# 2013 CLIMATE ACTION PLAN UPDATE

## & ROADMAP 2014–2015

Cornell University

# ABOUT THIS DOCUMENT

The Climate Action Plan (CAP) and this 2013 update were developed by the Campus Sustainability Office in collaboration with the President's Sustainable Campus Committee (PSCC), co-chaired by Kyu Whang, Vice President of Facilities Services, and Tim Fahey, Liberty Hyde Bailey Professor, Department of Natural Resources, College of Agriculture and Life Sciences.

The first iteration of the Cornell University Climate Action Plan was released in September 2009, as part of the Cornell Sustainable Campus website. The original CAP was developed by Cornell faculty, staff, and students with funding from the New York State Energy Research and Development Authority (NYSERDA), and it has since served as a resource to many other institutions. The 2009 plan contains valuable documentation about the strategies and tools used to initiate Cornell's Climate Action Planning process, as well as detailed descriptions of the original 19 actions. The 2009 CAP and all subsequent updates are available online at climateaction.cornell.edu.

To ensure that the plan is responsive to changing technology and circumstances, the CAP is updated on a biennial basis. The first update was released in 2011. This document represents the second update, capturing progress made in 2012-2013, and presenting a roadmap for actions to be rolled out during 2014-2015.

The first half of this document, the **Climate Action Plan Update 2013**, lays out the overarching impetus for action, reviews progress to date, and presents Cornell's key long-term strategies to create a climate neutral campus and a sustainable future.

The second half, the **Roadmap 2014-2015**, presents an overview of the comprehensive actions Cornell will undertake during the next two years to meet our **Neutrality, Innovation,** and **Leadership (NIL)** goals. Detailed descriptions of each action, including **Goals, Next Steps,** and necessary **Resources,** are included in **Appendix 1.**

Production of this update is a reflection of Cornell's commitment to sustainability. Updates are accessible to all online at climateaction.cornell.edu and via limited printed copies on recycled paper. Photos, unless otherwise noted, are by Cornell University Photography.

**Cover Image:** Members of the Cornell community came together at Newman Arena for a zero-waste basketball game in support of the **Three Pillars** of our CAP: **Neutrality, Innovation,** and **Leadership,** or **NIL. NIL** represents our goal – a carbon neutral campus and a sustainable future.

Photo by Cory Pomerantz

Designed by Iron Design | www.irondesign.com

# TABLE OF CONTENTS


1 EXECUTIVE SUMMARY

5 CLIMATE ACTION PLAN UPDATE 2013

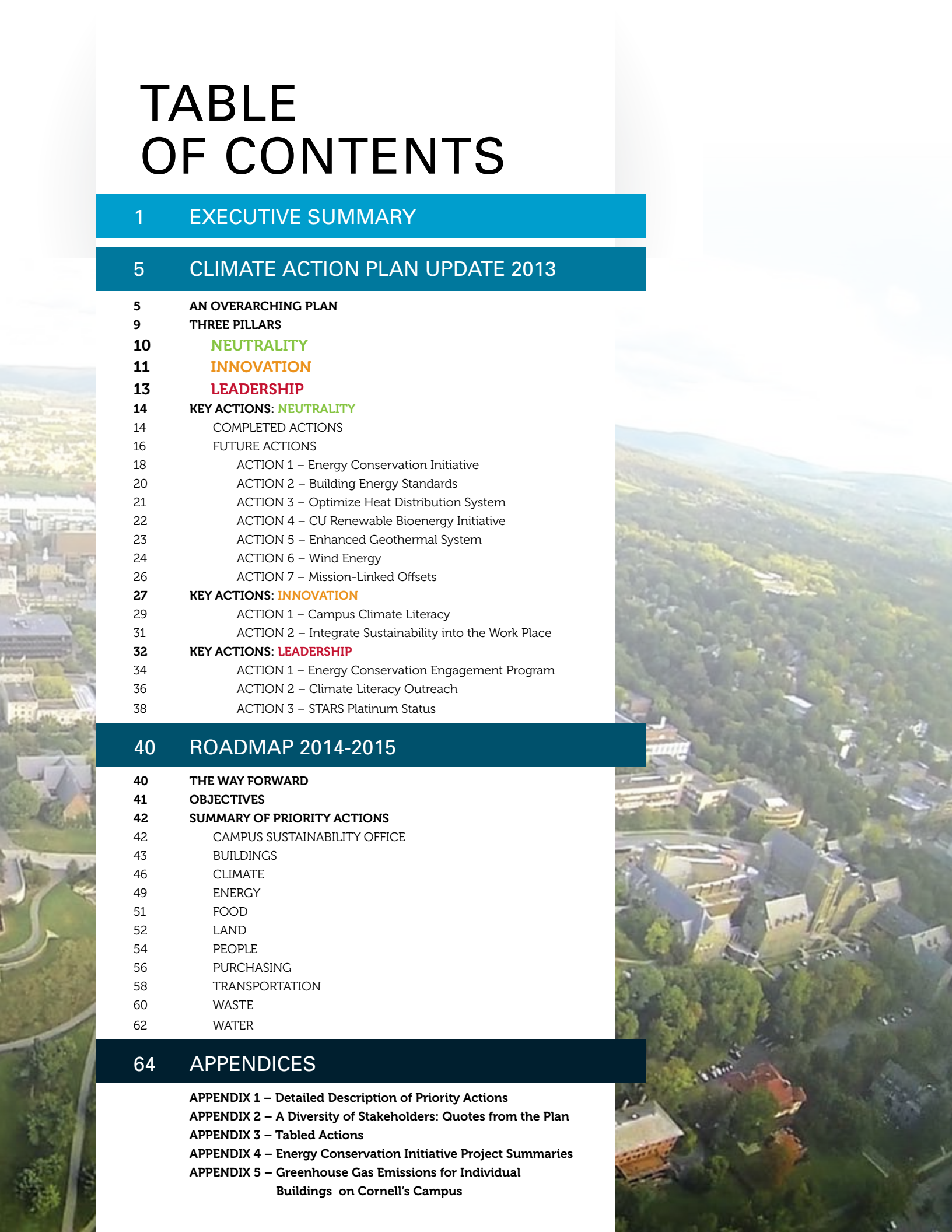
5 AN OVERARCHING PLAN
9 THREE PILLARS
10 NEUTRALITY
11 INNOVATION
13 LEADERSHIP
14 KEY ACTIONS: NEUTRALITY
14 COMPLETED ACTIONS
16 FUTURE ACTIONS
18 ACTION 1 – Energy Conservation Initiative
20 ACTION 2 – Building Energy Standards
21 ACTION 3 – Optimize Heat Distribution System
22 ACTION 4 – CU Renewable Bioenergy Initiative
23 ACTION 5 – Enhanced Geothermal System
24 ACTION 6 – Wind Energy
26 ACTION 7 – Mission-Linked Offsets
27 KEY ACTIONS: INNOVATION
29 ACTION 1 – Campus Climate Literacy
31 ACTION 2 – Integrate Sustainability into the Work Place
32 KEY ACTIONS: LEADERSHIP
34 ACTION 1 – Energy Conservation Engagement Program
36 ACTION 2 – Climate Literacy Outreach
38 ACTION 3 – STARS Platinum Status

40 ROADMAP 2014-2015

40 THE WAY FORWARD
41 OBJECTIVES
42 SUMMARY OF PRIORITY ACTIONS
42 CAMPUS SUSTAINABILITY OFFICE
43 BUILDINGS
46 CLIMATE
49 ENERGY
51 FOOD
52 LAND
54 PEOPLE
56 PURCHASING
58 TRANSPORTATION
60 WASTE
62 WATER

64 APPENDICES

APPENDIX 1 – Detailed Description of Priority Actions
APPENDIX 2 – A Diversity of Stakeholders: Quotes from the Plan
APPENDIX 3 – Tabled Actions
APPENDIX 4 – Energy Conservation Initiative Project Summaries
APPENDIX 5 – Greenhouse Gas Emissions for Individual Buildings on Cornell's Campus

# CLIMATE ACTION PLAN UPDATE 2013

In 2007, President Skorton signed the American College & University Presidents' Climate Commitment, setting Cornell University on a path to carbon neutrality by 2050. The pursuit of this goal has sparked the imagination of our staff, stimulated innovative solutions, and created a whole new dimension of educational opportunities for our students as they help to green our campus, waste less, and become better stewards of our resources.

**"Inequalities in society and climate change are the two biggest challenges we face in the world today."**

**– Cornell University President David J. Skorton, President's Sustainable Campus Committee Summit, November 6, 2013**

**The Climate Action Plan (CAP) is Cornell's overarching plan to move to a low carbon future.** The original CAP was developed in 2009 by Cornell faculty, students, and staff with funding from the state energy authority, NYSERDA. The plan was intended to enhance the university's core mission of education, research, and outreach, while cutting net carbon emissions to zero by 2050. Since 2008, we have initiated a total of 62 actions to green our campus and have reduced gross emissions by nearly 32%, and by nearly 50% since 1990. These collective actions are significant steps forward and have established Cornell as a national leader among universities that have committed to climate neutrality.

In February 2014, in response to a Faculty Senate resolution calling for accelerated action, President Skorton established a faculty/administrative working group to develop strategies to accelerate Cornell's progress toward carbon neutrality. *"I accept and endorse the Faculty Senate's recommendation that we seek a more aggressive reduction in the use of fossil fuels that could bring us to carbon neutrality by 2035. I say 'could' because it will require a set of decisions and changes in behavior and priorities throughout the campus to achieve this more aggressive goal,"* said Skorton in his response to the Faculty Senate. Skorton has asked the working group to report back to the campus by June 1, 2014, with specific recommendations for how to accelerate the CAP.

**"...Truth shall be taught for truth's sake."**

**– Andrew Dickson White, first President of Cornell University, 1866-1885**

The Cornell community is committed to work together to find effective solutions to reduce campus emissions, use energy more efficiently, and produce energy in new ways. We are working to reduce our transportation impacts, promote energy efficiency in campus buildings, integrate cleaner energy sources, and adopt higher performance standards for new construction. We're improving greenhouse gas data collection and management in our transportation, waste, food, water, and energy systems to provide a solid foundation for more effective policies. And we're promoting the growth of a smart energy grid that is more resilient, more efficient, and capable of incorporating more renewable energy.

As we work together to create a living laboratory for climate smart behaviors, education, and research, we are engaging the Cornell community in constructive conversations about how best to move forward. These conversations involve faculty across disciplines, students across colleges, staff across campus, and university leadership. For example, the new minor in Climate Change is available to every undergraduate at Cornell, 431 sustainability-related courses are offered in 74 departments across the university, and the "Think Big, Live Green" campaign has launched a building dashboard system for the community to visualize their energy use in real-time. What has kept Cornell at the forefront of the sustainability movement is our institution-wide commitment to focus our collective strengths in education, research, and public engagement toward one of humanity's greatest challenges – climate change.

Early successes were achieved through projects that yielded a return on capital investment. Current economic realities, including cheap natural gas and the absence of a price penalty for carbon emissions, mean that further significant progress will be more difficult and will require making key actions institutional priorities to benefit Cornell's academic mission and achieve carbon neutrality. For all projects described in this plan, specific funding and approvals are sought case by case, as resources become available and conditions are deemed favorable for implementation.

# NIL

All 62 CAP actions are designed to be consistent with these **THREE PILLARS**, or guiding principles:

**NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.**

**INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.**

**LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.**

While greenhouse gas reduction has been a critical focus from the inception of the CAP, this update recognizes the importance of Cornell's education, research, and public engagement activities—which are at the core of everything we do—and highlights those opportunities through the **Innovation** and **Leadership Pillars** of the plan.

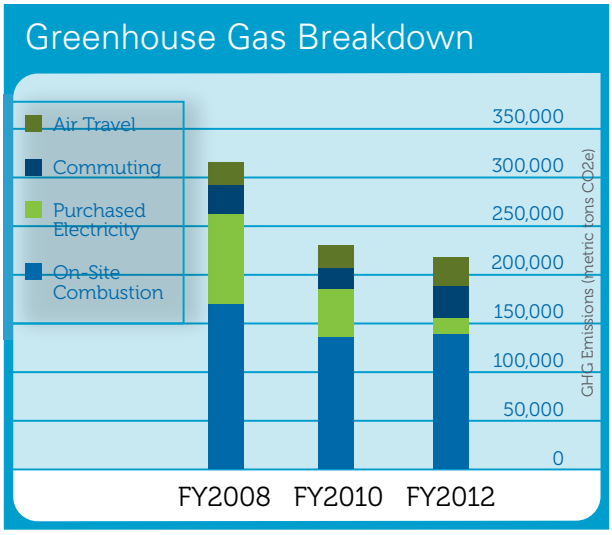
# KEY ACTIONS

## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

The following seven **Key Actions** were identified in the 2009 CAP as strategic components of Cornell's long-term carbon reduction plan. Implementing these seven actions, in combination with the other 18 Neutrality actions described in this plan (such as expansion of solar generation capacity), will enable Cornell to significantly reduce its greenhouse gas emissions and advance its carbon neutral goal. These **Neutrality Key Actions** are technically achievable, but currently unfunded:

1. Complete Phase 1 of the **Energy Conservation Initiative (ECI)** and initiate Phase 2 to conserve energy in campus buildings.
2. Integrate **Building Energy Standards** and energy modeling into the building design, review, and approval process in order to maximize energy efficiency.
3. **Optimize the campus Heat Distribution System** to increase efficiency and cost-effectiveness and to facilitate the integration of Cornell's future energy sources.

4. Capitalize on more than 50 campus waste streams and other university-owned biomass resources to generate renewable energy through **CURBI (Cornell University Renewable Bioenergy Initiative)**.
5. Eliminate the combustion of fossil fuel for campus heating by developing an **Enhanced Geothermal System (EGS)** hybridized with biogas. Prepare a preliminary design and phased implementation plan for a Hybrid Enhanced Geothermal System and build a demonstration project.
6. Support the expansion of regional wind generation capacity and integrate **wind power** into Cornell's renewable energy portfolio.
7. Implement broad-based, **mission-linked carbon management strategies** such as forest management, carbon capture and sequestration, and community projects to offset unavoidable university emissions.




The 2012 carbon footprint for the campus was 218,000 metric tons of CO2-e. Roughly 142,000 tons were attributable to On-Site Combustion, 17,000 tons to Purchased Electricity, and 59,000 tons to Commuting and Air Travel.

## INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

Building on the core mission of Cornell in education and research, the **Innovation Pillar** of our Climate Action Plan acknowledges that Cornell's ability to mitigate climate change involves engaging students, staff, and faculty in new ways, both on and off campus. **Key Actions** include:

1. Work to ensure that **climate literacy** and sustainability are part of the curriculum and educational experience at Cornell.
2. **Integrate sustainability** as an overarching principle into the performance management process.

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

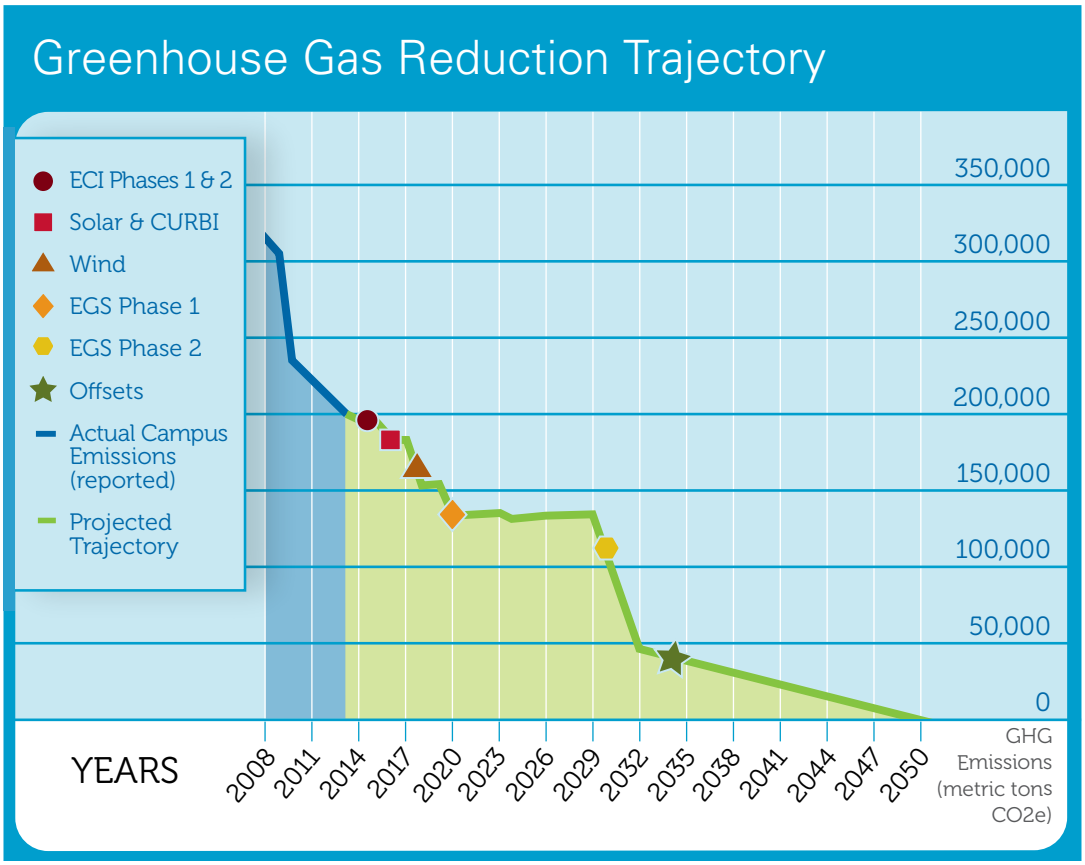
The **Leadership Pillar** of our CAP commits us to lead by example here on our Ithaca Campus, as well as to reach across disciplines, institutions, industries, sectors, and borders to effectively address climate change on a broader scale. **Key Actions** include:

1. Expand Cornell's **Energy Conservation Engagement Program** to achieve a 1% reduction in annual electrical energy usage and to educate the campus community, including thousands of future graduates, on the value of sustainable energy use.
2. Participate actively in **climate literacy outreach** to ensure that the broader community receives Cornell's assistance in making critical decisions for a sustainable future.
3. Identify realistic actions and responsible parties to lead the effort to increase Cornell's STARS® (Sustainability Tracking, Assessment, & Rating System™) rating to become one of **the first Platinum-rated STARS campuses** in the nation.

# ROADMAP 2014-2015

The **President's Sustainable Campus Committee (PSCC)** manages campus sustainability-related initiatives. Ten PSCC focus teams comprised of staff, students, and faculty from across the university develop program recommendations, assess progress, and help implement policy changes.

Cornell's **Climate Action Plan Roadmap 2014-2015** presents the comprehensive set of 62 "Priority Actions" endorsed by each of the ten PSCC focus teams: **Buildings, Climate, Energy, Food, Land, People, Purchasing, Transportation, Waste,** and **Water,** as well as one action being spearheaded by the **Campus Sustainability Office.** Actions are listed according to the focus team that is responsible for following up and tracking progress.




The scope of the roadmap is to identify specific actions each team can realistically undertake in the next two years. Action Managers are accountable for making progress on each action in the plan. Detailed descriptions of each action, including **Goals, Next Steps,** and necessary **Resources**, are included in **Appendix 1** of this document.

Each action in the roadmap is a part of the whole. Each is a piece of the solution which is needed to address the complexity of the challenges we face. There are no competing priorities; every action in this plan counts, from waste reduction to energy efficiency to campus climate literacy. For the purposes of this plan, we are all on the same team. Our scientists, engineers, economists, humanists, artists, communicators, investment strategists, trustees, deans, administrators, faculty, staff, and students are all part of the solution, and our success is imperative.

This plan is our collective vision of the way forward. Implementing the recommendations outlined here will send a clear message that climate change and decisions about how we make and use energy are critical priorities for Cornell University and for the current administration.

# AN OVERARCHING PLAN

Here's what the evidence is telling us: the climate of our planet is warming at an alarming rate and human activities are the cause. How to reverse this trend poses an immense challenge, and the imperative to change our course is here, now. The choice is clear: aggressive climate action (top–right) minimizes future warming, while business as usual (bottom–right) results in catastrophic levels of warming of 9°F over much of the U.S.

**"Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased."**

**– Working Group 1 Contribution to the Intergovernmental Panel on Climate Change Fifth Assessment Report**

Each of us has a responsibility to make near-term emissions reductions – every nation, every institution, every household. The costs of inaction get more and more expensive the longer we wait, and the longer we wait, the less likely we are to avoid the worst.

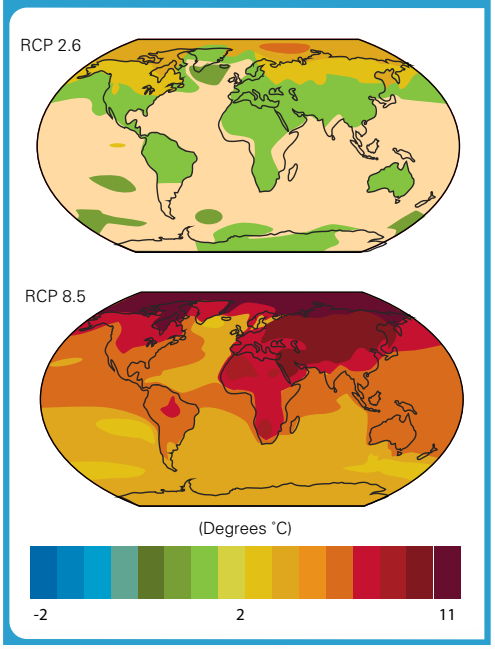
The U.S. has the highest per capita emissions among the world's big economies. At roughly 18 tons of carbon pollution per person per year, the average American emits four times the global average of 4.5 tons. While that's a sobering reality, it also means our nation can make a profound difference. The decisions we make today – right now – could determine the sustainability of our planet for generations to come.

As one of the world's leading universities, Cornell University has a pivotal role to play. We have a responsibility both to reduce our contribution to climate change and to generate solutions to address the mounting impacts on our planet. The eyes of the world are upon us.

**"We cannot solve climate change when we seek to spew more emissions. I express this with all due sincerity."**

**– Naderev "Yeb" Saño, Philippine Climate Change Commissioner, in the wake of Super Typhoon Haiyan**

Change in Average Surface Tempurature (1986-2005 to 2081-2100)




"Scenarios RCP2.6 and RCP8.5 in 2081–2100 of annual mean surface temperature change… Most of the CMIP5 and Earth System Model simulations were performed with prescribed CO2 concentrations reaching 421 ppm (RCP2.6), 538 ppm (RCP4.5), 670 ppm (RCP6.0), and 936 ppm (RCP 8.5) by the year 2100." Quote (on the left above), image, and caption from Working Group 1 Contribution to the IPCC Fifth Assessment Report, Climate Change 2013: The Physical Science Basis, "Summary for Policymakers," pages 3 & 34, (http://climatechange2013.org/).

Photo by NASA

**Cornell is a leading research institution committed to climate action, and our students are pushing us to do better."**

– Susan H. Murphy, Vice President for Student and Academic Services

In 2007, President Skorton changed the course of this institution by adding his signature to the American College & University Presidents' Climate Commitment (ACUPCC), setting the Ithaca campus on a path to carbon neutrality by 2050. The pursuit of this goal has sparked the imagination of our staff, stimulated innovative solutions, and created a whole new dimension of educational opportunities for our students as they help to green our campus, waste less, and become better stewards of our resources. Cornell, like most institutions, faces extreme challenges as we seek to make the transition to renewable energy, given our current dependence on fossil fuels. Yet we see great potential for success, given the sense of commitment and creative spirit of the Cornell community.

**When President Skorton signed the American College & University Presidents' Climate Commitment … we didn't know how Cornell would become climate neutral by 2050, but we knew we would figure it out. And that's exactly what we're doing."**

– Robert R. Bland, Senior Director, Energy and Sustainability Department

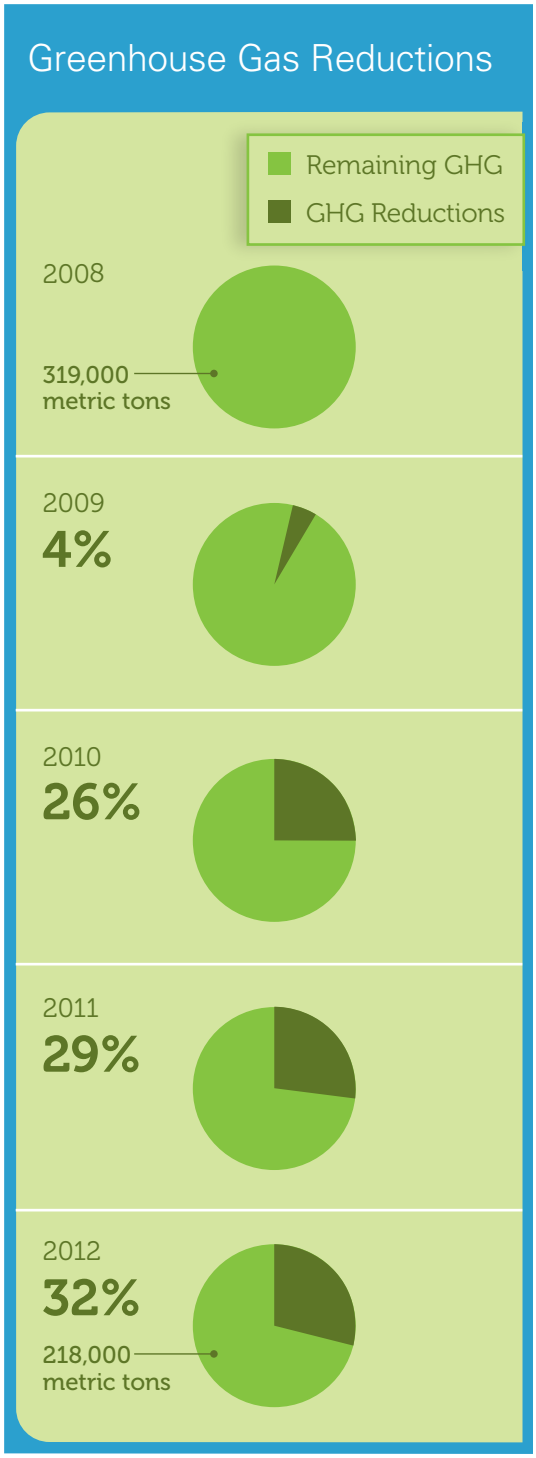
**The Climate Action Plan (CAP) is Cornell's overarching plan to move to a low–carbon future.** Working together, we're making progress – starting right here on the Ithaca campus. We have initiated a total of 62 actions to green our campus and reduced gross emissions by nearly 32% since 2008, and by nearly 50% since 1990. These collective actions are significant steps forward and have established Cornell as a national leader among universities that have committed to carbon neutrality.

**Leading academic institutions like Cornell must serve as role models for broader society to demonstrate how individual, collective, and concerted actions can successfully solve the climate change problem."**

– Timothy James Fahey, Professor, Natural Resources, College of Agriculture and Life Sciences

**Cornell is continuing to chip away at our carbon footprint by sticking to the course outlined in our Climate Action Plan. Our staff knows that they are part of this effort, which makes the small actions they take on a personal level feel bigger."**

– Mary George Opperman, Vice President for Human Resources and Safety Services



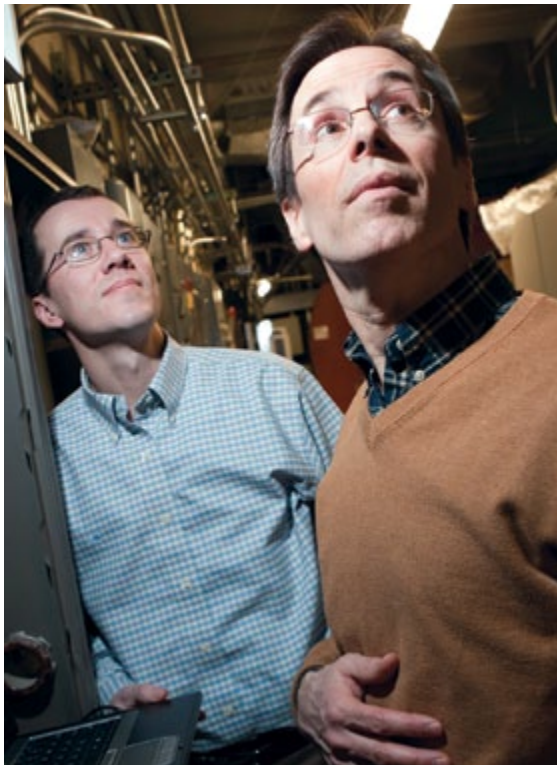

These charts show the substantial progress Cornell has made to reduce its greenhouse gas emissions over the past five years. The university's greenhouse gas emissions in 2008—the baseline year in which Cornell made its commitment—were estimated at 319,000 metric tons of CO2 equivalent (shown in light green above). From 2008 to 2012, we have reduced the carbon footprint of the Ithaca Campus by nearly 101,000 tons, leaving roughly 218,000 tons per year remaining to be addressed by future CAP actions.

The Cornell community is committed to working together to reduce carbon pollution, use energy more efficiently, and produce energy in new ways. We are working to reduce our transportation impacts, promote energy efficiency in campus buildings, integrate cleaner energy sources, and adopt higher performance standards for new construction. We're improving greenhouse gas data collection and management in our transportation, waste, food, water, and energy systems. This data will provide a solid foundation for more effective policies. And we're promoting the growth of a smart energy grid that is more resilient, more efficient, and capable of incorporating more renewable energy.

**"At Cornell we try to make the best decisions for the future of our campus, our community, and our planet – because this is the right thing to do."**
**– KyuJung Whang, Vice President for Facilities Services**

The **President's Sustainable Campus Committee** (http://www.sustainable-campus.cornell.edu/initiatives/president-s-sustainable-campus-committee) (PSCC) manages campus sustainability-related initiatives across ten focus areas, including: energy, climate, water, food, waste, buildings, people, land, purchasing, and transportation. Ten PSCC focus teams comprised of staff, students, and faculty from across the university develop program recommendations, assess progress, and help implement policy changes in each of these critical areas.

Oversight of the Climate Action Plan occurs at multiple levels, starting with the CAP Action Managers and including the PSCC Focus Teams, PSCC Executive and Advisory Committees, senior leadership at the university (both academic and non-academic), the University President, and the Board of Trustees.



Mark Howe, Program Manager for the Energy Conservation Initiative, left, and Lanny Joyce, Director of Energy Management in Cornell's Department of Energy & Sustainability, right, examine the Cornell Store's recently updated HVAC system.

| | |
|---|---|
| **CAP Action Managers** | Implementation of individual CAP actions. |
| **PSCC Focus Teams** | General oversight of CAP actions in their respective Focus Area; facilitation of CAP updates and campus-wide CAP action planning. |
| **PSCC Executive Committee** | Advocacy and strategic oversight of the CAP, including CAP updates and implementation, and GHG emissions inventories. |
| **PSCC Advisory Committee** | Development and advancement of policy recommendations. |
| **Campus Sustainability Office** | Coordination and management of the CAP update process and communication of the CAP to internal and external audiences. |
| **Deans & Department Heads** | Awareness and support of CAP actions that fall under their areas of responsibility; promotion of CAP actions. |
| **Senior Staff** | Establishment of capital planning, funding, and priorities for CAP actions and review and approval of CAP policies. |
| **President of the University** | Review, endorsement, and promotion of the CAP to both internal and external audiences. |
| **Board of Trustees** | Fiduciary oversight of the climate neutrality commitment and institutional decision making with regard to environmental, community, and financial impacts. |

Several of the actions in the plan arose from conversations within the ten focus teams, starting with those who said, "Let's just start small and begin with what we have at hand." The Land Team's green infrastructure research and interpretation action, the Food Team's "Beyond Ramen" food literacy program, and the Water Team's green events planning efforts are recent examples of grassroots initiatives to make our campus more sustainable. Detailed descriptions of all of the focus team actions are included in **Appendix 1** of this document.

In the process of preparing the **Cornell Climate Action Plan Update 2013 & Roadmap 2014-2015**, many campus leaders – faculty, staff, students, and alumni – were asked to provide input on the direction and focus of our CAP. The words of some of these individuals are included in the plan to provide a glimpse into the diversity of stakeholders who stand behind Cornell's climate action commitment. See **Appendix 2 – A Diversity of Stakeholders** for the full text of the quotes excerpted in this plan. Beyond the individuals who are quoted are many, many more Cornellians who care deeply about this plan and ensuring its success.

Putting Cornell on a path to a clean energy future will create untold opportunities for our young people because it will unleash the very best of their entrepreneurial spirit and creativity. The global energy market is currently valued at $6 trillion, with four billion users worldwide. In 40 years, the number of users will more than double to encompass nine billion people. And the fastest growing segment of this market is clean and renewable energy. If Cornell can serve as an incubator for renewable energy solutions, we can help to secure our young people's place in the energy economy of the future.

Revolutionizing the way we use and produce energy can be a "win–win–win" – a win for Cornell, a win for our young people, and a win for the planet. The eyes of the world are upon us: let us move boldly forward toward carbon neutrality. The eyes of our children are upon us: let us innovate and lead.

**"The world must become carbon neutral by 2050, and if Cornell cannot achieve that status sooner, then we are not doing enough... We should be targeting carbon neutrality by 2030."**
**– Charles H. Greene, Professor, Earth & Atmospheric Sciences, and Director, Ocean Resources and Ecosystems Program**

**"From President Skorton to Cornell's faculty, staff, and students, we share a passionate commitment to having the major portion of our energy come from renewable resources and utilizing them in the most efficient manner possible."**
**– Jefferson W. Tester, Croll Professor of Sustainable Energy Systems and Director of Cornell Energy Institute**
**http://energyinstitute.engineering.cornell.edu/energyinstitute**

**"It is imperative that Cornell continue to work across campuses, sectors, and continents to meet the needs of society. Our Climate Action Plan builds on the progress we've already made and prepares us to do what the future demands: strive for carbon neutrality, innovate, and lead the way to a cleaner, safer, more stable world."**
**– Cornell University President David J. Skorton**

# THREE PILLARS

## Cornell's Climate Action Plan (CAP) creates a framework for understanding, protecting, and preserving our climate through research, education, and public engagement.

The CAP is more than simply a "carbon" action plan. ***The American College & University Presidents' Climate Commitment*** states that all signatories will: **"***Within two years of signing this document, develop an institutional action plan for becoming climate neutral, which will include:*

1. *A target date for achieving climate neutrality as soon as possible.*
2. *Interim targets for goals and actions that will lead to climate neutrality.*
3. *Actions to make climate neutrality and sustainability a part of the curriculum and other educational experience for all students.*
4. *Actions to expand research or other efforts necessary to achieve climate neutrality.*
5. *Mechanisms for tracking progress on goals and actions.***"**

The **Cornell Climate Action Plan Update 2013 & Roadmap 2014-2015** incorporates Cornell's strategies for advancing our carbon neutrality goal and integrating sustainability into students' educational experience, as well as strategies to create, test, and deploy innovative solutions to preserve our climate for future generations.

> **"Because of Ezra Cornell's foresight to create an institution where any student can find instruction in any study, Cornell is uniquely qualified to be the international leader in developing solutions to climate change and sustainability."**
>
> **– Dan Miller, Managing Director, The Roda Group, College of Engineering class of 1978**

While greenhouse gas reduction has been a critical focus from the inception of the CAP, this update recognizes the importance of Cornell's education, research, and public engagement activities – which are at the core of everything we do – and highlights those opportunities more prominently through the **Innovation** and **Leadership Pillars** of the plan.

**While we work to reduce the carbon footprint of our campus, we also need to educate the next generation of thought leaders and find research-based solutions to global climate challenges.** These efforts are mutually beneficial and critically important. Making climate neutrality a part of the Cornell curriculum and a focus of Cornell research advances the mission of the university and is fundamental to the long-term success of our CAP. Our intent is to expand the breadth and depth of CAP actions which focus on education, research, and public engagement over time.

**All of the CAP actions are designed to be consistent with these THREE PILLARS, or guiding principles:**

**NEUTRALITY:** Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

**INNOVATION:** Create a living laboratory for low-impact behaviors, climate education, and research.

**LEADERSHIP:** Lead by example on campus and exercise climate leadership beyond campus.

> **"What's really important… is that we develop forms of adaptation but never allow these to take focus away from long term changes that might lead to solutions. All students must become better educated and must mobilize – it's crucial."**
>
> **– Karen Pinkus, Professor, Italian and Comparative Literature and Faculty Fellow with the Atkinson Center for a Sustainable Future**

## Neutrality Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

The CAP positions Cornell on a path to neutrality through a four-tiered approach combining: **1)** avoidance of future energy use, **2)** reduction of carbon pollution, **3)** replacement of high-carbon fuels with low or zero-carbon sources, and **4)** offsetting of unavoidable emissions.

**1. AVOID** carbon–intensive activities.

**2. REDUCE** by doing what you do more efficiently.

**3.REPLACE** high-carbon energy sources with low-carbon energy sources.

**4. OFFSET** those emissions that cannot be eliminated by the above.

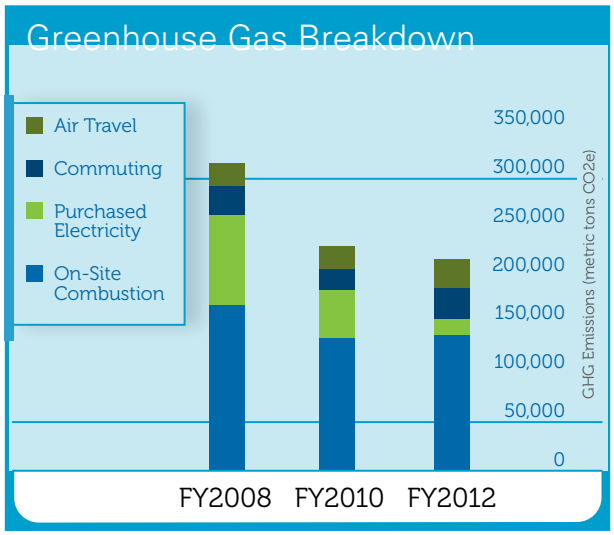
Cornell's 2008, 2010, and 2012 greenhouse gas (GHG) inventories as reported to the American College and University Presidents Climate Commitment are posted on the ACUPCC website at http://rs.acupcc.org. For consistency in reporting, annual emissions are reported in the following three categories:

**Scope 1 – On-Site Combustion:** Direct and fugitive emissions including on-site electrical, heating, and cooling generation, as well as fleet vehicle fuel use.

**Scope 2 – Purchased Electricity:** Indirect emissions occurring as a result of purchased electricity.

**Scope 3 – Commuting and Air Travel:** Indirect emissions occurring as a consequence of commuting and university-sponsored air travel. For more information refer to the **World Resource Institute GHG Protocol** (http://www.wri.org/project/ghg-protocol).

Since the 2009 CAP was released, Cornell has reduced GHG emissions by nearly 101,000 metric tons, an improvement of roughly 32%. This improvement is due to many factors, most significantly the high level of performance of the Cornell Combined Heat and Power Plant and a decision to eliminate all coal combustion at the University. The 2009 CAP assumed that coal would not be phased out until about 2030, when retirement of the existing coal boilers was planned. Cornell's "Beyond Coal" action serves as an indicator of the strength of our commitment to the carbon neutrality goal. See pages 17–18 of this report for details about these Completed Actions.




The 2012 carbon footprint for the campus was 218,000 metric tons of CO2-e. Roughly 142,000 tons were attributable to On-Site Combustion, 17,000 tons to Purchased Electricity, and 59,000 tons to Commuting and Air Travel.

## Way Beyond the Baseline: A Historical Perspective

By Lanny Joyce, Cornell University Director of Energy Management

In 2001, Cornell students concerned about global climate change and the U.S. refusal to adopt the Kyoto Treaty asked the university administration to adopt the Kyoto carbon reduction goal – as if Cornell were the U.S. government. At the time, we had no idea what our carbon emissions were, nor did we have any idea what might be needed to reach such a goal. Undeterred, members of the KyotoNOW! student group chose Earth Day 2001 to formally protest, chain themselves to the trees surrounding Day Hall and to furnishings inside the building, and declare that they would not leave until the administration adopted the Kyoto target.

Students rally outside Day Hall in 2001 for adoption of the Kyoto Protocol.

Cornell's Utilities and Energy Management staff quickly created a carbon inventory at the request of Senior Vice President Hal Craft, and debated the likelihood that Cornell could adopt such a goal and actually achieve it. After intense discussion, SVP Craft drafted a letter to the students which committed the university to "striving toward a Kyoto compliance goal." This commitment made national news and put the Cornell students at the head of a national movement in higher education to get colleges and universities to strive toward carbon reduction.

Adoption of the Kyoto target meant that Cornell needed to reduce 1990 baseline emissions from the Central Energy Plant fuel combustion and electricity purchases by 7% by the year 2012. SVP Craft asked Lanny Joyce to lead this effort as the new Manager of Engineering, Planning, and Energy Management in the new department of Utilities and Energy Management. Craft's letter also stipulated that the university administration would maintain an open and transparent relationship with students. The Kyoto Task Team was created in 2001, consisting of students, staff, and faculty who met every other week to evaluate progress.

Recent photo of student members of KyotoNow!

Cornell's Energy Conservation Initiative was launched that same year, with capital provided for energy studies and projects, as well as funding to create a team of controls technicians charged with re-commissioning and continuous commissioning of energy control systems in campus buildings. Capital spending for conservation studies and projects totaled $10 million through 2008, and the Energy Conservation Controls Team grew from one technician to ten. Savings from the initial program totaled over $1 million per year in fuel and electricity costs.

The Cornell Combined Heat and Power project was completed in December 2009 with "first fire and commercial operation" of the new combustion turbine/heat recovery steam generators that transformed electricity and heat generation. The project was designed to reduce total campus carbon emissions by over 20%, providing half of annual heating needs from "waste energy." Total electricity generation by Cornell, including combustion turbines, steam turbines, and hydro turbines, was expected to meet 85% of campus needs. At the completion of the project in January of 2010, President Skorton announced Cornell's "Beyond Coal" initiative, committing Cornell to cease burning coal before the 2011 winter heating season. The university burned its last coal in spring 2011, and the 2011/2012 fiscal year was Cornell's first "all gas" year.

## Innovation Create a living laboratory for low-impact behaviors, climate education, and research.

Cornell is an institution dedicated to excellence in education and research with a public purpose. How we will achieve carbon neutrality, find better ways to produce and use energy, and sustain a hospitable climate are problems that Cornell's faculty, staff, and students can help solve, day by day and year by year. Our ability to innovate is key: without innovation in education and research we cannot achieve our goals.

The CAP commits us to model low-impact behaviors, educate future leaders, and seek out new solutions. Cornell's Ithaca Campus can and should serve as an incubator for solutions – as a showcase for climate education and research and a living laboratory for our local, regional, national, and international community.

Sustainability is now the overarching principle of Cornell's **Skills for Success** (https://www.hr.cornell.edu/life/career/skills_for_success.pdf). Sustainability is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." The goal of the new principle is to foster work places in which university employees act in ways that have a positive impact on their environment in terms of people, the planet, and resources. Over the next few years, as part of their performance review process, Cornell employees will be asked to consider how sustainability factors into their work. These changes will help to ensure that individually and collectively our employees make a difference on campus, in our communities, and beyond.

**"As an active member of KyotoNOW! and the Kyoto Task Team, … I am thrilled to see that Cornell has continued conserving energy, has stopped using coal, and is now building a large-scale solar installation."**
**– Abigail Krich, President of Boreas Renewables LLC, College of Engineering and College of Agriculture and Life Sciences class of 2004, and MEng, College of Engineering, 2006**

K.C. Alvey (CALS 2011) participating in the Keystone XL protests in Washington D.C. in September 2011.

Today, the Central Energy Plant makes enough electricity on an annual basis to meet nearly 100% of our needs, but due to summer/winter heating load changes, we buy some electricity in summer and export some electricity in winter. Together, the Energy Conservation Initiative, Combined Heat and Power, and Beyond Coal actions have reduced carbon emissions from the Central Energy Plant fuel combustion and electricity purchases to ~140,000 tons in FY12 and FY13. This is less than 50% of the 1990 "Kyoto baseline emissions" reported in our annual **Energy Fast Facts** (http://energyandsustainability.fs.cornell.edu/em//fastfacts/default.cfm), way beyond the 7% reduction required by the Kyoto Protocol.

**"A change in culture at Cornell brought about by an overriding theme of sustainability in all performance reviews could potentially impact every emission source."**
**– Michael P. Hoffmann, Director of the Cornell University Agricultural Experiment Station and Associate Dean, College of Agriculture and Life Sciences**

As we work together to create a living laboratory for climate smart behaviors, education, and research, we are engaging the Cornell community in constructive conversations about how best to move forward. These conversations involve faculty across disciplines, students across colleges, staff across campus, and academic and administrative leadership. For example, the new minor in Climate Change is available to every undergraduate at Cornell, 431 sustainability-related courses are offered in 74 departments across the university (see sidebar: Cornell Sustainability Curricula), and the "Think Big, Live Green" campaign has launched a building dashboard system for the community to visualize energy use in real-time. Campus sustainability initiatives are now being highlighted in the tours offered to prospective students and their families, and the Cornell home page has been updated to include a link to a **Sustainability bridge page** to connect visitors to Cornell's sustainability-related education, research, and outreach efforts both on campus and beyond (http://www.cornell.edu/sustainability/).

**"By establishing institutional goals to reduce Cornell's energy consumption and greenhouse gas footprint, we have inspired our faculty, staff, and students to work together to conduct research and develop cost-effective, innovative solutions."**

**– W. Kent Fuchs, Provost**

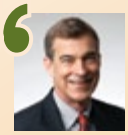
What keeps Cornell at the forefront of the sustainability movement is our institution-wide commitment to focus our collective strengths in education and research toward one of humanity's greatest challenges – climate change.

**"Sometimes we forget that we're going to class to better ourselves and to better the world at large. We think about our own futures, rather than our planet's future… Sustainability helps to bridge the gap: to prepare for the future, we must think about what we do today."**

**– Claire Siegrist, STARS Sustainability Intern, Campus Sustainability Office, College of Agriculture and Life Sciences, 2015**

The LEED Gold-Certified Nevin Welcome Center at Cornell Plantations.

A preliminary analysis conducted by STARS Sustainability Intern Claire Siegrist estimates that from October 2010-October 2013, Cornell has received over $154M in grant funding to support climate and sustainability related research and projects. This figure comprises roughly 6.8% of Cornell's total grant dollars during this time period. We anticipate that this revenue stream will continue to increase as Cornell's scientists and engineers work to develop new technologies, understand and balance Earth's integrated human and natural systems, and catalyze human behavior to preserve a favorable climate for future generations. Financing the actions laid out in our CAP is a significant challenge, and our success may hinge on our ability to identify new funding sources, utilize innovative financing mechanisms, and leverage internal investment with external partnerships, as opportunities arise.



**"World-class research institutions like Cornell can help to foster open, balanced, and clear communication about sustainability to a lay audience, including our alumni… Our scientists and other communicators should seek opportunities to engage these individuals in conversations about big issues like this one."**

**– Charles D. Phlegar, Vice President for Alumni Affairs and Development**

# Policy Recommendations

The **Cornell Climate Action Plan (CAP) Update 2013 & Roadmap 2014-2015** proposes several policy recommendations which were identified by the PSSC focus teams as potential actions the university can take to move our CAP agenda forward and institutionalize change. The PSSC Advisory Committee will further explore these recommendations during the next two years. Next steps include preparing financial, environmental, and social impact assessments for each policy; obtaining approval from the appropriate parties; and convening stakeholders to develop implementation plans. Key policy recommendations include:

## Buildings Team

Adopt a university-wide policy that all new construction projects and renovations valued over $5M must achieve a minimum 50% energy savings compared to the baseline established by ASHRAE 90.1.

## Climate Team

Establish a university-wide Carbon Neutral Travel Policy that fosters zero-footprint travel through purchase of carbon offsets.

## Land Team

Assess the feasibility of obtaining LEED Neighborhood Development certification for the Ithaca Campus and collaborate with other universities to advocate in favor of applying this standard to existing campuses, as well as to new developments.

## Purchasing Team

Implement an efficiency standards policy for equipment purchases at Cornell.

## Transportation Team

Establish a campus-wide policy for reduced fossil-fuel consumption among Cornell-owned vehicles.

## Waste Team

Develop a university–wide waste reduction policy, including a comprehensive, campus-wide materials management strategy.

## **Leadership** Lead by example on campus and exercise climate leadership beyond campus.

The ACUPCC Commitment recognizes the unique responsibility that institutions like Cornell have as role models for their communities. Looking beyond the Ithaca campus, the CAP lays out a series of thoughtful actions that build on Cornell's leadership role as a land-grant institution and globally engaged university as we work to mitigate climate change. Over the past decade Cornell's two agriculture experiment stations have assisted farmers in adapting to a changing climate, and Cornell Cooperative Extension (CCE) programs have assisted New Yorkers to reduce their climate impacts. From helping thousands of homeowners reduce emissions and lower their energy bills to working with municipal leaders to implement responsible zoning for renewable energy systems, Cornell's public engagement efforts have been at the forefront of efforts to create more resilient, low-impact communities.

**Cooperative Extension is… helping to establish energy efficiency and renewable energy as key economic drivers for the upstate New York economy, with potential to generate well over a half billion dollars in economic activity annually."**

**– Ken Schlather, Executive Director, Cornell Cooperative Extension of Tompkins County**

At the same time, leading by example on the Ithaca campus is critically important. Many of the actions described in this plan reflect Cornell's commitment to take responsible action here on our own campus. As campus stakeholders consider the life-cycle cost savings that can be realized, they are increasingly taking the lead to replace energy–intensive systems with more efficient systems. For example, Cornell Athletics' recent decision to upgrade to LED lighting systems in ten recreational facilities on campus will result in more efficient operations, lower maintenance costs, and improved lighting performance at these sites. Moving forward, the University can consider the carbon, economic, and community impacts of the farms that grow the food served on campus, the processes we use to dispose of waste, and the sites that produce Cornell's energy.

**Cornell's early success in cutting greenhouse gas emissions has positioned us as a national leader. In order to maintain our credibility and keep moving in the right direction, we need to continue to tend to our own emissions and we need to educate our own students to become future climate leaders."**

**– John A. Siliciano, Senior Vice Provost for Academic Affairs**

# KEY ACTIONS: NEUTRALITY

## Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

The **Neutrality Key Actions** in this section highlight the opportunities and challenges which lie before us. The subset of actions listed here were identified in the 2009 CAP as strategic components of Cornell's long-term carbon reduction plan.

## COMPLETED ACTIONS

The Beyond Coal initiative and combined heat and power (CHP) plant were identified as high-impact actions in Cornell's original Climate Action Plan. **These two actions are now complete and have reduced the Ithaca Campus greenhouse gas footprint by nearly 25% since 2008.**

### 1. Eliminate on-site coal combustion.

**Goal:** Reduce greenhouse gas emissions by a total of approximately 70,000 tons (CO2 equivalent) by 2012; reduce particulates, oxides of nitrogen, and sulfur emissions; and reduce local traffic for coal deliveries and ash removal.

On March 21, 2011, Cornell's Central Energy Plant employees scooped and shoveled the last loads of coal from the outdoor storage site and into the plant, marking the success of the university's "Beyond Coal" initiative. Historically, Cornell burned approximately 63,000 tons of coal per year to produce steam to heat campus facilities. In 2012 coal consumption associated with purchased electricity at Cornell's Ithaca campus dropped to 2,433 tons – representing an overall reduction in coal consumption of 80%. To provide a sense of perspective, Cornell's combined heat and power plant emits 0.5 lbs. of carbon per kW hour of power produced; a natural gas power plant emits 1 lb. of carbon and heat per kWh of power; and a coal power plant emits 2.3 lbs. of carbon and heat per kWh of power.

Cornell employees shovel the last loads of coal into the Central Energy Plant.

## Proposed Solar Array Offers A Bright Energy Future

Excerpted from Cornell Chronicle story by Blaine Friedlander (http://news.cornell.edu/stories/2013/07/proposed-solar-array-offers-bright-energy-future)

An artist's rendering of the Lansing solar panel array.

### Here comes the sun

Cornell hopes to expand its renewable energy portfolio with a 2MW solar photovoltaic farm as it benefits from the NY-Sun Initiative, a series of large-scale, solar energy projects expected to add about 67 megawatts of solar electricity to the state.

New York Governor Andrew Cuomo's office announced July 9 that the New York State Energy Research and Development Authority (NYSERDA) will fund Cornell's project, and, in turn, the university will partner with grant awardee Distributed Sun LLC, a company that builds and operates state-of-the-art solar-power generation systems. This project advances the goals of the new Southern Tier plan to obtain two percent of the region's electricity from solar power by 2032.

On Cornell's behalf, current plans call for Distributed Sun to install 6,766 solar photovoltaic panels on a ten-acre Cornell property on Snyder Road, adjacent to the Ithaca Tompkins Regional Airport. The solar photovoltaic panel array will be Cornell's first large-scale solar project and is expected to produce about 2.5 million kilowatt-hours annually, or about one percent of Cornell's total electricity use. That's enough electricity to power about 320 homes for a year.

## 2. Utilize combined heat and power (CHP), or the simultaneous production of electricity and the utilization of "waste" heat for campus heating requirements, to optimize the efficiency of the Central Energy Plant.

**Goal:** Increase the efficiency of Cornell's Central Energy Plant by capturing more of a fuel's energy content and producing energy that is far more cost-effective and far cleaner than non-CHP systems.

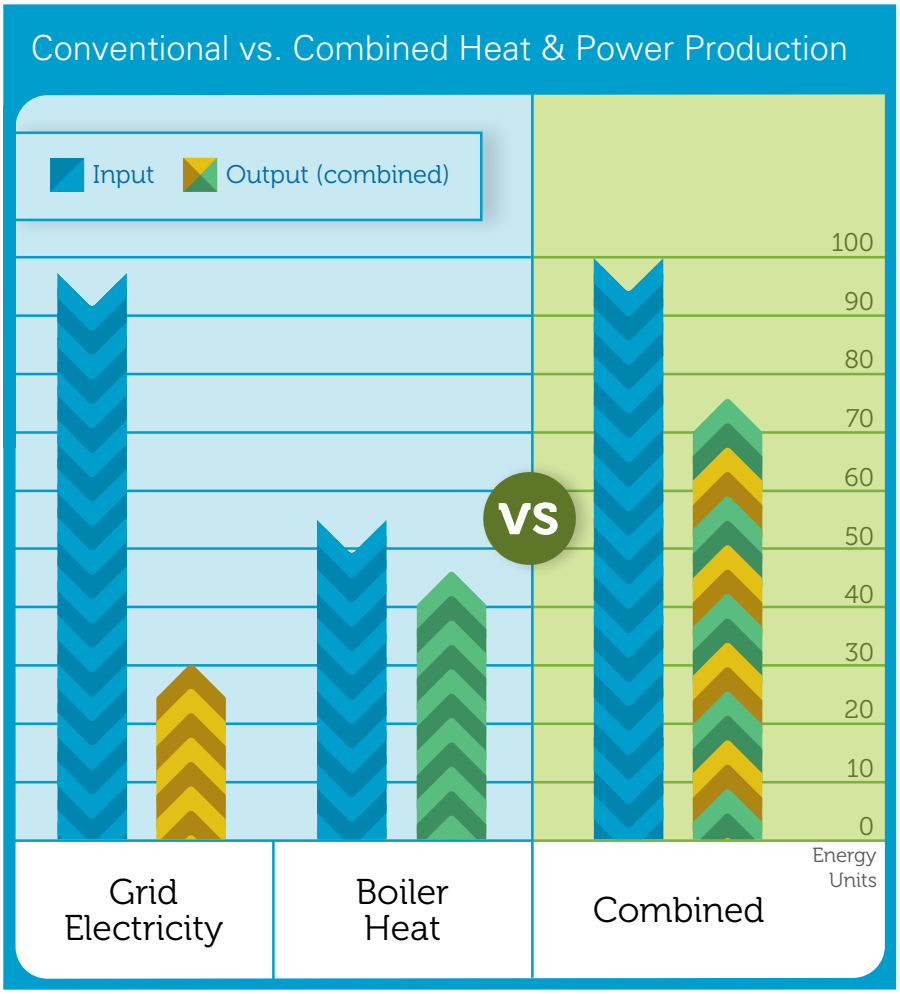
Standard power plants effectively use just 40 percent of the fuel they burn to produce electricity. The remainder of the fuel used in the electric production process ends up being rejected and "wasted" up the smokestack. Reject heat from Cornell's combined heat and power plant, on the other hand, is used to heat 150 buildings on campus encompassing 14 million square feet. In its first year of operation, Cornell's CHP has increased the total operational efficiency of supplied heat and power to the campus from 50% to 80%. The CHP and Beyond Coal initiative have resulted in an overall reduction in greenhouse gas emissions of roughly 25% from our 2008 baseline, eliminating more than 75,000 tons (CO2 equivalent)/year.

In September 2013, the International Energy Agency Technology Network awarded the Cornell Combined Heat and Power Plant the **Global District Energy Climate Award** (http://www.districtenergyaward.org/awards/2013-2/) for a campus-sized system. Cornell's application was one of many submissions from cities, communities, and campuses across North America, Europe, Asia, and the Middle East, and we were honored to receive this prestigious global award.

The CHP turbines currently combust natural gas, but they have a dual-fuel capability to allow them to run on distillate fuel oil. If future bio-fuels become economically available in sufficient capacity to warrant use, these could be blended or, depending on their characteristics, potentially burned "straight." Similarly, a clean biogas, such as that promoted by faculty on campus for farm applications, could supplement or substitute for the natural gas available now by pipeline. Alternately, the solid-fuel boilers could be modified to burn renewable solid fuels if a reliable supply were locally available. Renewable fuels in every form continue to be explored. The CHP system was intentionally designed to allow the use of renewable fuels as they become economically and technologically feasible. With its flexible design, Cornell's Central Energy Plant will continue to be a proactive component of Cornell's plan to achieve net carbon neutrality by 2050 or sooner.

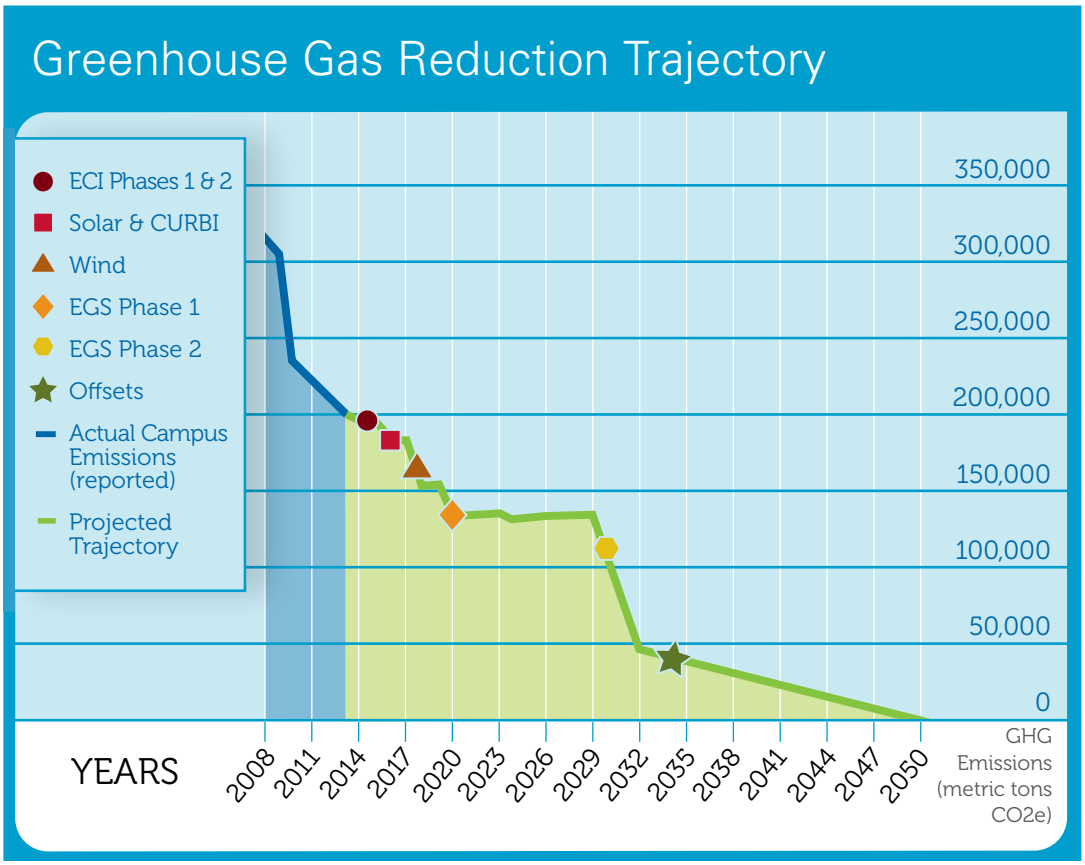
**"The Lake Source Cooling project of the late Nineties expanded the capacity of the University to cool buildings in a way that was environmentally friendly and at a lower operating cost than conventional alternatives. Similarly, the Combined Heat and Power Plant, which became operational in December 2009, was expected to lead to dramatically improved efficiency and thus lower operating costs, as well as lower greenhouse gas emissions."**

– Ronald Ehrenberg, Ives Professor of Industrial and Labor Relations and Economics, and Ross Milton, PhD student in Economics



## FUTURE ACTIONS

The **Neutrality Key Actions** outlined below have been identified as critical for the university to achieve its carbon neutral commitment. Implementing these seven actions, in combination with the other 18 Neutrality actions described in this plan (such as expansion of solar generation capacity), will enable Cornell to significantly reduce its greenhouse gas emissions and advance its carbon neutral goal.




Early successes were achieved through projects that yielded a return on capital investment. Current economic realities, including cheap natural gas and the absence of a price penalty for carbon emissions, mean that further significant progress will be more difficult and will require key actions to become institutional priorities to benefit Cornell's academic mission and achieve carbon neutrality. For all projects described in this plan, specific funding and approvals are sought case by case, as resources become available and conditions are deemed favorable for implementation.

Though some preliminary studies have been prepared, the following seven actions have not yet been approved by the university, and funding has not been secured to implement these high-impact actions, many of which require a substantial up–front investment. Other concerns include technical challenges involved with implementing large-scale renewable energy options. These actions will require rigorous frameworks for analyzing costs and benefits, detailed technical feasibility studies and implementation plans, consensus building, and serious commitments on the part of the university community prior to implementation.

The **"Next Steps"** box lists what the university can do within the next two years to move each of these key carbon reduction strategies forward. By taking the next steps listed for each of these **Key Actions,** Cornell will be better prepared to assess the long-term viability of our carbon neutrality plan and make adjustments to our carbon reduction strategies, as needed, prior to the next CAP update in 2016.

**...We can't rest on the past accomplishments – as great as they are. We need to allocate funding and resources to implement the next-phase strategic actions identified in our CAP."**

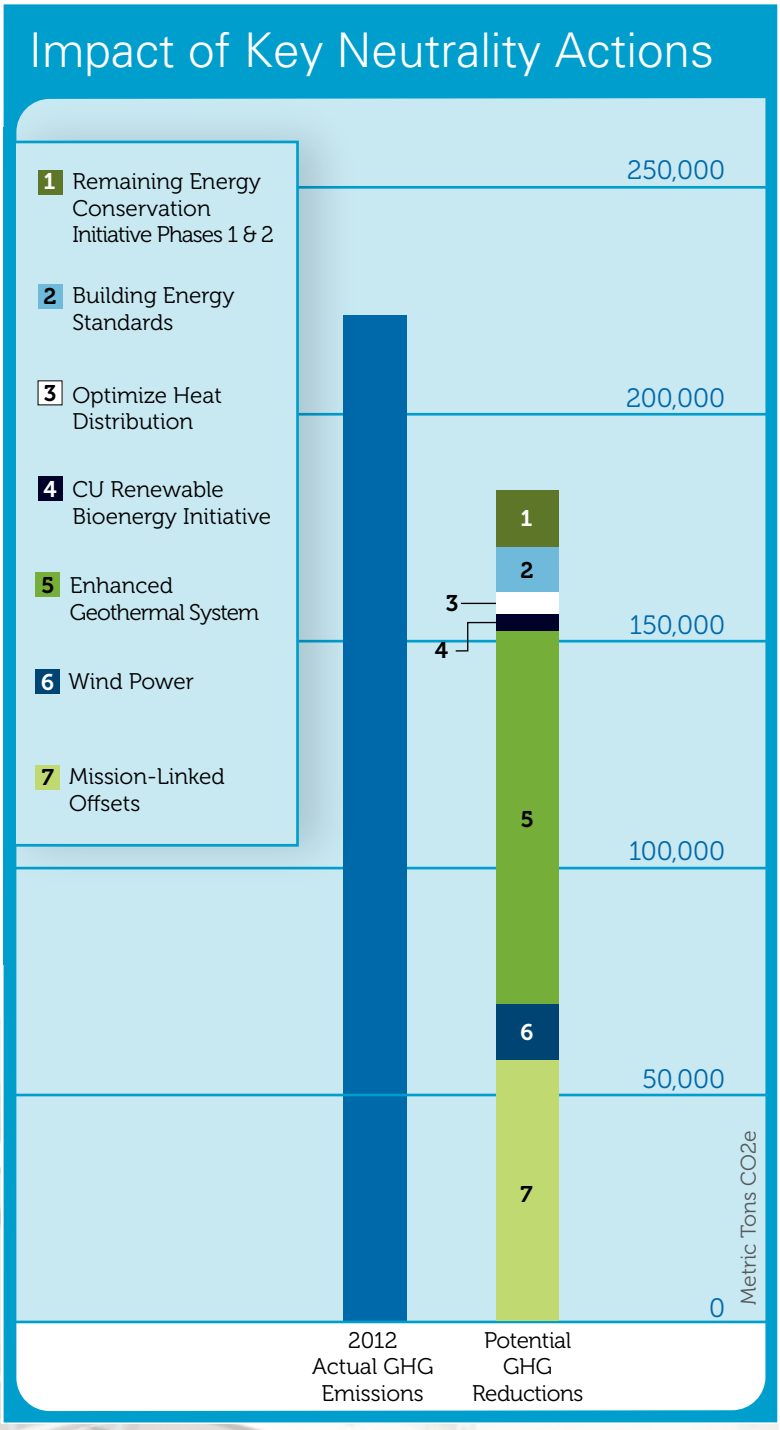
**– Lauren Chambliss, Communications Director for the Atkinson Center for a Sustainable Future**

**Demonstrating that the overall environmental damage is less than that from coal does not imply that gas production and use is cost-free, and the sooner we reduce our dependence on fossil fuel sources of energy of all kinds the better. Coal is worse — that doesn't mean that gas is great."**

**– Louis Derry, Associate Professor Earth and Atmospheric Sciences**

## The seven Neutrality Key Actions are:

1. Complete Phase 1 of the **Energy Conservation Initiative (ECI)** and initiate Phase 2 to conserve energy in campus buildings.
2. Integrate **Building Energy Standards** and energy modeling into the building design, review, and approval process in order to maximize energy efficiency.
3. **Optimize the campus Heat Distribution System** to increase efficiency and cost-effectiveness and to facilitate the integration of Cornell's future energy sources.
4. Capitalize on more than 50 campus waste streams and other university-owned biomass resources to generate renewable energy through **CURBI (Cornell University Renewable Bioenergy Initiative)**.
5. Eliminate the combustion of fossil fuel for campus heating by developing an **Enhanced Geothermal System (EGS) hybridized with biogas**. Prepare a preliminary design and phased implementation plan for a Hybrid Enhanced Geothermal System and build a demonstration project.
6. Support the expansion of regional wind generation capacity and integrate **wind power** into Cornell's renewable energy portfolio.
7. Implement broad–based, **mission–linked carbon management strategies** such as forest management, carbon capture and sequestration, and community projects to offset unavoidable university emissions.



