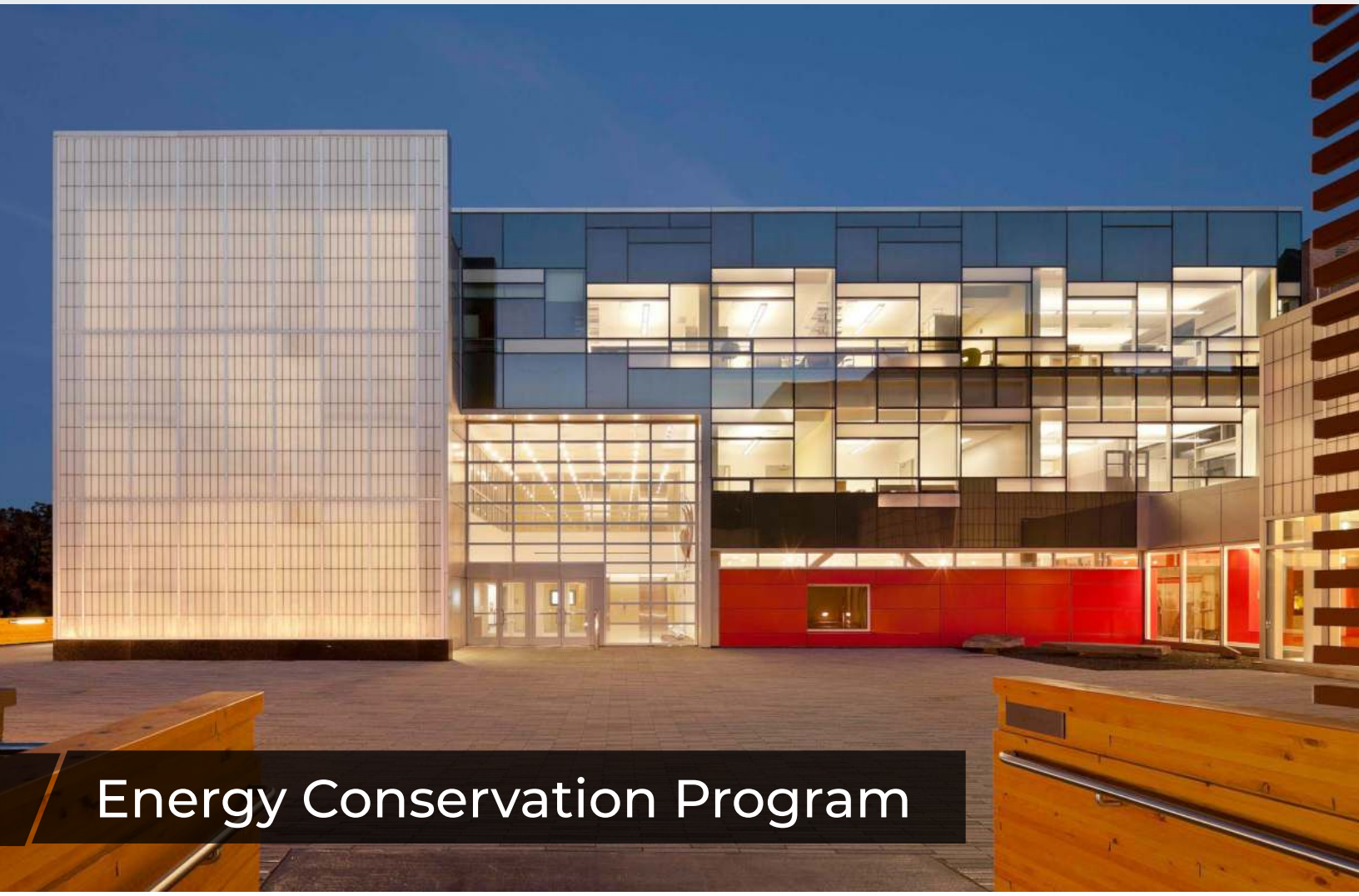
ME ENGINEERING



Energy Conservation Program

Designing, Incorporating & Implementing
Strategies To Maximize Your Investment

We Listen... We Understand... We Deliver...

ENGINEERING

OUR VISION

We are a client, employee and community focused firm who has extensive knowledge and experience with a variety of sectors and industries.

Regardless of the project, energy conservation features such as demand control ventilation, temperature reset strategies, heat recovery, and lighting efficiency and controls are always a priority in our system designs. Together, with high performance architectural elements, these features can result in a building that uses **30-40% less energy**.

As green building policies and energy conservation requirements are ever evolving, existing facilities and their associated systems can quickly become obsolete and inefficient. To date, we have completed hundreds of studies for a variety of clients to identify cost and savings for improvements to building heating, ventilating, air conditioning, and lighting systems. Once the study phase is complete, we work closely with the client to identify which recommendations / improvement strategies meet the facilities payback and energy reduction goals. From there, our team of expert engineers begin the design phase and incorporate the improvements into a biddable set of drawings and specifications. This same team will see the project through its construction phase.

Cornell University
Martha Van Rensselaer North Hall

New laboratory research building and parking garage for the College of Human Ecology. This project is LEED certified to the Platinum level.

ENERGY CONSERVATION

NYSERDA
Flexible Technical Assistance Program

As a certified Flex Tech consultant, we work directly with NYSERDA to reduce the cost incurred by the client by 50% through the Flex Tech Assistance program.

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

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Facility Improvement Strategies

Energy Conservation has a wide variety of mechanical and electrical system strategies to optimize building energy consumption. They must be designed and coordinated to be, cost effective, sustainable, easily maintained and energy efficient. These upgrades include the following:

Fan and Pump Variable Speed Drives

Converting constant volume systems to variable volume to reduce energy during part load conditions

Lighting Upgrades

Replacing with high efficiency fixtures, such as LED

Building Management (BMS) and Energy Management Control System (EMCS) Upgrades

Converting obsolete and out-of-date systems, such as pneumatic, to direct digital controls

Allows users to supervise, diagnose, and analyze energy usage and system operation

Heat Recovery

Recovering energy from exhaust air streams and utilizing it to preheat incoming outside air

Temperature Reset Strategies

Reduces heating and cooling by relaxing temperature setpoints during unoccupied conditions

Optimizing time of day schedules

Demand Controlled Ventilation

Occupancy sensor and Carbon Dioxide level based airflow reduction

Static Pressure Rest

Reset the downstream static pressure setpoint to maintain the critical zone damper position at 95% open

Minimum Outside Air and Economizer Mode Optimization

Incorporating controls to allow minimizing outdoor air during design days and increasing outdoor air during economizer mode to reduce the hot water heating and chilled water cooling demand

Filtration

Optimizing filtration systems to reduce static pressure

Occupancy Sensors and Daylight Controls

HVAC system temperature, airflow, and/or humidity set backs during occupied and unoccupied hours Daylight level based controls for space lighting

Recalibration and Retro-Commissioning

Ensure existing sensors, control valves, and equipment are operating per the control sequence of operation

CASE STUDY

Studies have shown that commercial facilities including office buildings, hospitals, retail stores, and universities are responsible for approximately **20%** of the nation's total energy consumption.

Of that, 30% of the energy used within these buildings is utilized inefficiently or unnecessarily. Many of these buildings were constructed prior to 1970, before the development of modern building and energy codes and decades before the formation of the United States Green Building Council and its Leadership in Energy and Environmental Design (LEED) rating systems.

Many towns, cities, and associated office buildings, healthcare facilities, and universities are striving to reduce energy consumption and greenhouse gas emissions generated from burning fossil fuels that are utilized for heat, electricity, and transportation.

CORNELL UNIVERSITY

Located in Ithaca, NY, Cornell University is at the forefront of reducing energy and working toward achieving carbon neutrality. M/E Engineering has been an integral part of the campus' success by performing energy audits and implementing energy improvement strategies throughout a variety of occupied buildings on Campus.

