**SSC Final Report for the ECE $150,000 Grant to Fund Solar Panels on the North Parking Garage for the Zero Net Energy New ECE Building**

**The purpose** of the SSC $150,000 grant for the new ECE Building was to provide

1. Complete structural studies and comprehensive engineering plans for solar panels on the roof of the North Parking Garage—toward the zero-net energy goal for the new ECE building.
2. Drawings and detailed plans and specifications for the project.
3. Support for a portion of the major equipment, notably the inverters that convert energy from the PV panels and connect to the campus and utility electricity grid and special metering that will allow the system to be monitored by anyone on campus.
4. Support for educational elements, include monitoring, metering, web site, and interconnection into campus laboratory facilities.

**Longer term**, the requested funds will initiate broader work on the green energy system for the new building. Some of the special features are as follows:

 • The PV panels will support smart grid test bed activities, now in the planning stages from the Illinois
 Center for a Smarter Electricity Grid (ICSEG).

 • We anticipate that the solar system will provide a demonstration site for at least two major solar power
 conversion technologies invented at the University of Illinois. It may also provide a test bed for two or
 three solar cell technologies invented here.

 • Electric power data, webcams, and various data tracking methods will be featured in kiosks in the main
 public areas of the new ECE building, and will also be available generally on the web.
 • The systems will be monitored, controlled, and applied in at least five engineering classes taught in the
 College of Engineering.

**Project summary**

The North Campus Parking Deck Solar Array has been designed in concert with the new Electrical and Computer Engineering Building, furnishing the portion of the renewable energy component required to achieve “net zero” energy status. The solar array must generate 1.0 MW of peak power output, with an annual energy production of 1,600 MWh/year. The solar array will cover the top deck of the existing North Campus Parking Deck, and will be mounted atop an elevated steel structure. The study evaluates the major solar panel technologies, including thin-film and crystalline panels. The use of high-efficiency monocrystalline solar panels will enable the installation to satisfy the peak power and energy required for the project

* The University established an open call for architectural and engineering firms to document suitable expertise and submit initial proposals for the work. Three firms were interviewed by a campus committee on February 18, 2013. Based on these interviews and committee feedback, the University awarded the design contract to the team of PositiveEnergy Practice (PEP) and Hanno Weber Associates (HW), in an amount not to exceed $150,000.
* The PEP/HW team met in person on campus several times with major stakeholders, including Campus Parking, Facilities and Services, the Department of Electrical and Computer Engineering, and the College of Engineering. On July 18, 2013, they submitted the final design report for the project. This comprehensive report is awaiting the next step – full implementation on the North Campus Parking Structure.

• The final report evaluates three solar panel distinct array configurations. Of the three, PEP/HW recommended a trellis configuration as the best option for power production goals, while facilitating aesthetic concerns, the introduction of natural light, stormwater management, and ongoing maintenance. The final installation configuration was based on 3,664 silicon solar panels, each rated at 345 W peak. The supporting trellis takes the form of a frame system mounted above the garage upper deck, with framing to support solar panels. The proposed panel arrangement uses two panels in landscape orientation per row.

• A number of architectural/structural design solutions were studied for the support structure, including custom fabricated truss assemblies and space frames. The installation of a space frame affords complete flexibility for solar panel placement, minimizes structural impacts to the parking structure, is most readily and quickly constructed, affords an aesthetically pleasing installation, and is the lowest cost option. The existing structure is sufficient to accommodate the installation of the solar array and associated structure without major modification. An important advantage of a space frame configuration is that it can span open parking spaces and has not direct impact on parking capacity. It also lends itself well to maintenance access and water management, supporting a gutter system that directs water into the stormwater waste system.

• The study evaluated three DC to AC inverter technologies, namely microinverters, string inverters, and central inverters. The installation of four (4) 250 kW central inverters was the recommended alternative, furnishing an efficient, maintainable, cost effective solution. In panel areas near the southeast and southwest stair towers, microinverters were suggested as a means to manage the shading configurations in those locations.