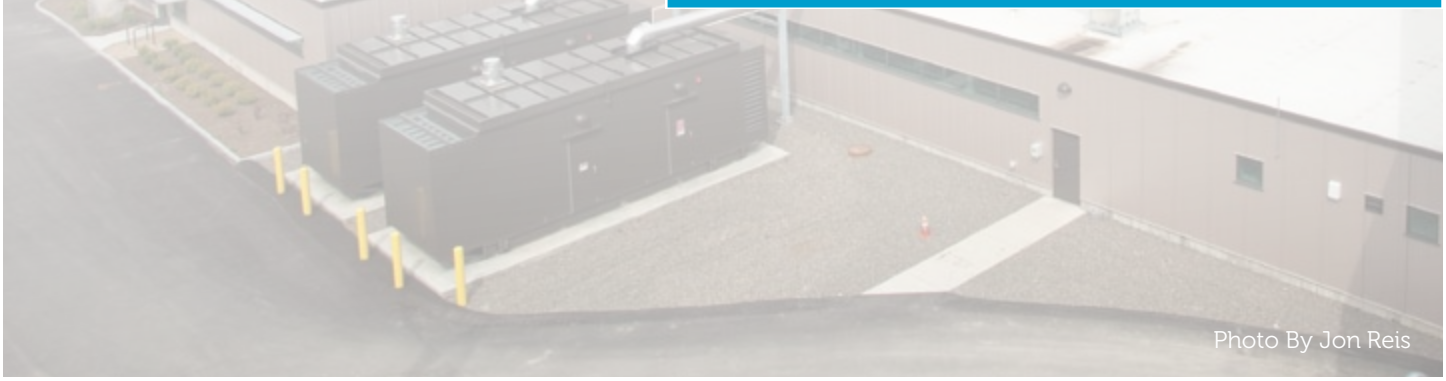



Photo By Jon Reis

## ACTION 1 – Energy Conservation Initiative

### Complete Phase 1 of the Energy Conservation Initiative (ECI) and initiate Phase 2 to conserve energy in campus buildings.

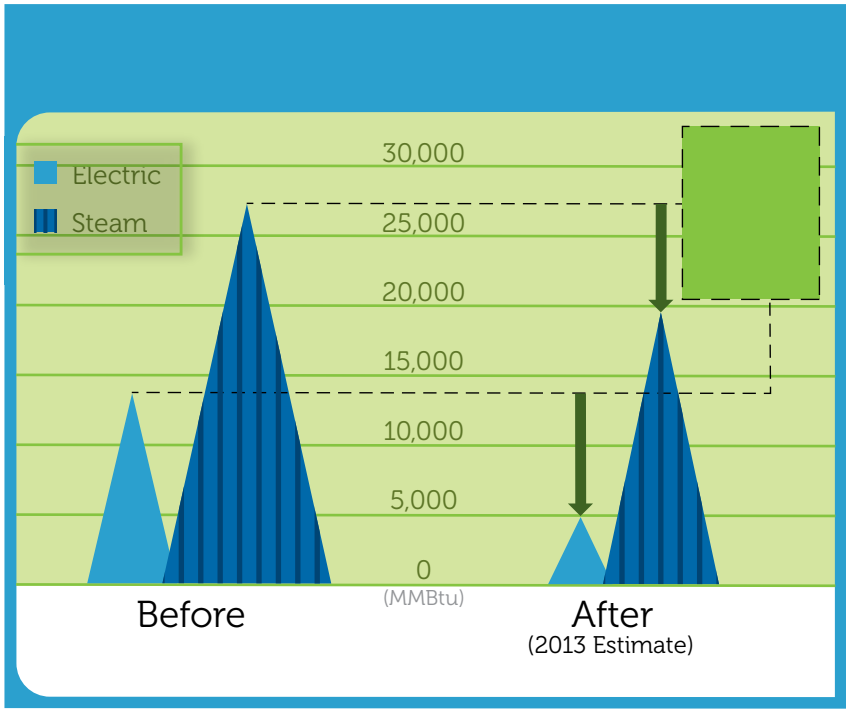
**Goal:** Cornell's Energy Conservation Initiative includes retrofits, replacements, and weatherization projects in buildings across campus. ECI projects are designed to optimize the energy efficiency of building automation and control systems, heat recovery systems, and lighting systems. Additional goals include increased occupant comfort and reduced maintenance expenses. ECI Phase 1 projects are expected to reduce Ithaca Campus utility costs by over $3 million per year by 2016. **The completion of Phase 1 and full implementation of Phase 2 of the Energy Conservation Initiative would reduce university emissions by about 11,800 metric tons (CO2 equivalent) annually – roughly 5% of the current carbon footprint.**

Building automation systems are microprocessor-based computers that monitor and control a range of building functions, including heating, ventilating, air-conditioning, refrigeration, lighting, fire and smoke alarms, utilities, elevators, access control, and intrusion detection. These systems are used in virtually every building on the Cornell campus. Dramatic and lasting conservation results can be achieved by optimizing Cornell's building automation and control systems, heat recovery systems, and lighting systems. Conservation–focused preventive maintenance on these systems reduces usage and maintains performance. Wherever feasible, the latest features are cost effectively retrofitted into existing systems.

Phase 1 of the university's Energy Conservation Initiative from 2010 through 2015 allocated roughly $33M toward projects which met the criteria for either a seven-year billed or ten-year marginal payback. Marginal cost is the commodity only cost; while billed cost is the "all in" cost of supplying the utility to the end user, including Central Energy Plant Personnel, debt servicing, maintenance and so forth; marginal cost is the commodity-only cost. To date, Phase 1 ECI projects have saved over one million dollars in energy use and enabled the university to maintain a flat energy use profile, while increasing the Ithaca campus footprint by over one million square feet of new construction.

**"...Investment in our Energy Conservation Initiative, coupled with continuous optimization, have dramatically reduced energy usage and maintenance issues, while improving the comfort and safety of campus buildings."**

**– Lanny Joyce, Director of Energy Management**




A recent lighting retrofit at Guterman Greenhouse resulted in a 39% reduction in energy consumption and 386 fewer tons of greenhouse gas emissions per year. To view more **ECI Project Summaries** (http://energyandsustainability.fs.cornell.edu/em/projsum/default.cfm), please see **Appendix 4** of this report.

A full-time staff of two Certified Energy Managers and a Senior Engineer/ Director of Energy Management oversee the university energy management program for the central plant (supply side) and campus buildings (demand side). Completion of Phase 1 ECI projects is expected in 2015.

The second phase of the program would stretch the payback criteria to 20 years marginal or 15 years billed, to enable further energy reductions throughout campus facilities. The Phase 2 Energy Conservation Initiative aims to reduce Cornell's marginal utility costs by $1.5 million per year. Cornell is presently tracking seven applications submitted to the New York State Energy Research & Development Authority (NYSERDA) New Construction Program to extend the ECI program and help fund the $12M cost of Phase 2 projects.

**"Since the majority of energy conservation projects have a maintenance component, we are essentially killing two birds with one stone – we address a deferred maintenance item and reduce energy use."**

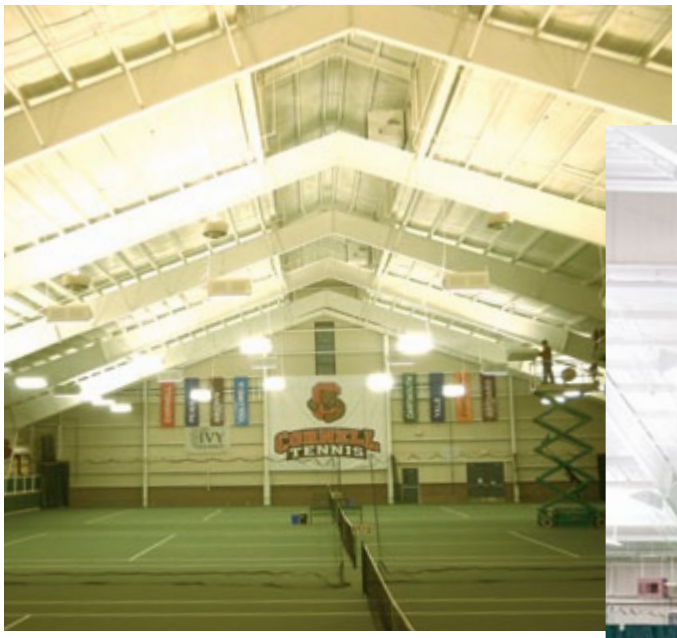
**– Mark J. Howe, P.E. CEM, Program Manager Energy Conservation Initiative**

**Next Steps**

- Complete Phase 1 ECI projects, including weather–corrected regression analysis of energy savings from all projects by FY16.
- Develop a timeline for conducting building energy studies to guide Phase 2 energy conservation projects.
- Initiate and complete energy studies on approximately 10% of campus buildings each year.
- Based on the results of the studies, develop a list of program priorities.

**Resources**

Meet with colleges and units to develop funding plans and continue to seek external funding, including NYSERDA rebates, for Phase 2 ECI projects.

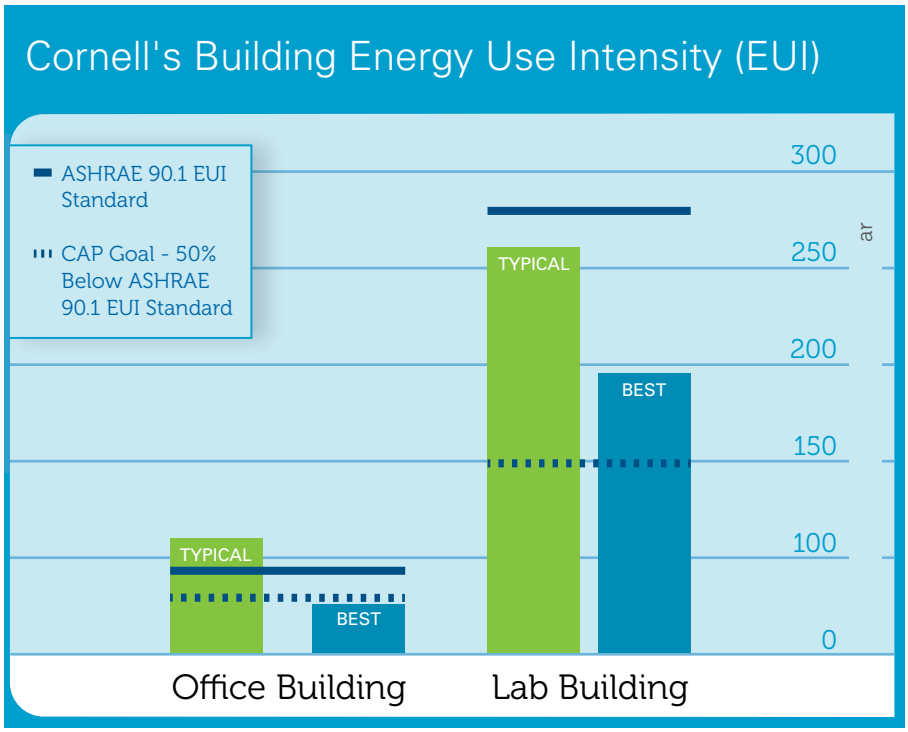


Cornell's Reis Tennis Center before and after lighting retrofit. The new lights are twice as bright and far more efficient, using 70 percent less energy annually compared with the old metal halide lights. They will also save $20,000 per year on energy costs.

## ACTION 2 – Building Energy Standards

### Integrate Building Energy Standards and energy modeling into the building design, review, and approval process in order to maximize energy efficiency.

**Goal:** Cornell continues to refine its energy efficiency standards for campus buildings to reduce laboratory and office energy use by 30 – 50% over the energy-code-compliant baseline (ASHRAE 90.1). The goal is to establish aggressive, but achievable goals for each major project and incorporate these goals as contractual obligations into architectural and engineering agreements. **Coupled with an aggressive space management program, Cornell's building energy standards can help the university avoid over 10,000 metric tons (CO2 equivalent) of emissions annually.**




Energy use intensity (EUI) is calculated by dividing the total energy consumed by a building in one year (measured in kBTU) by the gross floor area of that building (measured in square feet). As of 2008, Cornell's policy is for all major new and renovated buildings (over $5M) to achieve an EUI that is 30% below industry standards with a goal of achieving 50% when possible.

The 2009 Climate Action Plan (CAP) mandated that the university adopt energy standards by building type and a well-defined energy modeling protocol. These mandates were created to ensure that future construction on campus would be optimized to Cornell's Leadership in Energy and Environmental Design (LEED) program and also achieve a minimum of 30% reduction in building energy use as compared with the industry standard (ASHRAE 90.1). The target in the 2009 CAP was established through a careful review of recent Cornell construction projects and comparison with benchmarks used elsewhere.

In 2013, Cornell's Facilities Engineering Department updated two campus-wide standards, "Energy Guidelines" and "Energy Modeling Guidelines", to standardize and more fully explain Cornell's energy requirements for buildings on campus. **Cornell's Design and Construction Standards** are found at the following URL: http://cds.fs.cornell.edu/toc.cfm. These guidelines set aggressive goals that require innovation, design discipline, and steady enforcement by our project management teams.

"Energy Use Intensity" (EUI) goals are now being incorporated into architectural and engineering agreements for all our major building projects. Standard EUI units are expressed in terms of BTUs per square foot per year. Each new building and major renovation on campus has a unique EUI, depending on how the building will be used. On average laboratories use 5-10 times more energy than dormitories on a per square foot basis. Cornell's goals are generally 150 kBTU/ft2/year for lab buildings and 50 kBTU/ft2/year for offices and classrooms. When compared to a business-as-usual approach, Cornell's building energy standards can help the university to avoid thousands of metric tons of emissions.

**Next Steps**

- Continue to refine the modeling process, particularly early in design. Standard modeling techniques are not well suited for evaluating energy performance at the conceptual stage of design. We will work to develop better modeling tools or better ways to adapt the tools we have for evaluating building massing and envelopes. This will ensure that energy modeling done at the conceptual design stage is a meaningful indicator of future energy performance.
- Consistently implement our building energy standards.
- Refine our target goals to keep them aggressive and achievable. We will continue to benchmark our targets against the performance of the best buildings on our campus and elsewhere.
- Track modeled energy use and actual performance of recent buildings.

**Resources**

Energy modeling software is improving, and we may be able to hire a third–party consultant to refine how the modeling is done, standardize the assumptions being made, and improve the accuracy of modeling predictions.

## ACTION 3 – Optimize Heat Distribution System

### Optimize the campus Heat Distribution System to increase efficiency and cost-effectiveness and to facilitate the integration of Cornell's future energy sources.

**Goal:** Cornell currently owns and operates over 60,000 feet of underground steam, condensate, and hot water lines to provide heat to the Ithaca campus. Approximately 15% of the metered heat energy produced at the Central Energy Plant is currently lost in the distribution system. Optimizing the campus heat distribution system could potentially cut those losses by more than half, increase reliability and flexibility to accommodate alternate heat sources, and **reduce the university's GHG emissions by about 6,500 metric tons (CO2 equivalent) or about 3% of the current carbon footprint**.

The campus Heat Distribution System has not been optimized for efficiency or operations, and the deferred maintenance backlog is increasing. A planning study will evaluate the current system and provide specific and quantified recommendations for prioritizing of future improvements to optimize efficiency and alternative energy integration. The study will focus on prioritizing future capital work to reduce overall operating and maintenance costs, including energy, maintenance, and repair expenses. Optimizing the campus Heat Distribution System should reduce future energy costs, resulting in lower utility rates for customers.

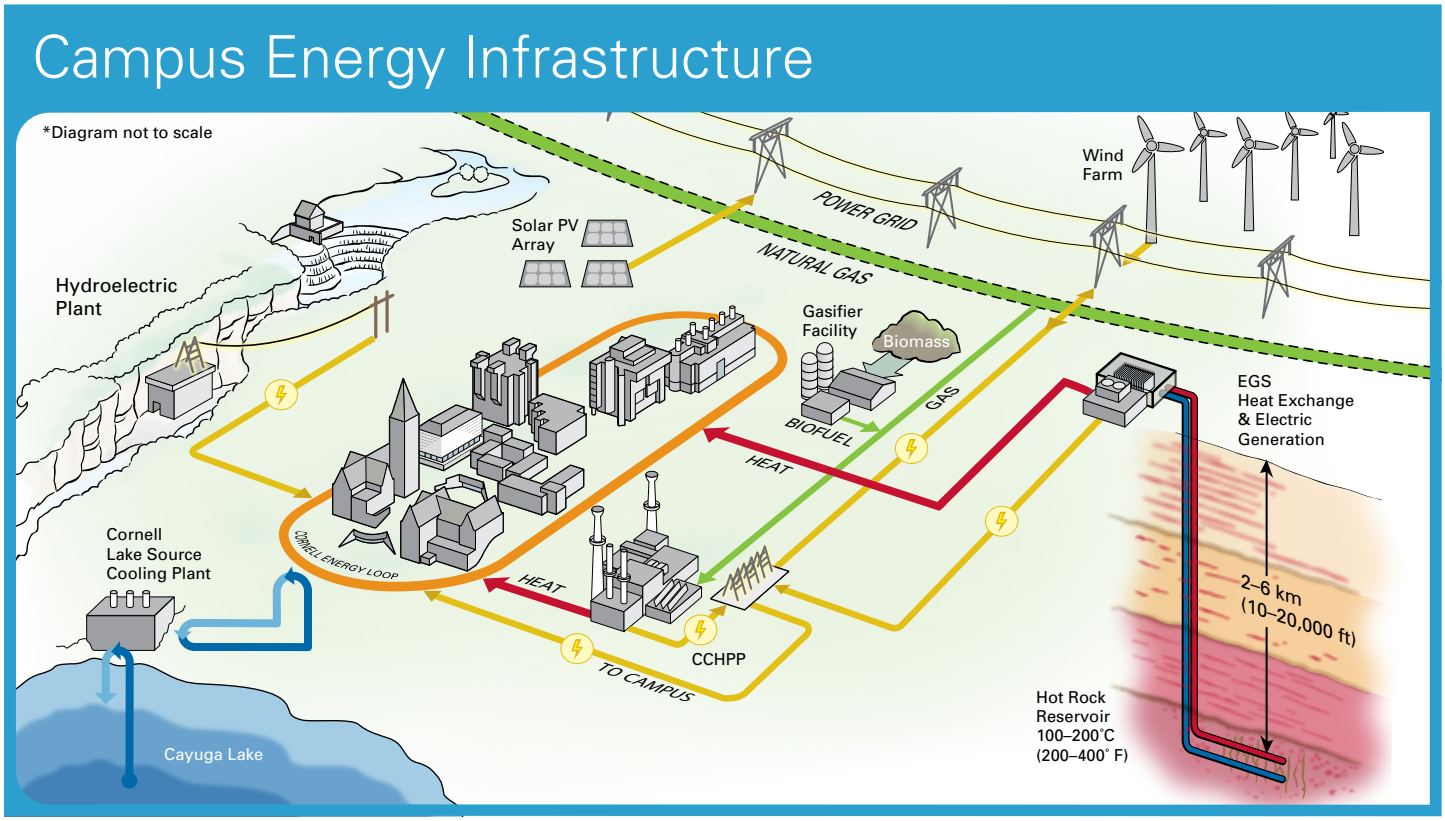
**Next Steps**

- Perform an in-house study to pri oritize and determine near-term requirements for steam line renewal and maintenance to increase reliability and efficiency.
- As part of Action 5, Enhanced Geothermal System (EGS), study the optimum heat distribution system for a single well pair demonstration project to serve one zone of campus.

**Resources**

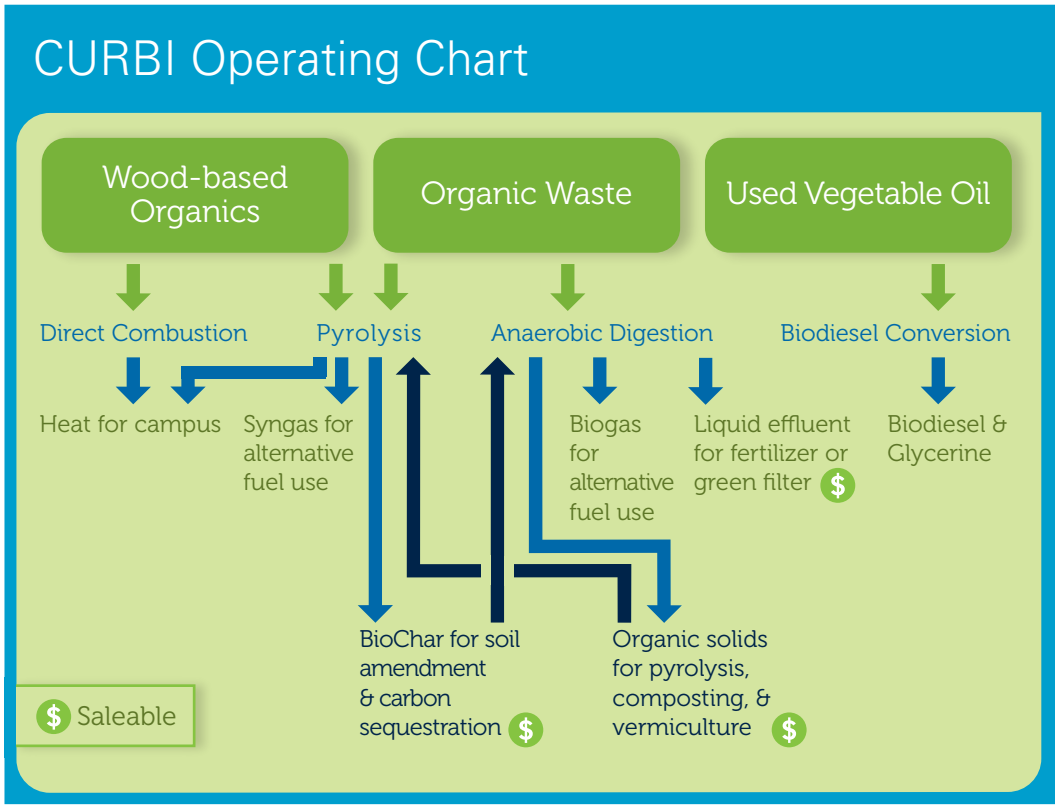
The core knowledge for this task resides within Energy & Sustainability and Facilities Engineering Departments at Cornell. Outside support will be needed to assist with the EGS study.

(Below) A vision of how an ultra-efficient campus Heat Distribution System that fosters integration of renewable resources might work.



## ACTION 4 – Cornell University Renewable Bioenergy Initiative

**Capitalize on more than 50 campus waste streams and other university-owned biomass resources to generate renewable energy through CURBI (Cornell University Renewable Bioenergy Initiative).**




**Goal:** Cornell University's Renewable Bioenergy Initiative (CURBI) is a research and demonstration platform for bio-fuel research. While the carbon reduction potential of CURBI research and demonstration is relatively small, CURBI can help identify larger-scale agriculture-based opportunities to produce bioenergy that could significantly offset traditional energy sources. Biomass could be turned into biogas to fuel Cornell's combined heat and power systems, and heat generated through CURBI could be used to heat campus greenhouses and other energy-intensive facilities. **Although the exact combination and utilization of energy conversion technologies is yet to be determined, CURBI at demonstration scale has a carbon reduction potential of about 3,000 metric tons (CO2 equivalent) per year or about 1% of the current carbon footprint.**

CURBI is a scalable research and demonstration platform which can support a number of different technologies. These technologies may be simultaneously employed and will likely alter as the focus of research changes over time. A feasibility study for the CURBI concept was completed in January 2010 with support from the New York State Energy Research and Development Authority (NYSERDA). The feasibility study evaluated several options, including direct combustion, anaerobic digestion, and pyrolysis/gasification as potentially "stackable" technologies, meaning that waste products from one system could be used as feed stocks (or inputs) for another system.

The Cornell University Agricultural Experiment Station (CU AES) currently manages most of the bio-energy resources for the Ithaca campus. CU AES administration and farm support staff stand ready to support CURBI, and the necessary biomass is readily available and includes manure, food wastes, woody and agronomic (bio-energy) crops. CURBI could have substantial positive impacts on the local agricultural economy and communities, if the research and demonstration projects conducted through the project result in the successful commercialization of specific technologies.

**Next Steps**

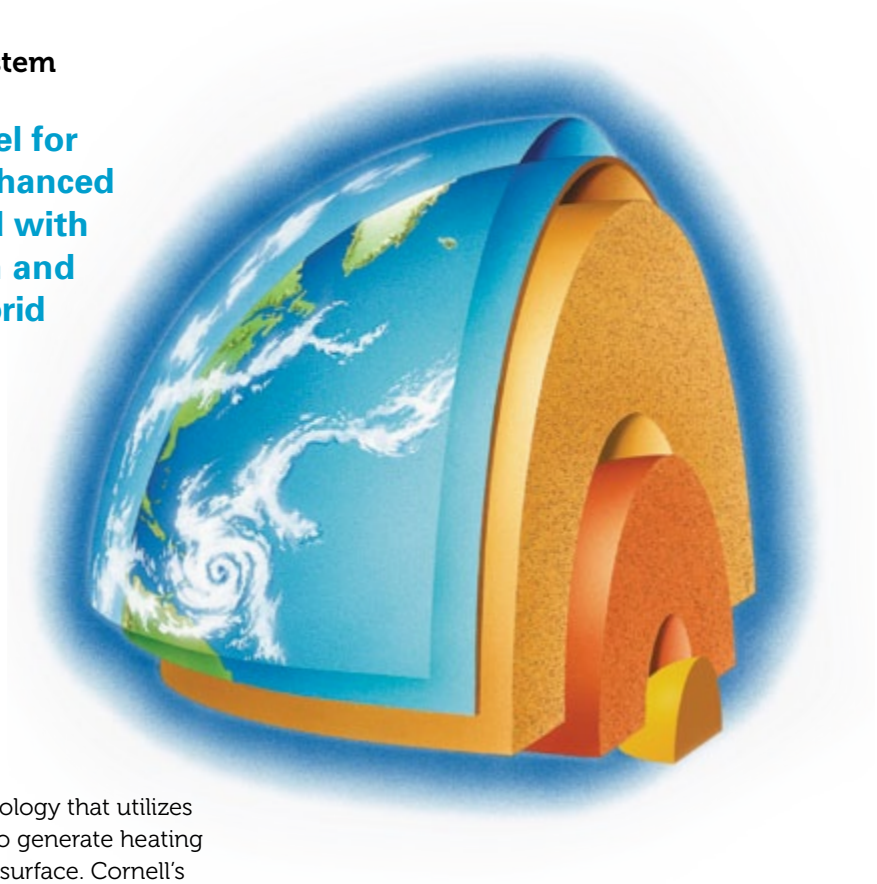
- Revise the 2010 project plan for the design and construction of a flexible work platform to support CURBI initiatives, similar to the facility recommended in the feasibility study. Without such a facility to house and facilitate research, there are limited opportunities to obtain grants for specific research. Con versely, a functional research platform would provide numerous diverse research and development opportu nities for campus.
- Study and develop financial metrics for a small-scale digester at Harford or the on-campus dairy.

**Resources**

Cost estimates for the CURBI initiative as presented in the feasibility study are about $12M, but the basic research platform would likely be more in the $6M range. Grant funding is available to help pay a significant share of the technology costs once the supporting structure and systems are in place.

## ACTION 5 – Enhanced Geothermal System

**Eliminate the combustion of fossil fuel for campus heating by developing an Enhanced Geothermal System (EGS) hybridized with biogas. Prepare a preliminary design and phased implementation plan for a Hybrid Enhanced Geothermal System and build a demonstration project.**



**Goal:** Build a demonstration project and assess the feasibility of installing a full-scale project that would allow Cornell to substantially heat and cool the campus using only natural, renewable resources and stored heat energy from the earth. **Completely realized, this hybrid innovation could provide for over 82,000 metric tons (CO2 equivalent) of average annual carbon abatement – more than 38% of the university's current carbon footprint.**

**Engineered Geothermal Systems** is an emerging technology that utilizes heat energy available deep beneath the earth's surface to generate heating and electricity via distribution equipment located at the surface. Cornell's Hybrid Enhanced Geothermal System (HEGS) is a combination of two innovative, demonstration-scale research projects: Engineered Geothermal Systems (EGS) and Bio-Mass Gasification. The hybrid system would link the EGS to a biomass-to-biogas system scaled up from CURBI (**Neutrality Key Action 4** above). During very cold weather when EGS alone is not enough, the biogas would be used to supply the additional electricity and heating needs of campus.

### Next Steps

- Work with development professionals at the university to actively seek public and private funding for this project, using recent analyses con ducted by the Cornell Energy Institute.
- Study, conceptually design, and develop financial metrics for a small scale demonstration project to include a single well pair, heat exchange facilities, and interconnection for target areas on North Campus and East Campus.
- Complete a Full Environmental Assessment Form (FEAF) to document the project's potential environmental, social, and economic impacts.
- Draft a white paper that documents the steps needed over the next decade to bring the full-scale project to fruition.

### Resources

Recent cost estimates are $19 million for a demonstration system consisting of a single well pair, and $40-50M for a full-scale project which includes one well pair and heat extraction/delivery systems, tie into the campus distribution system, and two years of operations. This system could supply 25% of energy for campus.

## ACTION 6 – Wind Energy

### Support the expansion of regional wind generation capacity and integrate wind power into Cornell's renewable energy portfolio.

**Goal**: Support the expansion of regional wind power generation capacity through procuring energy for university facilities from external projects and through construction of dedicated facilities. This action will increase renewable generation capacity in our region and the overall renewable energy portfolio of New York State, as well as enabling Cornell to expand research and teaching opportunities around wind power. **Full-scale implementation of this action, including power purchased from external projects and power produced by Cornell wind facilities, could provide 11,900 metric tons (CO2 equivalent) of average annual carbon abatement, or roughly 5% of the current carbon footprint.**

Photo by Ross B. Hansen

This 80-foot-high wind turbine was installed in June 2007 at the Shoals Marine Laboratory on Appledore Island in Maine. Shoals Marine Lab is a seasonal field station operated by the College of Agriculture and Life Sciences at Cornell University in cooperation with the University of New Hampshire.

Wind power is among the most cost effective, large-scale renewable energy sources currently available. Cornell is actively investigating opportunities to harness wind power for education, research, demonstration-scale projects, and full-scale utilization to provide power for the university.

Since wind energy generation is variable (produced only when the wind blows), Cornell will implement strategies to reconcile seasonality and variability in wind with campus needs. During the winter months, all of the energy needs of the Ithaca Campus are currently met through on-campus production at the Central Energy Plant. Cornell purchases the majority of its grid power in the summer. Yet adequate storage, transmission, and "back up" electricity is needed to ensure sufficient and reliable electricity is provided for campus at all times. Large–scale wind energy will produce more power during the winter months, so some mechanism for balancing Cornell's energy demands with wind energy production is needed.

The **Black Oak Wind Farm (BOWF)** (http://www.blackoakwindny.com/) serves as a recent example of Cornell's commitment to work with the local community to encourage the development of renewable energy. Upon completion in 2015, BOWF is projected to produce about 42 million kWh per year. Cornell is working with the BOWF leadership team in an effort to negotiate a reasonable power purchase contract. Large-scale renewable energy typically requires a long–term power purchase contract to secure the private equity financing that is critical to project success.

Under current regulatory limits, Cornell has the capacity to utilize the electricity from three to five additional remote-net-metered renewable energy projects, which could include wind, solar, hydro, etc. If all these projects come to fruition, they would produce a minimum of 10-15 million kWh, or 6% of Cornell's total electricity use. At this time, large (~2MW) off-campus installations that take advantage of remote net metering offer Cornell the best opportunity for increasing its renewable energy portfolio.

Cornell researchers and economists continue to work with small towns, land owners, and rural communities throughout our region to explore and evaluate wind power opportunities. Recent technological advances have decreased the generating cost per kilowatt hour from many times grid prices to nearly equal to grid prices after subsidies, making wind energy one of the few economically viable alternatives ready for large-scale adoption. There can be significant economic advantages for communities that have favorable wind sites near electric grids; landowners receive lease payments and royalties from wind generators, while the energy generated creates profits for companies and revenues for local governments. In one New York town, wind-energy revenues account for 30 percent of the local school budget. Cornell Cooperative Extension has documented the positive impacts of the Maple Ridge project in Lewis County, which now has close to 300 commercial-style wind generators, in a widely distributed publication: **Wind Energy Development in New York State: Issues for Landowners** (http://aem.cornell.edu/outreach/extensionpdf/eb0405.pdf, Brian Henehan, Applied Economics and Management; Deborah Grantham, Natural Resources).

**Next Steps**

- Complete a market analysis of external renewable projects, including wind, solar, geothermal, and biogas. Based on the results of the market analysis, determine if a demonstration-scale wind project on Hungerford Hill and/or other renewable energy projects should be pursued.
- Determine the extent of Cornell's involvement with Black Oak Wind Farm.

**Resources**

Funding has been identified to pay a consultant to assess Cornell's load profile, develop Cornell-specific decision making criteria, and complete a market analysis.

## ACTION 7 – Mission-Linked Offsets

### Implement broad-based, mission-linked carbon management strategies such as forest management, carbon capture and sequestration, and community projects to offset unavoidable university emissions.

**Goal**: The roughly 14,000 acres of land owned by Cornell currently sequester approximately 11,000 metric tons of CO2 annually; through active management practices it is possible to significantly increase the carbon sequestration rate of these lands. If the university does not actively plant new trees and manage its mature forest stands, the carbon abatement capacity of these lands will diminish over time. The current sequestration rate is trending downward and will be near zero by 2050, because the existing forest is aging. **Fully realized, mission-linked offsets could account for an annual carbon abatement equivalent to the University's current total commuting and business travel footprint – roughly 59,000 tons (CO2 equivalent) and about 27% of the targeted reduction of 218,000 tons.**

Cornell faculty and the Cornell Lands Committee continue to investigate the potential to "afforest" or convert about 4,000 acres of Cornell's land holdings from idle pasture or cropland to forest by planting trees. Afforestation and active forest management can enhance the carbon-storage capacity of Cornell lands, as well as enhance the educational and research mission of the university. For example, a demonstration nut grove on Cornell land currently serves as a research site for a practicum in agro-forestry.

Faculty and the CALS (College of Agriculture and Life Sciences) Forest Advisory Committee continue to refine estimates for the carbon-capture potential for Cornell lands and seek ways to make these efforts economically feasible. The recent dramatic reduction in the price of natural gas has made solid biofuel production less attractive as a back-up fuel source for the Ithaca Campus Central Energy Plant.

Future regulation of carbon emissions would provide a compelling incentive for Cornell to move forward with afforestation and active forest management. But changes in the regulation of carbon emissions at the state, national, and global scale are difficult to predict. In the absence of a price on carbon, we will continue to seek ways to preserve our forested lands and to optimize the carbon storage services they provide.

Land application of biochar (charcoal produced from the slow pyrolysis of organic biomass) has been proposed as an effective method for long-term capture and sequestration of carbon. Cornell researchers continue on-going efforts to understand and quantify the short- and long-term effects of biochar application for carbon sequestration.

**"Mission-linked offsets can provide Cornell with the opportunity to reach beyond our hill and invest in tangible actions with multiplicative benefits to our immediate and global community."**

**–Abena Sackey Ojetayo, '07, MEng '09, Engineer, Division of Facility Services**

**Next Steps**

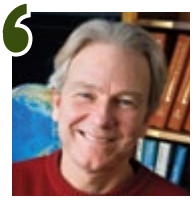
- Actively seek public and private fund ing for research and demonstration projects utilizing Cornell lands to sequester carbon and create viable, value-added products.
- Closely monitor the regulatory climate over the next decade to identify favorable conditions needed to make afforestation and active forest management projects economically viable for the university.

**Resources**

This action is dependent on favorable economic and regulatory conditions to mobilize investment on the part of the university.

# KEY ACTIONS: INNOVATION

## Create a living laboratory for low-impact behaviors, climate education, and research.



**"Cornell is one of the few universities in the country to offer a minor in climate change… Through these and other courses offered at Cornell, students can gain a depth of understanding about climate change issues that will make them effective leaders in whatever career track they follow."**

**– David Wolfe, Professor, Horticulture, and Chair of the Atkinson Center for a Sustainable Future's Climate Change Focus Group**

Building on the core mission of Cornell in education and research, the **Innovation Pillar** of our Climate Action Plan acknowledges that Cornell's ability to mitigate climate change involves engaging students, staff, and faculty in new ways, both on and off campus.

We know that renewable technologies are within our grasp, but they need to be tested, evaluated, refined, scaled up, and deployed on a broad scale. A 2011 report from the United Nations' Intergovernmental Panel on Climate Change concluded that existing renewable technologies could, in combination, produce almost 80 percent of the global energy supply by 2050 and reduce greenhouse gas emissions by a third from business-as-usual projections (**IPCC, Special Report on Renewable Energy Sources and Climate Change Mitigation.** Prepared by Working Group III of the Intergovernmental Panel on Climate Change (Cambridge, UK and New York: Cambridge University Press, 2011), http://srren.ipcc-wg3.de/report). Cornell can serve as a living laboratory to study and optimize these technologies through demonstration-scale projects that will advance research applications and commercialization around the world.

**"The Center for Engaged Learning + Research is fully committed to supporting the goals of the CAP. We will provide seed grants and educational programs for faculty and students to design service–learning courses and engaged research projects that focus on addressing sustainability issues at Cornell and with local and global communities."**

**– Richard Kiely, Ph.D. 2002, Director of Engaged Learning + Research**

**Innovation Key Action 1** is Cornell's ongoing work to ensure that **climate literacy** and sustainability are part of the curriculum and educational experience at Cornell. Cornell is committed to educating future leaders, scientists, artists, and global citizens who are climate-literate and solutions-oriented.

Photo by Anja Timm

Student volunteers help to plant trees at Thompson Research Farm. The Cornell University Agricultural Experiment Station has planted almost 9,000 trees and shrubs as riparian buffers, as windbreaks to reduce heating, or on marginal agricultural land to reduce mowing and increase carbon sequestration and biodiversity.

**To assign 'sustainability education' to the classroom or even the research lab is to miss the mark. Every action from Frosh to Senior should be part of an emerging experiment in sustainable living."**

**– Alexandra Moore, Director, Cornell University Field Program in Earth and Environmental Systems**

As we reconsider the role the traditional college/university in the face of competition from MOOCs (massive open on-line courses) and less expensive educational options, the potential to serve as a "living laboratory" provides an outstanding opportunity. Universities such as Cornell have the potential to transform the experience and behavior of their undergraduate and graduate students within the framework of a residential campus setting. Climate education occurs in the classroom and the research lab, but it also extends far beyond the formal curriculum to encompass our dining halls, residences, campus events, and just about every action that occurs on campus. All members of Cornell community can take part in actions to make our campus more sustainable. Through such "experiments" in low-impact living, we engage our students in seeking the solutions we need to achieve climate neutrality.

AguaClara Team Leader Julia Morris operates the program's demonstration plant, which represents the processes used to treat water in AguaClara municipal-scale drinking water treatment plants.

**Personally, I would love to interact more with the CAP… Making a direct tie for students between their actions and CAP goals would allow groups like Cornell University Sustainable Design to assist with completion of certain goals and better align our missions with the plan."**

**– Aylin Gucalp, College of Agriculture and Life Sciences, 2014**

Similarly, the work culture that the university promotes among employees has a significant impact on encouraging low-impact behaviors both on and off campus. **Innovation Key Action 2** is to **integrate sustainability** into the performance management process for all of Cornell's employees. Given that sustainability is now a unifying principle within the official 'Skills for Success' matrix, our **Next Steps** will be to help our managers effectively implement these new expectations with their teams. An important initial step will be to expand the university's existing Sustainability Leadership Development Programs, including the Cornell Management Academy's sustainability course.

## ACTION 1 – Campus Climate Literacy

### Work to ensure that climate literacy and sustainability are part of the curriculum and educational experience at Cornell.

Cornell University Sustainable Design students at work on their **Schoolhouse South Africa project**. See the project profile at http://cusd.cornell.edu/ssa/index.html.

**Goal**: Build climate literacy in the campus community through curricular and extra–curricular programs for students, and professional development programs for faculty and staff.

Climate literacy is understanding how human society influences the climate and how the climate influences human society – and it is fundamental to meaningful climate action on campus and in the world beyond. This **Key Action** involves the development and implementation of educational programs for students, faculty, and staff to be integrated with freshman orientation, undergraduate club leadership development, residential life, and professional development trainings.

In 2007 CALS Communications Professor Katherine McCommas began surveying students and staff on their attitudes, behaviors, and knowledge relating to climate change. Her research determined that an overwhelming majority of undergraduate students, almost 85%, agree or strongly agree that global warming is a serious problem. A similar majority of students recognized the processes contributing to global warming and believe that human activities, especially the emission of greenhouse gases, contribute to global warming. The full report is available at https://stars.aashe.org/media/secure/270/2/22/389/Carbon%20Neutral%20Survey%20Report.pdf. A separate series of surveys were administered in 2010 and 2012 that focused more on knowledge and attitudes related to energy conservation actions. The full report is available at http://cuaes.cornell.edu/cals/cuaes/sustainability/loader.cfm?csModule=security/getfile&PageID=1087236. Follow-up surveys of Cornell students and employees will be necessary to determine the ongoing success of campus climate literacy initiatives.

Currently Cornell offers more than 40 courses that cover the science and implications of climate change from various departments on campus. The **Climate Change Minor** (http://www.geo.cornell.edu/eas/PeoplePlaces/Faculty/mahowald/Climate%20Change%20Minor/) administered by the Department of Earth and Atmospheric Sciences is available to undergraduate students from any college at Cornell.

Siddharth Ramshankar (Eng '11) uses pedal power to light a series of light bulbs during Earth Day activities on Ho Plaza.

A **new website** (http://climatechange.cornell.edu/students-courses/) for students lists climate change courses, student initiatives, and programs.

The EcoReps program was launched in 2012 to help engage students in campus sustainability efforts through educational programs and positive role modeling. Over 60 students serve as EcoReps – or sustainable living peer educators – during freshman orientation and in freshman residence halls on North Campus. The majority of EcoReps also participate in a 3-credit service learning capstone course that focuses on sustainable living concepts, peer education methods, social marketing strategies, and the psychology of behavior change.

Looking beyond the classroom, Cornell students, faculty, and staff are applying the principles of sustainability to solve real-world problems. These efforts directly benefit the Cornell community, as well as people in communities around the globe. Recent examples of experiential learning both on and off–campus include:

- Energy Corps efforts to replace incandescent light bulbs across campus with more efficient LED and CFL bulbs are projected to yield $245,539 in savings over the next seven years.
- CU Compost Club is currently conducting a fundraising campaign to install a compost bin to serve residents of Collegetown.
- Sustainability Internship Program students have tackled projects throughout Tompkins County to address energy planning, wood smoke assessment, waste reduction, greening operations, and wetlands development, among others.
- Cornell University Sustainable Design's (CUSD) Schoolhouse South Africa project is an award-winning design-build project focusing on resilient design and collaboration.
- Cornell faculty and students are creating sustainable micro-energy systems for cooperative agriculture projects on Hawai`i Island.
- Educational videos by Cornell staff, faculty, and students are helping to share climate change information and inspiring action. View recent video projects at the following links:
    - **Professional Climate Action Plan Educational Video:** http://www.cornell.edu/video/sustainable-cornell-making-climate-neutrality-a-reality
    - **Student-made Climate Action Plan Video:** http://www.youtube.com/watch?v=kBFXDxTjwig
    - **Over 30 climate change educational videos by faculty:** http://www.cornell.edu/video/topic/climate%20change

**Next Steps**

- Promote the Climate Change Minor and advocate for expansion of sustainability related courses with the support of the Vice Provost for Undergraduate Education.
- Reach out to students at freshman orientation and throughout the year to inform them about climate issues and publicize opportunities to take action through the EcoReps program.
- Provide leadership development training for staff and graduate students in college buildings through the Green Ambassadors, Green Office Certifi cation, and Green Lab Certification programs. In 2014 these programs will be expanded university wide.
- Develop and implement climate change and climate action staff development trainings related to the recent inclusion of sustainability as an overarching principle in Cornell's Skills for Success" matrix.
- Develop tools and strategies to assess the climate literacy of incoming freshman, graduating seniors, and university staff.
- Evaluate the success of educational programs and make ongoing adjust ments, as needed.

**Resources**

Secure support and ongoing funding from Human Resources and Student Academic Services, and college deans for current campus climate literacy programs, including "Think Big, Live Green," EcoReps, student leadership development, and Green Offices and Labs.

## ACTION 2 – Integrate Sustainability into the Work Place

### Integrate sustainability as an overarching principle into the performance management process.

**Goal**: Integrate sustainability and climate action into the annual objectives and job expectations of every employee in order to foster a culture of sustainability at Cornell.

In 2013, the Division of Human Resources revised the university-wide guidance document for employee expectations, "Skills for Success," to include sustainability as an overarching principle. The new Skills for Success ask all employees to: 1) develop and implement best practices, 2) encourage others to adopt a culture of sustainability and efficiency, and 3) consider environmental, economic, compliance and social impacts in decision-making. In order to fully embrace these changes, we need to reach out to employees to help them understand the long-term and far reaching impacts of acting sustainably, and how they can most effectively contribute to a culture of sustainability through their day-to-day decisions and actions.

The performance management process, including the annual performance review process, has also been revised to align with the new Skills. The updated performance review process is set to launch in 2014, with full implementation university wide by 2015. Demonstration of the new skills – including sustainability – will soon become a performance expectation for every Cornell employee.

Next steps include training managers and supervisors on how sustainability and climate action can be integrated into their work places to support these new expectations. The new Sustainability Module in the Cornell Management Academy was designed to provide hands-on training for our supervisory staff, by: 1) demonstrating how sustainability fits into Cornell's culture, 2) communicating Cornell's vision and a manager's role in fostering sustainability, 3) giving managers tools to encourage sustainable practices in their units, 4) identifying interests, passions, and skills related to sustainability, and 5) developing plans for integrating sustainability into their units.

Careen Aresnault fills up her reusable water bottle at her work place. Her building is also piloting a compost program.

**Next Steps**

- Create outreach programs to help employees fully appreci ate the importance of sustainability in the work place and its implications on their daily actions.
- Provide training for all supervisors to provide them with tools to integrate sustainability into their work places and the per formance management process.
- Develop strategies to evaluate the success of the outreach and training programs described above.

**Resources**

Develop metrics to measure success and find the most effective ways to provide training to campus supervisors.

# KEY ACTIONS: LEADERSHIP

## Lead by example on campus and exercise climate leadership beyond campus.

**Cornell is recognized nationally for our leadership in climate action and any wavering in our commitment would be a setback for this cause."**

**– Randy Lacey, University Engineer and Senior Director of Facilities Engineering Department**

For Cornell to remain a leader on the issues of sustainability and climate protection, we need to both model responsible action on campus and support climate action around the globe. Cornell's credibility in engaging others in new energy solutions rests on our continuing success in reducing our own carbon footprint. Cornell is committed to lead by example here on our Ithaca Campus by expanding our Energy Conservation Engagement Program. This action advances Cornell's carbon neutral goal by reducing university emissions, and it is **Leadership Key Action 1** of our plan.

Cornell, with its legacy in public engagement and expertise in a broad array of disciplines, including agriculture science, is uniquely positioned to address sustainability issues and be a global leader in this field. To create the kind of networks we need to effectively address climate change on a broader scale, we will need to reach across disciplines, institutions, industries, sectors, and borders. According to a recent **United Nations report**, universities around the world are reaching out to partner with the public and private sectors to drive the sustainability transformation both on their campuses and in their larger communities (http://ourworld.unu.edu/en/universities-co-creating-urban-sustainability). These partnerships are creating jobs, building energy and food security, encouraging responsible stewardship of the environment, and engaging communities in a dialogue to generate local, regional, and global solutions.

The **Cornell Climate Change web portal** www.climatechange.cornell.edu documents the breadth and depth of Cornell's support for a scientifically informed and engaged global community. Continued and enhanced climate literacy outreach is **Leadership Key Action 2** of our Climate Action Plan.

For a more comprehensive list of Cornell's sustainability outreach programs, visit http://www.cornell.edu/outreach/programs/search_results.cfm?SearchTerms=sustainability&FormAction=Search&SearchTermsChanged=Y.

**"Universities and colleges can become truly sustainable only if they adopt the perspective of 'ecosystem awareness' and work with the communities around them to become sustainable."**

**– Peter W. Bardaglio, Ph.D., Senior Advisor, Second Nature**

**Cornell Cooperative Extension works closely with Cornell researchers to understand climate change and weather impacts on agriculture. Efforts are being made statewide to mitigate the impacts… and to help farmers adapt to new conditions."**

**– Deb Grantham, Assistant Director for Natural Resources and Environment for Cornell Cooperative Extension**

Photo by Anja Timm

Nick Van Eck, Growth Chamber Supervisor with the Cornell University Agricultural Experiment Station, checks the new energy-efficient lights in one of the retrofitted growth chambers. New lights, controls, and lining have increased the light output while slashing the energy use by 54%.

**"In 1949… with the generation capacity of 1000 kWh, the university demand was approximately 1000 kWh… In this era the university electric demand was so low at nights that our generators would feed back to the NYSEG system."**

**– Electric System History Memorandum, Department of Buildings and Properties, April 16, 1976**

# Our Changing Earth

Founded in 1932, the Paleontological Research Institution (PRI) is a national leader in the development of informal (i.e., outside the classroom) Earth science education resources for educators, students, and the general public. PRI is formally affiliated with Cornell University and works closely with numerous University departments in research, teaching, and public outreach. PRI has two public venues for education located in Ithaca: the Museum of the Earth and the Cayuga Nature Center.

Through hands-on, visual exhibitions and outreach, the **Museum of the Earth** (www.museumofthee-arth.org) tells the story of the history of the Earth and its life. New permanent exhibits at the Museum show the effects of climate change on glaciers and coral reef ecosystems and encourage critical thinking about how our species is affecting the natural world. "Moving Carbon, Changing Earth," a temporary exhibit, explains the carbon cycle and how Cornell scientist Natalie Mahowald and her team are modeling the interactions of carbon and climate. The traveling exhibit "Weird Weather" focuses on climate change in New York State and is available to organizations and community centers throughout the region.

The Museum of the Earth's new glacier exhibit. Visitors explore the science of glaciers by touching ice, investigating ice cores, and learning how glaciers shaped the Finger Lakes.

The museum offers education programs on topics such as Ice Ages and Glaciers to its visitors, and professional development workshops on climate-related topics for area teachers. In 2014 PRI will publish a new teaching resource on climate change, the latest addition to its Teacher Friendly Guide book series. *Climate Change Past Present and Future: A Very Short Guide* (2010, 200 pp.) is another PRI resource available to the general public.

The Cayuga Nature Center cultivates an awareness, appreciation, and responsibility for the natural world through outdoor and environmental education. "Our Changing Climate" is the Center's new permanent exhibit for teaching and learning about the impacts of climate change on the fauna and flora of Tompkins County. The Nature Center's live animal programs, camps, and Citizen Science tree phenology walk provide climate change education in the context of the ecosystems around us.

In August 2013, Cornell was named among the top 10 "coolest schools" by the **Sierra Club** (http://www.sierraclub.org/sierra/201309/coolschools/default.aspx), and among the top 1% of greenest colleges nationwide by the **Princeton Review** (http://www.princetonreview.com/green-honor-roll.aspx). This recognition is based on an objective assessment of Cornell's commitment to sustainability and our progress toward the **STARS** (https://stars.aashe.org/) (Sustainability Tracking, Assessment & Rating System) performance metrics established by the Association for the Advancement of Sustainability in Higher Education.

**"Cornell is a trailblazer in sustainability… I'm glad to have two of my daughters as Cornell alumni."**

**– Susana M. Reyes, Director of Human Resources, Los Angeles Department of Water and Power**

We are honored that our green practices have been recognized: when prospective students look at our ratings, they know that we "get it." Over the next two years, we will identify realistic actions we can take to increase Cornell's STARS rating by at least 15 points to earn STARS Platinum certification. **Key Action 3** of the **Leadership Pillar** is to become one of **the first Platinum-rated STARS campuses** in the nation.

**"When admitted students are trying to decide among academically similar schools, Cornell's commitment to sustainability makes a difference. The opportunity to eat local, be a steward of our gorges, recycle, and reduce our carbon footprint are important lifestyle choices for them, and for all of us."**

**– Becca Macies, CALS Ambassador, Student Sustainability Coordinator, College of Agriculture and Life Sciences, 2014**

Gorge Stewards Lisa Malloy, Sarah Kennedy, and Jamie Sternlicht on Sackett Foot Bridge.

## ACTION 1 – Energy Conservation Engagement Program

### Expand Cornell's Energy Conservation Engagement Program (ECEP) to achieve a 1% reduction in annual electrical energy usage and to educate the campus community, including thousands of future graduates, on the value of sustainable energy use.

**Goal**: Educate individual users to reduce their energy consumption, resulting in more sustainable energy use, long-term behavior change, and savings for the University. **A 1% reduction in university-wide annual electrical energy usage will reduce emissions by about 800 metric tons (CO2 equivalent) per year. Estimated annual savings based on a 1% university-wide reduction of electrical energy costs are roughly $181,400.**

Changes in the day-to-day behaviors of the campus community in terms of how individuals use lighting, heating, and office and laboratory equipment can potentially result in substantial energy savings – with a relatively low up-front investment. To foster such behavior changes, conservation outreach is needed.

Conservation Outreach was one of the 19 initial actions included in the 2009 Climate Action Plan. Previous outreach efforts were largely ad hoc: this **Key Action** seeks to formalize and improve on existing efforts, quantify the energy savings, and expand the effort across campus.

Cornell's new budget model provides a compelling incentive for colleges and units to reduce their energy consumption and increase cost-saving measures. In July 2013, the University transitioned from centralized utilities to a budget model in which each college/unit is responsible for its own utilities.

Cornell's Energy Conservation Engagement Program (ECEP), the **Think Big, Live Green Campaign** (thinkbiglivegreen.cornell.edu), employs multiple complementary initiatives to educate users and build a culture of conservation at Cornell. Users are provided with real-time energy use and cost data, as well as best practices for conserving energy which are customized to that user's particular work place, whether it be a classroom, office, lab, residence hall, kitchen, etc. Peer educators, or "Green Ambassadors," provide education, leadership development, social marketing, resources, and oversight of these initiatives.

When fully implemented, the Think Big, Live Green Campaign aims to reduce campus electric use by 1% from 2012. Early results from the pilot program in the College of Engineering are encouraging: from November 11 – December 10, 2013, the ten buildings participating in the "Fall 2013 Energy Smackdown" saved over 191,000 kWh and $15,000. Based on the projected electric budget for the College of Engineering (COE), the 1% reduction target (300,000 kWh or $24,000) is achievable by the end of the academic year – with continued engagement on the part of the COE community.

## CO2e Metrics

- CO2e reduction if every student on campus used the power saver features on their computer: **1,300 tons per year** (representing just over 1% of Cornell's annual electricity usage)
- CO2e reduction if 1,000 new office printers were energy star certified: **60 tons per year**
- CO2e reduction if every staff member turned off two 4' fluorescent lamps for 2 hrs /day: **120 tons per year**
- CO2e reduction if 1,000 students used a "smart" plug strip with printers and laptops plugged in: **170 tons per year**

College of Engineering (COE) Dean Lance Collins with the COE Green Ambassadors.

**To learn more about the Think Big, Live Green Campaign visit: thinkbiglivegreen.cornell.edu**

The four components of the **Think Big, Live Green Campaign** (thinkbiglivegreen.cornell.edu) include:

1) **College Engagement Program:**
This program educates students, faculty, and staff within a college or unit about energy saving practices they can adopt. The program was piloted in the College of Engineering in Fall 2013, with the following monthly themes:

   **September**: The BIG Paper Cut focused on reduced paper use and reduction.

   **October**: GREEN Your Workplace focused on certifying Green Labs and Green Offices.

   **November**: Fall Energy Smackdown focused on recognizing buildings that achieved the highest energy reductions.

   **December**: Setback = Payback focused on unplugging equipment and setting back thermostats during the break.

2) **Green Ambassadors:**
Faculty, staff, and graduate student volunteers support resource conservation within their respective workgroup, and serve as a point of contact between Cornell's Energy & Sustainability Department and the college community.

3) **Cornell Building Dashboard (buildingdashboard.cornell.edu):**
This Internet-based display tool tracks building energy performance through "real-time" metering (in 15-minute intervals) of electric, steam, and chilled water usage. The dashboard enables end users to see firsthand the energy and cost savings that result from specific conservation actions within their work places. A total of 96 buildings will be integrated by spring 2014, and the remaining 54 buildings on campus will be added as funds become available.

4) **Green Labs and Offices Certification Program (http://greenyourlab.cornell.edu or http://greenyouroffice.cornell.edu):**
Participating labs and offices commit to sustainable practices that are feasible for their particular situation, and, by successfully implementing these practices, they earn points towards a green certification.

Photo by Blaine P. Friedlander

Two of the College of Engineering's Green Ambassadors, Abbey Alexiades (left), administrative assistant in the dean's office, and Gail Bauman, associate director for corporate and foundation relations, discuss how they get to work. Alexiades rides a bike, while Bauman hops a bus.

**Next Steps**

- Complete the successful pilot of the Think Big, Live Green engagement program within the College of Engi neering and assess progress on the 1% electrical energy reduction goal within the first year.
- Conduct research and focus groups on community behaviors and mindsets in each college/unit prior to launching the Think Big, Live Green campaign in that college/unit.
- During the 2013-2014 academic year, expand the Think Big, Live Green Campaign to the College of Human Ecology and to Student Academic Services (to serve approximately 10,000 students).
- Evaluate and refine the pilot pro gram, and launch the Green Labs and Green Offices Certification Program university wide in 2014.
- Add the remaining 54 buildings on campus to the Building Dashboard as funds become available.
- Roll the Think Big, Live Green Cam paign out within three colleges by 2015 and university wide over the subsequent 2 3 years.

**Resources**

Secure funding for the Energy Outreach Coordinator and two outreach specialists to manage and coordinate the Think Big, Live Green Campaign roll out across campus ($200,000 annually).

## ACTION 2 – Climate Literacy Outreach

### Participate actively in climate literacy outreach to ensure that the broader community receives Cornell's assistance in making critical decisions for a sustainable future.

**Goal**: As the 2013 **IPCC (Intergovernmental Panel on Climate Change) report** (http://www.ipcc.ch/report/ar5/wg1/#.UknR9mXD-Uk) makes clear, the option of "business-as-usual" is no longer acceptable. Continued growth in greenhouse gases poses a clear and present danger to the Cornell community, our nation, and the world. The climate change challenge is understood by some, but not all, and a sense of urgency needs to be conveyed in order to motivate long-term behavior change.

As New York's land grant university, Cornell and the Cornell Cooperative Extension (CCE) system provide research-based education, resources, and tools to help individuals, families, and communities make better decisions to mitigate and adapt to climate change. Current education and outreach efforts to New Yorkers are guided by several interdisciplinary efforts:

1) **The Atkinson Center for a Sustainable Future's Climate Change Program Focus Group (CCFG) consists of 17 interdisciplinary faculty members from departments across campus, which provide a focal point for campus climate change activities and information, including teaching and outreach efforts.**

2) **Cornell's Climate Change Program Work Team (PWT) is comprised of over sixty Cornell faculty, staff, CCE educators and stakeholders from around New York State who are working to share information on climate change research and funding opportunities, develop new educational materials and outreach programs for the public, and incorporate climate change into existing outreach programs, including train the trainer efforts.** Faculty and CCE educators regularly provide climate change presentations to community groups and key stakeholders, such as the Farm Bureau, Soil and Water Conservation Districts, local county legislatures and municipal boards, and climate change materials at events such as Empire Farm Days and the NYS Fair. Two concrete examples are:

   a) Climate change training provided to New York State Master Gardener Volunteer (MGV) Programs through Cornell Cooperative extension. The NYS Master Gardener Volunteer Coordinator organized an October 2013 conference for CCE educators and Master Gardener Volunteers on "Gardening in a Changing Climate." Additional materials will be developed to help support MGVs as they work to educate New York's gardeners about climate change. (http://www.gardening.cornell.edu/)

   b) USDA-funded Animal Agriculture and Climate Change Program. This is a national extension project, with the Northeast region led by Cornell University. An online train-the-trainer course on climate change was developed for extension educators, who can then provide information to livestock producers on issues such as heat stress in dairy and extreme weather events.

3) **The Institute for Climate Change and Agriculture (ICCA) at Cornell University was established in 2013 to facilitate research, education, and outreach, to reduce the agricultural sector's collective impact on the climate and help farmers to become more resilient to climate change.** The ICCA will serve as an interactive clearinghouse of information about climate change impacts on agriculture for farmers, researchers, decision-makers, officials, and the public. The Institute will also foster collaborations and seek to increase funding to address needs related to climate change and agriculture; assess farm-level impacts, knowledge gaps, and needs around warming trends and more extreme weather; promote the development of policies and decision-tools for farmers; and provide clear, research-based educational tools and outreach about climate change and agriculture to help encourage adoption of climate change adaptation or mitigation measures.

4) **The climatechange.cornell.edu website provides a comprehensive, interdisciplinary gateway to climate change initiatives, research, student courses and organizations, events, and public engagement at Cornell.**

The premise of all of these outreach efforts is that greater awareness will lead to long-term behavior change both within the Cornell community and among key stakeholders across New York State. A short- to medium-term goal is that climate change concepts will be incorporated into two new statewide outreach programs and will reach thousands of New Yorkers through multiple community events within the next two years. Additional outreach efforts will be coordinated with the PSCC Climate Team, members of the CCFG, Climate Change PWT, and Institute for Climate Change and Agriculture.

**Next Steps**

- Continue to provide research-based climate change tools and resources through the climatechange.cornell.edu website.
- Provide training and resources for CCE Educators to educate New Yorkers, in order to extend the scope of the out reach effort.
- Work with the Institute of Climate Change and Agriculture to review the concept of creating and strengthening a network for climate change to allow researchers to broadcast new informa tion quickly and to enable farmers and natural resource managers to share their adaptation strategies. The development of this network may involve university and public/private partnerships.

**Resources**

Build partnerships with state and federal agencies, associations, and NGOs through the Institute for Climate Change and Agriculture and the Atkinson Center.

Fred Krupp, President of the Environmental Defense Fund, speaks on climate change and natural gas exploration in Milstein Hall on October 22, 2013.

President David J. Skorton and members of the President's Sustainable Campus Committee celebrate Cornell's STARS Gold certification.

## ACTION 3 – STARS Platinum Status

### Identify realistic actions and responsible parties to lead the effort to increase Cornell's STARS (Sustainability Tracking, Assessment, & Rating System) rating to become one of the first Platinum-rated STARS campuses in the nation.

**Goal**: Identify cost-effective and high–impact actions needed to increase Cornell's STARS rating by at least 15 points and engage the PSSC teams to commit to achieving these targets by 2015.

In 2010, Cornell began participating in a performance-based tracking systems called **Sustainability Tracking, Assessment & Rating System (STARS)** (www.aashe.org/stars), administered by the Association for the Advancement of Sustainability in Higher Education (AASHE).

AASHE's STARS program is the only one of its kind that involves publicly reporting comprehensive information related to a college or university's sustainability performance. Participants report achievements in four overall areas: **1)** academics, **2)** engagement, **3)** operations, and **4)** planning and administration. Currently, nearly 600 higher education institutions participate in STARS.

**Next Steps**

The Campus Sustainability Office will meet with PSCC teams to identify and prioritize realistic one and two year goals and integrate STARS Platinum planning into the April PSCC Summit. The following are potential actions that Cornell can target to attain the additional points needed:

- Expand peer to peer outreach programs for Cornell students.
- Incorporate sustainability learning outcomes into additional college curricula.
- Utilize faculty mentors and student interns to assess sustainability learning outcomes and review sustainability course designations.
- Develop and implement sustainability lit eracy assessments for all students enrolled in sustainability related courses and as part of the exit survey given to all graduating seniors.
- Pilot an incentive program for faculty to develop new sustainability courses or incorporate sustainability into existing courses.
- Increase local food expenditures.
- Expand renewable energy production on campus.
- Increase purchasing of EPEAT Silver or higher rated computers and monitors.
- Increase purchasing of Green Seal and/or EcoLogo certified cleaning products.
- Increase purchasing of recycled-content office paper.
- Increase purchasing of alternative fuel and alternative power vehicles at Cornell.
- Reduce Cornell's total waste generation, including all materials recycled, composted, and disposed of as trash.
- Begin tracking institutional efforts to reuse, donate, or re sell items rather than landfill them.
- Reduce total water consumption on campus.
- Expand sustainability outreach efforts for Cornell employees.
- Expand Cornell's sustainable investment portfolio.

**Resources**

This action is dependent on engaging multiple stakeholders around the STARS Platinum goal, in order to mobilize the university to take on a national leadership role. Success will hinge on securing support from PSCC Co-Chairs, administrative leadership, and academic deans, as well as funding for strategic priorities.

# Campus Debate:
## Greening the Endowment

Rebecca Macies and Dennis Fox, student members of Kyoto Now!, asking the board to divest from fossil fuel companies at a 2013 open session of the Board of Trustees.

Currently Cornell's endowment has nearly $71 million invested in sustainable industries, from forestry to green energy. The Cornell investment office continues to seek out investments in sustainable energy that meet the risk/return requirements established by the investment committee. Some members of the Cornell community believe that the university should move more quickly to reduce the carbon footprint of the endowment.

Major cities like Seattle and San Francisco have committed to divesting their investments in the fossil fuel industry, but, so far, no major U.S. university with a sizable endowment has done so. Based on estimates by the Cornell Investment Office, full divestment from fossil fuels would impact the financial return from the endowment and its contribution to the operating budget of the University.

**"Forward–looking estimates suggest that energy related investments will have the highest returns going forward. Not investing would impact not only portfolio returns, but also the level of diversification in the portfolio and finally, the ability to hedge against inflation."**
**– A.J. Edwards, CFA, Chief Investment Officer, Cornell University**

Beginning in 2011, the student group KyotoNow! launched a campaign calling on Cornell to completely divest the endowment from all fossil fuel companies by 2020 and reinvest 30% of the endowment in sustainable funds by 2030. After months of campaigning, on February 7, 2013, the Student Assembly passed a resolution in support of the Divest-Now! campaign. On December 11, 2013, the Faculty Senate passed its own divestment resolution, calling on university officials to implement steps to achieve carbon neutrality and full divestment from fossil fuels by the year 2035. Read the **faculty resolution** at www.theuniversityfaculty.cornell.edu. The Graduate and Professional Students Assembly (GPSA) has postponed action on its divestment resolution in light of the potential impact on rates of return from university investments, but GPSA members have announced that they will be taking this issue up again in the near future.