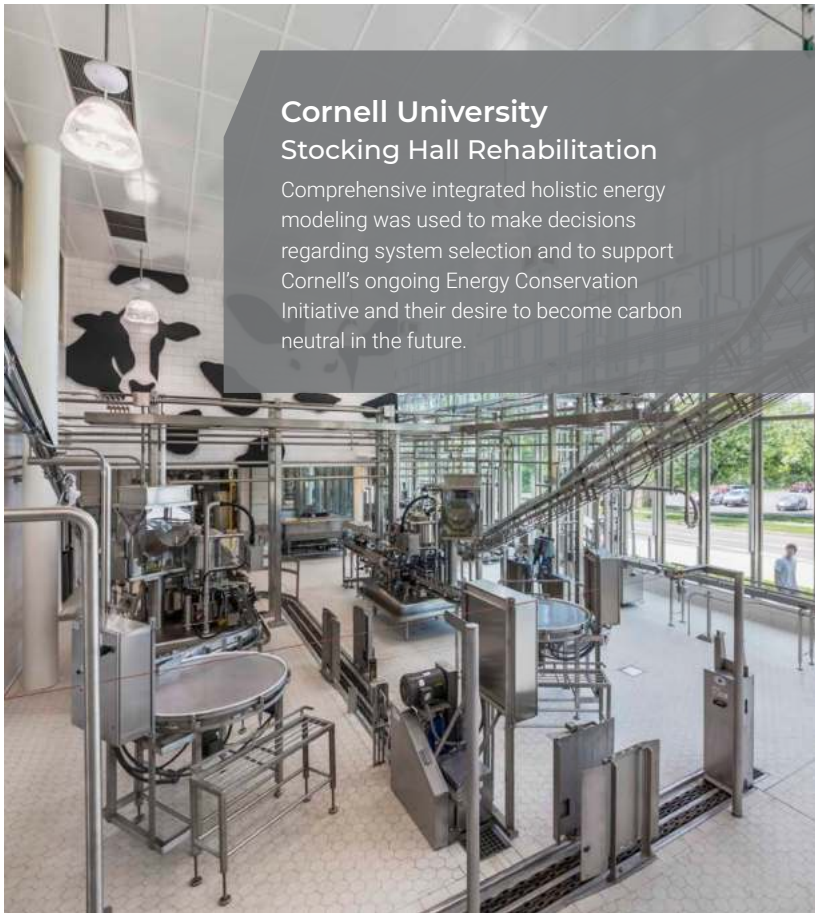
By The Numbers

From 2000 through 2020, Cornell has achieved the following with a total current investment of **$33,701,213**:

54/1 Total Projects Funded (completed/in-progress)

$49.7M Financial Savings

2.35M MMBTU Energy Savings



Cornell University
Stocking Hall Rehabilitation

Comprehensive integrated holistic energy modeling was used to make decisions regarding system selection and to support Cornell's ongoing Energy Conservation Initiative and their desire to become carbon neutral in the future.

> "Cornell has always been at the forefront of energy conservation. While this is a noble cause for sure, the true measure of success is that every project was justified by a business case. If the economics didn't work, it wasn't pursued - paybacks must be justified. What we showed was that not only is energy conservation achievable, it can pay for itself."

John A. Dredger, President
M/E Engineering P.C.

Energy Conservation Initiative (ECI) Project Summary
Appel Controls Upgrade, Facility 3204

What We Did: We repaired and upgraded controls throughout the facility areas. In non-dining areas, reheat valves were replaced and occupancy sensors were added. A significantly oversized air handling system was replaced by fan coil units. Space controls were re-commissioned and repaired throughout the building.

In the dining area, hood exhaust variable airflow controls were added. The controls regulate exhaust airflow dependent on smoke concentration and temperature.

The new dining hood sensors and controls are complemented by new air handler and space air controls. The hoods operate on schedules and vary from minimum to maximum airflow based on ventilation demands.

What It Cost: $430,000

How Long It Took: 8 months. Completed April 2013.

What We Saved: $75,000 and 220 tons/per year carbon equivalent annually.

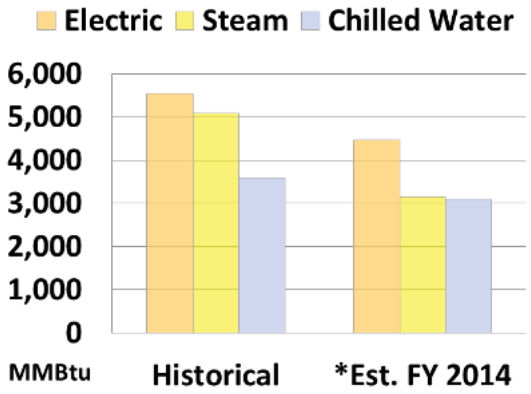
Benefits: The new controls restore fully automated operation with minimum airflow and reheat to accomplish energy efficient space conditioning. The new operation improves comfort, reduces maintenance issues, and reduces energy usage. In the kitchen areas airflow is now controlled based on cooking demands (50% minimum) and schedules can be easily adjusted so that equipment is only running and air is exhausted when it needs to be. If needed, staff turn on a hood "early" at the hood controller. The result is a significant reduction in annual energy used to heat and cool, supply and exhaust the ventilation and make up air.

> Appel Commons general space controls were very much in need of maintenance. This project not only dramatically reduces energy usage, it fixed many comfort and reliability issues cost effectively with one large project.
>
> Chris Edwards
> Supervisor of Facilities

Appel Controls Upgrade

Map
Utilities Costs and Use

Appel Controls Upgrade:
Total Energy Use - Pre & Post ECI



*based on energy study

Appel Controls Upgrade: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	*Est. FY 2014 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	*Est. FY 2014 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	5,500	4,500	1,000	18%	$114,000	$92,000	$22,200	25
Steam	5,100	3,200	1,900	37%	$115,000	$72,000	$44,000	20
Chilled Water	3,600	3,100	500	8%	$66,000	$57,000	$9,100	10
Totals	14,200	10,800	3,400	**24%**	$295,000	$221,000	$75,000	**55**

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Energy Conservation Initiative (ECI) Project Summary
Barton Lab Geneva, Facility 4935A

What We Did: The project upgraded Barton Hall laboratory building with a new building automated system with the newest digital control system. We installed new variable air boxes throughout the building for proper laboratory ventilation performance with occupancy based demand. We upgraded all the ventilation fans on each floor with new controls, new valves, damper actuators and variable speed drives. We also reconfigured some ductwork throughout the floors. The building exhaust system was brought up to modern code by installing a new exhaust manifold on the roof that allows for proper disbursement of exhaust effluent.

What It Cost: $1,100,100

How Long It Took: 16 months. Completed January 2015.

What We Saved: $77,000 and 65 tons/per year carbon equivalent annually.

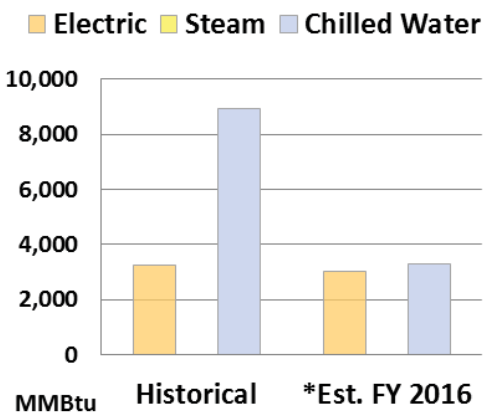
Benefits: Updating controls and replacing variable air volume boxes throughout the building addressed a significant differed maintenance item. The new controls enable the building to operate in a safer more comfortable manner.

> The project was a success in updating outdated mechanical systems with newer more efficient systems reducing maintenance and energy use while improving comfort and lab safety for the occupants.
>
> Mark Howe, P.E., CEM,
> Campus Energy Manager

Barton Lab Geneva Upgrade

Map
Utilities Costs and Use

Barton Lab Geneva Upgrade:
Total Energy Use - Pre & Post ECI



*based on energy study

Barton Lab Geneva Upgrade: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	*Est. FY 2016 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	*Est. FY 2016 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	3,300	3,000	300	9%	$78,000	$73,000	$6,000	8
Steam								
Chilled Water	8,900	3,300	5,600	63%	$112,000	$41,000	$71,000	112
Totals	12,200	6,300	5,900	48%	$190,000	$114,000	$77,000	**120**

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

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.

