

## ASES National Solar Conference

### Maryland Net Zero Energy Schools Program

David L. Comis<sup>1</sup>

<sup>1</sup> Rockville, MD, USA

#### Abstract

The State of Maryland is in the midst of designing and building three schools that will meet the criteria of Net Zero Energy, meaning that they produce as much energy as they consume. At present, the construction of one school is about 75% complete, the design of one school is about 50% complete, and site selection for the third school is in progress. This paper describes the finances, programmatic decisions and initial lessons learned from the viewpoint of the state. This paper represents the author's personal opinions and does not reflect the official view of the State of Maryland.

Keywords: *NZE, Maryland, Net Zero Energy, school.*

---

#### 1. Introduction & Program History

In 2012, the Maryland Public Service Commission approved the merger of Exelon Corporation and Constellation Energy. At the time of merger, Baltimore Gas and Electric Company (BGE) was a distribution utility for gas and electricity under Constellation Energy. As a condition of this merger, money was placed in certain Maryland accounts for various purposes: \$113.5M was placed in the state's Customer Investment Fund (CIF) for the purpose of providing improvements, including energy efficiency, to BGE customers (Public Service Commission of Maryland, 2012). From this fund the Maryland Energy Administration (MEA) requested and received \$9M for the purpose of incentivizing the development of three Net Zero Energy (NZE) schools.

#### 2. The Money

MEA split the \$9M as follows: \$680K was designated for Architectural and Engineering (A/E) technical support for MEA and up to \$2.7M could be spent on each school. Of the \$2.7M designated for each school, up to \$533K was designated for support of the design process, while the remainder, about \$2.2M, was to be used to offset construction costs directly associated with achieving the NZE goal.

The Net Zero Energy Grant pays on a reimbursement basis, meaning that the school district must have already paid the bill before the money is reimbursed. The school district may request reimbursement at any time, although they normally tend to do so when they submit their mandatory quarterly status report and invoice.

#### 3. The Policy

A number of program policies were instituted to support the success of the program:

- Because the source of the funding was the Customer Investment Fund, the funding could only be used within the Baltimore Gas and Electric service area.
- In order to maximize the opportunity to achieve the NZE goal, MEA decided that the program would only support NEW schools. This policy removed any school renovation projects.
- To prevent concentration of benefit in a single county, MEA intended to support only one school within a given school district. In Maryland, a school district constitutes an entire county.

- While state law requires new schools to meet the LEED Silver standard, some counties have instituted higher standards. To maximize the use of funds, MEA instituted the policy that the NZE program money could only be used to support upgrades from the county's existing standard to achieve Net Zero Energy status. As such, funding uses in one county might not be authorized in a different county with a higher baseline school design standard.

#### **4. The Team**

The MEA project team consists of an MEA Program Manager and two contractors who provide programmatic support. The MEA team arranges for the Grant, reviews the design documents, addresses funding questions, and continually monitors the project to ensure the design and construction of the project will result in a NZE school. An Architecture and Engineering team is contracted to support the MEA team in this effort. Their primary job is to review the design drawings at the various stages of design and answer one question: If the school is constructed and operated as indicated in the design documents, will the school achieve a net zero energy status? This A/E team is also authorized to make comments on the design, but this is not their primary duty, nor is the Architect of Record required to respond to their comments.

#### **5. The Process**

In Maryland, the normal process for the design and construction of a school is as follows:

The school district brings on an Architect of Record (normally a complete A/E team) and provides it with the school district requirements for the new school. The Architect of Record then provides Schematic Designs for approval by the school board. Design Development finishes the basic design, followed by the development of Construction Drawings. Following School Board approval, the plans are sent to the Maryland Public School Construction Program (PSCP) where the plans are reviewed and approved. Following State approval, the school district puts the plans out for bid using a Request for Proposal. Construction is conducted, the school is commissioned, and the students and staff move in.