**"A committee of Cornell faculty members has studied the issue and determined that the University could commit to a phased divestment plan, consistent with its Climate Action Plan, that would have a negligible impact on annualized rates of return while reducing the risks of unburnable fossil fuel assets to its investment portfolio."**
**– Faculty Senate Divestment Resolution Committee**

Both sides of the debate agree that divesting would have no real impact on the companies involved and would be primarily a symbolic move on the part of Cornell. The amount of university assets invested in energy related companies is not big enough to impact the stock prices of those companies, even if every large endowment were to sell their shares today.

**"Cornell's commitment to divest would pave the way for other Ivy League universities and large institutions to follow suit and demonstrate the moral urgency of taking action on climate change and investing for a sustainable future."**
**– K.C. Alvey, Organizer, 350.org, College of Agriculture and Life Sciences, 2011**

Given the financial impacts estimated by the Investment Office, the divestment debate continues on campus. While the University has not committed to divest its endowment from the fossil fuels industry in the immediate future, President Skorton remains committed to sustainability and has agreed to an ongoing dialogue with campus advocates for divestment.

# THE WAY FORWARD

**Cornell University's Climate Action Plan Roadmap 2014-2015 presents a set of "Priority Actions" endorsed by the President's Sustainable Campus Committee's (PSCC) ten focus teams. Actions are listed according to the focus team that is responsible for following up and tracking progress.**

**Cornell's Climate Action Plan Roadmap 2014-2015** presents the comprehensive set of 62 "Priority Actions" endorsed by the President's Sustainable Campus Committee's (PSCC) ten focus teams. Actions are listed according to the focus team that is responsible for following up and tracking progress.

Action Managers have been assigned to each action. These Action Managers are accountable for moving their action forward, whether through planning, implementing, or tabling a particular action. There is no single path to achieving sustainability, and some actions may not be economically, socially, or technically feasible at the present time. These actions have not been taken off the table, however, and they will remain in the plan pending more favorable conditions for implementation. See **Appendix 3 – Tabled Actions**, for a more detailed description of the actions in this category.

This is not a plan which is intended to sit on a shelf and gather dust. This is a living document, inspired by the collective wisdom of Cornell scientists, engineers, designers, builders, administrators, managers, planners, educators, hydrologists, architects, artists, community organizers, and media relations professionals, among others.

Each of the 62 actions in the roadmap is a part of the whole. Each is a piece of the solution which is needed to address the complexity of the challenges we face. There are no competing priorities; every action in this plan counts, from waste reduction to energy efficiency to campus climate literacy. For the purposes of this plan, we are all on the same team – from our scientists and engineers to our economists and humanists, our investment strategists and trustees, our deans and administrators, and our faculty, staff, and students. We are all part of the solution, and our success is imperative.

This plan is our collective vision of the way forward. Implementing the recommendations outlined here will send a clear message that climate change and decisions about how we make and use energy are critical priorities for Cornell University and for the current administration.

**"To effectively address climate change, we need to understand how to change human behavior… We need to get people's attention and help them understand the concrete, tangible steps they can take to make a difference."**

**– Kathryn J. Boor, Dean, College of Agriculture and Life Sciences**

# OBJECTIVES

The overall objectives of the **Cornell Climate Action Plan Roadmap 2014-2015** are to describe the critical role of each of the PSCC focus teams in the pursuit of a sustainable future and to lay out high-priority policies and programs in each of the ten focus areas. The roadmap includes actions forwarded by our ten focus teams, as well as one action being spearheaded by the Campus Sustainability Office.

The scope of the roadmap is to identify specific actions each team can realistically undertake in the next two years, from January 2014-December 2015. Action Managers are accountable for making progress on each action in this plan, and many of the actions described here are already underway.

The roadmap describes the challenges and highlights the opportunities associated with each priority action. The roadmap also provides current data and a status update on actions which impact the carbon neutrality goals established by the original 2009 Climate Action Plan. In short, the roadmap shows us how far we've come and where we need to go next in order to achieve our long-term goals.

A central objective of the roadmap is not only to provide recommendations regarding new and ongoing initiatives, but also to identify the resources necessary for execution of these initiatives. Each action in the plan includes three key components: **Goals, Next Steps,** and necessary **Resources**. For all projects described in the plan, specific funding and approvals are sought case by case, as resources become available and conditions are deemed favorable for implementation.

**"We need to move the three pillars of Neutrality, Innovation, and Leadership (NIL) out to every Cornellian, so that every one of us can serve effectively as an ambassador for our plan."**

– Tommy Bruce, former Vice President for University Communications

# SUMMARY OF PRIORITY ACTIONS

This section presents a summary of priority actions endorsed by each of the ten President's Sustainable Campus Committee's (PSCC) focus teams: **Buildings, Climate, Energy, Food, Land, People, Purchasing, Transportation, Waste,** and **Water,** as well as one action being spearheaded by the **Campus Sustainability Office.** Detailed descriptions of each action are included in **Appendix 1** of this document.

## CAMPUS SUSTAINABILITY OFFICE

A **Leadership Key Action** for the university during the roadmap timeframe is to **identify realistic actions and responsible parties to lead the effort to increase Cornell's STARS (Sustainability Tracking, Assessment & Rating System) rating, with the goal of becoming one of the first Platinum-rated STARS campuses in the nation.**

Cornell needs to earn 15 additional points (85 points total, up from 70 currently) to become the first Platinum-rated university in the U.S. under the STARS program. This effort will involve multiple actions across many levels of the university in order to strengthen Cornell's sustainability outreach and education programs, increase local and sustainable purchasing, reduce waste, conserve water and energy, improve the fuel efficiency of our vehicles, and so on.

**"The advantage of STARS is that institutions can earn credits for all of their contributions to sustainability. From providing sustainability coursework, to using green cleaning products, to energy efficiency in campus buildings, there are lots of opportunities for a school to identify and track its sustainability progress."**
**– Paul Rowland, AASHE Executive Director**

This action impacts the work of all ten of the President's Sustainable Campus Committee focus teams and therefore will be overseen by the Campus Sustainability Office, within the university's Energy and Sustainability Department. Our institution is committed to this ambitious goal, and the Campus Sustainability Office will lead the way as we reach for the STARS!

**"There is a tough road ahead to be number one. Such recognition and achievement will be possible through a steady and persistent commitment to carbon reductions in all campus operations, high performance buildings, climate change education, and the application of innovative renewable energy research."**
**– Dan Roth, Director, Campus Sustainability Office**

## BUILDINGS

The U.S. accounts for five percent of the Earth's population but 30 percent of its resource consumption. According to an August 2013 article published by the **Sustainable City Network** (http://www.sustainablecitynetwork.com/topic_channels/building_housing/article_951afefa-ffb3-11e2-b3cb-001a4bcf6878.html), new construction accounts for half of American consumption.

"While the most sustainable structure is the one that is never built, physical growth is necessary to support the university's mission." This sobering statement from the 2009 CAP is still true today. By quantifying space needs and availability and by coordinating re-purposing activities on campus, we have cut campus space projections in half compared to our 2009 projections – from 4M to 2M square feet of new space. Given that a million gross square feet (GSF) equates to approximately 13,000 tons of emissions, deferring growth by 2 million GSF could avoid about 26,000 tons of CO2-e emissions annually by the year 2040.

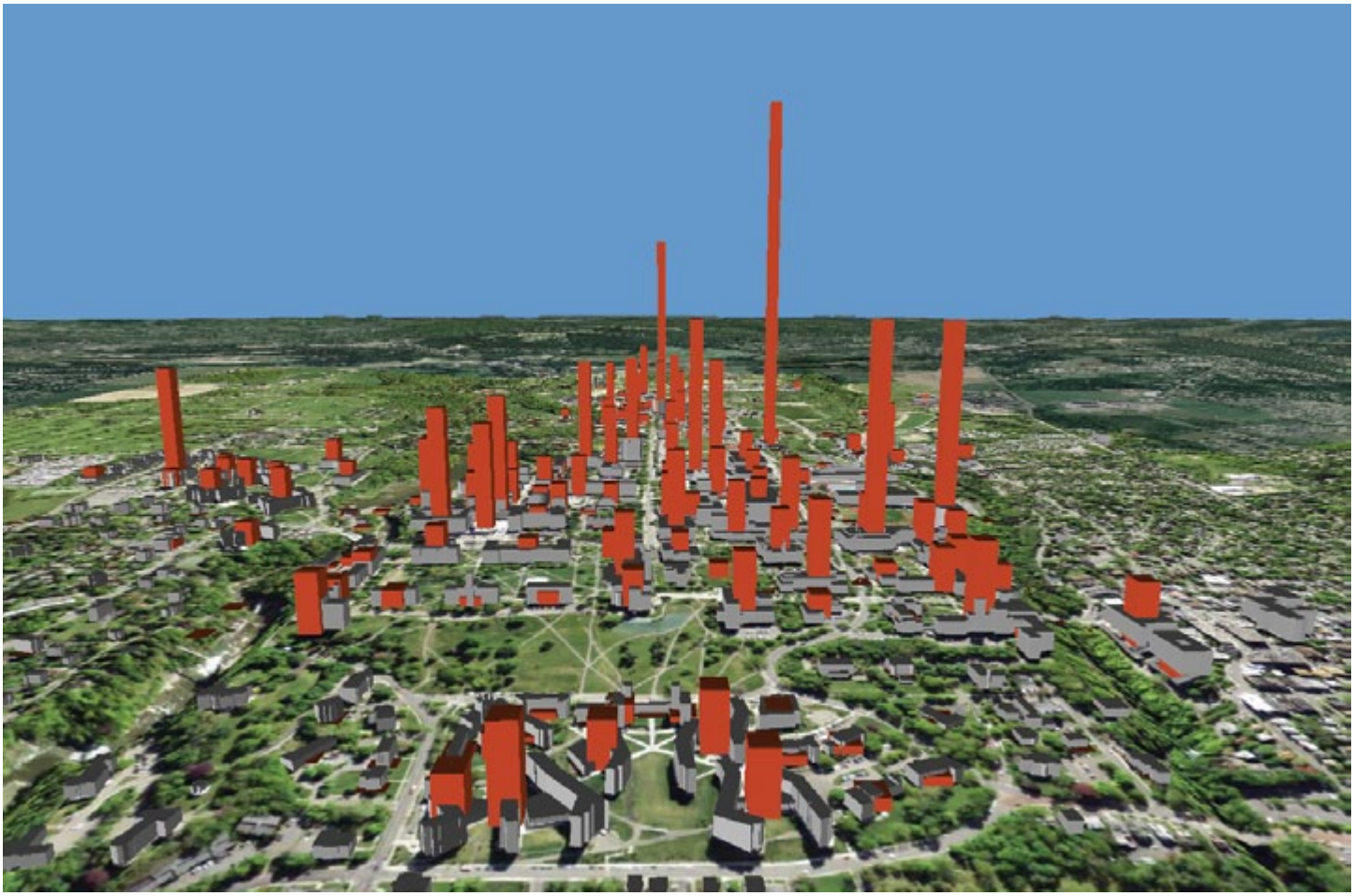
**Greenhouse gas emissions for individual buildings on Cornell's campus:** (looking east across campus from Cayuga Lake) The orange bars represent the volume of greenhouse gas emissions associated with each building's operation. Real time energy use and carbon emissions of buildings on campus are now accessible to the public on the **Cornell Energy Dashboard** at: http://building-dashboard.cornell.edu. See **Appendix 5, Greenhouse Gas Emissions** for additional details.

**"We have seven billion people on this earth, and in the last 50 years we've consumed more raw materials than in all previous human history … The EPA says that new construction is the single largest source of human toxicity."**

**– Jean Carroon, FAIA, LEED, principal in Goody Clancy's preservation practice, based in Boston**

**"We don't have to always build new – instead we can 'defragment' our existing space to repurpose and reuse it more efficiently."**

**– Elmira Mangum, Ph.D., Vice President for Budget and Planning**



Cornell's Facilities Engineering Department has updated two campus-wide standards, "Energy Guidelines" and "Energy Modeling Guidelines," to standardize and explain Cornell's requirements. Energy efficiency goals are now being incorporated into architect agreements for all major building projects on campus, and our Energy Modeling approach is being shared with project architects and contractors to maximize the energy efficiency of campus buildings.

Adopting **achievable** Building Energy Standards and **aggressively applying** these standards to building projects on campus have allowed Cornell to achieve our current goal of a minimum of a 30% reduction in building energy use as compared with the ASHRAE Standard 90.1, the national reference for building energy efficiency. Energy modeling that was conducted as a part of the original CAP suggests that a 50% reduction in laboratory and office energy use is feasible and will result in significant life-cycle savings for Cornell. Current performance is averaging 35-40% below the ASHRAE standard, and so we are well on our way toward our goal.

Buildings that have been constructed recently are performing well compared to projections from our energy use models:

- **Milstein Hall - Model 56 kBTU/ft2/y; Actual 52 kBTU/ft2/yr**
- **Weill Hall - Model 293 kBTU/ft2/yr; Actual 276 kBTU/ft2/yr**
- **Physical Sciences Building - Model 251 kBTU/ft2/yr; Actual 196 kBTU/ft2/yr**
- **Human Ecology Building - Model 115 kBTU/ft2/yr; Actual 118 kBTU/ft2/yr**

The modeled "Energy Use Intensity" (EUI) for several buildings under design is also encouraging:

- **Gates Hall modeled EUI is 63 kBTU/ft2/yr**
- **Klarman Hall modeled EUI is 45 kBTU/ft2/yr**
- **Law School Addition modeled EUI is 48 kBTU/ft2/yr**
- **Stocking Hall modeled EUI is 104 kBTU/ft2/yr**



**"Our first step should always be reduction of energy consumption. We need to put our best foot forward to make the campus built environment a showcase for Cornell's commitment to sustainability."**
**– Brad Newhouse, Senior Project Manager, LEED AP, PSCC Buildings Team**

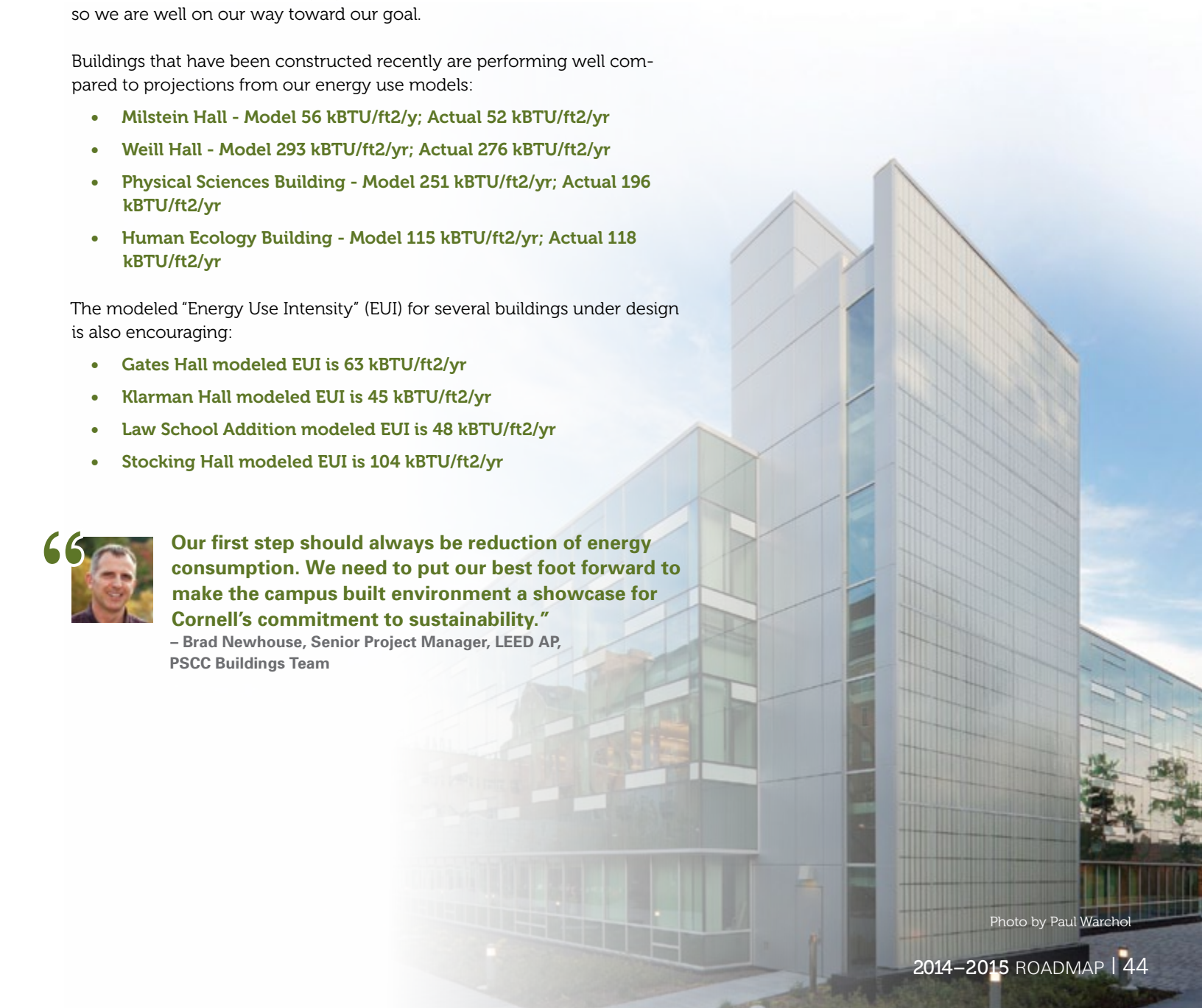


Photo by Paul Warchol

The roadmap recommends that Cornell continue to seek ways to optimize the efficient use of space and minimize the energy needed to effectively heat, cool, and power buildings on campus. The Buildings Team will focus on the following priority actions in the January 2014 – December 2015 planning window:

### NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

1. Strengthen strategies to manage the use and allocation of campus space, and plan for maximum space efficiencies in renovation and construction projects.
2. Integrate Building Energy Standards and energy modeling into the building design, review, and approval process in order to maximize energy efficiency.
3. Monitor and evaluate building energy performance of recent projects by comparing design, modeling, and actual energy use, and utilize best practices that are identified through the performance review process to inform future projects.

### INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

4. Evaluate the viability of constructing an "energy net zero" building on campus to serve as a new benchmark in sustainable building design.
5. Launch a Green Building education program to enhance student and public understanding of sustainable building practices in Cornell's built environment.

### LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

6. Adopt a university-wide policy that all new construction projects and renovations valued over 5M should achieve a minimum 50% energy savings compared to the baseline established by ASHRAE 90.1.
7. Assess the feasibility of applying US Green Building Council's LEED (http://www.usgbc.org/leed) (Leadership in Energy and Environmental Design) standards to existing buildings, in addition to new construction projects.

## CLIMATE

**"In the future, New Yorkers can expect an increase in average temperature of 1.5 to 3°F by the 2020s; 3 to 5.5°F by the 2050s; and 4 to 9°F by 2080, depending on the amount of greenhouse gases humans continue to emit into the atmosphere."**
**– Climate Change Facts, Cornell University College of Agriculture and Life Science, October 2011**

The number and intensity of extreme precipitation events are increasing in New York, and this trend is expected to continue. More rain, coming in sustained heavy downpours, heightens the danger of localized flash flooding, stream bank erosion, and storm damage. Local infrastructure, the energy grid, agricultural crops, and institutions such as schools and hospitals are all susceptible to these climate impacts. Additionally, the threat posed by climate-change-driven extreme weather to physical infrastructure and assets is of growing concern to the investment and insurance industries.

Cornell can play a leadership role nationally by incorporating vulnerability assessments and climate preparedness into our Climate Action Plan in order to minimize potential disruptions to campus as a result of extreme heat events, localized flooding, road closures, etc. Cornell has immense faculty resources to draw upon, including the **Atkinson Center for a Sustainable Future's Climate Change Focus Group (CCFG)** and the **Cornell University Climate Change Program Work Team (PWT**) (http://climatechange.cornell.edu/about/). The CCFG consists of 17 faculty members from across campus, representing disciplines such as: climate science, ecology, agriculture, engineering, economics, architecture, history, and social sciences. The Climate Change PWT is comprised of more than 25 Cornell faculty, staff, and Cooperative Extension educators from around New York State who are working to share climate change research and develop outreach materials for the public and other stakeholders.

As we evaluate the need for smarter, more resilient infrastructure to withstand extreme weather events and increased flood risks, we will evaluate impacts on Cornell's current systems, including:

- storm water management;
- waste water management;
- water treatment;
- food security (in light of increased vulnerability of local food safety and transportation networks);
- emergency response (including protocols to preserve human health in response to extreme weather);
- energy grid (incorporating on-site micro-grids that remain online during disaster events);
- investment strategies and liability assessments; and
- disaster preparedness (providing resources to internal and external communities in the event of disaster).

## Carbon Neutrality in Action

In Spring 2013, 16 students from four universities spent the semester living on Hawai`i Island, working with Cornell faculty and island mentors as participants in the **Cornell Sustainability Semester in Hawai`i** (www.geo.cornell.edu/hawaii). Underlying the program's formal coursework is an ongoing commitment to run a carbon-neutral program. Students monitor the group's energy use, reduce carbon emissions wherever possible, and offset the emissions they could not eliminate. Their offset strategy involves partnering with island conservation groups to plant trees and help restore native Hawaiian forest ecosystems. In 2013, they worked at four dryland forest sites, planting 1,975 native trees, shrubs and vines! These plants have the capacity to sequester more than 8,600 tons of atmospheric carbon dioxide.

Linda Callery measures a three-year-old Halapepe (*Pleomele hawaiiienses*), an endangered tree species, at Ka`upulehu Dryland Forest. Photo courtesy of Alexandra Moore.

Students in the program are also charged with tracking their weekly waste statistics, i.e., how many pounds of trash, compost, and recyclables they produce each week. "The results are astonishing," reports Program Director Alexandra Moore. "Without even trying hard we divert 85% of our waste from the landfill. The students learn for themselves that it is really easy to be very successful – and in this case it's a triple-bottom-line win: less landfill, less CO2, plus compost for the garden."

**"Understanding that we as educated and moral citizens have both the tools and the responsibility to repair the tragedy of the commons, rather than just describe it, is no doubt one of the most valuable things we have gained from this semester." –**
**– Nathan Greene, Interdisciplinary Studies, 2014**

# Cornell Sustainability Curricula

The Atkinson Center for a Sustainable Future started maintaining a list of sustainability courses at Cornell in the summer of 2009. For the 2013-2014 Cornell University school year, 163 sustainability-focused and 268 sustainability-related courses were counted, for a total of 431 sustainability courses. These courses are offered in 74 different departments, or 71.2% of all departments at Cornell.

**Since the 2009-2010 school year, there has been a reported increase of 241 sustainability related and focused courses. This is a 126.8% increase over the course of 5 years.**

**Below is the annual % increase:**

| Year | % Increase |
|---|---|
| 2009-2010 | -- |
| 2010-2011 | 15.8% |
| 2011-2012 | 36.8% |
| 2012-2013 | 11.6% |
| 2013-2014 | 28.3% |

The graph on the left below shows the increase in the total number of sustainability courses offered at Cornell since Fall 2009. The graph on the right below shows the percentage of sustainability courses offered per college out of the total number of courses offered by that college.

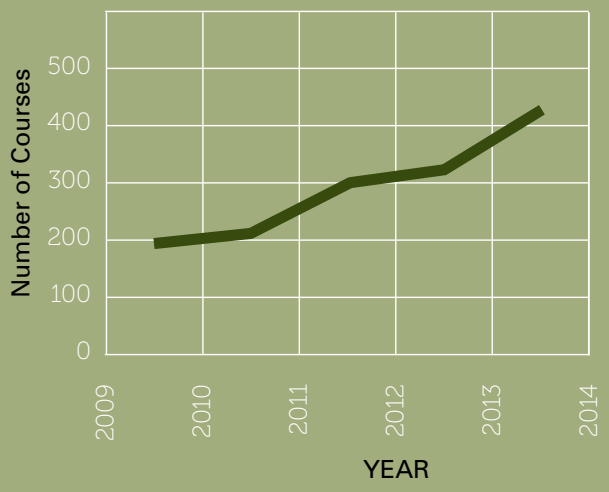
Cornell will continue to partner with local, regional, and statewide planning initiatives, such as the **Tompkins County Climate Protection Initiative (TCCPI)** (http://www.tccpi.org/), the **Cleaner Greener Southern Tier** (http://www.cleanergreenersoutherntier.org/), and other efforts to address challenges posed by climate change and increase resiliency.

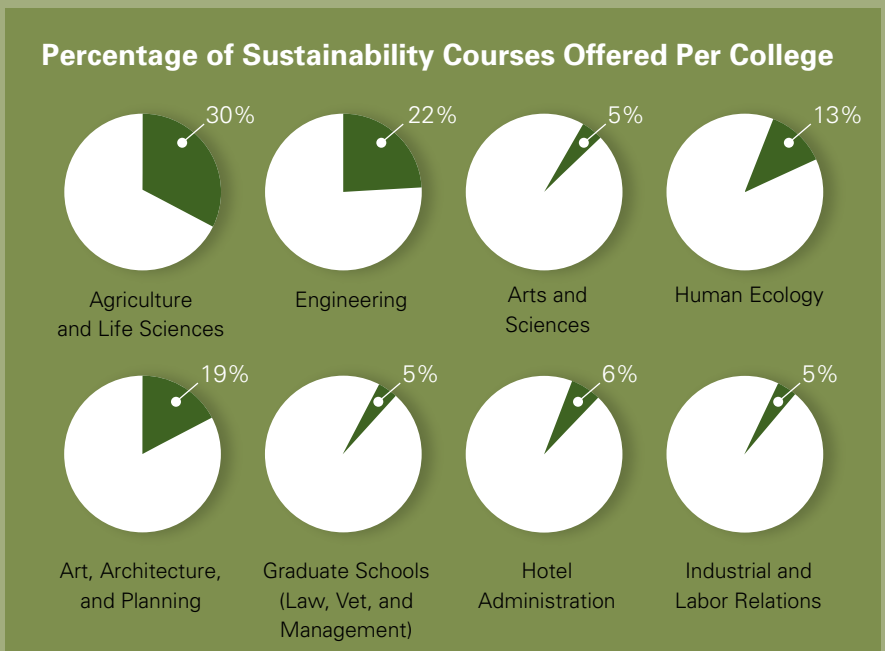
**"When students plant trees to offset their travel emissions, they begin to get a sense of scale for managing forests. Student engagement can be our greatest asset."**

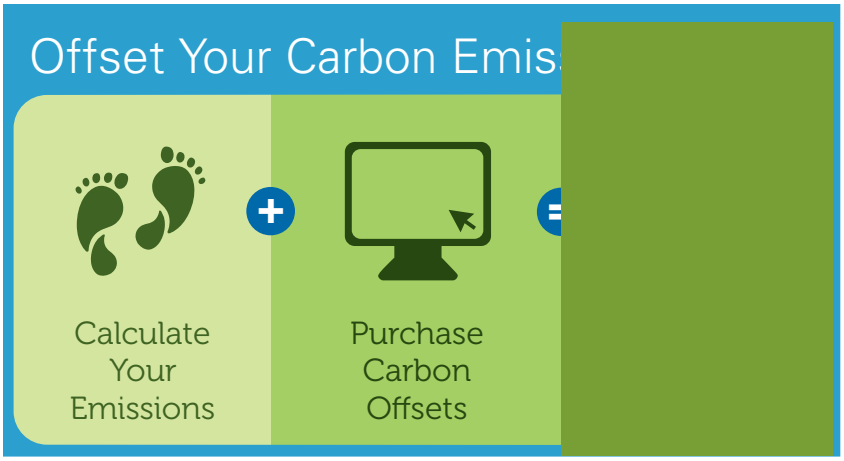
**– Frank DiSalvo, Director of the Atkinson Center for a Sustainable Future**

**Even with our best efforts, Cornell's commitment to climate neutrality cannot be achieved without some offsetting actions to mitigate travel–related emissions.** University–funded air travel and individual commuting comprised 27% of the 218,000 tons of our greenhouse gas emissions in 2012, or nearly 60,000 tons (CO2 equivalent).

A community-based carbon offset initiative, such as the **Finger Lakes Climate Fund** (http://fingerlakesclimatefund.org/), provides an excellent opportunity for Cornell to begin to address the carbon impact of university–related travel. The Finger Lakes Climate Fund is a local carbon offset program intended to promote greenhouse gas emission reductions in our region. Funds generated from carbon offset sales are used to assist low-income homeowners with paying for residential energy efficiency renovations such as insulation, weatherization, and high-efficiency heating systems. Carbon emission reductions in the community resulting from these renovations would help offset a portion of the emissions resulting from university–funded travel and from daily commuting.






**NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.**

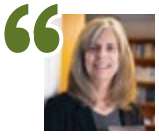
1. Implement broad-based, mission-linked carbon management strategies such as forest management, carbon capture and sequestration, and community projects to offset unavoidable university emissions.

**INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.**

2. Conduct vulnerability assessments and climate adaptation planning in order to minimize disruptions to campus as a result of extreme weather events and increased flood risks.
3. Work to ensure that climate literacy and sustainability are part of the curriculum and educational experience at Cornell.

**LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.**

4. Establish a university-wide Carbon Neutral Travel Policy that fosters zero-footprint travel through purchase of carbon offsets.
5. Collaborate in local, regional, state, national, and international planning efforts to address challenges posed by climate change and to increase resiliency.
6. Participate actively in climate literacy outreach to ensure that the broader community receives Cornell's assistance in making critical decisions for a sustainable future.



**"When we think about climate action, we tend to focus on our facilities and physical footprint. We need to break out of this stereotype and look at this issue as an integral part of the university's educational mission."**

– Laura Brown, Senior Vice Provost for Undergraduate Education

## ENERGY

As evidenced by the ovation that followed the official endorsement of Cornell's Climate Action Plan by the Board of Trustees back in 2009, there is broad support for pursuing energy sustainability at the university. However, there are significant technical, economic, and political challenges that have thus far limited Cornell's transition to energy independence. Key challenges include the precipitous drop in energy prices since 2009, and the technical challenges and financing costs of implementing large-scale renewable energy options.

Uncertainty about future conditions does not mean that a "wait and see" strategy is best. Cornell must anticipate the challenges and issues that will arise around exploiting renewable resources to produce energy and around constructing a reliable and sustainable energy system. The university can prepare for innovative new developments by creating rigorous frameworks for analyzing potential renewable energy projects. Among the new actions included in the Climate Action Plan is creation of an "Energy Procurement Plan" for the Ithaca campus to identify long-term (30-year) strategies for energy procurement at Cornell. The Energy Procurement Plan will be reviewed on a regular basis, thus providing an opportunity for Cornell's energy planners to integrate emerging technologies, assess progress on the road to carbon neutrality, and make necessary adjustments to the university's carbon reduction strategies.

In the short-term Cornell can maximize its own production of renewable energy as opportunities arise. Cornell can also serve as an early adopter of technologies which are likely to help achieve the state's energy goals in the future. As a leading research institution, the university can pilot renewable energy projects to test, evaluate, and facilitate the orderly and appropriate development of renewable energy resources.

There are many ways to lower energy expenditures through energy efficiency investments. Total annual savings in the FY 2014 budget resulting from Phase 1 of the university's Energy Conservation Initiative are $1,200,000, and annual sales show a clear decrease in total campus energy usage. The immediate priorities of the university should focus on actions to further reduce energy costs and increase efficiencies in its own facilities and operations.

### NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

1. Complete Phase 1 of the Energy Conservation Initiative (ECI) and initiate Phase 2 to conserve energy in campus buildings.
2. Optimize the campus Heat Distribution System to increase efficiency and cost-effectiveness and to facilitate the integration of Cornell's future energy sources.
3. Capitalize on more than 50 campus waste streams and other university-owned biomass resources to generate renewable energy through CURBI (CU Renewable Bioenergy Initiative).
4. Eliminate fossil fuel combustion for heating campus by developing an Enhanced Geothermal System (EGS) hybridized with biogas. Prepare a preliminary design and phased implementation plan and build a demonstration project.

> **"When he first saw the mills in 1828, Cornell felt that enough power was going to waste over the falls in Fall Creek to operate ten times the capacity of the mills… By the next year, Ezra Cornell had the solution."**
> – excerpted from Cornell University's application to the Federal Energy Regulatory Commission for the Ithaca Falls Water Power Project, June 1982

> **"By building on the leadership of states and cities that are moving to cleaner energy sources, … we can spur innovation and investment to help create new jobs and new industries, and be better stewards of the world we leave to our children."**
> – President Barack Obama, EPA FACT SHEET: Reducing Carbon Pollution from Power Plants

5. Support the expansion of regional wind generation capacity and integrate wind power into Cornell's renewable energy portfolio.
6. Integrate solar power into Cornell's renewable energy portfolio by building or buying into solar photovoltaic energy systems.
7. Optimize the operation of the existing steam turbine generators to improve the efficiency of the campus Central Energy Plant.
8. Complete upgrades to the existing hydroelectric plant to optimize electric generation.
9. Increase the amount of hydroelectric power in Cornell's renewable energy portfolio by building or buying into hydroelectric generation facilities.

## INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

10. Implement a Smart Grid which combines supply and demand management technologies to optimize the campus electrical system.
11. Explore innovative financing mechanisms, including third-party financing, federal and state grants, and other means to fund demonstration and scale-up projects.
12. Establish a framework for Green Electricity pricing to enable buildings/departments/colleges on campus to purchase renewable energy at a slightly higher cost from both internal and external sources.
13. Create a Green Revolving Fund to invest in energy conservation projects and capture energy cost savings for reinvestment.
14. Work with Cornell Energy Institute to assess the feasibility of establishing a renewable energy research park to increase the visibility of new technologies and serve as a teaching tool for the university.

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

15. Recruit key faculty to serve as advocates with university leaders to advance renewable energy projects and progress toward carbon neutrality.
16. Draft an Energy Procurement Plan to identify long-term (30-year) strategies for energy procurement at Cornell.

## FOOD

Local food production supports local farmers, keeps food dollars in the local economy, and reduces transportation, processing, and packaging associated with imported food, thus reducing the carbon footprint of our food system. Cornell University Dining actively partners with the local and regional farming community, and about 23% of the produce served by Cornell Dining is sourced regionally and/or locally. This figure is impressive, considering that New York State produces only about 10 percent of the green leafy vegetables needed to feed its residents and only about 18 percent of the fruit consumed in the state. Cornell Dining serves local beef, produce, grains and legumes, dairy products, bakery products, and locally roasted coffee.

Additionally, more than 515 tons of pre-consumer food scraps and organic waste were composted from Cornell Dining facilities in 2012. Not only does this effort divert waste from the landfill, it also produces a valuable soil amendment that can be used in the local food system to replace chemical fertilizers and enhance soil health. In the next two years the Food Team will work with the Waste Team to make food composting easier and more accessible on campus, and to encourage more food service establishments on campus to participate. Another important focal point for the Food Team is to help motivate students to reduce their own personal food waste. A campaign to "Taste, Don't Waste" was launched in Fall 2013 to encourage students to take smaller portions and consider the impact of their own food waste on the economy and environment.

Although the Ithaca Campus is seemingly surrounded by farms and local foods enthusiasts, many Cornell students remain largely disconnected from the region's food system. Most lack knowledge about where their food comes from and are unable to participate in the food system as responsible and engaged consumers. No fresh food stores exist in close proximity to campus, leaving car-less students without adequate access to healthy food. In the coming school year, The Food Team will launch two programs to address these challenges. A new Farmers Market on campus will be the first step in transforming students' relationship to food. The market enables students to see the range of products grown by local farmers and to purchase fresh local produce. The Cornell Farmers Market was held every Wednesday during the Fall 2013 harvest season on the Agriculture Quad. The Farmers Market is a student-led effort which serves approximately 300-400 students per market day.

In Spring 2014 the Food Team will implement a second pilot program, "Beyond Ramen," which targets second semester freshmen who will be moving off campus in Fall 2014 to their own apartments. The Beyond Ramen program will target Cornell undergraduate students at a time in their lives when tremendous opportunities exist to positively impact their eating habits and future health trajectories. The pilot program will:

- Promote wholesome food choices, including fresh, locally sourced foods.
- Serve as a resource center for learning about diet, health and nutrition, local food systems, and health and environmental implications of food choices.
- Teach food skills, including cooking, menu and meal planning, selecting and storing food, and reducing waste through efficient and wholesome use of leftovers.

**NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.**

1. **Reduce the environmental footprint of the food supply chain through increased regional purchasing.**

**INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.**

2. **Enhance and expand Cornell's food recovery program.**

**LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.**

3. **Teach food skills and increase students' knowledge of and interest in the local food system.**

**"Our students are the future leaders of the sustainability movement, and so the moment when they decide to sort their waste into composting and recycling, and not into landfill waste, is key. We are trying to make sure that, in that moment, they make the right choice."**

**- Richard D. Adie, General Manager, Statler Hotel**

**"Last spring members of the Food Team attended a workshop with people from the other nine sustainable committees to brainstorm how our teams were going to move the Climate Action Plan agenda forward. One suggestion was that the Food Team initiate a project directed at educating students about food – everything from cooking and shopping, to food sheds, to where food comes, etc. We now have pilot project for this almost in place! We even have a name for it: 'Beyond Ramen!'"**

**– Jane Mt. Pleasant, Associate Professor, Department of Horticulture**

## LAND

The foundation of sustainability lies in integrating systems to function holistically together. Cornell's Ithaca campus has complementary built and natural environments that enhance one another, and the interplay between open spaces and buildings creates a rich, complex, experiential environment for our community. The interconnectivity between internal spaces and open spaces is essential to the whole, as are the connections to transportation, services, and infrastructure. Cornell values open spaces as learning landscapes – as our open air classrooms and labs – as well as places that foster reflection, resilience, and the mental and physical health of our students and staff. From this perspective, the entire campus can be considered green infrastructure. There is considerable diversity in types, elements, and functions of the landscapes on campus, but each one contributes to the overall ecological services provided by the whole.

**The 'soul' of Cornell is embodied in its campus. More than 2/3 of the Ithaca Campus is open space, a fact which really distinguishes us from other campuses."**
**– Minakshi M. Amundsen, Director of Capital Budget and Integrated Planning, Budget and Planning Office**

**Cornell's Master Plan (MP)** www.masterplan.cornell.edu/ focuses on responsible development with environmental stewardship. The MP recommends a strategy of "smart growth," including higher densities and mixed land uses, along with no net loss of "ecosystem services" on campus as a result of new development. Natural areas on campus provide critical ecosystem services, such as: carbon sequestration, storm water retention, filtration (bioremediation), groundwater recharge, maintenance of water quality, erosion control, shade and climate control, biodiversity of plants and animals, and soil health, as well as opportunities for education, recreation, and aesthetic appreciation of nature. **These services are provided by the natural systems at a lower cost than it would take to design, install, and maintain mechanized systems to provide the same services for the campus.**

**Cornell is uniquely positioned to be a leader in cutting edge research… that harnesses the power of soils and vegetation to abate storm water, reduce summer temperatures, store carbon, create habitat for pollinators, and create enjoyable spaces for people."**
**– Nina Lauren Bassuk, Professor, Horticulture, College of Agriculture and Life Sciences**

All photos shown above by Jon Reis.

Image (top): The 2,300 acre Ithaca campus encompasses a diverse set of land uses. Defined by two spectacular gorges on either side, denser development is clustered and interwoven with a range of green open quadrangles, athletics fields, gardens, courtyards, and a creek running through the heart of campus – all interconnected through greenways that also tie the campus to its agricultural and natural landscapes

Image (middle): Libe Slope is one of the last remaining open parts of the original landform of East Hill rising up from Cayuga Lake. A treasured campus open space, it forms a sweeping foreground for the expansive Arts Quad – the iconic image of Cornell. Portions of the slope have been recently naturalized with grasses that hearken back to the pre-development history of the land.

Image (bottom): The Cornell Plantations Botanical Gardens and Nevin Welcome Center, the campus' first LEED Platinum building, sit in a natural bowl just off the central campus. A series of gardens includes an award winning landscape that re-establishes a natural drainage swale that retains and filters stormwater, serves as a habitat for birds and insects, and is an important outdoor teaching tool for students in many programs.

By identifying, mapping, quantifying, and enhancing ecosystem services on campus, it is possible to improve storm water retention, soil health, shade and climate control, etc. – all of which are critical to adapting to the extreme weather events which accompany global climate change. In other words, maintaining a robust green infrastructure is one way to ensure that the campus can withstand more frequent and more severe storms. Green infrastructure on campus can also serve as interpretive sites, to enhance student and public understanding of green infrastructure and its value.

The Land Team's priority actions focus on three major areas, **1)** ensuring the holistic implementation of the Master Plan, **2)** integrating sustainability metrics for land development and conservation with sustainability metrics for campus buildings, sites, and transportation and, **3)** enhancing the stewardship of unique open spaces and ecosystem services on campus to advance the university's carbon neutrality, education, student and staff health, and climate leadership goals. During the next two years, the Land Team will seek to pilot a LEED-EN certification for existing neighborhoods, develop a tour of green infrastructure sites on the campus, and create an "open space values map" of the campus including working landscapes and natural areas, overlaid with storm water management, $CO_2$ emissions absorption, sites for recreation and reflection, and other ecological services. This map will allow us to see what is already happening, as well as what might potentially happen at various sites across campus. The map can serve both as a source of research data and as a source of innovative solutions to the impacts of climate change.

**"Not only do activities such as planting trees and maintaining trails help provision ecosystem services, but such nature-based activities also foster student mental and physical well-being."**
**– Marianne Elizabeth Krasny, Professor and Director of the Civic Ecology Lab in the Department of Natural Resources, College of Agriculture and Life Sciences**

A tree planting and awards ceremony as the Cornell Plantations' Natural Areas program receives the 10th annual Richard B. Fischer Environmental Conservation Award for contributions to the Town of Ithaca's environment.

### NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

1. **Implement the land use recommendations and sustainability principles articulated in Cornell's Master Plan.**

### INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

2. **Enhance green infrastructure and associated research and interpretation on campus.**

### LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

3. **Assess the feasibility of piloting a LEED Existing Neighborhood (EN) certification for the Ithaca Campus similar to the LEED- Existing Buildings (EB) for building renovations. Collaborate with other universities to advocate in favor of applying this standard to existing campuses, as well as to existing development anywhere – campus or municipality or neighborhood.**

## PEOPLE

Equipping students, staff, faculty, and community members with the tools, knowledge, and motivation to adopt behavior changes that promote sustainability is an essential activity of a sustainable campus. Cornell's Energy Conservation Engagement Program focuses on catalyzing the source of the problem – human behavior – to drive the solution – energy conservation. The potential for meaningful climate action through fostering a culture of conservation is enormous. Educating and enabling individual users to reduce energy and conserve resources generates life-cycle benefits for the university as well as lifelong behavior changes for thousands of future graduates.

> **"Seventy percent of the carbon emissions generated by cities (which account for 70% of the planet's total carbon emissions) come from the homes and vehicles of citizens, so it stands to reason that significant reductions can't occur without ordinary people making changes to their everyday habits and behaviors."**
>
> **– David Gershon, co-founder and CEO of Empowerment Institute**

> **"The impact of what we do here on campus is magnified many-fold by the impact that Cornell's thousands of graduates can have on the world around them."**
>
> **– Lance Collins, Dean, College of Engineering**

Cornell's **Think Big, Live Green** (thinkbiglivegreen.cornell.edu) Campaign mobilizes the campus community through programs, events, and contests centered around a monthly theme. For example, the September 2013 theme was The BIG Paper Cut, focused on reducing paper use by promoting digital document reading and editing rather than printing, and reducing paper waste by promoting double sided printing. Faculty and staff representatives, or "Green Ambassadors," advise and encourage engagement in the campaign and monitor progress on implementing targeted best practices.

Think Big, Live Green (TBLG) was piloted in the College of Engineering in Fall 2013, with a goal of expanding the campaign university wide within the next 3-5 years. The TBLG Campaign utilizes the **Cornell University Building Dashboard** (buildingdashboard.cornell.edu), an online tool which provides colleges and units the ability, in real time, to save money by adjusting their energy consumption.

> **"When many people take the same actions and steps, together they can make more thoughtful use of campus resources."**
>
> **– Erin Moore, Energy Outreach Coordinator**

Another prong of the Energy Conservation Engagement Program is the Green Labs and Offices Certification Program, an initiative designed to promote sustainable practices in lab and office spaces. Each lab or office participating in the program commits to specific energy conservation actions that are feasible for that workplace in order to earn points towards "certification."

The People Team will continue to implement strategies identified in the 2009 CAP, such as expansion of Cornell's flexible work arrangements and virtual conferencing capacity. Virtual conferencing not only reduces emissions from business travel, but it also enables employees to work remotely, thereby reducing emissions from commuter travel.

## The Triple Bottom Line, or You Are What You Measure

The impacts an organization measures are a good indicator of what that organization pays attention to. The triple bottom line (TBL) consists of measuring impacts on the three Ps: profit, people, and planet. The TBL approach aims to measure the financial, social, and environmental performance of an organization over a period of time. The term was coined in 1994 by John Elkington, and the concept paved the way for the Global Reporting Initiative and the Dow Jones Sustainability Indexes.

### Visit these sites to learn more:

http://www.economist.com/node/14301663

http://www.johnelkington.com/activities/ideas.asp

**"I've always said we need to do everything all at once… that if you could invent a better battery, a better way to store electricity, you would change the world. And if you were to do that in a way that you could manufacture and export it, you would also do very well financially."**
**– Bill Nye '77, The Science Guy**

The effort to green our campus community also includes sustainability leadership training for Cornell's managers, integrating sustainability information into our employee orientation process, and incorporating sustainability criteria into our employees' performance review process.

Through the **Cornell Global Labor Institute** (http://www.ilr.cornell.edu/globallaborinstitute/), the university is working beyond the borders of our campus, with partners around the globe, to develop climate solutions, promote sustainable transportation, and advocate for renewable energy policies.

The People Team will focus on the following priority actions in 2014-2015:

### NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

1. Expand Cornell's **Energy Conservation Engagement Program** to achieve a 1% reduction in annual electrical energy usage and to educate the campus community, including thousands of future graduates, on the value of sustainable energy use.
2. Expand the university's **virtual conferencing** capacity to provide an alternative to business travel.

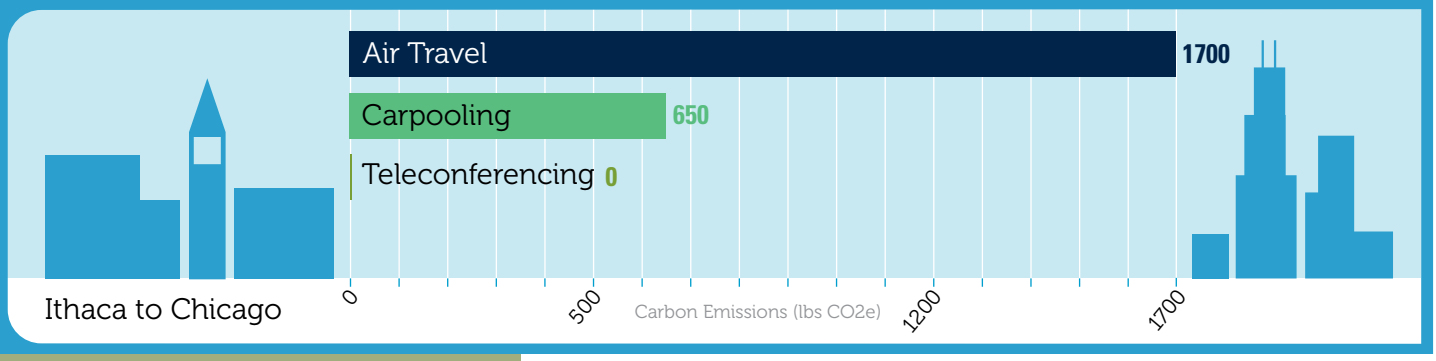
### INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

3. **Integrate sustainability** as an overarching principle into the performance management process.
4. Continue to promote and expand Cornell's **flexible work arrangements,** which enable employees to vary their starting/departure times and work place, thereby reducing commuting and associated GHG.

### LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

5. Provide training on **triple bottom line decision making** for Cornell's leadership.
6. Develop and advance labor policies to support climate protection goals and a global transition to decarbonized energy through the **Cornell Global Labor Institute.**

## Encouraging less carbon-intensive travel alternatives



## PURCHASING

The ACUPCC Climate Commitment that President Skorton signed explicitly identifies, "Adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist," as a tangible action that participating universities should include in their Climate Action Plans. As of August 2013, 82% of the universities that have signed the commitment have adopted an appliance efficiency policy. A policy establishing energy efficiency requirements for new purchases and bids can help to reduce the life-cycle cost of the product or equipment purchased. Energy efficient products (such as ENERGY STAR-rated products) reduce energy consumption by 10-75% and result in operational cost savings of 5-75% percent on a continual basis, depending on the product replaced. The Purchasing Team will look at how to move this policy recommendation forward at Cornell.

Local investment and business incubation are part of Cornell's land grant mission, i.e., Cornell returns New York State's investment by directing its education, applied research, and outreach to benefit the citizens of New York. As a major enterprise, Cornell makes a significant contribution to the State's economic prosperity. Roughly 20% of Cornell's business is done locally, and 50% is done in New York State. The Purchasing Team has worked diligently to incorporate, promote, and give increased weight to sustainability criteria, including locality and GHG emissions, as part of the university's product and vendor selection process.

Sustainability is one metric used to grade a key group of the university's most strategic partners, called "preferred suppliers." Cornell's Purchasing Department asks these 20+ suppliers to describe their key sustainability efforts and accomplishments. These efforts can be specific to Cornell or can include practices the company is implementing on a global basis.

For example, last year VWR Scientific implemented a Cornell-specific program to recycle pipet tip boxes which recovered 4,500 pipet tip boxes that would otherwise have ended up in a landfill. A more global example is provided by Staples, which has introduced a competitively priced sugarcane-based copy paper to its product lines, converted a portion of its delivery fleet to electric vehicles, and installed solar power at more than 30 of its stores. Staples is also providing Purchasing with data on the amount of packaging Cornell is saving as a result of a new requirement that all orders placed on campus meet a $50 minimum.

In the next two years, Cornell will work with key local partners to assist them to become more competitive in our marketplace and to make their products more appealing options to the campus. Procurement Services will review inbound logistics to develop a program to assist small and local businesses with freight consolidation. A longer–term or "stretch" goal is to further consolidate shipments among local suppliers over the next 3-5 years, thereby resulting in fewer vehicles making the trip to campus.

**"Cornell staff have been engaged in and conscious of reducing the university's carbon impact for many years. Through such actions as use of public transit to reduce business travel, switching off lights, and two-sided printing, everyone can contribute."**
**– Joanne M. DeStefano, Vice President for Finance and Chief Financial Officer**

The Procurement Services' website now highlights EPEAT, ENERGY STAR, and Green Seal certified products, and markets the benefits of purchasing locally. Visitors to the website are encouraged to ensure the products they purchase are sustainable by looking for the following labels and certifications:

## Reducing Consumption of Plastic Bags on Campus

The Cornell Store has long supported environmentally responsible use of their "big red bag" plastic bags. Beginning on Earth Day, April 22, 2013, store management took its commitment to reduce plastic bag use to a new level through implementation of a five-cent fee for each new single-use bag requested by customers.

Revenues collected through the fee are deposited into the Green Revolving Fund, which was recently established at the university to fund projects that encourage energy conservation and reduction of Cornell's carbon footprint. As of November 13, 2013 (roughly six months after the five-cent fee was implemented), The Cornell Store had collected $1,921.55 in bag fees to seed the new fund. The fee does not cover the cost to produce the bags, so The Cornell Store is continuing to underwrite the cost of the bags.

**"Paying for the bag places an intrinsic value on it and makes the consumer more apt to reuse it or to opt for no bag or a tote bag."**
**– Pat Wynn, Director of The Cornell Store**

Ongoing practices The Cornell Store has supported for many years will continue, including:

- Plastic bags are optional, so many customers already decline bags and use their own backpacks or tote bags.
- Plastic bags used at the store are composed of a high percentage of recycled materials and are fully recyclable and biodegradable, while still being strong enough to hold textbooks and to be reused.
- Plastic bag recycling drop-off locations are accessible throughout the store.
- The Cornell Store piloted the first plastic film collection process at Cornell.

**NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.**

1. Implement an efficiency standards policy for equipment purchases at Cornell.

**INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.**

2. Utilize "Fast Tracks" in Cornell's online Procurement Gateway to facilitate purchasing of sustainable office equipment and supplies, recycled paper, remanufactured toner, EPEAT certified computers, etc., and to limit the availability of less sustainable products (see sample template below).

**LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.**

3. Consider sustainability criteria, including locality and GHG emissions, in the vendor selection process to reduce the environmental footprint of Cornell's supply chain.

## Cornell is Bag Smart

In Spring 2013, the Cornell Store implemented a five cent fee for new bags in an effort to reduce consumption of single-use bags. Students are encouraged to use a backpack, a reusable bag, or "big red bags" they've already saved instead of purchasing a new bag.

See the Cornell Store, The Society for Natural Resource Conservation, Student Assembly resolution **"Student Support for a Campus–Wide Plastic Bag Free"** http://assembly.cornell.edu/SA/20121129R28, and the Green Revolving Fund.

## TRANSPORTATION

Reducing transportation energy demand and shifting to non-fossil energy sources will require long-term, concerted effort. In the short-term, Cornell should continue to focus its attention on mass transit system improvements. Tompkins Consolidated Area Transit, Inc., usually referred to as TCAT, is a private, non-profit public transportation operator, managed jointly by Cornell University, Tompkins County, and the City of Ithaca. As TCAT's largest customer, accounting for roughly 71% of annual ridership, Cornell wields significant influence as a major proponent of mass transit in Tompkins County. In 2011, TCAT was recognized as the nation's "Outstanding Public Transportation System" in the 1-4M ride category by the American Public Transportation Association.

**"We have the best public transit system for a community our size in the country."**

**– Dave Howe, Director of Facilities Services**

**"Leading with a good example in Ithaca, where transportation sector greenhouse gas emissions top the charts, can have widespread impacts in other regions where transportation is also target #1 – like California!"**

**– Paul F. Mutolo, PhD, Director of External Partnerships, emc2 — the Energy Materials Center at Cornell**

In 2014 TCAT will add New York State's first **hydrogen fuel-cell bus** (http://www.emc2.cornell.edu/news/story/tcat-to-receive-ithaca-s-first-cutting-edge-fuel-cell-bus.html) to its fleet, and a hydrogen station will open in Ithaca to fuel the bus and other fuel-cell vehicles. The station will generate hydrogen right on site, and it will be the first public hydrogen station in upstate New York and one of only a dozen in the country. Fuel cells produce electricity from a chemical fuel, so fuel cell powered vehicles have long ranges, fast refuel times, and emit no carbon pollution. Fuel-cell cars could be commercially available by 2015. Paul Mutolo (EMC2), a fuel cell chemist and director of external partnerships for the Energy Materials Center at Cornell, helped develop the federal grant proposal to purchase the new bus. Seed funding to research sustainable hydrogen production, awarded by the Atkinson Center in 2012, was instrumental in facilitating this groundbreaking effort to create an infrastructure for emissions-free transportation.

**"We would like to stress the significant positive impacts of Cornell's community-based approach to transportation… [which] reverberate throughout the community and create significant goodwill with other local agencies and organizations."**

**– Jennifer Dotson, Executive Director, Ithaca Carshare**

Other priority actions in the roadmap include continuing support for the Campus to Campus Bus between Ithaca and New York City, incorporating new and better vehicles that consume little or no fossil fuel into the existing fleet and operations, and promoting alternative transportation options such as enhanced car-share and bike-share programs.

Members of the Fleet Services crew, including bus drivers, pose in front of the Campus to Campus (C2C) Bus.

**NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.**

1. Increase the use of mass transit by the Cornell community through the OmniRide Program and enhanced outreach for Cornell employees during the onboarding process.
2. Encourage mass transit between Ithaca and NYC through continued support for Campus to Campus Bus.
3. Reduce fossil-fuel consumption of the Cornell fleet through MPG standards in vehicle purchases, alternative-fueled vehicle purchasing, and a fleet management system.
4. Encourage the use of existing private platforms for car sharing, carpooling, and ridesharing by the Cornell community.

**INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.**

5. Implement a comprehensive bike master plan to improve the safety and accessibility of campus and public roadways.
6. Continue support for the Big Red Bike sharing program.

**LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.**

7. Develop and implement comprehensive strategies to support mass transit in Tompkins County and increase ridership.
8. Establish a campus-wide policy for reduced fossil-fuel consumption among Cornell-owned vehicles.

## WASTE

**A big piece of the waste reduction story isn't counting how much less we throw away, but rather reducing what we purchase. If we all buy fewer coffee cups, copy paper, and bottled water, then we will throw less away."**
**– Spring Buck, Manager, R5 Operations, Cornell University**

Waste prevention conserves resources such as metals, water, and petroleum, and minimizes the environmental impacts associated with mining, drilling, extracting, processing, and transporting raw materials needed to manufacture new goods or reprocess materials. Reusing or prolonging the lives of products also means that new items don't need to be purchased as frequently. Through effective campus engagement and green purchasing decisions, Cornell can help prevent waste and reduce the need to extract precious raw materials.

The 2009 and 2011 Climate Action Plans did not account for the impacts of Cornell's waste stream on the university's carbon emissions. To better inform decision making on campus, the Waste Team is currently conducting a systemic analysis of campus waste, including the impact of waste operations on Cornell's GHG emissions. This waste impact study can serve as the foundation for improved management of university materials. The study can help Cornell to identify and quantify waste streams which are not currently being optimally utilized. Some of these waste streams can serve as additional feed stocks for **CURBI** (Cornell University Renewable Bioenergy Initiative) (See **Neutrality Key Action 4**), or for local non-profit and for-profit ventures. For example, wastewater from the animal digester at the Cornell University College of Veterinary Medicine is now being delivered to the Ithaca Area Wastewater Treatment Facility, where it is digested to serve as an energy source, and surplus furniture from campus was recently donated to the Finger Lakes Fresh Food Hub to outfit their new facility.

Cornell's composting operation.

## One Bar at a Time

In February 2013, The Statler Hotel at Cornell University launched a new collaboration with Clean the World, a not-for-profit organization that aims to deter the spread of preventable diseases around the world by recycling and redistributing soap and bottled amenities that would otherwise be discarded. As of October 2013, soap from the Statler had been repurposed to create 2,518 bars of soap and leftover plastic bottles found their way into 1376 hygiene kits to be distributed at homeless shelters, while also diverting a significant amount of waste from landfills.

Since 2009, **Clean the World** (www.cleantheworld.org) has given away more than 12 million bars of soap collected from more than 1,700 hospitality partners. Clean the World distributes recycled soap and hygiene products to children and families who are at risk from the top two killers of children worldwide: acute respiratory infection (pneumonia) and diarrheal diseases (cholera).

Clean the World is the first program launched by the Statler as part of the hotel's sustainability partnership with EarthView®, an award-winning program developed by The Hersha Group. Since the partnership was announced in February 2013, EarthView and the Statler have been working together to launch 25 green initiatives as part of a comprehensive sustainability program. The partnership enables the Statler to further enrich its educational program while also realizing significant triple-bottom-line (See sidebar: The Triple Bottom Line) savings for the hotel.

The Statler serves as the teaching hotel for students at the Cornell School of Hotel Administration and is the 2014 winner of the Good Earthkeeping Award from the New York State Hospitality and Tourism Association (NYSH&TA) for successfully implementing many green initiatives.

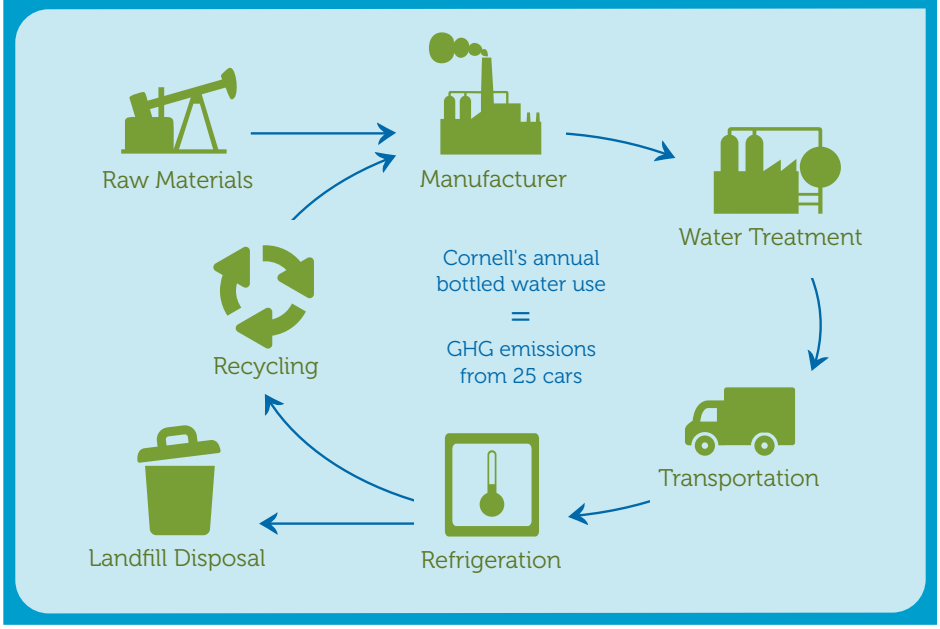
Cornell's R5 Operations (Respect, Rethink, Reduce, Reuse, Recycle) manages the non-hazardous waste and recycling program for Cornell's Ithaca campus. R5 Operations hosts programs for recycling of papers, plastics, cans, glass, electronics, used oil, scrap metals, wood, tires, light bulbs, batteries, and more. All of Cornell's solid waste recycling is tracked and measured as part of an aggressive program to cut waste to an absolute minimum while maximizing recycling, composting, and the reuse of materials. Roughly 68% of the waste generated on Cornell's Ithaca Campus is diverted from the area landfill. About 37% of the total waste stream is compost, virtually all of which is captured and processed here on campus. Composting programs can be expanded to include coffee shops, office spaces, and residence halls on campus. The R5 Operations Department continues to work on identifying ways to reduce overall waste and develop comprehensive, life-cycle materials management strategies.

**Sustainability matters to me because I care deeply about not wasting precious materials. Even things like food waste can be transformed into something incredibly useful."**

**– Yining Dai, College of Engineering, 2016**

Cornell's Environmental Health and Safety (EH & S) Department operates the university's hazardous waste management program. EH & S collects hazardous wastes from campus, implements pollution prevention efforts, and selects disposal options which minimize environmental impacts associated with these wastes. Each type of hazardous waste is handled and processed differently, but in a safe and compliant manor. The department works to reduce both the volume of hazardous waste generated and the volume which is disposed of. Cornell has a variety of programs and processes to track and reduce chemicals used in campus labs. The Surplus Chemical Recycling Program collects un–used products which labs no longer need, stores them, and makes them available to other labs on campus via a web-based procurement system.

## The Life Cycle of a Plastic Water Bottle




**NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.**

1. Complete a carbon impact study for Cornell's waste stream to establish a baseline of GHG emissions associated with the current waste stream.

**INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.**

2. Work to integrate composting into events, offices, and residence halls on campus.
3. Develop strategies for improved management of university materials and identify opportunities to utilize recovered materials as inputs for local not-for-profit or for-profit ventures.
4. Develop a deconstruction program to divert waste from building clean outs, renovations, and decommissions from the landfill.

**LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.**

5. Develop a university–wide waste reduction policy, including a comprehensive, campus-wide materials management strategy.
6. Expand re–use programs both for internal reallocation of university owned materials and for repurposing of surplus materials no longer needed on the campus, either by offering these items for sale or by donating them to non–profit organizations.

## WATER

The source of Cornell's water is the 125-square mile Fall Creek watershed. Cornell's **Water Filtration Plant** (http://energyandsustainability.fs.cornell.edu/util/water/drinking/default.cfm) provides a population of about 34,000, including the campus community and some residents of the neighboring Forest Home and Cornell Heights neighborhoods, with safe and reliable drinking water. In 2012, the plant produced 507,000,000 gallons of potable water: approximately 9% of this water was used to generate energy for campus, while 91% of the total supplied campus potable water and agricultural needs.

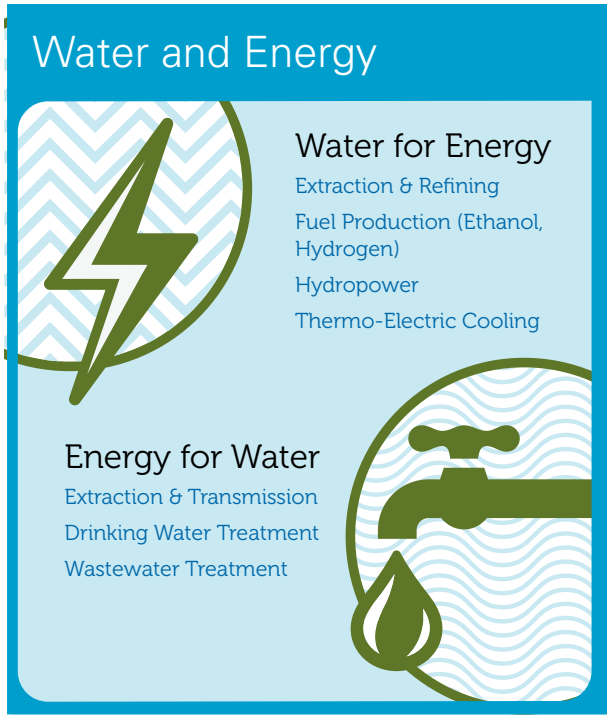
The Water Team promotes water conservation, storm water management, watershed protection, and the consumption of tap water (rather than bottled water) at events on campus and throughout the community. To more precisely quantify the energy associated with Cornell's water system, the Water Team is proposing a water/energy nexus study for the Ithaca campus. This study will quantify energy use associated with the current water delivery system as a basis for prioritizing and implementing infrastructure upgrades, such as pump replacements. The study will also provide a basis for implementing water conservation measures on campus, by linking these measures to reductions in energy use.

A preliminary analysis conducted in 2012 showed that approximately 4% of campus energy is used to treat and pump campus potable water, and 9% of campus water is used to generate energy. The next phase of the study will assess how much energy is used to treat campus wastewater at the Ithaca Area Wastewater Treatment Plant, and may also attempt to quantify the volume of water used to extract the natural gas used to generate campus electricity.

The Water Team's near-term strategies to promote water conservation on campus include:

- Continue to add water meters to buildings (15-20% of the water produced by the Cornell Water Filtration Plant is currently unmetered).
- Add water usage to the **Cornell University Building Dashboard** (buildingdashboard.cornell.edu), an online tool which provides colleges and units the ability, in real time, to save money by adjusting their consumption.
- Include water conservation in the college engagement campaign, **Think Big, Live Green** (thinkbiglivegreen.cornell.edu).

