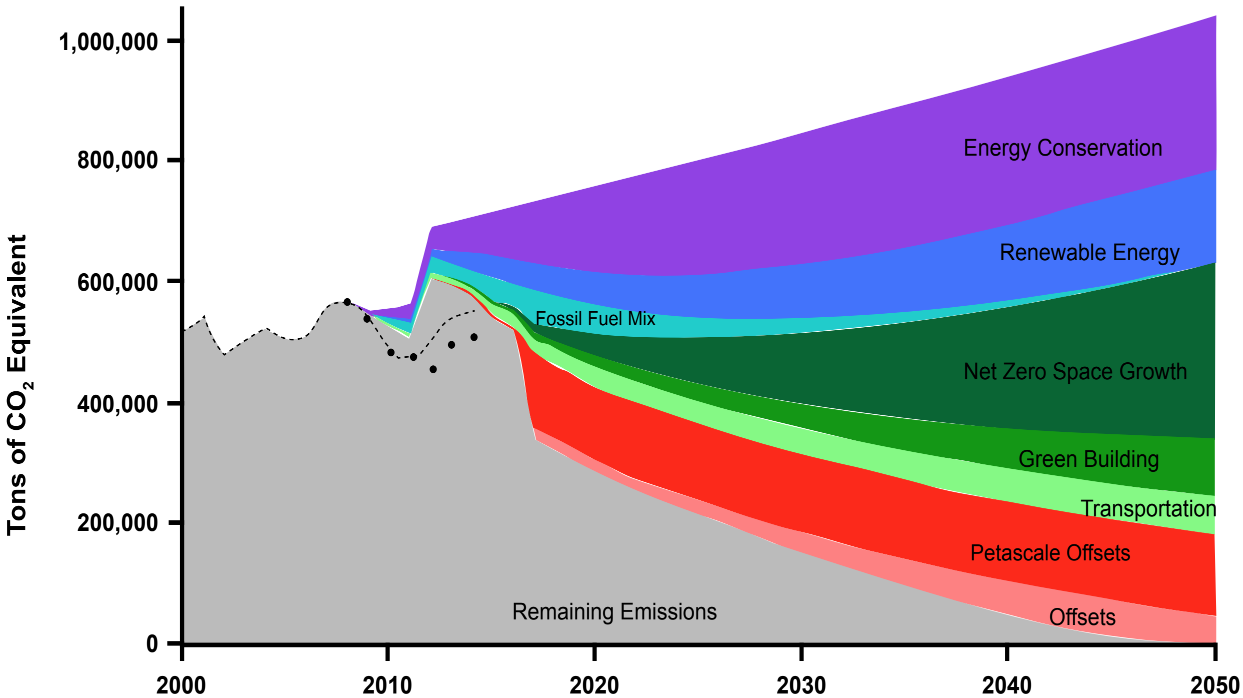


Figure 2: 2010 iCAP Wedge Diagram with annual emissions through FY14 shown as dots and reported emissions through FY14 shown as dotted line

Greenhouse Gas Emissions

The first step in developing the 2015 iCAP was an update to the greenhouse gas emissions inventory. Our campus has utilized the Campus Carbon Calculator (CCC)[12] to determine our greenhouse gas emissions since signing the American College and University Presidents' Climate Commitment (ACUPCC) in 2008. This tool was an industry standard, used by the majority of U.S. colleges and universities that report their emissions publicly; recently, however, various sustainability advocates on our campus have questioned the underlying assumptions in the CCC. Therefore, we have decided to review the greenhouse gas emission inventory methodology for future emissions reporting, yet continue to use the CCC for consistency. As described in future chapters, various strategies for updating the emissions calculations are under consideration for future inventories. It should be noted that greenhouse gas emissions are reported in "tons of CO_2 equivalent," a quantity that includes all greenhouse gases (including methane, nitrous oxide, and others) appropriately adjusted for their climate impacts relative to CO_2.

Greenhouse gas emissions are generally categorized into three "scopes." Scope 1 consists of emissions resulting from on-campus activities that we have direct control over, and includes combustion at Abbott Power Plant, fleet emissions, and agricultural emissions. Scope 2 consists of emissions resulting from purchased electricity, which we have a moderate degree of control over. For example, we could reduce Scope 2 emissions by entering into power purchase agreements with low-carbon energy sources such as wind farms, biomass power plants, or nuclear power plants. Scope 3 consists of other emissions that occur off campus as a result of campus activities; these include commuting, air travel, solid waste, and the effects of purchasing goods and services.[13] Figure 1 (left) shows a breakdown of the largest contributions to our FY14 emissions, color coded by scope.

12) The Campus Carbon Calculator was managed by nonprofit Clean Air-Cool Planet (http://campuscarbon.com/About.aspx).
13) The Scope 3 emissions here are those computed using the CCC; some of the objectives in this iCAP address ways of reducing other Scope 3 emissions that have yet to be fully accounted for in our emissions inventory.

Figure 2 (top of previous page) shows an updated version of the “wedge diagram” from the 2010 iCAP[14] showing expected emissions under business-as-usual (top curve), and expected reductions based on various strategies such as energy conservation and renewable energy. Aside from a change in labeling, the major differences are the addition of the black dots, which show the actual campus emissions since the diagram was constructed, and the dotted line representing what our reported emissions will be once the sale of carbon offsets to Bonneville Environmental Foundation[15] is finalized. It is interesting to note that as of FY14 our annual emissions[16] are more than 200,000 tons lower than the anticipated business-as-usual trajectory, and also almost 70,000 tons lower than hoped for at the time the 2010 iCAP was completed. This is primarily the result of energy conservation and shifts in our energy generation and purchasing methods.

Potential Mitigation Strategies

The central vision of our future is to completely eliminate all Scope 1 and 2 emissions by 2050. As of the metrics available for FY14, about 61% of our Scope 1 and 2 emissions are from Abbott Power Plant, 36% of them are from purchased electricity, and the remainder is from fleet and agricultural emissions. Eliminating emissions from Abbott and purchased electricity will require a combination of reducing our energy demands through conservation and shifting our energy generation and purchasing toward clean energy sources.

In terms of energy conservation, we envision cutting our current energy demand at least in half by FY50. This will require:

- Putting a firm cap on the gross square footage of our campus to prevent growth in energy demands.
- Improving our building standards such that new buildings (when replacing old ones) and major renovations[17] will lead to significantly reduced consumption of energy from fossil fuels.
- Upgrading existing building systems to reduce energy use, especially when rooms are unoccupied.
- Encouraging and incentivizing significant behavior change and energy-conscious decision-making across campus.

In terms of energy generation and purchasing, we envision gradually shifting to renewable and carbon-free energy sources, and completely eliminating emissions from energy generation by FY50. As discussed in Chapter 3, it is not yet clear exactly how this is best accomplished, but some key elements are likely to include:

- Entering into power purchase agreements with suppliers of non-fossil-fuel electricity, such as wind farms, biomass plants, or nuclear power plants.
- Installing considerable solar photovoltaic generation capacity on our campus.
- Fully or partially electrifying our heating systems, ideally using high-efficiency heat pumps, so that a significant fraction of our heating needs can be met by non-fossil-fuel electricity rather than by combustion of fossil fuels.
- Developing biomass combustion on our campus to provide for the balance of our heating needs.

14) The original wedge diagram appeared in the 2010 iCAP book as Figure 6 on Page 40.
15) http://icap.sustainability.illinois.edu/project/chevy-campus-clean-energy-efficiency-campaign
16) http://icap.sustainability.illinois.edu/project/greenhouse-gas-emission-reports
17) For the purposes of this document, a major renovation is defined as a project with a construction cost that equals or exceeds 40% of a building’s current replacement cost, which is consistent with the Illinois Green Building Act.

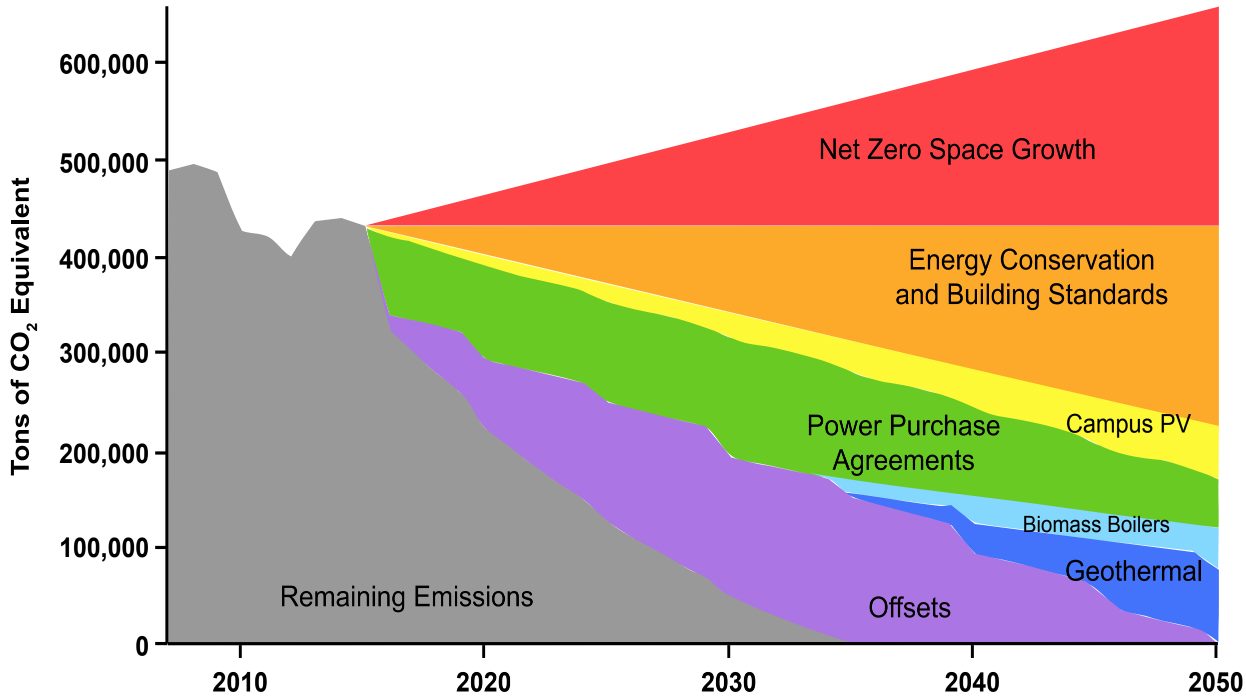


Figure 3: 2015 iCAP Wedge Diagram showing only energy emissions projected, with potential clean energy scenario

Figure 3 (above) shows the 2015 iCAP energy emissions wedge diagram, reflecting the successful implementation of the above clean energy strategies, along with minimal purchases of carbon offsets (see Chapter 8).

The other two contributions to our Scope 1 emissions should be easier to eliminate. Emissions from our fleet vehicles could be eliminated by switching the fleet to a fuel source that does not require fossil fuels (options include sustainably produced biodiesel, compressed natural gas from anaerobic digestion of agricultural wastes, and/or non-fossil-fuel electricity). Agricultural emissions could be eliminated by shifts in practices so that carbon sequestration in the soil exceeds the emissions from fertilizers, livestock, and equipment.

A potential scenario for reaching carbon neutrality is presented in more detail in Chapter 13. The scenario provides hope for a carbon neutral future.

2015 iCAP Structure

The 2010 iCAP was the initial comprehensive roadmap toward a sustainable campus environment, helping to guide and support the great progress over the last five years. This new 2015 iCAP is both an update and a revision to the original. Many of the 2010 iCAP targets are restated in this document, often with the same future objectives. Some new targets have been added, some have been revised. Additionally, an updated nomenclature is used to provide consistency throughout the document. Within the following chapters, there are generally three levels of targets: goals, objectives, and potential strategies.

Goals are the long-term targets, including the primary goal for our campus to become a global model of sustainability by creating effective, positive change. These overarching goals may be specifically related to our previously defined Climate Commitment,[18] or they may be aspirational goals such as mitigating our contribution to the hypoxic "Dead Zone" in the Gulf of Mexico.

Objectives are defined to be specific, measurable, achievable, relevant, and time-bound. iSEE, in collaboration with F&S and other campus units, will measure progress toward these objectives and work with campus and University budgetary authorities to identify funding to implement them, while striking an appropriate balance with other mission-critical budgetary priorities. Generally, the objectives include short-term targets, such as to decrease energy consumption 30% by FY20. The full list of objectives is collected in the Executive Summary.

Potential strategies are methods that the campus could consider to aid in reaching the specific objectives, and many of the potential strategies were motivated by aspirational goals, beyond the formal Climate Commitment. Annually, the SWATeams and iSEE will review progress on the specific 2015 iCAP objectives and make recommendations for additional strategies campus should take toward meeting the objectives. The SWATeam recommendations may pull from the potential strategies described here, or they may include new strategies.

Chapters 2 through 7 present the goals, objectives, and potential strategies for six topical areas: Energy Conservation and Building Standards; Energy Generation, Purchasing, and Distribution; Transportation; Water and Stormwater; Purchasing, Waste, and Recycling; and Agriculture, Land Use, Food, and Sequestration. Chapter 8 discusses carbon reduction options through the use of carbon offsets. Chapter 9 outlines objectives for financing. Chapter 10 addresses our efforts to integrate sustainability into the education our students receive in the classroom, and Chapter 11 lists outreach efforts such as co-curricular student events and recurring major annual sustainability events. Chapter 12 discusses the span of sustainability research on our campus and describes the initiatives currently being undertaken by iSEE to spawn new interdisciplinary research themes. Chapter 13 offers a potential scenario for successfully reaching carbon neutrality, and concluding remarks.

With the approval of this 2015 version of the Illinois Climate Action Plan, we make an enhanced commitment to environmental sustainability and proudly recognize the leadership role we play in paving a way toward a sustainable future. The developments of the past five years in climate science, and the fact that we are already experiencing the troubling effects of climate change, provide a new sense of urgency for tackling the climate challenge. As a result, we have decided to undertake a detailed study during the 2015-16 academic year, using the sustainability process described above, to determine what steps our campus would need to take to accelerate our efforts and achieve carbon neutrality by 2035. This study will include an examination of the costs and benefits of those steps, considering both the short- and long-term impacts on our campus finances, environmental impact, and reputation. Following the completion of this study, we expect the Sustainability Council to advise the Chancellor as to whether the goal of carbon neutrality by 2035 should be adopted. If adopted, it would mean that when the children of the men and women of the Class of 2015 head to our campus for their freshman year, they will be attending a sustainable and carbon neutral campus that is poised for another 150 years of excellence.

18) http://icap.sustainability.illinois.edu/files/project/489/Climate_Commitment.pdf

Chapter 2. Energy Conservation and Building Standards

As described in Chapter 1, 88% of our greenhouse gas emissions result from on-site combustion and grid electricity purchases that heat, cool, and provide electricity to campus buildings. Consequently, achieving our carbon neutrality goal will require both a strong building energy conservation program and also a shift in our energy generation and purchasing toward renewable sources (discussed in Chapter 3). While both of these elements are critical and must be pursued by our campus, energy conservation is considered to be a top priority as it leads directly to both emission reductions and cost savings that can facilitate even further emission reductions.

Energy Conservation Goals

The 2010 iCAP called for a reduction in total energy use of existing buildings of 20% by FY15, 30% by FY20, and 40% by FY25. That goal assumed, in conjunction with the "no new space" 2010 iCAP target, there would be no growth in campus gross square footage (GSF), while the campus actually increased from 20,113,569 GSF in FY08 to 21,003,246 GSF in FY14.[19] Therefore, energy conservation metrics have been

19) The GSF growth from FY08 to FY14 was anticipated in the 2010 iCAP due to the previously approved constructions projects underway in FY10. Therefore, the future growth in GSF is reflected in this document as zero, as described in Objective 1 for this chapter.

Fiscal Year	Total Energy Delivered to Campus MWh/year	% Change in Campus Energy Use from FY08	Gross Square Feet GSF	Energy Use Intensity (EUI) MWh/year/GSF	% Change in EUI from FY08
2008	1,299,520	n/a	20,113,569	0.065	n/a
2009	1,169,953	-10%	20,128,325	0.058	-10%
2010	1,093,500	-16%	20,389,897	0.054	-17%
2011	1,064,004	-18%	20,771,195	0.051	-21%
2012	988,614	-24%	20,918,296	0.047	-27%
2013	1,061,399	-18%	20,908,187	0.051	-21%
2014	1,076,722	-17%	21,003,246	0.051	-21%
2020	*909,664*	*-30%*	*21,003,246*	*0.043*	*-33%*
2025	*844,688*	*-35%*	*21,003,246*	*0.040*	*-38%*
2030	*779,712*	*-40%*	*21,003,246*	*0.037*	*-43%*
2040	*714,736*	*-45%*	*21,003,246*	*0.034*	*-47%*
2050	*649,760*	*-50%*	*21,003,246*	*0.031*	*-52%*

Table 1: Energy Conservation Goals

tracked using the industry standard metric of Energy Use Intensity (EUI), which is the total energy delivered to campus divided by the total gross square footage of our building stock.[20] As of FY14, we have reduced our EUI by 21% from the FY08 baseline and are thus on track to achieve the 20% goal set forth in the 2010 iCAP (see Table 1, left).

The total energy delivered to campus is defined here as the energy consumed by buildings and facilities on the main campus property, not including Abbott Power Plant or the National Petascale Computing Facility. This quantity does not include efficiency losses at Abbott, energy transmission losses, or energy consumed at off-campus locations, such as Willard Airport and leased spaces. The campus will continue to exclude the National Petascale Computing Facility (and any similar successor facilities that primarily serve noncampus users) from our building energy conservation goals. Although the campus is responsible for the energy and associated emissions from this unique facility, including such facilities in our conservation goals would make it essentially impossible to continue or expand those facilities, especially considering that the next-generation supercomputing facility could use even more electricity. This conservation metric is also less than the total energy consumed by campus facilities because it does not include energy produced at a building to satisfy its own needs. Note that net zero energy buildings still require significant energy inputs at certain times of day and year due to the intermittency of renewable energy sources, and the energy delivered to these buildings, from Abbott Power Plant or via electric purchases, will be included in the total energy delivered to campus.

Moving forward, it is appropriate to benchmark our conservation successes by the total energy delivered to buildings each year to satisfy heating, cooling, and electrical needs, while continuing to use EUI as a metric for evaluating individual buildings or units. The use of total energy (rather than EUI) reflects the fact that our climate impact is related to the total energy demanded by buildings; if our gross square footage were to increase in the future even as our EUI remained constant, we would still increase our energy needs. However, our overarching goal is to reduce total energy needs, and then (as discussed in Chapter 3) meet those needs with renewable energy sources. Our annual conservation goals through FY50 are listed in Table 1, and the corresponding EUI goals through FY20 (assuming no growth in square footage) are illustrated in Figure 4 (right).

Objectives

The success we have achieved so far in energy conservation has primarily been the result of a variety of centrally-administered programs, including retrocommissioning (RCx), heating, ventilation, and air conditioning (HVAC) improvements, scheduling and control strategies, lighting retrofits, and new execution methodologies, such as Energy Performance Contracting (EPC). While much has been achieved, a lot more needs to be done, with both an expansion of the existing programs and a more comprehensive campaign

20) See map of included buildings at http://icap.sustainability.illinois.edu/files/project/199/2014%20Energy%20Use%20Facilities.pdf.

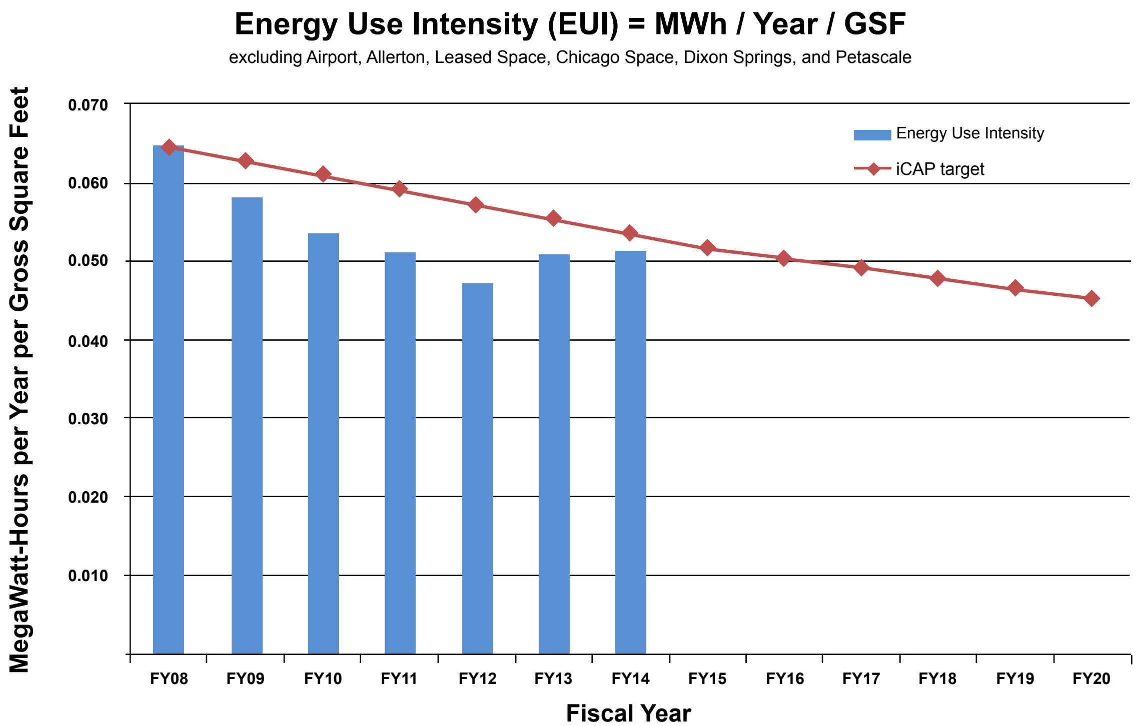


Figure 4: Energy Conservation Goals

that engages the campus at the college, department, building, and individual levels. Because easy fixes come first, the way forward will require more than incremental improvements: academic experts in many disciplines will need to collaborate with F&S to develop a comprehensive energy conservation plan if we are to achieve our goal of carbon neutrality by 2050. This plan should be data driven and analytical in the approach and derivation of scenario alternatives, consistent with best practices for planning efforts.

Meeting our aggressive energy conservation goals will require more efficient building use, as continuous growth in the campus building footprint would undermine the gains of increased efficiency of existing buildings. Underused spaces require the same operational expenses as fully utilized space; removing underutilized assets and fully using critical buildings will help in meeting campus energy goals. When new buildings are built to replace old ones, or major renovations are undertaken, our campus standards need to ensure that the highest energy efficiency standards are adopted, and renewable energy production is incorporated to achieve net zero energy status. The efficiency of existing building systems needs to be further improved through strengthened centralized conservation programs. Finally, the occupants of our buildings (colleges, departments, units, and individuals) need to be engaged and incentivized so that they will seek to buy efficient equipment and reduce their energy consumption.

