

Sustainability Success at the University of Illinois Urbana-Champaign



Facilities & Services
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Sustainability efforts are at the core of the University of Illinois Urbana-Champaign's commitment to its land-grant university mission and to making a global impact across the state, nation, and world. Employees, students, and community members all help to define, implement, and support the university's successful and dynamic, multidisciplinary approach, which strives to achieve objectives aligned with renewables, energy conservation, waste management, active transportation, and enhanced sustainability education, innovation, and research.

The university signed the President's Climate Leadership Commitments in 2008, pledging to be carbon neutral as soon as possible and building resilience to climate change in the local community. In 2010, Illinois was the first Big Ten institution to submit a climate action plan that set strategic sustainability targets, including reducing emissions through decarbonizing legacy energy generation systems, adding significant on-site renewable energy sources, implementing aggressive conservation programs, and encouraging robust occupant behavioral change efforts.

The Illinois Climate Action Plan (iCAP) is the university's strategic plan to meet its goals and benchmark progress, with a new version to be released in 2025. Total campus greenhouse gas emissions have been decreased by more than 32 percent (183,809 MTCO₂E) from the iCAP baseline, and achieving the lofty standards in the plan has positioned the university as a sustainability leader within higher education and among its leading research university peers.

Over the last 15 years, momentum and bold actions from campus stakeholders, along with funding from the campus, student sustainability committee, federal and state grants, and centralized energy conservation

program reinvestments, have helped the university to incorporate new technologies and streamline the energy management processes of a ~\$100M/year energy enterprise. Since 2007, the campus has reduced its annual energy consumption per square foot by approximately 40 percent (116,433 BTU/GSF) through sustained energy conservation measures and programmatic focus.

Sustainability is embedded in campus operations and is critical to the work of all employees, who are dedicated to preserving and maintaining more than 600 buildings and almost 10 square miles of grounds. The university is continuing to transform and modernize its services to meet industry trends and adapt to the evolving needs of the campus, primarily through enhancements in utilities and energy production, distribution, conservation, permitting, and business operations. Thanks to ongoing teamwork, thoughtful planning, and collaborative outreach, the university has made remarkable achievements over the last two decades and is well positioned for significant advancements in the years ahead. Below is a list of the university's vital accomplishments to date:



Renewable and Low Carbon Energy

SOLAR

- **Solar Farm 2.0** – The 54-acre, 12.3 MWdc bifacial solar array with a tracking system was energized in January 2021. The site has already produced 56.6 GWhs of energy for use by the campus. The installation was built with zero waste construction and is also the home to an ongoing multi-university research study about pollinator plantings under solar arrays. Last summer, sorghum, soybeans, and red clover plots were established by the Sustainably Colocating Agricultural & Photovoltaic Electricity Systems (SCAPE) research team. This work represents some of the initial steps this group has taken to initiate photovoltaic field research plots on the campus. Additionally, the solar farm serves as a public site for campus community tours. The university has also collaborated with Illinois State University to produce a virtual reality solar tour for K-12 students in Illinois.
- **Solar Farm 1.0** – A 21-acre, 5.87 MWdc fixed-panel solar array was energized in December 2015 on south campus and has produced 57.6 GWhs of energy since inception. The first on-site utility-scale array at the university generates approximately 7,000 MWh/year, the equivalent of about 700 homes, or two percent of the annual power needs of the campus.
- **Wind Power Purchase Agreement (PPA)** – An agreement with Rail Splitter Wind Farm, LLC, to purchase 8.6 percent of the wind farm production and associated Renewable Energy Certificates (RECs) from a wind farm north of Lincoln, Illinois was signed in November 2016. This PPA includes the delivery of wind energy to campus when the resource is prevalent, and it provides 25,000 MWh/year.
- **Medium and Small Scale Solar Installations** – Numerous rooftop/ground-mounted solar installations are active throughout campus property. The sites range from the 278,000 kW rooftop array on the Electrical and Computer Engineering (ECE) Building to photovoltaic panels at Allerton Park & Retreat Center and Wassaja Hall. These installations began with the Business Instructional Facility in 2009 and continue to be installed with new construction or major renovations whenever feasible. These smaller-scale installations are contributing over 575 MWh/year of electricity.
- **Environmental Protection Agency Green Power Partner** – Since 2015, The Environmental Protection Agency (EPA) has recognized the university as a Green Power Partner for its production and acquisition of electricity from clean, renewable sources. The EPA Green Power Partnership encourages organizations to purchase green power to reduce environmental impacts associated with conventional electricity use. The U of I is ranked 30th nationally with 46,698 MWh/year of usage.