The Water Team also plans to continue to promote the **"Take Back the Tap"** (http://www.sustainablecampus.cornell.edu/initiatives/take-back-the-tap) (TBTT) bottled water reduction campaign. Between 350,000-400,000 single-serving bottles of water are sold on the Cornell campus annually. In addition, approximately 33,000 five-gallon carboy bottles of water are purchased for use in office water coolers. Bottled water costs the campus community an estimated $640,000 per year, but the same volume of tap water would cost just $1,000. Cornell's annual consumption of bottled water causes nearly 115,000 kg of CO2 emissions, or the equivalent of 265 barrels of oil. The goal of the Take Back the Tap initiative is to reduce bottled water consumption and associated costs, energy use, and GHG emissions through education and behavior change.



**Cornell tap water is clean and safe to drink; in fact, Cornell tap water is held to far higher standards than that bottled water you were about to waste $2.50 on."**
**– Joseph S. Spivak, Sustainability Communications Intern, College of Agriculture and Life Sciences, 2016**

The TBTT campaign is making a difference: bottled water sales at campus convenience stores and community centers have decreased by roughly 25%. Other recent achievements include:

- All incoming students receive reusable bottles.
- Cornell's design standards for new buildings and renovations now include bottle fillers.
- Many existing drinking fountains have been upgraded with bottle fillers.
- An **inventory of bottle filling stations** has been posted online (http://energyandsustainability.fs.cornell.edu/file/DAT-2013-04-22-BottleFillerInventory.pdf)
- Inline water coolers, which are fed by Cornell water, are a sustainable, cost effective option to replace carboy style water coolers. Mister Koffee, a local business, has been selected as Cornell's vendor of choice, and the new coolers are now available through eShop. More than 25 inline coolers have been installed on campus to date.

Bottled water sales at campus events have, however, not declined – emphasizing the need for increased outreach and education around green event planning. Our "green events team" will identify existing communications channels and processes through which university events get planned and advocate for making events bottle–free.

## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

1. **Complete a water/energy nexus study for the Cornell campus and implement comprehensive strategies to monitor usage, conserve water, and reduce energy associated with treating potable and waste water.**
2. **Increase the energy efficiency of the campus water delivery system through upgrading aging pumps and infrastructure.**

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

3. **Continue the "Take Back the Tap" outreach campaign to promote the use of reusable water bottles and containers, particularly at events and conferences, thereby reducing supply chain emissions and waste associated with bottled water.**

Giant bottle the student TBTT group built in 2012 as part of their campus outreach efforts, which also featured signs stating how many water bottles are disposed of on campus each day and how much oil it took to produce/transport those bottles ("Enough to drive you to Disney World"), reminding students that tap water is free ("Spend your BRBs on a cookie instead!"), and directing students to a bottle filling station.

Cornell President David Skorton "takes back the tap" with his reusable water bottle.

**APPENDIX 1 – Detailed Description of Priority Actions**

**APPENDIX 2 – A Diversity of Stakeholders: Quotes from the Plan**

**APPENDIX 3 – Tabled Actions**

**APPENDIX 4 – Energy Conservation Initiative Project Summaries**

**APPENDIX 5 – Greenhouse Gas Emissions for Individual Buildings on Cornell's Campus**

# Detailed Description of Priority Actions

## TABLE OF CONTENTS


2 Campus Sustainability Office
2 Action 1 - STARS Platinum Status

4 Buildings
4 Action 1 - Maximum Space Efficiencies
6 Action 2 - Building Energy Standards
8 Action 3 - Energy Performance Review
9 Action 4 - "Energy Net Zero" Building
10 Action 5 - Green Building Education Program
11 Action 6 - Building Energy Standards Policy
12 Action 7 - LEED Standards for Existing Buildings

13 Climate
13 Action 1 - Mission-Linked Offsets
15 Action 2 - Climate Adaptation Planning
17 Action 3 - Campus Climate Literacy
19 Action 4 - Carbon Neutral Travel Policy
20 Action 5 - Collaborate in Climate Planning Beyond Campus
21 Action 6 - Climate Literacy Outreach

23 Energy
23 Action 1 - Energy Conservation Initiative
25 Action 2 - Optimize Heat Distribution System
26 Action 3 - CU Renewable Bioenergy Initiative
27 Action 4 - Enhanced Geothermal System
28 Action 5 - Wind Power
29 Action 6 - Solar Power
31 Action 7 - Optimize Steam Turbines
32 Action 8 - Hydroelectric Plant Upgrades
34 Action 9 - Hydroelectric Power
35 Action 10 - Campus Smart Grid
37 Action 11 - Innovative Financing Mechanisms
38 Action 12 - Green Electricity Pricing
39 Action 13 - Green Revolving Fund
40 Action 14 - Renewable Energy Research Park
41 Action 15 - Faculty Advocacy Group
42 Action 16 - Energy Procurement Plan

43 Food
43 Action 1 - Increase Regional Purchasing
45 Action 2 - Expand Food Recovery
46 Action 3 - Teach Food Skills

47 Land
47 Action 1 - Implement Cornell's Master Plan
49 Action 2 - Green Infrastructure
51 Action 3 - LEED for Existing Neighborhoods Policy

52 People
52 Action 1 - Energy Conservation Engagement Program
54 Action 2 - Virtual Conferencing
55 Action 3 - Integrate Sustainability into the Work Place
56 Action 4 - Flexible Work Arrangements
58 Action 5 - Triple Bottom Line Decision Making Training
59 Action 6 - Cornell Global Labor Institute

61 Purchasing
61 Action 1 - Equipment Efficiency Standards Policy
62 Action 2 - Sustainable Products Procurement
63 Action 3 - Incorporate Sustainability into Vendor Selection

64 Transportation
64 Action 1 - Increase Campus Use of Mass Transit
66 Action 2 - Campus to Campus Bus
67 Action 3 - Increase Efficiency of Cornell Fleet
68 Action 4 - Car Sharing, Carpooling, & Ridesharing
70 Action 5 - Campus Bike Master Plan
72 Action 6 - Big Red Bike Sharing Program
73 Action 7 - County-wide Support for Mass Transit
74 Action 8 - Campus-wide Vehicle Efficiency Standards Policy

75 Waste
75 Action 1 - Carbon Impact Study of Campus Waste Streams
76 Action 2 - Expand Campus Composting
77 Action 3 - Improve Campus Materials Management
78 Action 4 - Deconstruction Program
79 Action 5 - University Waste Reduction Policy
80 Action 6 - Re-use Programs

82 Water
82 Action 1 - Water/Energy Nexus Study
83 Action 2 - Increase Efficiency of Water Delivery System
84 Action 3 - Take Back the Tap

This Appendix presents a detailed description of the priority actions endorsed by each of the ten President's Sustainable Campus Committee's (PSCC) focus teams: **Buildings, Climate, Energy, Food, Land, People, Purchasing, Transportation, Waste,** and **Water**, as well as one action being spearheaded by the **Campus Sustainability Office**. Each action description includes three key components: **Goals, Next Steps,** and necessary **Resources**. For all projects described in the plan, specific funding and approvals are sought case by case, as resources become available and conditions are deemed favorable for implementation.

# CAMPUS SUSTAINABILITY OFFICE

## 1. Identify realistic actions and responsible parties to lead the effort to increase Cornell University's STARS® (Sustainability Tracking, Assessment, & Rating System™) rating with the goal of becoming one of the first Platinum-rated STARS campuses in the nation.

**Goal:** Identify cost-effective and high-impact actions needed to increase Cornell's STARS rating by at least 15 points, and engage the PSSC teams to commit to achieving these targets by 2015.

In 2010, Cornell began participation in a performance-based tracking systems called **Sustainability Tracking, Assessment & Rating System (STARS)** (www.aashe.org/stars), administered by the Association for the Advancement of Sustainability in Higher Education (AASHE).

### Next Steps

The Campus Sustainability Office will meet with PSCC teams to identify and prioritize realistic one- and two-year goals and integrate STARS Platinum planning into the April PSCC Summit. The following are potential actions that Cornell can target to attain the additional points needed:

- Expand peer-to-peer outreach programs for Cornell students.
- Incorporate sustainability learning outcomes into additional college curricula.
- Utilize faculty mentors and student interns to assess sustain ability learning outcomes and review sustainability course designations.
- Develop and implement sustainability literacy assessments for all students enrolled in sustainability related courses and as part of the exit survey given to all graduating seniors.
- Pilot an incentive program for faculty to develop new sus tainability courses or incorporate sustainability into existing courses.
- Increase local food expenditures.
- Expand renewable energy production on campus.
- Increase purchasing of EPEAT Silver or higher rated computers and monitors.
- Increase purchasing of Green Seal and/or EcoLogo certified cleaning products.
- Increase purchasing of recycled-content office paper.
- Increase purchasing of alternative fuel and alternative power vehicles at Cornell.
- Reduce Cornell's total waste generation, including all materi als recycled, composted, and disposed of as trash.
- Begin tracking institutional efforts to reuse, donate, or re-sell items rather than landfill them.
- Reduce total water consumption on campus.
- Expand sustainability outreach efforts for Cornell employees.
- Expand Cornell's sustainable investment portfolio.

### Resources

This action is dependent on engaging multiple stakeholders around the STARS Platinum goal, in order to mobilize the university to take on a national leadership role. Success will hinge on securing support from PSCC Co-Chairs, administrative leadership, and academic deans, as well as funding for strategic priorities.

AASHE's STARS program is the only one of its kind that involves publicly reporting comprehensive information related to a college or university's sustainability performance. Participants report achievements in four overall areas: **1)** academics, **2)** engagement, **3)** operations, and **4)** planning and administration. Currently, nearly 600 higher education institutions participate in STARS.

Cornell needs to earn 15 additional points (85 points total up from 70 currently) to become the first Platinum-rated university in the U.S. under the STARS program. This effort will involve multiple actions across many levels of the university in order to strengthen Cornell's sustainability outreach and education programs, increase local and sustainable purchasing, reduce waste, conserve water and energy, improve the fuel efficiency of our vehicles, and so on. This action impacts the work of all ten of the President's Sustainable Campus Committee focus teams and therefore will be overseen by the Campus Sustainability Office, within the University's Energy and Sustainability Department.

# BUILDINGS

## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

### 1. Strengthen strategies to manage the use and allocation of campus space, and plan for **maximum space efficiencies** in renovation and construction projects.

**Goal:** Reduce energy (and greenhouse gas emissions) associated with new building construction by reducing the amount of new space required on campus.

Future energy use can be reduced and avoided through efficient and effective use of existing campus space. The intended use, project needs, and source of funds to cover projected maintenance costs are all factored into decision making about whether to build new space on campus. Cornell's Space Use Advisory Committee (SUAC), formed in March 2010, has successfully incorporated the principles of space planning and management into the university's capital project decision-making process. SUAC members are vice provosts/vice presidents or their direct representatives. In the past few years, the SUAC has codified Cornell's space planning and management protocols as follows:

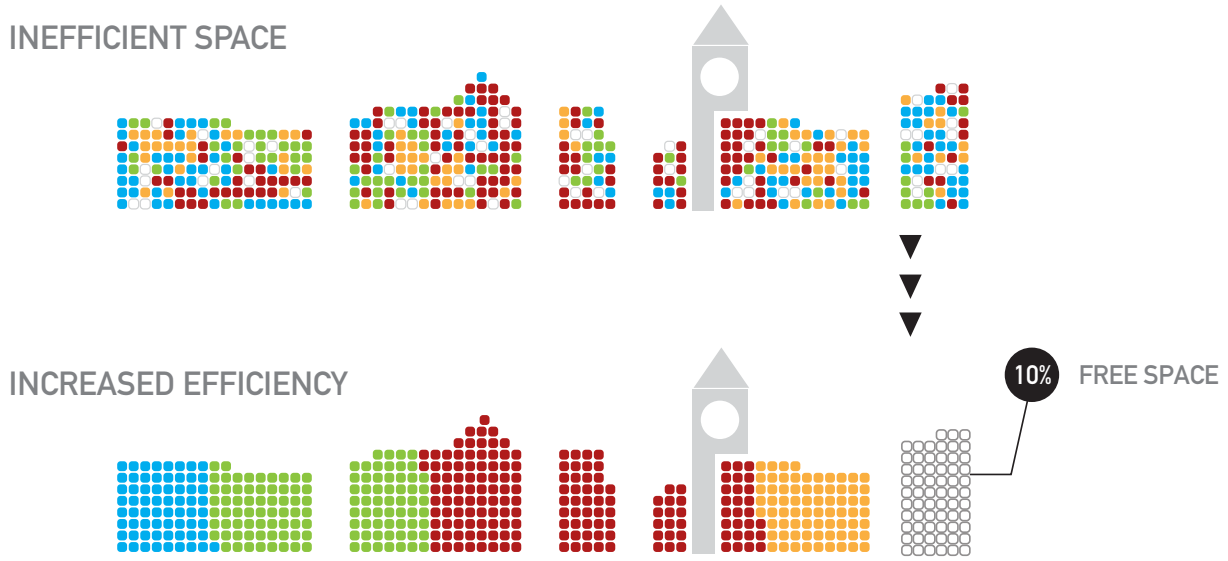
- Published Guidelines for Space Needs Studies (2011), which requires units to present projects proposing the addition of space to the SUAC
- Published Space Management Principles (2012)
- Published Procedure for the Reallocation of Space; proposals for 8 different spaces have been solicited (2012)

**Next Steps**

- Implement Ithaca Campus Space Utilization Study recommendations, including publishing updated space guidelines; launching new sched uling software for classroom and event spaces; and integrating that software with HVAC (heating, venti lation, and air conditioning) control software. Currently, the university uses class schedules to determine HVAC cycles but applies the sched ule at a fairly high level. So, for instance, the systems might come on at 6 AM and turn off at 11 PM. If the HVAC systems can be interfaced with the scheduling system, many spaces would likely turn on" less, and thus the university would save energy.
- Revise the university s architectural agreements to include clearer defi nitions and deliverable expectations for space programs.

**Resources**

This action is dependent on continued funding and senior leadership support for the role of space planning in capital project development.

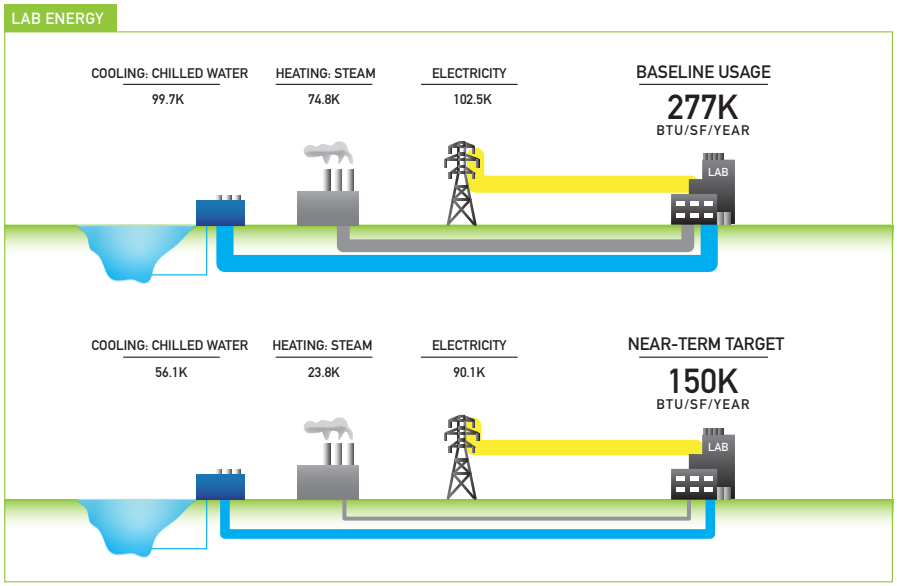


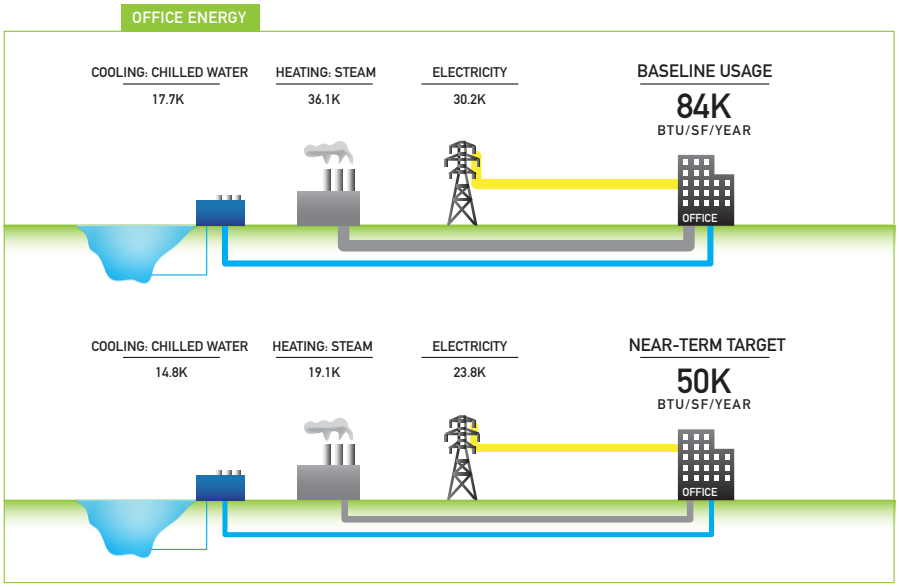
- Developed standard process for pulling and analyzing space data; created standard reports for space data (1996- 2013)
- Implemented SUAC review of needs for leased space (2013)

The Ithaca Campus Space Utilization Study, initiated in January 2012, will make recommendations to inform Cornell's space management program over the next several years and identify opportunities to improve utilization of existing space. The study should make it easier for units to consider strategies to more fully utilize existing space, through re-purposing to higher priority needs, sharing with other units, reallocating to other units, and/or making strategic capital investments to improve quality and functionality. For more information, visit **Cornell's Space Planning website** at: http://dbp.cornell.edu/offices/space-planning.

## 2. Integrate **Building Energy Standards** and energy modeling into the building design, review, and approval process in order to maximize energy efficiency

**Goal:** Cornell continues to refine its energy efficiency standards for campus buildings to reduce laboratory and office energy use by 30 - 50% over the energy-code-compliant baseline American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) 90.1. Our goal is to establish aggressive, but achievable goals for each major project and incorporate these goals as contractual obligations into architectural and engineering agreements. **Coupled with an aggressive space management program, Cornell's building energy standards can help the university avoid over 10,000 metric tons (CO2 equivalent) of emissions annually.**



The 2009 Climate Action Plan (CAP) mandated that the university adopt a well-defined energy modeling protocol and energy standards by building type to ensure that future construction on campus would be optimized to Cornell's Leadership in Energy and Environmental Design (LEED) program and also achieve a minimum of a 30% reduction in building energy use as compared with the industry standard (ASHRAE 90.1). The target in the 2009 CAP was established through a careful review of recent Cornell construction projects and comparison with benchmarks used elsewhere.

In 2013, Cornell's Facilities Engineering Department updated two campus-wide standards, "Energy Guidelines" and "Energy Modeling Guidelines" to standardize and more fully explain Cornell's energy requirements for buildings on campus. **Cornell's Design and Construction Standards** are found at the following URL: http://cds.fs.cornell.edu/toc.cfm. These guidelines set aggressive goals that require innovation, design discipline, and steady enforcement by our project management teams.

"Energy Use Intensity" (EUI) goals are now being incorporated into architectural and engineering agreements for all our major building projects. Standard EUI units are expressed in terms of BTUs per square foot per year. Each new building and major renovation on campus has a unique EUI, depending on how the building will be used. On average laboratories use 5-10 times more energy than dormitories on a per square foot basis. Cornell's goals are generally 150 kBTU/ft2/year for lab buildings and 50 kBTU/ft2/year for offices and classrooms. When compared to a business-as-usual approach, Cornell's building energy standards can help the university to avoid thousands of metric tons of emissions.

**Next Steps**

- Continue to refine the modeling process, particularly early in design. Standard modeling techniques are not well suited for evaluating energy performance at the conceptual stage of design. We will work to develop better modeling tools or better ways to adapt the tools we have for evaluating building massing and envelopes. This will ensure that energy modeling done at the conceptual design stage is a meaningful indicator of future energy performance.
- Consistently implement our building energy standards.
- Refine our target goals to keep them aggressive and achievable. We will continue to benchmark our targets against the performance of the best buildings on our campus and elsewhere.
- Track modeled energy use and actual performance of recent buildings.

**Resources**

Energy modeling software is improving, and we may be able to hire a third-party consultant to refine how the modeling is done, standardize the assumptions being made, and improve the accuracy of modeling predictions.

## 3. Monitor and evaluate building energy performance of recent projects by comparing design, modeling, and actual energy use, and utilize best practices that are identified through the **performance review** process to inform future projects.

**Goal:** Develop additional metrics and targets for post–occupancy evaluations of building performance.

Cornell's Facilities Engineering Department team has developed energy "budgets" for each building on campus, for a range of weather scenarios. We know how each building should be performing based on the daily weather, and we can track when a particular building uses more or less energy than the budget predicts. Comparing the budget to actual performance will help us to understand where there are discrepancies, so that we can assess what is causing these discrepancies and how best to address them. The Department has developed rigorous algorithms to track building performance and to identify factors which might help to improve performance. For example, lessons learned from Milstein Hall on how to maintain energy savings in buildings with extensive glass windows can help to inform decisions about how to optimize energy efficiency in new buildings, such as Gates Hall, which also has extensive glass windows.

**Next Steps**

- Develop and populate a spreadsheet with key data fields for each major project in order to compare: **1)** design phase energy goals with **2)** energy modeling predictions, and with **3)** actual building performance.
- Consult with project architects and engineers to determine how each building is actually performing com pared to what was expected from the design and modeling process.
- Share the results of each building s performance review to inform the design process going forward, and incorporate the evaluation results into project management seminars and into university engineering design standards.
- Identify strategies that have been employed successfully to reduce energy use and incorporate these strategies as standard practices in future projects.

**Resources**

Work with multiple stakeholders to ensure that the data to be tracked for each project is obtainable and mutually agreed upon. Ensure that accurate data is collected from the initial design phase through building occupancy.

## INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

### 4. Evaluate the viability of constructing an "energy net zero" building on campus to serve as a new benchmark in sustainable building design.

**Goal:** Design and build an ultra-efficient academic building that will have "net zero" energy usage over time.

For the Ithaca Campus, Cornell continues to evaluate upcoming projects to identify a suitable candidate for an energy net-zero building. To achieve this goal will require integration of renewable technologies, including on-site solar power and a geothermal-based heat pump system, and a combination of efficiency measures, including minimizing heat losses using well-sealed, high performance windows and super insulating the building envelope.

Meanwhile, planning for Cornell's permanent campus in NYC is moving forward at a rapid pace. Cornell is scheduled to break ground on the new campus in early 2014 and open the doors on Roosevelt Island in 2017. The Master Plan for the NYC Campus includes a combination of academic space, corporate facilities, an executive education center and hotel, housing for students and employees, and more than two acres of open space. The first academic building is being designed by Pritzker Prize-winning architect Thom Mayne of Morphosis and will aspire to achieve net-zero energy usage by producing as much energy as it uses. This will be achieved in part via an array of photovoltaic cells covering the roof of the building. Learn more about the NYC Campus at http://www.news.cornell.edu/stories/2013/12/connectivity-be-hallmark-cornell-tech-campus-design and at http://tech.cornell.edu/future-campus/.

**Next Steps**
Continue to evaluate new projects and renovations on the Ithaca Campus to identify a suitable candidate for an energy net zero building.

**Resources**
Consider building size and function, and project budget, to determine the best fit. The ideal candidate should be highly visible to the community, since an energy net zero building will represent a new level of achievement in sustainable building design.

## 5. Launch a **Green Building education program** to enhance student and public understanding of sustainable building practices in Cornell's built environment.

**Goal:** Provide outreach and education about Cornell's LEED (Leadership in Energy and Environmental Design) certified buildings, focusing on each building's: sustainable design features, aesthetics, functionality, history, and energy performance.

Since 2008 Cornell has required all new construction over $5M to obtain LEED Silver certification or higher. There are currently 8 Gold buildings and 1 Platinum building at Cornell, as well as two Commercial Interiors Gold certifications for building renovations. An additional 9 certifications are currently in process for the Ithaca Campus, and the NYC Tech building is also in process and is targeting LEED Platinum certification.

Cornell typically includes an educational program for each building in the LEED application. The Central Energy Plant, the Plantations Visitor Center, and the Human Ecology Building are actively conducting tours and outreach through their students, staff, and faculty. Tours and presentations on Cornell's green buildings are currently offered by request.

The **Green Buildings page** (http://www.sustainablecampus.cornell.edu/initiatives/green-buildings) on Cornell's Sustainable Campus website lists all of the university's LEED buildings and their points. Data on the performance of each building, as well as background on green design features and ultra-efficient building systems, could be used to supplement the information currently on the website and to create a downloadable application for mobile devices. As a visitor walks around campus, he/she could scan codes and download relevant green building information. The new downloadable app could provide a more broadly accessible focus for green building education and tours on campus, and promote greater understanding of sustainable building practices for both the internal and the broader community.

**Next Steps**

- Develop enhanced outreach about Cornell's LEED certified buildings, including supplements to the existing Green Buildings page, a download able application for mobile devices, signage, and pamphlets as appropri ate.
- Integrate green building data with the new Building Dashboard, to track building performance.

**Resources**

Identify a staff person to develop and oversee a university-wide Green Building education and interpretative program.

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

### 6. Adopt a university-wide policy that all new construction projects and renovations valued over 5M should achieve a minimum 50% energy savings compared to the baseline established by ASHRAE 90.1.

**Goal:** The 2009 Climate Action Plan (CAP) prescribed Energy Use Intensity (EUI) standards by building type to ensure that future construction on campus would be optimized to limit energy consumption. Cornell's current EUI standards reduce laboratory and office energy use by 30% over the energy-code-compliant baseline (ASHRAE 90.1). The 2009 CAP recommended that, in order to achieve carbon neutrality by 2050, the university should ultimately require new buildings on campus to limit energy usage to 50% of the industry standard baseline. Achieving a goal of 50% lower energy use effectively reduces the rate of growth in GHG emissions by half.

In 2008 Cornell's Trustees approved a policy that Ithaca Campus new construction projects over $5M total project cost must attain US Green Building Council's LEED (Leadership in Energy and Environmental Design) certification at a minimum of Silver level, and that these projects must achieve a minimum 30% energy savings compared to the baseline established by American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) 90.1, the national standard for energy efficient buildings. Current performance for buildings constructed since 2008 is averaging 35-40% below the ASHRAE standard. It is important to note that the ASHRAE standard becomes more stringent as it is updated, effectively raising the bar on building energy performance over time. Cornell's Facilities Engineering Department will continue to review the university's EUI standards to assure that our goals are both ambitious and achievable. To make ongoing reductions, we need to evaluate the type of project being proposed and work with our engineers to set realistic goals for that type of project.

**Next Steps**

- Incorporate EUI goals into the architectural and engineering agreements so that they become obligations within the project con tract.
- Adopt realistic interim goals and reinforce that these are minimum standards.
- Encourage project teams to con tinually improve performance by making building envelopes tighter and building systems more sophis ticated.

**Resources**

Achieving the long-term goal will require innovation and discipline, as well as steady enforcement of interim EUI goals.

## 7. Assess the feasibility of applying US Green Building Council's LEED (Leadership in Energy and Environmental Design) standards to existing buildings, in addition to new construction projects.

**Goal:** Evaluate the feasibility of performing existing building commissioning (LEED EB) on Cornell facilities in a five-year cycle (every building re-commissioned every five years) versus current re-commissioning practices. This analysis could yield recommendations to improve upon current re-commissioning practices in a cost-effective manner.

Currently Cornell re-commissions campus building controls on a regular basis in order to maintain the energy efficiency of our facilities. To perform a comprehensive LEED EB re-commissioning on every facility on a five-year cycle would be considerably more labor and cost intensive than what we do now.

The proposed feasibility analysis will quantify the additional effort and costs associated with this LEED EB certification, as well as possible benefits that would result, including the potential to earn additional **STARS** (https://stars.aashe.org/) points.

**Next Steps**

- Evaluate the current re-com missioning program and make recommendations for: **1)** how to better coordinate building re-commissioning among the teams who are assigned to do this work, and **2)** how to incorporate re-com missioning practices into regular maintenance schedules for campus buildings.
- Identify incremental improvements in existing maintenance processes that could be implemented in order to save energy and reduce costs, while also improving Cornell's LEED EB and STARS ratings.

**Resources**

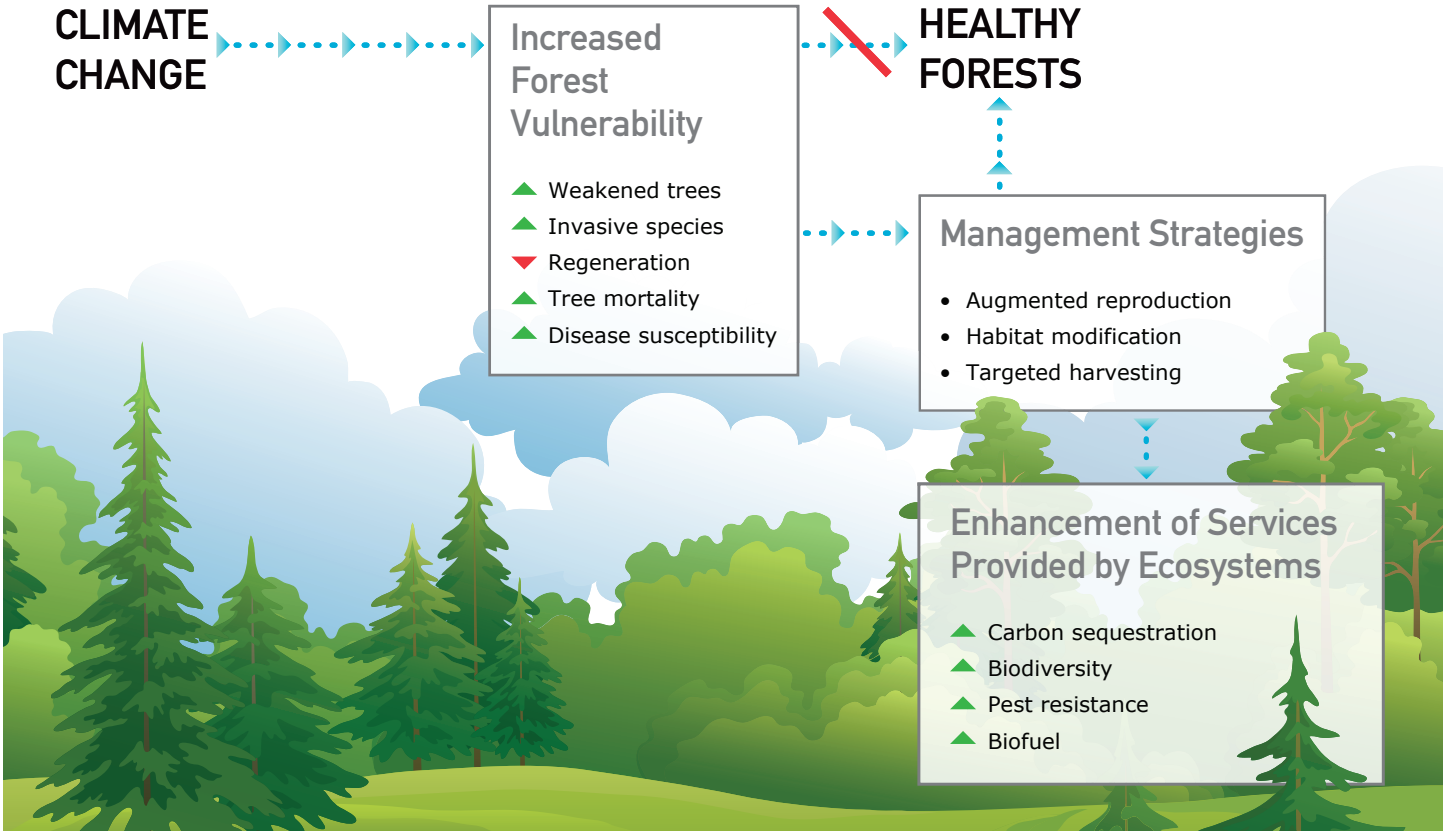
The Buildings Team will complete this analysis within the next two years, in consultation with the Energy and Sustainability Department Office.

# CLIMATE

## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

### 1. Implement broad-based, mission-linked carbon management strategies such as forest management, carbon capture and sequestration, and community projects to offset unavoidable university emissions.

**Goal:** The roughly 14,000 acres of land owned by Cornell currently sequester approximately 11,000 metric tons of CO2 annually; through active management practices it is possible to significantly increase the carbon sequestration rate of these lands. If the university does not actively plant new trees and manage its mature forest stands, the carbon abatement capacity of these lands will diminish over time. The current sequestration rate is trending downward and will be near zero by 2050, because the existing forest is aging. **Fully realized, mission-linked offsets could account for an annual carbon abatement equivalent to the University's current total commuting and business travel footprint – roughly 59,000 tons (CO2 equivalent) and about 27% of the targeted reduction of 218,000 tons.**



Cornell faculty and the Cornell Lands Committee continue to investigate the potential to "afforest" or convert about 4,000 acres of Cornell's land holdings from idle pasture or cropland to forest by planting trees. Afforestation and active forest management can enhance the carbon-storage capacity of Cornell lands, as well as enhance the educational and research mission of the university. For example, a demonstration nut grove on Cornell land currently serves as a research site for a practicum in agro-forestry.

Faculty and the CALS (College of Agriculture and Life Sciences) Forest Advisory Committee continue to refine estimates for the carbon-capture potential for Cornell lands and seek ways to make these efforts economically feasible. The recent dramatic reduction in the price of natural gas has made solid biofuel production less attractive as a back-up fuel source for the Ithaca Campus Central Energy Plant.

Future regulation of carbon emissions would provide a compelling incentive for Cornell to move forward with afforestation and active forest management. But changes in the regulation of carbon emissions at the state, national, and global scale are difficult to predict. In the absence of a price on carbon, we will continue to seek ways to preserve our forested lands and to optimize the carbon storage services they provide.

Land application of biochar (charcoal produced from the slow pyrolysis of organic biomass) has been proposed as an effective method for long-term capture and sequestration of carbon. Cornell researchers continue on-going efforts to understand and quantify the short- and long-term effects of bio-char application for carbon sequestration.

**Next Steps**

- Actively seek public and private funding for research and demon stration projects utilizing Cornell lands to sequester carbon and create viable, value-added products.
- Closely monitor the regulatory climate over the next decade to identify favorable conditions needed to make afforestation and active forest management projects eco nomically viable for the university.

**Resources**

This action is dependent on favorable economic and regulatory conditions to mobilize investment on the part of the university.

## INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

### 2. Conduct vulnerability assessments and climate adaptation planning in order to minimize disruptions to campus as a result of extreme weather events and increased flood risks.

**Goal:** Educate students and staff on campus about climate change impacts, engage faculty in climate adaptation research and demonstration projects, and help reduce future climate-related risks to the Cornell and Ithaca community through appropriate upgrades to campus infrastructure and protocols.

As part of the University's land-grant mission, Cornell faculty, graduate students, and extension staff support climate science and adaptation planning for New York State and the wider Northeast Region. According to the Higher Education Climate Adaptation Committee, Cornell also has a national leadership opportunity to engage the campus community and showcase the application of robust planning climate adaptation tools. Cornell is the first major U.S. university to include climate adaptation in its Climate Action Plan. By innovating and demonstrating new approaches to infrastructure development and emergency response, Cornell can serve as a state and national leader in climate adaptation planning.

As the host of the Northeast Regional Climate Center, Cornell works with federal agencies such as NOAA to provide accurate climate data and analysis tools for the 12 state region. The data and many interactive analysis tools are publicly available through the website http://www.nrcc.cornell.edu/. Cornell also provides climate adaptation support to farmers across the state through the Cornell Cooperative Extension and Agricultural Experiment Stations. The new Institute for Climate Change and Agriculture serves as a focal point to facilitate research, education, and outreach to reduce the agricultural sector's collective impact on the climate and to help farmers become more resilient to climate change.

In 2009, NYSERDA commissioned a comprehensive state-wide report, **Responding to Climate Change in New York State (ClimAid)** (http://www.nyserda.ny.gov/climaid). Cornell faculty including Professors Art DeGaetano and David Wolfe helped coordinate the partnership with Columbia University and Hunter College to produce the report. The ClimAid report was undertaken to provide decision-makers with cutting-edge information on the state's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge.

(Above) Figure 11. Adaptation Assessment Steps, Climate Adaptation Guidebook for New York State, page 20, http://www.nyserda.ny.gov/Publications/Research-and-Development-Technical-Reports/Environmental-Reports/EMEP-Publications/-/media/Files/Publications/Research/Environmental/EMEP/climaid/ClimAID-Annex-II.ashx .

The ClimAid report includes a useful tool for campus engagement, the **Climate Adaptation Guidebook for New York State**, which outlines a methodology for local and regional planning. The Guidebook and a similar model developed at Dalhouise University in Canada, provide a roadmap for Cornell to create a customized climate adaptation plan for campus.

Cornell's actions to mitigate climate change-related hazards will have widespread impacts across Tompkins County. Cornell University is the largest private land owner and employer in the county, and approximately 60,000 people live or work on Cornell property or adjacent to Cornell properties. Based on cost estimates from the **Tompkins County All Hazard Mitigation Plan** (http://tompkinscountyny.gov/files/planning/HazMitRpt/Tompkins%20County%20HMP%20Final%20Draft%20-%20July%202013%20-%20ALL.pdf), Cornell could experience significant capital losses and health related costs in the range of $10,000 to $10M per event from predicted increases in severe droughts, flash floods, heat waves, and disruptions to water filtration systems as a result of climate change. If climate adaptation planning can help the University to anticipate and mitigate just 10% of these losses, savings could range from $1,000 to $1M per event – or more.

The Tompkins County Hazard Mitigation Plan was updated in 2013 to reflect the increased understanding that climate change-related hazards needed to be specifically addressed. In the 2013 update the county's top three highest rated hazards identified using the Health Industry Representatives Association (HIRA) risk assessment process were: **1)** transportation accident, **2)** severe storm, and **3)** flash flood. Additionally the plan emphasized that the county should to prepare for the following impacts over the next 65 years:

- Heat waves will become more frequent and intense, increasing heat-related illness and death and posing new challenges to the energy system, air quality, and agriculture.
- Summer drought is projected to increase, affecting water supply, agriculture, ecosystems, and energy production.
- Heavy downpours are increasing and are projected to increase further. These can lead to flooding and related impacts on water quality, infrastructure, and agriculture.
- Major changes to ecosystems, including species range shifts, population crashes, and other sudden transformations, could have wide-ranging impacts, not only for natural systems but also for health, agriculture, and other sectors.

The County mitigation plan names Cornell as a partner in several key actions to mitigate the damage of climate change, including:

- Developing regulations to prohibit future building in flood-prone areas as well as creating incentives to encourage property owners to protect and improve streams and buffers. This should include improving gorge safety and carefully designed and maintained trails within these buffer areas.
- Developing and publicizing a heat response plan which includes the use of cooling centers.
- Working with the scientific community to update and refine regional climate projections/impacts and utilizing this information in planning and management.

**Next Steps**

- Develop a Cornell climate adapta tion working group.
- Evaluate the existing methodologies presented by ClimAid and Dalhousie University.
- Adopt a framework for climate adap tation planning.
- Administer a vulnerabilities survey of the campus community and develop prioritized actions based on identi fied vulnerabilities.

**Resources**

The success of this effort will require support and involvement from Cornell EH&S, Tompkins County planning staff, and Cornell faculty to develop a robust assessment process. Funding will be required to conduct a vulnerability study.

In the next two years faculty, staff, and local partners can utilize existing adaptation planning tools and processes to better prepare for the impacts of a changing climate. Scenario-based vulnerability assessments involving the campus community can be used to evaluate the need for smarter, more resilient infrastructure to withstand extreme weather events and increased flood risks.

## 3. Work to ensure that **climate literacy** and sustainability are part of the curriculum and educational experience at Cornell.

**Goal:** Build climate literacy in the campus community through curricular and extra-curricular programs for students and professional development programs for faculty and staff.

Climate literacy is understanding how human society influences the climate and how the climate influences human society – and it is fundamental to meaningful climate action on campus and in the world beyond. This **Key Action** involves the development and implementation of educational programs for students, faculty, and staff to be integrated with freshman orientation, undergraduate club leadership development, residential life, and professional development trainings.

In 2007 CALS Communications Professor Katherine McCommas began surveying students and staff on their attitudes, behaviors, and knowledge relating to climate change. Her research determined that an overwhelming majority of undergraduate students, almost 85%, agree or strongly agree that global warming is a serious problem. A similar majority of students recognized the processes contributing to global warming and believe that human activities, especially the emission of greenhouse gases, contribute to global warming. The full report is available at https://stars.aashe.org/media/secure/270/2/22/389/Carbon%20Neutral%20Survey%20Report.pdf. A separate series of surveys were administered in 2010 and 2012 that focused more on knowledge and attitudes related to energy conservation actions. The full report is available at http://cuaes.cornell.edu/cals/cuaes/sustainability/loader.cfm?csModule=security/getfile&PageID=1087236. Follow-up surveys of Cornell students and employees will be necessary to determine the ongoing success of campus climate literacy initiatives.

Currently Cornell offers more than 40 courses that cover the science and implications of climate change from various departments on campus. The **Climate Change Minor** (http://www.geo.cornell.edu/eas/PeoplePlaces/Faculty/mahowald/Climate%20Change%20Minor/) administered by the Department of Earth and Atmospheric Sciences is available to undergraduate students from any college at Cornell. A **new website** (http://climatechange.cornell.edu/students-courses/) for students lists climate change courses, student initiatives, and programs.

The **EcoReps program** (http://www.sustainablecampus.cornell.edu/initiatives/student-ecoreps) was launched in 2012 to help engage students in campus sustainability efforts through educational programs and positive role modeling. Over 60 students serve as EcoReps – or sustainable living peer educators – during freshman orientation and in freshman residence halls on North Campus. The majority of EcoReps also participate in a 3-credit service learning capstone course that focuses on sustainable living concepts, peer education methods, social marketing strategies, and the psychology of behavior change.

**Next Steps**

- Promote the Climate Change Minor and advocate for expansion of sustainability related courses with the support of the Vice Provost for Undergraduate Education.
- Reach out to students at freshman orientation and throughout the year to inform them about climate issues and publicize opportunities to take action through the EcoReps program.
- Provide leadership development training for staff and graduate stu dents in college buildings through the Green Ambassadors, Green Office Certification, and Green Lab Certification programs. In 2014 these programs will be expanded university wide.
- Develop and implement climate change and climate action staff development trainings related to the recent inclusion of sustainabil ity as an overarching principle in Cornell's  Skills for Success" matrix.
- Develop tools and strategies to assess the climate literacy of incoming freshman, graduating seniors, and university staff.
- Evaluate the success of educa tional programs and make ongoing adjustments, as needed.

**Resources**

Secure support from senior administration and ongoing funding for current campus climate literacy programs, including "Think Big, Live Green," EcoReps, student leadership development, and Green Offices and Labs.

Looking beyond the classroom, Cornell students, faculty, and staff are applying the principles of sustainability to solve real-world problems. These efforts directly benefit the Cornell community, as well as people in communities around the globe. Recent examples of experiential learning both on and off-campus include:

- Energy Corps efforts to replace incandescent light bulbs across campus with more efficient LED and CFL bulbs are projected to yield $245,539 in savings over the next seven years.
- CU Compost Club is currently conducting a fundraising campaign to install a compost bin to serve residents of Collegetown.
- Sustainability Internship Program students have tackled projects throughout Tompkins County to address energy planning, wood smoke assessment, waste reduction, greening operations, and wetlands development, among others.
- Cornell University Sustainable Design's (CUSD) Schoolhouse South Africa project is an award-winning design-build project focusing on resilient design and collaboration.
- Cornell faculty and students are creating sustainable micro-energy systems for cooperative agriculture projects on Hawai`i Island.
- Educational videos by Cornell staff, faculty, and students are helping to share climate change information and inspiring action. View recent video projects at the following links:
    - **Professional Climate Action Plan Educational Video:** http://www.cornell.edu/video/sustainable-cornell-making-climate-neutrality-a-reality
    - **Student-made Climate Action Plan Video:** http://www.youtube.com/watch?v=kBFXDxTjwig
    - **Over 30 climate change educational videos by faculty:** http://www.cornell.edu/video/topic/climate%20change

For a more comprehensive list of Cornell's sustainability outreach programs, visit: http://www.cornell.edu/outreach/programs/search_results.cfm?SearchTerms=sustainability&FormAction=Search&SearchTermsChanged=Y .

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

### 4. Establish a university-wide **Carbon Neutral Travel Policy** that fosters zero-footprint travel through purchase of carbon offsets.

**Goal:** University-funded air travel and individual commuting emitted roughly 59,000 tons of carbon into the atmosphere in 2012, a nearly 10% increase since the Climate Action Plan was initiated and the only emission category that did not improve. Cornell's commitment to climate neutrality cannot be achieved without some offsetting actions to mitigate these travel related emissions. Putting a price on GHG emissions via carbon offsets is an effective strategy to raise awareness about travel-related emissions and presents an excellent opportunity to invest in high impact local sustainability initiatives.

The Climate Team recommends instituting a Carbon Neutral Travel Policy encouraging purchase of local offsets. A draft policy is currently being reviewed by senior administration for further refinement and endorsement. The Climate Team is also partnering with the Study Abroad, Campus to Campus Bus, Business Procurement, and other departments that generate significant university related travel, to develop and integrate carbon offsets within their operations.

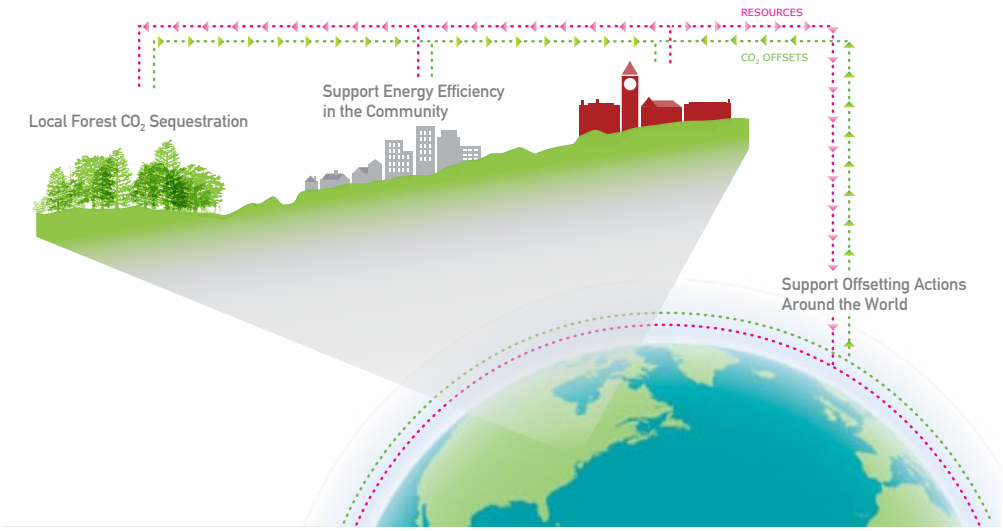
The **Finger Lakes Climate Fund** (www.fingerlakesclimatefund.org) (FLCF) is a local carbon offset program intended to promote greenhouse gas emission reductions in the Finger Lakes region. Though the current capacity of the FLCF cannot accommodate all of the university's unavoidable travel-related emissions, a partnership with FLCF presents an excellent opportunity to invest in a local sustainability initiative that is aligned with the university's mission. High impact carbon offsets can be purchased locally through FLCF for as little as $3 per trip. Donations are used to fund energy efficiency projects for low to moderate income households in our region. FLCF grants help these households pay for insulation, air sealing, energy efficient heating equipment, and other upgrades to reduce energy use and greenhouse gas emissions. A typical FLCF energy efficiency project yields a saving of ~100 tons CO2 per year – an amount equivalent to the carbon sequestration provided by 82 acres of forest or to the annual emissions of 20 passenger vehicles A partnership with FLCF could result in community based carbon offsets of 300-500 tons per year.

**Next Steps**

- Promote a voluntary program for employees to offset their carbon generated from daily commuting via FLCF. Add offsetting links to existing travel procurement and employee commuting websites.
- Integrate offsetting options within the Campus to Campus Bus online reservation process.
- Design and implement a Study Abroad student travel offset pro gram.
- Establish a university wide Carbon Neutral Travel Policy encouraging reduced business travel when pos sible and purchase of offsets when travel is unavoidable.

**Resources**

In order to properly account for carbon offsets purchased through FLCF, collect and transmit accurate travel data to FLCF and obtain third-party verified "certificates" or other proof of offsets purchased.



## 5. Collaborate in local, regional, state, national, and international planning efforts to address challenges posed by climate change and to increase resiliency.

**Goal:** Actively partner in local, regional, state, and larger-scale climate planning.

By **executive order** (http://www.dec.ny.gov/energy/80930.html) of the Governor, New York State has set a goal to reduce greenhouse gas emissions by 80% below the levels emitted in 1990 by the year 2050. As New York's land grant university, Cornell is committed to engaging the public in climate and energy solutions. Cornell Cooperative Extension offices in counties across New York State support renewable energy and energy efficiency planning and implementation among local governments, businesses, and directly with homeowners. For an overview of Cooperative Extension's climate and energy initiatives, visit http://www.cce.cornell.edu/EnergyClimateChange/Pages/default.aspx.

Cornell University is a significant stakeholder in the City of Ithaca, the Town of Ithaca, Tompkins County, and the six-county Southern Tier region, and Cornell has been an active participant in both climate and energy related planning processes and collaborative organizations within each of these jurisdictions. Cornell staff are currently engaged with the City of Ithaca's Energy Action Plan, the Climate Smart -Climate Ready conference, the Town of Ithaca Energy Action Plan, the Tompkins County Planning Department, the Tompkins County Hazard Mitigation Plan, the Tompkins County Climate Protection Initiative, and the Cleaner Greener Southern Tier initiative.

Cornell graduate students have provided research and expertise to assist with several recent county-wide climate and energy initiatives. Recent reports prepared by Cornell graduate students include the following:

- Assessment of Locally Sourced Biomass Energy for Residential Thermal Demand
- Geothermal Energy Potential in Tompkins County
- Energy Supply and Demand in Tompkins County
  - Energy Supply and Demand in Tompkins County (PPT)
- Wind: A Technical Analysis of Wind Power Potential in Tompkins County
  - Wind Power Potential in Tompkins County (PPT)
- Solar: Solar Energy Generation Potential of Tompkins County,
  - Solar Power Potential in Tompkins County (PPT)
- Biomass: Tompkins County Energy Road Map,
  - Biomass Power Potential in Tompkins County (PPT)

To ensure ongoing coordination between Cornell's Climate Action Plan and these numerous planning efforts will require that knowledgeable University staff actively participate. During 2014 and 2015, emphasis will be placed on participation in the **Tompkins County Comprehensive Plan Update** (http://www.tompkinscountyny.gov/compplan/news) and on collaboration with the county-wide education campaign, **Get Your Green Back** (http://getyourgreenbacktompkins.org/). The Campus Sustainability Office and the Cornell Center for Engaged Learning and Research will also explore opportunities to increase student and faculty participation in these regional initiatives.

**Next Steps**

- Actively participate in the Tompkins County Comprehensive Plan Update in 2014 with a focus on community sustainability and climate change adaptation.
- Identify and support collaborative funding proposals to NYSERDA, other state agencies, and private foundations to support campus-community climate and energy programs.
- Encourage faculty and students to develop academic connections (research and course) to regional planning initiatives.

**Resources**

Secure administrative support for staff time to be dedicated to community and regional planning efforts.

## 6. Participate actively in **climate literacy outreach** to ensure that the broader community receives Cornell's assistance in making critical decisions for a sustainable future.

**Goal:** As the 2013 **IPCC (Intergovernmental Panel on Climate Change) report** (http://www.ipcc.ch/report/ar5/wg1/#.UknR9mXD-Uk) makes clear, the option of "business-as-usual" is no longer acceptable. Continued growth in greenhouse gases poses a clear and present danger to the Cornell community, our nation, and the world. The climate change challenge is understood by some but not all, and a sense of urgency needs to be conveyed in order to motivate long-term behavior change.

As New York's land grant university, Cornell and the Cornell Cooperative Extension (CCE) system provide research-based education, resources, and tools to help individuals, families, and communities make better decisions to mitigate and adapt to climate change. Current education and outreach efforts to New Yorkers are guided by several interdisciplinary efforts:

**1)** The Atkinson Center for a Sustainable Future's Climate Change Program Focus Group (CCFG) consists of 17 interdisciplinary faculty members from departments across campus, which provide a focal point for campus climate change activities and information, including teaching and outreach efforts.

**2)** Cornell's Climate Change Program Work Team (PWT) is comprised of over sixty Cornell faculty, staff, CCE educators and stakeholders from around New York State who are working to share information on climate change research and funding opportunities, develop new educational materials and outreach programs for the public, and incorporate climate change into existing outreach programs, including train the trainer efforts. Faculty and CCE educators regularly provide climate change presentations to community groups and key stakeholders, such as the Farm Bureau, Soil and Water Conservation Districts, local county legislatures and municipal boards, and climate change materials at events such as Empire Farm Days and the NYS Fair. Two concrete examples are:

**a)** Climate change training provided to New York State Master Gardener Volunteer (MGV) Programs through Cornell Cooperative extension. The NYS Master Gardener Volunteer Coordinator organized an October 2013 conference for CCE educators and Master Gardener Volunteers on "Gardening in a Changing Climate." Additional materials will be developed to help support MGVs as they work to educate New York's gardeners about climate change (http://www.gardening.cornell.edu/).

**b)** USDA-funded Animal Agriculture and Climate Change Program. This is a national extension project, with the Northeast region led by Cornell University. An online train-the-trainer course on climate change was developed for extension educators, who can then provide information to livestock producers on issues such as heat stress in dairy and extreme weather events.

**3)** The Institute for Climate Change and Agriculture (ICCA) at Cornell University was established in 2013 to facilitate research, education, and outreach to reduce the agricultural sector's collective impact on the

**Next Steps**

- Continue to provide research-based climate change tools and resources through the climatechange.cornell.edu website.
- Provide training and resources for CCE Educators to educate New Yorkers, in order to extend the scope of the outreach effort.
- Work with the Institute of Cli mate Change and Agriculture to review the concept of creating and strengthening a network for climate change to allow researchers to broadcast new information quickly and to enable farmers and natural resource managers to share their adaptation strategies. The develop ment of this network may involve university and public/private part nerships.

**Resources**

Build partnerships with state and federal agencies, associations, and NGOs, through the Institute for Climate Change and Agriculture and the Atkinson Center.

climate and help farmers to become more resilient to climate change. The ICCA will serve as an interactive clearinghouse of information about climate change impacts on agriculture for farmers, researchers, decision-makers, officials, and the public. The Institute will also foster collaborations and seek to increase funding to address needs related to climate change and agriculture; assess farm-level impacts, knowledge gaps, and needs around warming trends and more extreme weather; promote the development of policies and decision-tools for farmers; and provide clear, research-based educational tools and outreach about climate change and agriculture to help encourage adoption of climate change adaptation or mitigation measures.

**4)** The www.climatechange.cornell.edu website provides a comprehensive, interdisciplinary gateway to climate change initiatives, research, student courses and organizations, events, and public engagement at Cornell. The site provides specific tools and resources that have been developed for farmers, natural resource managers, communities, youth educators, and the general public to understand the fundamentals of climate change science. The website also provides an interactive forum for the public to ask relevant questions about climate change science or its effects in the Northeast, and a "what's with the weather" explanation of recent extreme weather events.

The premise of all of these outreach efforts is that greater awareness will lead to long-term behavior change both within the Cornell community and among key stakeholders across New York State. A short- to medium-term goal is that climate change concepts will be incorporated into two new statewide outreach programs and will reach thousands of New Yorkers through multiple community events within the next two years. Additional outreach efforts will be coordinated with the PSCC Climate Team, members of the CCFG, Climate Change PWT, and Institute for Climate Change and Agriculture.

# ENERGY

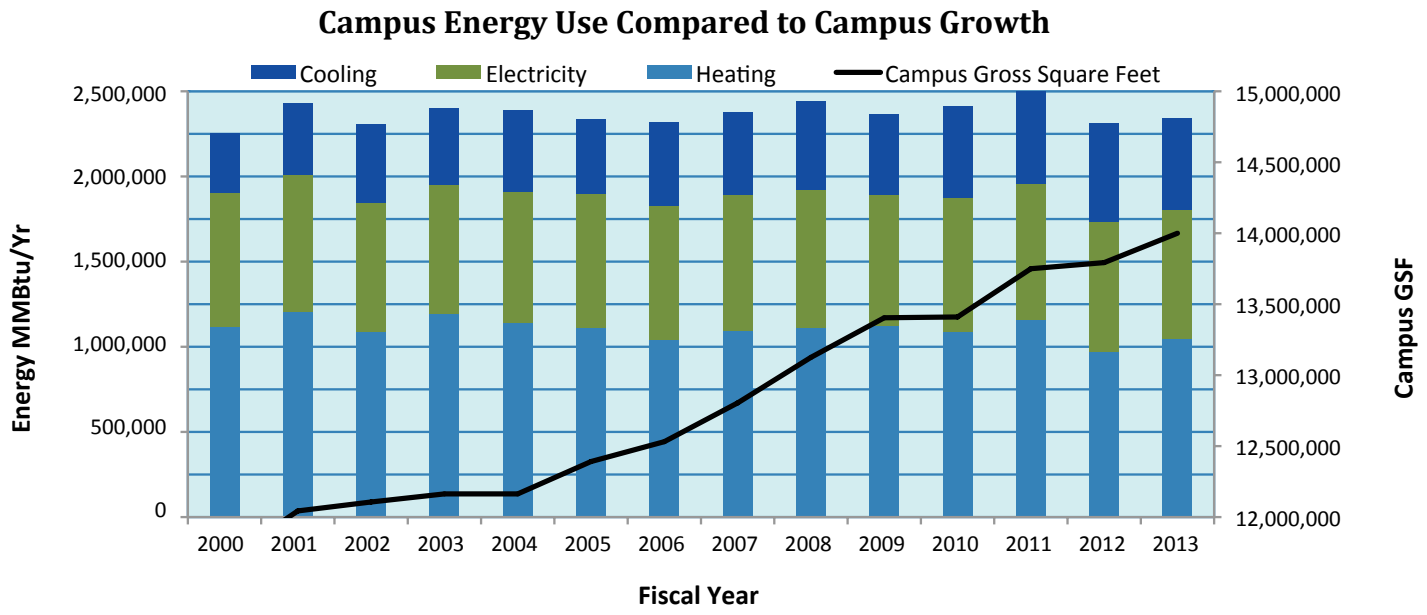
## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

### 1. Complete Phase 1 of the Energy Conservation Initiative (ECI) and initiate Phase 2 to conserve energy in campus buildings.

**Goal:** Cornell's Energy Conservation Initiative includes retrofits, replacements, and weatherization projects in buildings across campus. ECI projects are designed to optimize the energy efficiency of building automation and control systems, heat recovery systems, and lighting systems. Additional goals include increased occupant comfort and reduced maintenance expenses. ECI Phase 1 projects are expected to reduce Ithaca Campus utility costs by over $3 million per year by 2016. **The completion of Phase 1 and full implementation of Phase 2 of the Energy Conservation Initiative would reduce university emissions by about 11,800 metric tons (CO2 equivalent) annually – roughly 5% of the current carbon footprint.**

Building automation systems are microprocessor-based computers that monitor and control a range of building functions, including heating, ventilating, air-conditioning, refrigeration, lighting, fire and smoke alarms, utilities, elevators, access control, and intrusion detection. These systems are used in virtually every building on the Cornell campus. Dramatic and lasting conservation results can be achieved by optimizing Cornell's building automation and control systems, heat recovery systems, and lighting systems. Conservation focused preventive maintenance on these systems reduces usage and maintains performance. Wherever feasible, the latest features are cost effectively retrofitted into existing systems.

Phase 1 of the university's Energy Conservation Initiative from 2010 through 2015 allocated roughly $33M toward projects which met the criteria for either a 7-year billed or 10-year marginal payback. Marginal cost is the commodity only cost; while billed cost is the "all in" cost of supplying the utility to the end user, including Central Energy Plant personnel, debt servicing, maintenance, and so forth.




**To date, Phase 1 ECI projects have saved over one million dollars in energy use and enabled the university to maintain a flat energy use profile, while increasing the Ithaca campus footprint by over one million square feet of new construction.**

A full-time staff of two Certified Energy Managers and a Senior Engineer/ Director of Energy Management oversee the university energy management program for the central plant (supply side) and campus buildings (demand side). Completion of Phase 1 ECI projects is expected in 2015. To review completed **ECI Project Summaries** (http://energyandsustainability.fs.cornell.edu/em/projsum/default.cfm), please see **Appendix 4** of this report.)

The second phase of the program would stretch the payback criteria to 20 years marginal or 15 years billed – to enable further energy reductions throughout campus facilities. The Phase 2 Energy Conservation Initiative aims to reduce Cornell's marginal utility costs by $1.5 million per year. Cornell is presently tracking seven applications submitted to the New York State Energy Research & Development Authority (NYSERDA) New Construction Program to extend the ECI program and help fund the $12M cost of Phase 2 projects.

**Next Steps**

- Complete Phase 1 ECI projects, including weather corrected regression analysis of energy savings from all projects by FY16.
- Develop a timeline for conducting building energy studies to guide Phase 2 energy conservation projects.
- Initiate and complete energy studies on approximately 10% of campus buildings each year.
- Based on the results of the studies, develop a list of program priorities.

**Resources**

Meet with colleges and units to develop funding plans and continue to seek external funding, including NYSERDA rebates, for Phase 2 ECI projects.

## 2. Optimize the campus Heat Distribution System to increase efficiency and cost-effectiveness and to facilitate the integration of Cornell's future energy sources.

**Goal:** Cornell currently owns and operates over 60,000 feet of underground steam, condensate, and hot water lines to provide heat to the Ithaca campus. Approximately 15% of the metered heat energy produced at the Central Energy Plant is currently lost in the distribution system. Optimizing the campus heat distribution system could potentially cut those losses by more than half, increase reliability and flexibility to accommodate alternate heat sources, and **reduce the university's GHG emissions by about 6,500 metric tons (CO2 equivalent) or about 3% of the current carbon footprint.**

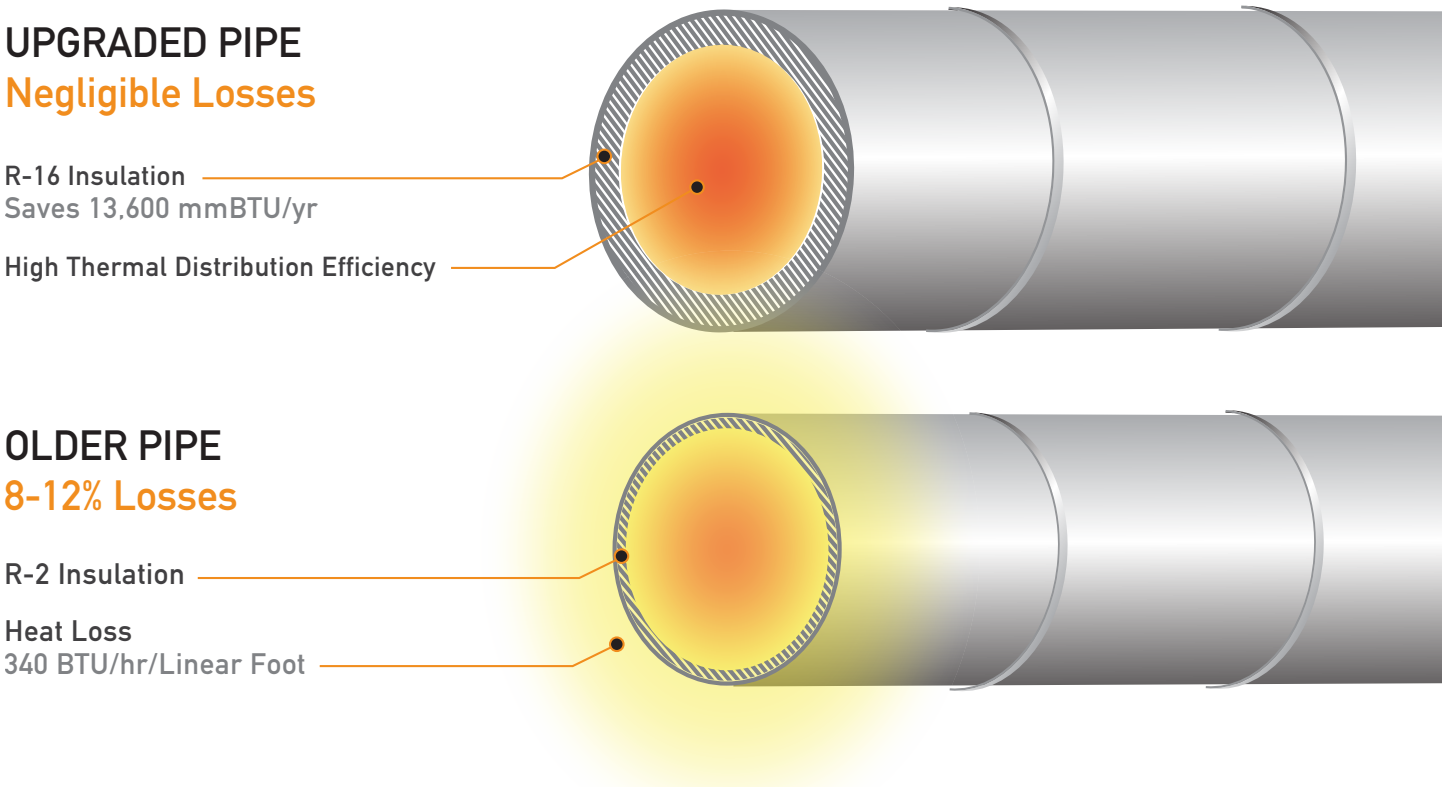
The campus Heat Distribution System has not been optimized for efficiency or operations, and the deferred maintenance backlog is increasing. The existing system is also not optimized for the integration of future renewable resources, such as geothermal or solar thermal energy. A planning study will evaluate the current system and provide specific and quantified recommendations for prioritizing of future improvements to optimize efficiency and alternative energy integration. The study will focus on prioritizing future capital work to reduce overall operating and maintenance costs, including energy, maintenance, and repair expenses. Optimizing the campus Heat Distribution System should reduce future energy costs, resulting in lower utility rates for customers.

**Next Steps**

- Perform an in-house study to prioritize and determine near-term requirements for steam line renew al and maintenance to increase reliability and efficiency.
- As part of Energy Action 4 Enhanced Geothermal System (EGS), study the optimum heat distribu tion system for a single well pair demonstration project to serve one zone of campus.

**Resources**

The core knowledge for this task resides within Energy & Sustainability and Facilities Engineering Departments at Cornell. Outside support will be needed to assist with the EGS study.



## 3. Capitalize on more than 50 campus waste streams and other university-owned biomass resources to generate renewable energy through CURBI (CU Renewable Bioenergy Initiative).

