Facilities & Services – University of Illinois at Urbana-Champaign

Introduction

The University of Illinois at Urbana-Champaign is proud of its sustainability initiatives, and Facilities & Services (F&S) is honored to support the campuswide Illinois Climate Action Plan (iCAP). Sustainability is a systemic part of F&S and is critical to the work of all 1,250 employees dedicated to preserving and maintaining 647 buildings and the campus grounds. F&S provides physical plant, utility, operational, and essential services to sustain an environment that fosters research, teaching, and public engagement. Sustainability is incorporated into everything from simple ideas like using low-flow water fixtures to complex initiatives such as dedicated retrocommissioning (RCx) teams for energy conservation (2011 award winner).

In February 2008, the Chancellor signed the Climate Commitment pledging our campus to be carbon neutral as soon as possible and no later than 2050. The iCAP includes strategic goals and specific objectives toward achieving this carbon-neutrality goal. One of the most important and challenging goals is a shift from conventional carbon-intensive energy production to a future of low-carbon or renewable energy for campus. F&S is submitting this application to the Illinois Governor's Sustainability Award for the Renewable Energy Program and specifically the new 20-acre Solar Farm.

Efforts to incorporate renewable energy for campus have been underway for well over a decade. This award application focuses on the approved renewable energy projects that are within the scope of the iCAP goals, from both the original 2010 iCAP and the updated 2015 iCAP. [1] The iCAP physical boundary is the contiguous main campus property; the financial boundary is limited to the operational items over which the campus has direct operational control. Operational control refers to the authority to introduce and implement operational policies. Thus, renewable energy projects outside of the contiguous main campus are not included in this application; for example, the biomass, geothermal, and solar photovoltaics (PV) at Allerton Park and Recreation Center. Likewise, student engagement projects like the international Solar Decathlon competition are not included within this Renewable Energy Program.

Context of Renewable Energy Program

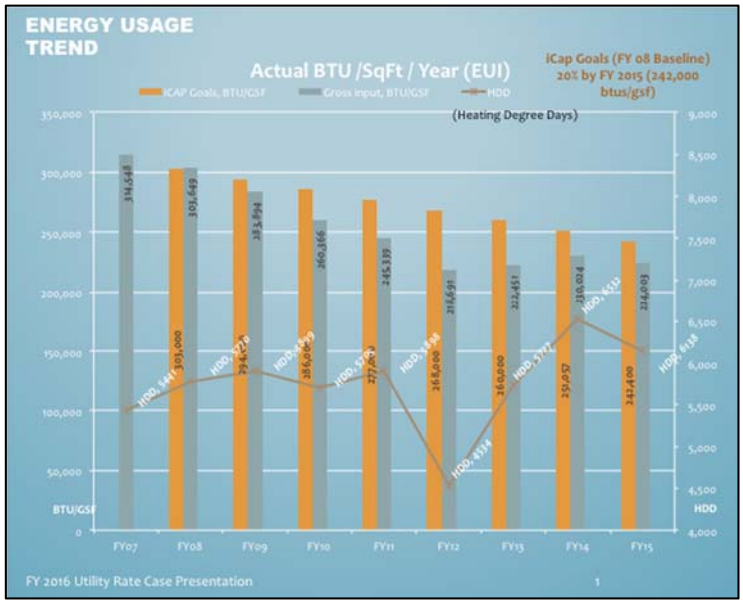
After the 2010 iCAP was established, F&S worked with sustainability staff, students, faculty, and campus administration to initiate a comprehensive energy master plan in 2012. In addition to identifying a path toward carbon neutrality, the plan focused on providing the best possible safe, reliable, cost-effective, and sustainable utilities service that meets campus energy needs. The Utilities Production and Distribution Master Plan (UMP)[2], completed in September 2015, included several key recommendations for moving forward with Climate Commitment goals. Four key UMP recommendations:

Limit campus growth to net zero gross square feet

Campus growth has the single greatest impact on greenhouse gas (GHG) emissions and greatly affects energy and carbon reduction strategies presented in the study. The UMP recommends strongly enforcing the Net Zero Growth Space Policy.[3] Doing so will reduce the need to build additional utilities infrastructure, including costs of acquiring and installing new utility assets, and keep the campus within current air permitting regulations.

