PARTNERSHIP TO DEVELOP A SOLAR EDUCATION FARM

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Abstract

Milwaukee Area Technical College (MATC) has been confronted by limited new revenue and increasing costs primarily energy and specifically electricity. The majority of electricity consumed in the Milwaukee area is generated by burning coal which has caused the MATC carbon footprint to exceed that of comparable institution of higher education in other areas of the United States. As the Federal and Wisconsin Government promote renewable energy and reducing carbon footprints, MATC recognized an opportunity to reduce its electrical consumption, its carbon foot print and provide education programs which will provide workers to support the United States conversion to renewable energy and to build the "Smart Grid".

To reduce the economic and carbon footprint most efficiently, renewable energy needs to be produced as close to the area of consumption as possible. As an urban college, MATC recognized the high cost of land in the urban setting which made building a large solar education farm very challenging. Evaluation of the situation led MATC and Johnson Controls Inc. (JCI) to form a partnership to develop a design for an economically feasible urban solar education farm that could also be used to train workers for the renewable energy workforce. This solar education farm would also provide data to support urban distributive solar power generation and the impact this power would have on the "Smart Grid".

The concepts developed and being deployed by MATC in partnership with JCI is based on the fact that every urban setting has land that is underutilized and/or being held in inventory for future development. This includes land used for parking lots, roads, remediated and capped land fills, land under television and radio towers and odd and small lots. With a useful life of over thirty (30) years, solar installations need to be portable to allow them to be moved as the underutilized urban sites are redeveloped for a more important use.

MATC owns approximated thirty two acres of land located in the City of Milwaukee on the bank of the Milwaukee River. MATC owns the public television licenses for Milwaukee and the site contains the transmission building and towers for the TV stations. This site consumes over 170,000 kWh monthly, at an approximate cost of $ 10,000 per month. MATC will be using the solar education farm to reduce its electric utility expense by over $ 65,000 annual. As inflation and cap and trade impact power costs, the annual savings will be greater.

MATC and JCI are now developing a program for private taxpayers to invest in additional urban solar education farms in public private deals whereby the public sector will provide the land and receive rental income and power generation income while the private sector invests in the hardware and receive tax credits, depreciation deductions and power generation income.

Introduction of the Organization

Milwaukee Area Technical College (MATC) is the largest community college in the mid-west. Serving over fifty-seven thousand (57,000) students which comprise over fourteen thousand seven hundred (14,700) FTE's MATC offers over two hundred programs leading to an associate's degree and or a diploma. MATC is also the committed to sustainable operations and has under taken this project to receive multiple benefits for itself and other colleges, universities and k-12 programs. . First, it will provide MATC with a one of a kind training area where all trades and skills related to photovoltaic power generations can be taught in the MATC tradition of "hands on training". The site incorporates eight different demonstration installations: Small (residential) installation, moderate (commercial) installation, large (industrial) installation, over the road (traffic sign) installations, over parking lot (plug in recharging station) installation, under TV tower installation, on capped remediated site installation and tracker installations. Second, it will provide MATC with a site to train electricians new technologies related to "Smart Grid" distributive power generation.

Third, the project provides a model that any public institution can duplicate to erect photovoltaic equipment on urban sites which is underutilized at the time. Finally, the site will be used to provide renewable energy, reducing MATC's dependence on power generated by coal thus reducing MATC carbon footprint and annual utility expenses.

The University of Wisconsin – Milwaukee, Marquette University, Concordia University and Milwaukee School of Engineering will also benefit from the

installations as they will have access to the site and date obtained at the site to advance research in distributive urban power generation. MATC will provide stem curriculum to k-12 based on the solar education farm and the on line access that will be provided to data and video from the site.

Statement (Restatement) of the Problem/Initiative

The challenges facing MATC were increasing utility expenses during a period of limited resources, a need to reduce its carbon footprint and the need to develop educational opportunities to train workers for the emerging technologies related to renewable energy and the “Smart Grid”. The challenge was complicated by the desire to create a model for economical distributed urban photovoltaic installations that would use portability to overcome the cost of land in an urban setting. To accomplish this goal, designs based on portability needed to be developed. The design also had to incorporate a technology to place solar panels on a capped land fill without impacting the cap or compromising the remediation that had been completed. A number of organizations had to be enlisted to endorse the project, which do to its uniqueness, required acceptance of concepts with which the approval organizations were unfamiliar. This included an environmental impact study approval, zoning approval, acceptance that the design was portable and thus qualified as movable equipment, community groups and neighbors.

Design

The critical element of the project was to find a partner to assist in the design and development of the project. MATC needed to partner with a firm that shared MATC's dedication to sustainable practices and that had the financial strength to make the initial investment to develop the project until the required approvals to proceed were obtained. The two organizations, MATC and JCI had to openly share information and design ideas. As the project proceeded, challenges required the team to take up the mantra, "Every obstacle is a hurdle, and hurdles are conquered or circumvented". At no time did the design team focus on the challenge as insurmountable, rather they were viewed as another opportunity to design a better site.

As the project proceeded, the design had to be revised over five times. The resulting design that is described on the Johnson Controls Web Site http://www.johnsoncontrols.com/publish/us/en/products/building_efficiency/smart_environments/december-2009/urban-solar-farm.html

"On 32 acres in the middle of the city, we're building the largest solar education farm in the state of Wisconsin to train tomorrow's energy leaders.