**Goal:** Cornell University's Renewable Bioenergy Initiative (CURBI) is a research and demonstration platform for bio-fuel research. While the carbon reduction potential of CURBI research and demonstration is relatively small, CURBI can help identify larger-scale agriculture-based opportunities to produce bioenergy that could significantly offset traditional energy sources. Biomass could be turned into biogas to fuel Cornell's combined heat and power systems, and heat generated through CURBI could be used to heat campus greenhouses and other energy-intensive facilities. **Although the exact combination and utilization of energy conversion technologies is yet to be determined, CURBI at demonstration scale has a carbon reduction potential of about 3,000 metric tons (CO2 equivalent) per year or about 1% of the current carbon footprint.**

CURBI is a scalable research and demonstration platform which can support a number of different technologies. These technologies may be simultaneously employed and will likely alter as the focus of research changes over time. A feasibility study for the CURBI concept was completed in January 2010 with support from the New York State Energy Research and Development Authority (NYSERDA). The feasibility study evaluated several options, including direct combustion, anaerobic digestion, and pyrolysis/gasification as potentially "stackable" technologies, meaning that waste products from one system could be used as feed stocks (or inputs) for another system.

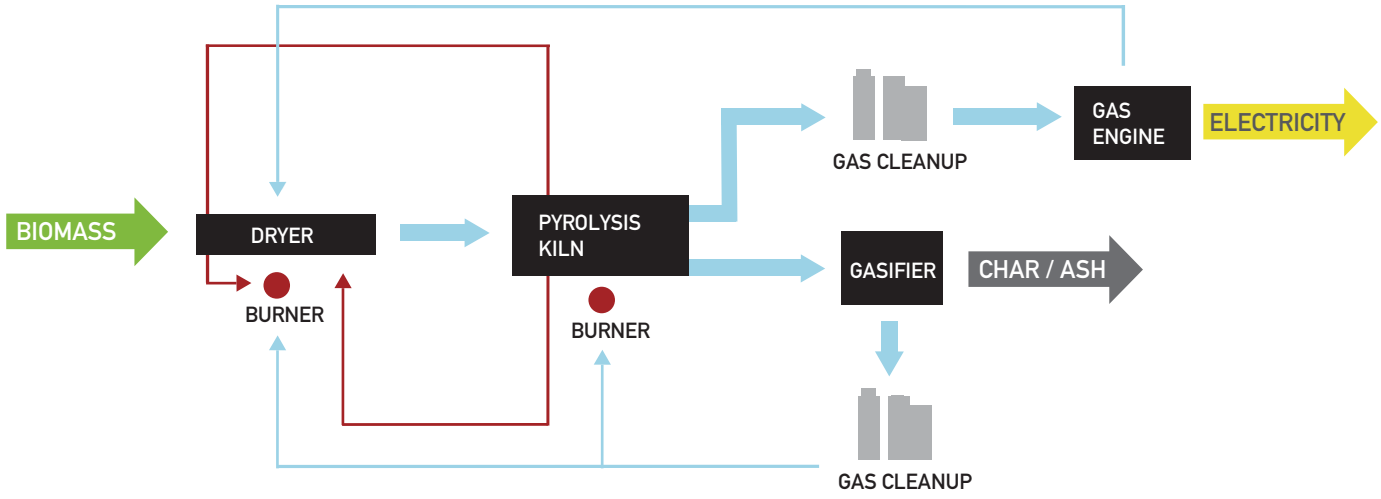
The Cornell University Agricultural Experiment Station (CU AES) currently manages most of the bio-energy resources for the Ithaca campus. CU AES administration and farm support staff stand ready to support CURBI, and the necessary biomass is readily available and includes manure, food wastes, woody and agronomic (bio-energy) crops. CURBI could have substantial positive impacts on the local agricultural economy and communities, if the research and demonstration projects conducted through the project result in the successful commercialization of specific technologies.

**Next Steps**

- Revise the 2010 project plan for the design and construction of a flexi ble work platform to support CURBI initiatives, similar to the facility rec ommended in the feasibility study. Without such a facility to house and facilitate research, there are limited opportunities to obtain grants for specific research. Conversely, a functional research platform would provide numerous diverse research and development opportunities for campus.
- Study and develop financial metrics for a small-scale digester at Harford or the on-campus dairy.

**Resources**

Cost estimates for the CURBI initiative as presented in the feasibility study are about $12M, but the basic research platform would likely be more in the $6M range. Grant funding is available to help pay a significant share of the technology costs once the supporting structure and systems are in place.



## 4. Eliminate fossil fuel combustion for heating campus by developing an **Enhanced Geothermal System (EGS) hybridized with biogas.** Prepare a preliminary design and phased implementation plan and build a demonstration project.

**Goal:** Build a demonstration project and assess the feasibility of installing a full-scale project that would allow Cornell to substantially heat and cool the campus using only natural, renewable resources and stored heat energy from the earth. **Completely realized, this hybrid innovation could provide for over 82,000 metric tons (CO2 equivalent) of average annual carbon abatement – more than 38% of the university's current carbon footprint.**

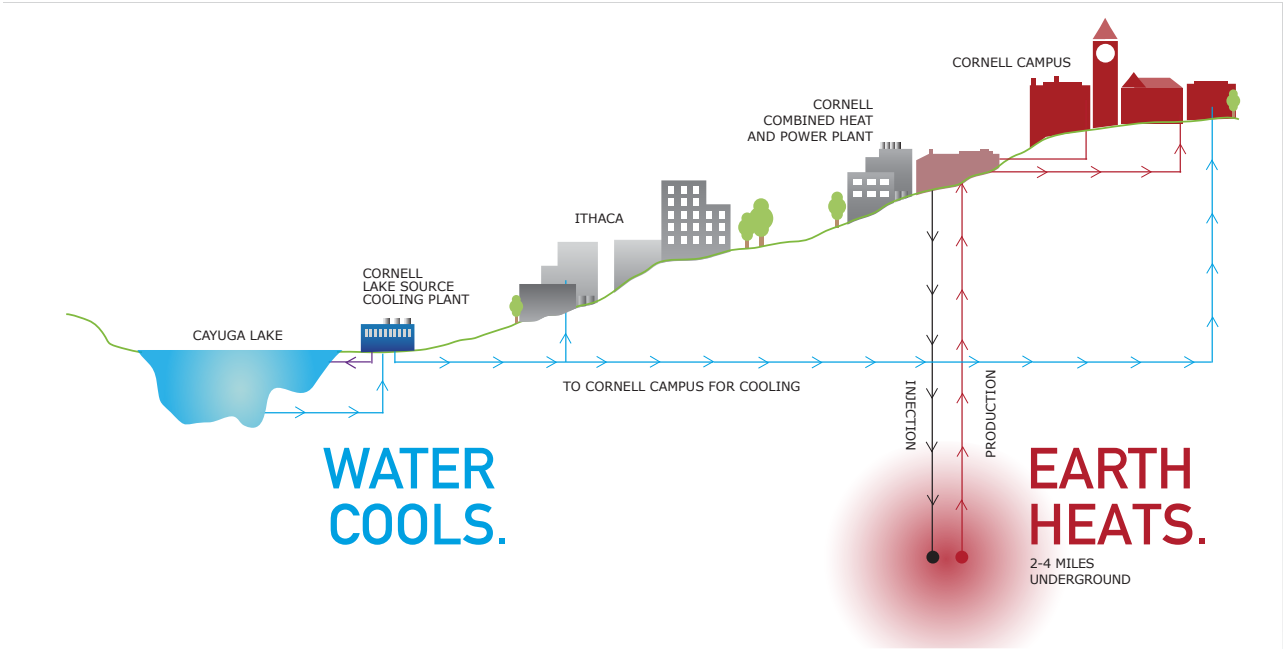
EGS is an emerging technology that utilizes heat energy available deep beneath the earth's surface to generate heating and electricity via distribution equipment located at the surface. Cornell's Hybrid Enhanced Geothermal System (HEGS) is a combination of two innovative, demonstration-scale research projects: Engineered Geothermal Systems (EGS) and Bio-Mass Gasification. The hybrid system would link the EGS to a biomass-to-biogas system scaled up from CURBI (See Energy Action 3). During very cold weather when EGS alone is not enough, the biogas would be used to supply the additional electricity and heating needs of campus.

### Next Steps

- Work with development profes sionals at the university to actively seek public and private funding for this project, using recent analyses conducted by the Cornell Energy Institute.
- Study, conceptually design, and develop financial metrics for a small-scale demonstration project to include a single well pair, heat exchange facilities, and intercon nection for target areas on North Campus and East Campus.
- Complete a Full Environmen tal Assessment Form (FEAF) to document the project's potential environmental, social, and eco nomic impacts.
- Draft a white paper that docu ments the steps needed over the next decade to bring the full-scale project to fruition.

### Resources

Recent cost estimates are $19 million for a demonstration system consisting of a single well pair, and $40M for a full-scale project which includes one well pair and heat extraction/delivery systems, tie into the campus distribution system, and two years of operations. This system could supply 25% of energy for campus.



## 5. Support the expansion of regional wind generation capacity and integrate wind power into Cornell's renewable energy portfolio.

**Goal:** Support the expansion of regional wind power generation capacity through procuring energy for university facilities from external projects and through construction of dedicated facilities. This action will increase renewable generation capacity in our region and the overall renewable energy portfolio of New York State, as well as enabling Cornell to expand research and teaching opportunities around wind power. **Full-scale implementation of this action, including power purchased from external projects and power produced by Cornell wind facilities, could provide 11,900 metric tons (CO2 equivalent) of average annual carbon abatement – or roughly 5% of the current carbon footprint.**

Wind power is among the most cost effective, large-scale renewable energy sources currently available. Cornell is actively investigating opportunities to harness wind power for education, research, demonstration scale projects, and full-scale utilization to provide power for the university.

Since wind energy generation is variable (produced only when the wind blows), Cornell will implement strategies to reconcile seasonality and variability in wind with campus needs. During the winter months, all of the energy needs of the Ithaca Campus are currently met through on-campus production at the Central Energy Plant. Cornell purchases the majority of its grid power in the summer. Yet adequate storage, transmission, and "back up" electricity is needed to ensure sufficient and reliable electricity is provided for campus at all times. Large-scale wind energy will produce more power during the winter months, so some mechanism for balancing Cornell's energy demands with wind energy production is needed.

The **Black Oak Wind Farm** (BOWF) (http://www.blackoakwindny.com/) serves as a recent example of Cornell's commitment to work with the local community to encourage the development of renewable energy. Upon completion in 2015, BOWF is projected to produce about 42 million kWh per year. Cornell is working with the BOWF leadership team in an effort to negotiate a reasonable power purchase contract. Large-scale renewable energy typically requires a long term power purchase contract to secure the private equity financing that is critical to project success.

Cornell researchers and economists continue to work with small towns, land owners, and rural communities throughout our region to explore and evaluate wind power opportunities. Recent technological advances have decreased the generating cost per kilowatt hour from many times grid prices to nearly equal to grid prices after subsidies, making wind energy one of the few economically viable alternatives ready for large-scale adoption. There can be significant economic advantages for communities that have favorable wind sites near electric grids; landowners receive lease payments and royalties from wind generators, while the energy generated creates profits for companies and revenues for local governments.

**Next Steps**

- Complete a market analysis of external renewable projects, includ ing wind, solar, geothermal, and biogas. Based on the results of the market analysis, determine if a demonstration-scale wind project on Hungerford Hill and/or other renewable energy projects should be pursued.
- Determine the extent of Cornell's involvement with Black Oak Wind Farm.

**Resources**

Funding has been identified to pay a consultant to assess Cornell's load profile, develop Cornell-specific decision making criteria, and complete a market analysis.

In one New York town, wind-energy revenues account for 30 percent of the local school budget. Cornell Cooperative Extension has described the positive impact in the Maple Ridge project in Lewis County, which now has close to 300 commercial-style wind generators, includes a widely distributed and discussed publication: **Wind Energy Development in New York State: Issues for Landowners** (http://ageconsearch.umn.edu/bitstream/122033/2/Cornell_AEM_eb0504.pdf, Brian Henehan, Applied Economics and Management; Deborah Grantham, Natural Resources)

## 6. Integrate solar power into Cornell's renewable energy portfolio by building or buying into solar photovoltaic energy systems.

**Goal:** New York State has identified solar photovoltaic energy as a critical renewable resource, and Cornell will seek to increase the solar photovoltaic electricity supply for campus. Opportunities for deploying this technology using State tax incentives and subsidy programs are expected to cotinue – making solar projects an economically viable option for the University. Cornell's first solar PV project, the Snyder Road Solar Farm, consisting of a 2MW array on eleven acres of Cornell property in the Town of Lansing, is slated for completion in 2014 and is expected to reduce the university's annual GHG emissions by 625 metric tons per year. Additional GHG reductions can be achieved as new projects are identified and completed.

The Snyder Road Solar Farm is expected to produce 2.5 million kilowatt-hours annually – about 1 percent of Cornell's total electricity use, the equivalent electricity to power about 320 homes for a year. The project includes ten solar panels and an inverter which will be dedicated to academic research. These panels will be installed on a "tilt" racking system which allows for adjustment to facilitate research studies, and they will be available for Cornell sponsored research and teaching projects as well as for collaborative projects with local community K-12 schools, colleges and their students. Tours of the solar facility will also be offered. Cornell is partnering with a private developer, Distributed Sun LLC, to implement this project. Learn more at: http://www.sustainablecampus.cornell.edu/initiatives/solar-power.

In the process of securing approvals to construct its first solar project, Cornell filed a petition with the NYS Public Service Commission (PSC) seeking clarification on how "remote net metering" rules had to be applied by electric distribution companies. Remote net metering allows an entity to build a renewable energy project (e.g. solar, wind, etc.) where it has space that is well-suited for this purpose, and to credit the energy value generated by the project towards consumption of energy at another location. The PSC ruled that utilities must credit electricity at the same rate they charge for electricity at a particular location, that the customer does not have to have an account at that particular location prior to the installation of the renewable energy project, and that there is no minimum electrical load required. The PSC ruling was extended to apply to all utilities and types of renewable generation projects throughout New York State. This ruling resulting from Cornell's efforts means that there are now many more options for siting renewable projects at locations with electricity rates that make such projects economically feasible. See the **Cornell University, Declaratory Ruling on Minimum Load Requirements for Remote Net Metering** (http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={4FE3D755-C41F-4607-AA8F-058A631C5B0D}) for more details.

Under current regulatory limits, Cornell has the capacity to utilize the electricity from 3 to 5 additional remote-net-metered renewable energy projects, which could include solar, wind, hydro, etc. If all these projects come to fruition, they would produce a minimum of 10-15 million kWh, or 6% of Cornell's total electricity use. At this time, large (~2MW) off-campus installations that take advantage of the PSC ruling on remote net metering offer Cornell the best opportunity for increasing its renewable energy portfolio.

**Next Steps**

- Implement a solar PV project at Snyder Road.
- Cornell Energy and Sustainabil ity and Facilities Engineering will partner with Cornell University Sustainable Design, a student led analysis and design team, to con duct a Solar Potential Inventory and Analysis to evaluate roofs on campus. The analysis will be used to develop a ranked list of sites so that solar installations can be con sidered when roofs are replaced, and/or when funding/innovative ownership opportunities become available. This analysis will help quantify how much solar energy is possible on campus, which will in turn inform Cornell's long-term renewable energy strategy.
- Identify the next project and fund ing opportunities.

**Resources**

- Obtain support and approval from the unit that has stewardship responsibility for potential proj- ect locations, since encumbering a rooftop or land parcel for solar energy production is a long-term commitment that must be weighed against other potential uses and maintenance needs.
- Meet economic criteria for internal approval of renewable energy proj- ects. Currently solar energy projects require subsidies (NYSERDA grants, tax benefits, donations, etc.) to bring their costs on par with grid electricity.

Other small solar installations are in process or proposed for buildings across campus. These include a research array on the roof of Snee Hall, a 30 kW installation on the roof of Klarman Hall, and a third-party owned array of up to 100 kW on the roof of the new Gannett Health Services renovation and expansion project.

The recently released **Southern Tier Regional Sustainability Plan** developed in coordination with the Regional Economic Development Councils calls out solar as a priority initiative. The Cleaner Greener Plan suggests that solar can produce 2% of total electricity in our region, with a doubling of capacity every four years. (See http://assets.metroquest.com/img/cgst/CGST_Regional_Sustainability_Plan_FINAL_5_22_13.pdf, p. 21)

## 7. Optimize the operation of the existing steam turbine generators to improve the efficiency of the campus Central Energy Plant.

**Goal**: Investigate methods of reducing energy losses when Turbine Generator 1 (TG-1) is not operating (during most of the year), and consult with the manufacturer on possible upgrades to increase the operating efficiency of TG-1 during times of peak steam demand in the winter.

The Cornell co-generation facility consists of two back pressure steam turbine generators, TG-1 and TG-2. The turbines' main function is to reduce the steam pressure going out to campus from approximately 400 psi to 30-60 psi. Since 2012, TG-2, which is a larger and more efficient unit than TG-1, has been run continuously all year, and TG-1 has only been run during times of peak steam demand in the winter. TG-2 was overhauled in the summer of 2010 to improve efficiency through redesigning the turbine blades and changing the steam path through the turbine. It may be possible to make similar upgrades to increase the operating efficiency of TG-1, as well as to reduce energy losses from TG-1 during the vast majority of the year when it is not being utilized.

**Next Steps**

- Investigate methods of reducing energy losses when TG 1 is not operating, for example a dry layup.
- Consult with the turbine manu facturer (Dresser Rand) regarding possible upgrades and their impacts on steam consumption and electri cal generation.
- If any upgrades to TG 1 or TG-2 are found to be economically ben eficial, place the turbine upgrade project in the 5-year capital plan.

**Resources**

The proposed changes must be economically beneficial and receive funding in the capital plan.

## 8. Complete upgrades to the existing hydroelectric plant to optimize electric generation.

**Goal:** Upgrade Cornell's existing hydroelectric plant to optimize electric generation. When completed, plant upgrades are expected to increase electric production by 1 million kWh per year and reduce greenhouse gas emissions by 450-600 metric tons per year.

Fall Creek has played an important role in Cornell's history since Ezra Cornell first arrived in Ithaca in spring 1828. According to The Ezra Cornell Bicentennial Exhibition, "Ithaca in the 1820s was a growing community. Water from the creeks powered lumber, flour, plaster, paper, cotton, and woolen mills… Cornell first found work as a carpenter, before being hired as a mechanic by Otis Eddy to work at his cotton mill on Cascadilla Creek. On Eddy's recommendation, Jeremiah S. Beebe then hired Cornell to repair and overhaul his plaster and flour mills on Fall Creek. During Cornell's long association with Beebe, he designed and built a tunnel for a new mill race on Fall Creek; a stone dam on Fall Creek, which formed Beebe Lake; and a new flour mill. By 1832, he was in charge of all Beebe's concerns at Fall Creek." See http://rmc.library.cornell.edu/ezra/exhibition/ithaca/ for more details.

The first electrical generation facility in Fall Creek gorge was built in the early 1880s. That plant was powered by water from a dam just above the present plant and a cable to a generator located near the Cornell Foundry. In 1904, the plant was built in its present site under the Suspension Bridge.

**Next Steps**

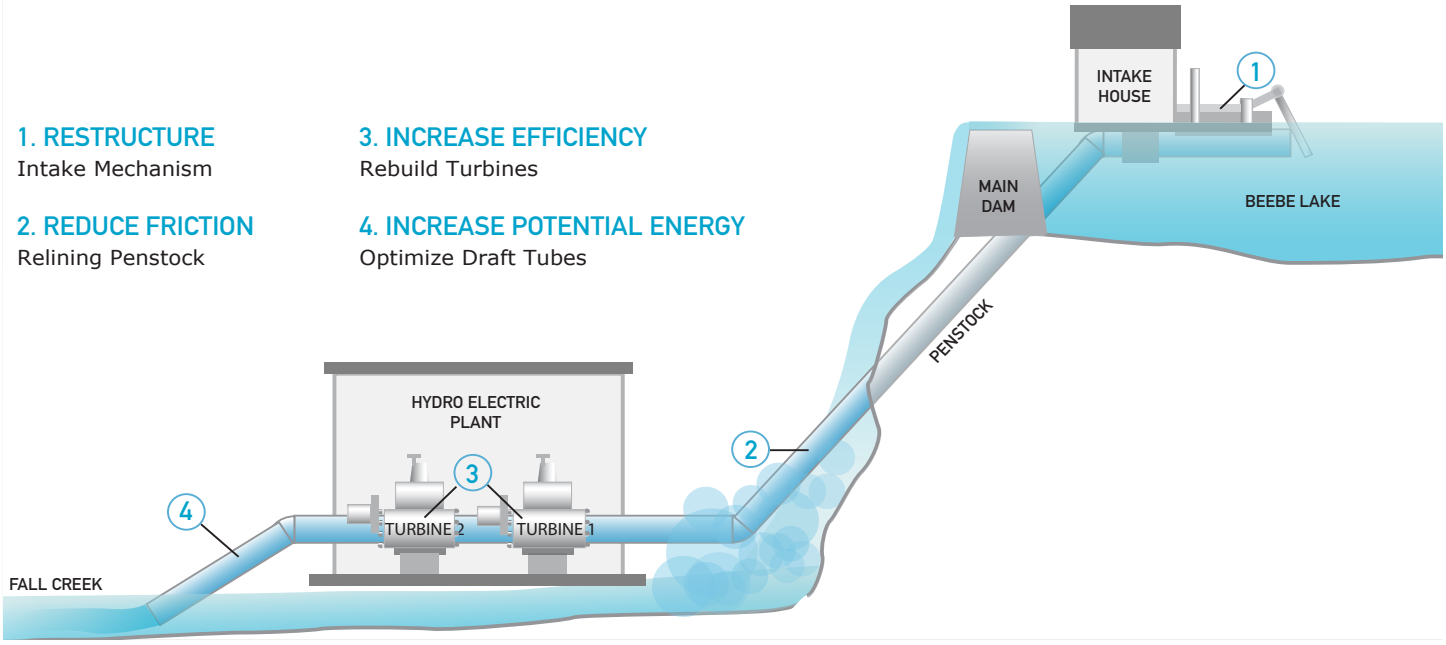
- Complete upgrades to the first turbine in Fall/Winter 2013.
- Complete upgrades to the second turbine in Fall/Winter 2014.
- Design and rebuild the intake to reduce head losses and increase plant efficiency by 10%.
- Investigate installing a smaller, more efficient turbine for low summer flows.
- Investigate modifying the plant's Federal Energy Regulatory Commission operating license to permit partial water storage at Beebe Lake – which would enable electric generation at peak daytime hours during the summer months.
- Reline or rebuild and resize the penstock to reduce head losses at peak production times.

**Resources**

Most other renewable power sources are subsidized to offset high installation costs. If hydropower customers at the University paid a premium for their hydro-electricity, the rate of payback on the investment in plant upgrades would be considerably shorter than it is currently.

Water is supplied to the plant from Beebe Lake by a five-foot diameter underground penstock, which is 1700 feet long. The water is then directed to one of two turbines, causing them to spin and drive an induction motor – thus generating electricity. Cornell's hydroelectric plant is "run of river," which means that no water is stored. At all times, 10 cubic feet per second of water must continue to pass over the dam. The average production for the plant is 4.5M KWh to 5.5M KWh per year depending on rainfall.

One of the 30-year-old turbines is in the process of being rebuilt and the second one is scheduled to be refurbished in Summer 2014. Other plant upgrades include the restructuring of the intake, relining of the penstock, and possible optimization of the draft tubes. When the turbine upgrade project is completed, it will allow complete remote starting of the units – which will enable Cornell to take advantage of increased flows and operate two turbines (for example, during rainfall events) to generate more power without the need for manual adjustments.



## 9. Increase the amount of **hydroelectric power** in Cornell's renewable energy portfolio by building or buying into hydroelectric generation facilities.

**Goal:** Support regional hydroelectric power generation through procuring energy for university facilities from external projects, and through construction of dedicated facilities. Along with Energy Action 5, wind power, and Action 6, solar power, this action will increase renewable generation capacity in our region and the overall renewable energy portfolio of New York State.

Partnering with private developers may provide opportunities for Cornell to procure long-term, cost-effective hydroelectric power – while also helping to conserve and restore historical sites and expand employment, educational, and recreational opportunities in the region. The 2013 Public Service Commission (PSC) ruling **Cornell University, Declaratory Ruling on Minimum Load Requirements for Remote Net Metering** (see Energy Action 6) created options for siting renewable projects at locations with electricity rates that make such projects economically feasible. See the **Cornell University Declaratory Ruling on Minimum Load Requirements for Remote Net Metering** (http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={4FE3D755-C41F-4607-AA8F-058A631C5B0D}) for more details. A petition for additional clarification from the PSC on the applicability of remote net metering to hydroelectric projects has been filed by Clarkson University (http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B357E59DE-5513-498D-A090-17779D19DAF6%7D). The outcome of this ruling may impact the feasibility of future external projects.

Building dedicated hydroelectric facilities is not financially feasible at present. The current cost of grid electricity is too low for the University to justify the investment required for construction.

Students with Cornell University Sustainable Design (CUSD) have identified three sites along Fall Creek for potential future hydropower generation projects. Each of the three sites could support a different kind of hydroelectric generation system. A conventional turbine-generator system could be implemented at a site in the Forest Home Neighborhood, a hydrokinetic system could be implemented upstream of the Sackett Footbridge, and a capacity extension project could be implemented at the existing Cornell hydro plant. The Cornell Hydro Plant Extension Project is currently the most promising of the three projects. Follow-up investigations are planned to identify systems that could optimize energy generation and cost effectiveness at these sites.

**Next Steps**

Monitor Public Service Commission rulings and the status of regulations for opportunities to pursue external projects with private developers.

**Resources**

Support CUSD team follow-up investigations and continue to explore future options.

## INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

### 10. Implement a **Smart Grid** which combines supply and demand management technologies to optimize the campus electrical system.

**Goal:** Utilize supply and demand management technologies to optimize the campus electrical system. By closely monitoring energy use and continuing to refine the campus Smart Grid, Cornell can take advantage of opportunities to sell excess generation back to the utility, or decrease the energy supply in response to decreased demand.

Microgrids that provide localized self-generation of electricity have been around for decades. By matching generation to local demand and by utilizing energy storage, microgrids provide improved security and reliability in the event of an interruption in the external grid (the macrogrid) due to natural or manmade disruptions.

A "Smart Grid" is a microgrid that continuously manipulates its load in order to fiscally optimize generation. A Smart Grid that can supply extra power when demand spikes, as well as usefully take in extra power when supply is high, can increase energy efficiency, and thus support carbon and greenhouse gas reduction goals. Coordinating a constantly-changing supply with power consumers' constantly-changing demand requires serious planning and intelligent software to manage the second-by-second ebbs and flows throughout the system.

**Next Steps**

- Document existing Smart Grid components at Kite Hill, Gates Hall, etc.
- Seek NYSERDA funding to perform an engineering study to articulate how the existing system can incorporate demand-side manage ment through:
  - integration of building systems with distribution systems,
  - integration of the installed Smart Metering with controls to activate demand response,
  - integration of Smart Controls at substations and large buildings,
  - possible regulation of the Hydropower plant intake for "time of use" during peak hours, and
  - exploration of alternate storage mediums such as chilled water or batteries for peak shaving
- Obtain funding for a demonstration project.
- Demonstration of effective storage, power generation, and demand curtailment processes that result in lower capacity and demand charges from the utility will be an indication of success. Lowering the total energy imported annually from the utility will be a second indicator. Decreasing total energy exported from generation may be a third indicator if coupled with efficiency data.

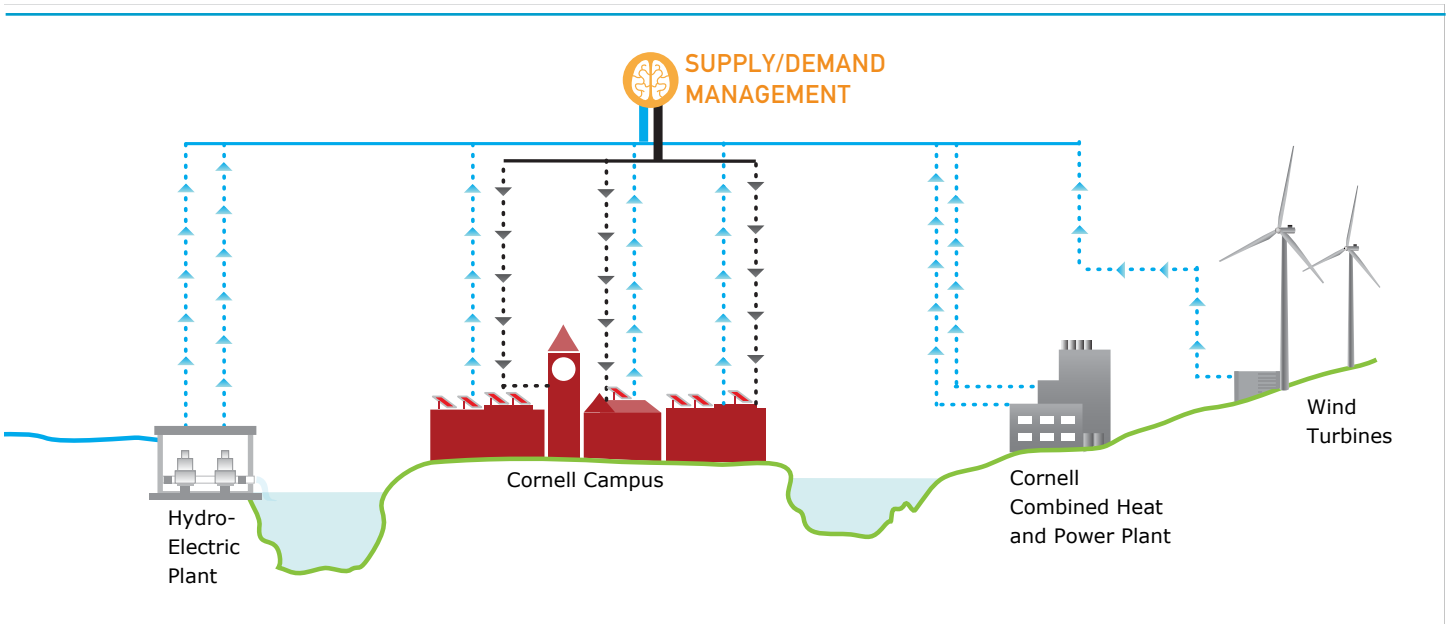
**Resources**

A NYSERDA incentive application has been submitted to fund the $50,000 cost of the engineering study. Full implementation costs and benefits will be evaluated during the study phase. After the study phase, a small pilot project will need to be implemented on a portion of the campus.

Cornell's Energy Management and Control System (EMCS) currently collects steam, electricity, and chilled water data from nearly 200 locations around the campus and, for many of these locations, has archival data for the past several years. This information is fed into our Utility Data System in order to bill the responsible campus departments and to perform various energy analyses. Monitoring is done both passively, by routinely observing system operation, and actively, by responding to any of the more than 9,500 computer-generated alarms that are currently defined. In addition, operators can interactively make adjustments to more than 8500 motorized fans, pumps, dampers, and valves at buildings throughout the campus.

Cornell already has well-integrated building management systems to adjust temperature, lighting, and other indoor environment settings, according to time of day, occupancy, season, and room use. We are now investing in state-of-the art electrical transformers and switchgear across campus, allowing our energy managers to track energy usage in real time. Smart Grid implementation would add a new level of sensors and controls into the electrical distribution systems at the building or equipment level. Benefits of these new features include the following:

1) Better visibility of daily system trends that allow plant operators to adjust fuel usage.
2) Optimized distribution of electricity to campus through voltage regulation and power flow.
3) More efficient operation of the Central Energy Plant.
4) Integration of renewables (hydro/solar) into the campus micro-grid.



## 11. Explore innovative financing mechanisms, including third-party financing, federal and state grants, and other means to fund demonstration and scale-up projects.

**Goal:** This is an "enabling" action that will facilitate other priority actions by identifying alternative sources of funding for both capital and operating expenditures. The Energy Team will explore innovative financing mechanisms such as:

- A systematic way to identify grant opportunities
- Third-party ownership of solar, wind, and other renewable energy facilities
- Strategies to support the work of the Green Revolving Loan Fund action team

The University is constrained in obtaining capital funds, and there is no new debt policy. CAP projects that require a capital expenditure cannot obtain funding through conventional debt instruments that have been used to finance projects such as Lake Source Cooling and Combined Heat and Power in the past. This action explores innovative financing strategies to allow projects which require capital funding to move forward.

For priority actions in the CAP, the Energy Team will work to identify funding needs and promising funding streams. Specific strategies to be employed include:

1) Develop a system to monitor NYSERDA, DOE, and other public and private grants, identify promising opportunities, and coordinate a response.
2) Engage the University's Energy Risk Oversight Committee on actions involving third party ownership and long-term Power Purchase Agreements. The Committee can recommend "hedging" strategies to ensure greater price certainty for renewable fuels.
3) Coordinate with development professionals within the university to identify mutual areas of opportunity.
4) Collaborate with the Johnson School Center for Sustainable Global Enterprise and other academic units to leverage Cornell's educational and research capacity. For example, in fall 2012, Professor Mark Milstein and students at the Center for Sustainable Global Enterprise created a very accurate financial model of the Cornell Tech Campus energy systems, in order to analyze the economic feasibility of integrating renewable energy. The Energy Team will continue and expand such collaborations.

**Next Steps**

- Demonstrate the viability of third-party ownership of renewable energy facilities serving the univer sity by commissioning the Snyder Road 2MW solar facility, which will provide electricity to Cornell through a long-term Power Purchase Agree ment.
- Navigate and resolve issues of ownership of renewable energy attributes" and other issues that impact the economic viability of renewable energy projects, such as hedging" strategies and escalation of power prices.
- Develop a methodology for consider ation by the University administration to sell carbon credits through a veri fied third-party certification process to raise funds for other CAP actions.
- Implement a system to track and follow through on relevant grant opportunities through NYSERDA, DOE, or other entities.

**Resources**

The intended outcome of these tasks is to either procure green energy at costs similar to conventional energy, or if the costs are higher, to ensure that green energy is appropriately valued through a process which has been agreed to by the University administration.

## 12. Establish a framework for Green Electricity pricing to enable buildings/departments/colleges on campus to purchase renewable energy at a slightly higher cost from both internal and external sources.

**Goal:** Building/departments/colleges purchase renewable energy from internal sources (solar, hydro, etc.) at a slightly higher cost, and revenue generated through the surcharge is used to implement small energy conservation projects.

Current renewable energy production on campus from the hydroelectric plant and solar installations on Day Hall and The Campus Store amounts to roughly 5,711,500 kWh per year. The Snyder Road solar farm will add 2.5M kWh to this total. This green energy can be sold to various units on campus for a slightly higher surcharge, on the order of $.02 per kWh. All buildings, departments, and colleges would be invited to participate in the Green Electricity Pricing scheme, and they could choose to buy anything from a small fraction of their total usage to 100% of their electricity from internal renewable sources.

Once adequate funds accumulate from the surcharge, they could be used to finance energy saving projects, such as efficient lighting upgrades or replacement of space heaters with foot warmers. Funds could also be combined with unit or college allocations to buy down the payback on larger projects, for example, to upgrade lab controls to reduce airflow. Qualifying projects would have a minimum of five-year simple payback on the initial investment.

**Next Steps**

- Establish a process for pooling and distributing the surcharge funds.
- Determine how energy savings from small projects will replenish the fund over time.
- Work to ensure that 100% of avail able renewable energy is sold" to various buildings/departments/col leges on campus.
- Accumulate renewable energy sur charge proceeds for two years, and utilize these proceeds to implement energy conservation projects.

**Resources**

Educate and raise awareness among buildings/departments/colleges about the value of renewable energy and the proposed energy conservation projects, so that they purchase this energy at a slightly higher cost.

## 13. Create a **Green Revolving Fund** to invest in energy conservation projects and capture energy cost savings for reinvestment.

**Goal:** Projects funded by Phase 1 of the Energy Conservation Initiative (ECI) must meet the criteria for either a 7-year billed or 10-year marginal payback. The proposed Green Revolving Fund (GRF) would reinforce existing ECI efforts and provide funding for: **1)** small projects with longer returns on investment, **2)** student led projects, and **3)** research projects which are not currently eligible for funding under the ECI. The GRF can complement larger-scale energy conservation projects by providing quick access to funding for smaller college, unit, and student initiated ideas. It can also provide a source of smaller grant funds (which don't require repayment) for projects that foster campus collaboration and sustainability.

The proposed GRF would provide capital, in the form of loans or grants, to individual colleges and units to fund small-scale sustainability projects, such as:

- Building insulation and weatherization
- Electricity plug load reduction
- High-efficiency office and research equipment purchasing
- HVAC upgrades
- Lighting and water efficiency retrofits
- Renewable energy projects
- Sustainable purchasing
- College/unit specific energy efficient improvements

Cornell could also consider joining the nationwide Green Billion Dollar Challenge, which would provide access to the Green Revolving Investment Tracking System (GRITS), a tool to assist with project selection and tracking of project-specific finances, energy data, and carbon data. The Challenge requires that participating colleges and universities pledge at least $1 million dollars in a fund structure that ensures a continuously available, self-financing source of capital for sustainable improvements. Energy Corps at Cornell and the Student Assembly have proposed the GRF concept to the university administration, with a goal to initiate a $1 million dollar fund. To support the establishment of the new fund, The Cornell Store implemented a 5 cent surcharge on plastic bags on Earth Day 2013. As of November 2013, The Store had collected nearly $2K in funds to seed the GRF.

**Next Steps**

- Facilities Services staff, in partnership with the Budget and Finance Office, will work to establish a business plan for the GRF that meets university requirements.
- Invite campus stakeholders, includ ing college/unit, faculty, staff, and student representation, to determine how the GRF can be effectively man aged, utilized, and maintained.
- Determine how energy savings from funded projects will replenish the fund over time.
- Determine which available resources are best suited to fund a GRF for a three- to five-year trial period, and secure funding for the pilot program.
- Establish guidelines for projects to be funded by the proposed GRF and appropriate payback criteria, as applicable.
- Utilize funds from the GRF to imple ment energy conservation projects which meet the specified criteria.

**Resources**

Secure initial funding and build ongoing funding mechanisms into the overall business model for the GRF. Based on the success of the fund, the size of the GRF could be increased (or decreased) to respond to future opportunities and needs.

## 14. Work with Cornell Energy Institute to assess the feasibility of establishing a **renewable energy research park** to increase the visibility of new technologies and serve as a teaching tool for the university.

**Goal:** Assess the feasibility of establishing a renewable energy research park to **1)** increase the visibility of new technologies, **2)** demonstrate their viability at scale, and **3)** serve as a teaching tool for the university in a living laboratory setting.

Faculty at the **Cornell Energy Institute** (http://energyinstitute.engineering.cornell.edu/energyinstitute) will take the lead to prepare a white paper and conceptual illustration of the proposed research park, highlighting how the facility will function as a living laboratory for renewable energy research and demonstration. Possible renewable and efficient technologies to be demonstrated or deployed at the park include: solar photovoltaic, solar thermal, geothermal heat pumps, biomass thermal gasification and liquefaction concepts for a range of feedstock types (CURBI), and small-scale wind energy.

The proposed energy research park would provide a living laboratory for faculty conducting research in renewable energy, as well as for engineering and CALS students. At the appropriate time, the community, including K-12 schools, would be welcome to tour and take advantage of the educational opportunities provided by the various projects deployed at the energy research park.

**Next Steps**

- Cornell Energy Institute will prepare a conceptual drawing and a white paper to describe the value of the project to the university.
- Convene a planning team to help determine the appropriate site on campus for the park and potential funding sources.
- Actively seek public and private funding for this project.

**Resources**

The project cost is expected to range between $10-15M.

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

### 15. Recruit key faculty to serve as advocates with university leaders to advance renewable energy projects and progress toward carbon neutrality.

**Goal: Cornell Energy Institute** (http://energyinstitute.engineering.cornell.edu/energyinstitute) will recruit key faculty to advance Climate Action Plan (CAP) renewable energy actions with university leadership. Faculty advocacy will demonstrate the value of these actions to the educational mission of Cornell, both in terms of enhancing teaching and research, and in terms of attracting new investment on campus.

During the next two years, the Energy Institute Director (Professor Jeff Tester), working closely with the Atkinson Center for a Sustainable Future and the CALS Agricultural Experimental Station, will organize a Faculty Advocacy Group to help promote the deployment of sustainable energy systems on campus. A key objective of this group will be the development of a plan for a renewable energy research park (see Energy Action 13) that could serve as a living laboratory for students and faculty to evaluate renewable energy supply and end use technologies at scale and provide usable low carbon energy to advance the university's CAP goals. In addition, the Faculty Advocacy Group will work with Cornell's Facilities and Cooperative Extension teams to identify state, federal, and private groups interested supporting clean energy technology demonstration and deployment on campus. The goal of the Faculty Advocacy group will be to facilitate energy education, research, and outreach projects which are consistent with Cornell's land-grant commitment to advance the common good, in this case by developing and sharing sustainable energy options.

**Next Steps**

- Identify and recruit key faculty to participate in the group.
- Convene members to develop an advocacy plan and identify potential funding sources.
- Actively support renewable energy demonstration projects on campus and seek public and private funding for these projects.

**Resources**

Need to demonstrate the value of renewable energy projects to enhance Cornell's mission and generate new investment on campus.

## 16. Draft an **Energy Procurement Plan** to identify long-term (30-year) strategies for energy procurement at Cornell.

**Goal:** Prioritize investment and develop a realistic timeline for Cornell's transition to renewable energy through a long-term Energy Procurement Plan.

Natural gas is not a long-term greenhouse gas alternative, and it does not provide a direct path for Cornell to make the transition to renewable energy. A long-term Energy Procurement Plan will establish a clear pathway for the University to achieve its desired energy portfolio. Preparation and periodic updating of an Energy Procurement Plan will require Cornell to engage in a proactive strategic planning process to maximize renewable energy resource development and deployment and reduce dependence on fossil fuels. In short, the plan will provide the Cornell community with a clear vision of the energy portfolio it wants to achieve, as well as strategies for getting there.

By identifying clear action steps in a long-term Energy Procurement Plan, Cornell can target future investment and policy decisions. The plan will increase understanding and awareness about the financial and operational aspects of specific renewable energy and energy efficiency technologies. It could also spur action by presenting short– and long–term steps to achieve the desired scenario.

The plan will evaluate the energy generation potential of renewable energy (including solar, wind, biomass, geothermal, and hydropower), the energy saving potential of these renewable technologies, energy resource availability, financial resource availability, market conditions, community buy–in, and pathways for technology deployment through existing or future networks. Energy consultants will partner with staff to quantify the University's existing load profile, the energy generation potential of renewable energy (including solar, wind, biomass, geothermal, and hydropower) based on resource availability, and the cost of each option.

While no immediate reductions in GHG emissions will be achieved by creating this plan, the plan will provide decision makers with a more detailed understanding of the University's energy demand and renewable supply potential. The plan could also help to define and accelerate key demonstration projects and determine the most effective and efficient means of meeting our long–term energy goals.

**Next Steps**

- Hire a consultant to complete a load profile and perform a market analysis of available external projects (wind, solar, geothermal, biogas, and hydropower) that could be incorporated into Cornell's long-term energy portfolio.
- Investigate remote net metering opportunities.
- Develop an initial energy procurement plan with an annual review process.
- Amend the energy procurement plan as needed to achieve the desired scenario.

**Resources**

Need to prioritize investment in renewable energy projects to enhance Cornell's mission and achieve our long-term energy goals.

# FOOD

## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

### 1. Reduce the environmental footprint of the food supply chain through increased regional purchasing.

**Goal:** About 23% of the produce served by Cornell Dining is sourced regionally/locally. To increase the volume of local purchasing, the Food Team is recommending that the university conduct an analysis of all campus food purchases to **1)** identify local and regional food vendors, and **2)** identify opportunities to increase both the supply and delivery of local and regional products.

Cornell's commitment to local food dates back to the formation of the Cornell Dining Local Foods Advisory Council, (CDLFAC) a student/staff effort initiated in 2005. The council supports efforts to increase university procurement of locally grown food, provide education and outreach related to sustainable food and agriculture, and promote relationships with local farmers – in order to improve the quality of life for the Cornell campus and the surrounding community. Council members include students, chefs, staff, faculty, Cooperative Extension Agents, and Cornell University Agricultural Experiment Station (CU AES).

An ongoing challenge to increasing the local market share of Cornell food purchases has been that local producers cannot always guarantee crops or provide delivery to multiple locations. Cornell Dining contracts with a local distributor who can manage relationships with local growers and deliver a consistent supply to multiple dining facilities. Another challenge is that local products are often more costly than food imported from other regions. To maintain a balanced budget, Cornell Dining incorporates higher priced items as unique features rather than as consistent menu items.

Cornell Dining actively partners with the regional farming community to purchase seasonal produce and locally grown foods, including the following:

- Local beef burgers
- Local and regional produce
- Local grains and legumes
- Local dairy products
- Local/regional shelf-stable products
- Locally produced bakery products such as bagels and breads
- Locally roasted coffees

In addition to Cornell Dining, there are many other food service and catering providers serving the campus community, including Maines, Cooper Booth, Sysco (which supplies most of non-Cornell Greeks & Coop housing), Premier Catering, F&T Distributing Company, the Statler Hotel/School, Aramark, the Temple of Zeus, Mandibles Café, and the Law School. These "vendors" need to be included in data collection efforts and local food purchasing outreach campaigns.

In November 2013, Albert R. Mann Library, Cornell Cooperative Extension of Tompkins County, Cornell Small Farms Program, and the Farmers' Market at Cornell co-hosted the fifth annual Local Fair in Mann Library on the Ag Quad. The fair featured an open market of food, fiber, and energy products from the Finger Lakes region, as well as displays highlighting campus and community initiatives which support fair and equitable local economies and **"value chains"** (http://localfair.mannlib.cornell.edu/subpages/valuechains.html). The goals of the Local Fair are to:

- Celebrate the productivity and ingenuity of the Finger Lakes region;
- Educate community members about local food, fiber, and energy systems, and localized economies;
- Highlight campus-community partnerships that are vital to fulfillment of Cornell's Land Grant mission; and
- Encourage greater collaboration and innovation in support of these goals.

Learn more at http://localfair.mannlib.cornell.edu.

**Next Steps**

- Approach all food providers on campus, as well as university pur chasing and contracts divisions, to supply their buying information for analysis.
- Determine the current volume of local/regional purchases.
- Work with the Cornell Purchasing Department to explore sourcing areas and develop best practices to increase the local market share.
- Attempt to increase local/regional food purchases by 5 to 10% over the next five years.

**Resources**

Designate a staff person to collect the requisite data and compile reports. Allocate funding to pay for these activities.

## INNOVATION: Create a living laboratory for low–impact behaviors, climate education, and research.

### 2. Enhance and expand Cornell's food recovery program.

**Goal:** Implement practices and motivate patrons to reduce food waste at dining facilities and programs on campus.

Cornell Dining has implemented several business practices specifically designed to reduce food waste in their facilities on campus. These include:

1) Decreasing portion sizes so that students and staff discard less food.
2) Implementing tray-less dining to discourage students/staff from taking more dishes (and food) than they will actually eat.
3) Preventing food waste through improved tracking of prepared food to more accurately predict how much food to serve on a daily basis.
4) Incorporating excess food that has not been placed in service (food that has not been taken from cold or hot holding) into menu options that will be served the following day.
5) Donating perishable foods to the Food Bank of the Southern Tier (FBST) during academic breaks when many dining units are closed. This typically occurs two or three times per year, and the value of donated food ranges between $2,500 and $5,000. Donations are consolidated at one unit for pick up by FBST, and the food is redistributed to the food bank's six-county region. Cornell Dining has partnered with FBST since 2010 in this "food rescue" program.

After transitioning to tray-less service at all units between 2009-2012, Cornell Dining has reduced the use of water and chemicals in its facilities – but there is no way to assess exact usage and cost reductions specific to dining operations. Dining halls are rolled into the overall building meters, and there are currently no separate meters for measurement of water, energy, and heat loss for individual dining halls.

Another important focal point for Cornell Dining is to help motivate students to reduce their own personal food waste. In fall 2013, student sustainability coordinators launched a "Taste, Don't Waste" campaign in North Campus dining halls. The goals of the campaign were to encourage students to take smaller portions and consider the impact of their own food waste on the economy and environment. Student coordinators weighed food waste prior to the campaign and then again after the campaign, and they surveyed diners to assess the effectiveness of the campaign in reducing personal plate waste in selected dining units. The next phase of the campaign will involve more formal outreach programs targeted at first- and second-year students to educate them about how their actions in the dining hall can substantially reduce the volume of wasted food.

Many opportunities exist to expand food recovery beyond Cornell Dining facilities to other food outlets, caterers, and programs (e.g. Athletics) on campus. These opportunities need to be assessed and included in future efforts to enhance Cornell's food recovery program.

**Next Steps**

- Design the next phase of the Taste, Don't Waste" awareness campaign to launch in fall 2014.
- Continue plate waste studies and awareness raising to reduce per sonal food waste.
- Evaluate and refine existing strategies to reduce food waste in selected dining units.
- Work to engage other food provid ers on campus, as well as Cornell Dining, to implement practices to reduce food waste in their opera tions.

**Resources**

Develop tools to assess the overall impacts of practices such as tray-less dining on reducing water, energy, and heat loss for individual dining halls.

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

### 3. Teach food skills and increase students' knowledge of and interest in the local food system.

**Goal:** Ithaca is surrounded by farms and local foods enthusiasts, but Cornell students are largely disconnected from the region's food system. Most lack knowledge about where their food comes from and are unable to participate in the food system as responsible and engaged consumers. No fresh food stores exist in Collegetown, leaving car-less students without adequate access to healthy food. The Food Team will implement two programs to address these challenges: **1)** a Farmer's Market on campus to increase access to fresh, locally grown food, and **2)** a pilot program, "Beyond Ramen," to build food skills and literacy among second semester freshmen who will soon be moving off campus to their own apartments.

The Cornell Farmer's Market is an important step in increasing student access to fresh local produce. The market is a student-led effort which serves approximately 300-400 students per market day. The market was held on the Agriculture Quad every Wednesday during the fall 2013 harvest season and featured a range of products grown by local farmers. More than 15 local producers participated in the 2013 market, including produce and dairy farmers, bakers, prepared food vendors, and crafters. Key challenges to sustaining the Cornell Farmers Market are limited student budgets and the need to educate students to understand the importance of eating locally. As more students purchase local produce, more farmers will be interested in selling on campus.

In spring 2014 the Food Team will implement the "Beyond Ramen" pilot program. The pilot will include four weekly sessions for 10-12 students, focused on improving their shopping and food preparation skills and food system knowledge. Food skills lab sessions will be held in the Martha Van Rensselaer teaching kitchens, and will be supplemented with farm tours, a supermarket tour, and a local food processing facility tour. A pre-intervention survey to assess food skills self-efficacy and food system knowledge was administered in fall 2013, via an online questionnaire sent out to the entire freshman class residing in North Campus housing. After the four-session pilot series, participants will be interviewed to assess changes in knowledge and skills as well as intended and reported changes in food-related behavior. Project coordinators will then assess resources and institutional capacity for scaling up the program to involve a greater number of students.

**Next Steps**

- Establish Farmers Market on cam pus in fall 2013.
- Implement a pilot program for off -campus students in spring 2014 to present food system knowledge and hands-on cooking activities.
- Seek funding to scale up the pilot project from the Office of Cam pus Life; the Office of Student and Academic Services; the Office of Fraternities, Sororities, and Indepen dent Living; and/or other sources.
- Expand the "Beyond Ramen pilot and evaluate the efficacy of the program in building students' food skills and food system literacy.

**Resources**

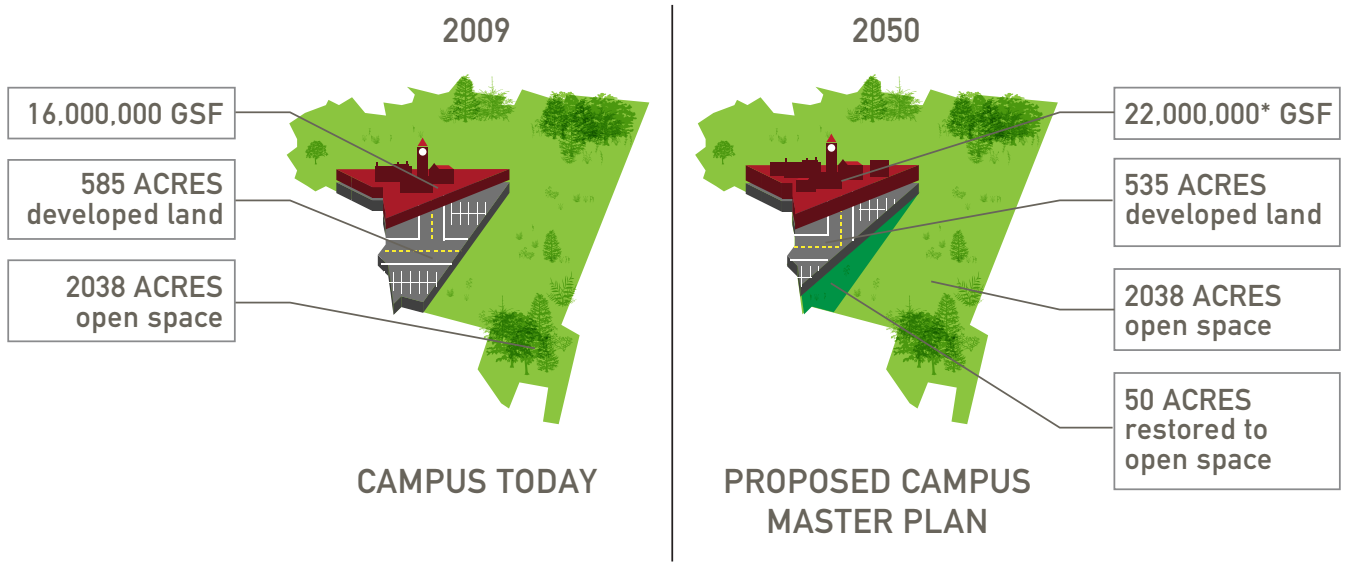
The cost of the pilot "Beyond Ramen" program is roughly $4,000, which includes a student assistant, food, supplies, and equipment.

# LAND

## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

### 1. Implement the land use recommendations and sustainability principles articulated in Cornell's Master Plan.

**Goal:** The land use recommendations of the Cornell Master Plan (CMP) seek to create a balanced mix of land uses, which lessen infrastructure demands, and to conserve, increase, and enhance green spaces on campus, which provide carbon sequestration and other ecosystem services.




The sustainability goals articulated in the CMP were intended to ensure that the Ithaca Campus would be a learning landscape in every sense of the term. Cornell's Ithaca campus provides multiple opportunities within walking distance for students to learn about sustainable development in urban contexts and land and natural resource conservation in urban and rural contexts. Land adjacent to and on the developed urban core campus is used for agriculture as well as natural resource protection. The main campus showcases several best practices for land use as well as transportation.

The Land Team will continue to advocate for and seek to implement Cornell Master Plan recommendations for compact development, open lands management, and conservation on campus. Since the 2009 CAP was released, several building projects have been completed which exemplify the kind of compact development supported by the CMP. These include the Human Ecology Building (with under-building parking); the Johnson Art Museum Expansion (largely sub-surface and extending the existing facility); the

Combined Heat and Power Plant (built on a brownfield area where coal was formerly stored); the new Food Sciences building under construction on the site of the former building; the Animal Health and Diagnostic Center on the site of several smaller and obsolete buildings; and several major renovations which have avoided new construction and related land, space, infrastructure, and energy use. Many of these projects have also effected improvements to the site landscape and transportation infrastructure, in keeping with CMP objectives and recommendations.

The CMP states that there will be no net loss of ecosystem services, such as carbon sequestration, storm water retention, filtration (bioremediation), groundwater recharge, water quality, erosion control, shade and climate control, biodiversity of plants and animals, soil health, etc. These services are provided by the natural system at a fraction of the cost it would take to design, install, and maintain mechanized systems to provide the same services for the campus. The CMP's commitment to no net loss of ecosystem services also means that stands of trees or mature trees cannot be cut without addressing the resulting loss of ecosystem services. As Cornell moves forward with future land use improvements, the Land Team will work to ensure that these improvements enhance landscape ecosystem services and link to pedestrian and bike networks.

Visit the **Cornell Master Plan website** for more information: (http://www.masterplan.cornell.edu/)

**Next Steps**

- Continue the holistic implementa tion of the Campus Master Plan development and open space recommendations.
- Create a heat map of campus to identify hot spots" and understand relationships of buildings to site and landscape. Analyze tree profiles on campus to see where/if trees are contributing to climate control of adjacent buildings. MIT has devel oped and utilized a model to map Cambridge, and this model could be applied here at Cornell. Approach faculty in the Colleges of Engineer ing and Architecture to see if they could utilize the MIT model to create a heat map of the Ithaca Campus.
- Create an ecosystem services map of campus. Utilize the map to quantify ecosystem services on sites across the campus, and identify areas which can be enhanced to optimize storm water retention, climate control (shade, wind breaks, etc.), subsurface water flows, etc. This map could serve as a tool for sustainable site development and for allowing Cornell's natural systems to complement the campus built environment, by identifying how natural systems can work to reduce energy needs for campus buildings (for example, by building below grade to reduce heating and cooling needs). The map can also identify areas which can provide enhanced erosion control, by working with hydrology, soil types, and the existing ecosystem to catch and slow water at the source before it flows into the gorges.
- Work with the Transportation Team to ensure that systems for transportation and circulation are coordinated with future land devel opment.

**Resources**

Secure resources (staffing and funding) to create an ecosystem services map of campus. This could be complemented by the heat map of campus.

## INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

### 2. Enhance green infrastructure and associated research and interpretation on campus.

**Goals**:

**1)** The Land Team will seek to document how green space (plants and soils) on Cornell's campus serves as a natural storm buffer and provides ecosystem services, such as: habitat, carbon sequestration, storm water mitigation, water filtration, soil remediation, energy conservation, and enhanced biodiversity. Existing green infrastructure projects across campus can be expanded to serve as a research and teaching tool, as a showcase for sustainable landscape practices, and as an effective means of adapting to the weather-related impacts of climate change.

**2)** The Land Team will identify areas on campus that are suitable for different types of green infrastructure interventions.

Each landscape on campus brings a set of values that contribute to the overall ecological services provided by Cornell's open spaces. Individual green infrastructure projects demonstrate and highlight different values and functions within our campus landscapes. For example, climate models are predicting high-intensity rainfall and other extreme weather events that will impact water management at Cornell. The Land Team will advocate for the inclusion of green infrastructure components in campus projects and attempt to study, document, and interpret the specific effects of different green infrastructure projects to capture runoff on campus. The **Sustainable Sites Initiative**™ (http://www.sustainablesites.org/) should be considered as a standard for site development and maximizing green infrastructure at project sites on campus.

In 2014 the Land Team will be collaborating in the creation of a bioswale and sidewalk along entire south side of Tower Road. On-street parking spaces will be converted to an 8'-wide sidewalk with structural soil underneath connecting to the bioswale, and a 5'-wide planted bioswale will be constructed with curb cuts to allow water into the bioswale. The Urban Eden class will landscape the bioswale in the fall. Groups of woody plants, mostly low growing shrubs, will be used on site. There will be three replicates of five different groups of stormwater tolerant shrubs along the road. These were chosen based on the research recently completed by Master's student Ethan Dropkin (see http://www.hort.cornell.edu/uhi/outreach/index.htm#selection). The goal of this project is to evaluate the growth and efficacy of these shrubs over time, and to collect data on water quantity and quality after construction of the bioswale and sidewalk is complete.

Other green infrastructure projects focus on long term soil remediation after construction to improve the chemical, biological, and physical properties of soils and allow for improved plant growth. Measurements before and after remediation can document the beneficial effects of these projects on soil health and biomass production.

**Next Steps**

- Formalize and convene the Green Infrastructure team regularly to coordinate existing efforts and collaborate on upcoming projects, such as providing stakeholder input on the Concept Plan for the Arts and Ag Quads and streetscape design for Tower Road. Input from the team could significantly influ ence the plan and could integrate existing projects in the vicinity of both Quads into a larger vision for how to incorporate green infra structure into research, teaching, and outreach at Cornell.
- Work collaboratively with the Green Infrastructure Team to develop consistent interpretive signage for campus sites. Coordinated interpre tation will help raise awareness and build public understanding of the value of these efforts.
- Identify and collaborate to obtain grant funding for priority projects to mitigate storm water runoff, improve water quality, etc. Look specifically at the Green Innovation Fund of NYS, water quality grants, Atkinson Center grants, etc.
- Work with the Atkinson Center to host topical lunches featuring green infrastructure topics to draw in others who might be interested in collaborating on grant seeking for particular projects on campus.
- Develop and pilot a green infra structure tour of campus, utilizing green system signage, with multiple loops to interpret various focal points. Highlight the ecosystem values of Cornell's open spaces and natural areas and utilize Cornell's green infrastructure as a tool for research and education. (cont...)

Where soil compaction is necessary under pavement and along sidewalks, structural soils have been used to provide a medium for tree growth, as well as a base for turf that improves storm water and snowmelt infiltration, while resisting snowplow and de-icing salt damage in the winter and early spring. These practices may reduce the need to repair miles of sidewalk each year. Examples of these practices on the Cornell campus can be measured and interpreted.

There are also numerous green roofs, rain gardens, and bio-swales on campus. Some of these will be developed into water detention and filtration systems in addition to providing habitat for birds and pollinators. The ability of green roofs to mitigate storm water while creating habitat and improving roof membrane performance will be measured.

Existing green infrastructure projects at Cornell that could be inventoried and interpreted for the greater campus community include:

- Thirteen years of soil remediation and landscape development conducted by the "Creating the Urban Eden" class. Research is underway to evaluate the effects of soil remediation and plant growth over time.
- Three depths of structural soil including a control have been replicated along a stretch of Tower Road and tall fescue sod planted. The objectives are to evaluate the effects of snow plowing and deicing salt on the turf grown.
- Tree growth in structural soil on campus.
- Low-mow turf areas on campus.
- Proposed water filtering, habitat-enhancing bio-swale behind Rice Hall and existing bio-swale by Plantations Nevin Welcome Center.
- Acoustic monitoring of birds in different planting schemes.
- Green roofs, bio-swales and rain gardens to conduct research with controls.

These projects can be used for research as a source of data and potential innovative solutions. They can also serve as interpretive sites, to enhance student and community understanding of green infrastructure and its value to the campus.

Potential partnerships with the City of Ithaca and the Town of Ithaca are also possible. The City maintains a street tree inventory and uses Forest Service metrics that quantify ecosystem benefits provided by the trees and associated green space. Several research projects are on-going in the City, such as the use of Cornell University Structural Soil, identification of stress tolerant trees, and use of porous pavements and structural soil to reduce storm water runoff and improve tree growth. Cornell and the city could work in partnership to enhance the development and use of these green infrastructure practices.

(cont...)

- Develop outreach tours of the sus tainability "trail" for municipalities, extension educators, classes, and appropriate professional and com munity groups.
- Develop interpretive information for each site and create a downloadable application for mobile devices. As a visitor walked around campus, he/she could scan codes and download rel evant green infrastructure education.

**Resources**

An engaged group of faculty and staff are actively pursuing these practices for research and teaching/interpretation purposes. Many green infrastructure practices are not cost prohibitive, although monitoring and data collection will require some modest but on-going funding. By fostering greater integration of these practices with the curriculum, students could be engaged to incorporate various green infrastructure sites on campus into a sustainability "trail."

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

### 3. Assess the feasibility of piloting a LEED Existing Neighborhood (EN) certification for the Ithaca Campus similar to the LEED- Existing Buildings (EB) for building renovations. Collaborate with other universities to advocate in favor of applying this standard to existing campuses, as well as to existing development anywhere – campus or municipality or neighborhood.

**Goal:** Develop a new standard for LEED that can be applied to existing development. LEED-EN would provide an incentive to redevelop existing neighborhoods to green standards, rather than building new, which is the focus of the current LEED-ND (Neighborhood Development) certification. By focusing on the existing built and developed footprint, this action can potentially avoid or significantly reduce the carbon impact of building on open space.

Land is a resource which is increasingly in short supply. In a time of constrained budgets and resources, LEED-EN can provide low-cost options for achieving sustainability and avoid the use of more open land for new development. Using existing infrastructure and land significantly lowers the cost of development and encourages the introduction of retrofits and redevelopment that can reduce energy use, enable greater walkability and sustainable transportation alternatives, and encourage greater density, the conservation of open space, better integration of the built environment into the natural environment, and enhancement of open spaces to provide critical ecosystem services.

The Land Team will evaluate the feasibility of developing a pilot LEED-EN standard that could be proposed to the USGBC (U.S. Green Building Council) to include in their suite of LEED options. This new standard could be applied to existing development, retrofits, or redevelopment initiatives that achieve the outcomes desired by LEED-ND. The new LEED-EN standard, like the LEED-EB (for building renovation), could serve as an incentive to optimize existing built, infrastructure, and open space resources at a relatively lower cost than new construction. LEED-EN would be applicable to campuses as well as to existing urban and suburban environments.

LEED-EN could potentially be applied on a national and international basis and be a low-cost way to improve upon existing resources for sustainable development. Cornell has an opportunity to pioneer the new standard and to lead the effort to change existing USGBC policy. This would involve partnering with other interested campuses to advocate collectively with LEED administrators to allow existing developments to be certified LEED-EN.

**Next Steps**

- Work collaboratively with Cornell University Sustainable Design to develop metrics for LEED-EN to achieve outcomes comparable to the existing LEED ND standard.
- Create a table summarizing the new LEED-EN requirements show ing how Cornell's Ithaca Campus meets these requirements.
- Present the new standard to the Ivy Plus Coalition to seek partners who would like to certify their campuses as well.
- Lobby USGBC for a policy change to allow existing developments to be certified LEED-EN.
- Collaborate with other campuses across the country to demonstrate the value of ecosystem services and pedestrian/bicycle/transit oriented development as part of an inte grated approach to campus master planning.

**Resources**

Engage faculty and students in the research and development of the new standard. Seek assistance from the PSCC Advisory Board to strategize on how best to lead the effort to change existing USGBC policy.

# PEOPLE

## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

### 1. Expand Cornell's Energy Conservation Engagement Program to achieve a 1% reduction in annual electrical energy usage and to educate the campus community, including thousands of future graduates, on the value of sustainable energy use.

**Goal:** Educate individual users to reduce their energy consumption, resulting in more sustainable energy use, long-term behavior change, and savings for the University. **A 1% reduction in university-wide annual electrical energy usage will reduce emissions by about 800 metric tons (CO2 equivalent) per year. Estimated annual savings based on a 1% university-wide reduction on electrical energy costs are roughly $181,400.**

Changes in the day-to-day behaviors of the campus community in terms of how individuals use lighting, heating, and office and laboratory equipment can potentially result in substantial energy savings – with a relatively low up-front investment. To foster such behavior changes, conservation outreach is needed.

Conservation Outreach was one of the 19 initial actions included in the 2009 Climate Action Plan. Previous outreach efforts were largely ad hoc: this **Key Action** seeks to formalize and improve on existing efforts, quantify the energy savings, and expand the effort across campus.

Cornell's new budget model provides a compelling incentive for colleges and units to reduce their energy consumption and increase cost-saving measures. In July 2013, the University transitioned from centralized utilities to a budget model in which each college/unit is responsible for its own utilities.