Expand the energy conservation program[4]

As recognized by the 2011 Illinois Governor's Sustainability Award, campus has successfully reduced energy use in existing buildings, and this trend continues today. Energy conservation is considered the easiest and most cost-effective way to achieve reductions in emissions. Campus has achieved great success in conservation, with project payback periods and energy savings guarantees through two RCx teams, Energy Performance Contracting, campuswide lighting retrofits, and incorporating LED technologies. After RCx work to improve the operation and maintenance of building systems, the average energy use reduction is 28% with an estimated total cost avoidance of $30M since the start of the program in FY08 (see chart on right).



[1] http://sustainability.illinois.edu/campus-sustainability/icap/
[2] http://www.fs.illinois.edu/services/utilities-energy/production/master-plan
[3] http://cam.illinois.edu/viii/VIII-23.htm
[4] http://www.fs.illinois.edu/services/utilities-energy/energy-conservation

Enhance best-in-class diversified fuel cogeneration plant[5]
Abbott Power Plant is a combined heat and power (CHP) plant, producing electricity and recovering waste heat from that process to heat the campus. That makes Abbott nearly twice as efficient as a conventional power plant. Also, since CHP uses much of the waste heat that otherwise would have been rejected to the atmosphere, CHP results in lower overall emissions. Due to lower natural gas fuel prices and conservation initiatives to reduce steam demand on campus, Abbott Power Plant has been able to reduce coal consumption by almost 50% since 2009. Additionally, carbon capture technology is under investigation, which would enable campus to meet the iCAP carbon-neutrality goals while maintaining fuel flexibility.

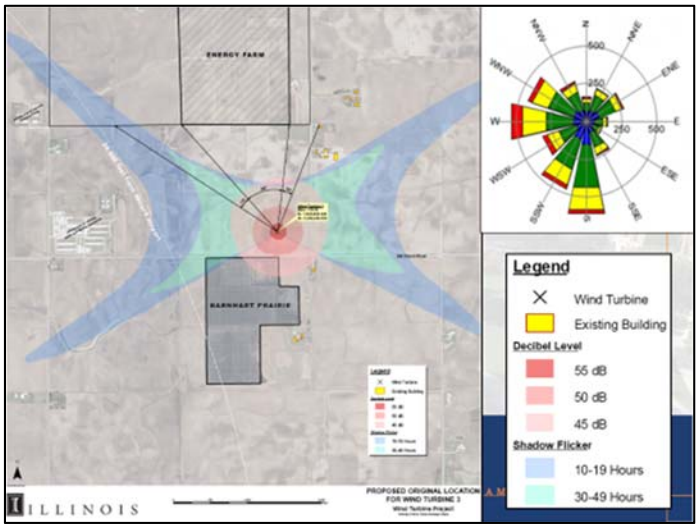
Pursue additional renewable projects and renewable power purchase agreements
Five major Renewable Energy Program projects (described below) have been implemented since signing the Climate Commitment in 2008. The most significant project went into commercial operation in 2015, with the completion of the Solar Farm. The UMP recommends continuing to pursue renewable energy projects and power purchase agreements (PPA), which supports the current iCAP renewable energy goals.

In the 2010 iCAP, campus committed to a preliminary goal of 5% renewable electricity by FY15, with an initial focus on wind energy. With the approval of the updated 2015 iCAP in October 2015, the campus set two updated renewable energy targets: (1) expand on-campus solar energy production to produce at least 12,500 MWh/year by FY20, and (2) expand the purchase of clean energy to obtain at least 120,000 MWh/year by FY20. Much of the progress in the Renewable Energy Program so far has been initiated and supported by the Student Sustainability Committee [6] (SSC) (2010 award winners).