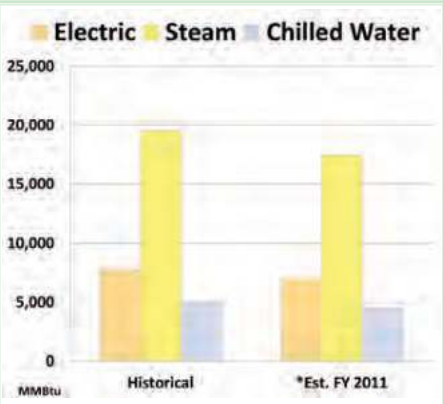
Dick Clark,
Manager of Facilities,
Biotechnology Center

Biotechnology Building

Map

Utilities Costs and Use

Biotechnology Lab:
Airflow Reduction Total Energy Use
Pre & Post ECI



* based on energy study

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

Energy Conservation Initiative (ECI) Project Summary
Boyce Thompson Institute, Facility 1076

What We Did: We upgraded and optimized the majority of the main air handlers for the building, with variable speed drives and new valves with modified ductwork to introduce return air thereby reducing energy consumption. We upgraded the legacy controls on the hot water heating systems to optimize and implement greater efficiency. We installed variable speed drives on exhaust fans to reduce energy consumption.

What It Cost: $377,000

How Long It Took: 6 months. Completed December 2014.

What We Saved: $80,000 and 113 tons/per year carbon equivalent annually.

Benefits: The project addressed many deferred maintenance items removing pneumatic controls in installing variable speed drives on supply and exhaust fan motors. Updated control sequences were added to optimize energy use.

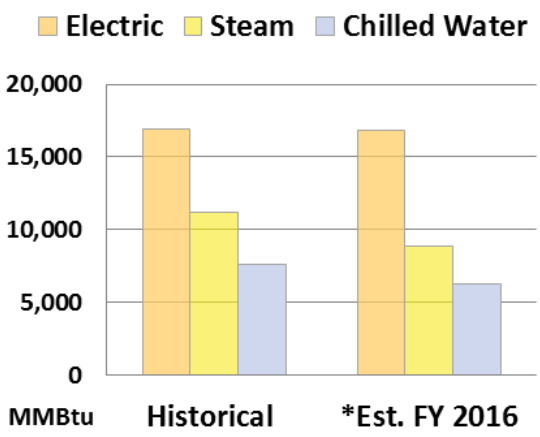
The energy conservation project at BTI addressed significant deferred maintenance. The updated building control system reduced energy use while increasing occupant comfort.

Mark Howe
Campus Energy Manager
Energy and Sustainability

Boyce Thompson Institute

Map
Utilities Costs and Use

Boyce Thompson Institute
Total Energy Use - Pre & Post ECI



*based on energy study

Boyce Thompson Institute: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	*Est. FY 2016 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical (billed rates)	*Est. FY 2016 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	17,000	16,800	200	1%	$348,000	$345,000	$3,000	5
Steam	11,200	8,900	2,300	21%	$252,000	$200,000	$52,000	30
Chilled Water	7,600	6,300	1,300	17%	$140,000	$115,000	$25,000	26
Totals	35,800	32,000	3,800	**11%**	$740,000	$660,000	$80,000	**61**

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
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.

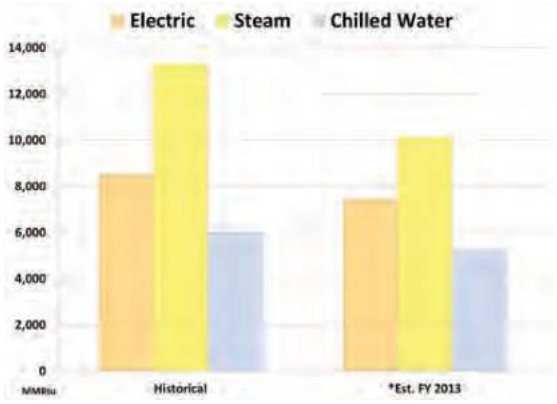
Benefits: Air flows and temperatures are now accurately controlled and minimized to reduce energy use and improve comfort and safety. Heat recovery systems are now all fully controlled and monitored digitally. Deferred maintenance issues were addressed while minimizing energy usage.

> 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

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.

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

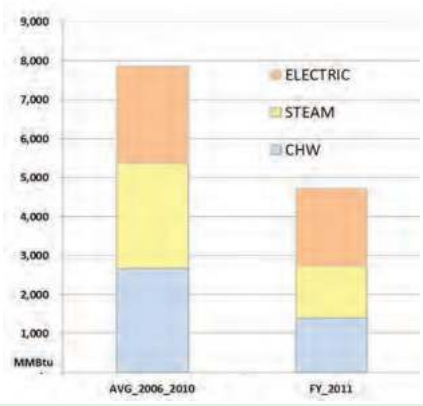
Cornell Store

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**

Energy Conservation Initiative (ECI) Project Summary
Duffield Hall Control Upgrade Facility 2000

What We Did: An energy study of this energy intensive laboratory building dedicated to nano-science found that many space controls were not functioning properly. New space controllers, network wiring, and logic upgrades now allow full functionality of control logic that varies laboratory and general space airflows and temperature setpoints based on occupancy. Relief air from general space conditioning now reduces mechanical room heated ventilation air.

How It Cost: $820,000

How Long It Took: 12 months. Completed March 2013

What We Saved: $221,500 and 550 tons/per year carbon equivalent annually.

Benefits: Even though a building is relatively "new," the controls can be outdated as was found in Duffield (vintage 2002). The new controls fixed a deferred maintenance renewal issue and they will be repaid through energy savings. The new controls will reduce routine maintenance costs along with providing energy savings and increased laboratory safety.

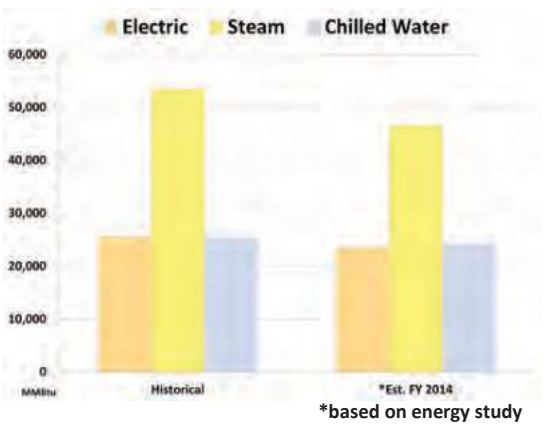
This was a very challenging project to complete in a fully operational lab building, but we did the work as this project is critical to our efforts to reduce energy usage in our buildings with the extra benefits of decreasing maintenance and increasing safety. We are really happy with the results and the ability of the ECI team to work in a fully functioning highly complex laboratory environment.

Bill Bader
Facilities Director
College of Engineering

Duffield Hall

Map
Utilities Costs and Use

Duffield Hall:
Total Energy Use - Pre & Post ECI



*based on energy study

Duffield Hall: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	2014 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	*Est. FY 2014 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	25,500	23,500	2,000	8%	$523,600	$482,000	$41,600	50
Steam	53,500	46,600	6,900	13%	$1,210,400	$1,052,800	$157,600	80
Chilled Water	25,300	24,100	1,200	5%	$464,400	$442,100	$22,300	24
Totals	104,300	94,200	10,100	**10%**	$2,198,400	$1,976,900	$221,500	**154**

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

Energy Conservation Initiative (ECI) Project Summary
Emerson Hall Controls, Facility 1028E

What We Did: We replaced outdated space and central system controls served by Air Handling Unit-1 (AHU1) with new digital controls with occupancy sensors. Minimum and maximum airflows were adjusted to current standards on hoods and laboratory spaces. Lab airflow control boxes were replaced with improved boxes which eliminated space airflow balance issues. Pneumatic reheat valves were replaced with electric valves optimizing space temperature control. Occupancy sensors were installed to minimize energy use by allowing space temperatures and airflow set points to reset during periods of unoccupancy.

What It Cost: $215,000

How Long It Took: 8 months. Completed September 2013.