Solar Farm 2.0

GEOTHERMAL



Hydrosystems Laboratory Heat Exchanger Loops

- **Campus Instructional Facility** – This innovative installation for one of the campus' newest buildings used cutting-edge research from faculty to reduce the up-front installation costs of low-temperature geothermal heat exchange technology and monitor the operational efficiency of the system. Through this collaboration, the project reduced the number of boreholes required while shortening the payback period from 40 to 28 years.
- **Hydrosystems Laboratory** – This method of reducing greenhouse gas emissions incorporated conventional geothermal heat exchanger loops in the foundation of a new "smart" suspension pedestrian bridge that connects the Hydrosystems

Laboratory addition to the Newmark Civil Engineering Laboratory. The construction process used 50-foot-deep drilled shaft foundations to reduce overall geothermal installation costs, provide for onsite research, and heat and cool a new instructional geotechnical laboratory in the building. By drilling separate boreholes for the exchanger loops, the innovative approach is almost 40 percent cheaper than the conventional methods of geothermal systems. The project is estimated to supply 515 million BTU/year and an annual greenhouse gas emissions (GHG) reduction of approximately 100 metric tons of CO₂/year.

- **Wymer Hall** – Geothermal energy technologies will support heating and cooling for the new 100,000 GSF state-of-the-art hybrid educational facility, which will be used primarily by the Gies College of Business. Substantial completion of the facility, including the geoexchange system, is expected in 2025.

ENERGY FARM



Underground Thermal Battery Test System

- **Battery Storage** – An underground thermal battery (UTB) test system at the university's Energy Farm uses a water tank installed in the shallow subsurface to exchange heat with the ground. A ground-source heat pump coupled with the UTB can heat or cool a building more efficiently than conventional air-source heat pumps or combined air conditioners and furnaces. Because the geothermal system is installed in a shallow borehole less than 25 feet deep, installation costs could be cheaper than a conventional borehole heat exchanger, usually installed at depths of more than 200 feet. In addition, the large thermal capacity of the UTB can be used for either passive or active thermal energy storage, which can help reduce energy costs by utilizing low-cost electricity during the day and shedding the demand for electricity during peak hours for the electric grid.

- **Agrivoltaics Solar Installation** – The Energy Farm also facilitates a small-scale solar panel setup for vegetable growth research. This project generates solar energy that is connected to the campus grid.
- **Biomass Boiler** – Activated in June 2017, a demonstration site for biomass energy at the Energy Farm produces exclusive heating for a two-story greenhouse with a 198 kW boiler.



Biomass Boiler

Research and Innovative Solutions



Abbott Power Plant Research and Engagement Support

- **Carbon Capture at Abbott Power Plant** – Abbott Power Plant, a cogeneration facility that simultaneously produces steam and electricity, has facilitated several carbon-capture research projects funded by the Department of Energy, in partnership with researchers from the Prairie Research Institute. First, staff collaborated with Linde Gas North America to test three technologies for reducing aerosol particle concentrations in flue gas. This work is intended to help make solvent-based carbon capture technology more economical on a commercial scale. The second project strived to advance the early development of a CO₂ absorption technology at 40 kilowatts following successful proof-of-concept and lab-scale research. This technology uses a novel biphasic CO₂ absorption process that involves applying a proprietary solvent developed by Illinois State Geological Survey

researchers for post-combustion CO₂ capture. This method could dramatically improve energy efficiency, lower the equipment cost and footprint, and maintain operational simplicity. Third, a 500 kW carbon capture system engineering design and feasibility study was completed over the past few winters. This project tested new absorbents and carbon capture system modifications that focused on increasing the efficiency and lowering the cost of removing CO₂ from flue gases.

- **Illinois Geothermal Coalition** – The Illinois Geothermal Coalition is a group of corporations, nonprofits, geothermal professionals, and researchers seeking to establish Illinois as a leader in geothermal energy. Through sharing experiences with new technology, implementation of existing and future technologies, support for the various geothermal efforts by members, and utilization of the campus as a living learning laboratory, this coalition is collaborating to strengthen and advance the implementation and design of geothermal energy systems in the Midwest.
- **Illinois Microreactor Demonstration Project** – Faculty in the Department of Nuclear, Plasma, and Radiological Engineering (NPPE) received funding to develop an energy model for the campus and test the integration of micronuclear technology with the district heating system. The project has the potential to make the campus the first to demonstrate how microreactor systems integrate with existing fossil fuel infrastructure to accelerate the decarbonization of existing power-generation facilities, introduce a safe and climate-conscious solution for next-generation energy markets, and provide the critical training necessary for the emerging clean-energy focused workforce. If implemented, this system could produce 12.9 percent of the total energy demand on campus, with 137,867 MWh/year steam and 11,945 MWh/year power. The technology could reduce campus emissions by 27,500 tons/year.