History of Renewable Energy Program
Starting in 2002, students began aggressively advocating for a campus renewable energy program. In 2003, the Students for Environmental Concerns initiated a student fee in support of clean energy (the Cleaner Energy Technologies Fee). The types of projects can include wind power, solar energy, and other renewable technologies such as hydrogen, biomass, and geothermal systems. In 2007, the students campaigned for an additional fee (the Sustainable Campus Environmental Fee) in support of a wider variety of sustainability initiatives including sustainable campus development, green buildings, energy efficiency, sustainable resource purchasing, education, and campus engagement to create a more sustainable campus environment.

Today these two fees allow the SSC to annually allocate nearly $1.1 million to projects that promote the campus goals and directly impact Illinois students through improved infrastructure, services, and educational events. Since the inception of the SSC fees, the students have contributed $1,893,577 to various renewable energy projects that fit within the iCAP objectives. Several smaller SSC funding allocations went toward feasibility studies and pilot programs, and some of the funds were pledged for projects that are still underway. Of the five fully implemented projects described below, SSC contributed a total of $1,206,464. The group continues to be a strong stakeholder and advocate for campus sustainability initiatives.

Wind Farm Effort: 2003-2011
With strong support from the student body, in 2005 F&S began working with the students to purchase one to three utility-scale wind turbines on campus property. The students were primarily interested in a visible symbol and educational opportunity for increasing awareness among the student body of clean energy production options and the existing and planned sustainability programs on campus.



The wind farm effort continued for several years — from feasibility studies (see study images to the left) to seeking funding and evaluating proposals, to gaining campus and university approvals — until 2011. Ultimately, the wind farm project was cancelled due to neighborhood concerns including noise impacts, shadow flicker effect, property values, cell phone and wireless internet signal strength, agricultural aviation requirements, and quality of life impacts. With the various commercial wind farms available for educational purposes, and considering the community feedback, the project was cancelled in 2011 by a University of Illinois Board of Trustees (BOT) subcommittee. This

[5] http://www.fs.illinois.edu/services/utilities-energy/production
[6] http://ssc.sustainability.illinois.edu/

setback, however, did not stall efforts in support of renewable energy. While the wind farm effort was progressing, campus made strides in solar energy generation.

Business Instructional Facility (BIF) Solar PVs: June 2009

The first major renewable energy project implemented on campus was on the roof of the Business Instructional Facility in June 2009. The 32.76 kilowatt (kW) array is above the DeLoitte Auditorium (see photo on right), with a maximum output of 40 kilowatt-hours (kWh) per hour. The array is composed of 24 strings of seven modules each. Each module is rated at 195 Watts. The system uses six 5 kW rated inverters and is connected to the campus grid. The College of Business hosts a website that shows the solar output of this system by day and another site that shows the annual output (screen shots shown below). In FY15, the BIF solar array generated 42,151 kWh total.

These solar panels are part of the LEED®-Platinum design of the building, which was also the first LEED® certified[7] building on our campus. The $270,829 cost of the PV array received funding of $81,863 from the SSC and $186,500 from the Illinois Clean Energy Community Foundation (ICECF).

Building Research Council (BRC) Solar PVs: June 2013

The BRC solar test bed was completed in June 2013.[8] This 14 kW array provides the Illinois Center for Smarter Electricity Grid (ICSEG) with a research platform. According to the ICSEG website, "The key objective is to test and validate within a laboratory setting how new and more cost-effective Smart Grid technologies, tools, techniques, and system configurations can be used in trustworthy configurations that significantly improve upon the ones that are in common practice today. The laboratory is becoming a resource for Smart Grid equipment suppliers and integrators and electric utilities to allow validation of system designs before deployment."[9] This array also provides accessible instrumentation to allow visualization of performance data in real time over a secure web connection. This project was installed with support from the Illinois Department of Commerce and Economic Opportunity (DCEO).[10]

Activities and Recreation Center (ARC) Solar Thermal: January 2014

Solar thermal water heating was originally considered in conjunction with an Energy Performance Contract at the College of Veterinary Medicine. During financial discussions regarding that project, it was determined that the overall payback period would be negatively impacted by the Solar Hot Water Heating component, so it was not implemented at that location. Further discussions led to installation of the first solar thermal water heating at the ARC instead.