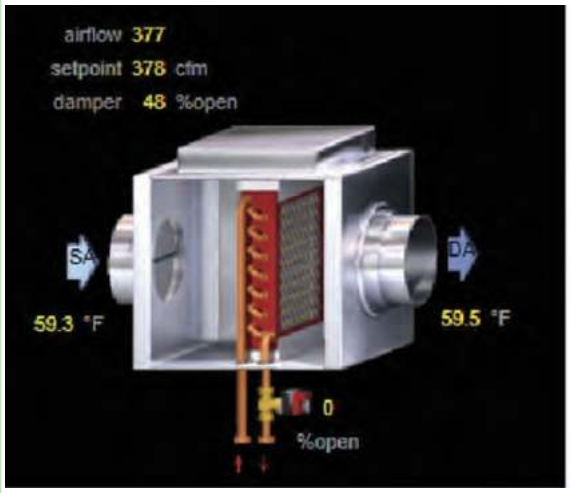
What We Saved: $54,000 and 107 tons/per year carbon equivalent annually.

Benefits: Air flows and temperatures are now accurately controlled and minimized to reduce energy use and improve comfort and safety.

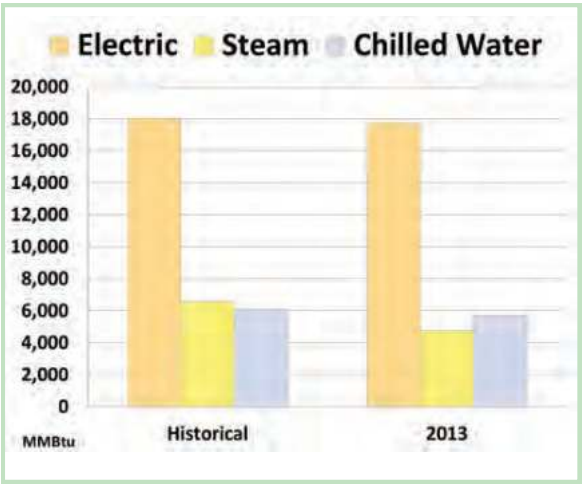
Updating the building HVAC controls provides increased functionality as well as contributing to a reduction in energy use.

Brian Flannigan
Facilities Manager
College of Agriculture and Life Sciences

Emerson Hall Controls



Emerson Hall Controls
Total Energy Use - Pre & Post ECI



Emerson Hall Controls: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	2013 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical (billed rates)	2013 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	18,000	17,800	200	1%	$370,600	$364,000	$6,000	5
Steam	6,600	4,800	1,800	27%	$149,000	$108,000	$41,000	20
Chilled Water	6,100	5,700	400	7%	$112,000	$105,000	$7,000	8
Totals	30,700	28,300	2,400	**8%**	$631,000	$577,000	$54,000	**33**

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

Emerson Heat Recovery, Facility 1028E

What We Did: The office and general space relief air was ducted to the lab's outdoor air intake which converted the existing 100% outside air supply system to a "mixed air" system. The laboratory space exhaust is not returned and leaves the building through dedicated exhaust. New air flow and temperature controls along with return ductwork were added to the system.

What It Cost: $120,300

How Long It Took: 4 months. Completed October 2013.

What We Saved: $25,500 and 48 tons/per year carbon equivalent annually.

Benefits: The returning of office and general space air as part of a "mixed air" system is very normal and reduces the need to heat and cool new air to provide temperature control in the occupied spaces. Air is only 100% exhausted from laboratory spaces. Because this "older" design did not have a return air component, energy use was significantly increased higher than necessary.

The reuse of conditioned air from offices is a common practice in new facilities and will have a huge benefit in reducing the carbon footprint of Emerson Hall. In addition, updating the building HVAC controls provides increased functionality as well as contributing to a reduction in energy use.

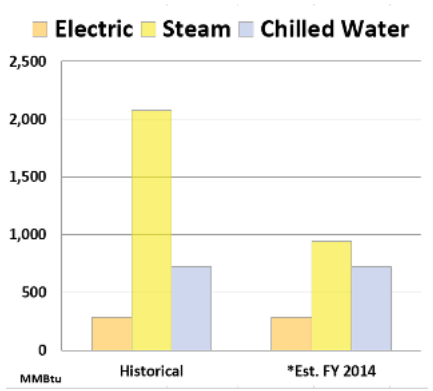
Brian Flannigan
Facilities Manager
College of Agriculture and Life Sciences

Emerson Heat Recovery

Map

Utilities Costs and Use

Emerson Heat Recovery:
Total Energy Use
Pre & Post ECI



* based on energy study

Emerson Heat Recovery: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	2014 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	*Est. FY 2014 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	300	300	0	0%	$5,900	$5,900	0	N/A
Steam	2,100	900	1,200	57%	$46,900	$21,400	$25,500	10
Chilled Water	700	700	0	0%	$13,300	$13,300	0	N/A
Totals	3,100	1,900	1,200	**57%**	$66,100	$40,600	$25,500	**10**

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

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.

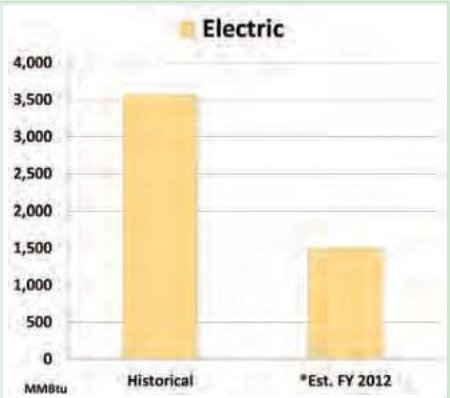
This project greatly improved the light intensity and usability of many of our old, dimly-lit growth chambers with a significant reduction in annual cost.

Nick VanEck,
Growth Chamber Supervisor

Growth Chamber Phase 2

Utilities Costs and Use

Growth Chamber Phase 2
Total Energy Use
Pre & Post ECI



* based on energy study

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

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.

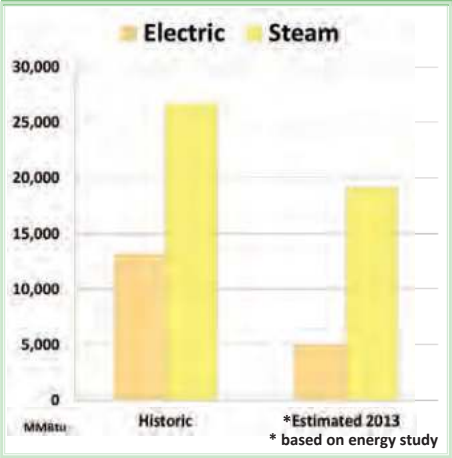
Andrew Leed,
Greenhouse Manager, Cornell University Agricultural Experiment Station

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
Totals	39,833	24,164	15,669	**39%**	$873,000	$536,000	$337,000	**287**

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
Ives Hall Complex , Facility 1003, 1007, 1007A, 1007E, 1007R, 1008

What We Did:
We implemented energy conservation measure throughout the Ives Hall Complex (Ives Hall, Ives East, Ives West, Dolgen Hall, IRL Conference Center and IRL Research). The existing building controls system was outdated and in need of repair. Outside air flow stations and control dampers, control valves, and control logic were added to accurately control temperatures and ventilation air. Variable speed drives were upgraded on a number of air handler fans. Space controls were upgraded throughout the complex.

What It Cost: $1,680,000

How Long It Took: 10 months. Completed April 2014.

What We Saved: $280,000 and 410 tons/per year carbon equivalent annually.

Benefits: The old controls in the building were a mixture of older digital and pneumatic technology that resulted in higher than necessary energy usage, maintenance issues, and maintenance costs. The new controls allow energy savings strategies, full web access for operations and maintenance, and much higher reliability. Air flow measurement allows accurate control of ventilation air with changes in occupancy, along with proper tracking of supply and return air flows.

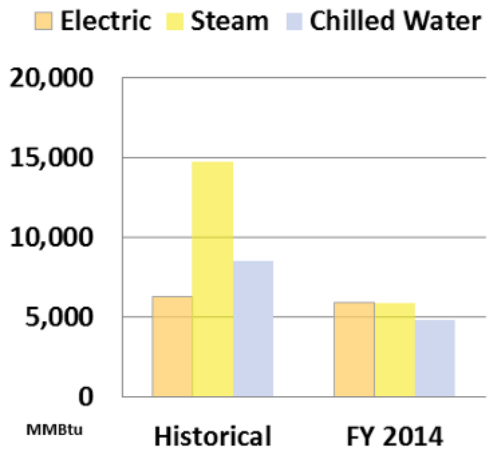
The Energy conservation project updated our building controls that were nearing the end of their useful life. The new controls will reduce our energy cost while increasing occupant comfort and reducing maintenance issues.