Cornell's Energy Conservation Engagement Program, the "**Think Big, Live Green"** campaign (thinkbiglivegreen.cornell.edu), employs multiple complementary initiatives to educate users and build a culture of conservation at Cornell. Users are provided with monthly real-time energy use and cost data, as well as best practices for conserving energy which are customized to that user's particular work place, whether it be a classroom, office, lab, residence hall, kitchen, etc. Peer educators, or "Green Ambassadors," provide education, leadership development, social marketing, resources, and oversight of these initiatives.

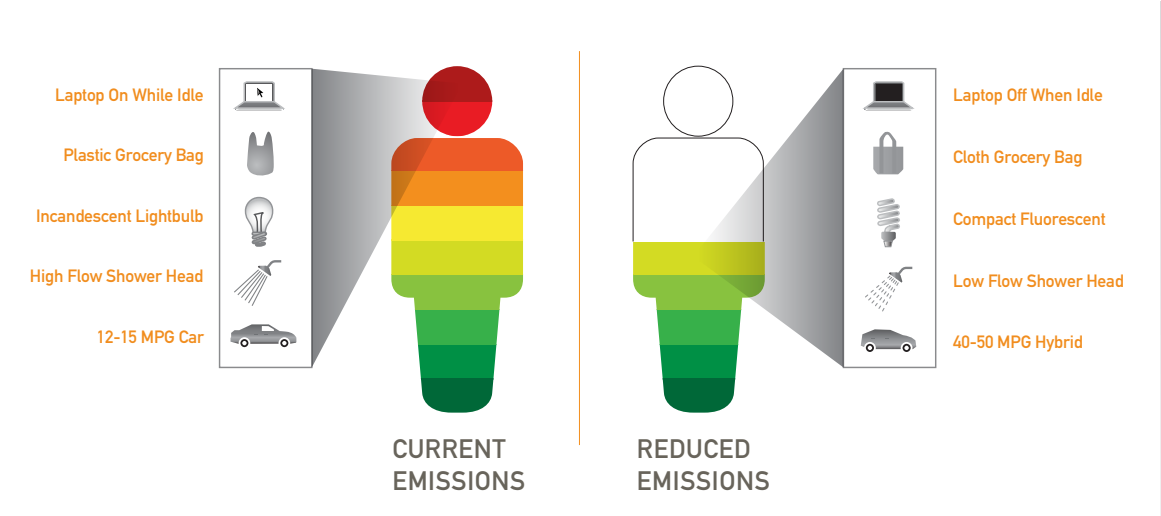
When fully implemented, the Think Big, Live Green campaign aims to reduce campus electric use by 1% from 2012. Early results from the pilot program in the College of Engineering are encouraging: from November 11 – December 10, 2013, the ten buildings participating in the "Fall 2013 Energy Smackdown" saved over 191,000 kWh and $15,000. Based on the projected electric budget for the College of Engineering (COE), the 1% reduction target (300,000 kWh or $24,000) is achievable by the end of the academic year – with continued engagement on the part of the COE community.

**Next Steps**

- Complete the successful pilot of the Think Big, Live Green engagement program within the College of Engi neering and assess progress on the 1% electrical energy reduction goal within the first year.
- Conduct research and focus groups on community behaviors and mind sets in each college/unit prior to launching the Think Big, Live Green campaign in that college/unit.
- During the 2013-2014 academic year, expand the Think Big, Live Green Campaign to the College of Human Ecology and to Student Academic Services (to serve approximately 10,000 students).
- Evaluate and refine the pilot pro gram, and launch the Green Labs and Green Offices Certification Program university wide in 2014.
- Add the remaining 54 buildings on campus to the Building Dashboard as funds become available.
- Roll the Think Big, Live Green Cam paign out within three colleges by 2015 and university wide over the subsequent 2 3 years.

**Resources**

Secure funding for the Energy Outreach Coordinator and two outreach specialists to manage and coordinate the Think Big, Live Green Campaign roll out across campus ($200,000 annually).




The four components of the Think Big, Live Green campaign include:

1) **College Engagement Program:**

   This program educates students, faculty, and staff within a college or unit about sustainable practices they can adopt. The program was piloted in the College of Engineering in fall 2013, with the following monthly themes:

   - **September**: The BIG Paper Cut focused on reduced paper use and reduction
   - **October**: GREEN Your Workplace focused on certifying Green Labs and Green Offices
   - **November**: Fall Energy Smackdown focused on recognizing buildings that achieved the highest energy reductions
   - **December**: Setback = Payback focused on unplugging equipment and setting back thermostats during the break

2) **Green Ambassadors:** Faculty, staff, and graduate student volunteers support resource conservation within their respective workgroup, and serve as a point of contact between Cornell's Energy & Sustainability Department and the college community.

3) **Cornell Building Dashboard** (http://buildingdashboard.cornell.edu): This Internet-based display tool tracks building energy performance through "real-time" metering (in 15-minute intervals) of electric, steam, and chilled water usage. The dashboard enables end users to see firsthand the energy and cost savings that result from specific conservation actions within their work places. A total of 96 buildings will be integrated by spring 2014 and the remaining 54 buildings on campus will be added as funds become available.

4) **Green Labs and Offices Certification Program** (http://www.sustainablecampus.cornell.edu/initiatives/green-your-lab or http://www.sustainablecampus.cornell.edu/initiatives/green-your-office): Participating labs and offices commit to sustainable practices that are feasible for their particular situation, and, by successfully implementing these practices, they earn points towards a green certification.

## 2. Expand the university's virtual conferencing capacity to provide an alternative to business travel.

**Goal:** Expand the Cornell community's access to and use of virtual conferencing options, as a means of reducing energy and emissions associated with University-related travel.

Cornell University procured a WebEx site license for "One Cornell" in April 2012. A pilot program to test the software was launched in June, and WebEx service for campus employees began in August 2012. Since then, WebEx has been broadly adopted as the Cornell's web conferencing platform, replacing existing spending on multiple program licenses. Over 14,000 WebEx sessions were hosted in the first year of service offering, and Cornell is currently hosting between 1,600 - 1,800 WebEx meetings a month. A pilot project to expand the program to Cornell students is currently underway at the Samuel Curtis Johnson Graduate School of Management.

User feedback on WebEx is generally very positive. The service support team has heard from staff members that WebEx has been transformative, allowing them to telecommute and work effectively with virtual teams. Approximately 100 staff and faculty have attended formal WebEx trainings, which are offered quarterly by Cornell Information Technology (CIT) staff. Trainers report that participants in these formal WebEx trainings also have positive feedback about the new service. Campus usage of WebEx and other video and web conferencing tools, including Lync and standards based video conferencing, will continue to be monitored by CIT staff.

**Next Steps**

- Continue integration of WebEx into physical spaces (conference rooms and classrooms) on campus.
- Continue providing formal WebEx trainings to campus employees.
- Review progress on expanding WebEx access and usage with the University s Travel Policy group, in order to incorporate this initiative into the ongoing work of this group.
- Evaluate and refine the WebEx stu dent pilot program, and assess the costs and benefits of expanding the student service.
- Think through how to evaluate the cost effectiveness of WebEx and track the impacts of this initiative in reducing business travel.

**Resources**

Secure approvals to continue integration of WebEx into physical spaces on campus. Identify a responsible party to monitor the effectiveness of this initiative in reducing energy and emissions associated with University-related travel.

## INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

### 3. Integrate sustainability as an overarching principle into the performance management process.

**Goal:** Integrate sustainability and climate action into the annual objectives and job expectations of every employee in order to foster a culture of sustainability at Cornell.

In 2013, the Division of Human Resources revised the university-wide guidance document for employee expectations, "Skills for Success," to include sustainability as an overarching principle. The new Skills for Success ask all employees to: **1)** develop and implement best practices, **2)** encourage others to adopt a culture of sustainability and efficiency, and **3)** consider environmental, economic, compliance and social impacts in decision-making. In order to fully embrace these changes, we need to reach out to employees to help them understand the long-term and far reaching impacts of acting sustainably, and how they can most effectively contribute to a culture of sustainability through their day-to-day decisions and actions.

The performance management process, including the annual performance review process, has also been revised to align with the new Skills. The updated performance review process is set to launch in 2014, with full implementation university-wide by 2015. Demonstration of the new skills – including sustainability – will soon become a performance expectation for every Cornell employee.

Next steps include training managers and supervisors on how sustainability and climate action can be integrated into their work places to support these new expectations. The new Sustainability Module in the Cornell Management Academy was designed to provide hands-on training for our supervisory staff, by:

1) Demonstrating how sustainability fits into Cornell's culture
2) Communicating Cornell's vision and a manager's role in fostering sustainability
3) Giving managers tools to encourage sustainable practices in their units
4) Identifying interests, passions, and skills related to sustainability, and
5) Developing plans for integrating sustainability into their units

**Next Steps**

- Create outreach programs to help employees fully appreciate the importance of sustainability in the work place and its implications on their daily actions.
- Provide training for all supervisors to provide them with tools to integrate sustainability into their work places and the performance management process.
- Develop strategies to evaluate the success of the outreach and training programs described above.

**Resources**

Develop metrics to measure success and find the most effective ways to provide training to campus supervisors.

## 4. Continue to promote and expand Cornell's **flexible work arrangements**, which enable employees to vary their starting/departure times and work place, thereby reducing commuting and associated GHG.

**Goal:** In partnership with faculty from the School of Industrial and Labor Relations (ILR), implement a Remote Work Pilot Program involving staff from two large campus units in order to evaluate and maximize desired outcomes and better inform and support future flexible work initiatives at Cornell.

Flexible work schedules enable Cornell employees to vary their starting and departure times and work place. With large-scale implementation, remote work programs could reduce commuting to and from campus, resulting in reductions in the university's carbon emissions, and reduce the amount of office space required on campus. The University's new budget model charges departments/units/colleges for occupied space. Savings on rent and utilities costs could provide an incentive for supervisors to utilize flex work arrangements to reduce the space their unit uses and their lighting and heating bills.

Remote work also has been shown to positively impact employees' level of engagement by helping them to better balance their work and personal lives. A robust flex work program could help attract new recruits to the university, as flex options increasingly become an expectation for our workforce. Remote work options could also support the university's goal of recruiting and retaining diverse talent, by allowing employees to live in neighboring communities such as Syracuse, Rochester, Binghamton, but not requiring them to commute to the Ithaca Campus on a daily basis.

Cornell has supported flexible work arrangements since 1998, and flex arrangements are becoming increasingly prevalent on campus. Flex options include flexing standard hours, remote work arrangements, job sharing, partial-year assignments, and more. The Division of Human Resources has a flexible work policy and online resources for employees. Live webinars on "Understanding Flexible Work Arrangements" are available to both employees and supervisors to explain university policies and recommended best practices for requesting and managing flexible work arrangements. In these webinars, employees learn how to draft a proposal for consideration by their supervisor, and supervisors learn how to review these proposals. All participants also learn how to leverage flexible work to help departments and individuals achieve their established goals.

As remote work programs have expanded to work places across the country, academic interest in the topic has also grown. Over the past decade, numerous studies have been conducted to understand how remote work impacts employees, teams, and organizations, as well as to identify the best practices that organizations can utilize to maximize the success of their remote work programs. Bradford S. Bell, Associate Professor in the ILR School, has been engaged in several projects designed to better understand the consequences of remote work.

**Next Steps**

- Implement the Remote Work Pilot Program & Research Study with roughly 60 employees participating in remote work arrangements. Com plete the supporting website, initial training, and initial surveys.
- Continue collecting data on all planned metrics, including engage ment, commitment/satisfaction, impacts on sustainability, supervi sory feedback on managing remote workers, and work performance.
- Document outcomes in terms of multiple parameters, including: space reduction (office sharing), reduced vehicle miles traveled, reduced greenhouse gas emissions, reduced energy costs for office space, reduced traffic on local roads, reduced stress on families, enhanced wellness, dollar savings to employ ees and/or departments, increased organizational commitment, appeal to diverse population, etc.

**Resources**

Apply lessons learned from the pilot program to develop recommendations and best practices that support future remote work initiatives and maximize benefits for employees and Cornell.

The Remote Work Pilot Program & Research Study, launched in October 2013, will carefully assess potential benefits to both employees and the university resulting from remote work arrangements. The pilot study is being conducted by Dr. Brad Bell, in partnership with Michelle Artibee, Cornell's Program Manager for Career/Life, and Dr. Linda Croll Howell, Cornell's Director of Inclusion and Diversity Metrics. The pilot involves roughly 60 employees from two units on campus, and includes employee and manager training, formal tracking of remote work arrangements, a variety of online resources, and multiple participant surveys conducted throughout the two-year program.

The pilot program will closely examine how employees transition to working outside the office, and results will be used to identify strategies for further enhancing the remote work program at Cornell. Lessons learned from the pilot project will be used to create tools and other support systems which ensure that future remote work initiatives at Cornell maximize potential benefits.

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

### 5. Provide training on triple bottom line decision making for Cornell's leadership.

**Goal:** Incorporate climate and sustainability impacts into organizational decision making and management practices at Cornell.

Pioneered in the late 1980s by **The Natural Step** (http://www.naturalstep.org/), sustainability-based decision making and organizational leadership has evolved over the years into a sophisticated set of tools and processes that can support managers and leaders at all levels of an organization.

Cornell was one of the first universities in the country to integrate sustainability management tools into a university management academy. Sustainability training for Cornell managers is offered twice a year, and 36 managers have completed the program since it was launched in 2012. The 3-hour sustainability module provides an introduction to the core decision-making concept of 'triple bottom line' thinking through case studies and scenario-based activities. Through these activities managers practice how to incorporate environmental, social, organizational, and economic factors into day-to-day decision making. The goal is for participants to:

1) Understand Cornell's vision and a manager's role in sustainability
2) Demonstrate how sustainability fits into Cornell's culture
3) Practice tools to encourage sustainability practices in their unit
4) Identify interests, passions, and skills in relation to sustainability
5) Develop plans for integrating sustainability into their units

A new leadership training initiative designed for the realities of departmental directors, associate deans, deans, associate provosts, and vice presidents will be needed to build on the sustainability trainings for Cornell managers that have occurred during the past two years. The goal of this new initiative will be to further integrate sustainability into institutional decision-making at Cornell.

Consultation services have been identified that could support development of a sustainability leadership program for higher level directors and administrators at Cornell. The Harvard Center for Health and the Global Environment offers executive education services based on the groundbreaking work of Leith Sharpe. A possible collaboration between the Harvard Center and Cornell is currently being explored. For more information on the Harvard program, visit https://ccpe.sph.harvard.edu/programs.cfm?CSID=EELS0614.

**Next Steps**

- Draft a Senior Leadership Sustain ability Education initiative concept paper.
- Form a planning team with rep resentatives from the Campus Sustainability Office, Human Resources, and the Presidents Sustainable Campus Committee to meet with representatives of the Harvard Center.
- Develop and administer a survey to departmental directors, associate deans, deans, associate provosts, and vice presidents to assess their needs and interests for customized sustainability trainings.
- Pilot a one-day training program with ten Cornell administrators in collaboration with the Harvard Center for Health and the Global Environment.

**Resources**

The success of this action hinges on securing senior administration support for additional trainings and establishing a partnership with external professionals who are experienced in delivering senior administration sustainability trainings.

## 6. Develop and advance labor policies to support climate protection goals and a global transition to decarbonized energy through the **Cornell Global Labor Institute.**

**Goal:** Work with trade unions at a global level to develop and advance policies to support climate protection goals and a transition to decarbonized energy.

The Cornell Global Labor Institute (GLI), a program of the Worker Institute of Cornell University's School of Labor and Industrial Relations, was established in 2005 to work with trade unions in the U.S. and internationally to solve major social, economic, and environmental challenges, such as climate change. Since then, GLI has organized over 100 conferences, forums, and seminars. Thousands of trade unionists have attended these events and trade union leaders from more than 25 countries have shared their ideas and experiences with union leaders and activists in the U.S.

GLI also provides trainings on the following topics:

- Labor and Climate Change
- U.S. Legislation on Climate Change
- Labor, Energy Transition, and Democracy
- International Climate Change Negotiations
- Labor and Sustainable Transportation
- Climate Jobs: Direct Hire Approaches to Climate Policy and Job Creation
- Green Jobs in the U.S. Context
- Green Jobs in a Low Carbon World

Current GLI projects include:

- **Labor Leaders Climate Forum** to assist unions in developing and advancing policies that support ambitious, science-based and equitable climate protection goals, sustainable transport, and a transition to decarbonized energy.
- **Sustainable Transportation Policy Working Group** to engage labor unions in the public policy discussion about developing sustainable transportation systems that provide equitable, accessible, low-carbon, and safe transportation options for U.S. residents and communities.
- **Trade Unions for Energy Democracy** to engage the international labor movement in the transition away from extreme energy extraction and towards a renewables-based energy system.
- **Climate Jobs Research** to explore how direct-hire climate jobs programs can both reduce greenhouse gas emissions and reduce current levels of unemployment.

**Next Steps**

Achieve significant changes in Union Policy in core areas through the following initiatives:

- **Trade Unions for Energy Democracy** (www.energydemocracyinitiative.org) - A global, multi-sector initiative to advance democratic direction and control of energy in a way that promotes solutions to the climate crisis, energy poverty, the degradation of both land and people, and the repression of workers' rights and protections. GLI is organizing this initiative with the goal of building a global community of unions and close allies that are committed to public and democratic direction of energy resources and options.
- Global Advisory Group Meetings - Representatives of 30 unions, national and global union federations, and allied organizations from many different countries are now participating in this GLI initiative.
- **UN Conference of the Parties (COP) 20 Planning Retreat** in Lima, Peru (http://climate-l.iisd.org/events/unfccc-cop-20/) - The 20th session of the Conference of Parties to the UNFCCC; Sean Sweeney and Lara Skinner of GLI will attend to gain knowledge about UN and intergovernmental activities to address global climate change.

**Resources**

Project funding needs to be increased, and shifts in the public discourse around climate and energy policy need to occur. GLI's climate change agenda has garnered support from liberal foundations and trade unions. Current funds for Calendar Year 2014 total approximately $221,000. However, the scope of the project is such that funding should grow considerably in order for GLI to exert a major impact on union policy.

Specifically, GLI is working to:

1) Secure union commitments to join the effort to impede "carbon lock-in" and the expansion of "extreme energy" like shale gas and tar sands oil,
2) Advance union engagement in municipal and community based renewable energy systems,
3) Highlight the health and economic impact of fossil fuel pollution, and
4) Support the civil society effort to secure a global climate agreement by 2015 under the auspices of the United Nations.

The notion of energy democracy is still undeveloped in terms of promoting practical policy approaches and best practices. GLI is thus exploring relatively uncharted territory. Progress is being made one union at a time through targeted outreach focusing on leadership. Each union sometimes requires months of engagement before a decision to participate is made. Funding is needed for outreach and research support. A full-time person with research and writing skills is required to expand the horizons of the project. Union participation could rise by 100-200% with the right attention to outreach and profile building.

# PURCHASING

## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2040 or sooner.

### 1. Implement an efficiency standards policy for equipment purchases at Cornell.

**Goal:** Establish energy-efficient standards based upon Energy Star certification for new purchases and bids.

Establishing energy efficiency requirements for new purchases and bids can help to reduce the life-cycle cost of the product or equipment purchased. Energy-efficient products (such as ENERGY STAR-rated products) reduce energy consumption by 10-75% and result in operational cost savings of 5-75% percent on a continual basis, depending on the product replaced.

The ACUPCC Climate Commitment that President Skorton signed explicitly identifies, "Adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist," as a tangible action that participating universities should include in their Climate Action Plans. As of August 2013, 82% of the universities that have signed the commitment have adopted an appliance efficiency policy. The Purchasing Team will work to move this recommendation forward at Cornell, by promoting and encouraging the purchase of energy-efficient equipment and appliances.

To effectively encourage this practice and communicate potential savings, the Purchasing Team will work to educate the campus how to evaluate the life-cycle costs of their purchases. The Procurement Services Buying Manual will be updated to include information to assist users in arriving at the correct decisions based on the life-cycle costs of various products or appliances. Procurement Services will also publish a list of appliance standards and equipment that end users are encouraged to purchase, and update Cornell's sustainable purchasing brochure.

The Procurement Services' website currently highlights ENERGY STAR, EPEAT, and Green Seal certified products, and markets the benefits of purchasing locally. Learn more about **Cornell's Energy Star Purchasing initiative** at http://www.dfa.cornell.edu/procurement/sustainability/energy-star.cfm.

**Next Steps**

- Publish and distribute information on recommended equipment and supplies to campus. Include an update to the Procurement Services Buying Manual, with specific attention paid to Energy Star certification.
- Improve and enhance selections, monitor percentages, and focus on key areas to encourage improvement.

**Resources**

Effective, campus-wide communication of the life-cycle costs will be needed to promote the cost savings and incentivize employees to make energy-efficient purchases.

## INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

### 2. Utilize "Fast Tracks" in Cornell's online Procurement Gateway to facilitate purchasing of sustainable office equipment and supplies, recycled paper, remanufactured toner, EPEAT certified computers, etc., and to limit the availability of less sustainable products.

**Goal:** Encourage sustainable purchasing decisions and reduce the availability of non-sustainable goods.

Creation of "Fast Tracks" in Cornell's purchasing website will enable Procurement Services to more easily direct buying choices for office equipment and supplies, paper, toner, and so on. Fast Tracks will be a group of "favorites" that will be set up in the e-SHOP system that Cornell users will have access to when they log into the e-SHOP system. Fast Track options will be limited in number, and the intention will be to give users the easiest and quickest path to sustainable choices. For example, only 100% and 30% post-consumer waste recycled paper and EPEAT certified computers will be included in the Fast Tracks menu, and remanufactured toners will be featured.

Implementation of Fast Tracks is expected to result in increased purchasing of the featured items, as well as decreased purchasing of non-sustainable options, such as virgin paper.

Fast Tracks options are still being refined through interactive discussions with campus constituents, as the options are intended to help the university meet multiple goals, including sustainability. While there will be no requirement to buy the items recommended through Fast Tracks, Procurement Services will market these items via their newsletters and attempt to influence campus decision making by streamlining and simplifying the process to purchase featured items. Office paper, computers, toner, and cleaning products will likely be included in the Fast Tracks system.

Cornell needs to earn 15 additional points (85 points total up from 70 currently) to become the first Platinum-rated university in the U.S. under the STARS program. By increasing sustainable purchasing through Fast Tracks, Cornell can work to increase its 2012 STARS rating of 3.8 out of a possible 7.5 points in the Purchasing category.

**Next Steps**

- Build product lists, complete website programming, and launch Fast Tracks.
- Expand and improve Fast Tracks selections on an ongoing basis.
- Improve Cornell's STARS rating for paper, computers, toner, and clean ing supplies purchases.
- Document the positive impact of the new ink refilling station at The Cornell Store on decreasing purchases of toner cartridges by the campus community.

**Resources**

Programming costs to implement Fast Tracks are estimated at about $6,000. Procurement Services hopes to implement Fast Tracks sometime in the 2013-14 fiscal year, pending availability of funds.

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

### 3. Consider **sustainability criteria**, including locality and GHG emissions, in the vendor selection process to reduce the environmental footprint of Cornell's supply chain.

**Goal:** Ensure that Cornell's purchasing decisions are in alignment with the university's overarching commitment to sustainability.

Local investment and business incubation are part of Cornell's land grant mission, i.e., Cornell returns New York State's investment by directing its education, applied research, and outreach to benefit the citizens of New York. As a major enterprise, Cornell makes a significant contribution to the State's economic prosperity. Roughly 20% of Cornell's business is done locally, and 50% is done in New York State. The Purchasing Team has worked diligently to incorporate, promote, and give increased weight to sustainability criteria, including locality and GHG emissions, as part of the university's product and vendor selection process.

Sustainability is one metric used to grade a key group of the university's most strategic partners, called "preferred suppliers." Cornell's Procurement Services asks these 20+ suppliers to describe their key sustainability efforts and accomplishments. These efforts can be specific to Cornell or can include practices the company is implementing on a global basis.

For example, last year VWR Scientific implemented a Cornell-specific program to recycle pipet tips boxes which recovered 4,500 pipet tip boxes that would otherwise have ended up in a landfill. A more global example is provided by Staples, which has introduced a competitively priced sugarcane-based copy paper to its product lines, converted a portion of its delivery fleet to electric vehicles, and installed solar power at more than 30 of its stores. Staples is also providing Procurement Services with data on the amount of packaging Cornell is saving as a result of a new requirement that all orders placed on campus meet a $50 minimum.

Through the competitive bidding process, Procurement Services can give increased weight to vendors that meet sustainability criteria, including locality and potential for reduced GHG emissions. A local business, The Computing Center, was recently awarded the contract for all university purchases of print toners. This contract represents approximately $750K of consolidated business which was previously done by a variety of Cornell suppliers, most of whom were not local.

Procurement Services will incorporate sustainability criteria into preferred vendor recognition and give greater weight to sustainable practices when evaluating preferred vendor performance. These practices will be shared with the campus community through annual business reviews and through marketing and communications. Selected vendors will be encouraged to showcase their sustainable practices for student interns and thus build pathways for Cornell students to work in these businesses after graduation.

**Next Steps**

- Encourage and market the benefits of purchasing locally, and highlight EPEAT, ENERGY STAR, and Green Seal certified products in all areas for which such ratings exist.
- Include sustainability initiatives on the Procurement Services website, and distribute a brochure which highlights these initiatives across campus.
- Include a section devoted to sus tainable accomplishments in the Procurement Services quarterly newsletter and highlight sustainable vendors in each issue.
- Expand the number of participating suppliers by 20-25%.
- Review inbound logistics, and implement a program that assists small and local businesses with freight consolidation.

**Resources**

Procurement Services purchases goods and services locally when possible, but it has not formally evaluated how much of Cornell's overall business could be done locally and how this shift would impact the University's carbon footprint. Such analysis could inform future purchasing decisions.

# TRANSPORTATION

## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2040 or sooner.

### 1. Increase the use of mass transit by the Cornell community through the OmniRide Program and enhanced outreach for Cornell employees during the onboarding process.

**Goal:** Expand the use of public transit and reduce parking demand at Cornell by providing discounted and no-fee transit access to Cornell employees and students.

Drawing by Trowbridge & Wolf Landscape Architects, LLP

Tompkins Consolidated Area Transit, Inc., usually referred to as TCAT, is a private, non-profit public transportation operator, managed jointly by Cornell University, Tompkins County, and the City of Ithaca.

Cornell offers its employees and students partially- or fully-subsidized transit through the OmniRide transit program. Students who are new-to-Cornell (roughly 6,500 active annually) and employees who enroll in OmniRide have anytime, anywhere access to TCAT buses with their Cornell ID card; Cornell pays the fare.

Students who are not new-to-Cornell and student spouses can purchase deeply discounted OmniRide privileges ($200; the comparable TCAT pass is $600). Access to the buses is gained by using the Cornell ID card at the fare box. Eligible Cornell employees, retirees, and affiliates also receive fully-subsidized ride privileges on TCAT buses within TCAT zone one, Monday- Friday. The number of eligible riders was approximately 15,000 in December 2013 – 10,000 of whom are faculty and staff.

**Next Steps**

- Evaluate possibilities and determine how to fund the OmniRide program sustainably. Study the financial implications of Campus to Campus expansion and the feasibility of using this revenue stream to offset TCAT deficits.
- Include temporary staff, as well as permanent staff, in the transporta tion outreach program for new hires.

**Resources**

- Continuation of the OmniRide program depends on adequate fares and partner contributions to meet TCAT's operating and capital expenses.
- May need additional support to enable Transportation staff to provide onboarding outreach to temporary employees.

Cornell's OmniRide program is part of the University's Transportation Demand Management strategy and has been highly successful at reducing parking demand at Cornell since its inception in 1990. By avoiding the need to build hundreds of extra faculty and staff parking spaces, Cornell has experienced a notable cost savings benefit through the OmniRide program.

Since March 2011 a representative from Transportation Services has participated in Cornell's employee onboarding program to ensure that all new hires to the university are made aware of their transportation options, including the OmniRide program, car sharing, carpooling, and ride sharing. Transportation staff are able to provide new staff members with an objective view of the various travel options and information about incentives to encourage the use of alternative commuting methods – before employees make a commuting decision. From March 2011 through June 2013, a total of 1,299 onboarding appointments were held, and current projections indicate that there will be more than 1,000 onboarding appointments between July 2013 and June 2014. The total number of OmniRide passes issued to employees has increased by 26% in the past three years - from 1,586 passes in 2010 to 1,974 passes in 2013.

Student OmniRide participation has expanded by 35% in the past 6 years, from roughly 4,000 riders in 2005, to 6,500 riders in 2013. In 2012, 741,000 TCAT rides were purchased by Cornell students (3,705 passes @ $200 each), and 1,070,000 free rides were given to Cornell students using OmniRide passes. Because of the substantial increase in ridership, the university is currently realizing a $1M deficit for the free pass program annually - and this deficit is growing. For the past few years, Cornell has been using proceeds from the Campus to Campus (C2C) bus program to offset the OmniRide deficit. The Transportation Team is proposing to study the financial implications of C2C expansion and the possibility of using this revenue stream to offset TCAT deficits.

The Transportation Services eBusiness site offers TCAT OmniRide passes for sale, so that Cornell community members can purchase or appeal their passes online. The list of valid Cornell riders is updated daily and sent to TCAT.

## 2. Encourage mass transit between Ithaca and NYC through continued support for **Campus to Campus Bus.**

**Goal:** Provide express bus service between Cornell's Ithaca and New York City campuses to reduce carbon emissions resulting from individual vehicle trips to and from the city.

The Campus to Campus (C2C) bus has been in operation since 2004, providing the Ithaca Campus and surrounding communities with express service to New York City. The C2C bus service operates seven days a week, year round except on Thanksgiving and during the University's Winter Break. The coaches offer single and double seating for up to 32 passengers, with ample work room, internet service, and a well-stocked galley. The C2C service is currently achieving 146 passenger-miles per gallon, and highway speed is monitored to increase fuel efficiency.

When U.S. Air discontinued its LaGuardia service three years ago, the C2C bus load factor (how full the bus is) increased from 72% to 74% - resulting in a 2.8% increase in overall ridership since 2010. Annual ridership in 2012 was 23,838 passengers. The C2C program is profitable and is currently supporting deficit's in Cornell's OmniRide program.

C2C's five buses are owned by Cornell and maintained, serviced, and driven by Cornell employees, as part of the university's Transportation Services. In October 2013, Cornell made the decision to hire its own drivers and insource C2C operations completely. Seven new bus operators and a program manager were recently added to the C2C team.

A new, more fuel-efficient bus was added to the fleet in November 2013. The new bus will have lower particulate emissions and should increase overall fuel efficiency from 5.8 mpg to 6.4 mpg. In addition the new bus will be equipped with a reverse osmosis water system, eliminating the need to provide bottled water.

Another C2C bus has recently been re-engineered with an altered rear differential gear ratio to improve its mileage. Once adequate data has been collected from this vehicle, Transportations Services will determine whether or not sufficient fuel efficiency has been achieve to justify similar modification of the entire fleet. Transportation Services is also considering the integration of water coolers into each bus to decrease the use of plastic water bottles and encourage the use of refillable containers. All buses are equipped with recycling bins, and biodegradable bags are available at all seats.

University administrators are currently considering a possible partnership with the **Finger Lakes Climate Fund** (http://fingerlakesclimatefund.org/) to offer Cornell business travelers the option to offset their travel emissions by making donations to the Fund. Passengers could use the Fund's carbon calculator to determine the amount of greenhouse gas emissions resulting from their trip, and choose to make a donation to offset these emissions via investing in residential energy efficiency projects for qualified local residents.

**Next Steps**

- Study the financial implications of C2C expansion to serve Washington D.C. or Boston, and the possibility of using this new revenue stream to support the OmniRide program or other transportation initiatives.
- Evaluate carbon offset options, secure approval from University administrators, and once consensus is reached, implement changes to C2C reservations programming to allow for passenger donations to be accepted and processed.

**Resources**

- Evaluate the return on investment for additional C2C runs.
- Secure approval for the travel offset program and create internal processes to manage passenger donations.

## 3. Reduce fossil-fuel consumption of the **Cornell fleet** through MPG standards in vehicle purchases, alternative-fueled vehicle purchasing, and a fleet management system.

**Goal:** Reduce fuel consumption of the campus fleet and increase use of alternative fuel.

One of the 2009 CAP's original 19 actions, "Greening the Fleet" seeks to reduce fuel energy needed to operate university vehicles. The two main components of this action are: **1)** to require higher efficiency standards for the campus fleet, and **2)** to consider alternative fuels for university-operated vehicles.

Five years ago, the original CAP established goals to reduce the size of the Cornell fleet by 30%, reduce overall costs by 30%, and increase average mileage by 30%. The university has achieved a 32% reduction in the size of the fleet – from 220 vehicles in 2009 to 149 vehicles in 2013, and it has increased fuel efficiency by 15%, from 18.9 mpg in 2009 to 21.7 mpg in 2013. In 2013 alone, the Agile Fleet Commander fleet management system enabled Cornell to better manage use of its existing vehicles and reduce the fleet vehicle count from 166 to 149 vehicles.

High–efficiency vehicles have been incrementally added to the fleet since 2009, including:

- 2 all-electric vehicles (EVs)
- 6 compact hybrids
- 9 sub-compact hybrids
- 2 sub-compact plug in hybrids

Plans are to continue expanding the campus fleet with hybrid vehicles.

Fleet Services is currently working on the installation of a charging station at the Maple Avenue Transportation facility to further promote the use of electric and plug-in hybrid vehicle technology. The charging station will charge the all-electric fleet vehicles and will also be available for Cornell employees to recharge personal electric vehicles used for commuting to and from work.

At the start of 2014, Transportation Services replaced 12 midsize sedans and 3 subcompacts with Partial Zero Emission Vehicles, which will reduce greenhouse gas emissions for these vehicles by 25%. Transportation Services purchased 15 new Toyota Camrys, with a 34 mpg rating, to replace 12 Chevy Impala and 3 Malibu vehicles with a 29 mpg rating. After careful analysis, staff chose the Toyota Camry for its total cost of ownership over the lifetime of the vehicle, which includes mileage, resale value, maintenance costs, etc.

**Next Steps**

- Continue tracking changes in tech nology and fuel options to further enhance fuel efficiency of the campus fleet.
- Study the feasibility of installing more EV charging stations at optimal locations (Cornell currently has 3 EV charging sites on campus).

**Resources**

Continue outreach to campus stakeholders on how utilizing the lifetime cost of ownership impacts vehicle selection.

## 4. Encourage the use of existing private platforms for car sharing, carpooling, and ridesharing by the Cornell community.

**Goal:** Expand Cornell community membership and participation in alternative transportation options in order to reduce transportation emissions.

**Carsharing** helps to reduce traffic congestion, improve local air quality, reduce wear on roads, and free up parking spaces. Transportation Services currently operates a carshare at the Humphreys Service Building (HSB) for employees requiring transportation for Cornell business. The HSB fleet consists of two all-electric vehicles and two hybrid vehicles. The average travel distance for these vehicles is six miles, so all four vehicles are typically operated as completely electric vehicles. Fleet Services is currently working on the installation of a second carshare program at Cornell's East Hill Office Building. Two vehicles will be located at East Hill in order to accommodate up to five employees for business travel needs.

**Ithaca Carshare** (http://www.ithacacarshare.org/) is a community-based commuting service. Ithaca Carshare is a membership service offering 24/7 self-serve access to 23 fuel-efficient cars, a minivan, and a pickup truck located in Ithaca. The program allows members to reserve a car or truck online or by phone, drive wherever they like during their reserved time, and then return the car or truck to the same location once they are finished.

The University offers special incentives to Cornell community members to become Carshare members. All Cornell employees enrolled in the OmniRide program are provided with free Just in Case membership or discounted *It's My Car* membership to Ithaca Carshare. Non-OmniRide employees are provided with smaller discounts on their memberships. All enrolled Cornell students may can get free or discounted membership as well. In the 2012-2013 academic year, 584 students and 237 employees took advantage of these incentives. Cornell participation has grown from 508 total participants in 2008 to 821 participants in 2012-2013, or about 63 % of Ithaca Carshare's total membership. Cornell has been subsidizing Cornell community members' Ithaca Carshare memberships since 2008, through an annual contribution of roughly $30,000 per year.

There are now four Ithaca Carshare locations on the Cornell campus, at Carpenter Hall, in the Maple Avenue parking lot, on North Campus, and on Tower Road across from Kennedy Hall. There are four additional Carshare locations on city streets in Collegetown and surrounding neighborhoods, for a total of eight locations that directly support Cornell students and employees. Since 2011, Ithaca Carshare has added nine Toyota Prius Cs, averaging 43 mpg, to their fleet – representing 36% of the total fleet. Within the next five years Ithaca Carshare hopes to incorporate some electric vehicles as well.

Cornell community member can also choose to **carpool** to work to save on commuting and campus parking permit costs. One person purchases and is responsible for the commuter parking permit. Carpoolers can link up to six license plates to the permit so it can be switched among registered vehicles. Carpool members make their own arrangements for sharing commuting costs.

**Next Steps**

- If current growth trends continue, add one or two carshare locations on or near the Cornell campus per year to meet demand from the university community.
- Seek opportunities to incorporate more low-emission/electric vehicles into the campus and community carshare fleets.

**Resources**

Continue outreach to campus stakeholders on the value of alternative transportation options, including carsharing, carpooling, and ridesharing.

Cornell's award-winning Faculty & Staff **RideShare** is a more formal version of a carpool, with added incentives and benefits for participants. The RideShare program helps over 1,500 eligible employees save on parking permit costs, and many qualify for free parking. Members turn in their individual parking permits and receive one permit on which all of their vehicles are listed. The RideShare parking permit can include up to six vehicles and may be used in any group member's car. Fees can be shared equally, but all members of the RideShare must be regular Cornell employees receiving university benefits and work in locations where permits are required.

Besides sharing parking permit costs, there are numerous other benefits to joining RideShare, including:

- Savings on fuel and vehicle maintenance fees.
- Possible discounts on auto insurance premiums.
- Eligible groups can receive free books of ten one-day parking permits valid in all Perimeter and Outer Tier Parking areas.
- A thirty-day risk-free trial period.
- Cornell provides numerous support services, such as emergency ride and FamilyCare.
- On-campus transit from parking areas.
- Ride free on TCAT buses when traveling among Cornell's Ithaca facilities via the OmniRide Program.
- Need help finding a ride partner? Check out **Zimride!** http://www.zimride.com/, an online ridesharing community.

## INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

### 5. Implement a comprehensive bike master plan to improve the safety and accessibility of campus and public roadways.

**Goal:** Develop a Bicycle Master Plan for Cornell's Ithaca Campus, with recommendations for increasing bicycle usage, improving bicycle infrastructure, implementing bicycle friendly policies, and increasing overall safety of cyclists.

Cornell supports cycling as a sustainable means of commuting to and from campus, as well as an excellent means of transportation within the campus. In April 2006, as part of the transportation-focused Generic Environmental Impact Statement, Cornell conducted a travel survey of the entire campus community that provides the most recent bicycle commuting data. The survey indicated that 3% of employees, 4% of graduate students, and 1.4% of undergraduate students commute by bicycle. The bike master plan will target the employee and student populations in an effort to increase these percentages.

The Campus Planning Office, in cooperation with Transportation Services, is currently seeking a consultant to assist with the development of a Bicycle Master Plan for campus, to be completed by December 2015 or sooner. It is intended that this Plan will be part of an update to the Cornell Master Plan. The bike plan will include recommendations for improving the accessibility and safety of the campus for cyclists, as well as recommendations regarding cycling policies, procedures, and staffing for the University. The plan will examine and prioritize various infrastructure improvements, such as additional marked bike lanes, pedestrian-shared paths, dismount zones, covered bike parking, bike stairs, etc.

The proposed bike master plan will also include recommendations regarding improvements to better facilitate inter-modal use with the transit system. The Tompkins Consolidated Area Transit (TCAT) buses which serve Cornell's Ithaca Campus are currently equipped with bike racks.

Cornell's Bicycle and Pedestrian Committee meets regularly to address bicycle issues and needed improvements. This group, as well as existing biking organizations at Cornell, will be among the broader Cornell community stakeholders who will be engaged in a comprehensive process to create the bike plan.

**Next Steps**

- Secure funding to hire a consultant, hire a consultant, and prepare a plan.
- Encourage stakeholder participation in the planning process, and document/prioritize stakeholder input into a plan which has broad community consensus, to the extent possible.

**Resources**

The success of this action item hinges on support from the University administration, financial resources to prepare the plan, and stakeholder participation and advocacy.

**Goals of the Bike Master Plan include:**

1) Increase ridership among students and employees to reduce single occupancy vehicle commuting.
2) Identify amenities and resources needed to promote increased ridership and address key obstacles to behavior change, for example, "It's too hot, too cold, too far, too hilly, too bumpy, too unsafe, etc."
3) Identify bike routes on campus and incorporate these routes into complete street planning for future construction/renovations on campus to ensure set-backs, etc. for cyclists).
4) Encourage stakeholder participation in the planning process, and document/prioritize stakeholder input into a plan which has broad community consensus, to the extent possible.
5) Set realistic and measurable goals to increase cycling and reduce commuter travel impacts at Cornell, including quantifiable GHG emissions resulting from implementation of the plan.

The implementation of the Bicycle Master Plan recommendations will have a direct impact on the larger community by improving connectivity between neighborhoods and improving neighborhood livability for residents. By reducing single occupancy vehicle use, the Plan should also reduce carbon emissions and traffic congestion, and improve the overall health of the community.

Drawing by Trowbridge & Wolf Landscape Architects, LLP

## 6. Continue support for the Big Red Bike sharing program.

**Goal:** Assess opportunities to expand and improve the bike share program and promote bicycling as a commuting alternative.

**Big Red Bikes** http://bigredbikes.cornell.edu is Cornell University's student-run bike share program. It is open to all current students and employees who register for the program, with no membership fee or fees for use. The bike share fleet includes 30 bicycles that are available for use from Spring Break in mid-March until Thanksgiving Break in late November. Registered users can check out a bike at Mann Library, Uris Library, or at Appel Commons, a student residence community center. The bikes must be returned to one of these three locations by closing time on the same day.

During the 2012-2013 fiscal year, Big Red Bikes were checked out over 1,600 times by 742 active users. User surveys indicate that usage is primarily recreational. Thus far, the bike share has little or no positive effect in changing employee or student commuting behavior, or in increasing bicycling as a commuting alternative.

Transportation Services serves as sponsor and provides a staff advisor for the program. Transportation Services currently contributes $10,000 per year for a vendor hosted bike share management database and web interface, provides offseason and out-of-service storage for the bikes, and allocates $5,000 annually to hire student employee(s) to oversee maintenance and safety checks for the bikes. Cornell Outdoor Education contributes administrative and logistical support to manage and assist the student employee(s) with bike share operations. University Libraries and the Appel Commons Service Center contribute administrative support – checking the bikes, keys, and helmets in and out, as well as alerting student organization officers about user registration issues, and maintenance or safety issues reported by users.

Partial funding for the program comes from a Student Assembly fee of $1 per undergraduate. Facilities Services finance personnel provide administrative support for the Big Red Bikes operating account, under Transportation Services oversight, through which the Student Assembly funding is received and disbursed. In addition to Student Assembly funding, the program has also received private gifts from alumni and other individuals.

Students working in Big Red Bikes have a unique opportunity to impact Cornell's campus as part of an innovative business practicing social entrepreneurship. Several active members of the organization have designed and completed class projects and independent study plans related to their involvement in development, management, and improvement of the bike share program. Former student officers report that their leadership and collaborative experience with the program proved invaluable as they sought employment and transitioned to the workplace.

**Next Steps**

- Investigate the New York City bike share program, and other examples of bike share programs to discover options for improving security and accountability that may be financial ly sustainable at a scale appropriate to the campus.
- Support student leaders in exploring options for a more sustainable pro gram of bicycle safety inspections and maintenance.
- In the context of development of the Bicycle Master Plan, examine and assess relative costs and benefits of the program and recommend changes or improvements.

**Resources**

Future success hinges on student involvement and commitment, institutional commitment and funding, evaluation of program benefits, integration of program goals into the larger bike master plan.

Challenges to sustaining and expanding the program include:

- The current volunteer model for performing daily safety checks and basic maintenance is inadequate. Funding for a more appropriate model for safety checks and maintenance has not been identified.
- The current check-out and check-in system does not adequately protect against theft and loss of bikes and other equipment.

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

### 7. Develop and implement comprehensive strategies to support mass transit in Tompkins County and increase ridership.

**Next Steps**
Continue operations and management role with TCAT.

**Resources**
Continuation of the OmniRide program depends on adequate fares and partner contributions to meet TCAT's operating and capital expenses.

**Goal:** Support Tompkins Consolidated Area Transit, Inc. (TCAT) to reduce impacts of Cornell commuter travel.

Reducing transportation energy demand and shifting to non-fossil energy sources will require long-term, concerted effort. In the short-term, Cornell will continue to focus its attention on mass transit system improvements. As TCAT's largest customer, accounting for roughly 71% of annual ridership, Cornell wields significant influence as a major proponent of mass transit in Tompkins County. Supporting the local mass transit system is Cornell's single largest transportation initiative.

TCAT is a not-for-profit corporation that provides public transportation for Tompkins County. TCAT's annual ridership is more than 4 million and its routes cover a distance of about 1.6 million miles. TCAT's fleet of approximately 55 buses currently includes 8 hybrid electric-diesel buses. TCAT also offers complementary ADA Paratransit services called Gadabout. In 2011, TCAT was recognized as the nation's "Outstanding Public Transportation System" in the 1-4M ride category by the American Public Transportation Association. For more information about **TCAT**, visit www.tcatbus.com.

The three TCAT partners—Tompkins County, the City of Ithaca, and Cornell University—allocate operational funding for TCAT, each currently contributing about $900,000 annually. Cornell makes an estimated annual contribution of $3.5M to TCAT: roughly $900,000 in operating funds plus $2.6M in bulk fares to fund the OmniRide program. The three partners split budget deficits and capital acquisitions three ways.

In 2014 TCAT will add New York State's first **hydrogen fuel-cell bus** (http://www.emc2.cornell.edu/news/story/tcat-to-receive-ithaca-s-first-cutting-edge-fuel-cell-bus.html) to its fleet, and a hydrogen station will open in Ithaca to fuel the bus and other fuel-cell vehicles. The station will generate hydrogen right on site, and it will be the first public hydrogen station in upstate New York and one of only a dozen in the country. Fuel cells produce electricity from a chemical fuel, so fuel cell powered vehicles have long ranges, fast refuel times, and emit no carbon pollution. Paul Mutolo (EMC2), a fuel cell chemist and director of external partnerships for the Energy Materials Center at Cornell, helped develop the federal grant proposal to purchase the new bus. Seed funding to research sustainable hydrogen production, awarded by the Atkinson Center in 2012, was instrumental in facilitating this groundbreaking effort to create an infrastructure for emissions-free transportation.

## 8. Establish a campus-wide policy for reduced fossil-fuel consumption among Cornell-owned vehicles.

**Goal:** Set carbon reduction goals for Cornell's non-fleet vehicles.

Cornell owns a total of 1,354 vehicles (as of July 2013), but only 12% of these are university fleet vehicles. While major improvements in tracking mileage and fuel usage for the 1,205 non-fleet vehicles have been made in the past few years, Transportation Services has not yet established carbon reduction goals for its non-fleet vehicles.

One major class of low-mileage vehicles on campus is the pickup truck. Transportation Services will partner with other university departments that utilize pickup trucks (Grounds, Shops, Vet College, Plant Breeding, the Plantations, etc.) to explore the feasibility of replacing these low-mileage, high-GHG vehicles with alternative fuel vehicles, namely liquid propane gas (LPG) burning vehicles, to greatly reduce campus vehicle emissions. Each LPG vehicle that replaces an unleaded gasoline vehicle represents a potential 31% reduction in GHG emissions. Many of Cornell's service vans are also driven primarily within a 10-mile range for various campus work assignments, and these vans are another viable candidate for replacement with LPG fueled vehicles.

A recent event at the East Campus Service Center featured a demonstration of propane-powered trucks for use by various university departments, including Grounds, R5, Shops, and the Plantations. A follow-up meeting is planned for spring 2014 to assess the feasibility and cost of utilizing LPG-powered utility vehicles at Cornell.

The **Cornell Climate Action Plan (CAP) Update 2013 & Roadmap 2014-2015** proposes several policy recommendations which were identified by the PSSC focus teams as potential actions the university can take to move our CAP agenda forward and institutionalize change. Key policy recommendations include establishing campus-wide fuel efficiency standards for Cornell-owned vehicles. The PSSC Advisory Board will further explore this policy recommendation during the next two years. Next steps include preparing financial, environmental, and social impact assessments; obtaining approval from the appropriate parties; and convening stakeholders to develop implementation plans.

**Next Steps**

- Explore the feasibility of replacing low-mileage, high-GHG vehicles, such as pickup trucks and vans, with LPG fueled vehicles.
- Work with the PSSC Advisory Board to explore the feasibility of implementing a campus-wide fuel efficiency policy.

**Resources**

Develop a strategy for working with campus stakeholders to encourage the transition to LPG-fueled trucks and vans.

# WASTE

## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

### 1. Complete a carbon impact study for Cornell's waste stream to establish a baseline of GHG emissions associated with the current waste stream.

**Goal:** Quantify carbon impacts associated with the campus waste stream in order to identify opportunities to better manage Cornell's waste and reduce emissions.

Cornell's 2009 and 2011 Climate Action Plans did not account for the impacts of the campus waste stream on the university's carbon emissions. To better inform decision making on campus, the Waste Team is currently conducting a systemic analysis of campus waste, including the impact of waste operations on Cornell's GHG emissions. This waste impact study can serve as the foundation for improved management of university materials. The study can help Cornell to identify and quantify waste streams which are not currently being optimally utilized. Some of these waste streams can serve as additional feed stocks for CURBI (Cornell University Renewable Bioenergy Initiative) (see Energy Action 3), or for local non-profit and for-profit ventures. For example, wastewater from the digester at the Cornell University College of Veterinary Medicine is now being delivered to the Ithaca Area Wastewater Treatment Facility, where it serves as an energy source, and surplus furniture from campus was recently donated to the Finger Lakes Fresh Food Hub to outfit their new facility.

Cornell's R5 Operations (Respect, Rethink, Reduce, Reuse, Recycle) is working with Cornell's Facilities Engineering Department, with vendors, and with campus partners to prepare an Ithaca Campus GHG Waste Inventory. The Cornell Solid Waste Institute is working to identify the carbon impacts related to the campus compost stream. The inventory will identify and collect metrics for all wastes on campus.

Once completed, this inventory can be used to analyze current business decisions the university makes regarding its waste handling procedures and contracts. For example, the primary landfill the university contracts with in Ontario County captures methane, which reduces carbon impacts. Both the data itself and the methodology for collecting and interpreting the data may be useful to the Tompkins County Solid Waste and Recycling Department, to both local and benchmark colleges and universities, and to University vendors.

**Next Steps**

- Identify the parameters of the study, identify all wastes, and col lect metrics for all wastes.
- Complete the Ithaca Campus GHG Waste Inventory and use the results to analyze current waste management practices, contracts, underutilized waste streams, and opportunities to reduce waste and associated carbon impacts.

**Resources**

Think through how best to complete the study, including the feasibility of utilizing student assistance to compile the necessary data from campus sources and vendors.

## INNOVATION: Create a living laboratory for low-impact behaviors, climate education, and research.

### 2. Work to integrate **composting** into events, offices, and residence halls on campus.

**Goal:** Expand compost collection on campus to include campus events and small generator locations, such as office spaces and residence halls.

Compost collection on Cornell University's Ithaca Campus is expansive and highly successful. All major dining facilities on campus collect food waste compost, capturing the majority of the food waste stream. Roughly 37% of the total campus waste stream is compost, virtually all of which is captured and processed here on campus. Cornell Dining chefs separate composting material during food preparation, and students, faculty, and staff compost their waste after their meals. About 515 tons of food scraps and organic waste were composted from Cornell Dining facilities in 2012-2013. All campus dining units use compostable take-out containers, flatware, table ware, and napkins.

Next steps involve expanding existing composting programs to include office spaces, residence halls, and coffee shops on campus, and to uniformly implement compost collection at campus events. Campus demand for growth of compost collection is high. Ad hoc volunteer programs currently exist in many locations throughout campus. For true waste diversion impacts, these ad hoc programs need to be centrally coordinated and institutionalized. Cornell's R5 Operations (Respect, Rethink, Reduce, Reuse, Recycle) manages the non-hazardous waste and recycling program for Cornell's Ithaca campus. Cornell's Farm Services Department manages compost collection and works in partnership with Cornell Dining and the Statler Hotel for material collection.

Compost collection at events and in office and residence spaces presents an excellent opportunity to educate the campus community through compost monitoring interactions, and to motivate staff and students to participate in these efforts. In 2014-2015, Cornell's Solid Waste Institute will be working to quantify the carbon reduction impacts of compost collection on University emissions.

A significant challenge to the success of the effort to expand composting to small generator locations is that, at present, the compost being collected through these streams is highly contaminated. Therefore, the majority of material collected through the green offices pilot program or at special events is landfilled. Additionally, labor and implementation costs for this action are high. At current rates, small-scale collection at multiple locations could increase waste collection costs for campus facilities.

**Next Steps**

- Cornell's R5 Operations intern will inventory and assess strategies to institutionalize the existing volunteer compost collection efforts in North Campus residence halls. (Current volunteer efforts range in scope and success. Ongoing challenges range from rodent and bug infestations to volunteer coordination and man agement.)
- Farm Services and R5 Operations are jointly piloting a volunteer compost collection in one office building on campus, with paid pickups by Farm Services at central building collec tion points. The pilot project will be designed to eliminate contamination.
- Review success of pilot programs in both office spaces and residence halls related to contamination of collected material, longevity of volunteer efforts, solutions related to on-site collec tion/storage pending pickup by Farm Services, and strategies to control rodent and bug infestation.
- Streamline and institutionalize com post collection system for special events, which range in size from small office parties to multi-day annual Reunion events.
- Identify and pilot paper towel com post collection in targeted facilities.

**Resources**

- Current pilot projects are funded through R5 Operations as feasibility studies. Maintenance or expansion of pilot projects beyond FY14 will require identification of future funding.
- Ongoing success of an expanded composting program will need to demonstrate resulting environmental benefits and landfill diversion.

## 3. Develop strategies for improved management of university materials and identify opportunities to utilize recovered materials as inputs for local not-for-profit or for-profit ventures.

**Goal:** Perform ongoing analyses of the inputs and outputs to Cornell's Ithaca campus in order to identify opportunities to divert materials from the landfill and, when possible, redirect these materials to new and existing businesses.

Cornell's R5 Operations (Respect, Rethink, Reduce, Reuse, Recycle) manages the non-hazardous waste and recycling system for Cornell's Ithaca campus. With many campus partners, R5 Operations hosts programs for recycling of papers, plastics, cans, glass, electronics, used oil, scrap metals, wood, tires, light bulbs, batteries, and more. Visit the **R5 Operations website:** (http://r5.fs.cornell.edu/about/faq.cfm) for a detailed inventory of Cornell's recycling metrics. R5's overarching goals are to increase the campus waste diversion rate, to reduce overall waste, and to ensure regulatory compliance.

One goal of this action is to develop programs to capture wastes which have not yet been identified. Cornell's new recycling program for pesticide containers serves as a good example. While the larger generators of this material (for example, the golf course) have been identified, identifying and capturing material from smaller generators of the material (i.e., labs) will improve landfill diversion.

Another goal of this action is to identify opportunities to utilize materials recovered from campus as feed stocks for new and existing businesses. For example, R5 Operations is currently reviewing strategies for improved management and potential diversion of polystyrene, clean wood waste, and construction plastics. This action targets non-hazardous and Universal Wastes, and excludes compostable waste. Additional diversion streams for Universal and non-hazardous waste, depending on the material stream, will have both positive and negative costs. R5's goal is to keep costs neutral.

A good example of an existing mutually beneficial partnership to utilize "waste" inputs to produce valuable outputs is Cornell's mulching operation. The Grounds Department and Cornell Plantations create mulch from leaves, brush, and tree waste which are collected on campus and from neighboring municipalities. In the fall the City of Ithaca and the Village of Cayuga Heights send most of their leaf waste to Cornell Plantations for mulch generation. Cornell's Farm Services processes the material for the Plantations at their campus compost facility.

**Next Steps**

- Continue to build relationships with local partners, including: Tompkins County, local colleges, and existing and potential vendors.
- Look for opportunities to coordinate this action with Cornell Cooperative Extension programs.
- Build relationships with regional partners and strengthen ties through participation in the New York State Association for Reduction, Reuse and Recycling (NYSAR3).

**Resources**

As new material streams are identified, cost-benefit analyses will be conducted.

Graphic provided by The Compost Crew, LLC.

## 4. Develop a **deconstruction program** to divert waste from building clean outs, renovations, and decommissions from the landfill.

**Goal:** Develop a deconstruction program on campus to divert construction waste from the landfill.

This action expands construction waste diversion practices for capital building projects, with a specific focus on deconstruction. Deconstruction is the process of systematically removing a building or structure by taking it apart in the reverse order of construction, with a goal of maximizing re-use and recycling of building materials and increasing the diversion of campus waste from the landfill.

The Waste Team is proposing to partner with the PSCC Buildings Team and Facilities Contracts Office to provide the necessary tools and resources to increase waste diversion in the demolition or construction phases of capital building projects. These tools include access to local and regional vendors for demolition and deconstruction, sample vendor contracts, project manager toolboxes, and other resources to be determined in conjunction with the Buildings Team.

Implementing a robust deconstruction program on campus should result in improved waste diversion percentages per project, and could result in additional points for LEED certification of the particular building being renovated or constructed.

This action will involve working with the local and regional construction industry, re-use vendors, and recycle vendors – and could build mutually beneficial relationships with these area businesses.

**Next Steps**

Work with Buildings Team to:

- Study current and past Cornell capital projects to identify opportunities for improvement in waste diversion for waste streams that are not currently captured (for example, wood, drywall, windows, doors, etc.).
- Benchmark capital project construc tion practices of peer institutions that are working to achieve LEED certifications.
- Identify regional deconstruction vendors and conduct a formal Request for Information (RFI) process.
- Work with the Facilities Contracts Office to incorporate increased diversion goals into campus capital projects.

**Resources**

From a single bottom line perspective it is anticipated this action will have a (financial) point of diminishing returns whereby increased labor costs will outweigh the landfill savings. Where this threshold lies will be dependent on the project type, construction site, and waste diversion goals. The RFI process will serve as a valuable tool to help determine accurate financial cost estimates.

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

### 5. Develop a university-wide waste reduction policy, including a comprehensive, campus-wide materials management strategy.

**Goal:** Implement a Universal Waste Management and Non-Hazardous Waste Handling Policy at Cornell to establish strategies for achieving waste reduction, clarify responsibilities, and ensure university-wide compliance with applicable laws and regulations.

As a member of the Tompkins County community, Cornell University is committed to supporting the County's solid waste and recycling diversion goals. Cornell strives to maintain its record of responsible environmental stewardship with regard to waste reduction and landfill diversion, and the University follows proper disposal practices for both non-hazardous waste and Universal wastes. However, given the complexity of Cornell waste streams, the variety of facilities, the decentralized structure of the university, and the breadth of staff, students, and vendors who generate and handle waste, the Waste Team is advocating for an overarching waste reduction policy for the university.

This policy would provide standardized reporting and handling practices, and resources for waste reduction. It would clarify responsibilities and strategies for achieving waste reduction and maintaining university-wide compliance with government laws and regulations. It would also streamline the collection of metrics to meet local, state, and peer reporting requirements. By improving existing practices and establishing a comprehensive materials management strategy, the policy would reduce the potential for inconsistencies and oversights – thereby reducing institutional liability.

The implementation of a campus-wide waste reduction policy will not incur additional costs for the university. In fact, the proposed policy could provide potential cost savings through streamlined waste management processes, increased efficiencies, increased awareness resulting in increased waste reduction and diversion, and reduced risks of non-compliance with applicable regulations.

**Next Steps**

- Present an impact statement for the Universal Waste Management and Non-Hazardous Waste Handling policy to Cornell's Executive Policy Review Group for approval.
- Following approval, collaborate with stakeholders to draft the campus-wide policy.
- Obtain approval for the policy from Cornell's Executive Policy Review Group.
- Implement the policy and educate the campus community to build stakeholder buy-in and ensure compliance.

**Resources**

Collaborate with stakeholders to draft the policy and build consensus for approval among the members of Cornell's Executive Policy Review Group.

## 6. Expand re-use programs both for internal reallocation of university owned materials and for repurposing of surplus materials no longer needed on the campus, either by offering these items for sale or by donating them to non-profit organizations.

**Goal:** Strengthen existing practices and develop new programs to reduce the campus waste stream through re-use.

Cornell University has a longstanding tradition of re-use of materials. Campus re-use programs support the local community through a variety of channels, including, but not limited to:

- Direct donations to non-profit organizations and local schools
- Funds raised for local non-profit organizations through the annual Dump and Run event
- Computers given to communities that would not otherwise have access to them
- Support of Tompkins County Solid Waste reduction goals, and
- Promotion of culture change through reduced use of disposable materials and reduced waste

Formal existing programs in support of re-use on Cornell's Ithaca campus include the following:

- **The Cornell Assets Transfer System (CATS**) – run by the Division of Financial Affairs – Cost and Capital Assets Department. This system is intended for capital assets, and is designed to connect those with available campus assets to those who can put these assets to further use.
- **System for Trade & Auction of Cornell Surplus (STACS)** - managed by Cornell's R5 Operations Department. STACS has TWO components: 1) an online public auction system for surplus materials no longer needed on the campus, and 2) an online system for internal reallocation of university owned materials. The STACS Re–use program saved more than $40,000 in its first seven months of operation, mainly by repurposing office furniture which is offered for free to worksites on campus. After one month, unclaimed items are auctioned off to the community for personal use, for $1, the value of the scrap metal, or for a nominal fee. STACS is designed specifically for distribution of non-capital materials and does not change or replace any function of the Capital Assets Transfer System (CATS). Visit http://r5.fs.cornell.edu/about/reuse.cfm for more information about STACS & other Re–Use programs at Cornell.
- **Chemical Re-use Program** – managed by the Environmental Health and Safety Department. Cornell University maintains a surplus chemical recycling program available for Cornell researchers. By using (and helping to promote) the surplus chemical recycling program, researchers can save money on chemical purchases and help to minimize chemical waste. The chemicals available through the surplus chemical recycling program are free of charge and are stored in containers that are either unopened or in very good condition.

**Next Steps**

- Identify all re-use programs on the Cornell Ithaca Campus.
- Raise awareness on campus about existing re-use opportunities.
- Identify additional opportunities for re-use on campus (for example, capture of additional scrap wood for the making of mulch).
- Raise comfort levels within the Cornell community associated with utilizing re-used materials (examples range from utilizing Chemical Re-use Program for research materials to comfort with tap water in reusable water bottles).
- Grow markets and outlets for re-used materials off the Cornell campus (examples include creating formal relationships with local re-use merchants, to creating outlets in local schools, to exploring the potential to create outlets in larger metropolitan areas).
- Implement a campus-wide policy to standardize donation and sale of re-use materials.
- Track the volume of re-use on campus.

**Resources**

Re-use programs are anticipated to have a financial cost saving through both reduced landfill costs and averted purchasing costs. Both a cost-benefit analysis and GHG impact study should be conducted to identify where cost and GHG savings are being realized, and where opportunities for improvement are available.

- **Cornell Computer Re-use Association (CCRA)** – managed by Cornell students. The CCRA works to donate computers and other technology to humanitarian organizations in the local community and to community centers, orphanages, schools, and other organizations around the world. The computers are used to create educational opportunities that the recipients would not otherwise have without access to the technology. Whenever possible, the CCRA provides technical assistance to the communities that are receiving donations so that the computers' use and longevity can be maximized. The Association has donated to many international locations, including South Africa, Nigeria, Afghanistan, Iraq, Nicaragua, and Jamaica. CCRA promotes the University's sustainability mission by reducing the amount of technology-related waste that Cornell creates.
- **Dump & Run** – managed by Student and Academic Services. Dump & Run is Cornell's annual campus-wide waste-reduction and recycling program. Students and staff volunteers collect items students might otherwise throw away when they leave campus in May, sort and organize the collected items over the summer, and resell them at a large community sale when students return in August. Admission is free, and the sale is open to the public. Proceeds from each Dump & Run sale are donated to local nonprofit organizations. The 2013 Dump & Run sale featured approximately 30 tons of recycled furniture, clothing, jewelry, lamps, kitchenware, and electronics, and the event raised almost $55,000 to benefit local charities. Since the program began in 2003, Cornell has contributed nearly $250,000 to Ithaca-area charities and donated many tons of reusable goods to local human service agencies. For more information visit: http://living.sas.cornell.edu/explore/news/1305-dump-run-collection.cfm.
- **Sedgwick Business Interiors Asset Inventory Management (AIM) Program** – available for use by Cornell departments through a contract with Procurement Services. The AIM Program inventories all furniture for a University department or unit's project and provides a customized Internet-based asset inventory (AIM) list of all items stored. AIM allows users to view all products online for future moves and reconfigures. AIM provides reliable and consistent information to promote better utilization of assets and reduced customer storage costs.
- **Donations** – Cornell's Community and Government Relations Department collaborates with departments and units campus–wide to oversee donations of materials to non-profit organizations and government entities.

# WATER

## NEUTRALITY: Reduce Cornell's carbon emissions to net zero by the year 2050 or sooner.

### 1. Complete a water/energy nexus study for the Cornell campus and implement comprehensive strategies to monitor usage, conserve water, and reduce energy associated with treating potable and waste water.

**Goal:** Quantify energy use associated with the campus water delivery system, and implement measures to optimize the system and conserve both energy and water.

The source of Cornell's water is the 125-square mile Fall Creek drainage area. **Cornell's Water Filtration Plant** (http://energyandsustainability.fs.cornell.edu/util/water/drinking/default.cfm) provides a population of about 34,000, including the campus community and residents of the adjacent Forest Home and Cornell Heights neighborhoods, with safe and reliable drinking water. In 2012, the plant produced 507,000,000 gallons of potable water: approximately 9% of this water was used to generate energy for campus, while 91% of the total supplied campus potable water and agricultural needs.

Water and energy are inherently linked, intersecting on both the supply side and the end use side. This intersection is commonly called the "water/energy nexus." Efficiency programs that save water will also save energy and vice-versa. To more precisely quantify the energy associated with Cornell's water system, the Water Team is proposing a water/energy nexus study for the Ithaca campus. This study will quantify energy use associated with the current water delivery system as a basis for prioritizing and implementing infrastructure upgrades, such as pump replacements. The study will also provide a basis for implementing water conservation measures on campus, by linking these measures to reductions in energy use.

A preliminary analysis conducted in 2012 showed that approximately 4% of campus energy is used to treat and pump campus potable water, and 9% of campus water is used to generate energy. The next phase of the study will assess how much energy is used to treat campus wastewater at the Ithaca Area Wastewater Treatment Plant, and may also attempt to quantify the volume of water used to extract the natural gas used to generate campus electricity.