The ARC is used primarily by campus students, is directly north of Memorial Stadium, and is also the central gathering location for the annual Illinois Marathon. Thus, the ARC is a major destination and a great place to exhibit the sustainability efforts through highly visible use of renewable energy. This 24-panel, 955.84-square-foot, gravity-fed system significantly reduces steam usage for heating the outdoor and two indoor Olympic-sized swimming pools. The output of each panel is 40,000 Btu per panel per day (11.7 kWh per panel per day). When originally installed, the system had a malfunction that resulted in excessively high water temperatures. To resolve this issue, a balancing valve with a flow meter and safety release steam valve were installed in January 2014. The cost of this project was $402,347, including $74,601 from the SSC.

Renewable Energy Certificates Purchased: April 2014

In 2014 F&S approved the purchase of 20,000 Renewable Energy Certificates (RECs) of Midwest Independent Systems Operators (MISO) wind in April 2014, for $27,000. Each REC represents the environmental attributes of 1 megawatt-hour of electricity. With these RECs and the existing on campus solar generation described above, campus was able to meet the FY15 iCAP goal of 5% renewable electricity.

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[7] http://www.fs.illinois.edu/projects/leed-certifications

[8] http://icap.sustainability.illinois.edu/project/ground-mounted-solar-brc-research-test-bed

[9] http://icseg.iti.illinois.edu/

[10] http://granttracker.ildceo.net/ProgramMaps.aspx?GrantNumber=10022002&CompanyLocationId=1170

In May 2015, the University of Illinois at Urbana-Champaign was officially recognized as a Green Power Partner by the U.S. Environmental Protection Agency (EPA) for our purchase and generation of renewable electricity.[11] As a Green Power Partner, Illinois joined five other Big Ten universities in winning the EPA's Collective Conference Champion Award. This award recognizes the collegiate athletic conference, and its member schools, with the highest combined green power use in the nation. The Big Ten's collective green power use of more than 375 million kWh is equivalent to the electricity use of nearly 36,000 typical U.S. homes.

2015 Renewable Energy Program: Solar Farm

Immediately after the utility-scale wind farm effort was cancelled in 2011, F&S began applying the lessons learned from other renewable energy projects toward the development of a utility-scale solar farm. After four years of continuous effort, the Solar Farm achieved commercial operation on December 11, 2015.

Overview of Solar Farm

In November 2012, the BOT approved construction of a 20.8-acre Solar Farm to be located along the south side of Windsor Road between First Street and the railroad tracks. In December 2014 the University signed a 10-year PPA and lease agreement with Phoenix Solar South Farms, LLC (Phoenix). These agreements allowed Phoenix to design, build, operate, and maintain the Solar Farm on campus property, and sell all the electricity produced to the campus for exclusive use on campus. In addition, the University will own all the associated RECs and emission credits from the Solar Farm. The Solar Farm has a nameplate capacity of 5.87 MW, and it will produce an estimated 7,860 (MWh) annually, or approximately 2% of the annual electrical demand for campus.