Our Energy Conservation and Building Standards objectives are thus:

1. Maintain or reduce the campus gross square footage.
2. Identify the highest achievable energy standards for new buildings and major renovations, and incorporate these into the campus facility standards by the end of FY16.
3. Strengthen centralized conservation efforts focusing on building systems to achieve a 30% reduction in total campus building energy use by FY20. This includes meeting LED Campus[21] commitments.

21) http://icap.sustainability.illinois.edu/project/led-campus

4. Engage and incentivize the campus community in energy conservation, including a comprehensive energy conservation campaign, with at least 50% of units[22] participating by FY20.

Potential Strategies

1. Maintain or Reduce Gross Square Footage

The 2010 iCAP committed the campus to enacting a “no net increase in space” policy applicable to all space controlled by campus. Such a policy enables greenhouse gas emission reductions through restricting additional gross square feet of campus buildings, which is directly related to the peak energy demand for campus utilities. In addition to limiting future energy expenditures, there will also be a reduction in the use of resources for construction materials and processes, and a reduction of transportation emissions associated with urban sprawl.

A net zero growth space policy has been approved and incorporated into the Campus Administrative Manual.[23] According to this policy, when buildings are demolished or leases are vacated, their gross square footage would be added to a “square footage bank” held by the Provost’s office. The Provost may “retire” this square footage to effect a gradual reduction in campus gross square footage, or may make allocations of this square footage to offset individual projects that would otherwise increase gross square footage. Such an allocation from the bank would represent a negative square footage contribution to the project to enable it to result in no increase in gross square footage.

Modern building standards typically require more square footage for accessibility and mechanical needs. Nevertheless, campus could prevent the need for increases in square footage by judiciously examining existing and new space requirements at a departmental level. Campus could also consider best practices from other campuses, such as a space marketplace that provides rewards for space reduction and enables efficient space swaps. The campus could develop a standardized reporting system that measures use of classrooms, classroom laboratories, conference rooms, and meeting rooms based on variables such as time and day of the week, average percent fill, facilities demand, etc. Campus administrators could then identify underutilized spaces and reassign them for other purposes. A comprehensive space audit of the campus could also be considered.

2. Improve Standards for New Buildings and Renovations

While the utilization of current building certification programs such as Leadership in Energy & Environmental Design (LEED) has helped raise awareness of sustainable building standards, the campus could accelerate progress in reducing building energy use by shifting to performance-based building standards for new buildings and major renovations. A study could be conducted to determine the highest level of energy performance standards that would be achievable for all new campus buildings and major renovations, and these could be incorporated into the campus facility construction standards[24] by the end of FY16. The study could consider options such as requiring total building energy use to be a certain percentage lower than the baseline energy use according to the latest ASHRAE 90.1 standard, requiring the total nonrenewable energy usage to decrease by a certain fraction as a result of the renovation or building replacement, or requiring net zero[25] energy performance.

---

22) Units can be defined as groups of campus employees reporting to Deans, Directors, and Department Heads (DDDH) and groups of students organized by residential location.
23) http://cam.illinois.edu/viii/VIII-23.htm
24) http://www.fs.illinois.edu/resources/facilities-standards
25) We define a net zero energy building as one that, over the course of a year, generates at least as much energy from renewable sources as it consumes. This definition recognizes that it is impractical to assure an instantaneous balance of consumption and renewable energy production due to the intermittency of renewable energy sources. In some cases it may be necessary to install renewable energy generation facilities in locations not on/in the building itself, for example as planned for the solar photovoltaic array on the North Campus Parking Deck to make the Electrical & Computer Engineering Building net zero energy.

3. Strengthen Centralized Conservation Efforts

To reduce the energy demands of existing building systems, the campus needs to expand centrally funded programs, primarily with additional staff and money. The following strategies could be pursued to achieve additional energy reductions.

Develop a Campus Energy Conservation Master Plan

The campus would benefit from the development of an aggressive energy conservation master plan. Such a plan would entail a detailed timeline and investment strategy for campus energy conservation including specific strategies and financing mechanisms toward stated campus energy goals. This is an essential part of any overall strategic effort toward energy conservation, and it is also an important input into planning for renewable energy generation and purchasing. This plan could be developed through a collaboration between experts from our faculty (in various disciplines from engineering to planning), students, and staff.

Expand the Energy Performance Contracting Program

One limitation to effective building energy conservation is capital. Although investments made in building conservation can have very high rates of return (we estimate 20-25%), the initial capital needed to make these improvements is difficult to generate for a public entity with many demands on its capital resources. Energy Performance Contracting (EPC) can be an effective approach to generating capital for energy conservation projects in public buildings.

An Energy Performance Contract (EPC) is a partnership between the university and an Energy Services Company (ESCO) to execute an energy reduction project in addition to addressing deferred maintenance backlog deficiencies. ESCOs provide all of the services required to design and implement a comprehensive project at the customer facility, from the initial energy audit through the long-term guarantee of project savings. The EPC provides campus with a set of energy efficiency measures, accompanied by guarantees that the energy savings produced by the project will be sufficient to cover its full cost over the term of the contract.

To date, two EPC projects have been completed with expected energy cost avoidance totaling $2 million annually. There is already a long-term EPC plan in place to address 20 buildings over the next eight years. Targeted buildings are primarily research facilities with higher capital needs and larger energy consumption rates. Energy conservation projects associated with these buildings have been estimated to be worth over $40 million in capital costs. Moving forward, a cost-benefit analysis on the ramifications of expanding the EPC program is needed. This could be part of the larger energy conservation master plan. Expanding the EPC program to include auxiliary units should also be considered.

Expand the Campus Retro-Commissioning Program

Retro-commissioning (RCx) for existing buildings is a systematic process for investigating, analyzing, and optimizing the performance of building systems by improving their operations to ensure their continued performance over time. Commissioning of buildings, to properly balance and synchronize mechanical systems, is important in order to realize the full benefits of energy conservation opportunities. Since August 2007, more than 45 buildings have been retro-commissioned on campus. These buildings have shown an average energy reduction of 27.8% and a cost avoidance of $4.3 million per year.[26]

Campus could increase funding for RCx so that all buildings on campus get a comprehensive commissioning. This commissioning needs to be accomplished before some energy strategies take place. Also, auxiliary units, whose space accounts for 35% of campus gross square footage, could allocate funding to implement RCx in their facilities. Additionally, campus should study the impact of deep energy retrofits in existing buildings as part of the commissioning process.

Expand Campus Maintenance Programs

Sustaining energy conservation gains will require an increase in support for ongoing maintenance, with an emphasis on energy conservation. Additional resources could be allocated to the campus building maintenance programs with an emphasis on energy along with improved informational transparency in terms of program goals and plans. This includes the development of a campus deferred maintenance plan that incorporates iCAP goals, as well as other maintenance programs including steam traps, weatherization, and building envelopes. A program for deploying a building energy maintenance manager in all campus buildings could be considered. There is enormous conservation potential in this arena.

26) http://www.fs.illinois.edu/docs/default-source/retro/energyprojectsummary_varrate-rpt-1.pdf?sfvrsn=0

Follow-up Preventative Maintenance (PM) is important for continued energy efficiency performance. Campus has increased PM funding recently, and it could continue to increase base funding for the PM program. The campus could also complete a long-term plan and annual report of the PM program to plan for and report on funding, projects, and associated energy conservation results.

Extend Campus Lighting Projects

Lighting technologies are rapidly changing in favor of more efficient lamps and fixtures. Converting to more energy-efficient lamps and fixtures has a typical payback period of less than three years. The campus has more than 100,000 fluorescent lamps that have been upgraded from a T-12 standard to a more energy-efficient T-8 fixture. The campus could work to complete this overall transition before the end of FY16.

The campus has committed to becoming an LED campus, which requires all exterior fixtures and interior wayfinding fixtures be LED by FY25 and that the majority of all campus lighting use LED technologies by FY50. Cost avoidance by implementation of LED technologies typically provides a payback for initial investment within three to seven years. The Facility Standards could be updated to require that all lighting-related alteration and capital projects use LEDs. Additionally, the campus could increase funding for the LED transformation, so that the majority of all lighting on campus is LED well in advance of FY50.

Develop a Campus Fume Hood Efficiency Program

About 1,700 fume hoods are currently in operation on campus, and the majority of these are constant-air-volume hoods without heat recovery that operate all day, every day throughout each year. By performing a systematic evaluation of use schedules, taking unused hoods offline, removing unneeded and antiquated hoods, and converting to variable-air-volume systems, the majority of energy currently attributable to fume hoods could be avoided.

Campus could coordinate a taskforce to develop an energy conservation management program for its fume hood inventory. The taskforce could include different stakeholders including research Principal Investigators, the Division of Research Safety, and F&S representatives from Safety and Compliance, Utilities & Energy Services, and Engineering and Transportation Services. The taskforce could examine of the use of existing fume hoods, identify fume hoods that could be retired, and identify technologies that increase energy efficiency while maintaining research safety.

Institutionalize Energy Efficiency in Information Technology

Administrative information technology (IT) energy use guidelines could be updated to reflect a heightened emphasis on energy efficiency and general sustainable practices. Campus could continue to implement low-energy computing and media equipment, server virtualization, consolidation of IT facilities, reduction in the total number of server instances, and computer power management software in computer laboratories, classrooms, and other campus computers. The campus could also complete and publicize an annual report of the IT energy conservation program, including funding, projects, and energy efficiency results.

Hot Water Heating

The campus energy use for heating water could be reduced by switching to instantaneous/semi-instantaneous hot water heaters, increasing insulation on hot water tanks, using recovered heat from chiller condensers and other sources, and using temperature setbacks where appropriate. The campus could assess the potential energy savings in this arena, and develop a plan for implementing the best hot water-related strategies.

4. Engage and Incentivize the Campus Community

To date, our progress on energy conservation has been accomplished largely through centrally funded programs led by facilities staff. Meanwhile, there are a myriad of opportunities for the 50,000 or more people in the campus community to assist with these conservation efforts. To meet our energy conservation goals, the entire campus community needs to be informed and engaged. This could be accomplished in many different ways, including a comprehensive energy conservation campaign, engagement exercises with campus units and individuals, and unit-level climate action plans, such as the Allerton Climate Action Plan.[27]

Comprehensive Energy Conservation Campaign

The campus could initiate a comprehensive energy conservation campaign, engaging colleges, departments, administration, and individuals throughout campus. The energy use intensity for buildings, departments, and colleges could be communicated to campus, individualized reduction goals could be set, and conservation strategies could be identified and prioritized by simple payback period.

This campaign could incorporate behavior change incentives, educational programs about energy conservation options, and strong communication about the successes and failures across campus. By developing this comprehensive energy conservation campaign in a highly visible and engaging way to reach the thousands of people on campus who are unaware of our Climate Commitment and the urgent need to conserve energy, we can begin to see major changes in behavior of the campus community.

This campaign could expand upon and integrate two existing efforts: the Energy Conservation Incentive Program (ECIP) launched by F&S in FY13; and the Certified Green Office (CGO) Program launched by iSEE in FY15. ECIP is a building-level program designed to reward occupants of buildings that achieve significant energy savings (with or without centrally managed conservation efforts like RCx) by sharing the savings. In contrast, CGO focuses on encouraging members of the campus community to incorporate sustainability into their everyday decisions about lighting levels, thermostat settings, and powering off unused equipment.

The development of this comprehensive campaign would be most effective if it included both F&S and iSEE personnel, faculty experts in social marketing, and representatives from different target audiences (office staff, researchers, students, etc.).

Improve and Expand the Illini Energy Dashboard Project

The Illini Energy Dashboard project, which connects real-time energy meters for buildings to an open-access website, went live in December 2011. There are now 41 buildings with meters displaying some form of building energy information. The value in dashboard information to help engagement and improve awareness is well known, and it is considered an important component in an awareness campaign. However, the current dashboards could be improved to display relevant information in a way that is most understandable to building users and operators. The system could also be extended to every campus building to maximize its impact, and real-time energy information could be integrated into electronic building displays throughout campus, so the building occupants are aware of the energy usage in their space and how that compares with an average day and with other campus facilities.

Inform Success (and Failure)

Peer to peer competition can be an effective approach to behavioral modification. Success by one group can encourage another to strive to match — or do better. This is especially true in an institution with highly competitive faculty and administrators. By notifying students and faculty of our university, as well as those

27) http://allerton.illinois.edu/

of peer institutions, of ongoing conservation projects and project successes, the University of Illinois can increase awareness (and competition) both on and off campus.

Campus could institute a structured approach for delivering information on both the successes and failures of campus energy conservation efforts to encourage peer to peer learning and competition. Additionally, new competitions could be formed, with leaders in various roles throughout campus. For example, a competition about reducing research lab energy demand (primarily associated with fume hood requirements) could be developed and communicated by the campus administration. Likewise, a competition for reducing energy demand by departments could be developed and communicated by the participating colleges.

Revisit Stewarding Excellence Recommendations

The FY11 Stewarding Excellence @ Illinois[28] initiative included a project team review of campus utility management practices, which included a consideration of implementing decentralized energy billing. The final report[29] from this team stated "The campus utility budget will continue to be held centrally, with annual budget adjustments and the utilities billing data used to report out on usage and distribute the incentives." Given that the utility budget would continue to be held centrally, the report made a series of recommendations to ensure that colleges and departments would be encouraged to reduce energy usage, despite the fact that the burden of annual energy costs (or the direct benefit of reducing annual energy costs) would not be reflected directly in their budgets.

Key recommendations from the Stewarding Excellence report in this regard include the establishment of a campus utilities fiscal oversight committee (which would include representatives from the colleges, the faculty, and students), the formation of an incentive pool system wherein colleges that conserve energy would receive a nonrecurring budget increase and those that increase energy usage would be assessed a charge, an improved energy information program (elements of which are discussed above), and inclusion of energy use data in unit annual reports and the Division of Management Information's Campus Profile to raise the visibility and importance of energy conservation.

These recommendations could be revisited by the Energy Conservation and Building Standards SWATeam, and as appropriate that team could make specific recommendations through the sustainability process. In the event that the campus is unable to implement these programs to provide unit-level encouragement for energy conservation, it may be appropriate to reconsider the idea of implementing decentralized energy billing. If that became necessary, the first step could be a study of the pros and cons of a Responsibility Based Budgeting (RBB) allocation process, by a task force with key campus representatives including academics, staff, and students, to determine whether and how decentralized billing could be implemented on our campus. This would include, at a minimum, an analysis of the energy and monetary savings potential for

28) http://oc.illinois.edu/budget/
29) http://oc.illinois.edu/budget/Utilities_Project_Team_Report_Final.pdf

such a program, recommendations for RBB maintenance funding, identification of other issues, and recommendations for next steps.

Conclusion

Energy conservation represents an enormous opportunity to both reduce GHG emissions and to save money on campus. As easy and “low-hanging” projects get completed, continued savings will also require larger-scale investments and an increasing dedication to conservation as recommended above. The success in energy conservation from FY08 to FY14 was a great start; however, without a much stronger and more consistent message to the campus community, energy conservation will always be limited by our highly decentralized campus organizational structure. To achieve our goal of carbon neutrality by 2050, a comprehensive energy conservation campaign is an imperative.

In the near term, campus needs to expand the centrally funded energy conservation programs. By considering the energy avoided in FY14 compared to the FY08 baseline, the existing conservation programs saved campus $16.6 million through avoided energy costs in FY14 alone. The expansion of the existing centrally funded energy conservation programs would produce additional savings, and could be prioritized as follows, based on anticipated impacts on energy conservation and the ease of implementation: increase PM funding, increase RCx funding, increase EPC funding, allocate funding for fume hood efficiency, and increase funding for the LED Campus.

Chapter 3. Energy Generation, Purchasing, and Distribution

As shown in Chapter 1, the single largest source of campus greenhouse gas (GHG) emissions is energy generation and purchasing, which provides essential heating, cooling, and electricity for our campus operations. Eliminating these greenhouse gas emissions will be accomplished through a combination of conservation efforts (detailed in Chapter 2) and by shifting our energy generation and purchasing to sources that result in no net GHG emissions. Given that we expect to be able to cut our energy needs (and hence energy emissions) in half, the other half of our reductions must come from clean energy. Hence, conservation and clean energy are equally important efforts for reducing our campus emissions.

The majority of energy generation on campus comes from the burning of coal and natural gas at Abbott Power Plant, which cogenerates steam and electricity. Of our total energy usage in FY14, 56% was from steam produced at Abbott, 26% was from electricity generated at Abbott, and 18% was from purchased electricity (see Figure 5 on next page). An estimated 8% of the energy was used to produce chilled water, mostly in electric chillers. The electricity generated on campus is supplemented by the purchase of grid electricity.

Abbott Power Plant has two combustion turbines with heat recovery steam generators and is replacing the existing gas boilers. The heat recovery steam generators, gas boilers, and three coal boilers generate all of the steam used on campus. The steam that is produced at Abbott is typically run through a steam turbine that generates electricity before it is distributed to campus. The electricity that is not generated by a combustion turbine or steam turbine at Abbott Power Plant is purchased from the grid. In the cooling season, when our electrical demand is high and our heating (steam) demand is low, our electrical demand at times exceeds our electrical import limit. In these instances, Abbott must be operated to generate the difference. For ease of comparison and understanding, we will use the units of megawatt-hours (MWh) to discuss all energy needs, both steam and electrical. For reference, in 2009 the average Illinois household used about 38 MWh per year, between electrical and heating fuels.[30]

The FY14 total (electricity and steam) energy usage of campus was 1,076,722 MWh, which is equivalent to that of roughly 28,000 households. Our electricity usage was 475,707 MWh: 275,919 MWh generated by Abbott and 199,788 MWh purchased. Of this amount, about 80,000 MWh produced chilled water for cooling buildings and equipment. The FY14 steam usage of campus was 601,015 MWh.[31]

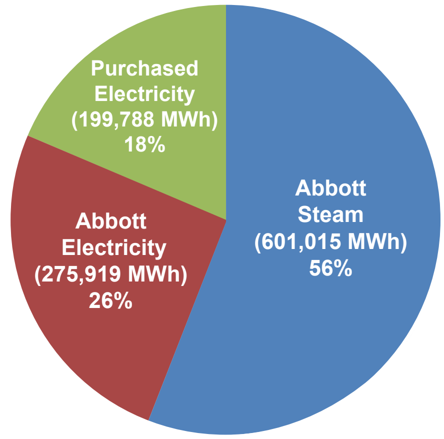


Figure 5: FY14 Total Energy Use Breakdown

Assuming that our conservation efforts (Chapter 2) will cut our energy needs in half, we will have to find ways to produce and/or purchase roughly 250,000 MWh/yr of electricity and 250,000 MWh/yr of heat in a carbon-neutral manner. Alternatively, the campus energy system could be redesigned to use heat pumps, which would require less heat from combustion in exchange for more electricity use.

It is conceivable that by 2050, carbon capture and sequestration (CCS) technology may become economical and widespread, which would allow the continued use of fossil fuels without releasing greenhouse gases. However, humanity is depleting the Earth's reserves of fossil fuels, and the increasing rate of extraction of such fuels cannot continue indefinitely. Additionally, the extraction of fossil fuels is often accompanied by various types of environmental damage. As a result, fossil fuels should be entirely eliminated from campus energy production and purchasing systems. So long as we continue to burn fossil fuels, we are not on a path that can possibly lead to a sustainable and zero-carbon future. In contrast, if our heating and cooling systems are based on electricity, there is a path to carbon neutrality as the amount of renewable electricity generation increases on and off campus.

Fiscal Year	Emissions (MT eCO_2)	% Change from FY08
2008	495,741	n/a
2009	486,879	-2%
2010	428,326	-14%
2011	421,928	-15%
2012	402,222	-19%
2013	438,073	-12%
2014	440,724	-11%
2020	*347,019*	*-30%*
2025	*297,445*	*-40%*
2030	*247,870*	*-50%*
2040	*123,935*	*-75%*
2050	*–*	*-100%*

Table 2: Energy Emissions History and Goals

Energy Emission Goals

Campus has made good progress in reducing GHG emissions since FY08, largely due to improvements in the energy efficiency of buildings. Looking ahead, we expect to see continued reductions due to improvements in energy efficiency and additional energy conservation efforts. However, to achieve zero GHG emissions, it is also necessary to change the way we generate, distribute, and purchase power.

Our total annual greenhouse gas emissions from energy production and purchasing have decreased by 11% since FY08 (see Table 2, left). This is primarily due to the reduction in heating demand (as measured by

30) http://www.eia.gov/consumption/residential/reports/2009/state_briefs/pdf/il.pdf
31) Although British Thermal Units (BTUs) are still often used for quantifying steam usage, we are using MWh for all energy units for consistency in this document. The conversion is 3,412 BTU = 1 kWh, or 3.412 MBTU = 1 MWh. Note that the unit MMBTU is often used in place of MBTU; both indicate 1 million BTUs. We also adopt a conversion of 1,200 BTU/lb of steam.

steam delivered to campus) of 208,176 MWh since FY08, a 29% reduction. Total campus electrical usage has increased slightly (7%) since FY08 to a total of 475,707 MWh/year, but this increase includes the new electricity demand from the National Petascale Computing Facility, which uses about 87,000 MWh/year.

The goals for emission reductions from energy production and purchasing from FY20 to FY50 are shown in Table 2. Achieving these goals will require that the campus community work together to continue and expand energy reduction efforts, fund renewable energy generation, and understand the short-term and long-term benefits of establishing a carbon neutral campus.

Objectives

Determining the best way to replace our reliable, safe, cost-effective, fossil-fueled combined heat and power system with a large-scale, zero-GHG-emission system is a daunting task. The 2010 iCAP called for a detailed study that examines campus energy generation and distribution. An outside architecture/engineering firm was hired in 2012 to produce a Utilities Master Plan, with the following project scope:

> *"The Illinois Climate Action Plan (iCAP) completed in 2010 identifies several goals related to energy production and distribution on the University of Illinois at Urbana-Champaign campus. The Professional Services Consultant shall perform a study that will be interactive with the sustainability goals in the iCAP with strategic planning for the execution of phased projects to safely and reliably meet the current and future campus energy needs and develop a comprehensive utility master plan for the utility production and distribution systems for the University of Illinois at Urbana-Champaign campus."*[32]

We expect the Utilities Master Plan to be an important component in developing a comprehensive path toward 100% clean campus energy. The Energy Generation, Purchasing, and Distribution SWATeam will lead an effort, in collaboration with F&S staff and topical Consultation Groups (described below), to identify clean energy generation and purchasing options that might work for our campus. These recommendations will then be forwarded by the SWATeam, following the established procedures for evaluating campus sustainability policies and initiatives. When a clean energy recommendation has been evaluated by the business unit and approved by campus administration for operational implementation, the utilities plan would be appropriately modified.