Johnson Controls, in collaboration with the Milwaukee Area Technical College (MATC), will turn an underutilized parcel of urban land into the state's largest solar education farm. The farm will serve as a training center for technicians, designers, site assessors, electricians, sales personnel and other professionals in the fields of renewable energy.

“Trained solar technicians and engineers are vital to our energy future,” said Don Albinger, vice president of Renewable Energy Solutions at Johnson Controls. “We are excited to collaborate with forward thinking institutions of higher education like MATC in the training of tomorrow’s energy leaders.”

The Photovoltaic (PV) farm will be unique in many ways:

- The project will feature eight different configurations of nearly 2500 Photovoltaic panels. The variety in configurations increases student learning opportunities.
- Along with training students from MATC, opportunities for education will be extended to other institutions.
- Energy produced by the solar education farm will be used to operate the Milwaukee Public Television transmitter that is located at the site. This will be the first public television transmitter in the country that will be taken off the traditional energy grid, saving an estimated $70,000 in annual energy costs used to power the transmitter.
- Built on nearly 32 acres in the city of Milwaukee, the farm provides the opportunity to demonstrate an effective use of underutilized urban land. The site includes a remediated land fill, a capped urban waste site, roads, parking lots, radio and television tower guy wires, rolling terrain and odd shaped parcels.
- The farm will be portable. Panels, fence posts and solar trackers will be mounted to concrete ballasts, rather than attached to the ground, which is

typical in a traditionally-constructed PV facility. In another first for the project, it is believed this is the first entirely portable PV facility in the United States.

The $6.9 million project will be located at 810 E Capitol Drive in Milwaukee.

With a requirement to obtain referendum approval for construction projects in excess of one million five hundred thousand dollars ($ 1,500,000) and the state of the economy leaving the outcome of a referendum in question, the project design had to incorporate portability to allow investment of equipment dollars which is not subject to the referendum requirement.

After the project was approved and the financing obtained using “Build America” bonds, the final design needed to be completed. Since the project is for a Solar Educational Farm, the involvement of faculty was very important to the project’s success. The complex teaching schedules of faculty made it difficult to schedule design meeting when faculty could attend. The deans and associate deans were also involved to insure that required curriculum was developed.

The design also incorporates sensing and monitoring equipment to gather data from the panels and arrays. All data is to be gathered and stored for future reference and research. This data is combined with stored weather data gather from a weather station built on site and video files recorded from six cameras on the TV tower which record conditions at the site. Movement of the data from the

site to the MATC campus required the addition of a server system on site located with the MPTV transmission building and the installation of a fiber cable bundle.

MATC, MSOE, Marquette University, Concordia University and the University of Milwaukee – Wisconsin have provided students who participated in the design phase.

The budget for this project was protected by creating a performance contract between MATC and JCI. This contract provides for a fixed price after the design is completed and a financial guarantee that the power projected to be generated is achieved.

Implementation

The implementation was paced by the weather in Milwaukee, Wisconsin. As soon as the frost is out of the ground in spring the installation will begin. To insure a rapid installation, a warehouse contiguous to the installations site was lease and used to stage and assemble the racks and solar panels. The proximity of the assemble site will allow the racks and panels to be delivered to the site using construction fork lifts. This will allow the installation to be completed with minimal interference with the eight (8) acre parking lot operated by the University of Wisconsin –Milwaukee located on the 32 acre site.

The civil work will begin in March 2010 and the project will be operational in August 2010. This schedule is permitted by the use of the warehouse to stage and assemble product, thus minimizing the impact of weather on the project. The panel assemblies will be completely wired and with the use of quick connectors, the installation time on site will be minimized.

The design incorporates technology to allow a tight schedule. The panels will be mounted on concrete ballast and set on a five inch layer of gravel. The gravel serves three purposes, leveling the area, reducing plant growth and maintenance and as storm water erosion control. The ballast will be precast off site and delivered to the staging area at the same time the civil work begins. As the gravel is applied to the site the ballast will be places on site and the installation of panels will begin.

To make the installation as sustainable as possible, the concrete utilized for the ballast will be on the Ancient Roman Formula which does not use Portland cement.

The racking used contains a mix of manufactures to insure adequate and timely supply. The design also incorporates five different panel types to insure timely delivery and adequate supply. The use of multiple types of equipment provides multiple training opportunities for students.

Security at the site is important. A seven foot fence designed to be mounted on ballast surrounds all panel sites. Security cameras mounted at elevation are

used to provide surveillance as well as to record data video files of conditions at the site.

Benefits

The benefits of developing a partnership with a strong commercial firm is that a one of a kind educational facility was designed developed and implemented in a timely manner, with a fixed budget and guaranteed results. MATC will reduce its electric expense approximately sixty thousand dollars ($60,000) annually, reduce the MATC carbon footprint and provide a state of the art training facility for MATC sustainability and renewable energy programs.

MATC and JCI have created a physical design and a working model of potential public – private venture to convert public owned and underperforming urban land into solar farms that benefit both the public institution and the private investor.

The project supports the nations desire to reduce dependence of fossil fuel and develop renewable energy.

The advanced nature of the facility provides the hands on training opportunities to students to insure their post graduation success.

Retrospect

The approval process time was under estimated and caused a delay which lead to missing the calendar 2009 construction season. More effort should have been expended to accelerate the approval process. The project includes a best

practice to be used in developing renewable energy sites and a design of an urban photovoltaic farm that can be utilized by other public and private institutions.