Conceptualization of the Illinois Microreactor Demonstration Project

ENERGY EFFICIENCY IMPROVEMENTS

- **Retrocommissioning (RCx)** – F&S established the RCx program in 2007 with a single team. Since then, the program has grown in personnel support and scope to address over 90 campus facilities, has achieved over \$118M in energy cost avoidance, and received \$1.4M in energy efficiency incentives. Staff expect to analyze and commission 500,000 GSF each year with energy savings projected of between 8,186 MMBTUs and 24,560 MMBTUs/year, which amounts to 10 to 27 percent of the energy consumption in buildings visited.



Retrocommissioning and Recommissioning

- **Recommissioning (ReCx)** – To retain the energy savings from RCx projects, a complementary preventative maintenance program was established. The focus of these ReCx visits is to reduce energy consumption while also evaluating building mechanical systems, which includes reviewing current codes and identifying noncompliant items so they operate safely and efficiently, as well as improving the building's environmental conditions for the occupants. ReCx teams have delivered evaluations for 1.25M square feet of campus space, a 10 to 25 percent decrease in energy per building, and a total of 23,000 to 60,000 MMBTU/year reduction.

- **Energy Performance Contracting (EPC)** – The Urbana campus has now executed over \$100M of EPC projects with energy service companies (ESCOs), starting with the College of Veterinary Medicine facilities in 2010, which resulted in an estimated cost avoidance of \$1M annually. To date, 17 energy-intensive, research-focused buildings have benefited from the EPC delivery method, resulting in guaranteed savings of approximately \$6M annually. EPC investments are projected to be \$95.6M from FY23–FY26, with an anticipated \$5.965M/year energy savings, a \$27M reduction of deferred maintenance, as well as a receipt of \$1.375M of energy rebates.
- **Boiler and Chiller Upgrades** – As a part of long-range utilities master planning efforts, the campus has continually invested in improved energy efficiency projects for production at Abbott Power Plant and the Campus Chilled Water System (CCWS). A controls upgrade for one of the electricity turbines saved 17,000 MMBTU/year. The conversion of another turbine at Abbott saved an additional 40,000 MMBTU/year due to the energy savings associated with running a backpressure turbine compared to a condensing turbine.
- **On-Site Demand Response Solutions** – The university utilizes a 6.5 million gallon Thermal Energy Storage (TES) tank as a part of the CCWS, which can provide 50,000 ton-hours of cooling. The tank allows an additional 8,000 tons of peak cooling for the central system and eliminates the need to install additional infrastructure. Multiple energy storage efforts are underway, with collaborations between researchers and F&S. This includes feasibility studies for natural gas storage, hydrogen energy storage, compressed air energy storage, and geothermal battery systems. There is also an effort to expand thermal energy storage with another tank on campus.
- **Heat Recovery Chillers** – There are now eight buildings utilizing heat pump technology and combining the outputs of both the high pressure side (for heat) and the low pressure side (for cooling). Under this arrangement, they are considered “heat recovery chillers” and take advantage of adjacent systems that have a simultaneous need for heating and cooling. This enables the campus to provide building heating from an electric source and approximately doubles the overall efficiency when operating in this mode.
- **Energy Efficiency Standards** – A goal set in the 2015 iCAP included establishing the highest achievable energy efficiency standards for the campus. The University Facilities Standards now require new construction buildings to “quantify energy performance as compared to a ‘baseline’ building detailed in the latest adopted edition of ASHRAE Standard-90.1, Appendix G. For the 2013 edition, each proposed building construction is to achieve a minimum 25 percent improvement, while major renovations are to achieve a minimum 20 percent improvement. For the 2016 and later editions, each proposed building construction is to achieve a minimum 25 percent reduction in its Performance Cost Index (PCI) as compared to its Performance Cost Index target (PCIt), while major renovations are to achieve a minimum 20% reduction.” This is an aspirational goal for some projects but is regularly achievable.
- **LEED Certification** – There are now 32 LEED® certified projects at the university, accounting for over 14 percent of building space, with more projects actively pursuing certification. In 2023, the Electrical and Computer Engineering Building became the university’s first zero energy-certified facility, recognized by the International Living Future Institute for innovative facility design and clean energy produced on campus. All of the operational energy associated with the building is now offset through a combination of on-site solar production and solar renewable energy credits.
- **LED Campus Commitment** – U of I’s relationship with light emitting diode technology goes back decades to when the inventor of the first practical visible-spectrum LED, alumnus Nick Holonyak, Jr., joined the faculty in 1963. Illinois has committed to becoming the first major research university to use the technology as its primary lighting source by 2050. This transformation began in 2008 with exit signs, continued with wayfinding signage, and included a Big Ten collaboration to reduce energy consumption in parking lots.