Defining the Project Scope

In 2011, when the Solar Farm was first envisioned, F&S expected that a 30-acre solar array could produce approximately 5% of the campus electrical demand, and thereby meet the FY15 iCAP renewable energy goal. Also through the wind farm efforts, we learned that the renewable energy tax incentives could be incorporated into the financial analysis of the project through a Public-Private Partnership. The first wind farm request for proposals (RFP) was simply for the purchase of the wind turbine generators and towers. The second wind farm RFP was for design and installation of the wind turbine generator and tower. It did not include maintenance of the project, and it did not include the connection of the wind turbine to the campus electrical grid. Thus in the RFP for the Solar Farm, the design, installation, operation, and maintenance of the project was included for the duration of the agreement. The RFP also included an option to incorporate the connection to the campus electric grid into the Solar Farm project price.

Site Selection Process

A Site Selection Committee was formed in February 2012, with the following project scope. "As a means of addressing the iCAP commitment to displace campus electrical use with renewable energy sources, the University is interested in entering into a Public-Private Partnership, leasing approximately 30 acres of land in the South Farms area for the installation and operation of a Solar Farm and establishing a Power Purchase Agreement for the renewable energy. The Solar Farm will be connected directly to the University's electrical distribution system." The College of Agricultural, Consumer and Environmental Sciences (ACES) agreed to transfer assignment of 27.8 acres at Kruse Farm[12] to F&S to provide property for the solar farm installation. In exchange, F&S provided ACES Crop Sciences with $84,250 to re-establish new organic acres as replacement for research plots.

Proactive Communications

Due to the neighborhood concerns with the wind farm effort, F&S focused heavily on proactive communications for the Solar Farm project. One of the first steps in the RFP process was a letter sent to each of the residential properties along First Street in proximity to the project location. Additionally, local community leaders were given an opportunity to comment on the draft RFP, and they were informed when the RFP was being published. The fact sheet included with the letter to residents[13] identified potential concerns they may have and provided additional information to address those potential issues.

Additionally, the wind farm effort encountered issues with a protected species on the proposed wind farm site: the state-listed threatened Franklin's Ground Squirrel. For the wind farm, F&S worked with Dr. Ed Heske at the Illinois Natural

[11] http://icap.sustainability.illinois.edu/project/epa-green-power-partner

[12] http://icap.sustainability.illinois.edu/project-update/land-assignment-solar-farm

[13] http://icap.sustainability.illinois.edu/project-update/rfp-released-and-notices-sent-community

History Survey to develop a Conservation Plan that would allow the wind farm to proceed. Thus, for the Solar Farm, we proactively reached out to Dr. Heske to check the proposed area. His documentation demonstrated that it was unlikely the site was occupied by the Franklin's Ground Squirrel, and the Illinois Department of Natural Resources therefore concluded it was unlikely the project would adversely modify any essential habitat for that species.

RFP Selection Process
The Solar Farm RFP was published on Feb. 29, 2012. On March 7, Amendment 1 was published, answering questions received from potential vendors. On March 13, a pre-proposal meeting was held, including a site visit. On March 22, Amendment 2 was published, extending the close date and defining the schedule for answering vendor questions. On March 28, Amendment 3 was published answering several questions from vendors and updating the available space to reflect the new flood plain map. The new space available was 24.3 acres. On April 2, Amendment 4 was published, clarifying specifications due to additional vendor questions. On April 5, 2012 the RFP closed.

Twelve proposals were submitted, and 11 were deemed responsive per University Purchasing's requirements. The evaluation team was: Kent Reifsteck (chair), Mike Marquissee, Keith Erickson, Morgan Johnston, Teresa Temples (student representative), Larry Altenbaumer, and Kim Porter (University Purchasing). The team met four times from May to June 2012 and identified the preferred vendor as Phoenix Solar, Inc. Established in California in 2010 as the U.S. subsidiary of Phoenix Solar AG, Phoenix Solar Inc. (www.phoenixsolar.us) is a leader in the design, construction, operation and maintenance of solar PV power plants in North America. Phoenix was asked to submit a Best and Final Offer, which was received July 6, 2012.