Approximately 15-20% of the water Cornell produces is currently unaccounted for. Metering all of the water produced would stabilize water rates and share costs equally among all customers. Utilities staff will continue to search for unmetered locations and install water meters as needed. In the longer term, water usage will also be added to the **Cornell University Building Dashboard** (http://buildingdashboard.cornell.edu), so that colleges and units can track their usage and save money by adjusting their consumption.

**Next Steps**

- Complete the water/energy nexus study, including a cost-benefit analysis, evaluate the study recommendations, and present findings to campus Utilities staff.
- Find un-metered water on campus. Install sub meters at strategic locations to account for all water used on campus and stabilize water rates for all customers, including Town of Ithaca and City of Ithaca customers.
- Add water usage to the Cornell University Building Dashboard.
- Include water conservation in the college engagement campaign, **Think Big, Live Green** (http://thinkbiglivegreen.cornell.edu).

**Resources**

Collaborate on joint water and energy utility programs to maximize savings and share tracking, metering, and data evaluation responsibilities.

## 2. Increase the energy efficiency of the campus water delivery system through upgrading aging pumps and infrastructure.

**Goal:** Optimize the energy efficiency of the campus water treatment and delivery system.

Several infrastructure upgrades are planned in the next two years to increase the efficiency of the Cornell Water Filtration Plant. The electrical service entrance to the Water Filtration Plant will be upgraded to improve efficiency in the plant's pumping operation, and five pumps will be replaced. The current pumps are either ON or OFF, pumping to their maximum capacity or off entirely. The current pumps will be replaced by pumps with variable frequency drives, so that plant personnel can adjust them to appropriate flow rates. Since the new pumps will provide only the necessary energy to deliver water, they will improve the overall efficiency of the water delivery system. Electrical savings will pay back the upfront costs of the pump replacement project.

In the next three to five years, additional improvements to the distribution system are planned, including replacement of aging pipes on North Campus. Such improvements will decrease the frictional losses in the system and remove potential vulnerabilities due to breakage or failure.

**Next Steps**

- Complete upgrades to the Water Filtration Plant and optimize pumping controls.
- Track current electrical usage before and after upgrades to evaluate results.

**Resources**

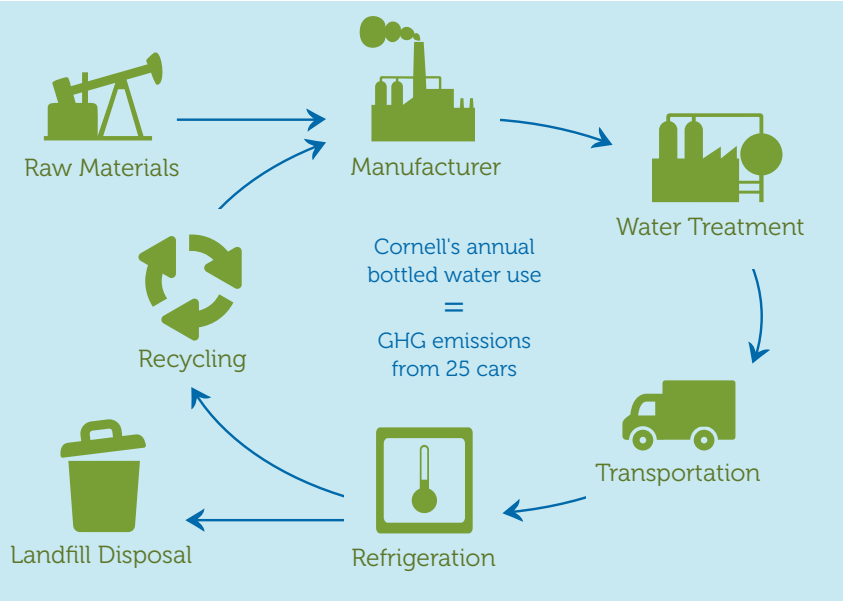
Assess costs and benefits of current projects as a basis for seeking approval/funding for future efficiency upgrades to the campus water delivery system.

## LEADERSHIP: Lead by example on campus and exercise climate leadership beyond campus.

### 3. Continue the Take Back the Tap outreach campaign to promote the use of reusable water bottles and containers, particularly at events and conferences, thereby reducing supply chain emissions and waste associated with bottled water.

**Goal:** Reduce bottled water consumption and associated costs, energy use, and GHG emissions through education and behavior change.

Between 350,000-400,000 single-serving bottles of water are sold on the Cornell campus annually, and more than 30,000 five-gallon carboy bottles of water are purchased for use in campus water coolers. Bottled water costs the campus community an estimated $640,000 per year, but the same volume of tap water would cost just $1,000. Cornell's annual consumption of bottled water causes nearly 115,000 kg of CO2 emissions, or the equivalent of 265 barrels of oil. **"Take Back the Tap"** (http://www.sustainablecampus.cornell.edu/initiatives/take-back-the-tap) (TBTT) is an education/awareness campaign at Cornell to reduce bottled water consumption – and associated costs, energy use, and GHG emissions. The goal is that this behavior change will be sustained even as students graduate and leave Cornell. The TBTT student club currently has ten members who regularly attend meetings. The club's main focus is changing the Cornell population's attitudes and habits relating to bottled water and making tap water more appealing and convenient to the campus community. The club owns four 10-gallon water jugs that they loan out for informal events, such as races, and three 3-gallon water dispensers that are available for more formal events, such as graduation receptions.




**Next Steps**

- Continue education and outreach to reduce bottled water sales on campus.
- Prioritize locations, secure fund ing to retrofit water fountains with in-line water coolers, and retrofit water fountains as funding permits.
- The green events team will identify existing communications channels and processes through which university events are typically planned and advocate for making events bottle-free.

**Resources**

Develop strategies to increase student engagement and work with University Communications to move TBTT messages out to the Cornell community.

The TBTT campaign is making a difference: bottled water sales at campus convenience stores and community centers have decreased by roughly 25%. Other recent achievements include:

- TBTT education is a part of orientation.
- All incoming students receive reusable bottles.
- Cornell's design standards for new buildings and renovations now include bottle fillers.
- Many existing drinking fountains have been upgraded with bottle fillers.
- An **inventory of bottle filling stations** has been posted online at http://energyandsustainability.fs.cornell.edu/file/DAT-2013-04-22-BottleFillerInventory.pdf.
- Inline water coolers, which are fed by Cornell water, are a sustainable, cost effective option to replace carboy style water coolers. Mister Koffee, a local business, has been selected as Cornell's vendor of choice, and the new coolers are now available through eShop. More than 25 inline coolers have been installed to date.

Tips on how to host bottle-free events are included in the **Sustainable Events Planning Guide** at http://www.sustainablecampus.cornell.edu/resources/13/download. The Guide is also available through the **Cornell Event Planning website** at http://www.cornell.edu/event-planning/. Bottled water sales at campus events have, however, not declined – emphasizing the need for increased outreach and education around green event planning. A newly formed ad hoc "green events team" is working to identify existing communications channels and processes through which university events are typically planned and to advocate for making events bottle-free.

TBTT concepts are included in the **"Green Your Workplace"** (http://www.sustainablecampus.cornell.edu/initiatives/october-green-your-workplace) initiative that is being launched as part of the Think Big, Live Green college engagement campaign. This initiative was piloted in the College of Engineering in Fall 2013, and will be expanded campus-wide in 2014.

# A Diversity of Stakeholders: Quotes from the Plan

## The full text of the quotes excerpted in the Cornell University Climate Action Plan Update 2013 & Roadmap 2014-2015 is provided here.

## Page 1

"Inequalities in society and climate change are the two biggest challenges we face in the world today."
– Cornell University President **David J. Skorton,** President's Sustainable Campus Committee Summit, November 6, 2013

"...Truth shall be taught for truth's sake."
– **Andrew Dickson White,** first President of Cornell University, 1866-1885

## Page 5

"Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gaseshave increased."
– **Working Group 1** Contribution to the Intergovernmental Panel on Climate Change Fifth Assessment Report

"We cannot solve climate change when we seek to spew more emissions. I express this with all due sincerity. In solidarity with my countrymen who are struggling to find food back home and with my brother who has not had food for the last three days, with all due respect and I mean no disrespect for your kind hospitality, I will now commence a voluntary fasting for the climate."
– excerpted from an address by **Naderev "Yeb" Saño**, Philippine Climate Change Commissioner and lead climate negotiator, during the opening session of the United Nations climate summit in Warsaw, Poland, November 11, 2013. On November 8, Super Typhoon Haiyan – the strongest typhoon to make landfall in modern recorded history – hit the Phillipines and left over 10,000 people dead or missing. Read Naderev Saño's full remarks at http://www.rappler.com/thought-leaders/43476-stop-this-climate-crisis-madness.

## Page 6

"It should be obvious to anyone looking at our Climate Action Plan that sustainability is an institutional priority. Cornell is a leading research institution committed to climate action, and our students are pushing us to do better. Students on this campus are vitally engaged in energy conservation, green development, and food sustainability – and their enthusiasm is helping to move our plan forward."
– **Susan H. Murphy**, Vice President for Student and Academic Services

"When President Skorton signed the American College & University Presidents' Climate Commitment, he did it because it was the right thing to do. We didn't know how Cornell would become climate neutral by 2050, but we knew we would figure it out. And that's exactly what we're doing."
– **Robert R. Bland**, Senior Director, Energy and Sustainability Department

"Leading academic institutions like Cornell must serve as role models for broader society to demonstrate how individual, collective, and concerted actions can successfully solve the climate change problem. Indeed, by setting the lofty goal of climate neutrality and working diligently towards that goal, Cornell is already an exemplar of climate change prevention."
– **Timothy James Fahey**, Professor, Natural Resources, College of Agriculture and Life Sciences

"Cornell is continuing to chip away at our carbon footprint by sticking to the course outlined in our Climate Action Plan. Our staff knows that they are part of this effort, which makes the small actions they take on a personal level feel bigger. Collectively, by being more efficient, we are saving the university money, conserving resources, and helping the environment. By sticking to our plan, we are making a positive impact and building a sense of pride and accomplishment in our workplaces."
– **Mary George Opperman,** Vice President for Human Resources and Safety Services

## Page 7

"At Cornell we try to make the best decisions for the future of our campus, our community, and our planet – because this is the right thing to do. We are proud of our systems; of the staff who design, implement, maintain and operate these sustainable systems; and of the future we are creating for Cornell University and the community. We also recognize the value of collaborating and sharing best practices. Learning from each other is important. We see signs of new district energy systems under consideration in Ithaca and across the country, and we stand ready to assist others with their journey toward cleaner and more efficient energy production."
– **KyuJung Whang,** Vice President for Facilities Services

## Page 8

"The Cornell Climate Action Plan is achievable but not ambitious enough. The world must become carbon (climate) neutral by 2050, and if Cornell cannot achieve that status sooner, then we are not doing enough. This is an existential issue for society, so nothing should be a higher priority for the University. We should be targeting carbon (climate) neutrality by 2030."
– **Charles H. Greene,** Professor, Earth & Atmospheric Sciences, and Director, Ocean Resources and Ecosystems Program

"It is rare to see such universal recognition of both the need for and commitment to transforming our energy system to a cleaner, more sustainable state. From President Skorton to Cornell's faculty, staff, and students, we share a passionate commitment to having the major portion of our energy come from renewable resources and utilizing them in the most efficient manner possible."
– **Jefferson W. Tester**, Croll Professor of Sustainable Energy Systems, Director of Cornell Energy Institute, Faculty Fellow with the Atkinson Center for a Sustainable Future

"It is imperative that Cornell continue to work across campuses, sectors, and continents to meet the needs of society. A focus on climate change aligns perfectly with Cornell's land grant mission, agricultural and other relevant expertise, legacy of leadership in sustainability, and long-standing commitment to responsible stewardship and community service. Our Climate Action Plan builds on the progress we've already made and prepares us to do what the future demands: strive for carbon neutrality, innovate, and lead the way to a cleaner, safer, more stable world."
– Cornell University President **David J. Skorton**

## Page 9

"Because of Ezra Cornell's foresight to create an institution where any student can find instruction in any study, Cornell is uniquely qualified to be the international leader in developing solutions to climate change and sustainability. I agree with the statement in the Atkinson Center's 2013-2017 Strategic Plan: 'The Cornell community has the unparalleled potential—and obligation—to be a global leader in shaping a sustainable future.' This obligation stems from both a moral responsibility to our community as well as the need to keep Cornell relevant—and an educational leader—in a rapidly changing world."
– **Dan Miller**, Managing Director, The Roda Group (www.rodagroup.com). Dan Miller received his Bachelor of Science in Electrical Engineering, with distinction, from Cornell University in 1978.

"Cornell is a great world university with an astonishing range of experts able to predict and offer resilience for the coming effects of climate change. What's really important – from an institutional and intellectual point of view – is that we develop forms of adaptation but never allow these to take focus away from long term changes that might lead to solutions. I particularly support student-led efforts, including carbon divestment (even if it is unlikely and problematic for all sorts of reasons). All students must become better educated and must mobilize – it's crucial."
– **Karen Pinkus,** Professor, Italian and Comparative Literature and Faculty Fellow with the Atkinson Center for a Sustainable Future

## Page 11

"As an active member of KyotoNOW! and the Kyoto Task Team, I was impressed by the dedication and zeal of Lanny Joyce and the Cornell Facilities staff to reduce energy use on campus. However, I also saw a need to increase the use of clean, renewable energy to meet the remaining campus energy needs as well as to educate the entire campus community and the public about clean energy in a highly visible way. Upon my graduation my family and I established the Krich Solar Fund for alumni. This fund provided the financial support that jump-started the installation of solar panels on Day Hall, the Cornell Outdoor Education Hoffman Challenge Course, and Shoals Marine Lab. I am thrilled to see that Cornell has continued conserving energy, has stopped using coal, and is now building a large-scale solar installation."
– **Abigail Krich**, President of Boreas Renewables LLC, College of Engineering and College of Agriculture and Life Sciences class of 2004, and MEng, College of Engineering, 2006

"A change in culture at Cornell brought about by an overriding theme of sustainability in all performance reviews could potentially impact every emission source. At the Cornell University Agricultural Experiment Station, we have adopted a 'culture of sustainability.' Our Sustainability Action Team generates ideas for how to be more sustainable across our many operations. The team has generated a long list of ideas, many of which have been implemented. We empower people by giving them the chance to offer their own ideas, and the results are inspiring to say the least."
– **Michael P. Hoffmann**, Director of the Cornell University Agricultural Experiment Station and Associate Dean, College of Agriculture and Life Sciences

## Page 12

"By establishing institutional goals to reduce Cornell's energy consumption and greenhouse gas footprint, we have inspired our faculty, staff, and students to work together to conduct research and develop cost-effective, innovative solutions. We are making progress by leveraging the enthusiasm of our students and the expertise of faculty. Achievements on the Climate Action Plan have brought national visibility to Cornell."
– **W. Kent Fuchs,** Provost

"Sometimes we forget that we're going to class to better ourselves and to better the world at large. Especially at a prestigious university like Cornell, students focus too much on grades and GPAs. We tend to focus on our individual futures, rather than the present moments. We think about our own futures, rather than our planet's future. Sustainability helps to bridge the gap: to prepare for the future, we must think about what we do today. We need to learn to see again, and to understand that our impact matters. We need to teach our future leaders to start understanding our place, caring for our place, and encouraging others to do the same so we can lead properly and effectively in the future."
– **Claire Siegrist,** STARS Sustainability Intern, Campus Sustainability Office, College of Agriculture and Life Sciences, 2015

"World-class research institutions like Cornell can help to foster open, balanced, and clear communication about sustainability to a lay audience, including our alumni. Cornell's huge diversity of alumni clubs, professional networks, and programs in major population centers like New York City and Silicon Valley provide fair and open avenues for reaching a large swath of alumni. Our scientists and other communicators should seek opportunities to engage these individuals in conversations about big issues like this one."
– **Charles D. Phlegar**, Vice President for Alumni Affairs and Development

## Page 13

"Cornell's largest outreach vehicle, Cooperative Extension, is working in partnership with local business, agriculture, government, and community leaders to improve the energy efficiency of commercial and residential buildings and farms, and introduce renewable energy, including solar and bulk wood pellets, to communities across the state. Their efforts are helping to establish energy efficiency and renewable energy as key economic drivers for the upstate New York economy, with potential to generate well over a half billion dollars in economic activity annually."
– **Ken Schlather,** Executive Director, Tompkins County Cooperative Extension

"Cornell's early success in cutting greenhouse gas emissions has positioned us as a national leader. In order to maintain our credibility and keep moving in the right direction, we need to continue to tend to our own emissions and we need to educate our own students to become future climate leaders. The tangible impacts of our CAP can be seen through reductions in our carbon footprint here on campus. The intangible impacts can be felt as our students and alumni take action in the world beyond campus. The synergies and symbolism of both types of action are critical to the long-term success of our plan."
– **John A. Siliciano,** Senior Vice Provost for Academic Affairs

## Page 15

"The Lake Source Cooling project of the late Nineties expanded the capacity of the University to cool buildings in a way that was environmentally friendly and at a lower operating cost than conventional alternatives. Similarly, the Combined Heat and Power Plant, which became operational in December 2009, was expected to lead to dramatically improved efficiency and thus lower operating costs, as well as lower greenhouse gas emissions. Although the debt for both projects is still being paid off, if the projected savings for the latter prove correct, both will have reduced the utility rates charged to units below what they otherwise would have been, and thus both will have been economically beneficial as well as environmentally friendly."
– **Ronald Ehrenberg**, Ives Professor of Industrial and Labor Relations and Economics, and Ross Milton, PhD student in economics. Excerpted from "The Other Debt Crisis," Cornell Alumni Magazine, November/December 2013 (http://cornellalumnimagazine.com/index.php?option=com_content&task=view&id=1766&utm_source=FeatureDebt&utm_medium=NovEmailUG&utm_campaign=NovDecIssue.

"Cornell has a huge opportunity to maintain a true leadership role in the next decade. But we can't rest on the past accomplishments – as great as they are. We need to allocate funding and resources to implement the next-phase strategic actions identified in our CAP."
– **Lauren Chambliss,** Communications Director for the Atkinson Center for a Sustainable Future

"For me, the picture is pretty clear. Displacing coal emissions with gas emissions is beneficial from a climate standpoint. Total U.S. greenhouse gas emissions decreased by 2.6 percent from 2010 to 2011, for example, and part of that decrease is the result of fuel switching. Gas is without any question advantageous from a standpoint of the other environmental damage caused by coal emissions, including heavy metals like mercury, cadmium, uranium and lead, particulates, and sulfur dioxide. However, it should also be very clear that gas production has both local environmental costs and contributes to climate change. Demonstrating that the overall environmental damage is less than that from coal does not imply that gas production and use is cost-free, and the sooner we reduce our dependence on fossil fuel sources of energy of all kinds the better. Coal is worse — that doesn't mean that gas is great."
– **Louis Derry**, Associate Professor Earth and Atmospheric Sciences

## Page 18

"Since making our Kyoto Protocol compliance pledge in 2001, Cornell has invested over $37M in capital projects. By 2016, the total will approach $43M. This investment in our Energy Conservation Initiative, coupled with continuous optimization, have dramatically reduced energy usage and maintenance issues, while improving the comfort and safety of campus buildings."
– **Lanny Joyce**, Director of Energy Management

## Page 19

"Since the majority of energy conservation projects have a maintenance component, we are essentially killing two birds with one stone – we address a deferred maintenance item and reduce energy use. An example of this would be the Guterman Greenhouse project where we upgraded the outdated lights and controls that were well past their useful life and in need of replacement."
– **Mark J. Howe,** P.E. CEM, Program Manager Energy Conservation Initiative

## Page 26

"The fact that more than a quarter of all our future reductions hinge on offsetting actions is a humble admission that achieving our mission as a university will involve some unavoidable carbon emissions. At the same time, mission-linked offsets can provide Cornell with the opportunity to reach beyond our hill and invest in tangible actions with multiplicative benefits to our immediate and global community."
–**Abena Sackey Ojetayo**, '07, MEng '09, Engineer, Division of Facility Services

## Page 27

"Cornell is one of the few universities in the country to offer a minor in climate change for interested students. The three required courses encompass physical, biological, and human dimensions of this environmental challenge. Through these and other courses offered at Cornell, students can gain a depth of understanding about climate change issues that will make them effective leaders in whatever career track they follow. Both the Cornell Agriculture Experiment Station and the Atkinson Center for a Sustainable Future put a priority on climate change projects in their internal grants programs, recognizing climate change as an overarching challenging affecting all aspects of natural resource management, food security, human well-being, and sustainability."
– **David Wolfe,** Professor, Horticulture and Faculty Fellow with the Atkinson Center for a Sustainable Future

"The Center for Engaged Learning + Research is fully committed to supporting the goals of the CAP. We will provide seed grants and educational programs for faculty and students to design service-learning courses and engaged research projects that focus on addressing sustainability issues at Cornell and with local and global communities."
– **Richard Kiely**, Ph.D. 2002, Director of Engaged Learning + Research

## Page 28

"Our students are part of a residential campus community every minute of every day. We have a 24/7/365 opportunity to engage them in creating and building the sustainable world that is humanity's central task for the 21st century. To assign 'sustainability education' to the classroom or even the research lab is to miss the mark. Every action from Frosh to Senior should be part of an emerging experiment in sustainable living. All members of this community can take ownership of the dreams, experiments – and ultimately – solutions we need to achieve climate neutrality."
– **Alexandra Moore,** Director, Cornell University Field Program in Earth and Environmental Systems, and Senior Research Associate in the Department of Earth and Atmospheric Sciences

"Cornell University Sustainable Design is a student-led design build team. Our mission is to provide students with the opportunity to learn about design, engineering, and sustainability through hands-on experience. We work alongside managers at Cornell Facilities and stakeholders in this community and beyond on projects like the Beebe Lake Redevelopment and Cornell Tech Campus. In regards to the Climate Action Plan, our role has been to try to put the latest innovations into action, by creating buildings that are 'living laboratories.' Personally, I would love to interact more with the CAP. As members of a sustainability- focused organization, we are aware of the plan and the environmental context within which we work. But even I understand the goals at a high level. Making a direct tie for students between their actions and CAP goals would allow groups like CUSD to assist with completion of certain goals and better align our missions with the plan."
– **Aylin Gucalp**, College of Agriculture and Life Sciences, 2014

## Page 32

"Institutions of higher education have a unique opportunity, and some would say an obligation, to lead by example in the challenge to reverse climate change. Cornell is recognized nationally for our leadership in climate action and any wavering in our commitment would be a setback for this cause."
– **Randy Lacey,** Associate Director, Office of Project Design and Construction

"Universities and colleges can become truly sustainable only if they adopt the perspective of 'ecosystem awareness' and work with the communities around them to become sustainable. They must commit not only to dramatically reducing the carbon footprint of the campus and become examples of ecological integrity, social justice, and economic health, but also to collaborating with the larger community in doing so, enabling solutions to be scaled up and replicated."
– **Peter W. Bardaglio,** Ph.D., Senior Advisor, Second Nature. Read more at http://secondnature.org/blog/2013-11-05/future-aint-what-it-used-to-be#sthash.xGSdACPM.dpuf.

"Cornell Cooperative Extension works closely with Cornell researchers to understand climate change and weather impacts on agriculture. Efforts are being made statewide to mitigate the impacts of agriculture on climate change by changing tillage practices and dairy feeding, and to help farmers adapt to new conditions by looking at controls for emerging pests and at opportunities for new crops."
– **Deb Grantham**, Assistant Director for Natural Resources and Environment for Cornell Cooperative Extension

"In 1949… with the generation capacity of 1000 kWh, the university demand was approximately 1000 kWh… In this era the university electric demand was so low at nights that our generators would feed back to the NYSEG system."
– **Electric System History Memorandum**, Department of Buildings and Properties, April 16, 1976

## Page 33

"I'm so proud to have Cornell University as one of the top ten coolest schools in the nation. Cornell is a trailblazer in sustainability and is the only one where you can minor in climate change. I'm glad to have two of my daughters as Cornell alumni."
– **Susana M. Reyes**, Director of Human Resources, Los Angeles Department of Water and Power

"The Princeton Review's 2013 College Hopes and Worries Survey (https://www.princetonreview.com/college-hopes-worries.aspx) showed that 62% of students consider a school's commitment to environmental issues as a significant factor in their choice of where to apply and attend college. In my experience speaking with prospective students, sustainability does matter. When admitted students are trying to decide among academically similar schools, Cornell's commitment to sustainability makes a difference. The opportunity to eat local, be a steward of our gorges, recycle, and reduce our carbon footprint are important lifestyle choices for them, and for all of us."
– **Becca Macies,** CALS Ambassador, Student Sustainability Coordinator, College of Agriculture and Life Sciences, 2014

## Page 39

"Forward looking estimates suggest that energy related investments will have the highest returns going forward. Not investing would impact not only portfolio returns, but also the level of diversification in the portfolio and finally, the ability to hedge against inflation (which is a big risk in the current environment given the amount of liquidity that central banks around the world are creating)."
– **A.J. Edwards**, CFA, Chief Investment Officer, Cornell University

"A committee of Cornell faculty members has studied the issue and determined that the University could commit to a phased divestment plan, consistent with its Climate Action Plan, that would have a negligible impact on annualized rates of return while reducing the risks of unburnable fossil fuel assets to its investment portfolio.
–**Faculty Senate Divestment Resolution Committee**

"Thanks to the efforts of student leaders, staff, administrators, and faculty, Cornell has made tremendous progress on sustainability initiatives over the past few years – from energy conservation and waste reduction, to alternative transportation and sustainable design. Looking forward, Cornell has an incredible opportunity to be a leader nationally, if we commit to divest from the dirtiest fossil fuel companies which have reserves with enough carbon to push our globe past two degrees Celsius of warming. Cornell's commitment to divest would pave the way for other Ivy League universities and large institutions to follow suit and demonstrate the moral urgency of taking action on climate change and investing for a sustainable future."
– **K.C. Alvey**, Organizer, 350.org, College of Agriculture and Life Sciences, 2011

## Page 40

"To effectively address climate change, we need to understand how to change human behavior. We need to think carefully about how people hear the messages we send, how they respond to those messages, and why they do or don't take action. It is incumbent on a place like Cornell to create effective messaging around climate change. We need to get people's attention and help them understand the concrete, tangible steps they can take to make a difference."
– **Kathryn J. Boor**, Dean, College of Agriculture and Life Sciences

## Page 41

"At Cornell we don't just genuflect to the concept of sustainability – we have real people doing amazing work at so many levels. If people here are not acting as ambassadors for our Climate Action Plan, it's because they don't have a simple concept they can share to show what Cornell is in fact doing. We need to move the three pillars of Neutrality, Innovation, and Leadership (NIL) out to every Cornellian, so that every one of us can serve effectively as an ambassador for our plan."
– **Tommy Bruce,** former Vice President for University Communications

## Page 42

"The advantage of STARS is that institutions can earn credits for all of their contributions to sustainability. From providing sustainability coursework, to using green cleaning products, to energy efficiency in campus buildings, there are lots of opportunities for a school to identify and track its sustainability progress."
– **Paul Rowland**, AASHE Executive Director

"Cornell has the opportunity to become the first university to achieve the Platinum ranking in the Sustainability Tracking, Assessment, and Rating System (STARS). While the Sierra Club praised Cornell as the #5 greenest school in the nation, there is a tough road ahead to be number one. Such recognition and achievement will be possible through a steady and persistent commitment to carbon reductions in all campus operations, high performance buildings, climate change education, and the application of innovative renewable energy research."
– **Dan Roth**, Director, Campus Sustainability Office

## Page 43

"We have seven billion people on this earth, and in the last 50 years we've consumed more raw materials than in all previous human history ...and it's still climbing. The EPA says that material consumption creates about 41 percent of our carbon dioxide emissions, and that new construction is the single largest source of human toxicity."
– **Jean Carroon,** FAIA, LEED, principal in Goody Clancy's preservation practice, based in Boston

"I believe that by being better stewards of our facilities, Cornell can reduce its footprint in the community. We don't have to always build new – instead we can 'defragment' our existing space to repurpose and reuse it more efficiently. We can also encourage our people to be better caretakers of their space. The small steps that colleges are taking are important. For example, the School of Hotel Administration is utilizing thermal maps to redesign its entryway and reduce thermal losses. This kind of thinking benefits the whole institution. By factoring the cost of energy resources into planning, we can reduce the heating and cooling that escape 'through the windows and doors,' and focus more resources on our academic mission."
– **Elmira Mangum**, Ph.D., Vice President for Budget and Planning

## Page 44

"Each building on campus can strive to be 'energy net zero' and minimize the need for carbon offsets. Our first step should always be reduction of energy consumption. Cornell's colleges, departments, and units can reduce thermal losses using well sealed high performance windows, better insulated roofs and exterior walls, and by sealing building envelopes. Other strategies include upgrading building mechanical systems and controls, installing more efficient lighting and occupancy sensors, and considering onsite photovoltaic systems. We need to put our best foot forward to make the campus built environment a showcase for Cornell's commitment to sustainability."
– **Brad Newhouse,** Senior Project Manager, LEED AP, PSCC Buildings Team

## Page 46

"Average temperatures across the Northeastern United States have risen by over 2°F since 1970. Winter temperatures are 4°F warmer... Here in New York, we have seen an increase in the number of extremely hot summer days (above 90°F) and a decrease in the number of cold winter days (below 32°F). In the future, New Yorkers can expect: an increase in average temperature of 1.5 to 3°F by the 2020s; 3 to 5.5°F by the 2050s; and 4 to 9°F by 2080, depending on the amount of greenhouse gases humans continue to emit into the atmosphere."
– **Climate Change Facts**, Cornell University College of Agriculture and Life Science, October 2011 (http://blogs.cornell.edu/climatechange/files/2011/03/ny_changing_climate.pdf)

"Our work in Hawai`i this spring has taught us the 'how' of small-scale change. It has showed us the tangible differences that individuals make every single day. But perhaps more importantly, it has showed us the 'why' – the pride, the importance, and the value of taking responsibility for practicing what we preach. Understanding that we as educated and moral citizens have both the tools and also the responsibility to repair the tragedy of the commons, rather than just describe it, is no doubt one of the most valuable things we have gained from this semester."
– **Nathan Greene**, Interdisciplinary Studies, 2014

## Page 47

"We're not going to save the day by not running the hot water too long. But by engaging our students in conserving energy, we get them to think about their individual actions within the larger context. When students plant trees to offset their travel emissions, they begin to get a sense of scale for managing forests. Demonstration scale projects like these foster a sense of commitment and passion, and they get people working together toward a common goal. Student engagement can be our greatest asset."
– **Frank DiSalvo,** Director of the Atkinson Center for a Sustainable Future

## Page 48

"When we think about climate action, we tend to focus on our facilities and physical footprint. We need to break out of this stereotype and look at this issue as an integral part of the university's educational mission. Cornell's University Courses Initiative (http://universitycourses.cornell.edu/) provides an opportunity for faculty and students to work across disciplines and across colleges to address issues such as climate change. For instance, last year we offered a course taught by collaborating faculty from Earth and Atmospheric Sciences and Comparative Literature to examine the human dimensions of climate change. What we've found is that our campus community is eager to think through complex, interdisciplinary issues such as this one."
– **Laura Brown,** Senior Vice Provost for Undergraduate Education

## Page 49

"When he first saw the mills in 1828, Cornell felt that enough power was going to waste over the falls in Fall Creek to operate ten times the capacity of the mills… By the next year, Ezra Cornell had the solution… The Ithaca Falls tunnel, blasted two hundred feet through solid rock over 150 years ago by a serious young man, overcame the skepticism of mill owners and townspeople and marked Ezra Cornell as a man of vision. For the succeeding 130 years, the shaft continued to supply power from Fall Creek to the factories along its banks."
– excerpted from **Cornell University's application to the Federal Energy Regulatory Commission** for the Ithaca Falls Water Power Project, June 1982

"By building on the leadership of states and cities that are moving to cleaner energy sources, and many power companies that are already working to modernize their plants, we can spur innovation and investment to help create new jobs and new industries, and be better stewards of the world we leave to our children."
– P**resident Barack Obama,** EPA FACT SHEET: Reducing Carbon Pollution from Power Plants (http://www2.epa.gov/sites/production/files/2013-09/documents/20130920factsheet.pdf)

## Page 51

"We are working to incrementally improve operations at the Statler by transitioning to more efficient lighting, moving away from table linens and skirting, incorporating more recycled paper products, repurposing leftover soap and shampoo, and increasing composting rates. All the plates, wrappings, and utensils used in our cafeterias are compostable, with a few minor exceptions. Our students are the future leaders of the sustainability movement, and so the moment when they decide to sort their waste into composting and recycling, and not into landfill waste, is key. We are trying to make sure that, in that moment, they make the right choice."
- **Richard D. Adie**, General Manager, Statler Hotel

"Last spring members of the Food Team attended a workshop with people from the other nine sustainable committees to brainstorm how our teams were going to move the Climate Action Plan agenda forward. One suggestion was that the Food Team initiate a project directed at educating students about food – everything from cooking and shopping, to food sheds, to where food comes, etc. I thought it was a great idea. We now have pilot project for this almost in place! We even have a name for it: 'Beyond Ramen!'"
– **Jane Mt. Pleasant**, Associate Professor, Department of Horticulture

## Page 52

"The 'soul' of Cornell is embodied in its campus. More than 2/3 of the Ithaca Campus is open space, a fact which really distinguishes us from other campuses. The Master Plan's commitment to create no new parking on campus promotes a place where people move between places without cars, thereby reducing vehicle miles traveled and the carbon footprint of our campus."
– **Minakshi M. Amundsen**, Director of Capital Budget and Integrated Planning, Budget and Planning Office

"Cornell is uniquely positioned to be a leader in cutting edge research and implementation of green infrastructure that harnesses the power of soils and vegetation to abate storm water, reduce summer temperatures, store carbon, create habitat for pollinators, and create enjoyable spaces for people. Faculty and students in the College of Agriculture and Life Sciences are investigating new technologies, and demonstrating and interpreting them on campus, to educate the Cornell community and society at large."
– **Nina Lauren Bassuk**, Professor, Horticulture, College of Agriculture and Life Sciences

## Page 53

"Engaging students in open space and natural area stewardship through classes and student organizations has numerous benefits for campus sustainability. Not only do activities such as planting trees and maintaining trails help provision ecosystem services, but such nature-based activities also foster student mental and physical well-being."
– **Marianne Elizabeth Krasny,** Professor and Director of the Civic Ecology Lab in the Department of Natural Resources, College of Agriculture and Life Sciences

## Page 54

"Seventy percent of the carbon emissions generated by cities (which account for 70% of the planet's total carbon emissions) come from the homes and vehicles of citizens, so it stands to reason that significant reductions can't occur without ordinary people making changes to their everyday habits and behaviors."
– **David Gershon**, co-founder and CEO of Empowerment Institute

"The real impact of the work we are doing is that we are training leaders. Through projects like Think Big, Live Green, we are infusing a sense of commitment and enthusiasm into our students to produce less CO2. When our students graduate, they go out into the world with this kind of thinking. The impact of what we do here on campus is magnified many-fold by the impact that Cornell's thousands of graduates can have on the world around them."
– **Lance Collins**, Dean, College of Engineering

"When people can see the impact of their actions on energy consumption, they understand that their actions really do make a difference. When many people take the same actions and steps, together they can make more thoughtful use of campus resources."
– **Erin Moore**, Energy Outreach Coordinator

## Page 55

"I've always said we need to do everything all at once. And this is an opportunity for the United States to innovate, to be the world leader in new technologies, that if you could invent a better battery, a better way to store electricity, you would change the world. And if you were to do that in a way that you could manufacture and export it, you would also do very well financially."
– **Bill Nye** '77, The Science Guy

## Page 56

"Cornell staff have been engaged in and conscious of reducing the university's carbon impact for many years. Through such actions as use of public transit to reduce business travel, switching off lights, and two-sided printing, everyone can contribute. We will continue to look for ways to make it simpler to purchase green products, to provide support for institutional CAP initiatives, and to recognize our dedicated staff for doing the right thing."
– **Joanne M. DeStefano**, Vice President for Finance and Chief Financial Officer

## Page 57

"I was inspired to institute the bag fee when the Society for Natural Resources Conservation student organization approached us about limiting bag usage, and also by the fact that many large cities, such as Seattle, have now instituted similar programs for all businesses. Paying for the bag places an intrinsic value on it and makes the consumer more apt to reuse it or to opt for no bag or a tote bag."
– **Pat Wynn**, Director of The Cornell Store

## Page 58

"We have the best public transit system for a community our size in the country."
– **Dave Howe**, Director of Facilities Services

"Transportation is one sector that can provide great strides toward carbon neutrality, while also benefitting local economies and energy use. To get there, we need more research, development, and demonstration attention, nationally. Cornell's Climate Action Plan is helping aim campus projects on this area of need. Leading with a good example in Ithaca, where transportation sector greenhouse gas emissions top the charts, can have widespread impacts in other regions where transportation is also target #1 – like California!"
– **Paul F. Mutolo**, PhD, Director of External Partnerships, emc2 — the Energy Materials Center at Cornell

## Page 58

"We have the best public transit system for a community our size in the country."
– **Dave Howe**, Director of Facilities Services

"Transportation is one sector that can provide great strides toward carbon neutrality, while also benefitting local economies and energy use. To get there, we need more research, development, and demonstration attention, nationally. Cornell's Climate Action Plan is helping aim campus projects on this area of need. Leading with a good example in Ithaca, where transportation sector greenhouse gas emissions top the charts, can have widespread impacts in other regions where transportation is also target #1 – like California!"
– **Paul F. Mutolo**, PhD, Director of External Partnerships, emc2 — the Energy Materials Center at Cornell

"We would like to stress the significant positive impacts of Cornell's community-based approach to transportation. Not only does this approach clearly benefit Cornell community members as they move around Ithaca and Tompkins County, but the positive impacts reverberate throughout the community and create significant goodwill with other local agencies and organizations."
– **Jennifer Dotson**, Executive Director, Ithaca Carshare

## Page 60

"A big piece of the waste reduction story isn't counting how much less we throw away, but rather reducing what we purchase. If we all buy fewer coffee cups, copy paper, and bottled water, then we will throw less away."
– **Spring Buck,** Manager, R5 Operations, Cornell University

## Page 61

"Sustainability matters to me because I care deeply about not wasting precious materials. Even things like food waste can be transformed into something incredibly useful."
– **Yining Dai,** College of Engineering, 2016

## Page 63

"Drinking bottled water is unsustainable and harms the environment, with 80% of plastic water bottles thrown away rather than being recycled. It takes the equivalent energy of 1/4 of a water bottle full of oil to manufacture and transport just one bottle! Cornell tap water is clean and safe to drink; in fact, Cornell tap water is held to far higher standards than that bottled water you were about to waste $2.50 on."
– **Joseph S. Spivak**, Sustainability Communications Intern, College of Agriculture and Life Sciences, 2016

# Tabled Actions

## ENERGY

### NEUTRALITY: Reduce Cornell University's carbon emissions to net zero by the year 2050 or sooner.

### 1. Utilize landfill gas energy at Cornell's Geneva Campus.

**Goal:** Reduce Cornell's Geneva Campus' use of conventional natural gas by purchasing captured methane from nearby landfills.

This action was intended to reduce the greenhouse gas emissions emitted by Cornell's College of Agriculture and Life Sciences New York State Agricultural Experiment Station in Geneva, New York, by replacing the current natural gas used with captured methane from two nearby landfills. The Geneva Campus is located approximately 40 miles northwest of Ithaca at the northern end of Seneca Lake. Emissions from the Geneva Campus are not currently included in the reported greenhouse gas inventory.

Two landfills are located within ten miles of the Geneva Campus, both of which collect their methane gas and use it to produce electricity onsite. The rights to the gas are owned by Innovative Energy Systems (IES). Future increases in either of these landfills' gas collection and electricity production could, theoretically, supply the Geneva Campus.

There are many options for utilizing the landfill gas, but none of these options is economically feasible at this time. The current raw cost of natural gas is $3-4/dekatherm. If and when the cost of natural gas increases to $12-14/dekatherm, the Energy Team will reconsider the viability of utilizing landfill gas energy at the Geneva Campus.

# Cornell University Energy Conservation Initiative Project Summaries


| | |
|---|---|
| 2 | Biotech Ventilation |
| 3 | Blue Light Service |
| 4 | Bradfield Exhaust Fan Controls and Air Re-commissioning |
| 5 | Cornell Store |
| 6 | Comstock |
| 7 | Duffield Clean Room Re-circulation Air Flow Control |
| 8 | Growth Chamber Phase 1 |
| 9 | Growth Chamber Phase 2 |
| 10 | Growth Chamber Phase 3 |
| 11 | Guterman Greenhouse Lighting and Controls |
| 12 | Kroch Library |
| 13 | Lynah Rink Conservation Project |
| 14 | Mann LED Elevator Lighting |
| 15 | Plant Science Space Control Upgrade |
| 16 | Plant Science Steam Traps and Radiator Control Valves |
| 17 | Reis Tennis Center Lighting |
| 18 | Rockefeller Hall Window Weatherization |
| 19 | Statler Hall |
| 20 | Steam Insulation Upgrade & Replacement |
| 21 | Upson Hall Wireless Thermostats |
| 22 | Wilson Lab Lighting |

# Energy Conservation Initiative (ECI) Project Summary

## Biotechnology Lab Airflow Reduction, Facility 1018

**What We Did:** A computational fluid dynamics (CFD) model was used to evaluate ventilation effectiveness in existing fume hood laboratory spaces. The CFD modeling determined that we could improve ventilation effectiveness by changing supply and general exhaust locations and configurations.

The project changed air flow patterns and reduced room minimum air change rates per hour from 8/4 to 6/3 occupied/unoccupied.

A previous project had converted all laboratories to occupancy sensor based fully automated digital air flow control (2004).

**What It Cost:** $169,250

**How Long It Took:** 4 months. Completed January 2011.

**What We Saved:** $76,000 and 195 tons/year carbon equivalent annually.

**Benefits:** The project reduced average outdoor air flow by about 10,000 CFM. This reduction was in addition to the previous project which reduced average airflow by over 50,000 CFM. Reducing outdoor air usage decreases associated heating, cooling, and electricity usage.

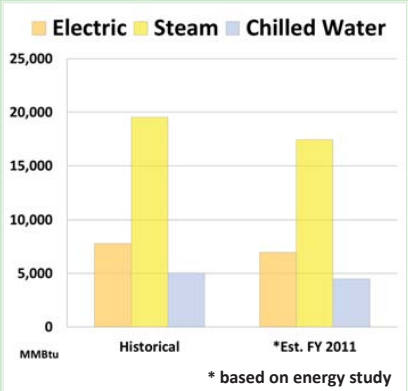
> Our energy conservation project has increased our lab occupants ventilation safety while reducing our energy cost.
>
> **Dick Clark,**
> **Manager of Facilities,**
> **Biotechnology Center**

## Biotechnology Building

Map

Utilities Costs and Use

**Biotechnology Lab:**
Airflow Reduction Total Energy Use
Pre & Post ECI




## Biotechnology Lab Airflow Reduction: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | Est. FY 2011 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | *Est. FY 2011 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Steam | 7,799 | 6,961 | 838 | 11% | $160,000 | $143,000 | $17,000 | 21 |
| Electric | 19,528 | 17,428 | 2,100 | 11% | $458,000 | $409,000 | $49,000 | 23 |
| Chilled Water | 5,022 | 4,482 | 540 | 11% | $92,000 | $82,000 | $10,000 | 11 |
| **Totals** | 32,349 | 28,871 | 3,478 | **11%** | $711,000 | $634,000 | $76,000 | **55** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
5/2013

# Energy Conservation Initiative (ECI) Project Summary
## Blue Light Service

**What We Did**: We replaced Blue Light security lights all across the campus in 120 locations with LED fixtures that use 13 watts, one tenth the energy usage of the metal halide lamps they replaced. The existing fixtures were a wide variety of ages and types, making maintenance difficult. The new fixtures utilize blue LED's with blue lenses to maximize efficiency.

**What It Cost:** $31,000

**How Long It Took:** 1 month. Completed June 2013.

**What We Saved:** $6,200 and 40 tons/per year carbon equivalent annually.

**Benefits:** The new lamps are expected to last 3 to 5 times longer than the existing fixtures. The decrease in maintenance and energy costs quickly repay the project, and the campus now has uniform performance in this critical security application.

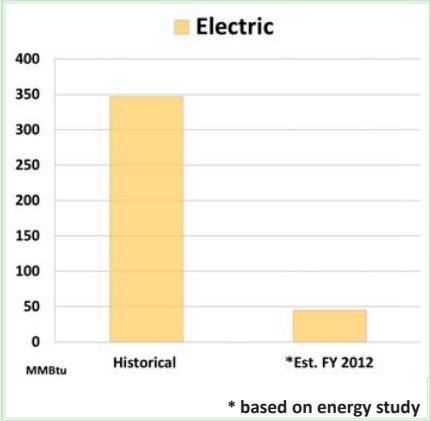
> We were extremely happy that Energy and Sustainability was able to cost effectively upgrade the Blue Lights to provide higher reliability in this critical need for campus. Our Facilities Services partners work hard to increase energy efficiencies without compromising the safety of our campus.
>
> **Kathy Zoner**
> **Chief, Cornell Police**

### Blue Light Service

Cornell electricians Jon Ryan, left, and Dave Pawelczyk assemble a new-style LED blue light prior to installing in a fixture. (Blaine Friedlander/Cornell Chronicle )

Utilities Costs and Use

**Blue Light Service**
Total Energy Use
Pre & Post ECI




## Blue Light Service: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | 2012 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | Est. FY 2012 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 350 | 45 | 305 | 90% | $7,100 | $900 | $6,200 | 8 |
| Steam | — | — | — | — | — | — | — | N/A |
| Chilled Water | — | — | — | — | — | — | — | N/A |
| **Totals** | 350 | 45 | 305 | **90%** | $7,100 | $900 | $6,200 | **8** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

# Energy Conservation Initiative (ECI) Project Summary

## Bradfield Hall Airflow Reduction, Facility 1028B

**What We Did**: The building systems are older "dual duct" design and require a much larger capital renewal cost than an energy conservation project can provide. The solution chosen to reduce energy usage was to re-commission airflows to all spaces to match airflow to current laboratory usage, and variable speed drives were added to the general exhaust to match the new constant volume supply airflows.

**What It Cost:** $30,000

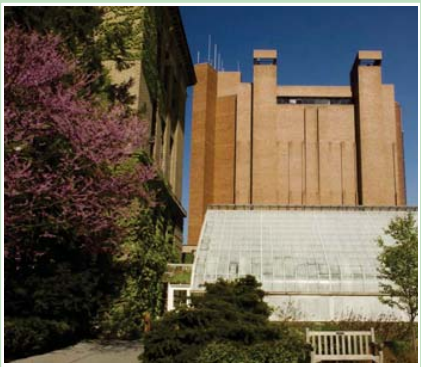
**How Long It Took:** 4 Months. Completed December 2011.

**What We Saved:** $51,600 and 74 tons/per year carbon equivalent annually.

**Benefits:** Laboratory and office space pressurization is now correct and the total building is now slightly positive. The airflows to all spaces match the space program and temperature controls are functional, providing more comfortable and safer working conditions along with energy savings. These changes will be followed in the future by a complete building systems replacement including variable airflow and heat recovery.

> The ECI project has resulted in a more uniform building environment and increased occupant comfort level throughout, at a reduced monetary cost and carbon footprint.
>
> **Brian Flannigan**
> **Facilities Manager**

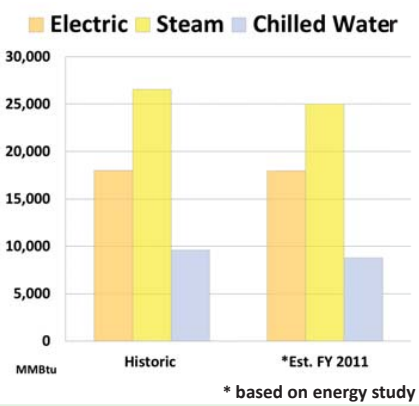
### Bradfield Hall Airflow Reduction



Map

Utilities Costs and Use

**Bradfield Hall Airflow Reduction**
Total Energy Use
Pre & Post ECI




### Bradfield Hall Airflow Reduction: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | 2011 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | *Est. FY 2011 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 18,000 | 17,900 | 100 | 1% | $370,000 | $368,000 | $1,600 | 3 |
| Steam | 26,600 | 25,000 | 1,600 | 6% | $600,600 | $565,800 | $34,800 | 20 |
| Chilled Water | 9,600 | 8,800 | 800 | 8% | $176,000 | $160,800 | $15,200 | 16 |
| **Totals** | 54,200 | 51,700 | 2,500 | **5%** | $1,146,200 | $1,094,600 | $51,600 | **39** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
1/2014

# Energy Conservation Initiative (ECI) Project Summary

## Cornell Store, Facility 2088

**What We Did:** Installation of new control system, including variable speed drives, digital air handling unit (AHU) and hydronic heating/cooling controllers, control valves, space temperature and carbon dioxide sensors, outside air flow temperature and humidity sensors. Perform system commissioning.

**What It Cost:** $227,000

**How Long It Took:** About 5 months, August 2010 to December 2010. Commissioning of system from December 2010 to March 2011.

**What We Saved:** Cost savings for fiscal year 2011 is approximately $67,000 (based on billed utility rates) and reflect the impact of just ½ year with the upgraded system. Total energy savings for FY 2011 is 3,100 MMBtu, a reduction of over 35%. Savings based on comparing the average energy consumption for fiscal years 2006-2010 with FY 2011. Annual savings for FY 2012, with a full 12 month after completion should exceed $100,000. See energy savings table for details.

124 carbon equivalent saved annually.

*The energy conservation project has reduced our energy usage dramatically while maintaining and improving indoor environmental conditions. We are very excited about the results.*

**Kevin Drake, Cornell Store, Assistant Director**

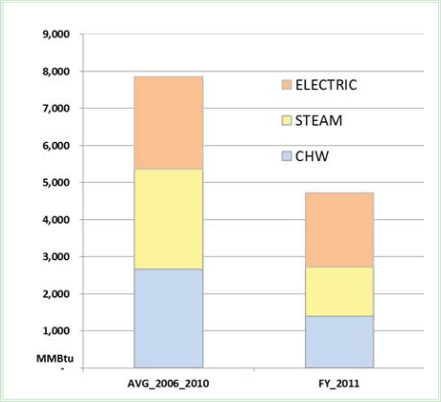
## Cornell Store

Map

Cornell Store Utilities Costs and Use

## Cornell Store:

**Total Energy Use Pre & Post ECI**




## Cornell Store: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | FY 2011 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | FY 2011 Cost (billed) | Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| **Electric** | 2480 | 2000 | 480 | 19% | $51,000 | $41,000 | $10,000 | 23 |
| **Steam** | 2760 | 1320 | 1440 | 52% | $70,000 | $34,000 | $36,000 | 23 |
| **Chilled Water** | 2650 | 1390 | 1260 | 48% | $44,000 | $23,000 | $21,000 | N/A |
| **Totals** | 7890 | 4710 | **3180** | 40% | **$165,000** | **$98,000** | $67,000 | **46** |

Cornell University
Facilities Services
Energy and Sustainability

**More Information**
energyandsustainability.fs.cornell.edu
8/2013

# Energy Conservation Initiative (ECI) Project Summary
## Comstock, Facility 1081

**What We Did**: We replaced outdated pneumatic space and central system controls with new digital controls with occupancy sensors. Minimum and maximum airflows were adjusted to current standards on hoods and laboratory spaces. The "auxiliary air" hoods were converted to two position variable volume. All labs and offices throughout the facility were recommissioned.

**What It Cost:** 650,000

**How Long It Took:** 8 months Completed march 2012.

**What We Saved:** $108,000 and 270 tons/per year carbon equivalent annually.

**Benefits:** Air flows and temperatures are now accurately controlled and minimized to reduce energy use and improve comfort and safety. Heat recovery systems are now all fully controlled and monitored digitally. Deferred maintenance issues were addressed while minimizing energy usage.

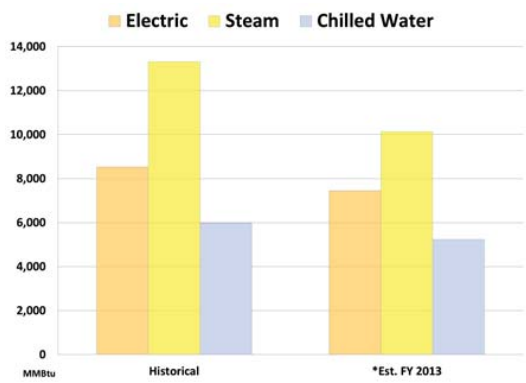
**This project jumped our building forward from 1984 to 2014 in many areas while improving safety and reducing energy usage. We can now see all new controls via the web with ease!**

**Ken Ayers,**
**CALS Building Coordinator**

### Comstock Hall

Map
Utilities Costs and Use

**Comstock Hall:**
Total Energy Use - Pre & Post ECI




*based on energy study

## Comstock: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | 2013 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | *FY 2013 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| **Electric** | 8,500 | 7,500 | 1,000 | 12% | $175,000 | $152,900 | $22,000 | 25 |
| **Steam** | 13,300 | 10,100 | 3,200 | 24% | $300,900 | $229,200 | $72,000 | 36 |
| **Chilled Water** | 6,000 | 5,200 | 800 | 13% | $109,600 | $96,100 | $14,000 | 16 |
| **Totals** | 27,800 | 22,800 | 5,000 | **18%** | $585,500 | $478,200 | $108,000 | **77** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

# Energy Conservation Initiative (ECI) Project Summary

## Duffield Clean Room Re-circulation Air Flow Control, Facility 2000

**What We Did:** We installed 25 particle counters throughout the Duffield clean room facility. The particle levels are used to control each of the 25 RA-HU's varying the air change rate from a minimum 30 air changes per hour. Originally the system maintained a flat air change rate of 90 air changes per hour. Typically clean rooms use extremely high air change rates through HEPA filters to reduce particles.

**What It Cost:** $145,000 and 291 tons/per year carbon equivalent.

**How Long It Took:** 12 months. Completed October 2011.

**What We Saved:** $45,000

**Benefits:** The Duffield clean room is now one of the few in the world to significantly reduce air energy usage by varying recirculated airflow based on meas-

*The project has enabled us to trend and monitor the particle count in the clean room facility. Reduction of air change rate has increased the life of our HEPA filters while decreasing the energy use significantly.*

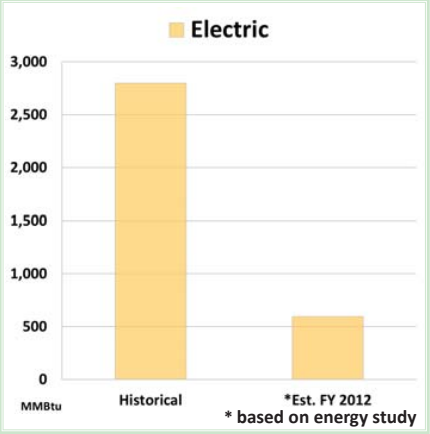
**Scott Albrecht, Duffield Building Manager**

## Duffield Hall

Map

Duffield Hall Utilities Costs and Use

## Duffield Hall: Total Energy Use Pre & Post ECI




## Duffield Hall: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | Est. FY 2012 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | Est. FY 2012 Cost (billed) | Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 2,800 | 594 | 2,206 | 80% | $57,000 | $12,100 | $45,000 | 55 |
| Steam | | | | | | | | N/A |
| Chilled Water | | | | | | | | N/A |
| | | | | | | | | 55 |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
8/2013

# Energy Conservation Initiative (ECI) Project Summary
## Growth Chamber Phase 1

**What We Did**: 57 environmental growth chambers used to house research plants were retrofit with new high efficiency lighting and digital controls in collaboration with the Cornell University Agricultural Experiment Station. The lighting is now T5 fluorescent with very high efficiency reflectors. The controls were updated to provide off cycle control on the refrigeration, modern digital controls with remote accessibility, and ease of scheduling. The interiors of many chambers were lined with a highly reflective surface. Electricity energy use on the chambers was reduced between 50 and 75% after retrofit.
**What It Cost:** $447,000
**How Long It Took:** 12 months. Completed December 2011.

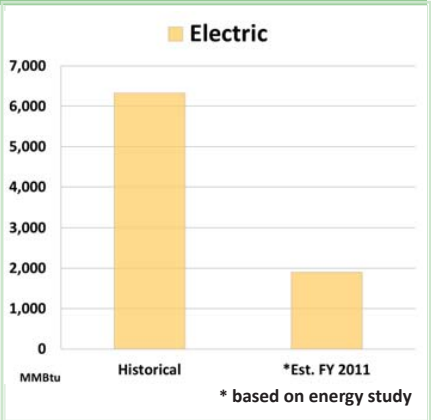
**What We Saved:** $91,000 and 580 tons/per year carbon equivalent annually.
**Benefits:** The growth chambers now provide energy efficient, properly controlled growing environments for plant research. The project cost per chamber was less than 20% of the cost of replacement chambers in a time when capital was extremely tight. Researchers and operations staff have full remote access to the controls and trend data.

**Our oldest and largest growth chambers now use half the energy while doubling the light intensity and providing greatly improved reliability.**

**Nick VanEck,**
**Growth Chamber Supervisor**

## Growth Chamber Phase 1

**Growth Chamber Phase 1**
Total Energy Use
Pre & Post ECI




## Growth Chamber Phase 1: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | Est. FY 2011 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | *Est. FY 2011 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 6,300 | 1,900 | 4,400 | 70% | 130,000 | 39,000 | 91,000 | 110 |
| Steam | — | — | — | — | — | — | — | N/A |
| Chilled Water | — | — | — | — | — | — | — | N/A |
| **Totals** | 6,300 | 1,900 | 4,400 | **70%** | 130,000 | 39,000 | 91,000 | **110** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
8/2013

# Energy Conservation Initiative (ECI) Project Summary
## Growth Chamber Phase 2

**What We Did**: This project retrofit a number of growth chamber's lighting systems to make the lighting more efficient. A previous growth chambers project retrofit refrigeration controls in a large quantity of chambers along with lighting. The lighting in these chambers typically is on 16 hours per day, 7 days per week and represents a great opportunity for efficiency improvement. The project typically replaced T12 VHO fluorescent lamps with magnetic ballasts with high efficiency T5 and electronic ballasts.

**What It Cost:** $90,000

**How Long It Took:** 6 months. Completed June 2012.

**What We Saved:** $42,000 and 270 tons/ per year carbon equivalent annually.

**Benefits:** The outdated fluorescent lighting results in high lamp maintenance and high energy costs. The installation of new, highly efficient T5 lamps and electronic ballasts results in more uniform lighting over time, along with less maintenance and energy cost in the chambers.

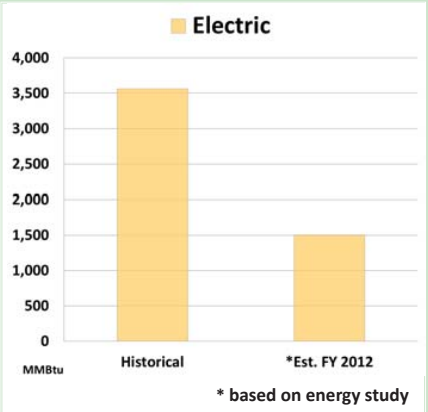
**This project greatly improved the light intensity and usability of many of our old, dimly-lit growth chambers with a significant reduction in annual cost.**

**Nick VanEck,**
**Growth Chamber Supervisor**

## Growth Chamber Phase 2

Utilities Costs and Use

**Growth Chamber Phase 2**
Total Energy Use
Pre & Post ECI




## Growth Chamber Phase 2: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | Est. FY 2012 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | *Est. FY 2012 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 3,600 | 1,500 | 2,100 | 58% | 73,000 | 30,800 | 42,200 | 53 |
| Steam | — | — | — | — | — | — | — | N/A |
| Chilled Water | — | — | — | — | — | — | — | N/A |
| **Totals** | 3,600 | 1,500 | 2,100 | **58%** | 73,000 | 30,800 | 42,200 | **53** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
8/2013

# Energy Conservation Initiative (ECI) Project Summary
## Growth Chamber Phase 3, Facility 1022

**What We Did**: In collaboration with the Cornell University Agricultural Experiment Station we replaced 10 outdated inefficient growth chambers with 6 new efficient chambers. The antiquated chambers used outdated controls, inefficient lighting and mechanical refrigeration. The new chambers utilize efficient T-5 lighting, digital controls and cooling provided by Cornell's district cooling system.

**What It Cost:** $300,000

**How Long It Took:** 6 months. Completed December 2012.

**What We Saved:** $37,000 and 237 tons/ per year carbon equivalent annually.

**Benefits:** Energy use was decreased by over 90%. Maintenance costs will be significantly reduced. Lighting level was increased by 50% improving research.

**We jumped at the chance to recycle 10 of our least efficient growth chambers in exchange for 6 new highly-efficient units that will enhance plant research at Cornell for decades.**

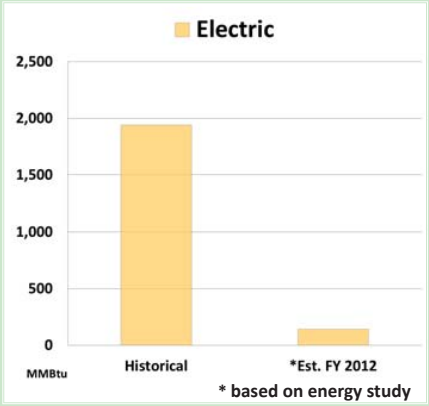
**Nick VanEck,**
**Growth Chamber Supervisor**

## Growth Chamber Phase 3

Map

Utilities Costs and Use

**Growth Chamber Phase 3**
Total Energy Use
Pre & Post ECI




## Growth Chamber Phase 3 ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | Est. FY 2012 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | *Est. FY 2012 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 1,900 | 140 | 1,760 | 93% | 40,000 | 3,000 | 37,000 | 44 |
| Steam | | | | | | | | N/A |
| Chilled Water | | | | | | | | N/A |
| **Totals** | 1,900 | 140 | 1,760 | **93%** | 40,000 | 3,000 | 37,000 | **44** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
9/2013

# Energy Conservation Initiative (ECI) Project Summary

## Guterman Greenhouse, Facility 1068, 1068B

**What We Did:** Working in partnership with Cornell University Agricultural Experiment Station all greenhouse lighting and environmental controls throughout 47 greenhouse ranges were replaced. The new lighting is dimmable high pressure sodium (replacing on/off metal halide) and is controlled by the same environmental controls that operate the heating and cooling systems.

**What It Cost:** $2,100,000

**How Long It Took:** 17 months. Completing April, 2013.

**What We Saved:** $337,000 and 386 tons/year carbon equivalent annually.

**Benefits:** The new lighting is significantly more efficient and will be controlled to provide a constant amount of total light energy (natural plus artificial) delivered to the plants each day. The environmental controls stabilize inside temperatures and dramatically reduce heating and lighting energy usage, with all data and controls web accessible to the user.

*The Guterman project is dramatically increasing our ability to manage and reduce energy usage in our greenhouse space with state-of-the-art lighting and controls. Our continued collaboration with the Energy Management staff in Facilities Services is transforming sustainability in our growth chambers and greenhouses across campus.*

**Andrew Leed,**
**Greenhouse Manager, Cornell University Agricultural Experiment Station**

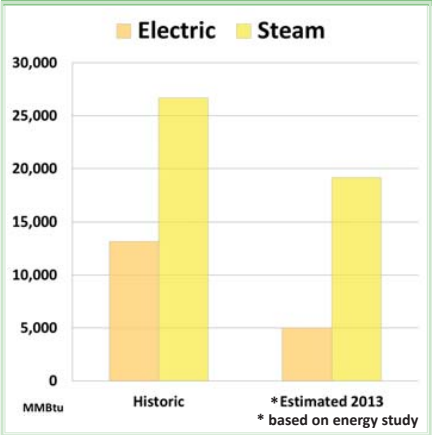
## Guterman Greenhouse

Map

Guterman Greenhouse:
Facility code 1068 Utilities Cost and Use
Facility code 1068B Utilities Cost and Use

## Guterman Greenhouse:

**Total Energy Use**
**Pre & Post ECI**




## Guterman Greenhouse: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | Est. FY 2013 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | *Est. FY 2013 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 13,156 | 5,025 | 8,131 | 62% | $270,000 | $103,000 | $167,000 | 203 |
| Steam | 26,677 | 19,139 | 7,538 | 28% | $603,000 | $433,000 | $170,000 | 84 |
| Chilled Water | — | — | — | — | — | — | — | N/A |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
5/2013

# Energy Conservation Initiative (ECI) Project Summary

## Carl A. Kroch Library , Facility 2047A

**What We Did:** The project replaced chiller based dehumidification with heat regenerated desiccant technology, and provided a new dedicated outdoor air handler and metered ventilation air to the individual collection air handlers. Humidifiers were also replaced to reduce unwanted air heating and improve control. Variable speed drives were retrofit to all fans to provide variable airflow. Campus chilled water only provides sensible cooling with a much higher return temperature. Timer operated switches were added on all collection area lighting.

**What It Cost:** $1,100,000

**How Long It Took:** 12 months. Completed September 2012.

**What We Saved:** $94,000

**What Are the Benefits:** Environmental conditions in the collection spaces are much more stable which will extend the life of the collection materials. The new systems allow a much tighter control of outdoor air usage and associated energy consumption. Significantly reduced energy usage resulted from:

- separation of conditioning ventilation air from sensible heating and cooling;
- desiccant dehumidification for the low dew point desired;
- reduced recirculated airflow.

Our special collections environmental control systems are now state-of-the–art. For the preservation of rare books and manuscripts a stable environment is absolutely critical. This new ability to set and maintain critical temperature and humidity levels, within very small fixed limits, ensures our ability to preserve these cultural resources for generations to come, while simultaneously minimizing the energy used. It is a great example of that old "win-win" adage.

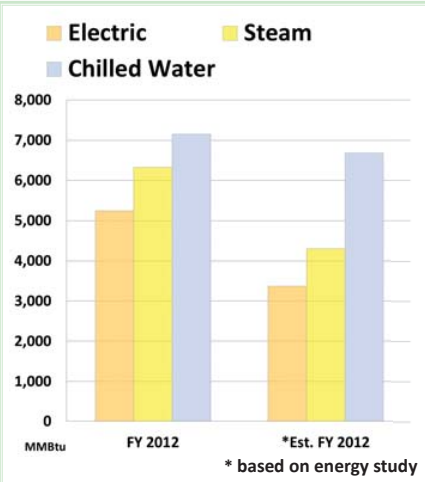
**David Corson**
**Kroch Library Curator**

### Exhibit in Kroch Library

Map

Kroch Library Utilities Costs and Use

### Kroch Library
Total Energy Use
Pre & Post ECI




## Kroch Library: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | FY 2012 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | Est. FY 2012 Cost (billed) | Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 5,250 | 3,370 | 1,880 | 36% | $95,000 | $61,000 | $34,000 | 47 |
| Steam | 6,323 | 4,300 | 2,023 | 32% | $164,000 | $112,000 | $52,000 | 22 |
| Chilled Water | 7,153 | 6,685 | 468 | 7% | $119,000 | $111,000 | $8,000 | 9 |
| **Totals** | 18,726 | 14,355 | 4,371 | 23% | $378,000 | $284,000 | $94,000 | **78** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
12/2012

# Energy Conservation Initiative (ECI) Project Summary

## Lynah Rink Conservation Project, Facility 2613

**What We Did:** The building controls that serve the team locker rooms and administrative spaces were upgraded, along with complete recommissioning of all building energy system controls. New variable air volume boxes were installed to better match the supply and exhaust requirements of the building occupants. Motion sensors were installed to control lighting systems and to minimize outdoor air during unoccupied periods.