Transportation Network Improvements and Engagement

- **Bicycle Friendly University** – The campus is recognized as a silver-level Bicycle Friendly University by the League of American Bicyclists. Ongoing upgrades to bike infrastructure and increases in bicycle programming, such as bike sharing and educational events, are promoting active transportation options as a viable alternative to single-occupancy vehicle usage and aiding in lowering campus community vehicle emissions.

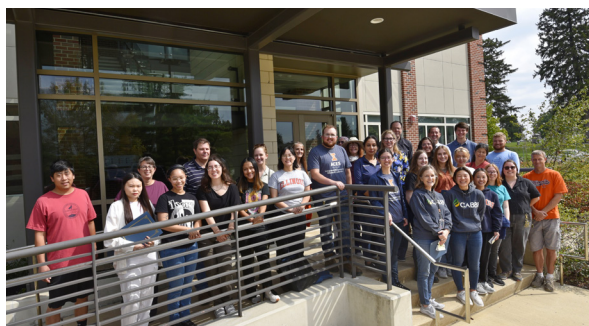
- **Complete Street Improvements** – The university prioritizes the transition of campus roads to complete streets whenever possible to better balance transportation modes, enhance accessibility, and help improve mobility and convenience for pedestrians and cyclists. Over the last several years, core University District streets like First Street, Fourth Street, Wright Street, Armory Avenue, Green Street, and Goodwin Avenue have been revitalized through priority projects.



Complete Street Improvements

- **Vehicle Fleet Emissions** – Decreasing fuel consumption and fleet emissions helped the University of Illinois earn accreditation as a sustainable fleet by the National Association of Fleet Administrators (NAFA). The accreditation shows that F&S is taking a proactive approach to managing its existing internal combustion engine vehicle fleet and pursuing electrification whenever possible to protect the environment. The university is the first state and Big Ten Conference to earn NAFA sustainability accreditation.

Education and Occupant Action



International Laboratory Freezer Challenge

- **International Laboratory Freezer Challenge** – For the last six years, the university has been honored with an award for achieving significant energy conservation results in the International Laboratory Freezer Challenge. From January to July 2023, researchers on the Urbana campus collectively earned a third “Winning Streak Award” by operating their labs with efficient and sustainable cold-storage sample management practices to improve energy efficiency, reduce costs, and protect sample integrity while earning competition points. Last year, 94 labs combined to save an estimated 479,792 kilowatt-hours (kWh), or the equivalent energy usage of 43 typical U.S. homes annually.

- **Energy Conservation Incentive Program (ECIP)** – Started in 2013, the ECIP encourages occupant action at the building-level by increasing departmental participation by recognizing the top energy reduction facilities on campus each year, compared to the previous year. In the initial years of this program, ECIP winners were provided a financial award that reflected their energy cost reductions. With a new Integrated and Value-Centered Budgeting model, all colleges with energy reductions receive the benefit from those reduced costs.
- **Beat the Peak** – The amount of energy the university consumes during the highest rate of demand on our regional electric grid helps to determine the campus’ annual utility rate. This peak period traditionally occurs in July or August. When peak energy occurs for our region, F&S activates a campuswide communication campaign to encourage immediate conservation efforts to the greatest extent possible.
- **Energy Dashboards** – Real-time electricity consumption data for the campus’ buildings is publicly available on a micro-website. A dashboard enables users in these selected buildings to view and track their energy usage. The top 80 buildings on campus are now on the dashboard and display load information for electricity, campus chilled water, steam, and domestic water. The dashboards display the entire building energy load in real time and average over the last 24 hours. The ECE Building also features a specific net zero energy display incorporating energy credits. Similarly, the Campus Instructional Facility tracks the geothermal system and the related energy avoidance.
- **Shut the Sash Program** – Fume hoods are an essential aspect of lab safety, yet they are also high energy users. To reduce the impacts of fume hood energy consumption, the campus has developed a Shut the Sash campaign, which educates fume hood users on best practices for the safe and sustainable operation of fume hoods in campus laboratories.