David Lippincott
ILR-Ives Facilities
Manager of Facilities

Ives Hall Complex

Map
Utilities Costs and Use

Ives Hall Complex
Total Energy Use - Pre & Post ECI



Ives Hall Complex: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	FY 2014 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	FY 2014 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	6,300	5,900	400	6%	$130,000	$120,000	$10,000	10
Steam	14,800	5,900	8,900	60%	$330,000	$130,000	$200,000	99
Chilled Water	8,600	4,800	3,800	44%	$160,000	$90,000	$70,000	76
Totals	29,700	16,600	13,100	**44%**	$620,000	$340,000	$280,000	**185**

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
Kinzelberg Hall, Facility 2032A

What We Did: We installed new digital space controls and upgraded the hood monitors and control sequence for each lab space. These new controls included new electronic Variable Air Volume (VAV) boxes, electric reheat valves, space motion detectors, variable frequency drives (on the fume hood fans), electronic space thermostats, discharge air temperature and hood sash monitors.

The new controls allow the supply and exhaust systems to operate together in order to reduce the lab air change rate when the space is not occupied.

New variable frequency drives were installed on the fume hood exhaust fans to adjust the hoods air flow (two positions) to reflect hood and lab usage, providing safe operating conditions for the researchers in the space.

A locally mounted space thermostat provides feedback to the control system to indicate whether space reheating is required. The discharge air sensor provides feedback to the control system preventing the control valve from delivering more reheated air to the space than is required.

What It Cost: $765,000

How Long It Took: 7 months. Completed June 2012.

What We Saved: $181,000 and 575 tons/per year carbon equivalent annually.

Benefits: The new electronic control system replaced an outdated constant volume and constant space temperature system with very limited control capability. The new system allows temperature and airflow setback which minimizes utility usage.

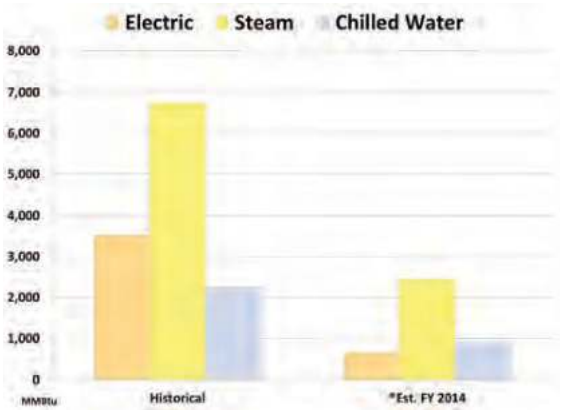
This was a very challenging project to complete in a fully operational lab building, but we did the work as a team very effectively. This laboratory now has up to date controls, increased safety, and significantly less energy use. The nearly 30 year old systems are now ready for the decades ahead.

Jim Hatch,
College of Human Ecology,
Facilities Manager

Kinzelberg Hall

Map
Utilities Costs and Use

Kinzelberg Hall:
Total Energy Use - Pre & Post ECI



*based on energy study

Kinzelberg Hall: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	2014 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	*Est. FY 2014 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	3,500	500	2,800	80%	$73,000	$14,000	$59,000	70
Steam	6,700	2,400	4,300	64%	$152,000	$55,000	$97,000	48
Chilled Water	2,300	900	1,400	61%	$42,000	$17,000	$25,000	28
Totals	12,500	3,800	8,500	**68%**	$267,000	$86,000	$181,000	**146**

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

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.

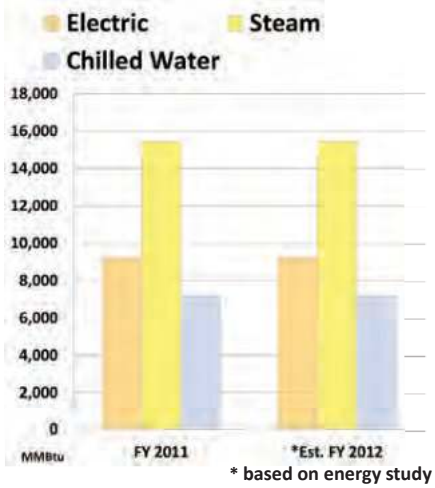
David Corson
Kroch Library Curator

Exhibit in Kroch Library

Map

Kroch Library Utilities Costs and Use

Kroch Library
Total Energy Use
Pre & Post ECI



* based on energy study

Kroch Library: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	FY 2011 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	2023	32%	$164,000	$112,000	$52,000	22
Chilled Water	7,153	6,685	468	7%	$119,000	$111,000	$8,000	9
Totals	21,746	17,398	4,348	**21%**	$463,000	$367,000	$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

Energy Conservation Initiative (ECI) Project Summary
Langmuir Lab Chiller Replacement, Facility 4204

What We Did: We replaced the "heart" of the air conditioning system in the building; an air cooled chiller. The new chiller was selected and installed in the same location as the original chiller to minimize project costs. The new chiller includes capacity controls and integration with the existing closed loop chilled water system in the building.

What It Cost: $256,000

How Long It Took: 6 months. Completed December 2013.

What We Saved: $6,000 and 23 tons per year carbon equivalent annually.

Benefits: The old chiller was nearing the end of its service life and was not efficient. The new chiller is fully automated for seasonal and daily on/off, is quieter, eliminates a deferred maintenance issue, and will use less electricity to provide building cooling.

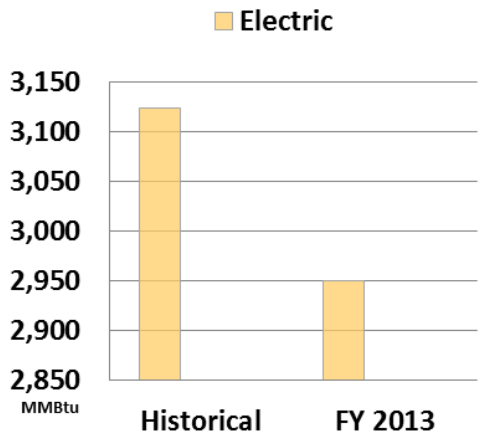
We were really happy to have the ECI team help us plan and execute the chiller replacement project. Customer reliability is key at this innovation hub, and we were able to tackle both deferred maintenance and significant energy reduction at the same time.

Tom LiVigne
Director, Real Estate

Langmuir Lab Chiller Replacement

Map
Utilities Costs and Use

Langmuir Lab Chiller Replacement:
Total Energy Use - Pre & Post ECI



Langmuir Lab Chiller Replacement: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	FY 2013 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	FY 2013 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	3,100	3,000	100	3%	$110,000	$104,000	$6,000	2.5
Steam								
Chilled Water								
Totals	3,100	3,000	100	**3%**	$110,000	$104,000	$6,000	2.5

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

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.

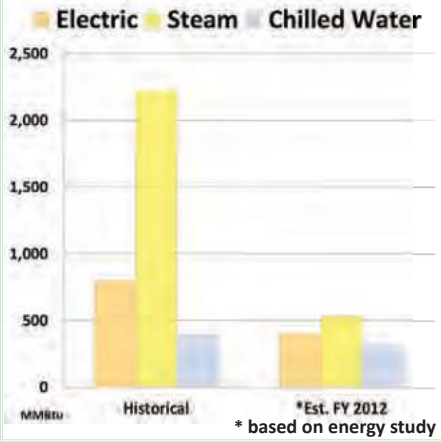
Pat Graham,
Facility Manager
Athletics and Physical Education

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

Energy Conservation Initiative (ECI) Project Summary
Malott Hall, Facility 2081

What We Did: We replaced and upgraded controls on both the central air handling systems and the occupied spaces throughout the building. Fan coil units in the building were modified to eliminate a previous piping arrangement that resulted in simultaneous heating and cooling.

What It Cost: $175,000

How Long It Took: 6 months. Completed 2013.

What We Saved: $30,000 and 60 tons per year carbon equivalent annually.

Benefits: The old controls in the building were a mixture of older digital and pneumatic technology that resulted in higher than necessary energy usage, maintenance issues, and maintenance costs.