Regardless of the details of our pathway toward 100% clean campus energy, there will be a substantial need for electricity, and we should pursue the potential to increase the use of solar photovoltaics on campus. Solar photovoltaics not only provide carbon-neutral electricity, but they also offer peak generation during the times of peak electrical demand on campus. Completion of the first Solar Farm, together with existing solar generation and the rooftop solar on the ECE Building and the North Campus Parking Deck, will yield approximately 10,000 MWh per year.

In the short term and possibly even the long term, it will be necessary to purchase renewable or other zero-carbon energy from off campus. A third objective is therefore to increase the amount of purchased energy that comes from low-carbon sources, including wind farms, nuclear power plants, and biomass power plants. Finally, a fourth objective is to purchase offsets for emissions from the National Petascale Computing Facility. Our objectives are thus:

1. The Energy Generation, Purchasing, and Distribution SWATeam, in collaboration with Facilities & Services and topical Consultation Groups, will lead an exploration of options for 100% clean campus energy during FY16 and submit recommendations through the formal sustainability process.

32) http://icap.sustainability.illinois.edu/project/master-plan-energy-production-and-distribution

2. Expand on-campus solar energy production. By FY20, produce at least 12,500 MWh/year, and by FY25 at least 25,000 MWh/year, from solar installations on campus property. These targets represent 5% and 10% of our expected 2050 electricity demand, respectively.
3. Expand the purchase of clean energy. By FY20, obtain at least 120,000 MWh/year, and by FY25 at least 140,000 MWh/year from low-carbon energy sources. These targets represent 48% and 56% of our expected 2050 electricity demand, respectively.
4. Offset all emissions from the National Petascale Computing Facility (and other successor facilities) by the conclusion of the current period of National Science Foundation support.

Potential Strategies

To meet the emission goals and objectives listed above, the following strategies are recommended.

1. Explore Options for 100% Clean Campus Energy

The campus community has considerable intellectual resources that can be brought to bear on the future of energy generation, purchasing, and distribution. The Energy Generation, Purchasing, and Distribution SWATeam has formed Consultation Groups consisting of faculty, staff, students, and other interested individuals, centered on each of the most promising clean energy technologies. Over the next year, input from these consultation groups, together with the Utilities Master Plan, can inform the development of recommendations for moving to 100% clean campus energy.

Below we list the most promising technologies for use on our campus, around which the consultation groups have been formed. Because wind and nuclear energy will be more effectively purchased from off campus, these technologies are not included in this section.

Geothermal heating and cooling

As it appears that it would be difficult to directly and entirely replace our existing steam production system with a carbon-free equivalent, we must examine the electrification of our thermal energy production system. One very promising technology for this involves the use of geothermal heat pumps.

As an example of what can be accomplished with current technology, we consider Ball State University, which commissioned a large-scale district geothermal heating and cooling system in 2012. It uses large heat pump chillers to simultaneously produce chilled and hot water. The system has a design coefficient of performance of 3.8 for heating and 2.9 for cooling, meaning that for each unit of electric energy consumed 6.7 units of heat are moved. Ball State University is at almost the same latitude as our university, so similar systems could be evaluated for use on this campus. A district geothermal system would reduce the use of fossil fuels on campus, but would increase the campus average demand for electricity by about 18 MW over our current average demand of about 52 MW. The amount of GHG emissions associated with heating and cooling would then depend on the source of the electricity to run the geothermal system. By generating renewable electricity on campus or purchasing renewable energy from off campus, we could greatly reduce our GHG emissions both in the short and the long term.

An additional attraction of geothermal is the use of a hot water distribution system. A study of the benefits of a possible transition from steam to hot water thermal distribution was recommended by the 2010 iCAP, which suggested that this transition, either central or distributed, can yield considerable energy savings.

Air-source heat pumps

About 10 percent of campus buildings are heated by steam but cooled by window air conditioners. If these were replaced by air-source heat pumps, each room could be both heated and cooled by the same unit. The required capacity of the heat pumps could be reduced by a deep retrofit of the building, including replacing the windows with high-quality double-pane windows, reducing the size of oversized windows, and adding insulation to the interior or exterior of poorly insulated walls. Rooms could be conditioned only when occupied, producing further energy savings. There would be no need for ductwork to distribute the cooled air, which can lead to cost savings. As with geothermal technology, the amount of GHG emissions associated with heating and cooling these buildings could be reduced by generating or purchasing renewable electricity.

Biomass

Biomass can replace coal for direct combustion, or replace natural gas if it is first used to create syngas through gasification or biogas through anaerobic digestion. In 2013, the University of Missouri commissioned a 100% biomass-fueled boiler in its combined cooling, heat, and power plant, initially using waste wood as the primary feedstock. Eastern Illinois University installed a gasifier in 2011, but it is not yet working reliably. These sample projects highlight two necessary conditions for the success of biomass: a sustainable supply chain; and reliable technology.

Due to the large acreage required to grow enough biomass to meet campus energy demands, some fraction of the biomass would likely need to come from off campus. This could be in the form of dedicated energy crops or agricultural waste. One must take into consideration the energy cost of growing, harvesting, processing, and transporting the biomass. While burning the biomass is carbon neutral if it is regrown, the growing, harvesting, processing, and transporting steps release greenhouse gases if they involve fossil fuels or certain fertilizers. On the other hand, the growth of perennial biomass crops such as miscanthus leads to an increase in the amount of carbon stored in the soil; this sequestration of carbon in the soil may more than offset the emissions from biomass processing. As a result, the entire life cycle of biomass growth, harvesting, processing, and combustion may result in a net removal of carbon dioxide from the atmosphere.

Solar Photovoltaics and Solar Thermal

Solar energy is a proven technology that has become more cost-effective in recent years. There are some existing installations of solar photovoltaics and solar thermal on campus now, and some installations currently in the implementation process. A consultation group is working to identify the best locations for installation of additional photovoltaics on campus, and to help expedite those installations. Solar thermal is also being considered where appropriate.

2. Expand On-Campus Solar Energy Production

The campus has a 33 kW photovoltaic array on the roof of the Business Instructional Facility (with an annual production of 44 MWh/yr) and a 14.7 kW ground-mounted array at the Building Research Lab (20 MWh/yr). During FY15, we began installation of a 300 kW array on the roof of the new Electrical and Computer Engineering Building (402 MWh/yr), and the 5.87 MW Solar Farm on the south campus (7,860 MWh/yr). There is also a solar thermal array on the roof of the Activities and Recreation Center. Many other buildings, parcels of land, and parking lots are well positioned to host sizable photovoltaic and/or solar thermal arrays. Although each array in itself would make a small contribution to campus energy generation, taken together the contribution could be significant.

Identify best solar locations and implement solar projects

The solar consultation group is identifying the best places to install the next round of photovoltaic projects, and planning to move forward on several projects simultaneously. Solar thermal may make sense in some situations, as well. Student design teams could be organized through classes and volunteer groups to assist with the planning and prioritizing of on-campus solar installations.

Require solar PV on rooftops for new construction and major renovations

The best time to plan for the installation of photovoltaics on a building is during the design phase. The campus could implement standards requiring that all new construction and additions include solar photovoltaics on the roof. In some cases, it might also be effective to install photovoltaics on the exterior walls of buildings.

3. Expand the Purchase of Clean Energy

In the near term and possibly even in the long term, it will not be possible to meet our emission reduction goals entirely with on-campus clean energy generation. We must therefore purchase some off-campus renewable and other zero-carbon energy.

Enter into Power Purchase Agreements

A power purchase agreement (PPA) is a contract with an energy generation facility. A long-term PPA with a renewable energy generation facility could enable the construction of new renewable energy generation. At the time of this writing, the most economical renewable PPAs are for wind energy from large farms of wind turbines, but we expect that other types of renewable PPAs may become affordable in the future.

Although nuclear power is not considered renewable, an existing nuclear power plant produces no carbon dioxide emissions and can help us meet our emissions goals. A PPA with a nuclear power plant would enable us to purchase energy from a zero-carbon source.

Campus has already begun working to investigate the potential for entering into PPAs with zero-carbon energy providers to help meet emission reduction goals.

Renewable Energy Certificates

Electrical output from both renewable and nonrenewable power sources are combined in a regional transmission grid. In order for a consumer to claim the use of renewable energy, it must own the associated Renewable Energy Certificates (RECs), each of which represents the environmental attributes of 1 MWh of renewable electricity generation.

Only the owners of RECs can claim that they are using renewable energy. For example, if a wind farm operator sells its electricity to one party but sells the associated RECs to a second party, only the second party can claim to be using green energy. To qualify as renewable, any energy the campus purchases must be bundled with RECs, and the campus must retain the RECs for any renewable energy it produces. Therefore, the forthcoming Solar Farm will count toward our renewable energy goals only so long as campus does not sell the associated RECs.

Another method to increase our use of renewable energy is to separately purchase “unbundled” RECs, without purchasing power from the same generation source. For example, we could purchase power from a coal plant, but purchase a corresponding number of RECs from a wind farm (in this case, the wind farm would sell its electricity without the environmental attributes to a customer who is not willing to pay for the environmental attributes). The purchase of unbundled RECs reduces our carbon footprint according to generally accepted carbon accounting procedures, but it is not clear if it adds renewable energy to the grid.

At the time of this writing, there is exceptionally low demand for RECs in our local grid region because there are no effective government standards requiring the purchase of renewable electricity. At the same time, a significant number of wind farms have been built and are profitable even without selling RECs (due in large part to a federal tax credit for wind production), leading to a very large supply of RECs. Given the low demand and the oversupply, prices for RECs are very low, and therefore it is not clear that the purchase of RECs really provides an incentive for generators to produce more renewable electricity, or that it leads to an actual reduction in overall CO_2 emissions.

When unbundled RECs are purchased as part of a long-term contract, this can facilitate the construction of new renewable energy generation facilities. Long-term RECs contracts would also have the economic advantage of "locking in" the current low prices. Conversely, the voluntary purchase of short-term unbundled RECs from existing facilities does not add new renewable energy to the grid. For these reasons, the campus would have a greater environmental impact by purchasing long-term RECs contracts, either bundled with renewable energy in a PPA, or unbundled.

4. Purchase Offsets for Supercomputers

The National Petascale Computing Facility (NPCF) is a supercomputing facility funded by the National Science Foundation (NSF) that serves users across the country. It is important to the Illinois research mission to continue to be at the forefront of research in supercomputing-intensive fields, including the modeling of climate change. As of FY14, NPCF consumes about 87,000 MWh/year of electricity, which represents

roughly 18% of the campus electrical load. Because the NSF grant supporting NPCF is only five years in duration, and because the future load of this facility is uncertain, it is not practical for the campus to install electrical generation facilities (renewable or otherwise) to support the load. Given the relatively short timeframe, it is also not possible to enter into long-term Power Purchase Agreements to supply NPCF with renewable electricity.

The best option to eliminate the greenhouse gas emissions from NPCF and future supercomputing facilities is therefore to purchase carbon offsets (described in detail in Chapter 8) for the entirety of those emissions. As described above, it is not clear that the short-term purchase of Renewable Energy Certificates actually leads to a reduction in global greenhouse gas emissions. Ideally, the cost of purchasing offsets could be included in future proposals to NSF or other agencies to support supercomputers; alternately, the campus could assume those costs itself as part of its commitment to host such facilities.

Conclusion

There are many options available to the campus in terms of zero-carbon energy production and purchasing, and at the time of this writing it is not clear what combination of them will make the most sense logistically and financially as we move toward carbon neutrality. As a result, there is a clear need to identify solutions for achieving 100% clean campus energy.

At present, the most viable technologies and markets that appear promising for clean energy are: (1) electrification of our heating needs, through the use of geothermal and/or air-source heat pumps, (2) the use of biomass and perhaps solar thermal to provide the balance of our heating needs, (3) on-campus solar photovoltaic arrays, (4) power purchase agreements for zero-carbon electricity from off-campus sources including wind farms and nuclear power plants, and possibly (5) the purchase of Renewable Energy Certificates (RECs), preferably using long-term contracts.

Chapter 4. Transportation

Based on FY14 data, transportation emissions have increased by 30% since the FY08 baseline. Because emissions from the fleet and commuting are down by 3% and 6%, respectively, the increase in total transportation emissions is entirely due to a 52% increase in air travel emissions relative to FY08. Part, or all, of this increase may be due to the fact that the implementation of the Travel and Expense Management (TEM) tracking system in FY14 better captured air travel data; our previously estimated air travel emissions, from FY08 to FY13, may well have been underestimated.

Fiscal Year	Fleet Emissions MT eCO_2	Commuting Emissions MT eCO_2	Air Travel Emissions MT eCO_2	Total MT eCO_2	% Change from FY08
2008	5,688	11,522	27,453	44,664	n/a
2009	5,599	11,643	21,992	39,234	-12%
2010	4,633	11,946	25,299	41,879	-6%
2011	4,948	10,632	23,191	38,771	-13%
2012	5,348	10,238	27,344	42,930	-4%
2013	5,148	10,268	31,247	46,663	5%
2014	5,503	10,868	41,835	58,206	30%

Table 3: Transportation Emission History

As shown in Table 3 (left), the most significant challenge for transportation emissions is clearly air travel, but FY14 data also show disappointing results for fleet emissions, as well as for commuting.

There were impressive reductions in fleet emissions in FY10, although these emissions have bounced back in recent years. This is likely related to the reduced financial resources available to campus departments during FY10. Fleet utilization seems to have a direct correlation to the available budget for travel. Anecdotally, it was apparent in FY10 and FY11 that departments were carpooling more often to off-site business meetings, presumably to save money. With the recent financial rebound of many campus departments, fleet utilization is rising again. The campus needs to address fleet emissions primarily from an equipment approach, but also with complementary behavior change efforts.

There were also substantial reductions in student and employee commuting emissions in FY11, when the transportation mode choice survey indicated a shift to fewer single-occupancy-vehicle (SOV) trips. More commuters are using active transportation modes, such as walking, bicycling, and mass transit. The emission increases from commuting in FY14 are due only to increases in the number of people on campus since FY11. To continue to reduce commuting emissions, campus needs to implement a comprehensive mode-shift behavior change campaign as described below.

The minor reductions that have been achieved in terms of motor vehicle emissions have been overshadowed by the apparent increase in emissions from air travel. Given the centrality of air travel to the academic mission of the University, it is unlikely that GHG neutrality can be achieved for transportation, without resorting to the purchase of carbon offsets to adjust for air travel emissions.

Transportation Emission Goals

Fiscal Year	Transportation Total MT eCO_2	% Change from FY08
2020	*44,664*	*n/a*
2025	*37,964*	*-15%*
2030	*11,166*	*-75%*
2040	*4,466*	*-90%*
2050	*–*	*-100%*

Table 4: Transportation Emission Goals

The 2010 iCAP listed the goal of reducing transportation emissions by 30% relative to the FY08 baseline by FY15. Unfortunately, rather than decreasing, the total estimated emissions from transportation increased 30%, for reasons described above. Therefore, the first transportation emission goal is to bring the current transportation emissions down to the FY08 estimate by FY20 (see Table 4, right), reversing the apparent 30% increase. By accomplishing the objectives listed below, the total transportation emissions can be reduced an additional 15% by FY25, 75% by FY30 (relying upon purchased offsets for all air travel emissions), and 90% by FY40 (relying upon a yet-to-be-determined solution for low emissions for the campus fleet).

To provide an indication of the relative efficiency of transportation energy strategies, the campus could evaluate and report on both absolute and relative emission results, providing data for fleet, commuting, and air transportation adjusted per capita and per vehicle whenever possible.

Objectives

These objectives are based upon systematic changes in the fleet emissions, purchased carbon offsets for air travel, and incremental improvements in commuting emission reductions through a comprehensive mode-shift campaign. They are:

1. Reduce air travel emissions from a new FY14 baseline by 25% by FY20, 50% by FY25, and 100% by FY30.
2. Reduce emissions from the campus fleet by 20% for departmentally-owned and carpool vehicles by FY20.
3. Conduct a detailed study by the end of FY17 to develop scenarios for complete conversion of the campus fleet to renewable fuels.
4. Reduce the percentage of staff trips made using single-occupancy vehicles from 65% to 55% by FY20, 50% by FY25, and 45% by FY30.

5. Implement the Campus Bike Plan on the schedule noted in that plan. Notable deadlines include full implementation of new bikeway facilities by FY25, bike parking within 150 feet of every building in the core of campus by FY20, and bike rentals by FY20.
6. Appropriately staff sustainable transportation efforts, especially through the hiring of an Active Transportation Coordinator.

Potential Strategies

Reducing transportation emissions will require campus funding for air travel offsets, implementation of low-emission technologies for the fleet, and encouraging mode-shift away from single-occupancy vehicles. The campus will reduce commuting emissions with incentives, infrastructure changes, and the implementation of the Campus Bike Plan, with a full-time staff person focused on Active Transportation.

1. Reduce Air Travel Emissions

The campus mission often relies upon in-person visits to other towns, states, and countries. The most time-efficient travel mode is often air travel, and it is difficult to imagine that Illinois faculty, staff, and students could eliminate air travel entirely. International conferences, research, and study abroad have important impacts on the campus missions of scholarship, teaching, and service, including in the area of sustainability. However, there are certainly some situations when a plane trip can be replaced with a train trip or a videoconference, without sacrificing the impact of efforts to support the University's mission.

To encourage a reduction in air travel, the campus could implement a program to provide incentives for departments that reduce their annual air travel emissions. The program would include a method to track annual airline travel emission estimates per department, and an annual report of the per capita airline travel emission estimates and the total estimate for the campus. Additional information regarding the reason for travel and the source of funding could be collected though the Travel and Expense Management (TEM) system. The program would also educate the campus community on the alternatives to air travel, such as trains and videoconferencing. Additionally, campus could improve the infrastructure supporting online conferencing and other virtual meeting technology.

For the remaining GHG emissions associated with air travel, campus could purchase offsets, as described in Chapter 8. The amount of offsets to purchase could be incrementally increased over time such that air travel emissions would be reduced by 25% from the FY14 value[33] in FY20, 50% in FY25, and 100% in FY30.

2. Reduce Fleet Emissions in the Next Five Years

The campus fleet includes departmentally-owned vehicles, the car and truck pool vehicles, and the heavy equipment pool. The vehicular fleet is primarily cars and vans, while the heavy equipment pool is generally diesel-fueled large construction equipment, such as backhoes. Campus could increase the number of low-emission vehicles by 20% in the vehicular fleet.

The campus could require and activate anti-idling equipment for all new class 6 and above trucks (with gross vehicle weight rating of over 19,500 lbs), and could install idling-tracking equipment on all vehicles in the fleet. We could increase the use of biodiesel blends in fleet vehicles. Campus could increase the use of electric vehicles and departmental bicycles (including electric bicycles) with cargo trailers to move individuals and small tools and equipment across campus. To encourage the use of these low-emission options, campus could provide incentives to departments or individuals who make use of them.

---

33) The implementation of the Travel and Expense Management (TEM) tracking system in FY14 uncovered the fact that our previous air travel emissions, as calculated from FY08 to FY13, underestimated the total air travel emissions from our campus.

3. Develop Scenarios for Converting the Fleet to Renewable Fuels

To lay the groundwork for more significant and longer-term reductions in emissions from the campus fleet, the campus could perform a study of the potential to transition the fleet to renewable fuels. This study could be conducted by a task force formed under iSEE, with a faculty chair and appropriate campus representation. Options to be considered might include sustainably-produced biodiesel, compressed natural gas from anaerobic digestion of organic wastes, and electricity from zero-carbon sources such as solar and wind. The proposed study would review the types and usage of campus vehicles, evaluate the expectation for vehicle availability on a 10-year horizon, and propose various plans (i.e., conservative, moderate, and aggressive) for greenhouse gas emission reductions along with approximate fiscal impacts for each plan.

4. Reduce Single-Occupancy Vehicle Usage

To reduce commuting emissions, campus could strengthen the comprehensive mode-shift behavior change campaign. This campaign was initiated on campus in FY08, when the Transportation Demand Management department was established. Through coordination with the cities of Urbana and Champaign, the Champaign-Urbana Mass Transit District (MTD), and local advocacy group Champaign County Bikes (CCB), there has been a noticeable shift in mode choice for the campus community. The survey results in FY11 showed the impact of this collaborative and concerted effort toward a reduction in single-occupancy vehicle (SOV) mode-share[34] for staff, shifting from 74% in the 2007 survey[35] to 65%. Because this data point is the metric tied most directly to the resulting commuting emissions, the objective for mode shift is based upon this metric, with a target of 55% SOV mode-share for staff by FY20, 50% by FY25, and 45% by FY30. The strategies needed to accomplish this shift encompass multiple transportation modes and behavior shift programs.

Encourage Car-free Commuting

Our current parking permit structure, in which employees pay a fixed amount per year for the privilege of parking in a particular lot, offers little incentive for staff to use other commuting options once they have already paid for a parking permit. Campus could provide additional opportunities for employees and students to purchase less-than-full-time parking privileges at a reduced cost. This would enable commuters to take advantage of healthy commuting options, public transportation, and ridesharing when time, weather, and other circumstances permit, while maintaining the option to drive alone when needed. The financial model for such changes needs to be carefully explored, as the Parking Department is required to be entirely self-supporting. It might be necessary to raise parking rates; doing so would also provide an incentive for employees to explore options other than driving to campus. Raising rates may be challenging given the collective-bargaining requirements, but it has been successfully done on other campuses, including Illinois-Chicago. Without incurring any additional costs, campus could also provide incentives for commuters using low emission vehicles, including designated parking spaces close to entrances and preferential consideration for parking spaces in lots with waiting lists. The financial and operational impacts of these suggestions and others are being explored through the 2015 Parking Master Plan process.

34) http://icap.sustainability.illinois.edu/project-update/mode-shift-update
35) Page 14 of the document at http://www.ihavemiplan.com/shared/pdfs/employee_report_spring07.pdf

Guaranteed Ride Home programs address a common concern for commuters transitioning away from reliance on a personal vehicle, i.e., the ability to get home quickly in case of an emergency. The program would provide a free ride by taxi, in case of emergency, with the flexibility to stop at a hospital or day-care provider, if needed. The campus could work with MTD to implement a Guaranteed Ride Home program for employees living within the MTD borders who do not purchase an annual parking permit.

Another available program to reduce reliance on SOVs is Zipcar. This car-sharing program was initiated in FY09 by the campus, the City of Urbana, the City of Champaign, and the MTD, through a car-sharing RFP process. It has been very successful so far, and campus could encourage its expansion.