**What It Cost:** $160,000

**How Long It Took:** 6 months. Completed November 2012.

**What We Saved:** $48,000

**Benefits:** The new controls and recommissioning ensure indoor air temperature and quality through proper use of outside air, reheat energy, and space pressurization. People in the spaces are more comfortable and energy use is decreased.

The energy conservation project fixed a number of problems from original construction that caused both comfort issues and high energy usage. We really appreciate the support to make our energy systems more efficient.

**Pat Graham,**
**Facility Manager**
**Athletics and Physical Education**

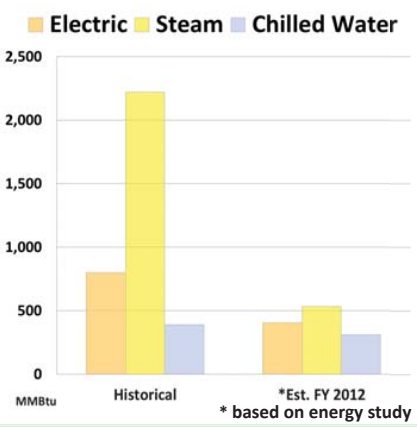
## Lynah Rink

Map

Lynah Rink Utilities Costs and Use

## Lynah Rink:

### Office & Locker Room Energy Use Pre & Post ECI




## Lynah Rink: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | Est. FY 2012 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | Est. FY 2012 Cost (billed) | Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 801 | 407 | 394 | 49% | $16,000 | $8,000 | $8,000 | 10 |
| Steam | 2,220 | 532 | 1,688 | 76% | $50,000 | $12,000 | $38,000 | 19 |
| Chilled Water | 390 | 313 | 77 | 20% | $7,000 | $6,000 | $1,000 | N/A |
| **Totals** | 3,411 | 1,252 | 2,159 | **63%** | $74,000 | $26,000 | $48,000 | **30** |

Energy use based on project scope in the office and locker room areas

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
1/2013

# Energy Conservation Initiative (ECI) Project Summary

## Mann LED Elevator Lighting, Facility 1027

**What We Did**: The Energy Management staff collaborated with the student group Energy Corps at Cornell University (ECCU) that identified elevator lighting as an opportunity. The Energy Corps students inventoried the elevators, determined an LED replacement lamp for the existing halogen lamps, calculated a cost benefit, and received approval from the College of Agriculture and Life Sciences to replace all lamps in all elevators. Energy Management provided the lamps and students replaced them in all four elevators in the building saving a total of ~1,700 watts on a continuous basis.

**What It Cost:** $830

**How Long It Took:** 6 months. Completed March 2013.

**What We Saved:** $1,000 and 7 tons/per year carbon equivalent annually.

**Benefits:** The new lamps are much cooler, lower energy usage, and will last up to 5 years versus the old lamps that required changing many times per year. The elevator temperatures are lower and rider comfort is improved.

*The project decreased energy usage and unwanted heat while improving the elevator aesthetics. This project, like other projects assisted by Energy Corps, incentivizes cost-effective, energy-saving behaviors such as lighting upgrades. We plan to help retrofit elevators all across campus.*

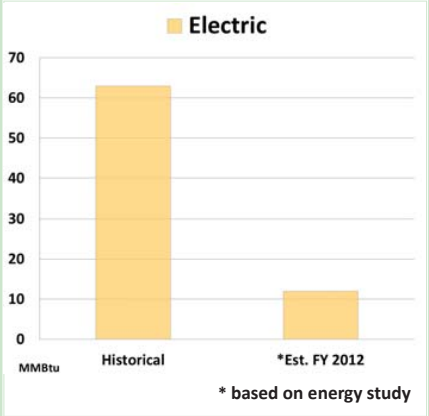
**Ashley Kossakowski '15,**
**Energy Corps Member,**
**Energy Conservation Intern**

## Mann LED Elevator Lighting

Map

Utilities Costs and Use

**Mann LED Elevator Lighting:**
Total Energy Use
Pre & Post ECI




## Mann LED Elevator Lighting: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | Est. FY 2012 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | *Est. FY 2012 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 63 | 12 | 51 | 81% | 1,300 | 200 | 1,000 | 2 |
| Steam | — | — | — | — | — | — | — | N/A |
| Chilled Water | — | — | — | — | — | — | — | N/A |
| **Totals** | 63 | 12 | 51 | **81%** | 1,300 | 200 | 1,000 | **2** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
7/2013

# Energy Conservation Initiative (ECI) Project Summary

## Plant Science Space Control Upgrades, Facility 1022

**What We Did:** The controls in 30 laboratory spaces were completely replaced and occupancy sensors added to significantly reduce energy use. All of the laboratory space controls were outdated and in poor condition. The new controls cut air flows in half and relax space temperatures when rooms are not occupied. The new controls also reset fume hood air flow. Typical energy savings will be 30-40% compared to constant air flow.

**What It Cost:** $65,000

**How Long It Took:** 3 months. Completed October 2011.

**What We Saved:** $28,000

**Benefits:** Along with energy and maintenance savings, this project increased laboratory safety and decreased air noise in the spaces.

The spaces with the controls upgrade perform so much better than before. Comfort has improved as well as the ability to verify space temperature and ventilation control.

**Brian Flannigan**
**Manager of Facilities**

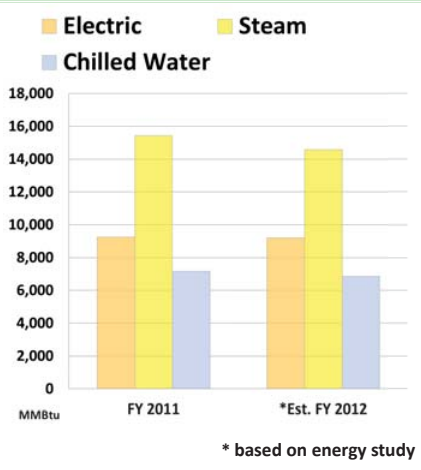
### Plant Science Building

Map

Plant Science Utilities Costs and Use

### Plant Science Space Control Upgrades

Total Energy Use Pre & Post ECI




* based on energy study

### Plant Science Space Control Upgrades: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | FY 2011 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | Est. FY 2011 Cost (billed) | Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 9,248 | 9,203 | 44 | 0.50% | $190,000 | $189,000 | $910 | 1 |
| Steam | 15,427 | 14,576 | 851 | 5.50% | $349,000 | $330,000 | $19,000 | 10 |
| Chilled Water | 7,153 | 6,685 | 468 | 6.50% | $119,000 | $111,000 | $7,800 | 9 |
| **Totals** | 31,828 | 30,464 | 1,363 | **4.3%** | $658,000 | $630,000 | $28,000 | **20** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
12/2012

# Energy Conservation Initiative (ECI) Project Summary

## Plant Science Steam Traps & Radiator Control Valves, Facility 1022

**What We Did:** 127 steam radiator hand valves were replaced with Danfoss Control Valves. The valves allow the room occupant to set an automatically controlled room temperature. 201 steam traps were replaced because they had failed.

**What It Cost:** $114,000

**How Long It Took:** 5 months. Completed November 2011.

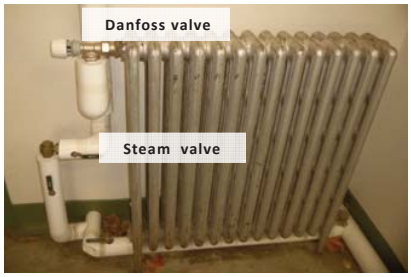
**What We Saved:** $100,000 and 176 tons/per year carbon equivalent annually.

**Benefits:** Occupants had no ability to control heat from their steam radiators. They could not even shut them off! They literally had to open their windows in winter. In addition, steam traps had failed blowing live steam through condensate.

*People have been so much more comfortable and very happy with the increased control. There were a lot less heating complaints last winter.*

**Brian Flannigan,**
**Building Coordinator; CSS Facilities and Resources**

### Danfoss valve and steam trap

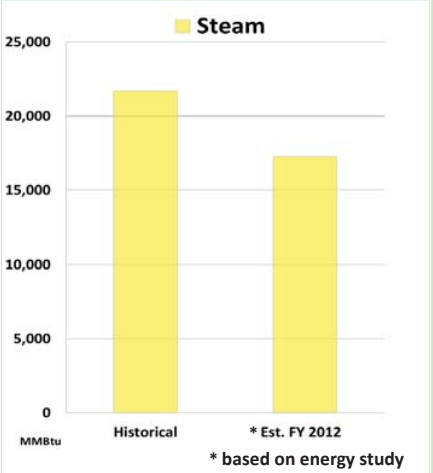



Map

Plant Science Utilities Costs and Use

### Plant Science Steam Traps & Radiator Control Valves

Total Energy Use Pre & Post ECI




### Plant Science Steam Traps & Radiator Control Valves: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | Est. FY 2012 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | *Est. FY 2012 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | | | | | | | | N/A |
| Steam | 21,686 | 17,241 | 4,445 | 20% | $490,000 | $390,000 | $100,000 | 49 |
| Chilled Water | | | | | | | | N/A |
| | | | | | | | | **49** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
8/2013

# Energy Conservation Initiative (ECI) Project Summary

## Reis Tennis Center, Facility 2667

**What We Did:** Installed a new multi-level T-5 fluorescent lighting system using custom direct and indirect light with occupancy sensors. The new lighting system doubled light levels at full brightness, but switching was added to be able to reduce indirect lighting to 50% or off.

**What It Cost:** $95,000

**How Long It Took:** Three weeks.

**What We Saved:** The project received a $46,316 rebate from the New York State Research and Development Authority based on expected energy savings of 394,500 kWhr annually. Savings are due to the much higher efficiency and occupancy/schedule based switching. Lights are now "instant" on and off and color quality is significantly improved. The savings in electricity is offset by an expected increase in natural gas use for heating, with the net cost savings expected to exceed $20,000 annually. The savings will result in a payback of under 3 years for the net project cost after the rebate. Lamp replacements will stretch from 2 years to over 5 years, with much better light output as lamps age.

See energy savings table for details.

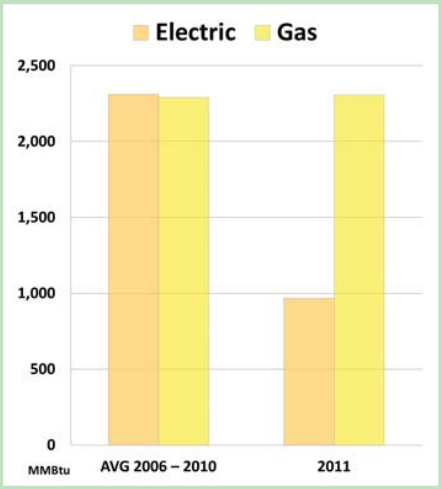
176 tons/per year carbon equivalent is saved annually.

> We went from the lowest to the highest light levels [among Ivy League NCAA tennis facilities], and expect to reduce energy use by over 50 %. Now others are following suit.
>
> Marty Johnson

### Reis Tennis Center

Map

### Reis Tennis Center
Total Energy Use
Pre & Post ECI




## Reis Tennis Center: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | FY 2011 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | FY 2011 Cost (billed) | Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 2,312 | 968 | 1,344 | 58 | $67,750 | $28,250 | $39,500 | 34 |
| Gas | 2,289 | 2,305 | (16) | (1) | $27,500 | $27,500 | (192) | .1 |
| Chilled Water | | | | | | | | NA |
| | | | | | | | | 67 |

# Energy Conservation Initiative (ECI) Project Summary

## Rockefeller Hall Window Weatherization, Facility 2014

**What We Did**: Rockefeller hall, built in 1904, still has many of its original windows. Over time the ability of the windows to stop outside air leaking into the building is decreased. During the winter months infiltration through the windows caused many comfort issues. Our project installed weather stripping and other window improvements to refurbish over 270 historic windows.

**What It Cost:** $80,000

**How Long It Took:** 6 months. Completed February 2011.

**What We Saved:** $11,700 and 20 tons/per year carbon equivalent annually.

**Benefits:** The project increased occupant comfort and decreased use of space heaters.

**The weatherization project has made our building much less drafty. Occupants are much more comfortable now the project is complete.**

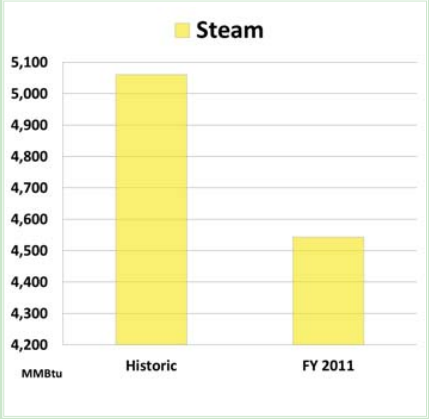
**Vincent Kotmel , Building Manager Rockefeller Hall**

**Rockefeller Hall Window Weatherization**

Map

Utilities Costs and Use

**Rockefeller Hall Window Weatherization**
Total Energy Use
Pre & Post ECI




**Rockefeller Hall Window Weatherization: ECI Savings Table**

| Utility | Historical Energy Use (MMBtu) | 2011 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | FY 2011 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | | | | | | | | N/A |
| Steam | 5,060 | 4,543 | 517 | 10% | 114,000 | 103,000 | 12,000 | 6 |
| Chilled Water | | | | | | | | N/A |
| **Totals** | 5,060 | 4,543 | 517 | **10%** | 114,000 | 103,000 | 12,000 | **6** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
7/2013

# Energy Conservation Initiative (ECI) Project Summary

## Statler Hall, Facility 2033

**What We Did:** The project replaced outdated controls in 12 air handling systems to improve operation and minimize outside air. All kitchens were retrofit with hood controls that modulate airflow based on cooking needs. New coordinated digital room control was installed in two dining areas and the ballroom.

**What It Cost:** $1,000,000 ($375,000 NYSERDA ARRA grant received)

**How Long It Took:** 12months. Completed July 2012.

**What We Saved:** $220,000 and 520 tons/ per year carbon equivalent annually

**Benefits:** Before the project, air handling unit controls were operating poorly and kitchen hoods ran nearly continuously. The new controls allow proper operation, use of occupancy schedules, and match ventilation air to kitchen operations. New space temperature and lighting controls stop unwanted energy usage. Maintenance efforts are significantly reduced and are more productive.

*The upgraded controls have enabled us to better operate our facility while reducing the buildings overall energy use.*

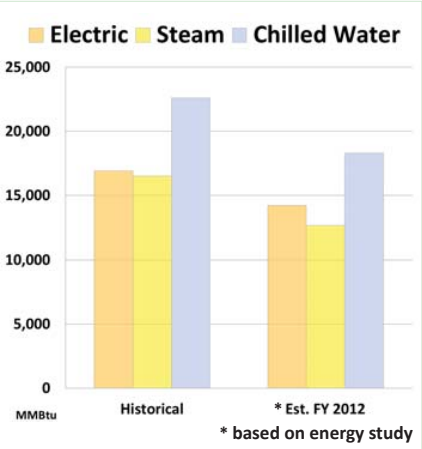
**Peter Meixell**
**Facilities Manager**

## Statler Hall

Map

Statler Hall Utilities Costs and Use

## Statler Hall
Total Energy Use
Pre & Post ECI




## Statler Hall: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | Est. FY 2012 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | *Est. FY 2012 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 16,900 | 14,200 | 2,700 | 16% | $347,000 | $290,000 | $55,000 | 68 |
| Steam | 16,500 | 12,700 | 3,800 | 23% | $373,000 | $287,000 | $86,000 | 42 |
| Chilled Water | 22,600 | 18,300 | 4,300 | 19% | $414,000 | $335,500 | $79,000 | 86 |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
8/2013

# Energy Conservation Initiative (ECI) Project Summary

## Steam Pipe Insulation Repair and Replacement

### What We Did

Surveys of mechanical rooms in buildings were completed to identity areas where insulation could be improved cost effectively. We then replaced worn or missing insulation in 64 mechanical rooms throughout the academic, research and teaching buildings and campus life facilities.

### What It Cost

*Academic research and teaching buildings* — $345,000

*Campus Life Facilities* — $30,000.

### How Long It Took

16 months

### What We Saved

$290,000 per year at the billed utility rate, yielding a 1.2 year payback.

### Description of Photos

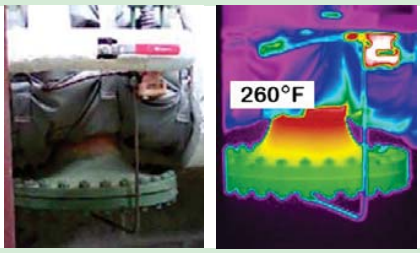
One of the many steam components insulated during the steam pipe insulation project. Insulating the Steam PRV (pressure reducing valve) saves the equivalent energy that would heat a typical one family home for two months.

The insulation project has made the mechanical rooms much more comfortable and safer to work in, while creating significant energy savings.

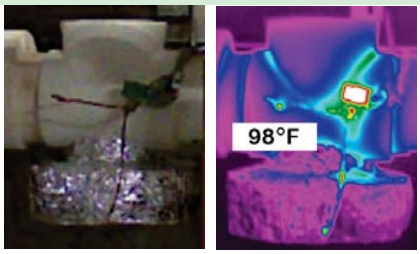
Rick Bishop , General Foreperson Control shop

### Infrared

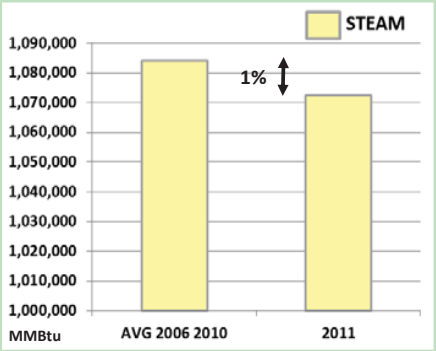
**BEFORE Insulation** -Surface up to 260 °F




**AFTER Insulation** -Surface down to 98° F




### Total Campus Heating Sales & Energy Use • Pre & Post ECI




## Steam Pipe Insulation Repair and Replacement: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | FY 2011 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | FY 2011 Cost (billed) | Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Steam | 1,084,000 | 1,072,500 | 11,500 | 1% | $26,400,000 | $26,110,000 | $290,000 | 100 |
| Electric | | | | | | | | NA |
| Chilled Water | | | | | | | | NA |
| Totals | 1,084,000 | 1,072,500 | 11,500 | 1% | $26,400,000 | $26,110,000 | $290,000 | 100 |

Cornell University
Facilities Services
Energy and Sustainability

More Information
energyandsustainability.fs.cornell.edu
11/2012

# Energy Conservation Initiative (ECI) Project Summary

## Upson Hall, Facility 2045

**What We Did:** Upson Hall's space temperature controls were mostly pneumatic, some heat only, some heating and cooling. The project installed wireless digital thermostats that directly retrofit on top of existing pneumatic thermostat tubing. The cost of the retrofit is significantly less than a full digital conversion which was not economic for this space type. 110 digital thermostats were installed.

**What It Cost**: $90,000

**How Long It Took:** 12 months. Completed September 2012.

**What We Saved:** $27,000 and 46 tons/year carbon equivalent annually.

**Benefits:** The new space controls are accurate and allow a 7 day schedule to save energy, and reduce maintenance issues related to "hot/cold" trouble calls. The new controls are fully visible through the Building Automation and Control System (BACnet). All trend data is available for maintenance trouble shooting.

The new thermostats have reduced maintenance costs and increased occupant comfort.

**Mark Howe ,**
**Program Manager Energy Conservation Initiative, Energy & Sustainability Dept.**

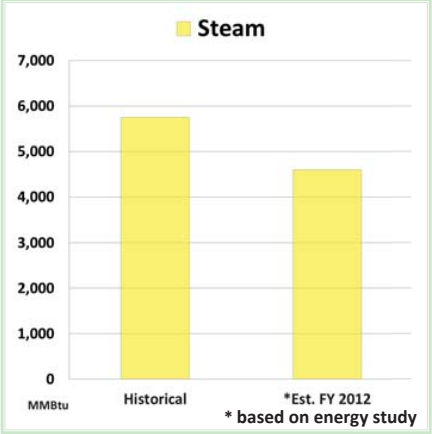
## Upson Hall

Map

Upson Hall Utilities Costs and Use

## Upson Hall :

Total Energy Use Pre & Post ECI




## Upson Hall : ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | Est. FY 2012 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | Est. FY 2012 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | | | | | | | | N/A |
| Steam | 5,750 | 4,600 | 1,150 | 20% | $132,000 | $105,000 | $27,000 | 12.8 |
| Chilled Water | | | | | | | | N/A |
| **Totals** | 5,750 | 4,600 | 1,150 | **20%** | $132,000 | $105,000 | $27,000 | **12.8** |

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
4/2013

# Energy Conservation Initiative (ECI) Project Summary
## Wilson Lab Lighting, Facility 2085

**What We Did**: Lighting contactors were installed to control lighting in the high bay and tunnels. The existing lighting controls required all lights in those areas to be on 24 hours a day. The new lighting scheme allows lighting to be reduced to 50% in the tunnels during times the synchrotron is in operation. Lighting in the high bay spaces was also minimized during low occupancy periods.

**What It Cost:** $8,000

**How Long It Took:** 3 months. Completed June 2011.

**What We Saved:** $5,700 and 36 tons/per year carbon equivalent annually.

**Benefits:** Reduced energy use and increased lamp life.

> The new lighting controls in the high bay and tunnel were the idea of our staff here at Wilson, and we are very thankful that the ECI team could implement that idea to make us more efficient.
>
> Rich Gallagher,
> Facility Engineer,
> Cornell Laboratory for Accelerator-based Sciences and Education

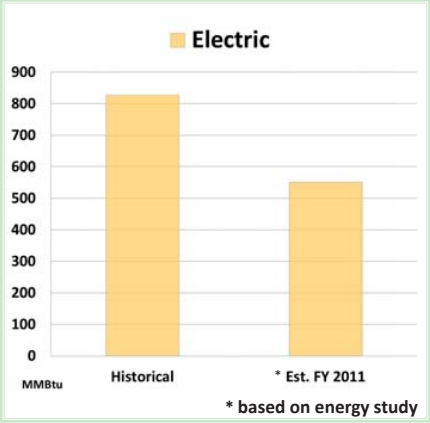
## Wilson Lab Lighting

Hans Bethe and Boyce McDaniel, professors of physics (PHYS), bicycling in the Wilson Synchrotron, 1968.

Map

Utilities Costs and Use

**Wilson Lab Lighting:**
Total Energy Use
Pre & Post ECI




## Wilson Lab Lighting: ECI Savings Table

| Utility | Historical Energy Use (MMBtu) | 2011 Energy Use (MMBtu) | Energy Savings (MMBtu) | % REDUCTION | Historical Cost (billed rates) | *Est. FY 2011 Cost (billed) | Annual Savings $ | Equivalent # Homes |
|---|---|---|---|---|---|---|---|---|
| Electric | 800 | 551 | 249 | 31% | $17,000 | $11,300 | $5,700 | 6 |
| Steam | — | — | — | — | — | — | — | N/A |
| Chilled Water | — | — | — | — | — | — | — | N/A |
| **Totals** | 800 | 551 | 249 | **31%** | $17,000 | $11,300 | $5,700 | **6** |

Energy use based only on affected systems within project scope

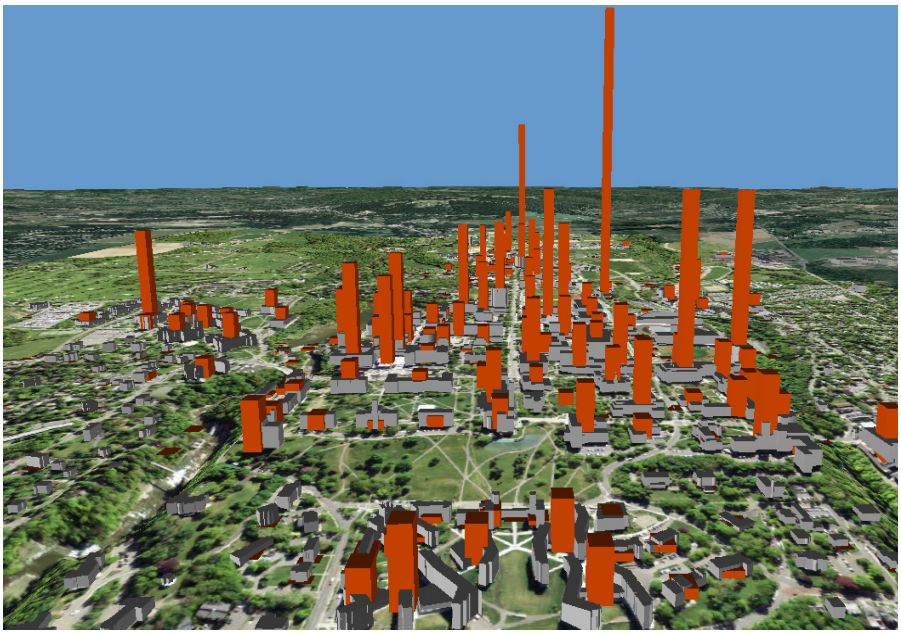
Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Cornell University

Energy and Sustainability
energyandsustainability.fs.cornell.edu
2/2014

# Greenhouse Gas Emissions for Individual Buildings on Cornell's Campus

This image is a visual representation of the volume of greenhouse gas emissions associated with each building's operation. The data used to create the graphic came from Cornell University's Electronic Billing System data for fiscal year 2013 and is the annual total usage recorded by each meter.



Energy use data is metered for buildings on Cornell's campus that are served by the Central Energy Plant. In some cases, groups of buildings are consolidated on one meter depending on one or more factors such as: similar use, owner, or physical proximity. For the purposes of this visual mapping, the emissions have been attributed to the building hosting the group meter. This means that the greenhouse gas emissions that are associated with that building may be higher than that building's actual use, while other nearby buildings may seem to have no emissions.

In addition, not every building has data available for electricity, steam, and chilled water because not every building receives each service. For example, there are many buildings that do not have air conditioning and thus do not have chilled water usage associated with them.

The electricity, steam, and chilled water usage was converted to metric tons of carbon dioxide equivalent using conversion factors provided by Cornell Facilities Engineering. These masses were then converted to the corresponding volume using the standard density of carbon dioxide  and adjusting it for Ithaca conditions .

As of summer 2013, real time energy use and carbon emissions of about 50 buildings on campus (with more to be added soon) are now accessible to the public on the **Cornell Building Dashboard** at http://buildingdashboard.cornell.edu.

## Next Steps:

In order to more accurately display the amount of emissions coming from each building, it is important that the utilities used by each building are attributed to the correct building. Therefore, meters should be installed on buildings that do not currently have them. Students, staff, and faculty can continue to utilize the Cornell Building Dashboard as a means of monitoring the electricity, steam, and chilled water usage of each building.

| | Pressure (Pa) | Temperature © | Density of CO2 (kg/m3) | Density of CO2 (metric ton/m3) | | | Electric Emissions Factor (metric tons CO2-e/MWhr) | 0.410 | |
|---|---|---|---|---|---|---|---|---|---|
| Standard Atmospheric Pressure/Temperature at Sea Level | 101325 | 15 | 1.87 | 0.00187 | | | Steam Emissions Factor (metric tons CO2-e/klb Steam) | 0.041 | |
| Ithaca Average (2012) | 101055 | 11.55 | 1.88 | 0.00188 | | | Chilled Water Emissions Factor (metric tons CO2-e/Ton-hr) | 0.0000330 | |
| | | | | | | | | | |
| Building | Facility Code | Data? | Electric Use (MWhr) | Electric GHG (metric tons CO2-e) | Steam Use (kLb Steam) | Steam GHG (metric tons CO2-e) | Cool Water Use (Ton-hr) | Cool Water GHG (metric tons CO2-e) | Total Carbon Footprint (in metric tons CO2-e) |
| 1001_BARTON HALL | 1001 | Y | 938.4 | 384.744 | 8775.51 | 359.79591 | 55549 | 1.833117 | 746.373027 |
| 1003_IVES HALL FACULTY WING | 1003 | Y | 335.28 | 137.4648 | 1010.81 | 41.44321 | 22537 | 0.743721 | 179.651731 |
| 1007_ILR_COMPLEX | 1007 | Y | 0 | 0 | 2254.98 | 92.45418 | 95984 | 3.167472 | 95.621652 |
| 1008_IVES HALL EAST | | Y | 1064.28 | 436.3548 | 0 | 0 | 230713 | 7.613529 | 443.968329 |
| 1009_IVES HALL | 1009 | Y | 1404.8 | 575.968 | 8861.04 | 363.30264 | 406794 | 13.424202 | 952.694842 |
| 1011_HUMAN ECOLOGY BUILDING | 1011 | Y | 1796.4 | 736.524 | 6511.04 | 266.95264 | 366000 | 12.078 | 1015.55464 |
| 1013B_RESOURCE ECOLOGY & MGT LAB | 1013B | Y | 18.398 | 7.54318 | 0 | 0 | 0 | 0 | 7.54318 |
| 1013C_FISH HATCHERY:ECO-TOXICOLOGY | 1013C | Y | 81.12 | 33.2592 | 0 | 0 | 0 | 0 | 33.2592 |
| 1013D_AQUACULTURE BLDG | 1013D | Y | 0.127 | 0.05207 | 0 | 0 | 0 | 0 | 0.05207 |
| 1014_WEILL HALL | 1014 | Y | 6662.4 | 2731.584 | 26237.92 | 1075.75472 | 1957109 | 64.584597 | 3871.923317 |
| 1015A_M VAN RENSSELAER HALL | 1015A | Y | 2014.72 | 826.0352 | 6578.592 | 269.722272 | 314581 | 10.381173 | 1106.138645 |
| 1015W_M VAN RENSSELAER WEST | 1015W | Y | 344.48 | 141.2368 | 2155.47 | 88.37427 | 87965 | 2.902845 | 232.513915 |
| 1016_COMPUTING & COMMUNICATIONS CTR | 1016 | Y | 1726.52 | 707.8732 | 1466.87 | 60.14167 | 417912 | 13.791096 | 781.805966 |
| 1018_BIOTECHNOLOGY | 1018 | Y | 4904.84 | 2010.9844 | 22737.83 | 932.25103 | 1156807 | 38.174631 | 2981.410061 |
| 1019_CORON_MUDD_COMPLEX | 1019 | Y | 3653.7 | 1498.017 | 0 | 0 | 754317 | 24.892461 | 1522.909461 |
| 1019E_DALE R CORSON BIO SCIENCE WING | 1019E | Y | 0 | 0 | 12206.31 | 500.45871 | 0 | 0 | 500.45871 |
| 1022_PLANT SCIENCE BUILDING | 1022 | Y | 2494.8 | 1022.868 | 14414.59 | 590.99819 | 502229 | 16.573557 | 1630.439747 |
| 1023A_TOWER RD WEST PURPLE CNS 1023A | 1023A | Y | 0 | 0 | 5.44 | 0.22304 | 0 | 0 | 0.22304 |
| 1023H_TOWER RD WEST PURPLE GH 1023H | 1023H | Y | 0 | 0 | 1076.12 | 44.12092 | 0 | 0 | 44.12092 |
| 1024_BAILEY HALL | 1024 | Y | 669 | 274.29 | 1575.1 | 64.5791 | 77122 | 2.545026 | 341.414126 |
| 1025_CALDWELL HALL | 1025 | Y | 247.56 | 101.4996 | 1459.06 | 59.82146 | 7448 | 0.245784 | 161.566844 |
| 1026_WARREN HALL | 1026 | Y | 623.16 | 255.4956 | 684.36 | 28.05876 | 12756 | 0.420948 | 283.975308 |
| 1027_MANN LIBRARY | 1027 | Y | 4243.29 | 1739.7489 | 23885.829 | 979.318989 | 1965711 | 64.868463 | 2783.936352 |
| 1028B_BRADFIELD HALL | 1028B | Y | 4242.8 | 1739.548 | 24671.02 | 1011.51182 | 765865 | 25.273545 | 2776.333365 |
| 1028E_EMERSON HALL | 1028E | Y | 0 | 0 | 5924.86 | 242.91926 | 501105 | 16.536465 | 259.455725 |
| 1029_FERNOW | 1029 | Y | 53.43 | 21.9063 | 763.27 | 31.29407 | 3280 | 0.10824 | 53.30861 |
| 1031F_POULTRY HOUSE F | 1031F | Y | 0 | 0 | 375.85 | 15.40985 | 0 | 0 | 15.40985 |
| 1032_FOH TEST GARDEN FACILITY | 1032 | Y | 48.48 | 19.8768 | 0 | 0 | 0 | 0 | 19.8768 |
| 1033_BEEBE HALL | 1033 | Y | 172.68 | 70.7988 | 666.41 | 27.32281 | 0 | 0 | 98.12161 |
| 1035_FEDERAL NEMATODE LAB & GRNHSE | 1035 | Y | 100.81 | 41.3321 | 0 | 0 | 0 | 0 | 41.3321 |
| 1040_RICE HALL | 1040 | Y | 98.28 | 40.2948 | 2553.006 | 104.673246 | 0 | 0 | 144.968046 |
| 1041_STOCKING HALL | 1041 | Y | 1788.541 | 733.30181 | 9868.18 | 404.59538 | 150110 | 4.95363 | 1142.85082 |
| 1041_STOCKING HALL Addition | 1041 | Y | 0 | 0 | 529.4 | 21.7054 | 79936 | 2.637888 | 24.343288 |
| 1042A_WING HALL | 1042A | Y | 317.76 | 130.2816 | 2582.35 | 105.87635 | 210864 | 6.958512 | 243.116462 |
| 1042W_WING HALL WING | 1042W | Y | 754.4 | 309.304 | 2928.36 | 120.06276 | 0 | 0 | 429.36676 |
| 1043_LIVESTOCK PAVILION | 1043 | Y | 10.88 | 4.4608 | 1343.24 | 55.07284 | 0 | 0 | 59.53364 |
| 1045A_KENNETH POST LAB | 1045A | Y | 435.233 | 178.44553 | 4252.7 | 174.3607 | 0 | 0 | 352.80623 |
| 1045G_TOWER RD EAST GREEN HDS 1045G | 1045G | Y | 0 | 0 | 22428.19 | 919.55579 | 0 | 0 | 919.55579 |
| 1047_CALS SURGE FACILITY | 1047 | Y | 49.26 | 20.1966 | 212.25 | 8.70225 | 0 | 0 | 28.89885 |
| 1048_EQUINE METABOLISM UNIT | 1048 | Y | 41.28 | 16.9248 | 0 | 0 | 0 | 0 | 16.9248 |
| 1060A_TOWER RD EAST YELLOW GH 1060A | 1060A | Y | 896 | 367.36 | 0 | 0 | 0 | 0 | 367.36 |
| 1061A_TOWER RD EAST BLUE GH 1061A | 1061A | Y | 398.34 | 163.3194 | 0 | 0 | 0 | 0 | 163.3194 |
| 1061D_TOWER RD EAST BLUE INSECT-NEW | 1061D | Y | 566.833 | 232.40153 | 6983.07 | 286.30587 | 0 | 0 | 518.7074 |
| 1062_RILEY-ROBB HALL | 1062 | Y | 1181.76 | 484.5216 | 9419.21 | 386.18761 | 192375 | 6.348375 | 877.057585 |
| 1063_FOOD SCIENCE LAB | 1063 | Y | 686.699 | 281.54659 | 2644.92 | 108.44172 | 200256 | 6.608448 | 396.596758 |
| 1064_MORRISON HALL | 1064 | Y | 1656.5 | 679.165 | 13250.66 | 543.27706 | 109297 | 3.606801 | 1226.048861 |
| 1068_GUTERMAN_COMPLEX | 1068 | Y | 754.32 | 309.2712 | 0 | 0 | 0 | 0 | 309.2712 |
| 1068B_GUTERMAN BIOCLIMATIC LAB | 1068B | Y | 3558 | 1458.78 | 19363.95 | 793.92195 | 0 | 0 | 2252.70195 |
| 1070_BRUCKNER LAB | 1070 | Y | 100.16 | 41.0656 | 258.2 | 10.5862 | 20011 | 0.660363 | 52.312163 |
| 1076_BOYCE THOMPSON INSTITUTE | 1076 | Y | 4608 | 1889.28 | 10120.73 | 414.94993 | 720234 | 23.767722 | 2327.997652 |
| 1080_KENNEDY_ROBERTS_COMPLEX | 1080 | Y | 1483.5 | 608.235 | 6597.7 | 270.5057 | 218706 | 7.217298 | 885.957998 |
| 1081_COMSTOCK HALL-ACADEMIC II | 1081 | Y | 1900.56 | 779.2296 | 7552.67 | 309.65947 | 353659 | 11.670747 | 1100.559817 |
| 1084A_RUMINANT NUTRITION LAB | 1084A | Y | 196.82 | 80.6962 | 0 | 0 | 0 | 0 | 80.6962 |
| 1084B_LRG ANIMAL RES. TEACHING UNIT | 1084B | Y | 64.72 | 26.5352 | 1374.85 | 56.36885 | 29602 | 0.976866 | 83.880916 |
| 1085A_FARM SERVICE SHOP | 1085A | Y | 19.84 | 8.1344 | 0 | 0 | 0 | 0 | 8.1344 |
| 1100_POMOLOGY COLD STORAGE SALES | 1100 | Y | 256.08 | 104.9928 | 0 | 0 | 0 | 0 | 104.9928 |
| 1134A_TOWER RD EAST GREEN GH 1134A | 1134A | Y | 125.33218 | 51.3861938 | 0 | 0 | 0 | 0 | 51.3861938 |
| 1135C_TOWER RD EAST YELLOW GH 1135C | 1135C | Y | 575 | 235.75 | 0 | 0 | 0 | 0 | 235.75 |
| 1140_VET RESEARCH TOWER | 1140 | Y | 3264.64 | 1338.5024 | 15878.45 | 651.01645 | 684325 | 22.582725 | 2012.101575 |
| 1148_VET MED ANNEX | 1148 | Y | 372.96 | 152.9136 | 2302.78 | 94.41398 | 10242 | 0.337986 | 247.665566 |
| 1150C_SCHURMAN HALL | 1150C | Y | 1698.72 | 696.4752 | 20103.01 | 824.22341 | 441137 | 14.557521 | 1535.256131 |
| 1150D_BASIC SCIENCE BUILDING | 1150D | Y | 0 | 0 | 0 | 0 | 78810 | 2.60073 | 2.60073 |
| 1150G_WASTE MANAGEMENT FACILITY | 1150G | Y | 237.24 | 97.2684 | 1793.39 | 73.52899 | 0 | 0 | 170.79739 |
| 1151_CLINICAL PROGRAMS - SURGERY | 1151 | Y | 0 | 0 | 7075.44 | 290.09304 | 0 | 0 | 290.09304 |
| 1153_CLINICAL_PROGRAMS_COMPLEX | 1153 | Y | 1260.96 | 516.9936 | 0 | 0 | 122807 | 4.052631 | 521.046231 |
| 1162A_LARGE ANIMAL ISOLATION | 1162A | Y | 479.92 | 196.7672 | 2754.86 | 112.94926 | 0 | 0 | 309.71646 |
| 1162B_LARGE ANIMAL ISOLATION | 1162B | Y | 55.95 | 22.9395 | 88.89 | 3.64449 | 0 | 0 | 26.58399 |

# Building Green House Gas Emissions

| Building | Facility Code | Data? | Electric Use (MWhr) | Electric GHG (metric tons CO2-e) | Steam Use (kLb Steam) | Steam GHG (metric tons CO2-e) | Cool Water Use (Ton-hr) | Cool Water GHG (metric tons CO2-e) | Total Carbon Footprint (in metric tons CO2-e) |
|---|---|---|---|---|---|---|---|---|---|
| 1163_VET EDUCATION CENTER | 1163 | Y | 635.36 | 260.4976 | 3648.18 | 149.57538 | 126814 | 4.184862 | 414.257842 |
| 1164_VET MEDICAL CENTER | 1164 | Y | 11080 | 4542.8 | 49786.79 | 2041.25839 | 2720202 | 89.766666 | 6673.825056 |
| 1165_EAST CAMPUS RESEARCH FACILITY | 1165 | Y | 2641.5 | 1083.015 | 12053.53 | 494.19473 | 817495 | 26.977335 | 1604.187065 |
| 1166_NYS Veterinary Diagnostic Lab | 1166 | Y | 3394.56 | 1391.7696 | 10234.01 | 419.59441 | 832293 | 27.465669 | 1838.829679 |
| 1901_LELAND LAB AGRONOMY | 1901 | Y | 215.64 | 88.4124 | 0 | 0 | 0 | 0 | 88.4124 |
| 1902_LOVE LAB - PLANT BREEDING | 1902 | Y | 213.84 | 87.6744 | 0 | 0 | 0 | 0 | 87.6744 |
| 1905_MUENSCHER LABORATORY | 1905 | Y | 178.16 | 73.0456 | 0 | 0 | 0 | 0 | 73.0456 |
| 1913_CALDWELL RD ORANGE GH 1913 | 1913 | Y | 542.64 | 222.4824 | 0 | 0 | 0 | 0 | 222.4824 |
| 2000_DUFFIELD HALL | 2000 | Y | 7098.4 | 2910.344 | 29070.48 | 1191.88968 | 1988557 | 65.622381 | 4167.856061 |
| 2001_MORRILL HALL | 2001 | Y | 314.24 | 128.8384 | 1985.68 | 81.41288 | 36053 | 1.189749 | 211.441029 |
| 2002_WHITE HALL | 2002 | Y | 364.08 | 149.2728 | 2838.15 | 116.36415 | 134642 | 4.443186 | 270.080136 |
| 2003_MCGRAW HALL | 2003 | Y | 191.76 | 78.6216 | 1857.06 | 76.13946 | 0 | 0 | 154.76106 |
| 2004_SIBLEY HALL | 2004 | Y | 530.96 | 217.6936 | 3945.98 | 161.78518 | 48713 | 1.607529 | 381.086309 |
| 2005_SAGE CHAPEL | 2005 | Y | 100.929 | 41.38089 | 1238.18 | 50.76538 | 0 | 0 | 92.14627 |
| 2006_A D WHITE HOUSE | 2006 | Y | 79.95 | 32.7795 | 755.23 | 30.96443 | 0 | 0 | 63.74393 |
| 2007_OLIVE TJADEN HALL | 2007 | Y | 482.75 | 197.9275 | 5516.37 | 226.17117 | 0 | 0 | 424.09867 |
| 2008_LINCOLN HALL | 2008 | Y | 861.44 | 353.1904 | 6904.32 | 283.07712 | 464887 | 15.341271 | 651.608791 |
| 2009_BARNES HALL | 2009 | Y | 188.26 | 77.1866 | 1113.83 | 45.66703 | 83118 | 2.742894 | 125.596524 |
| 2010_URIS LIBRARY | 2010 | Y | 1039.68 | 426.2688 | 3666.79 | 150.33839 | 292165 | 9.641445 | 586.248635 |
| 2011_STIMSON HALL | 2011 | Y | 232.44 | 95.3004 | 1804.69 | 73.99229 | 51778 | 1.708674 | 171.001364 |
| 2013_GOLDWIN SMITH HALL | 2013 | Y | 708.88 | 290.6408 | 2399.5 | 98.3795 | 123792 | 4.085136 | 393.105436 |
| 2014_ROCKEFELLER HALL | 2014 | Y | 617.28 | 253.0848 | 3989.71 | 163.57811 | 10531 | 0.347523 | 417.010433 |
| 2015_FOUNDRY | 2015 | Y | 83.9 | 34.399 | 789.001 | 32.349041 | 0 | 0 | 66.748041 |
| 2016_SCHWARTZ CTR-PERFORMING ARTS | 2016 | Y | 1408.8 | 577.608 | 9911.42 | 406.36822 | 0 | 0 | 983.97622 |
| 2017_RAND HALL | 2017 | Y | 250.52 | 102.7132 | 1916.69 | 78.58429 | 56340 | 1.85922 | 183.15671 |
| 2019_BAKER LABORATORY | 2019 | Y | 3364.849 | 1379.58809 | 26141.65 | 1071.80765 | 1090073 | 35.972409 | 2487.368149 |
| 2020_WILLARD STRAIGHT HALL | 2020 | Y | 1280.4 | 524.964 | 12114.89 | 496.71049 | 297159 | 9.806247 | 1031.480737 |
| 2021_MYRON TAYLOR HALL | 2021 | Y | 2164.59 | 887.4819 | 11008.73 | 451.35793 | 589264 | 19.445712 | 1358.285542 |
| 2023_HUMPHREYS SERVICE BLDG | 2023 | Y | 601.6 | 246.656 | 3760.74 | 154.19034 | 115793 | 3.821169 | 404.667509 |
| 2024_OLIN HALL | 2024 | Y | 2522 | 1034.02 | 9437.57 | 386.94037 | 588854 | 19.432182 | 1440.392552 |
| 2026_DAY HALL | 2026 | Y | 720 | 295.2 | 3557.77 | 145.86857 | 227435 | 7.505355 | 448.573925 |
| 2029_NEWMAN, FLOYD D. LABORATORY | 2029 | Y | 1704.32 | 698.7712 | 3311.43 | 135.76863 | 356629 | 11.768757 | 846.308587 |
| 2032_SAVAGE HALL | 2032 | Y | 1270.5 | 520.905 | 3927.61 | 161.03201 | 250912 | 8.280096 | 690.217106 |
| 2033_STATLER HALL & AUDITORIUM | 2033 | Y | 2084.64 | 854.7024 | 15810.69 | 648.23829 | 662676 | 21.868308 | 1524.808998 |
| 2033A_STATLER HOTEL | 2033A | Y | 2628.16 | 1077.5456 | 0 | 0 | 505665 | 16.686945 | 1094.232545 |
| 2037K_KIMBALL HALL | 2037K | Y | 1393.44 | 571.3104 | 8318.9 | 341.0749 | 267393 | 8.823969 | 921.209269 |
| 2038_ANABEL TAYLOR HALL | 2038 | Y | 117.9 | 48.339 | 2211.08 | 90.65428 | 0 | 0 | 138.99328 |
| 2039H_PHILLIPS HALL | 2039H | Y | 1461.08 | 599.0428 | 6088.49 | 249.62809 | 446299 | 14.727867 | 863.398757 |
| 2040_BIG RED BARN | 2040 | Y | 67.408 | 27.63728 | 680.7 | 27.9087 | 0 | 0 | 55.54598 |
| 2042_CARPENTER HALL | 2042 | Y | 474.24 | 194.4384 | 2031.83 | 83.30503 | 145974 | 4.817142 | 282.560572 |
| 2043_GRUMMAN HALL | 2043 | Y | 1515 | 621.15 | 0 | 0 | 605207 | 19.971831 | 641.121831 |
| 2044_BILL AND MELINDA GATES HALL | 2044 | Y | 36.24 | 14.8584 | 0 | 0 | 0 | 0 | 14.8584 |
| 2045_UPSON HALL | 2045 | Y | 1097.28 | 449.8848 | 9085.84 | 372.51944 | 244696 | 8.074968 | 830.479208 |
| 2046_HOLLISTER HALL | 2046 | Y | 1191.389 | 488.46949 | 6300.8 | 258.3328 | 228521 | 7.541193 | 754.343483 |
| 2047_OLIN LIBRARY | 2047 | Y | 1850.596 | 758.74436 | 8133.15 | 333.45915 | 415109 | 13.698597 | 1105.902107 |
| 2047A_KROCH,CARL A LIBRARY | 2047A | Y | 843.84 | 345.9744 | 3210.07 | 131.61287 | 416621 | 13.748493 | 491.335763 |
| 2048_GRAPHIC ARTS SERVICES BLDG | 2048 | Y | 215.931 | 88.53171 | 0 | 0 | 0 | 0 | 88.53171 |
| 2049_SNEE HALL GEOLOGICAL SCIENCE | 2049 | Y | 1197.6 | 491.016 | 3953.43 | 162.09063 | 238891 | 7.883403 | 660.990033 |
| 2051_FRANK H T RHODES HALL | 2051 | Y | 9221.2 | 3780.692 | 7429.16 | 304.59556 | 2648126 | 87.388158 | 4172.675718 |
| 2060_MACHINE LABORATORY, DRYDEN RD | 2060 | Y | 58.8 | 24.108 | 0 | 0 | 0 | 0 | 24.108 |
| 2061_WARD CENTER FOR NUCLEAR STDIES | 2061 | Y | 321.84 | 131.9544 | 1253.39 | 51.38899 | 45018 | 1.485594 | 184.828984 |
| 2070_BARD HALL | 2070 | Y | 1041.36 | 426.9576 | 7018.78 | 287.76998 | 388378 | 12.816474 | 727.544054 |
| 2076_PHYSICAL SCIENCES BUILDING | 2076 | Y | 3542.4 | 1452.384 | 14030.03 | 575.23123 | 1040652 | 34.341516 | 2061.956746 |
| 2080B_E ITHACA ENVIRONMENTAL HEALTH | 2080B | Y | 4.17 | 1.7097 | 140.13 | 5.74533 | 0 | 0 | 7.45503 |
| 2080C_MAPLE AVE PIPE/WELDING SHOP | 2080C | Y | 3.028 | 1.24148 | 365.48 | 14.98468 | 0 | 0 | 16.22616 |
| 2081_MALOTT HALL | 2081 | Y | 753.72 | 309.0252 | 3543.25 | 145.27325 | 142180 | 4.69194 | 458.99039 |
| 2082_CLARK HALL | 2082 | Y | 4275.5 | 1752.955 | 16213.5 | 664.7535 | 1363659 | 45.000747 | 2462.709247 |
| 2083_OLIN CHEMISTRY RESEARCH WING | 2083 | Y | 2431.64 | 996.9724 | 21167.7 | 867.8757 | 667761 | 22.036113 | 1886.884213 |
| 2084_SPACE SCIENCES BUILDING - CRSR | 2084 | Y | 962.192 | 394.49872 | 6669.6 | 273.4536 | 124687 | 4.114671 | 672.066991 |
| 2085_WILSON SYNCHROTRON LAB & RING | 2085 | Y | 23631.36 | 9688.8576 | 4270.74 | 175.10034 | 2125654 | 70.146582 | 9934.104522 |
| 2086_JOHNSON MUSEUM OF ART | 2086 | Y | 1004.4 | 411.804 | 11154.78 | 457.34598 | 759051 | 25.048683 | 894.198663 |
| 2087_URIS HALL | 2087 | Y | 2248 | 921.68 | 17831.32 | 731.08412 | 698768 | 23.059344 | 1675.823464 |
| 2088_THE CORNELL STORE | 2088 | Y | 532.64 | 218.3824 | 644.27 | 26.41507 | 84662 | 2.793846 | 247.591316 |
| 2101_ENVIRONMENTAL HEALTH & SAFETY | 2101 | Y | 167.6 | 68.716 | 0 | 0 | 0 | 0 | 68.716 |
| 2410_SALT STORAGE POLE BARN | 2410 | Y | 2.1 | 0.861 | 0 | 0 | 0 | 0 | 0.861 |
| 2444_PLANTATIONS_NEVIN_WELCOME_CENTER | 2444 | Y | 68.52 | 28.0932 | 0 | 0 | 0 | 0 | 28.0932 |
| 2540B_BLAIR FARM BARN | 2540B | Y | 1.882 | 0.77162 | 0 | 0 | 0 | 0 | 0.77162 |
| 2543A_MCCONVILLE BARN | 2543A | Y | 24.398 | 10.00318 | 0 | 0 | 0 | 0 | 10.00318 |
| 2543C_STATE ELEVATED PUMPHOUSE | 2543C | Y | 276.36 | 113.3076 | 0 | 0 | 0 | 0 | 113.3076 |
| 2598_PLANTATION_HORTICULTURAL_CTR | 2598 | Y | 25.14 | 10.3074 | 0 | 0 | 0 | 0 | 10.3074 |
| 2602B_SCHOELLKOPF MEMORIAL | 2602B | Y | 568.16 | 232.9456 | 4782.58 | 196.08578 | 88305 | 2.914065 | 431.945445 |
| 2603B_SCHOELLKOPF CRESCENT | 2603B | Y | 93.76 | 38.4416 | 0 | 0 | 0 | 0 | 38.4416 |
| 2603C_FISCHELL BAND CENTER | 2603C | Y | 40.24 | 16.4984 | 0 | 0 | 0 | 0 | 16.4984 |
| 2605_TOBOGGAN LODGE | 2605 | Y | 30.76 | 12.6116 | 0 | 0 | 0 | 0 | 12.6116 |
| 2608_SCHOELLKOPF WEST STANDS | 2608 | Y | 39.99 | 16.3959 | 0 | 0 | 0 | 0 | 16.3959 |
| 2610_GRUMMAN SQUASH COURTS | 2610 | Y | 291.28 | 119.4248 | 888.9 | 36.4449 | 0 | 0 | 155.8697 |
| 2611_TEAGLE HALL | 2611 | Y | 915 | 375.15 | 5067.29 | 207.75889 | 0 | 0 | 582.90889 |
| 2613_LYNAH RINK | 2613 | Y | 1243 | 509.63 | 3590.12 | 147.19492 | 52135 | 1.720455 | 658.545375 |
| 2615_JP PARSON OUTING CENTER | 2615 | Y | 2.837 | 1.16317 | 0 | 0 | 0 | 0 | 1.16317 |
| 2616_HELEN NEWMAN HALL | 2616 | Y | 850.88 | 348.8608 | 4229.53 | 173.41073 | 0 | 0 | 522.27153 |

| Building | Facility Code | Data? | Electric Use (MWhr) | Electric GHG (metric tons CO2-e) | Steam Use (kLb Steam) | Steam GHG (metric tons CO2-e) | Cool Water Use (Ton-hr) | Cool Water GHG (metric tons CO2-e) | Total Carbon Footprint (in metric tons CO2-e) |
|---|---|---|---|---|---|---|---|---|---|
| 2620_ALUMNI_FIELD_FLOODLIGHTS | 2620 | Y | 30.4 | 12.464 | 0 | 0 | 0 | 0 | 12.464 |
| 2630_TOBIN FIELD HOUSE | 2630 | Y | 11.96 | 4.9036 | 0 | 0 | 0 | 0 | 4.9036 |
| 2631_BARTELS HALL | 2631 | Y | 1657.026 | 679.38066 | 5770.6 | 236.5946 | 0 | 0 | 915.97526 |
| 2631A_FRIEDMAN STRENGTH & CONDTN CTR | 2631A | Y | 106.414 | 43.62974 | 691.19 | 28.33879 | 51946 | 1.714218 | 73.682748 |
| 2638_FRIEDMAN WRESTLING CENTER | 2638 | Y | 115.6 | 47.396 | 2424.54 | 99.40614 | 65959 | 2.176647 | 148.978787 |
| 2704_GANNETT HEALTH SERVICES | 2704 | Y | 492.16 | 201.7856 | 3468.22 | 142.19702 | 122799 | 4.052367 | 348.034987 |
| 2725_FED_NUT_LAB | 2725 | Y | 0 | 0 | 6238.75 | 255.78875 | 218855 | 7.222215 | 263.010965 |
| 2776_PARKING GARAGE | 2776 | Y | 800.06 | 328.0246 | 0 | 0 | 0 | 0 | 328.0246 |
| 2821_PLANT PRODUCTION GREENHOUSE | 2821 | Y | 74 | 30.34 | 0 | 0 | 0 | 0 | 30.34 |
| 2921_EAST HILL OFFICE BUILDING | 2921 | Y | 814.8 | 334.068 | 0 | 0 | 0 | 0 | 334.068 |
| 3001_CASCADILLA HALL | 3001 | Y | 632.76 | 259.4316 | 4592.34 | 188.28594 | 0 | 0 | 447.71754 |
| 3002_SAGE HALL | 3002 | Y | 1801.6 | 738.656 | 3177.73 | 130.28693 | 318055 | 10.495815 | 879.438745 |
| 3003_RISLEY, PRUDENCE RESD. COLLEGE | 3003 | Y | 492.72 | 202.0152 | 6008.38 | 246.34358 | 0 | 0 | 448.35878 |
| 3004N_BAKER NORTH | 3004N | Y | 261.92 | 107.3872 | 4811.51 | 197.27191 | 0 | 0 | 304.65911 |
| 3004S_BAKER SOUTH | 3004S | Y | 77.72 | 31.8652 | 611.77 | 25.08257 | 0 | 0 | 56.94777 |
| 3004T_BAKER TOWER | 3004T | Y | 0 | 0 | 114.71 | 4.70311 | 0 | 0 | 4.70311 |
| 3005_FOUNDERS HALL | 3005 | Y | 95.32 | 39.0812 | 1315.34 | 53.92894 | 0 | 0 | 93.01014 |
| 3006H_BOLDT HALL | 3006H | Y | 59.72 | 24.4852 | 1308.47 | 53.64727 | 0 | 0 | 78.13247 |
| 3006T_BOLDT TOWER | 3006T | Y | 32.28 | 13.2348 | 0 | 0 | 0 | 0 | 13.2348 |
| 3007_ANNA COMSTOCK HOUSE | 3007 | Y | 78.76 | 32.2916 | 2652.84 | 108.76644 | 0 | 0 | 141.05804 |
| 3009_BALCH HALL | 3009 | Y | 943.68 | 386.9088 | 10644.1 | 436.4081 | 0 | 0 | 823.3169 |
| 3010B_MAPLE AVE 120 | 3010B | Y | 1068.191 | 437.95831 | 1731.55 | 70.99355 | 0 | 0 | 508.95186 |
| 3011_LYON HALL | 3011 | Y | 271.465 | 111.30065 | 2893.32 | 118.62612 | 0 | 0 | 229.92677 |
| 3012_MCFADDIN HALL | 3012 | Y | 46.895 | 19.22695 | 1241 | 50.881 | 0 | 0 | 70.10795 |
| 3016_PDC SHOPS ANNEX | 3016 | Y | 2.771 | 1.13611 | 631.5 | 25.8915 | 0 | 0 | 27.02761 |
| 3018_CLARA DICKSON HALL | 3018 | Y | 737.76 | 302.4816 | 8354.02 | 342.51482 | 0 | 0 | 644.99642 |
| 3026_MARY DONLON HALL | 3026 | Y | 791.36 | 324.4576 | 6402.56 | 262.50496 | 0 | 0 | 586.96256 |
| 3028_HUGHES HALL | 3028 | Y | 374.21 | 153.4261 | 3472.88 | 142.38808 | 16019 | 0.528627 | 296.342807 |
| 3030_NORTH_CAMPUSES_TOWNHOUSES | 3030 | Y | 833.488 | 341.73008 | 0 | 0 | 0 | 0 | 341.73008 |
| 3031_ALICE H. COOK HOUSE | 3031 | Y | 882.72 | 361.9152 | 4602 | 188.682 | 128393 | 4.236969 | 554.834169 |
| 3032_CARL BECKER HOUSE | 3032 | Y | 1607.68 | 659.1488 | 9994 | 409.754 | 320287 | 10.569471 | 1079.472271 |
| 3033_HANS BETHE HOUSE | 3033 | Y | 1219.1 | 499.831 | 5756.97 | 236.03577 | 265770 | 8.77041 | 744.63718 |
| 3034_WILLIAM T. KEETON HOUSE | 3034 | Y | 1248.48 | 511.8768 | 5629 | 230.789 | 217379 | 7.173507 | 749.839307 |
| 3035_FLORA ROSE HOUSE | 3035 | Y | 944.4 | 387.204 | 4198 | 172.118 | 207942 | 6.862086 | 566.184086 |
| 3036_NOYES COMMUNITY AND REC CENTER | 3036 | Y | 355.76 | 145.8616 | 1091 | 44.731 | 47.339 | 0.001562187 | 190.5941622 |
| 3090_SHELDON COURT | 3090 | Y | 381.08 | 156.2428 | 1997.07 | 81.87987 | 0 | 0 | 238.12267 |
| 3126_NOYES LODGE - BEEBE LAKE | 3126 | Y | 138.373 | 56.73293 | 337.86 | 13.85226 | 0 | 0 | 70.58519 |
| 3201_GEORGE JAMESON HALL | 3201 | Y | 554.16 | 227.2056 | 4738.42 | 194.27522 | 0 | 0 | 421.48082 |
| 3202_COURT RESIDENCE HALL | 3202 | Y | 824.96 | 338.2336 | 7449.01 | 305.40941 | 244683 | 8.074539 | 651.717549 |
| 3203_MEWS RESIDENCE HALL | 3203 | Y | 679.68 | 278.6688 | 0 | 0 | 0 | 0 | 278.6688 |
| 3204_ROBERT J & HELEN APPEL COMMONS | 3204 | Y | 1359.915 | 557.56515 | 2868 | 117.588 | 246293 | 8.127669 | 683.280819 |
| 3205_NORTH CAMPUS HIGH RISE #5 | 3205 | Y | 819.52 | 336.0032 | 0 | 0 | 0 | 0 | 336.0032 |
| 3208_INTERNATL LIVING - LOW RISE #8 | 3208 | Y | 588.96 | 241.4736 | 0 | 0 | 0 | 0 | 241.4736 |
| 3212_ROBERT PURCELL COMMUNITY CTR | 3212 | Y | 2992.31 | 1226.8471 | 36055.62 | 1478.28042 | 0 | 0 | 2705.12752 |
| 3752_PARKING_OLD_OXLEY | 3752 | Y | 14.87 | 6.0967 | 0 | 0 | 0 | 0 | 6.0967 |
| 3802_PAUL_MILSTEIN_HALL | 3802 | Y | 254.04 | 104.1564 | 913.29 | 37.44489 | 87263 | 2.879679 | 144.480969 |
| 4001_LIBRARY ANNEX-STORAGE FACILITY | 4001 | Y | 1051.2 | 430.992 | 0 | 0 | 0 | 0 | 430.992 |
| 4005_PDC SHEETMETAL/MASON SHOP | 4005 | Y | 189.57 | 77.7237 | 0 | 0 | 0 | 0 | 77.7237 |
| 4007_CAMPUS STORE WHSE | 4007 | Y | 60.43 | 24.7763 | 0 | 0 | 0 | 0 | 24.7763 |
| 4008_CORNELL MAIL CENTER | 4008 | Y | 97.12 | 39.8192 | 0 | 0 | 0 | 0 | 39.8192 |
| 4009_PDC CARPENTER & PAINT SHOPS | 4009 | Y | 124.08 | 50.8728 | 0 | 0 | 0 | 0 | 50.8728 |
| 4011_GROUNDS OPERATIONS FACILITY | 4011 | Y | 124.48 | 51.0368 | 0 | 0 | 0 | 0 | 51.0368 |
| 4241_BLUEGRASS LN: TURF GRASS BLDG | 4241 | Y | 3.23 | 1.3243 | 0 | 0 | 0 | 0 | 1.3243 |
| 4413_BRIDGE_BEEBE_DAM | 4413 | Y | 155.061 | 63.57501 | 0 | 0 | 0 | 0 | 63.57501 |
| 4414_BRIDGE_TROLLEY | 4414 | Y | 22.68 | 9.2988 | 0 | 0 | 0 | 0 | 9.2988 |
| 4432_TOWER_ROAD | 4432 | Y | 8.078 | 3.31198 | 0 | 0 | 0 | 0 | 3.31198 |
| 4741_FOREST PARK LA 2,PSI UPSILON | 4741 | Y | 136.2 | 55.842 | 1294.97 | 53.09377 | 0 | 0 | 108.93577 |
| 4747_FOREST PARK LANE 1, SIGMA PHI | 4747 | Y | 129.24 | 52.9884 | 1315.67 | 53.94247 | 0 | 0 | 106.93087 |
| 4767_THURSTON AVE 626 | 4767 | Y | 46.402 | 19.02482 | 382.23 | 15.67143 | 0 | 0 | 34.69625 |
| 4776_MARYANN WD 104,DELTA TAU DELTA | 4776 | Y | 110.96 | 45.4936 | 1234.78 | 50.62598 | 0 | 0 | 96.11958 |
| 4777_MARYANN WD 120, PHI KAPPA PSI | 4777 | Y | 196.74 | 80.6634 | 1363.09 | 55.88669 | 0 | 0 | 136.55009 |
| 5101_CHILL WATER PLANT 1-WEINHOLD | 5101 | Y | 425.739 | 174.55299 | 0 | 0 | 0 | 0 | 174.55299 |
| 5102_CHW_KITE_CATH_PROT | 5102 | Y | 3.934 | 1.61294 | 0 | 0 | 0 | 0 | 1.61294 |
| 5111_CHILL WATER-PLANT 3 | 5111 | Y | 1205.02 | 494.0582 | 0 | 0 | 0 | 0 | 494.0582 |
| 5112_CHILL WATER-PLANT 4 LSC HEF | 5112 | Y | 0 | 0 | 0 | 0 | 235782 | 7.780806 | 7.780806 |
| 5142_BAILEY_PLAZA | 5142 | Y | 18.12 | 7.4292 | 0 | 0 | 0 | 0 | 7.4292 |
| 5160_CHILL WATER-PLANT 2-STATE | 5160 | Y | 206.4 | 84.624 | 0 | 0 | 0 | 0 | 84.624 |
| 5210_FILTER PLANT | 5210 | Y | 729.72 | 299.1852 | 0 | 0 | 0 | 0 | 299.1852 |
| 5212_UP INTAKE-F. CR. INLET A-FRAME | 5212 | Y | 0.451 | 0.18491 | 0 | 0 | 0 | 0 | 0.18491 |
| 5310_HYDRO ELECTRIC PLANT STATION A | 5310 | Y | 18.766 | 7.69406 | 0 | 0 | 0 | 0 | 7.69406 |
| 5311_HYDRO_PLANT_INTAKE | 5311 | Y | 16.11 | 6.6051 | 0 | 0 | 0 | 0 | 6.6051 |
| 5325_KITE HILL SUBSTATION | 5325 | Y | 191.28 | 78.4248 | 0 | 0 | 0 | 0 | 78.4248 |
| 5330_ENDOWED_STREET_LIGHTING | 5330 | Y | 46.76 | 19.1716 | 0 | 0 | 0 | 0 | 19.1716 |
| 5340_ENDOWED_TRAFFIC_SIGNALS | 5340 | Y | 1.951 | 0.79991 | 0 | 0 | 0 | 0 | 0.79991 |
| 5510B_CENTRAL HEATING PLANT | 5510B | Y | 3527.006 | 1446.07246 | 0 | 0 | 2846539 | 93.935787 | 1540.008247 |
| 5981A_ROBERT_KANE_SPORTS_COMPLEX | 5981A | Y | 6.48 | 2.6568 | 0 | 0 | 0 | 0 | 2.6568 |
| 6095_WILSON LAB MODULAR UNITS | 6095 | Y | 669.04 | 274.3064 | 0 | 0 | 0 | 0 | 274.3064 |
| 6127_ACADEMIC SURGE FACILITY A | 6127 | Y | 129.2 | 52.972 | 0 | 0 | 0 | 0 | 52.972 |

Innovation and Leadership
for Climate Neutrality

climateaction.cornell.edu