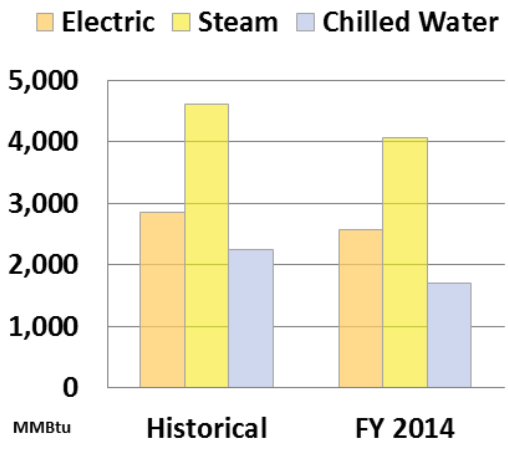
The new controls allow energy savings strategies, full web access for operations and maintenance, and much higher reliability. Air flow measurement allows accurate control of ventilation air with changes in occupancy, along with proper tracking of supply and return air flows.

The new controls provided by the energy conservation project reduced building energy use and increased occupant comfort. The control system allows me to easily monitor the building heating and cooling system to quickly address occupant comfort issues.
Joy Jones
Malott Hall building Coordinator

Malott Hall

Map
Utilities Costs and Use

Malott Hall:
Total Energy Use - Pre & Post ECI



Malott Hall: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	FY 2014 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	FY 2014 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	2,900	2,600	300	10%	$66,900	$60,300	$7,000	8
Steam	4,600	4,100	500	11%	$104,100	$92,100	$12,000	6
Chilled Water	2,200	1,700	500	0%	$41,100	$31,300	$10,000	10
Totals	9,700	8,400	1,300	**13%**	$212,100	$183,700	$28,000	**24**

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
Mann Library and Mann Library Addition, Facility 1027,1027A

What We Did:

Mann Library

We updated the sequences of operations to incorporate demand controlled ventilation allowing a reduction in minimum outdoor air setpoints in the air handling systems. Pumps were added to the preheat coils on the air handlers allowing better temperature control while reducing nuisance trips in cold weather. Adjustable speed drives were installed on multiple make up units and exhaust fans.

Mann Library Addition

Outdated controls were replaced throughout the space and central mechanical systems. Airflow stations were added to allow accurate control of outdoor air entering the building. Updated variable air volume (VAV) box controls enable improved temperature control throughout the building, occupancy sensor based unoccupied mode, and adaptive fan static pressure setpoint reset.

What It Cost: $840,000

How Long It Took: 12 months. Completed May 2014.

What We Saved: $150,000 and 198 tons/per year carbon equivalent annually.

Benefits:

The new controls allow the fan, pump and temperature control systems to be adaptive to user occupancy and significantly reduce energy usage. They also improve comfort and make maintenance much faster due to enhanced graphics, trends, and summary data.

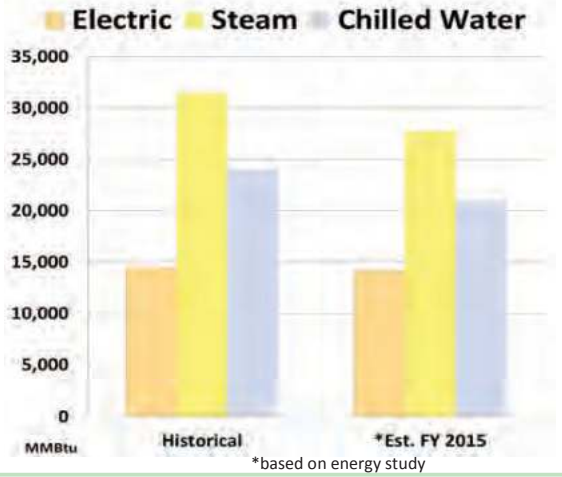
Updating the controls in Mann Addition along with the coordination of the building management systems between Mann and Mann Addition has resulted in a dramatic reduction of energy use at our facility. FY2014 is over 30% less than 2012!

Peter D. Paradise
Sr Director Facilities

Mann Library

Map
Utilities Costs and Use

Mann Library and Mann Library Addition,
Total Energy Use - Pre & Post ECI



*based on energy study

Mann Library and Mann Library Addition: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	*FY 2015 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	* FY 2015 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	14,500	14,000	500	3%	297,000	290,000	7,000	13
Steam	31,500	28,000	3,500	11%	710,000	630,000	80,000	39
Chilled Water	24,000	21,000	3,000	13%	440,000	380,000	60,000	60
Totals	70,000	63,000	7,000	**10%**	1,450,000	1,300,000	150,000	**111**

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
Olin Library Controls Upgrade, Facility 3680

What We Did: We replaced controls on all central air handling systems that were well past end of life and were in extremely poor condition. Outside air flow stations and control dampers, control valves, and control logic were added to accurately control temperatures and ventilation air. Variable speed drives were added on a number of air handler fans.

What It Cost: $737,200

How Long It Took: 10 months. Completed February 2013.

What We Saved: $139,000 and 227 tons/per year carbon equivalent annually.

Benefits: The project addressed severe deferred maintenance issues along with energy waste associated with non-functioning controls. The new outside air flow control ensures ventilation air at the correct quantities while minimizing energy usage.

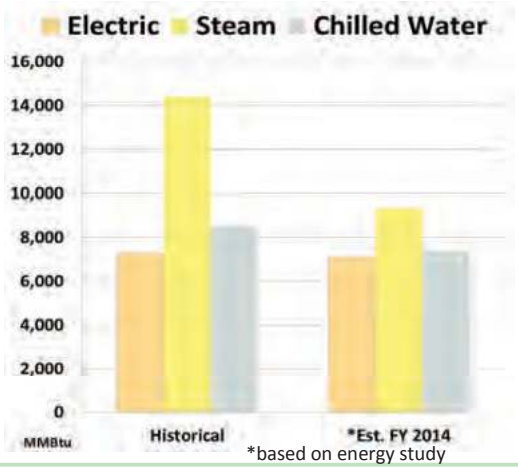
The Olin Library controls were in a severely deteriorated condition. With the completion of the ECI project we now have accurate control and full visibility of control logic and controlled parameters, ease of scheduling, and an improved level of occupant comfort. What a huge step forward while minimizing energy usage!

Phil Koons
Library Facilities Director

Olin Library

Map
Utilities Costs and Use

Olin Library Controls Upgrade
Total Energy Use - Pre & Post ECI



*based on energy study

Olin Library Controls Upgrade: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	*FY 2014 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	*FY 2014 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	7,277	7,099	178	2%	149,000	146,000	4,000	4
Steam	14,388	9,329	5,059	35%	325,000	211,000	114,000	56
Chilled Water	8,524	7,396	1,128	13%	156,000	136,000	21,000	23
Totals	30,189	23,823	6,365	21%	631,000	492,000	139,000	**83**

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
Olin Chemistry Research Wing , Facility 2083

What We Did: We replaced all space controls which were at end of life and not performing correctly with new controls and re-commissioned to new occupancy based airflows. We replaced 88 variable air volume boxes in areas where old boxes no longer worked. We replaced all reheat control valves to electric valves. We installed airflow stations on main exhaust system along with new controls to monitor exhaust airflow. Control logic was added to sum up ventilation air on supply boxes.

What It Cost: $1,240,000

How Long It Took: 15 months. Completed January 2015.

What We Saved: $246,000 and 440 tons/per year carbon equivalent annually.

Benefits: Updating controls and replacing variable air volume boxes and rebalancing to new air flows throughout the building addressed significant deferred maintenance. The new controls enable the building to operate in a safer, more comfortable, and efficient manner.

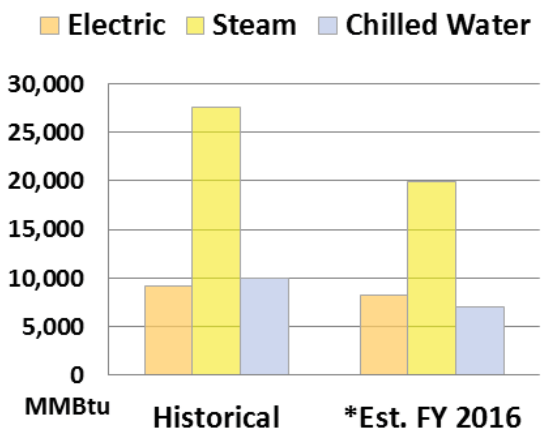
The HVAC controls upgrade for the Olin Chemistry Research Wing was a complete success on multiple levels. Your team was able to correct building deficiencies with minimal disruption to the building occupants and associated research activities. The building is now safer, significantly more energy efficient and has the added benefit of a user friendly control interface.