Encourage Ride Sharing and Transit for Faculty and Staff

Campus has worked with MTD since 1989 to establish excellent transit service on campus. Since 1999, all University iCard holders have enjoyed free access to the communitywide MTD service. The transit mode-share for faculty and staff, however, is currently only 10 percent. This could be increased through a clear communication program focused on campus employees, explaining the benefits of riding with MTD and encouraging employees to use the transit service. The campus could implement this communication program in collaboration with MTD. Also, campus could adjust policies related to employee work hours, to allow for an increase in transit utilization.

The carpooling mode-share for staff is currently only 13%. Campus could increase ride sharing by implementing van pooling for commuters living in nearby towns, with low-emission vehicles. Ride sharing could also be increased by providing incentives and support for employees who take advantage of this option.

Support Public-use Electric Vehicle Charging

In this region of the electric grid, an electric vehicle typically emits fewer GHG emissions than a conventional gas-fueled vehicle of similar size.[36] The Parking Department is supporting sustainability through implementation of public use electric vehicle charging spaces, with 20 "Level 1" charging spaces now on campus, and began installing "Level 2" stations in 2015. The campus could support additional electric vehicle charging infrastructure.

5. Implement the Campus Bicycle Plan

This campus is currently designated as a bronze-level Bicycle Friendly University by the League of American Bicyclists.[37] Campus should implement the 2014 Campus Bicycle Plan.[38] The plan outlines a five-step strategy (the Five E's, right) to improve bicycling to, from, and on campus.

36) http://www.afdc.energy.gov/vehicles/electric_emissions.php
37) http://bikeleague.org/sites/default/files/BFU_Master_Award_List_2014_.pdf
38) http://icap.sustainability.illinois.edu/project/2014-campus-bike-plan

Campus Bicycle Plan Five-Step Strategy

The five E's are:

- **Engineering** — This includes bikeway improvements, bike parking areas, and bike fix-it stations.
- **Education** — This includes dissemination of bike-related informational resources of various types, and bike-related classes.
- **Encouragement** — This includes the primary mode-shift efforts for transitioning people on campus from single-occupancy vehicles to active modes of transportation, such as Bike Month and building a culture for good cycling behavior, through programs like the Campus Bike Center.
- **Enforcement** — This includes bicycle registration programs, and enforcement of both the Illinois Rules of the Road and the UI Bicycle Ordinance.
- **Evaluation and Planning** — This includes tracking progress toward being a Bicycle Friendly University, such as counting bikes through the Every Bikes Count census events, gathering public input through the online bicycle feedback form, and prioritizing bike-related needs for campus.

The Campus Bicycle Plan includes specific objectives surrounding the overall effort needed. Notable deadlines include full implementation of new bikeway facilities by FY25, and bike parking within 150 feet of every building in the core of campus by FY20.

Implement a Bike-sharing Program

Currently, iSEE is investigating options for implementing a campuswide bike-sharing program.[39] Small-scale departmental bike-share programs are feasible and cost-effective. They allow faculty, students, and staff to travel around campus during the workday without using a car. Campus could develop guidelines and best practices to make it easier for individual departments to either start their own bike-share program, or to buy into a campuswide program. A promotional campaign could be conducted to encourage more departments to participate, with the goal of increasing the number of departmental shared bikes from the current level of 15 to a goal of 60 by FY20. Additionally, campus could continue to work with community partners to explore the implementation of a communitywide public bike-sharing program.

6. Appropriately Staff Sustainable Transportation Efforts

The five strategies outlined above (reducing air travel emissions, reducing fleet emissions, converting the fleet to renewable fuels, a comprehensive mode-shift campaign, and implementing the Campus Bicycle Plan) will require additional staff time. Efforts to reduce air travel emissions could be spearheaded by iSEE, and efforts to reduce fleet emissions and convert the fleet to renewables can be handled by Transportation & Automotive Services at F&S. However, the campus currently does not have staff with sufficient capacity to focus on mode-shift and bicycle issues. To fill this critical gap, campus could hire an Active Transportation Coordinator to serve under the Transportation Demand Management Coordinator at F&S. The Active Transportation Coordinator would collaborate closely with iSEE and the Transportation SWATeam on the non-infrastructure elements, including incentive programs and education and outreach programs.

Conclusion

We aim to completely eliminate our Scope 1 transportation emissions from the campus fleet, substantially reduce our Scope 3 emissions from commuting through an aggressive mode-shift campaign and the full implementation of the Campus Bicycle Plan, and reduce our Scope 3 emissions from air travel through incentives for units to switch to videoconferencing when feasible. As described in Chapter 8, we would gradually offset our remaining Scope 3 emissions.

39) http://icap.sustainability.illinois.edu/project/bike-sharing

Chapter 5. Water and Stormwater

The links between energy and water are both explicit and subtle. The explicit links are related to the fact that energy production and distribution are one of the largest uses of water for steam production, chilled water production, and the like. The subtle interconnections include the embedded energy use in water extraction, purification, transportation, and wastewater treatment. In addition, water can itself be creatively used as a means for storing, modulating, and transferring energy in the environment and between different engineered systems. Water is also a finite and fundamental natural resource that is critical for supporting campus operations and community life. With the above in mind, it is a worthwhile goal for the campus to reduce the use of all inputs — energy, water, and materials — simultaneously, recognizing that such an approach offers the most flexibility to achieve not only GHG reductions but also to help insulate the campus from potential negative circumstances such as drought, spikes in energy prices, etc.

It is important to recognize that our campus is the largest single user of water within the local community, accounting for approximately 20% of total demand. Virtually all of this water is drawn from regional aquifers that serve as the primary water source for many communities in Central Illinois. A progressive agenda on water conservation, water reuse, and stormwater management has the potential to create a wider ripple effect in the future by providing a living laboratory and platform for multidisciplinary scholarship integrated with sustainable real-world practices. This will provide the campus with a competitive advantage in attracting highly qualified staff and students from around the world, while also advancing groundbreaking research that provides new solutions to the ever-growing global need for water resources.

Water and Stormwater Goals

In the 2010 iCAP, the campus established a set of water conservation targets for 2015-25 that were based on a percent reduction of the baseline water use in FY08. As of FY14, the campus has already surpassed the 20% water conservation goal for FY15, with a 23% reduction of annual potable water use. This was achieved by a variety of water conservation efforts around campus including the detection and repair of leaks in the water distribution system and the installation of low-flow fixtures. It is notable that these reductions in total water use were achieved despite increases in both the number of campus users and the total square footage of campus buildings. Meeting the future water use reduction goals is expected to require continued efforts on water conservation and new efforts related to water reuse that can further reduce the net influx of potable water to support campus operations. Proposed targets for further reductions in water use from FY20 to FY50 are in Table 5 (left).

Fiscal Year	Water Consumption (KGAL)	% Change from FY08	Stormater Reuse Goals
2008	1,312,492	n/a	
2009	1,202,497	-8%	
2010	1,095,184	-17%	
2011	1,099,293	-16%	
2012	1,063,156	-19%	
2013	1,038,783	-21%	
2014	1,007,588	-23%	
2020	*918,744*	*-30%*	*25%*
2025	*787,495*	*-40%*	*40%*
2030	*721,871*	*-45%*	*50%*
2040	*656,246*	*-50%*	*75%*
2050	*524,997*	*-60%*	*90%*

Table 5: Water History and Goals

Here, we also establish targets to improve the sustainability of stormwater management practices by capturing stormwater for reuse in nonpotable water applications or for increased infiltration and recharge of groundwater, which better reflects natural hydrologic processes. Currently, the majority of stormwater is discharged directly to surface waters like the Boneyard Creek, which increases pollutant loads and forfeits various potential benefits of retaining that water, such as reduced needs for irrigation. The specific proposed targets for stormwater reuse (capture and subsequent reuse or recharge) are included in Table 5. In addition, it is recommended that the campus investigate the pollutant loads associated with stormwater runoff, though no specific targets are proposed at this time.

Objectives

While the water conservation results achieved so far have been impressive, reaching the further reductions needed to meet future iCAP targets will involve greater effort and expense. Water conservation has been the main tool for reducing water use on our campus. Looking ahead, conservation can continue to provide further water use reductions, but it is expected to have diminishing effects as the relatively easy, high-impact changes are implemented. Thus, additional tools are needed.

A detailed investigation is needed to assess the maximum reduction achievable by water conservation alone, using a bottom-up approach to estimate consumption by end-users and available best practices for water efficiency. This investigation should also include a plan for water reuse as this can be another major tool for reducing the campus demand for potable water. Additionally, this investigation should integrate the physical and natural elements of campus topography to reduce water demand on campus and facilitate water reuse.

To achieve the water and stormwater goals, we adopt the following objectives:

1. Obtain and publicize more granular water use data by FY16, including water quantity and quality data where available.

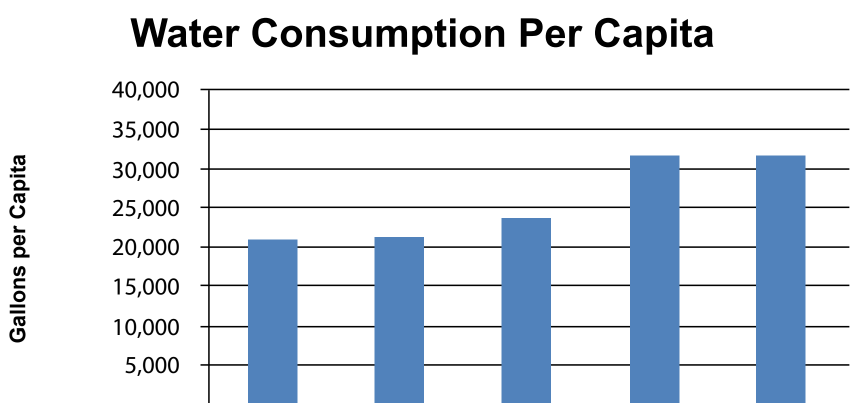
2. Improve the water efficiency of cooling towers by limiting the amount discharged to sewer to less than 20% of water intake for chiller plant towers, and less than 33% for stand-alone building towers, by FY20.
3. Perform a water audit to establish water conservation targets and determine upper limits for water demand by end-use, for incorporation into facilities standards by FY16.
4. Inventory and benchmark campus' existing landscape performance by FY17.
5. Through an open solicitation process, implement at least four pilot projects to showcase the potential of water and/or stormwater reuse by FY20, with the objective of implementing a broader program by FY25.
6. Investigate the water quality impacts of stormwater runoff and potential ways to reduce stormwater pollutant discharges by FY18.

Potential Strategies

1. Obtain and Publicize Water Data

Use of Relative Metrics

To quantify our water use reductions and to identify further opportunities, the campus could report not only the total absolute potable water usage, but also the water use relative to the number of weighted campus users and relative to gross square footage of building space. This is important because the number of campus users and the total building square footage have a direct effect on water demands, and evaluating changes in these metrics would be helpful in formulating conservation strategies and assessing the results of conservation activities.



	Ohio State	Iowa State	Illinois	Purdue	Michigan State
Gallons Per Capita	21,064	21,344	23,821	31,753	35,435

Figure 6: Water Consumption Per Capita at Peer Institutions, based on data available in 2015 STARS report

Providing this data would allow benchmarking of our campus relative to institutional peers and would support new water conservation measures that could establish our campus as a leader in water conservation. For example, Figure 6 provides a comparative analysis of current total water use per weighted campus user for some peer institutions in the Midwest. This figure shows that our FY14 water demand per weighted campus user was 23,821 gallons, which is in the middle of the pack for peer institutions. In contrast, the FY30 water use target would correspond to approximately 17,300 gallons per weighted user (assuming no growth in users), which is lower than the current water use of all the institutions shown in Figure 6 (above).

Data Display

The campus could publicly display water quantity and quality data to encourage transparency, instructional use, and campuswide participation in water conservation activities. The site interface could be modeled after the current energy dashboard to facilitate consistency, and could potentially be implemented in tandem with the energy dashboard to leverage the interest of current users of that system.

2. Reduce Cooling Tower Water Use

In FY11, the Student Sustainability Committee (SSC) sponsored a project to identify water conservation opportunities in our campus cooling tower operations. By increasing the number of times water can be recycled through a cooling tower before it is drained to the sewer, it was estimated that the overall water use can be reduced by 26%. We could initiate such a program in the chiller plant cooling towers by FY17, and extend this to all cooling towers by FY20. In general, the water efficiency of cooling towers should be such that the amount discharged to the sewer should be one-quarter or lower relative to the evaporated amount.

3. Water Audit to Establish Conservation Targets and Facilities Standards

The maximum reductions achievable by water conservation can be assessed using a bottom-up approach to estimate water needs by end-use across campus and the available best practices. This can form the basis for both refined water conservation targets and updated facilities standards for new construction, renovations, or retrofits of all buildings, facilities and auxiliaries. Campus facilities standards could be updated to reflect the intent to reduce the water use for campus buildings. These standards could define a maximum amount of water use per weighted user and per building area. In addition they could provide requirements that restrict or exclude landscape irrigation with potable water. These standards would apply to all new construction and renovations on our campus, including auxiliaries. The related facilities standards could be reviewed and updated every five years to incorporate technological advances. It is suggested that a campuswide inventory of installed fixtures, appliances and equipment by building be implemented in FY16 along with usage/efficiency factors to assist in establishing the water conservation targets and recommended methods for achieving them. A listing of best available practices by water end-use along with estimated implementation costs could also be compiled and made available in FY16.

4. Inventory and Benchmark Existing Landscape Performance

Another opportunity to increase the sustainability of campus water use is to improve the sustainability impacts of campus stormwater management practices. Initial investigations show a strong potential to increase stormwater capture, infiltration, and reuse of stormwater around campus. Various best management practices and green infrastructure systems can promote passive irrigation, and enable additional water conservation at campus facilities.

The campus could complete an inventory and evaluation of existing landscape performance and compare it with high-performance landscapes. This audit would define existing hardscape and softscape surfaces and features, measuring water, carbon, urban heat island, and biotic performance, along with associated maintenance and infrastructure cost. The existing landscapes would be compared with high-performance, sustainable campus landscape alternatives, quantifying economic value and ecosystem services including the following: potential rainwater capture for reuse or infiltration for aquifer recharge; biomass-/biodiversity indexes associated with native (versus turf) landscapes; and economic/environmental benefits of sustainable landscape maintenance (no-mow, no-fertilizer, no-irrigation, etc.). These support recommending a strategic, phased conversion of hardscape surfaces toward pervious/infiltrating surfaces and landscapes designed to capture rainwater, both for reuse and/or infiltration. These recommendations will establish priority sites and opportunities to convert the campus landscape from “traditional” to “sustainable.”

5. Implement Pilot Projects for Water Reuse and/or Non-Potable Water Substitution

Potable water consumption on campus can be reduced by water reuse or by the substitution of nonpotable water in some applications where potable water is currently used. Through an open solicitation process, campus could implement four projects by FY20 to showcase the capabilities and impact of this approach, with a broader rollout on campus by FY25.

Water Reuse

Water reuse includes using water multiple times in a cascade of applications that generally have less stringent water quality requirements (i.e., reusing washing water for toilet flushing). It can also include some purification steps that increase the water quality as needed for the subsequent reuse application. The benefits of water reuse include a reduced draw on the aquifer or surface water supplies, and reduced energy and chemical consumption from water treatment processes and distribution. Currently, the campus does not practice a substantial amount of water reuse and does not have a specific strategy for increasing water reuse. Given the potential of water reuse to significantly reduce net water consumption, it could be vigorously pursued as a part of the overall strategy for water use reduction on campus.

Substitution of Nonpotable Water

Certain uses for water, especially irrigation, do not require water that is potable. The campus could actively investigate opportunities to use untreated raw water, sump pump discharge, wastewater from cooling towers, stormwater, and gray water in appropriate applications. Prototypes or pilot projects for collection and reuse of stormwater and air conditioning condensate could be undertaken in FY16. The Oak Street Chilling Plant sump discharge water could be upgraded to provide make-up water for the Central Plant Cooling Tower.

6. Stormwater Runoff Pollutant Reduction

The current stormwater management paradigm on campus results in the direct discharge of most stormwater directly to local surface waters. This process washes a variety of pollutants into the surface water that could otherwise be adsorbed into the landscape, which would avoid the negative impacts of these stormwater pollutant discharges. For instance, the nutrients in stormwater ultimately drain to the Mississippi River and contribute to a hypoxic “Dead Zone” in the Gulf of Mexico that is greater than 5,000 square miles in some years. The capture of stormwater for infiltration, as described above, is expected to have a significant positive impact on pollutant discharges. However, the extent of campus stormwater impacts on surface water quality is not well understood at this time. Thus, the impact of stormwater discharges on water quality could be investigated along with the impact of different strategies for reducing pollutant discharges. This would include monitoring of infiltration pilot projects and various alternative landscape maintenance strategies (no-mow, no-fertilizer, no-irrigation, etc.). This investigation could then inform further plans and recommended standards for stormwater management on campus.

Conclusion

As noted above, our campus has made significant strides in conserving water through leak repairs, low-flow fixtures, etc. Further success in this area will require continued attention to conservation and new efforts in water reuse and improved stormwater management. The strategies outlined above provide a pathway to sizable reductions in potable water use and enhanced sustainability of stormwater management practices.

Chapter 6. Purchasing, Waste, and Recycling (Zero Waste)

Our campus has committed to reducing the environmental impacts from the products and services we purchase and discard. These impacts are generated when our vendors produce and extract natural resources, process and transport them to us, and later collect them to be disposed of as waste. Reducing campus purchases, selecting environmentally-preferred products and services, and decreasing waste that ends up in landfills will reduce GHG emissions, improve use of natural resources, educate students about sustainable practices, and contribute to other environmental benefits. Addressing sustainable materials management requires our campus to engage in a "life cycle" approach that considers the energy and other resources used for production and transportation of our purchases, as well as the impacts of wasteful practices such as landfilling a recyclable item.

According to the Zero Waste International Alliance, "Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them."[40] One approach to measuring campus waste

40) Zero Waste International Alliance, "ZW Definition" http://zwia.org/standards/zw-definition/

includes animal manure, landscape waste, and typical municipal solid waste (MSW) from buildings and exterior waste bins. Applying this definition, in FY14 our total diversion rate from landfill was 85.60%, as shown in Table 6 (right); this rate is dominated by "special recyclables" like animal manure and landscape waste.

Fiscal Year	Annual Total Landfilled (est. #)	Annual Total Commodity Recyclables (est. #)	Annual Total Special Recyclables (est. #)	Annual Total Recyclables (est. #)	Annual Diversion Rate (%)
2008	9,850,035	5,537,877	59,652,270	65,190,147	86.87%
2009	11,860,198	5,601,365	59,714,104	65,315,469	84.63%
2010	12,089,858	4,763,946	59,679,401	64,443,347	84.20%
2011	11,983,068	4,769,674	59,679,836	64,449,510	84.32%
2012	11,770,112	4,476,132	59,682,227	64,158,359	84.50%
2013	11,499,760	4,897,940	59,607,395	64,505,335	84.87%
2014	10,851,940	4,894,320	59,606,882	64,501,202	85.60%

Table 6: Total Diversion Rate from Landfill, FY08 to FY14

In analyzing our operations, however, it is also important to focus on our waste production and recycling of MSW, such as paper, cardboard, plastics, metals, glass, and food scraps. In FY14, the MSW diversion rate from landfill was 31.08%, shown in Table 7 (below).

Since FY08, the campus has taken many actions to move toward Zero Waste. In 2009, we switched from sending landfill waste to a site in Clinton, Illinois (which did not recover methane emissions) to a site in Danville, Illinois (which does recover methane emissions for electricity generation). According to the Campus Carbon Calculator (CCC), this change yielded a substantial benefit in greenhouse gas emissions from the landfilled waste — going from 14,697 metric tons of GHG emissions in FY08 to a negative (saving of) 172 tons of GHG emissions in FY09. For future GHG emission inventories, we will seek to more closely evaluate the emissions impacts from our campus waste stream. With the CCC calculations, our reported emissions declined 101%, even though total landfilled volume increased as much as 23% during the same time, as shown in Table 8 (below).

Fiscal Year	Total Landfilled (est. #)	Total Recyclables Sold (est. #)	MSW Diversion Rate (%)
2008	9,850,035	5,537,877	35.99%
2009	11,860,198	5,601,365	32.08%
2010	12,089,858	4,763,946	28.27%
2011	11,983,068	4,769,674	28.47%
2012	11,770,112	4,476,132	27.55%
2013	11,499,760	4,897,940	29.87%
2014	10,851,940	4,894,320	31.08%

Table 7: Municipal Solid Waste (MSW) Diversion Rate, FY08 to FY14

Among other actions that reduced solid waste, the Housing Department's dining halls now use trayless service, aerobic digesters, and some small-scale vermi-composting to reduce food waste and divert it from landfill. We started participating in the national RecycleMania competition, with Game Day Challenges and e-waste collections. Also, we have implemented innovative programs, such as nitrile glove recycling and reuse of laboratory chemicals. Likewise, we adopted policy statements on zero waste and recycled content of office paper,[41] certified cleaning products,[42] and standards for computers.[43]

While there have been several positive initiatives in this area, a lot more can be done to improve our performance on several measures related to purchasing and waste. Unfortunately, campus policy statements about environmental purchasing standards and preferences are not well-known, used, or enforced. As of FY13, 71% of office paper purchased on campus had no recycled content, purchases of

Fiscal Year	Primary Landfill Location	Landfilled Waste Tons	% Change from FY08	Waste Emissions MT eCO_2	% Change from FY08
2008	Clinton	4,741	n/a	14,697	n/a
2009	Danville	5,746	21%	(172)	-101%
2010	Danville	5,847	23%	(175)	-101%
2011	Danville	5,813	23%	(174)	-101%
2012	Danville	5,700	20%	(171)	-101%
2013	Danville	5,749	21%	(172)	-101%
2014	Danville	5,426	14%	(163)	-101%

Table 8: Waste Tons and Emissions History

41) Campus Administrative Manual, "Recycling, Recycled Products Procurement, and Waste Reduction" (2011) http://cam.illinois.edu/vii/VII-b-9.htm
42) Illinois Green Cleaning Schools Act, 105 ILCS 140/1 (2007) http://ilga.gov/legislation/ilcs/ilcs3.asp?ActID=2903&ChapterID=17
43) Campus Administrative Manual, "Acquisition Policy for Energy-Efficient Equipment" (2011) http://cam.illinois.edu/vii/VII-b-13.htm

office paper decreased only 3.2% from FY11 to FY13, and purchasing practices apply no or weak environmental preferences for vendors or products. According to the U.S. Environmental Protection Agency (EPA), 42% of carbon pollution emissions in the U.S. are associated with the energy used to produce, process, transport, and dispose of the food we eat and the goods we use.[44] Therefore, the campus must strengthen efforts to reduce, reuse and recycle purchased goods, and to select environmentally preferred products and services.