• The design of the new solar array structure will be configured to facilitate the removal of snow from the parking deck. The solar array installation will be equipped with a system to capture and remove stormwater from the premises. The system is designed to facilitate possible future installation of storm water storage, allowing water reuse for designated functions such as landscaping. The solar array installation will be equipped with lightning protection and surge suppression systems to protect against physical and electrical damage from lightning and electrical system surges.

• The output from the new solar array will be connected to the utility grid through the existing North Campus Parking Deck 480 Volt main electrical service equipment. The service was confirmed to have adequate unused capacity to support the complete solar installation. It is particularly advantageous that the parking structure has underground conduit linking to an Ameren substation north of the site This allows the solar facility to interconnect wither to the campus grid system or to the local utility. The connection flexibility offers advantages for future research programs.

• The new solar array installation will conform to the requirements of the International Building Code (IBC) – 2012 edition, NFPA 70, National Electrical Code, and to all UIUC Standards. The design includes a modern LED lighting system to be used on the top level of the North Campus Parking Garage

• The project will be bid according to the standard UIUC protocols utilizing multiple prime contractors

**Problems Encountered**

1. We had hoped that the funds would support a portion of the major equipment, notably the inverters that convert energy from the PV panels and connect to the campus and utility electricity grid and special metering that will allow the system to be monitored by anyone on campus. However, the funds were all used to complete the design documents, which are now fully ready for next steps.
2. We were not able to complete the study in time to install the solar panels by January 2013, since the campus process for vetting design firms did not finish until February 2013 and the design itself was delivered in July 2013. However, the delay has worked to our advantage, as the price of solar panels has continued to fall, permitting us to get much more for future money.

**Detailed description of resources/money saved because of project**

1. We have the complete design and report and are using it to seek funds for the solar panels and supporting structures. When the project is implemented we will be able to show the money saved.

**Financial statement**

1. See attached *Work Effort by Discipline* from Positive Energy
2. We have a complete report and are using it to seek funds for the solar panels and supporting structures. We will be able to show the amount of money saved when the project is completed.

**Statistics on student involvement/outreach**

1. Even though the solar panels have not yet been installed, student involvement and publicity has been organized around the aspiration to create a large zero-net-energy structure. This has captured the imagination of ECE students. The department has more than 1950 undergraduate students, and nearly all are aware of the energy emphasis for the new facility. The facility rivals the Research Support Facility (RSF) at the National Renewable Energy Laboratory (NREL) in Golden , Colorado, as the two largest zero-net projects in the United States.
2. The ECE Department intends to publicize the building project widely and recognize supporters. This will go far beyond a conventional permanent plaque: recognition in the new ECE building will take the form of permanent interactive displays that detail the nature of the support, show those portions of the overall project, and place the support in context. In the context of this project, the SSC efforts will be highlighted in the overall zero-net-energy context. The zero-net efforts will include extensive energy metering and interactive educational exhibits and displays. These displays will be in the main lobby of the facility. The objective is to keep the energy sustainability front-and-center for generations of students, and to link the outcomes to investments first made in 2012, with an impact lasting for decades.

This proposal was motivated and instigated by ECE students. There is growing interest in energy and sustainability issues everywhere on campus, and the ECE department is one of the most active units in this arena. Many of our students, for example, have participated in the past three Solar Decathlon projects. The leaders among these students realized that aggressive energy goals are possible on our campus. They had a role in pushing the building design team toward the zero-net goal. As the project unfolds, students will be involved in its research components, and will also be part of the planning teams. It is especially important to us that students be the primary designers of user interfaces and interactive displays: they are the best people to determine how to get the message across to the public

.Media opportunities for the new ECE building are extensive, as at present it is one of the largest zero net energy projects in the United States. We have been fielding press inquiries, and this will grow as the project proceeds. Campus publicity resources are available to help.

**Pictures of finished project**

1. See accompanying file: Parking\_Garage\_HannoWeber.