David R. Neish
Facilities Manager Chemistry and Chemical Biology

Olin Chemistry Research Wing

Map
Utilities Costs and Use

Olin Chemistry Research Wing
Total Energy Use - Pre & Post ECI



*based on energy study

Olin Chemistry Research Wing : ECI Savings Table

Utility	Historical Energy Use (MMBtu)	*Est. FY 2016 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical (billed rates)	*Est. FY 2016 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	9,200	8,200	1,000	11%	$189,000	$169,000	$20,000	25
Steam	27,600	20,000	7,600	28%	$624,000	$452,000	$173,000	80
Chilled Water	10,000	7,100	2,900	29%	$183,000	$130,000	$53,000	58
Totals	46,800	35,300	11,500	**25%**	$996,000	$751,000	$246,000	**163**

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

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

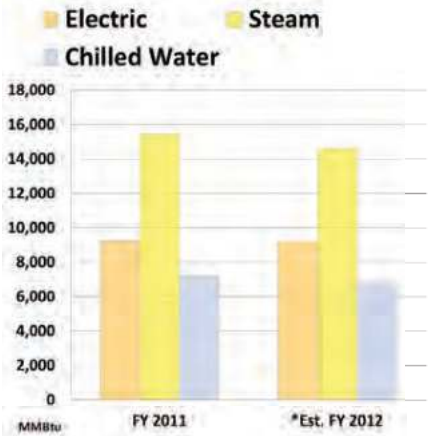
Plant Science Building

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

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.

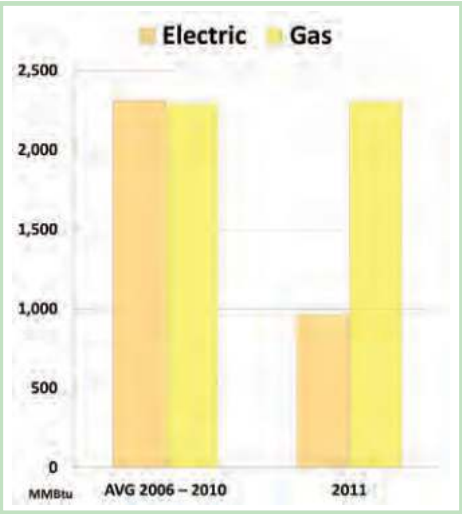
We went from the lowest to the highest light levels [among Ivy League NCAA tennis facilities], and expect to reduce energy use by over 50 %. Now others are following suit.

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
Totals	4601	3273	1328	**29**	95,250	55,750	39,500	**67**

Energy Conservation Initiative (ECI) Project Summary
Riley Robb Heat Recovery Project, Facility 1062

What We Did: We installed a new glycol loop and coils to transfer heat between the exhaust air and the outside air in a nominal 20,000 cfm 100% outside air laboratory ventilation system in the north wing. New controls were added to operate the system components and track energy recovery. All space controls were re-commissioned to minimize air usage with associated reductions in electricity, heating and cooling.

What It Cost: $160,000

How Long It Took: 6 months. Completed October 2013.

What We Saved: $35,000 and 61 tons/per year carbon equivalent annually.

Benefits: Heat leaving the building will be used to preheat incoming air in winter, and cool air leaving in summer will pre-cool outside air at peak conditions. Approximately 40% of all heat previously lost will be recovered reducing both peak and annual heating needs. Peak cooling reduction will help slow the need for future cooling capacity.

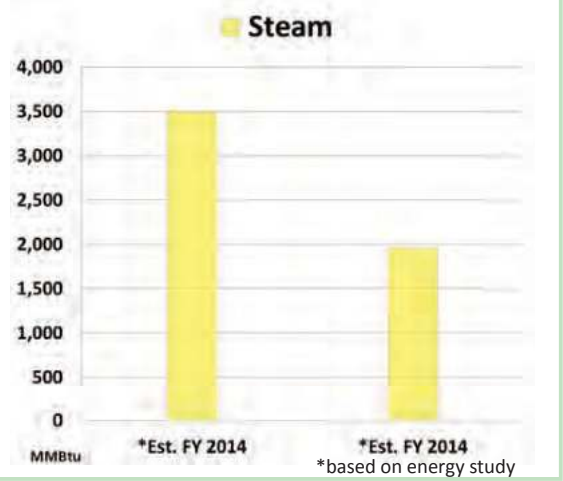
The project is very exciting because it is the first heat recovery ever retrofit to a building at Cornell. Our ECI team did a great job, and we have great hopes to retrofit further lab buildings based on the success at Riley Robb.

W.S. (Lanny) Joyce, PE
Director, Energy Management
Energy &Sustainability
Facilities Services

Riley Robb

Map
Utilities Costs and Use

Riley Robb:
Total Energy Use - Pre & Post ECI



*based on energy study

Riley Robb: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	*Est. FY 2014 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	*Est. FY 2014 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric								
Steam	3,500	2,000	1,500	43%	$79,200	$44,300	$35,000	20
Chilled Water								
Totals	3,500	2,000	1,500	**43%**	$79,200	$44,300	$35,000	**20**

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

Energy Conservation Initiative (ECI) Project Summary

Robert Purcell Community Center (RPCC) Space and Dining Kitchens Air-flow Control, Facility 3212

What We Did: We added dining cooking hood variable airflow controls that change exhaust and matching make up airflows with exhaust temperature and smoke concentration. New dining hood sensors and controls are complemented by new air handler and space air controls. The hoods operate on schedules and vary from minimum (50%) to maximum airflow based on ventilation demands. We completely replaced all space controls following a previous project that replaced all central mechanical controls. Central systems control logic was updated to utilize load information from the space controls, allowing central system pressure and temperature setpoints to vary with the load.

What Did It Cost? $824,000

How Long it Took? 8 months. Completed March 2013.

What We Saved:
$141,000 and 560 tons/year carbon equivalent annually.

Benefits: Airflow is now controlled based on cooking demands and schedules can be easily adjusted so that equipment is only running and air is exhausted when it needs to be. The result is a significant reduction in annual energy used to heat, cool, supply and exhaust the ventilation and make up air. User comfort was improved along with a significant reduction in energy use with the new controls providing accurate control of operation, airflows and temperatures. Significant deferred maintenance issues were eliminated due to the full controls replacement and recommissioning efforts.

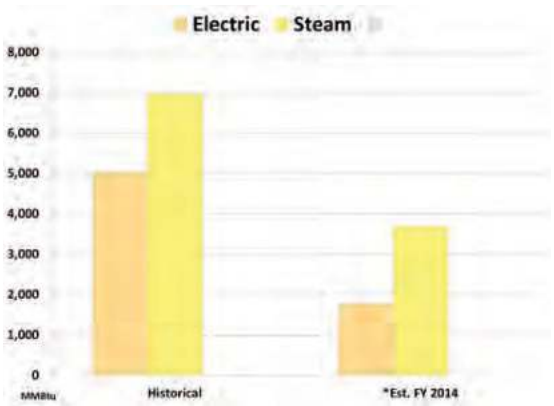
This project was part of our total kitchen controls updates to reduce energy usage and do better temperature control. It was a tough one to implement in operating kitchens, but the ECI team pulled it off with assistance from our Dining staff and it is working very well.

Bill Baldwin
Facilities Manager
Cornell Dining

RPCC Air-flow Control

Map
Utilities Costs and Use

RPCC Air-flow Control:
Total Energy Use - Pre & Post ECI



*based on energy study

RPCC Air-flow Control: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	*Est. FY 2014 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical Cost (billed rates)	*Est. FY 2014 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	5,000	1,800	3,200	64%	$103,100	$36,300	$67,000	80
Steam	7,000	3,700	3,300	47%	$157,600	$83,300	$74,000	40
Chilled Water								
Totals	12,000	5,500	6,500	**54%**	260,700	119,600	141,000	**120**

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
Snee Hall, Facility 2049

What We Did: The project converted building air handlers serving laboratory ventilation systems to full digital control. Variable speed drives and air flow stations were added to the air handlers to optimize ventilation entering the facility. The laboratory spaces were upgraded from pneumatic controls to full digital controls. Pneumatic reheat valves were replaced with electric control valves. All spaces throughout the building were re-commissioned to new airflows designated from Cornell EH&S (Environmental Health and Safety).