Zero Waste Goals

Going forward, campus should use a comprehensive Zero Waste Program to prevent waste at all stages of the life cycle of products — from reducing both the quantity and the environmental impact of products that we purchase, to encouraging the reuse of materials on campus, to recycling products that have reached the end of their service life. While the existing campus waste management system includes a sorting process to divert recyclables from the landfill waste stream at the campus scale, efforts to increase recycling (both on campus and around the world as students and employees travel throughout their lives) must ultimately rely upon the actions of individuals. Therefore, one of the aspirational goals of the Zero Waste Program is for individuals to take personal responsibility regarding the final destination of their own waste products. This program would apply and report waste-related measurements, establish baselines and accountability by campus unit for purchases and waste, implement training programs, and provide incentives. To raise awareness of waste reduction goals, this program should be communicated clearly to all academic and nonacademic units, employees, and students, including through events and competitions. Life-cycle analysis should be used to identify opportunities for improvement, and enforcement measures should be considered and implemented as appropriate.

Objectives

The comprehensive Zero Waste Program will include sustainable procurement components, targeted reuse programs, clear recycling education with incentives for participation, and specific targets focused on waste minimization. Therefore, the objectives for waste minimization cover all these aspects. They are:

1. By FY17, environmental standards will be applied to purchases of office paper, cleaning products, computers, other electronics, and freight/package delivery services. At least 50% of purchases in these categories will meet campus standards by FY20, and 75% by FY25.
2. Reduce MSW waste going to landfills. This involves reducing nondurable goods purchases, effectively reusing materials, and recycling. In the latter category, campus will increase the diversion rate of MSW to 45% by FY20, 60% by FY25, and 80% by FY35, while also increasing the total diversion rate to 90% by FY20 and 95% by FY25. MSW sent to landfills should decline to 2,000 tons annually by 2035.
3. Utilize landfills with methane capture.
4. Appropriately staff Zero Waste efforts through the hiring of a full-time Zero Waste Coordinator.

Potential Strategies

1. Develop and Apply Environmental Purchasing Standards

Develop Campus Environmental Purchasing Standards

Decisions about the purchasing of many products are handled in a very decentralized fashion on our campus. The University purchasing process ensures that such purchases meet various federal and state

44) U.S. EPA, "Climate Change and Waste" http://epa.gov/climatechange/climate-change-waste/

requirements. However, the process does not effectively apply standards or preferences to select vendors and products having low life-cycle carbon emissions and low embodied energy.

The campus could apply standards for the purchases of certain major categories of products; for example office paper (at least 30% recycled content), cleaning products (Green Seal), computers (EPEAT Silver), other electronics (Energy Star), and freight/package delivery services (EPA SmartWay). Also, the campus could identify environmental standards applicable to additional major categories of purchases. Compliance with these environmental standards should be required, or at least given significant weight, in purchasing decisions. Campus could revise its purchasing systems to curtail purchases of products and services which fail to satisfy selected environmental standards and preferences.

Track Compliance with Campus Standards

The University purchasing process could be enhanced to explicitly track purchases for compliance with campus environmental standards, so that it would be straightforward to measure progress. For example, the process could track the number of computer purchases that are EPEAT Silver and which campus units are falling short in applying this standard.

Utilize Standards from Other Organizations

The campus could also apply sustainable purchasing tools and standards provided by the U.S. General Services Administration, U.S. Department of Energy, U.S. EPA, State of Illinois Central Management Services, and other certifying organizations. It could also utilize and expand purchasing contracts that apply certified environmental standards and preferences, including contracts available for State of Illinois agencies and collectives of universities.

Promote Sustainable Purchasing

The iSEE Certified Green Office Program has been developed to engage campus units and vendors to improve campus sustainability in many areas, including reducing purchases and their associated emissions. This program could be expanded to more units, and could also include more types of sustainable purchasing practices. A similar campaign could also solicit and apply students' suggestions on reducing paper and other products used in classes and buildings. The Office of Business and Financial Services (OBFS) and its purchasing divisions could play a key role in an expanded program promoting sustainable purchasing by adopting goals to reduce purchases and to purchase sustainable products. The campus could also consider applying surcharges to the prices of any noncompliant purchases (through the purchasing system and other mechanisms) to encourage environmentally preferred purchases and recycling.

2. Reduce MSW Landfill Tonnage

Reducing the tonnage of MSW going to landfill will require a combination of reducing purchases, improving reuse of materials that have already been purchased, and increasing recycling rates.

Reducing Nondurable Goods Purchases

The campus could reduce purchases of office paper and computers by encouraging need-based printing and extending the replacement cycles for computers. An initial target could be a reduction of purchases in these categories relative to a FY15 baseline by 15% by FY20 and 30% by FY25. Additional major product categories could be identified for significantly reduced purchases. Purchases could be tracked by campus unit, with training and incentives for reductions; such incentives could potentially be implemented through the Certified Green Office Program.

Reuse Materials

The campus could implement a program to extend the replacement cycles for computers and other electronic products. This would involve educating the campus community about the benefits of postponing the purchase of new equipment, providing incentives for campus units, enhancing options for transferring the equipment to other users on campus, and investigating the potential for transferring equipment to non-campus users, in cooperation with Central Management Services.

The campus could also increase the reuse of materials on campus by expanding its durable-goods cataloguing system. The Surplus department on campus already offers the reuse of various campus property, such as furniture, and campus could increase this program's capacity as well as its visibility and utilization. Campus could work with students to widen and encourage use of surplus goods by all departments.

Raise Recycling Rates across Campus

To increase awareness of waste management, campus could measure the performance by campus units (such as specific building, department and auxiliary) on purchasing, waste, landfill, recycling of specific commodities, and other product reuse. Campus units could be asked to participate in a waste stream characterization study that will help them develop plans to decrease wastes and increase recycling, and conduct training to increase engagement efforts.

Campus could implement incentive programs for waste reduction by campus units and students and raise awareness of waste reduction goals through consistent communications and events, such as more zero-waste sports and cultural events. Finally, campus could increase the sorting of recyclables from combined waste at the waste sorting station.

Increase Availability and Visibility of Recycling Bins

The campus could institute uniform signage for recycling and landfill bins across campus; bins could be strategically placed around campus buildings and grounds to increase visibility of current waste diversion efforts. The number and locations of recycling bins could be increased by pairing them with trash bins. The campus then could reduce the total number of landfill bins. In the ideal case, every landfill bin on campus would be paired with one or more recycling bins.

The campus could also undertake a campaign to increase awareness of special recycling categories, such as glass, food waste, electronics, batteries, and nitrile gloves.

Increase Options for Recycling

The campus could also expand the categories of waste that are recycled on campus. Some examples include expanding the glass recycling initiative, by consulting new vendors for competitive prices, developing new recycling options for plastics types 3-7, and developing expanded polystyrene (Styrofoam) recycling.

Require Recycling of Construction and Demolition Material

Recycling of construction and demolition materials is a component of LEED certification, and is already required by campus for major projects. By extending this requirement to all new construction and renovation projects, the campus could provide further support for LEED building commitments and at the same time make a significant reduction in our waste stream.

3. Methane Capture at Landfill

According to the U.S. EPA, a landfill gas recovery energy project captures "roughly 60 to 90% of the methane emitted from the landfill, depending on system design and effectiveness." Also, carbon dioxide is emitted from electricity generation using landfill gas as well as trucking waste to landfills.[45] Campus could utilize landfills that effectively incorporate methane capture equipment and low-emission trucks.

4. Appropriately Staff Zero Waste Efforts

The strategies outlined here require additional staff time. These Zero Waste efforts would involve coordinating the campus efforts to improve the sustainability of our purchasing practices, to encourage the reuse of materials both on and off campus, and to improve recycling rates for MSW and other types of waste. Zero Waste staff would interface with University Purchasing, Facilities & Services, and units and students across campus.

Conclusion

The campus needs to emphasize waste-related measurements, accountability, incentive programs, communications and systems analysis for campus units and students. Promoting sustainable purchasing practices and reducing waste will not only reduce Scope 3 greenhouse gas emissions on campus, but also has the potential to lower expenditures on purchases, reduce landfill tipping fees, and earn revenue through recycling streams. With a comprehensive Zero Waste Program, enforcement of sustainable procurement standards and expansion of recycling programs, campus would be able to significantly reduce the indirect environmental impacts of its purchasing and disposal practices.

45) U.S. EPA, "Landfill Methane Outreach Program, Basic Information — It directly reduces greenhouse gas emissions" http://www3.epa.gov/lmop/basic-info/index.html

Chapter 7. Agriculture, Land Use, Food, and Sequestration

This campus comprises 6,368 acres (9.9 square miles) and six residence dining halls. This land includes 1,333 acres for crop production and research, 1,507 acres for animal husbandry or research, and many acres of managed landscape. Additionally, our residence halls serve about 25,000 meals daily during the academic year. Because of the volume of production, land management, and food services, these areas deserve serious consideration in regard to their environmental impacts, including greenhouse gas (GHG) emissions and mitigation strategies.

Agricultural practices contribute to GHG emissions in several ways, from production, processing, transportation, marketing, consumption, and waste. Non-agricultural landscape management also leads to emissions from lawn and garden maintenance, as well as from snow and ice removal. Land use practices also impact the environment through transportation infrastructure, methods of stormwater management, irrigation needs, and adverse impacts on biodiversity and ecosystem services, such as the use of non-native plants and trees. Food consumption leads to GHG emissions from production, processing, transportation, marketing, consumption, and waste. Additionally, our food purchasing practices can influence the environmental impacts of agricultural systems beyond campus, as well as influence the vibrancy of our local agricultural community. The sizable landmass of our campus also offers opportunities for carbon sequestration (the purposeful removal of greenhouse gases from the atmosphere), for example through the use of perennial plantings that store carbon in the soil.

Fiscal Year	Ag Emissions MT eCO_2	% Change from FY08
2008	8,177	n/a
2009	8,878	9%
2010	7,885	-4%
2011	8,236	1%
2012	7,775	-5%
2013	7,409	-9%
2014	6,733	-18%

Table 9: Agricultural Emissions History

Agricultural Emission Goals

As discussed in Chapter 1, the estimates of our agricultural emissions have been limited by the use of the Campus Carbon Calculator (CCC) to those from animal husbandry/research practices (see Table 9, right). We need to harness the considerable agricultural expertise on our campus to better understand these emissions; for example, the CCC does not reflect the fact that all of the manure generated by our animal husbandry/research is used as fertilizer for our crop land. Most of our nearly 3,000 acres of farmland receives fertilizer, pesticide applications, tillage, etc. — and all of these practices need to be accurately accounted for in our emissions inventory. Likewise, we need additional data for other land management practices, food procurement, and sequestration possibilities. Thus, a critical first step will be a complete assessment during FY16 of our baseline agricultural emissions using FY15 data. Our long-term goal in the arena of Agriculture, Land Use, Food, and Sequestration (ALUFS) is then to reduce these emissions (from the FY15 baseline that will be established) incrementally over time with an ultimate goal of 100% reduction or better by FY50 (see Table 10, left).

Fiscal Year	Ag Emissions % Change from FY08
2015	n/a
2020	*-30%*
2025	*-50%*
2030	*-70%*
2040	*-90%*
2050	*-100%*

Table 10: Agricultural Emissions Goals

Ideally, our agricultural and land use practices should ultimately result in negative greenhouse gas emissions by sequestering carbon into our soils.

Objectives

Our short-term objectives in this area are:

1. Perform a comprehensive assessment of GHG emissions from agricultural operations, and develop a plan to reduce them, by the end of FY16.
2. Design and maintain campus landscapes in a more sustainable manner; expand the specification of sustainable plantings in campus landscaping standards, and develop and implement a tree care plan by FY16 and an integrated pest management program by FY17.
3. Incorporate sustainability principles more fully into the Campus Master Plan.
4. Implement a project that examines the food service carbon footprint for Dining and other on-campus food vendors, while increasing local food procurement to 40% by FY25.
5. Increase carbon sequestration in campus soils by determining the sequestration value of existing plantings and identifying locations for additional plantings, with a specific objective of converting at least 50 acres of U of I farmland to agroforestry by FY20.
6. Reduce nitrates in agricultural runoff and subsurface drainage by 50% from the FY15 baseline by FY22.

Potential Strategies

1. Assess and Reduce Agricultural Emissions

The ALUFS SWATeam could commission an Agricultural Emissions Consultation Group of campus experts, including crop scientists, animal scientists, ecologists, students, and others, to perform a comprehensive assessment of the greenhouse gas emissions from the South Farms. This assessment would include the identification or development of an agricultural emissions calculator that can be used on an annual basis to estimate our emissions, along with the identification of the appropriate group of stakeholders in the relevant units who will annually provide the required input data. This work would result in an accurate FY15 baseline for measuring our future performance.

This Agricultural Emissions Consultation Group would also be charged with identifying specific actions that can be taken to reduce emissions. One group of actions may include changes to agricultural practices, such as the use of cover crops or the timing of fertilizer applications. Another category is technological changes, such as the use of renewably produced biodiesel in farm vehicles or the construction of an anaerobic digester to convert agricultural, landscaping, and food waste into energy.

2. Sustainable Plantings & Maintenance Across Campus

A Sustainable Plantings Consultation Group could be formed to evaluate existing campus landscaping standards and to identify ways in which these standards should be changed to increase the use of native and sustainable plantings across campus. This group would include experts at F&S, the Prairie Research Institute, and other faculty and staff with relevant expertise. Expansion of native and sustainable plantings would provide benefits in terms of reduced maintenance and irrigation needs, as well as an increase in biodiversity, an example being pollinators. It is also important to evaluate campus maintenance practices with respect to landscaped areas. Campus could develop and implement a tree care plan, as well as an Integrated Pest Management program.

3. Sustainability in the Campus Master Plan

When the Campus Master Plan[46] was last updated in 2007, it only minimally addressed campus sustainability. The Master Plan does state that "The campus will become a model of sustainable design and management through its everyday actions, monitoring, and reporting taking into account all appropriate economic, environmental, and social concerns." The Master Plan also includes an extensive discussion of alternative campus landscapes relating to the open space enhancements specified in the plan, and encourages areas of open space to be developed as examples of native and sustainable landscapes. The Master Plan also endorsed transportation ideas that give priority to pedestrian, bicycle, and mass transit movement, consistent with sustainability goals. However, the current Master Plan envisions extensive growth of existing facilities to accommodate future program needs, and anticipates future growth to continue much as it has in the past, at an average rate of about 1.73 million gross square feet of space per decade.

The campus is requesting approval to update the 2007 Campus Master Plan, which would provide an opportunity to better incorporate sustainability goals. This could include additional recommendations for sustainable landscapes and sustainable goals in the design guidelines for open space, landscapes, and facilities. Other opportunities for sustainable planning include, but are not limited to, designating specific sites as applicable for renewable energy production. Finally, the Campus Master Plan update offers a critical opportunity to reconcile the need for new additional program space, as traditionally expected in planning efforts, with the new campus net zero growth policy.

Energy Farm at the University of Illinois

In their search for alternative energy resources, sustainable food production and environmental stewardship, researchers at the University of Illinois have access to a gigantic "living laboratory" — the 320-acre Energy Farm on the Urbana-Champaign campus' South Farms. Under the leadership and management of the Department of Crop Sciences and Institute for Sustainability, Energy, and Environment (iSEE), the Energy Farm offers the space, resources, and expertise necessary for field research and production needs for University researchers, corporate partners, and collaborators. The Energy Farm was originally launched with the support of the Energy Biosciences Institute (EBI) and a major corporate partnership grant from BP. One current experiment includes a comparison of yield and environmental metrics for different energy grasses.

4. Reduce the Carbon Footprint of On-Campus Food

Dining Services has made excellent progress in terms of procuring foods locally and continuing to look for methods to reduce environmental impact. Dining already procures 28% of food from sources within 150 miles of campus, which includes 95% of all the produce grown on the Sustainable Student Farm. Up to now, these efforts have been primarily focused on increasing the fraction of local food, with less attention paid to explicit consideration of the associated greenhouse gas emissions.

With the assistance of relevant academic specialists and students, Dining Services could develop a Food Footprint for operations. This report would reveal the GHG emissions from food services, and inform future efforts to increase local food purchases, including which purchases contribute most to emissions and should be avoided.

The campus could make the information developed by Dining Services available to other campus food vendors. This information will help them make better decisions regarding the procurement of local foods and any associated reduction in greenhouse gas emissions from these efforts.

The campus could also make a concerted effort to work with local farmers to develop robust markets for local foods, and local food processing facilities, which will enable a greater use of local foods both by our campus and our community.

46) https://www.uocpres.uillinois.edu/resources/uiucplan

The environmental footprint of the aerobic digesters used in Dining Services should be assessed to determine whether this is the best option for disposing of food waste, or whether vermi-composting or traditional composting would be better long-term solutions.

5. Increase Carbon Sequestration in Campus Soil

The campus should actively investigate means of sequestering carbon in the soils of our campus. Campus could determine the sequestration value of existing plantings and identify locations for additional plantings, with a specific objective of converting at least 50 acres of U of I farmland to agroforestry by FY20. Some avenues to be explored include:

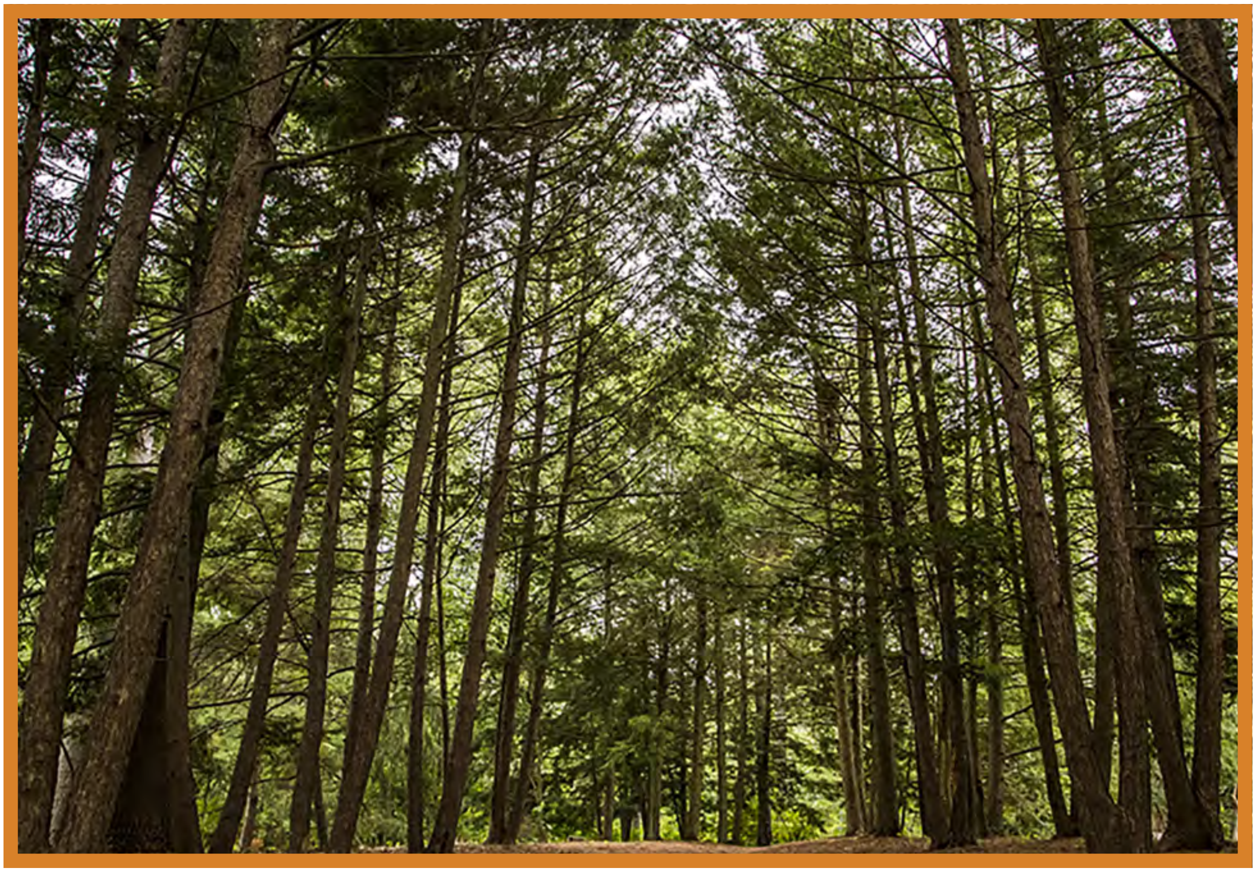
- Completing an inventory of trees and other plantings on the main campus, to determine the carbon sequestration already occurring and to guide future plantings to maximize sequestration.
- Investigating the production and use of biochar as a soil amendment, which increases agricultural production while also sequestering carbon.
- Assessing the sequestration of perennial crops on the South Farms, including the extensive plantings at the Energy Farm.
- Developing agroforestry, or woody perennial polyculture, as a means to sequester carbon while simultaneously producing energy crops (e.g., wood from coppicing poplars) and/or food crops (e.g., hazelnuts and fruits) and also providing valuable ecosystem services. A project has been funded by iSEE to convert 21 acres of traditional crops to a perennial polyculture research site.

6. Agricultural Runoff and Subsurface Drainage

Fertilizer applications used to produce corn have profound environmental impacts that are often not fully recognized. In addition to direct greenhouse gas emissions during the synthesis and transportation of these products, nitrogen applications also lead to increased nitrate concentrations in agricultural runoff and subsurface drainage. Most farm fields in Illinois have underground drainage tile that intercepts subsurface drainage and quickly transports this drainage into surface waters that ultimately drain to the Mississippi River. Draining the corn belt via the Mississippi creates a "Dead Zone" each spring in the Gulf of Mexico that is greater than 5,000 square miles in extent. Further, under anaerobic conditions, nitrate can be reduced to nitrogen gas and nitrous oxide (a powerful greenhouse gas). Up to 75% of the world's nitrous oxide emitted into the atmosphere is believed to be due to agricultural nitrogen fertilization. By FY20, the campus could substantially reduce its contribution to this problem, and serve as a model for agricultural operations in the Mississippi watershed. The strategy may require both changes to the timing and extent of fertilizer applications and the installation of equipment to treat subsurface tile drainage.

Conclusion

The strategies recommended here would help us to more accurately quantify our emissions from agriculture, land use, food, and sequestration. In turn, we can then identify the best alternatives for mitigating these emissions to reach net zero, or even negative, emissions by 2050.