Funding Commitments
With the preferred vendor selected and the pricing determined, F&S completed a financial analysis of the Solar Farm, based on a 20-year life cycle. While researchers indicate the solar panels will continue to produce electricity beyond 20 years, the warranty for the panels and inverters is only for that period. The estimated degradation of the solar production was provided by Phoenix, the cost of maintenance was assumed to be negligible, and the avoided purchased electricity cost was assumed to escalate at 3% per year. This analysis showed a total cost of $15.5M and an avoided cost of $10.2M. The result was an additional cost of $5.3M.

In October 2012, F&S submitted a project proposal to the SSC for a contribution to the Solar Farm project.[14] At the SSC meeting, several questions were raised and discussed about the location, impact on historic buildings, cost of renewable energy, visibility to students, educational components, impact to land use, impact on migratory birds, impact on waterways, ownership and longevity of the PVs, relationship to other campus sustainability projects, relationship to the iCAP goals, alternative sites for solar production, political impact of the SSC support, and the possibility of a higher or lower kwh output than anticipated.

Also in October 2012, F&S received approval from the BOT Audit, Budget, Finance, and Facilities subcommittee to seek BOT project approval. This was further in the process than the wind farm effort was able to achieve. On Nov. 8, 2012, the BOT approved moving forward with negotiating the contract details for the PPA and Land Lease Agreement. This presumed SSC funding support of $1,050,000 and a contribution from the Campus Utilities Budget of $4,250,000 over the 20-year life of the Solar Farm.

The SSC had raised several concerns during the analysis of whether to fund the project. Ultimately, the SSC agreed to contribute funding, with specific expectations.[15] One of the expectations led to the salvage of the Kruse Family Barn that was located on the project site. The salvage vendor provided this explanation: "It would be our intention to reuse 100% of the wood components. We would re-erect the building as it stands with only modifications being to the interior layout spacing. We will recycle the steel roofing. We would handle the concrete in non-landfill manner; planned use is as a fencing fill for the new owner. Battens and doors and any exterior wood treatments would be reused in the renewed structure."

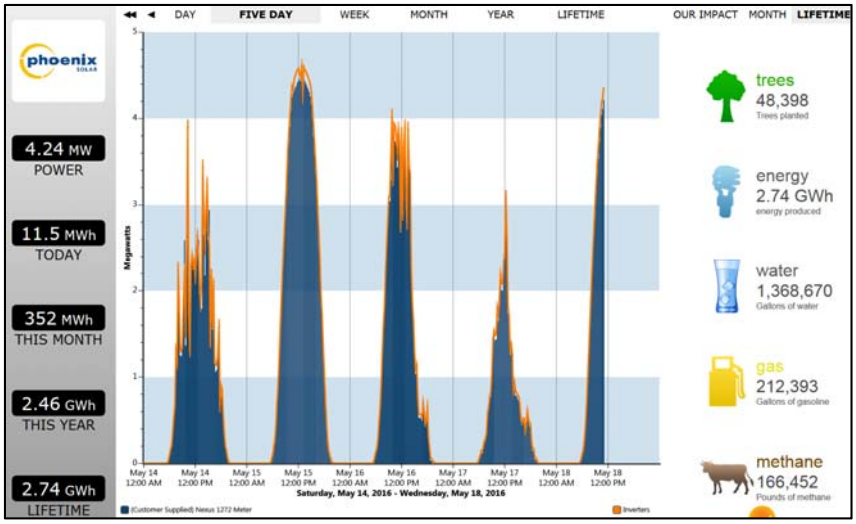
Agreement Negotiations
With the funding commitments received, the final step was negotiating the PPA and Land Lease Agreements. This process began with discussions between F&S, University Purchasing, and the State Procurement Officer. Then University Counsel determined that the proposed Public-Private Partnership and PPA warranted outside legal counsel to provide expertise with renewable energy agreements. In October 2013 the outside counsel was brought into discussions.