What It Cost: $370,000

How Long It Took: 7 months. Completed November 2014.

What We Saved: $76,000 and 177 tons/per year carbon equivalent annually.

Benefits: The project upgraded space controls in a majority of the spaces throughout the building. The existing pneumatic controls were well past their useful life and a major deferred maintenance item.

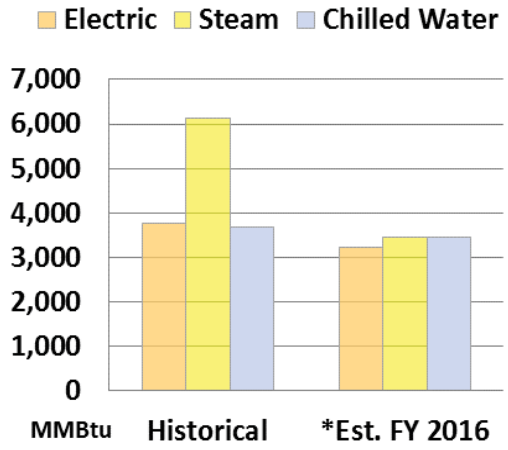
The project upgraded controls throughout many spaces in Snee Hall. Increasing comfort while saving energy.

Mark Howe, P.E., CEM,
Campus Energy Manager
Energy & Sustainability

Snee Hall

Map
Utilities Costs and Use

Snee Hall
Total Energy Use - Pre & Post ECI



*based on energy study

Snee Hall: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	*Est. FY 2016 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical (billed rates)	*Est. FY 2016 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	3,800	3,200	600	16%	77,000	66,000	11,000	15
Steam	6,100	3,500	2,600	43%	139,000	78,000	61,000	30
Chilled Water	3,700	3,500	200	5%	67,000	63,000	4,000	4
Totals	13,600	10,200	3,400	**25%**	283,000	207,000	76,000	**49**

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
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 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.

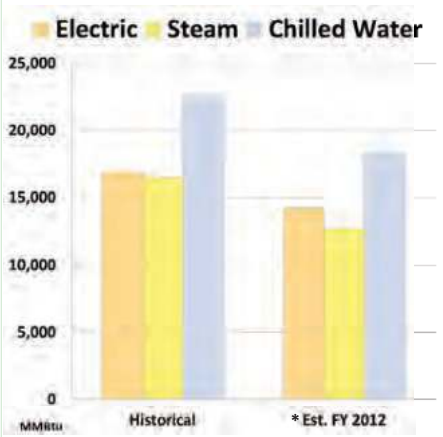
> The upgraded controls have enabled us to better operate our facility while reducing the buildings overall energy use.
>
> **Peter Meixell**
> **Facilities Manager**

Statler Hall

Map

Statler Hall Utilities Costs and Use

Statler Hall
Total Energy Use
Pre & Post ECI



* based on energy study

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
Totals	56,000	45,200	10,800	**19%**	$1,134,000	$914,000	$220,000	**196**

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
Vet Research Tower Facility Code 1140

What We Did: The temperature control system in this building was outdated and not performing properly and therefore needed to be upgraded with a new building automation system that improves efficiency and comfort. We upgraded the hydronic system in floors 2 through 7 with new electric valves on the reheat and radiation systems. Digital controls with temperature and occupancy sensors were added to control space temperature based on occupancy. In the basement and 1st floor we upgraded the space control to new controls with electric valves on the reheat. We installed new variable air volume boxes based on new air flow design criteria. We installed new temperature and occupancy sensors to adjust airflows and temperatures based on occupancy. We upgraded reheat, radiation and chilled water hydronic systems with new digital controls. We upgraded the mechanical system in the penthouse from pneumatic to digital.

What It Cost: $729,000

How Long It Took: 10 months. Completed October 2014.

What We Saved: $122,000 and 188 tons/per year carbon equivalent annually.

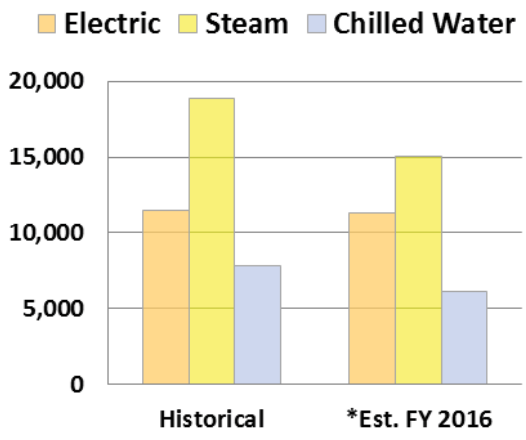
Benefits: The project replaced reheat and perimeter heating valves addressing a significant deferred maintenance item. These improvements allow better space temperature control and allow temperature setbacks during unoccupied periods.

> The upgraded building controls have significantly reduced energy use and improved occupant comfort.
>
> Mark Howe
> Campus Energy Manager
> Cornell Energy and Sustainability

Vet Research Tower

Map
Utilities Costs and Use

Vet Research Tower
Total Energy Use - Pre & Post ECI



*based on energy study

Vet Research Tower: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	*Est. FY 2016 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical (billed rates)	*Est. FY 2016 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	11,500	11,300	200	2%	$236,000	$231,000	$5,000	5
Steam	18,900	15,100	3,800	20%	$427,000	$340,000	$87,000	40
Chilled Water	7,800	6,100	1,700	22%	$143,000	$113,000	$30,000	34
Totals	38,200	32,500	5,700	**15%**	$806,000	$684,000	$122,000	**79**

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
Vet Education Center, Facility 1163

What We Did: We replaced and upgraded controls on both the central air handling systems and the occupied spaces throughout the building.

What It Cost: $145,000

How Long It Took: 8 months. Completed April 2014.

What We Saved: $21,000 and 55 tons/per year carbon equivalent annually.

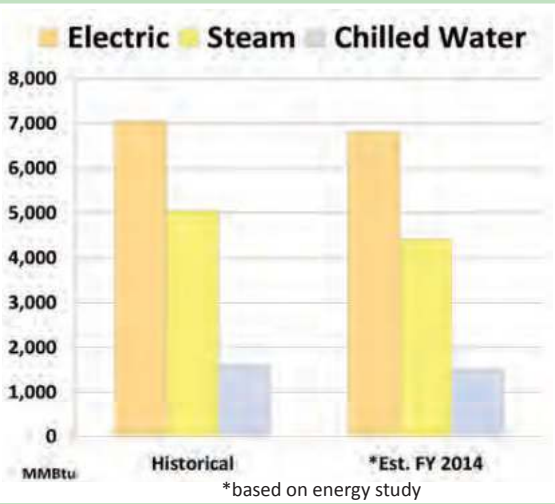
Benefits: The controls in VEC were a mixture of digital control generations and were poorly coordinated and difficult to maintain. The project allows the use of strategies that reduce energy usage and improve reliability, while making maintenance easier and faster when problems arise.

The ECI project at VEC was important because it brought all of the controls to a new common, highly functional and reliable level, while reducing energy use and maintenance costs.

Wayne Davenport
Director of Facilities
College of Veterinary Medicine

Vet Education Center

Vet Education Center
Total Energy Use - Pre & Post ECI



*based on energy study

Vet Education Center: ECI Savings Table

Utility	Historical Energy Use (MMBtu)	*Est. FY 2014 Energy Use (MMBtu)	Energy Savings (MMBtu)	% REDUCTION	Historical (billed rates)	*Est. FY 2014 Cost (billed)	Annual Savings $	Equivalent # Homes
Electric	7,100	6,800	300	4%	$145,000	$140,000	$5,000	8
Steam	5,100	4,400	700	14%	$114,300	$100,000	$15,000	10
Chilled Water	1,600	1,500	100	6%	$29,400	$28,000	$2,000	2
Totals	13,800	12,700	1,100	**8%**	$288,700	$268,000	$22,000	**20**

Energy use based on project scope

Equivalent # Homes Savings based on average home use: 40 MMBtu Electric ▪ 90 MMBtu Heat ▪ 50 MMBtu Cooling

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