Chapter 8. Carbon Offsets

In certain circumstances, it is impractical or not financially viable to reduce greenhouse gas emissions entirely to zero. For example, while there is certainly room to reduce the amount of air travel conducted by campus employees by encouraging the alternative of videoconferencing, there is some travel that is essential to the University's mission.

To handle such circumstances, the concept of a carbon offset (or carbon credit) has been developed. Carbon offsets allow the exchange of carbon emission reductions through a financial transaction. For example, entity A may wish to reduce its carbon emissions, but find that it is more expensive to reduce the emissions from its own operations than to pay entity B to reduce its emissions. Thus, entity B can reduce its emissions, have those emissions validated and verified by a third-party organization, and then sell those emission reductions to entity A. Entity A can then make environmental claims about its emission reductions, while entity B can no longer claim those emission reductions. As mentioned in Chapter 1, campus is engaging in such a transaction, acting as "entity B" in this example, with Bonneville Environmental Foundation serving as "entity A." More details on the carbon credits process is shown in Figure 7 (see page 61).

Our campus could elect to purchase carbon offsets from other entities (for example, companies that capture methane emissions from landfills, or plant trees to capture atmospheric CO_2). In fact, at some point we will certainly have to do so in order to become carbon neutral, as some of our emissions cannot be realistically reduced to zero. We could decide to simply purchase enough carbon offsets for our entire emissions and thereby become carbon neutral. With current bulk prices on the voluntary offset market in the $3/ton range, this would require an expenditure in the neighborhood of about $1.5 million per year to achieve and maintain carbon neutrality.

Relying on the purchase of offsets to reduce our emissions has the disadvantage that it must be done every year indefinitely if we are to be carbon-neutral, and prices for offsets may well rise in the future — especially if carbon emissions become regulated or taxed. In many cases, our long-term financial interests will be better served by making capital investments to directly and permanently reduce our emissions, rather than committing to the indefinite annual expenditure of purchasing offsets. For example, we could invest in clean energy solutions such as geothermal heat pumps or biomass boilers to reduce our emissions, rather than annually purchasing offsets for our emissions from burning fossil fuels at Abbott Power Plant. However, there are some cases (e.g., air travel, supercomputing facilities) where offsets are the most practical solution.

Offsets Goals

Our goal is to begin using carbon offsets on a limited basis, in sectors where direct reductions in emissions are either infeasible or prohibitively expensive. The offsets we purchase should be validated and verified by an international body, and should demonstrate "additionality" — that is, they should represent real reductions in GHG emissions that would not have occurred during a business-as-usual scenario. Ideally, the offsets that we purchase would be linked to our institutional mission. In the longer term, we will use offsets as a backstop to meet our emissions goals, but with a clear preference for direct emission reductions.

Objectives

Our short-term objectives in this area are:

1. By the end of FY16, conduct a Request for Proposals process for verified carbon offsets — and undertake the first campus purchase of offsets.
2. By the end of FY17, develop an administrative mechanism to enable campus units to voluntarily purchase carbon offsets.
3. By the end of FY18, develop a program of local or regional mission-linked verified carbon offsets, so that our purchases of offsets will also support our institutional missions.
4. By FY20, utilize offsets to meet all iCAP emissions targets that have not been met by direct emission reductions.

Potential Strategies

1. Conduct an RFP Process for Offsets

iSEE could develop detailed specifications for carbon offsets that are acceptable for campus purchases. These specifications would ensure that all purchased offsets are additional (in the sense that they enable reductions beyond business-as-usual), measurable, conservative (to ensure reductions are not overstated), permanent, independently verified, trackable, and transparent. Given the complex nature and intangibility of carbon offsets, it would be essential that the campus be able to justify its offsets purchases to all stakeholders. By the end of FY16, iSEE could conduct an RFP process, secure campus funding for a modest initial purchase of offsets, and complete such a transaction. This initial purchase could be related to a portion of air-travel emission offsets.

2. Develop a Mechanism for Units to Purchase Offsets

Some campus units (or individual faculty or staff) may wish to voluntarily offset their carbon emissions, for example from air travel to scholarly meetings. iSEE could work with the Office of Business and

Financial Services (OBFS) to develop an administrative mechanism that would allow such units to "buy in" to periodic campuswide purchases of verified offsets. For example, iSEE could execute a campuswide purchase of offsets at the start of each year, resell offsets to interested units throughout the year, and then increase the next year's campuswide purchase to replenish what had been sold to units. This mechanism, which could be in place by the end of FY17, would allow units and individuals to directly engage in emission reduction activities, above and beyond campuswide initiatives.

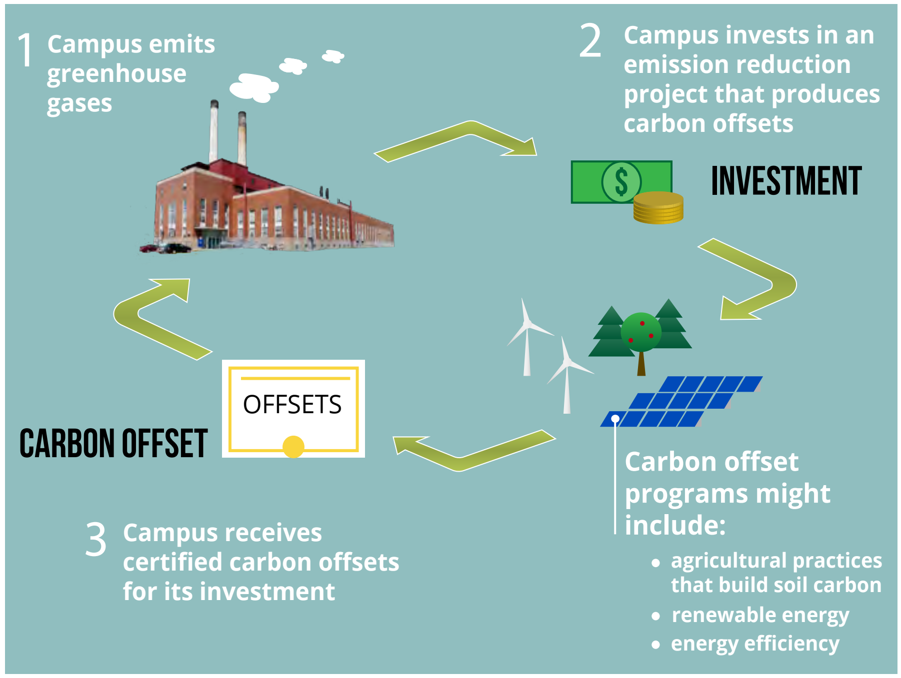


Figure 7: How Carbon Offsets Are Generated

3. Develop Local/Regional Mission-Linked Offsets

Rather than relying exclusively on the purchase of carbon offsets from international markets, where the effect of the purchase can be somewhat intangible, the campus could develop local community offsets that are linked to its institutional missions. Such a program is being considered by Cornell University as part of its effort to accelerate its carbon neutrality goal to 2035.[47] Cornell has suggested that options for local offsets could include energy efficiency renovations in low-income and rental properties, fuel switching to renewables such as biomass pellets for farms and rural homes, improving soil carbon storage in agricultural soils, and reducing methane sources in agricultural industries. Developing a program for such community offsets would require extensive planning, but it should be possible to complete this by the end of FY18. The program could be developed by iSEE in collaboration with U of I Extension and community partners, and could leverage the efforts underway at Cornell.

4. Use Offsets to Meet Unmet 2020 iCAP Targets

Once the administrative processes have been established to purchase carbon offsets, and ideally once a robust program of local, mission-linked offsets has been created, the campus would be positioned to use the purchase of carbon offsets to meet any shortfalls in its emission reduction goals in FY20.

Conclusion

We view the purchase of verified carbon offsets not as a primary method to achieve emission reductions, but rather as a secondary approach for those emissions that cannot be directly eliminated (e.g., air travel), and also as a potential fall-back option in cases where direct reductions are not financially viable. It is highly desirable to cultivate a robust system of community offsets, so that our purchases of carbon offsets can help support our institutional missions (including research, extension, and economic development).

47) http://csc-production.s3.amazonaws.com/2015/01/27/16/20/53/864/2015_01_24PublicClimateActionAccelerationReport.pdf

Chapter 9. Financing

A variety of financing mechanisms are currently in place to provide funding for sustainability projects, and are briefly reviewed here:

Campus Utilities Budget

We currently spend $98.8 million per year on utilities and energy services for the campus, which includes fuel and electricity purchasing as well as operations and maintenance of Abbott Power Plant. This recurring budget has been a successful source for funding conservation projects. This includes formal programs such as retrocommissioning, and ad hoc allocations for "quick payback" (less than two years) projects through the Office of the Provost.

Energy Performance Contracting

As described in Chapter 2, energy performance contracting allows the campus to pursue capital-intensive projects in energy efficiency that offer a payback of less than 20 years, using the cost savings from reduced energy consumption to pay off the initial investment. This does require the campus to assume additional debt, although there is a stream of energy savings to retire that debt.

Deferred Maintenance

The campus receives funding from the Academic Facilities Maintenance Fund Assessment (a student fee), which is dedicated to reducing our backlog of "deferred maintenance" (work that would have ordinarily been performed in previous years, but was not performed due to a lack of funding). Where possible, these funds are preferentially being deployed to address deferred maintenance projects that also reduce energy use, and thereby reduce greenhouse gas emissions.

Central Campus Budget

The Office of the Provost has made one-time allocations outside of the above mechanisms in support of various sustainability initiatives on campus, such as for LED exit signs and for the Campus Bike Center.

Student Sustainability Committee

The Student Sustainability Committee (SSC)[48] is a student-led campus committee charged with the distribution of two student fees: the Sustainable Campus Environment Fee and the Cleaner Energy Technologies Fee. The SSC allocates more than $1.1 million per year to fund projects that improve campus sustainability in areas ranging from renewable energy to energy conservation to waste reduction and beyond, specifically with a focus on direct student impact.

Revolving Loan Fund

The Revolving Loan Fund (RLF) was established in FY12 with funding from the SSC and the Office of the Chancellor as a source for utility conservation projects that pay themselves back through utility savings in less than 10 years. The Office of the President has since committed additional funds, and the RLF grew through a 2013 Illinois Department of Commerce and Economic Opportunity (DCEO) Grant for lighting retrofits. At the end of FY15, the total amount of funds in the RLF program (including those that have been loaned out to projects) was about $3.2 million.

External Grants

Our campus has been quite successful in applying for grants from the DCEO and the Illinois Clean Energy Community Foundation to advance our sustainability objectives. Since FY08, the University has been granted more than $13 million for projects that are either complete or in progress.

Private Donations

To date, we have had only limited success in obtaining private donations for campus sustainability projects, and this is clearly an area in which we have room to improve. One highly visible success story in this category is the installation of an impressive native prairie at Florida Avenue and Orchard Street.

Sale of Carbon Credits

In FY15, we agreed to retrospectively sell our carbon emission reductions for FY12, FY13, and FY14 to the Bonneville Environment Foundation, as part of the Chevrolet Campus Clean Energy Campaign.[49] This sale of carbon credits, together with a match from the Office of the Provost, yielded more than $1 million that has been earmarked to enable further emission reductions on our campus. Because Chevrolet is retiring these credits on behalf of the environment, we can retain credit for these historical emission reductions in our ACUPCC reporting, and we will have additional funds to reduce future emissions.

48) http://ssc.sustainability.illinois.edu
49) http://icap.sustainability.illinois.edu/project/chevy-campus-clean-energy-efficiency-campaign

Financing Goals

Our campus goal for financing sustainability is quite simple: We want to ensure that all of the best ideas for reducing our greenhouse gas emissions, as vetted by our established process of review by the SWATeams, the iCAP Working Group, and the Sustainability Council, are fully analyzed and then matched with the funding necessary to make them happen.

Objectives

1. By the end of FY16, develop criteria and a review process for the iCAP Working Group to allocate funding for feasibility studies of SWATeam-recommended sustainability projects and initiatives, using funds provided by campus administration and other sources.
2. By the end of FY16, increase the size of the Revolving Loan Fund (RLF) to a level commensurate with our aspirational peers, expand the reach of the Fund, and increase the use of Energy Performance Contracting.
3. By the end of FY16, identify the amount of funds that are available across campus for projects that do not offer a rapid financial payback, but which are nevertheless important for improving campus sustainability, and identify options to increase that amount annually.
4. By the end of FY16, evaluate the feasibility of internally putting a price on carbon emissions.

Potential Strategies

1. Studies of Feasibility, Costs, and Benefits

Proper assessment of the feasibility, cost (capital and recurring), and benefits (both financial and environmental) of various proposed sustainability projects and initiatives will require careful studies by qualified experts. Our campus is replete with such experts among our faculty and staff, and also has the benefit of a large pool of talented students who can make substantial contributions to such studies while simultaneously advancing their education. In many cases, we can conduct such studies better and more economically ourselves than by hiring an outside consulting firm. However, we generally cannot perform such studies for free; we may need to provide stipends or summer salary for participating faculty and students to attract qualified experts and assistants. In some cases, collaboration with external experts may also be required.

The SWATeams and the iCAP Working Group already represent a mechanism to identify those projects that would benefit from such studies, and to recruit the appropriate experts. However, the campus needs to develop a mechanism to provide the necessary funding for these efforts. The results of these studies will be essential in prioritizing our efforts and ensuring that we achieve the maximum environmental and financial benefits for sustainability expenditures.

The campus administration could allocate a recurring annual budget for such studies; these funds could be supplemented on a case-by-case basis by contributions from campus units that would benefit from these studies, including Facilities & Services. The iCAP Working Group could then develop criteria and a review process to optimally allocate those funds for feasibility studies that will have maximum impact on iCAP objectives.

2. Increase Funding for Projects with Financial Payback

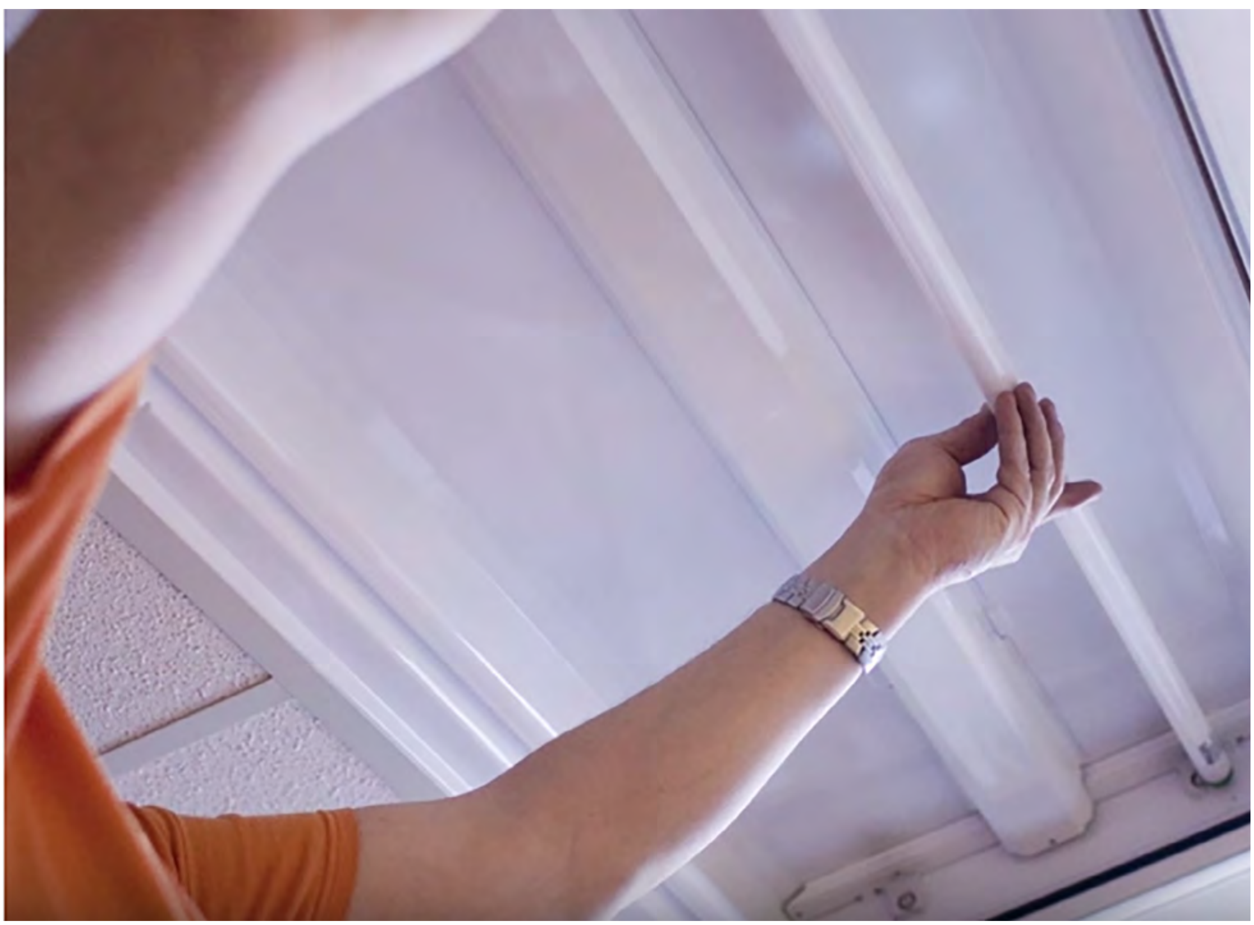
Many sustainability projects, especially in the area of energy conservation, by their very nature generate a long-lasting or indefinite stream of energy savings. Many such projects pay back their up-front costs in a reasonable period of time, and thus represent sound financial investments in addition to offering environmental benefits. The campus should increase the number of such projects that are implemented by committing additional funds to such projects, streamlining the review process, and encouraging units across campus to identify such projects.

Increase the Revolving Loan Fund

Given the state's financial challenges, our campus finds itself in a challenging financial situation with uncertain prospects for future state funding. To the extent that careful stewardship has enabled the campus to hold modest cash reserves, this is an ideal time to make an expansion in the RLF. A one-time strategic investment in the RLF will lead to a substantial reduction in utility expenditures for decades to come, and will strengthen our financial position going forward. A 2011 study[50] showed that the median annual return on investment (ROI) on RLFs is 32%, demonstrating that these funds "significantly outperform average endowment investment returns while maintaining strong returns over longer periods of time." We suggest that the RLF be increased to at least $10 million; this would put us in the company of aspirational peers such as Caltech ($8M), Harvard ($12M), and UCLA ($15M).

Expand the Reach of the Revolving Loan Fund

An increase in the RLF will need to be accompanied by an active outreach campaign to units across campus, including auxiliaries, so they are aware of this resource. The administrators of Harvard's RLF have cited the challenge of "promoting the fund across a decentralized campus," but even so Harvard's RLF has "experienced average annual returns of 30%, saved the university $4.8 million annually, and reduced Harvard's environmental footprint."[51]



50) http://greenbillion.org/wp-content/uploads/2011/10/GreeningTheBottomLine.pdf
51) http://greenbillion.org/wp-content/uploads/2011/10/Harvard.pdf

Currently, RLF projects are reviewed and funded on an ad hoc basis, whenever a substantial balance is available. To make it easier for units and auxiliaries to participate, the RLF review process could be modified so that proposals are reviewed for funding on a regular schedule, at least twice per academic year. The RLF guidelines could also emphasize that loans are not restricted to facility-oriented projects, but that the additional costs of purchasing energy-efficient equipment can also be considered.

Increase Energy Performance Contracting

Energy Performance Contracting has been enormously successful, and offers the potential of dramatic energy savings across campus. Given that debt incurred by EPC comes with a stream of energy savings to service the debt, and then continues to generate savings after the debt is retired, the use of this methodology could be substantially expanded.

3. Identify and Increase Available Funding for Projects without Payback

Certain sustainability-related activities need to be funded even though they may not offer clearly defined financial payback; examples might include stormwater management projects, electric vehicle charging stations, or projects to increase the biodiversity of our campus. These are worthy and important projects, but may not be eligible for funding through the RLF. Other projects will struggle to find funding because they have very long financial payback periods; examples might include the improvement of bicycle infrastructure. This section describes funding mechanisms that can be utilized to support such projects. Over the course of FY16, the campus could identify the total amount of funds of this type that are available, and identify ways to increase that amount annually.

Funding from Student Fees

Certain issues are important enough to the student body that students are willing to impose fees on themselves to address them. Examples include the long-standing Sustainable Campus Environment Fee and the Cleaner Energy Technologies Fee, which are allocated by the Student Sustainability Committee, and the forthcoming Bicycle Fee that was recommended by the student body in a referendum in November 2014. While the campus does not advocate for new fees, we must acknowledge that the funds from these fees are well-suited to supporting projects that are ineligible for RLF funding.

Central Campus Funding

We recognize that some projects and activities will require special commitments from campus, especially issues that are of great importance to students (e.g., bicycle infrastructure). Ongoing administrative costs, such as those for the Active Transportation and Zero Waste staff members proposed in Chapters 4 and 6, may also fall into this category. iSEE, Facilities & Services, and other impacted campus units will work with the Office of the Provost to identify funding for activities proposed in this iCAP or through the SWATeam process that do not have other funding avenues.

Private Donations and Corporate Partnerships

To date, there has not been a concerted effort to approach individual donors, private foundations, or corporate partners to fund campus sustainability projects. This is clearly an area with great potential for our campus, especially considering our exceptional performance and visibility in the sustainability arena. Donors, foundations, and corporate partners are likely to consider funding projects that have major impacts on campus sustainability, even if those projects do not offer clear payback. iSEE could, in collaboration with the UI Foundation and the Office of Corporate Relations, lead an effort to explore and expand such external funding opportunities for campus sustainability projects.

Arbitrage of Carbon Offsets

Carbon emission reductions from college campuses are considered “boutique” and carry a premium on the voluntary carbon offset market. We may be able to sell campus emission reductions, perhaps to corporations or to alumni, and then turn around and purchase the same amount of carbon offsets from other entities at a lower price. The proceeds from this arbitrage (which would not affect our campus emissions) could be used to fund sustainability projects, including those that do not fall under the purview of the RLF.

4. Evaluate the Feasibility of Internally Putting a Price on Carbon

At present, our economic environment allows us to add CO_2 to the atmosphere with no financial penalty, even though doing so imposes costs on the global community in the form of climate change, increased frequency of severe weather events, sea level rise, and so forth. The EPA estimates that the “social cost of carbon (SCC)” may be as high as $61 per ton of CO_2,[52] and the Intergovernmental Panel on Climate Change has stated that it is “very likely that [SCC] underestimates” the damages of CO_2.[53] Our current market system treats these costs as “externalities” that are free to the polluter, a situation that has been characterized as “the greatest market failure the world has ever seen.”[54] It seems likely that this situation will change in the future through the imposition of a carbon cap or carbon taxes, if the global community is to tackle the unacceptably high rate of CO_2 emissions.