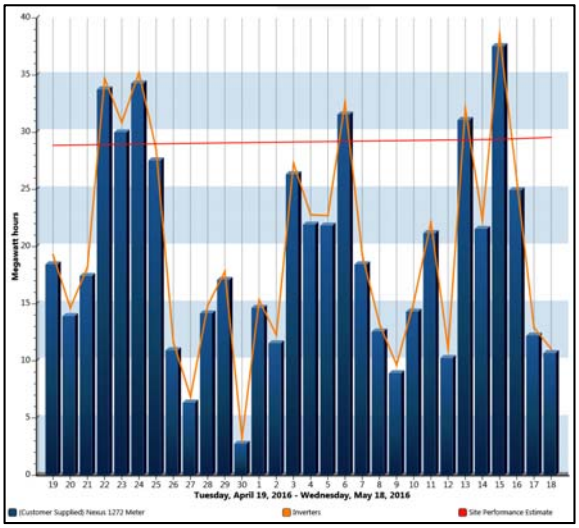
[14] http://icap.sustainability.illinois.edu/project-update/ssc-formal-proposal-submitted-email
[15] http://icap.sustainability.illinois.edu/project-update/fs-discussions-ssc-continued

During 2014, the agreement negotiations revolved around the need to assign the winning bid from Phoenix Solar, Inc to Phoenix Solar South Farms, LLC. This was resolved through the joint efforts and patience of the entire negotiations team, including great patience from the Phoenix representatives! On Jan. 20, 2015, the Solar Farm agreements were fully executed and the project design and installation began.[16]

Project Completion
During the first few months of 2015, Phoenix completed site grading and final design details for the Solar Farm. They worked with local engineering firms, Fehr-Graham and Midwest Engineering and Testing Inc. in Champaign. On Aug. 1, 2015, the construction crew arrived on site with several local union members hired by U.S. Utility Electrical Services Corporation. On Nov. 19, a formal ribbon cutting ceremony was held,[17] and the official commercial operation date was Dec. 11, 2015.

Awareness and Education
The real-time energy generation is published online (see screen shots below) at http://go.illinois.edu/solar. The solar panels used on the farm will exhibit normal degradation over time, yet the Solar Farm is still expected to generate up to 91% of its original output even in Year 20 of the project. F&S is monitoring the efficiency of the Solar Farm, compared to the design specifications, and in February 2016, the Solar Farm produced 100.2% of the anticipated electricity for that month.





F&S staff have provided answers to media inquiries, presentations to sustainability groups on and off campus, and an online repository of information about the renewable energy efforts.[18] Faculty are using the Solar Farm for student projects, and instructors have asked for presentations and tours for their classes.

Future of Renewable Energy Program
The Solar Farm was a significant achievement, but it is only a small step toward the FY20 iCAP goals for renewable energy. Moving forward, F&S is working with other departments on rooftop solar installations and clean energy PPAs. The newly constructed Wassaja Residence Hall is now providing 33 kW of rooftop solar. These panels recently came online, and students will move into the building in fall 2016. Also, a 300 kW solar array on the Electrical and Computer Engineering Building is being purchased.

Conclusion
The Climate Commitment is focused on educating the future leaders of the world, and the Renewable Energy Program is an important component of the overall strategy outlined in the 2015 iCAP. In addition to helping the local economy through jobs to complete the installation of the Solar Farm, F&S has helped other entities in their efforts to use solar energy. Recently, F&S staff talked about PPAs with the Director of Sustainability for Lewis and Clark Community College in Godfrey, Illinois. Thus, the Renewable Energy Program here has great impact on sustainability in Illinois at large.

The University of Illinois at Urbana-Champaign is not subject to an environmental enforcement action or notice of violation from the U.S. EPA or Illinois EPA.

[16] http://icap.sustainability.illinois.edu/project-update/solar-farm-agreements-signed
[17] http://www.fs.illinois.edu/resources/news-announcements/2015/12/01/solar-farm-completed
[18] http://www.fs.illinois.edu/services/utilities-energy/production/renewable-energy