In December 2014, a report[55] was released that indicated that 29 leading American companies (including Bank of America, Delta Air, Dow Chemical, Exxon Mobil, Google, Microsoft, and Walt Disney) have adopted an internal price for carbon emissions. These corporations have done this not because they are under any regulatory obligation to do so, but rather in anticipation of a carbon tax, to ensure that their business processes appropriately take the costs of carbon emissions into account. The adopted prices that have been disclosed range from $6-7/ton (Microsoft) to $60-80/ton (Exxon Mobil). In some cases, companies have simply implemented a shadow accounting system for carbon pricing; in others, companies actually tax themselves and use the proceeds to purchase carbon offsets.

The academic sector is also beginning to consider internal carbon pricing. Perhaps the most notable example is Cornell, where the president’s climate action acceleration working group has formally recommended implementing a carbon charge on utility bills in the $20-30/ton range.

Our campus could evaluate the feasibility of implementing an internal price on carbon, perhaps with a system similar to that proposed at Cornell. Doing so would provide a direct economic signal to all units producing emissions, and would help drive our campus toward carbon neutrality in advance of future regulatory burdens. For example, at present there is no cost associated with the CO_2 emissions from the combustion of coal and gas at Abbott Power Plant; as a result, the campus has no economic incentive to shift toward renewable energy sources (unless they happen to be less expensive). Having an internal price on carbon emissions would help to tip the balance in decision-making in favor of renewable energy, thereby helping to avoid future regulatory costs associated with emissions. The funds generated by an internal carbon price could be earmarked for projects that would reduce our greenhouse gas emissions and/or for the purchase of carbon offsets.

The decision of whether and how to adopt an internal price for carbon will be a complicated one. A detailed study by campus experts, drawing on expertise of corporate partners and other universities, could be conducted to determine what implementation would make the most sense for our campus.

---

52) http://www.epa.gov/climatechange/EPAactivities/economics/scc.html
53) http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm
54) Stern Review of the Economics of Climate Change, http://www.wwf.se/source.php/1169158/Stern%20Summary_of_Conclusions.pdf
55) https://www.cdp.net/CDPResults/global-price-on-carbon-report-2014.pdf

Conclusion

Too often, creative discussions about sustainability projects are quenched by the question “but how are you going to pay for that?” We need to allow topical experts across campus to focus on identifying solutions to the tough challenges involved in bringing our campus to carbon neutrality as soon as possible without ruling out potential solutions simply because no funding has been identified. We need to reframe the discussion to first identify the best and most cost-effective solutions, and then find ways to fund them. In many cases the solutions to sustainability challenges will also yield financial savings (even if long-term), but as a campus we must accept the fact that this will not always be the case. In order to serve as a sustainability role model for other institutions, to protect our climate, and indeed to protect our students’ futures, we must be willing to allocate resources for projects that improve our campus sustainability even if they do not provide financial returns.

Chapter 10. Curricular Education

The University of Illinois is committed to educating future leaders to address the most pressing issues facing society today. For almost 150 years, this campus has taught students about issues related to the environment and sustainability. In 2010, the Sustainability Education Task Force, with faculty from diverse disciplines, developed specific Sustainability Learning Outcomes for Illinois graduates. These six learning outcomes involve teaching students to consider sustainability in day-to-day life, to acquire sustainability knowledge and skills, and to embrace sustainability as a personal vision. (See Figure 8, next page).

With the formation of the Institute for Sustainability, Energy, and Environment (iSEE), we are now focused on creating opportunities for students to take a holistic, interdisciplinary perspective on sustainability and to directly apply their learning to address sustainability-related problems on campus, locally, nationally and globally. We also seek to provide opportunities for engaged and experiential learning through internships, and capstone and research projects that will prepare students for integrating sustainability in a professional context.

Curricular Objectives

We seek to complement the disciplinary educational experience of undergraduate and graduate students with opportunities for interdisciplinary learning about sustainability in a variety of ways. We have three overarching objectives for education within the classrooms:

Sustainability in Day-to-Day Life
1. Students will learn ways in which natural resources are used to produce what they consume, such as the food they eat, the water they drink, and the energy they use.
2. Students will understand ways in which their lifestyle and well-being are interconnected with those of diverse producers and consumers around the world, including impoverished communities.
Sustainability Knowledge and Skills
3. Students will learn core concepts of ecology and develop skills relevant to their chosen field to provide a basis for environmental sustainability.
4. Students will learn to think holistically about sustainability using perspectives across multiple disciplines.
Sustainability as Personal Vision
5. Students will understand relationships between global environmental and economic trends and their impact on diverse cultures and communities.
6. Students will develop an integrated vision for sustainability that embraces their personal lives, professions, local communities, and the world at large.

Figure 8: Six Sustainability Learning Outcomes

1. Offer an undergraduate minor in sustainability, starting with about 20 students in FY16, that will provide in-depth learning about the three dimensions of sustainability and enable students to make connections between the different disciplines to solve problems related to sustainability.
2. Provide opportunities for undergraduate students to obtain research and practical experience by participating in independent study projects on sustainability topics.
3. Add at least five new sustainability-focused courses by FY20.

Potential Strategies

1. Undergraduate Sustainability Minor

The School of Earth, Society, and Environment (SESE) in the College of Liberal Arts and Sciences has offered an undergraduate minor across disciplines, through the Environmental Fellows Program. Six campus departments are proposing to revise the Environmental Fellows Program into the Sustainability, Energy, and Environment Fellows Program (SEE FP), and to transfer the program from SESE to the Institute for Sustainability, Energy, and Environment (iSEE).

According to the proposal, the SEE FP will be a campuswide undergraduate minor to promote systems-level thinking about energy and sustainability and foster the development of an integrated view of the economy, society and the environment. It will provide selected students an opportunity to develop an integrated perspective on sustainable energy use and understand the feedbacks, trade-offs and barriers to achieving it and their implications for decision making. The coursework will enable students to make the connections between economics, business, environmental sciences, and technology and apply their learning to operationalize the concept of sustainability in their professional careers and day-to-day lives. The SEE FP will prepare students for pursuing careers in the corporate sector, non-profit organizations, government agencies and environmental advocacy groups.

Each SEE Fellow will take an individual program of study to satisfy the minor. A range of coursework options — spanning the humanities, natural sciences, and social sciences — can be taken to satisfy the introductory and advanced coursework requirements. The minor proposes to offer two new courses: a "Tools for Sustainability" course and an advanced capstone class.

2. Undergraduate Research and Practical Experiences

Five to 10 students will be selected each year for a 10-week summer program to conduct full-time research under the supervision of a faculty member to develop the scientific skills most important to success in a professional career (designing a research problem/experiments, problem-solving, interpreting results, communicating one's science to various audiences, working in a team). Students will conduct research on real-world problems related to sustainability at the campus level, in their communities or the national/global level. They will learn to apply various tools, such as life-cycle analysis, cost-benefit methods and impact analysis, to assess, evaluate and design sustainable approaches to meeting societal demands.

Many students aren't exposed to the broad and detailed aspects of practical implementation of sustainability principles through actual project implementation. There is a great desire by faculty and among our students to bring more meaningful experiences, exploration, and context to sustainability through using the campus as a living learning laboratory. Through a project and experiment-based learning approach, student teams will be able to address real problems facing the campus and work together to propose solutions.

3. Add New Sustainability-focused Courses

An inventory of sustainability courses and programs is available on iSEE website.[56] This inventory helps students identify courses by categories. If a student is looking for a sustainability course that fulfills a general education requirement, it can be found very easily through the inventory. The course inventory has identified more than 350 courses offered by 54 departments on campus. Additionally, iSEE will offer opportunities for developing new sustainability-focused courses or modifying existing courses by adding sustainability-related content and assignments. This will enable existing courses that are not categorized as sustainability-related to be augmented with sustainability-focused assignments, guest lecturers, or independent student projects and expand the course work offerings in the area of sustainability. Finally, iSEE has proposed a new course to begin in Fall 2015 entitled "Sustainability Experience" to provide course credit for students who are applying their disciplinary knowledge to tackle inherently interdisciplinary problems in campus sustainability. In this course, students will work with faculty, staff, and/or the Student Sustainability Committee to advance campus sustainability goals and the iCAP.

56) http://sustainability.illinois.edu/education/resources/student-resources-courses/

Chapter 11. Outreach

In addition to the learning opportunities in the classroom, Illinois is proud to offer a wide variety of co-curricular programs for students to get involved in the sustainability field. Our campus features numerous sustainability-related student organizations[57] and hundreds of opportunities to get engaged both on and off campus. To share historical information and ideas toward meeting our sustainability goals, details about projects, events, and programs are being collected on the iCAP Portal.[58] The information on the iCAP Portal is organized under 10 themes: Education, Energy, Funding, Land & Space, Outreach, Procurement & Waste, Reporting Progress, Research, Transportation, and Water.

The variety and breadth of existing sustainability programs can be overwhelming to someone new to campus and interested in getting involved. To address that, campus is working to coordinate and communicate the education and outreach opportunities through iSEE.

Outreach Objectives

The core component of co-curricular education and sustainability outreach is strong and effective communication; therefore these objectives center on communication. They are:

57) http://sustainability.illinois.edu/getting-involved
58) http://icap.sustainability.illinois.edu

1. Support and communicate about co-curricular student sustainability programs.
2. Strengthen and communicate about sustainability outreach programs. Specifically, at least half of the full-time campus staff will be participating in the Certified Green Office Program by FY20.
3. Organize and promote three major sustainability events on campus each year: Earth Week, Campus Sustainability Week, and the iSEE Congress.

Potential Strategies

1. Support Co-Curricular Student Sustainability Programs

Illinois is home to more than 20 sustainability student organizations focused on educating students about aspects of sustainability ranging from producing energy from algae, to sustainable design practices, to environmental activism. These student organizations meet on a regular basis under the umbrella of the Student Sustainability Leadership Council (SSLC). The SSLC is a place for student leaders to interact and collaborate, along with representatives from the Institute for Sustainability, Energy, and Environment, serving as a two-way conduit of information and concerns about campus sustainability issues. Students have a voice in the decisions being made about how our campus reduces its environmental footprint. Campus could broaden the impact of the SSLC by posting monthly meeting minutes online.

Students also directly contribute financially to the campus sustainability projects. The Student Sustainability Committee (SSC) is a student-led campus committee charged with the distribution of two student fees, totaling more than $1.1 million per year: the Sustainable Campus Environment Fee and the Cleaner Energy Technologies Fee. With the ultimate goal of making the University of Illinois at Urbana-Champaign a leader in campus sustainability, SSC solicits, reviews, and recommends funding projects that increase environmental stewardship, inspire change, and impact students. Campus will continue to support SSC's efforts, through employee time for faculty and staff advisers to SSC as well as administrative support as needed.

Additionally, the multitude of student groups offer events throughout the year, for their group members or wider audiences. These events are generally well-attended and they should be encouraged. Campus will continue to support these events, with administrative assistance from iSEE. iSEE staff also help with arranging rooms, communicating about upcoming events, and sharing success stories with campus administration.

2. Strengthen Sustainability Outreach Programs

Certified Green Office Program

The first iSEE initiative to engage the entire community in a campuswide commitment to sustainability is the Certified Green Office Program, launched in FY15. Through this program, offices make a pledge to reduce their use of resources and improve overall sustainability in their day-to-day practices. Small actions make a big difference when many take those small actions. In the first year of the program, 25 offices of various sizes signed up for the program. During FY16, the Certified Green Office Program will be focused on adding more campus units, with a target of 50% participation from full-time campus staff by FY20.

Existing Outreach Programs

There are various existing outreach programs that campus supports already. These include the local Urbana-Champaign Energy Star Challenge,[59] Champaign County Sustainability Network (CCNet),[60] the Sustainability Seminar Series,[61] and national competitions such as Campus Conservation Nationals[62] and RecycleMania.[63] Campus could work to increase awareness and participation in these programs through a

59) http://ucenergychallenge.com/
60) http://www.champaigncountynet.org/
61) http://www.istc.illinois.edu/about/sustainability_seminars.cfm
62) http://icap.sustainability.illinois.edu/project/campus-conservation-nationals-ccn
63) http://icap.sustainability.illinois.edu/project/recyclemania

staff person dedicated to being the face of campus sustainability outreach. This employee would be a part of iSEE and serve as the primary point of contact for anyone interested in working with campus to support a sustainability event.

Metropolitan Climate Action Plan

Additionally, campus could work with the local governments to establish a Metropolitan Climate Action Plan (MCAP). The MCAP would be a written document, perhaps in the form of an interagency agreement, aligning the sustainability and climate objectives of the local governments. These include at a minimum the University of Illinois at Urbana-Champaign, the City of Urbana, the City of Champaign, and the Champaign-Urbana Mass Transit District.

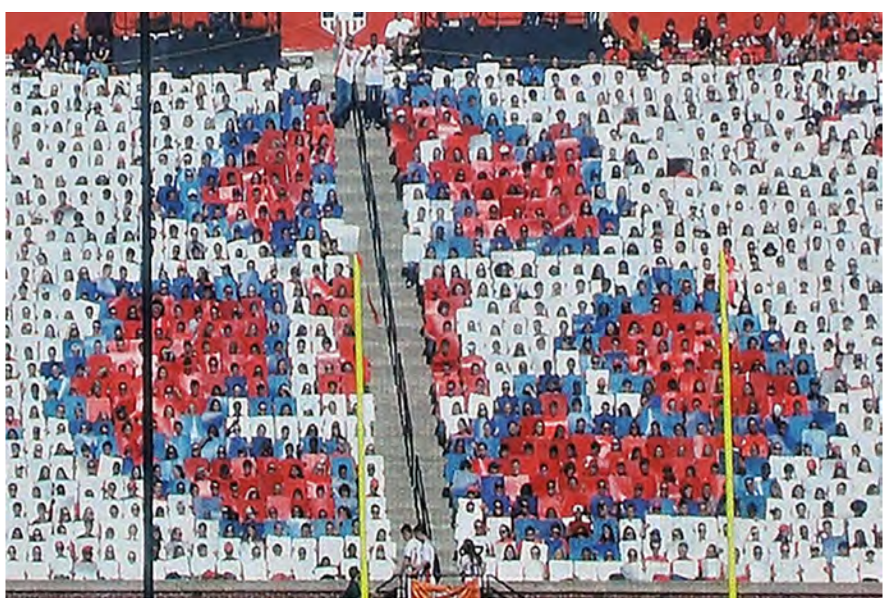
Guest Speaker Resource Base

As a recognized leader in sustainability, our campus gets numerous requests for guest speakers to visit off-campus sites and present on issues related to sustainability. Campus could establish a resource base of guest speakers, willing to present on sustainability-related topics. There could be a mechanism for identifying people to include in the guest speaker list and a database of prepared sustainability presentations to be shared or modified as needed. The outside agencies or groups could both review the list and submit a request for a speaker at their specific event.

3. Organize Three Major Sustainability Events Each Year

Earth Week

Earth Day — April 22, 2015 — marked the 45th anniversary of the environmental movement. Earth Day is the largest civic event in the world, celebrated simultaneously around the globe by people of all backgrounds, faiths and nationalities. More than a billion people participate in Earth Day campaigns every year.[64] On our campus, we typically celebrate the entire week. Earth Week is a time to enact change and real movement toward consciousness about how our decisions affect our campus environment and the planet. Earth Week activities are coordinated by Students for Environmental Concerns (SECS) and co-sponsored by iSEE. iSEE should continue to support Earth Day activities.



Campus Sustainability Week

National Campus Sustainability Day is celebrated each year in late October. Campus Sustainability Day is a time to recognize the success, challenges, and innovations of sustainability in higher education.[65] In collaboration with many partners, iSEE could host Sustainability Week in late October each

64) http://www.earthday.org/earth-day-history-movement
65) To learn more about Campus Sustainability Day visit http://campussustainabilityday.org/

year, to include activities to educate and encourage the campus and community to go green. The week would be a celebration of the University's sustainable successes, and provide educational motivation to make even more progress. Participants could visit the University's most sustainable sites, and watch intriguing presentations about environmental ideas.

iSEE Congress

In fall 2014, campus convened the first iSEE Congress to advance understanding of the state of science on the great challenges for agriculture in the coming decades. The Congress focused on providing a secure and safe supply of food, feed, and fuel to support an ever-increasing human population using agricultural practices that are ecologically sustainable and adaptable to climate change. The intent was to provide a forum to catalyze an agenda for actionable research on this issue that addresses technological, societal and policy solutions.

Each year, iSEE will convene a major Congress on a grand societal issue related to sustainability to catalyze actionable research, networking opportunities and disseminate state-of-the-art knowledge on ways to address this issue. This event will be coordinated with a major student- and campus-focused event, to promote excitement and mobilize action in all realms of the campus sustainability programs.

Chapter 12. Sustainability Research

As described in the introductory chapter, during the last few years, our campus underwent a "Visioning Excellence" exercise, followed by a "Stewarding Excellence" implementation phase. During the visioning portion, the challenges associated with energy, environment, and sustainability were identified as some of the most important challenges our society faces. In addition, participants in the process identified significant strengths on our campus to address this challenge. The Chancellor then made the area of energy, environment, and sustainability a major campus priority. To position Illinois as a world leader, emphasis has been placed on enhanced educational opportunities, faculty recruitment, and increased internal funding to further develop research in this area.

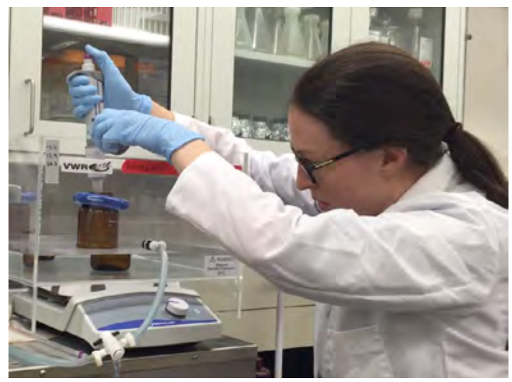
Existing Excellence in Research

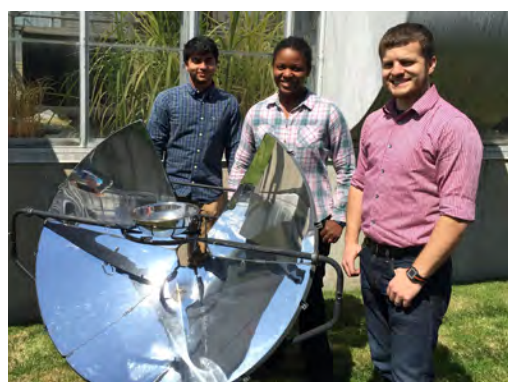
Research is central to the sustainability of the University and the region. Already a world leader in sustainability and climate research, Illinois is developing opportunities for researchers from diverse disciplines to come together to explore new frontiers in discovering solutions to the challenges ahead. Innovative research collaborations focused on creating knowledge and new technologies are being developed to discover, analyze, and implement new approaches for addressing sustainability and climate change challenges. At Illinois, hundreds of faculty and students are engaged in research related to energy, environment and sustainability. Approximately 350 faculty members from 83 different departments are engaged in sustainability research. An inventory completed in 2013 organized campus research expertise into the following categories:

- Bioenergy systems
- Materials for energy transport, generation, conversion, and storage
- Emission reduction and energy efficiency, including carbon sequestration
- Power grid and energy distribution
- Water resources sustainability and management
- Agriculture and food
- Environmental science
- Sustainable design
- Climate
- Social science and policy

Supporting and Enhancing our Research Excellence

Significant physical and programmatic infrastructure exists on campus to support current and future research by the faculty and scholars at Illinois. In addition to their home departments, researchers have access to state-of-the-art laboratories, centers, and institutes. Examples include the Beckman Institute for Advanced Science and Technology, the Carl R. Woese Institute for Genomic Biology, the Energy Biosciences Institute, and the Prairie Research Institute — which houses the Illinois Natural History Survey, the Illinois State Archaeological Survey, the Illinois State Geological Survey, the Illinois State Water Survey, and the Illinois Sustainable Technology Center. In addition, campus is home to the National Center for Supercomputing Applications, which features the National Petascale Computing Facility.





Research Objectives

Illinois intends to position itself as a world leader in the area of sustainability research. A direct result of the visioning excellence exercise was the development of the Institute for Sustainability, Energy and Environment (iSEE). The mission of the new Institute is to foster actionable, interdisciplinary research to address fundamental global challenges in sustainability, energy and environment; to provide national and international leadership in these areas through interdisciplinary education and outreach activities; and to develop and implement strategies for a sustainable environment on the University of Illinois campus and beyond. Three main iSEE objectives were identified to enhance Illinois' research portfolio in sustainability:

1. Create a hub for the sustainability community: to develop a comprehensive online gateway for faculty, staff, students, potential donors, and all interested parties to find information about sustainability research, education, outreach, initiatives, and operations.
2. Build connections: to bring together scholars from across campus to encourage collaboration, and to enhance research endeavors.
3. Foster "actionable" research: to encourage and support research that provides real-world solutions to

society's grand challenges in sustainability, energy and the environment. iSEE research themes are broken into five categories: Climate Solutions, Energy Transitions, Secure and Sustainable Agriculture, Sustainable Infrastructure, and Water and Land Stewardship.

Potential Strategies

1. iSEE Website

"One of the first recommendations that emerged from the visioning excellence exercise was the creation of an institute that would serve as a research and educational hub for environmental and sustainability initiatives for the entire campus community." Chancellor Phyllis Wise.[66]

To become the hub for sustainability, iSEE underwent a rebranding process to solidify its identity and create a strong, consistent image that will make iSEE a recognized world leader. The cornerstone of the new look is a revamped website intended to draw greater attention to the research, education, outreach, and campus sustainability work at Illinois. A cross-platform, more user-friendly interface encourages exploration and learning for potential donors, corporate partners, government entities, community members — and of course current and prospective faculty, students, staff, scholars, researchers, and administrators.

2. Scholars Program

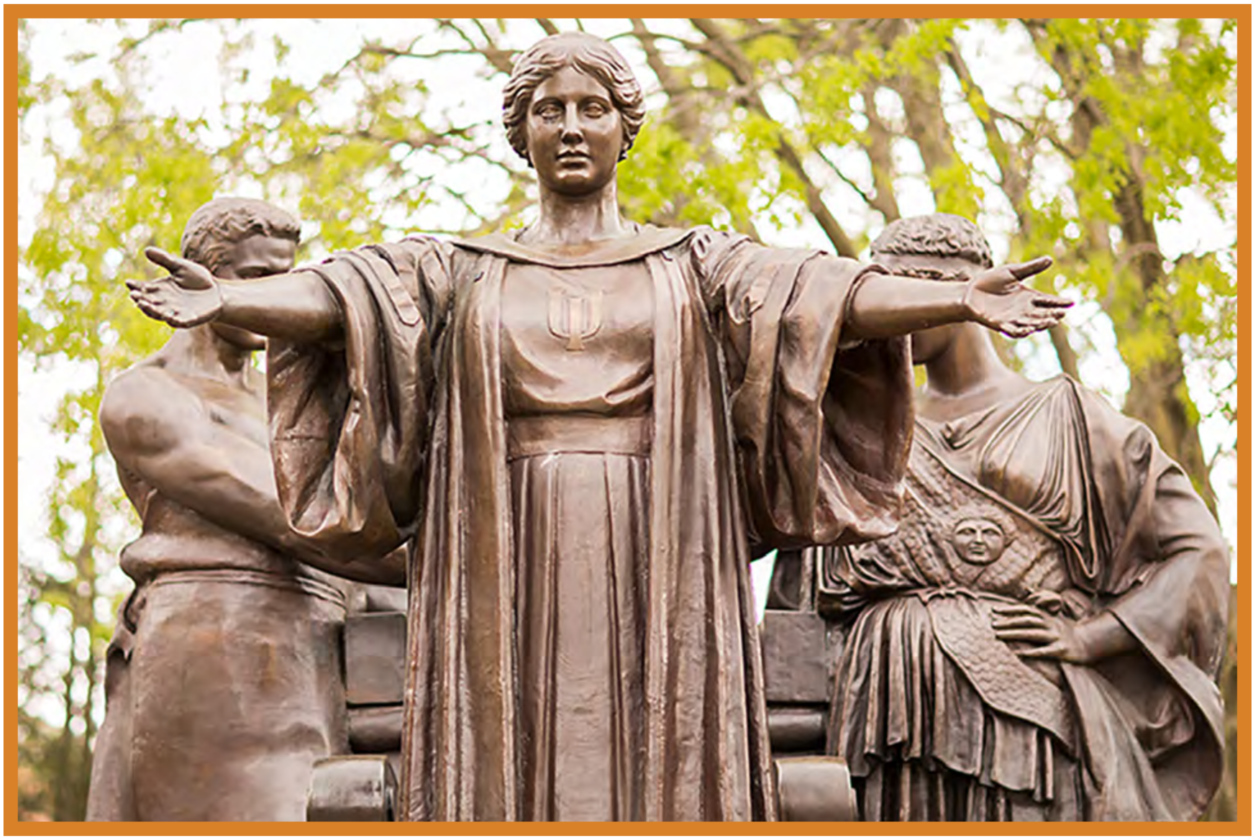
Officially established in December 2013, the Institute for Sustainability, Energy, and Environment (iSEE) "will create the organizational structure and paradigms that will draw together and further enable existing strength, coalesce our current [campus] resources, and address essential gaps in advancing discovery, learning, and engagement. The Institute will heighten our visibility and help Illinois achieve its goal of becoming a world leader in this global priority." Evan DeLucia (iSEE Annual Report 2014)[67]

The University of Illinois at Urbana-Champaign has hundreds of faculty already working on research that fits with iSEE's five major research themes. Because of the diversity of departments and variety of research facilities, however, many are unaware of the work their fellow faculty members are doing. The Scholars Program was developed to help build connections and to foster "uncommon dialogues" among colleagues. Already, iSEE has coalesced the water scholars from all corners of campus, fueling strong interdisciplinary connections within the water community. This group will also be able to market Illinois' great number of world-renowned scholars, major research centers and laboratories, and major research projects in one place — providing recognition for their innovative research and a gateway for future partnerships with industry, governmental departments and nongovernmental organizations (NGOs) who seek innovative solutions. iSEE has also started the process with campus energy scholars, and groups for climate and other themes will be explored.

3. Launch Thematic Research

The near-term strategic objective for research is to identify and develop five or six innovative, interdisciplinary research projects at Illinois in one or more of the iSEE's thematic areas to address fundamental challenges in sustainability, energy, and environment. One of iSEE's primary missions is to support "actionable research" — science that progresses toward solutions to grand world challenges that can have near-immediate and lasting impact. To achieve this, iSEE will deploy Illinois' world-renowned academic strengths and interdisciplinary collaboration under its five research themes. Research projects in three of these thematic areas — Water and Land Stewardship; Secure and Sustainable Agriculture, and Energy Transitions — were launched in 2014. More will be developed and funded in 2015.

66) http://icap.sustainability.illinois.edu/project-update/chancellor-blog-sustainability-illinois
67) http://issuu.com/sustainillinois/docs/annual-report-2014/1



Chapter 13. Conclusion

The preceding chapters have detailed a variety of changes that our campus can undertake to further our commitment to become carbon neutral as soon as possible, and no later than 2050. There is no doubt that meeting our commitment will be challenging, and indeed the challenge may be seen by some as overwhelming and even unattainable. However, we are convinced that our campus has both the intellectual capacity and the determination to rise to this challenge. Through the many efforts described in this document, ranging from finding solutions for clean campus energy to evaluating agricultural emissions, we expect that in the coming years the details of our pathway toward carbon neutrality will become more clear. In order to inspire these efforts, we present the following scenario that describes how carbon neutrality might be achieved, if funding allows. We wish to emphasize that this is not a specific recommendation or a prediction, but rather one vision for how many of the items discussed in this iCAP might come together to achieve carbon neutrality.

A Potential Scenario for Reaching Carbon Neutrality

Conservation: (Chapter 2)

The imposition of a firm cap on gross square footage prevents any additional growth in either electricity or heating demands. The improvement of building standards results in a decrease in demand as existing buildings are demolished and replaced by new buildings that are more energy efficient. Intensive conservation efforts, both centralized (e.g., retrocommissioning) and decentralized (e.g., behavior change campaigns), lead to even further reductions. Between these efforts, the campus heating and electricity demands linearly decrease from their current values (about 500,000 MWh/year each of electricity and heating) to half those values (250,000 MWh/year each) in 2050.

Transition from Fossil Fuels: (Chapter 3)

a) A district geothermal system similar to the one at Ball State University is installed in 2025, and a second phase of equal size is added in 2035. Each installation provides 80,000 MWh/year of thermal energy by using 20,000 MWh of electricity (with a coefficient of performance of 4). This system also provides the entirety of our chilled water needs as a by-product. Our resulting electricity demand (direct + geothermal) is 290,000 MWh/year.

b) Three biomass burners are installed at Abbott Power Plant (one each in 2030, 2040, and 2050) to cover the remaining 90,000 MWh of our 2050 heating needs, eliminating the use of fossil fuels to generate heat for our campus. This requires about 20,000 tons of biomass per year, which is less than half of the weight[68] of coal we currently burn, and would require about 2,000 acres of land devoted to miscanthus production, for example. Emissions from biomass burning are part of a closed loop with limited environmental impact.

c) On-campus photovoltaic generation, which is currently approximately 50 MWh/year, increases to 8,000 MWh/year in FY16 with the commissioning of a roughly 20-acre Solar Farm. The campus builds another Solar Farm every five years through 2050, with final generation of 64,000 MWh/year. The impacts of the land use (160 acres, or ¼ section) are minimized by combining agricultural production (partial-shade

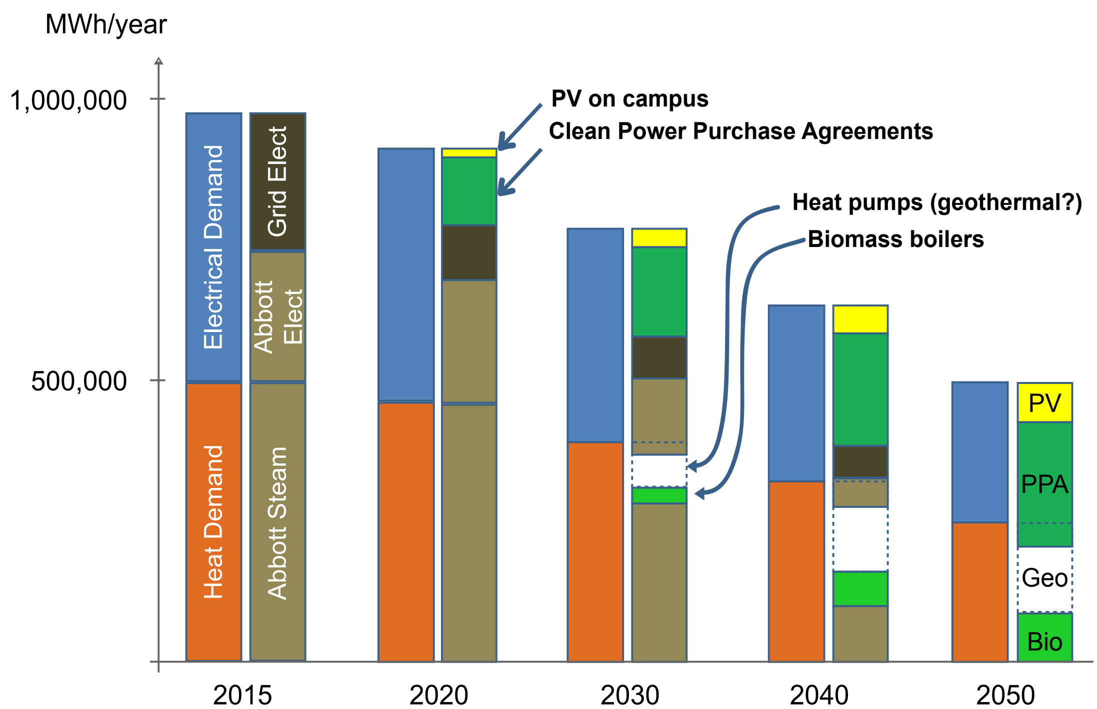


Figure 9: A Potential Scenario for the Evolution of Our Energy Demand (left bars) and Supply (right bars) toward 100% Clean Energy

68) The volume of biomass required depends greatly on the type of biomass: compressed wood pellets have a density of ~650 kg/m^3, wood chips are ~250 kg/m^3, baled Miscanthus ~140 kg/m^3, and chopped Miscanthus ~85 kg/m^3; in comparison bituminous coal has a density of ~800 kg/m^3. Thus, biomass with half the weight of coal we currently burn could translate to as much as 5 times the volume of coal we burn.

tolerant crops and/or pasture) with the solar arrays. An aggressive program to install photovoltaics on campus buildings leads to an additional 6,000 MWh/year of production, for a PV total of 70,000 MWh/year.

d) A power purchase agreement (PPA) with a wind farm supplies 100,000 MWh/year to campus, starting in FY16. The total amount of annual zero-carbon electricity purchased through PPAs increases 20,000 MWh/year in FY20 and every five years thereafter, up to 220,000 MWh/year in FY45.

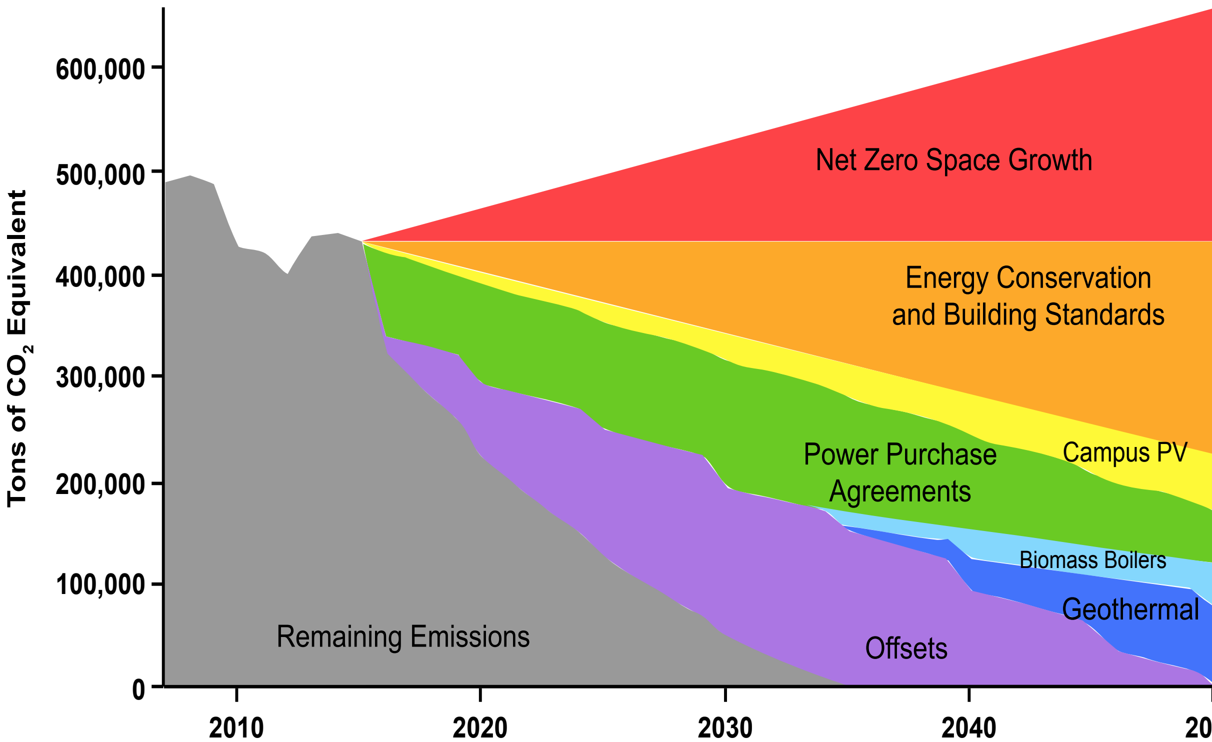


Figure 10: Wedge Diagram of Energy-related Emissions

Fleet Emissions: (Chapter 4)

An intensive program is undertaken to completely convert the campus fleet of service and rental vehicles to 100% biodiesel, compressed natural gas from an anaerobic digester, and other zero-emission alternatives with the result that our fleet emissions are reduced linearly to zero by FY25.

Agricultural Emissions: (Chapter 7)

A concerted effort is made to cut agricultural emissions from the South Farms in half by FY25 and reduce them to zero by FY50, while preserving the excellence of research in crop sciences and animal sciences.

A graphical representation of the resulting shift in energy demand and supply for this scenario is presented in Figure 9 (left). We wish to emphasize again that this scenario does not represent a recommendation or a prediction, but is simply to provide a sense of the types of efforts that will be required.

Figure 10 (above) shows a "wedge diagram," inspired by this potential scenario, of the resulting Scope 1 and 2 energy-related emissions as a function of time. This diagram also highlights how an aggressive program for purchasing carbon offsets (indicated in purple) could supplement the efforts in this scenario to achieve carbon neutrality even sooner than our current 2050 commitment.

As discussed earlier, Scope 3 emissions are not yet well quantified, and we do not foresee that it will be possible to completely eliminate these emissions. Consequently, we will have to rely on carbon offsets, preferably in the form of local, mission-linked offsets, in order to offset these emissions.

Reaffirming Our Commitment

With the approval of this 2015 Illinois Climate Action Plan, our campus recognizes the urgent need to dramatically reduce its greenhouse gas emissions in order to help mitigate the dangerous effects of climate change that are already becoming evident, and more generally to continually become better stewards of our environment. We reaffirm our commitment, as part of the American College & University Presidents' Climate Commitment, to become carbon neutral as soon as possible, and we look forward to the possibility of accelerating our climate efforts and setting a goal to attain carbon neutrality considerably sooner than 2050. In doing so, we aim to lay the groundwork for the continued excellence of the University of Illinois for the next 150 years and beyond.

Appendix A. Acronyms

ACUPCC	American College and University Presidents' Climate Commitment
ALUFS	Agriculture, Land Use, Food, and Sequestration (SWATeam)
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
CCC	Campus Carbon Calculator
CGO	Certified Green Office Program
CO_2	Carbon Dioxide
ECE	Electrical & Computer Engineering
ECIP	Energy Conservation Incentive Program
EPA	(U.S.) Environmental Protection Agency
EPC	Energy Performance Contracting
EPEAT	Electronic Product Environmental Assessment Tool
ESCO	Energy Services COmpany
EUI	Energy Use Intensity
F&S	Facilities & Services
FY	Fiscal Year; for the University of Illinois this runs July 1 to June 30, ending in the named year.
GHG	GreenHouse Gas
GSF	Gross Square Feet
HVAC	Heating, Ventilation, and Air Conditioning
iCAP	Illinois Climate Action Plan
iSEE	Institute for Sustainability, Energy, and Environment
IT	Information Technology
LED	Light Emitting Diode
LEED	Leadership in Energy & Environmental Design
MWh	MegaWatt-hour
MSW	Municipal Solid Waste
MTD	(Champaign-Urbana) Mass Transit District
NGO	NonGovernmental Organization
NPCF	National Petascale Computing Facility
NSF	National Science Foundation
OBFS	Office of Business and Financial Services
PM	Preventive Maintenance
PPA	Power Purchase Agreement
PV	PhotoVoltaic
RBB	Responsibility Based Budgeting
RCx	RetroCommissioning
REC	Renewable Energy Certificate
RLF	Revolving Loan Fund
SCC	Social Cost of Carbon
SEE FP	Sustainability, Energy, and Environment Fellows Program
SOV	Single Occupancy Vehicle
SSC	Student Sustainability Committee
SSLC	Student Sustainability Leadership Council
STARS	Sustainability, Tracking, Assessment, and Rating System
SWATeam	Sustainability Working Advisory Team
TEM	Travel and Expense Management

Appendix B. Contributors

2014-15 Sustainability Council

Phyllis Wise, Chancellor
Evan DeLucia, Director of the Institute for Sustainability, Energy, and Environment
Ilesanmi Adesida, Provost and Vice Chancellor for Academic Affairs
Peter Schiffer, Vice Chancellor for Research
Renee Romano, Vice Chancellor for Student Affairs
Dan Peterson, Vice Chancellor for Institutional Advancement
Allan Stratman, Executive Director of Facilities & Services
Robert Hauser, Dean of the College of Agricultural, Consumer, and Environmental Sciences
Andreas Cangellaris, Dean of the College of Engineering
Barbara Wilson, Dean of the College of Liberal Arts & Sciences
Tanya Gallagher, Dean of the College of Applied Health Sciences
Roy Campbell, Chair of the Senate Executive Committee
Mitch Dickey, President of the Illinois Student Senate
Amy Liu, Chair of the Student Sustainability Committee

2014-15 iCAP Working Group

Benjamin McCall, Associate Director for Campus Sustainability, representing iSEE
Morgan Johnston, Associate Director of Facilities & Services, representing F&S
Lowa Mwilambwe, Director of Illini Union, representing Student Affairs
Matthew Tomaszewski, Associate Provost for Capital Planning, representing the Office of the Provost
Nancy O'Brien, Chair of Committee on Campus Operations, representing the Academic Senate
Drew O'Bryan, Chair of the Student Sustainability Leadership Council
Kevin Duff, Assistant Director of Planning and Design, representing the Office of Business and Financial Services
Rob Fritz, Beckman Institute Director of Facilities, representing the community of college-level facility managers
Stephanie Lage, ex-officio, Assistant Director of iSEE

2014-15 SWATeam on Energy Conservation and Building Standards

Brian Deal, Associate Professor of Urban and Regional Planning
Scott Willenbrock, Professor of Physics
Fred Hahn, Associate Director of Engineering Services, F&S
Karl Helmink, Associate Director for Energy Conservation and Retrocommissioning, F&S
Claire McConnell, Student, Civil and Environmental Engineering
Dhara Patel, Student, Civil and Environmental Engineering
Claudia Szczepaniak, Student Clerk

2014-15 SWATeam on Energy Generation, Purchasing, and Distribution

Angus Rockett, Professor of Materials Science and Engineering
Scott Willenbrock, Professor of Physics
Mike Larson, Associate Director for Utility Production and Electricity Purchasing, F&S
Tim Mies, Deputy Operations Director, Energy Farm

Drew O'Bryan, Student, Physics and Earth, Society, and Environmental Sustainability
Nathan Wells, Student, Technical Systems Management
Benjamin Reeber, Student Clerk

2014-15 SWATeam on Transportation

Wojtek Chodzo-Zajko, Professor of Kinesiology and Community Health
Bumsoo Lee, Professor of Urban and Regional Planning
Richard Langlois, Senior e-Learning Professional, CITES
Peter Varney, Director of Transportation & Automotive Services, F&S
Garrett Fullerton, Student, Civil and Environmental Engineering
Grace Kyung, Student, Urban Planning
Justin Licke, Student, Engineering
Benjamin Cigelnik, Student Clerk

2014-15 SWATeam on Water and Stormwater

Mary Pat Mattson, Assistant Professor of Landscape Architecture
Lance Schideman, Assistant Professor of Agricultural and Biological Engineering
Keith Erickson, Associate Director for Utility Distribution, F&S
Kishore Rajagopalan, Associate Director for Applied Research, Illinois Sustainable Technology Center
Lance Langer, Student, Civil & Environmental Engineering
Amy Liu, Student, Urban Planning
Danielle Thayer, Student Clerk

2014-15 SWATeam on Purchasing, Waste, and Recycling

Dilip Chhajed, Professor of Business Administration
Warren Lavey, Adjunct Professor of Natural Resources and Environmental Sciences
Bart Bartels, Sustainability Outreach Specialist, Illinois Sustainable Technology Center
Janet Milbrandt, Director of Purchasing, Office of Business and Financial Services
Elizabeth Shancer, Student, Agricultural and Biological Engineering
Olivia Webb, Student, Bioengineering
Casey Kozak, Student Clerk

2014-15 SWATeam on Agriculture, Land Use, Food, and Sequestration

Bruce Branham, Professor of Crop Sciences
Neal Merchen, Associate Dean for Research, College of ACES
Dawn Aubrey, Associate Director of Housing and Dining Services, University Housing
Brett Stillwell, Architect, Capital Planning, F&S
Carol Strohbeck, Assistant Director of Dining Services, Equipment, and Facilities, University Housing
Alexandra He, Student, Law
Amanda Jacobs, Student, Earth, Society, and Environmental Sustainability
Zheyuan Gu, Student Clerk

iSEE Staff Contributors

Madhu Khanna, Associate Director for Education and Outreach
Tony Mancuso, Communications and Public Affairs Coordinator
Olivia Harris, Communications Assistant
Nishant Makhijani, Sustainability Engagement Specialist

Other Contributors

Many other members of the campus community, too numerous to list here, have made valuable comments and contributions to this document, and we are grateful for their efforts.

We especially thank Facilities & Services and the Office of Public Affairs for sharing some of the illustrative images for this document.

2015 iCAP

Illinois Climate Action Plan

University of Illinois at Urbana-Champaign