The addition of the Net Zero Energy grant added a few steps to the process. First, the school district/county is authorized to hire a consultant A/E firm that has already designed a completed Net Zero Energy School using the \$533K provided in the Grant. Eight such firms were vetted and pre-qualified, and additional firms that meet the requirements will be considered if requested. Second, a design charrette was placed in the schedule before the schematic drawings were started. The charrette is designed to ensure a meeting of the minds between the designers and the other stakeholders who will ultimately have to operate under the design. This was considered to be a key step as certain areas are greatly affected by the shift to Net Zero Energy, specifically the cafeteria staff, the audio-visual department, and the maintenance staff. In some cases, people will need to be trained on new equipment, while in other cases, the entire school process will be changed. Ensuring that the new Principal and teachers are onboard with the required procedural changes is key to the success of the new school. Third, the MEA Team is involved in review of the plans and drawings at the schematic drawing, design development, and construction drawing phases. The MEA team (including the A/E contracted to support MEA) may make nonbinding comments, which the Architect of Record may use or discard, and may make formal comments which require formal response. Formal comments are used very sparingly and only for Net Zero Energy design issues, as these comments have the potential to be very disruptive to the design effort. Luckily, very few have been required. Finally, the MEA team monitors the construction effort through the end of the commissioning process. This monitoring normally consists of quarterly site visits, as well as weekly 15-minute phone calls to discuss status and any net zero energy related issues.

#### **6. The Standard**

The Energy Use Index, also called the Energy Utilization Index, but normally just referred to as EUI, is a measure of the energy (of any type) used per square foot of a building. In the United States its units are in thousands of British Thermal Units per square foot (kBtu/ft<sup>2</sup>) (kW/m<sup>2</sup> in SI units). While there is no national EUI standard for a Net Zero Energy school, MEA established its upper limit at 25 kBtu/ft<sup>2</sup> (78.86kWh/m<sup>2</sup>). It is important to note that this value includes not only school functions, but also after school functions and scheduled community use. As such, it is very important to know how the school will be used, both before, during, and after school hours, when calculating the expected energy usage. The form of renewable energy selected to supply the school is

regional specific. Solar photovoltaic (PV) technology is normally selected in Maryland. Ground source heat pumps also serve to provide heat during the winter, while serving as a heat sink during the summer.

## 7. The Status

Howard County, Maryland, elected to build a new Wilde Lake Middle School on the site of the existing middle school of the same name. The Net Zero Energy grant became available about the same time that Howard County selected its Architect of Record, so the timing was perfect. Even so, this being the first Grant of its type, it took 4 months to get the Grant signed by both parties. By then, Schematic Drawings had been completed and were ready for review. The design was based on a prototype, which had been previously designed by the Architect and successfully utilized by the school system five times prior to Wilde Lake. It was felt that a design charrette would still be of value so it was held with the kitchen, IT, and facilities management personnel at a date immediately following the schematic design review. The DD and CD phases went smoothly and the final drawing package was sent to the state for review in early January 2015. The drawings were approved and a construction firm was selected. Groundbreaking occurred in June 2015. The construction of the school is currently 75% complete. Staff and student move-in is scheduled for late December 2016. The school has 633 kW of roof and ground mounted solar photovoltaics, 527.5 kW (1,800 MBtu/hr) (527.5 kW) of heat pump capability, a building enclosure with R-25 walls and R-30 roof. Ambient lighting is maximized for the classrooms, with installed LED lights used to fill in the gap. Demand Controlled Ventilation (DCV) is used, where CO<sub>2</sub> content is used to determine when fresh air is added to a space. The kitchen is designed without a deep fat fryer. These are just the highlights as obviously there are many other energy saving measures designed into the school. The EUI, even with evening activities factored in is 22.6 kBtu/ft<sup>2</sup>/year (71.3 kWh/m<sup>2</sup>). This project has remained on its timeline since inception. There have been no major issues to address during construction.



**Figure 1: Artist drawing of Wilde Lake Middle School**  
Architect of Record: TCA Architects  
(Graphic provided by and used with the permission of TCA Architects)

Baltimore City, Maryland, elected to build a new Graceland Park - O'Donnell Heights Elementary/Middle School, also on the site of the existing school of the same name. Although the Grant agreement was in place in April 2014, Baltimore City did not move forward with the project until November 2015 when it sent out a Request

for Proposal. Unlike the Howard County process, this was a combined Design/Build contract, a single contract to cover the design and construction of the school. Also unlike Howard County, the school district asked an Architect whom they frequently worked with to lay out a preliminary design for the new school prior to the release of the RFP. As it turned out, Baltimore City selected a team that included this same Architect, and an Engineering firm that had already designed a successful Net Zero Energy School. Also unlike Howard County, Baltimore City decided that they did not need an A/E consulting team to help them with the design because of the strength of the selected A/E team. Instead, Baltimore City used some of the design money to pay the A/E team for additional studies that had been conducted by the A/E Consultant team during the Howard County project. The Design Charrette was held after the completion of Schematic Drawings. At present, the design team is concluding the Design Development phase. Assuming State approval of the Design Development drawings in August 2016 and the Construction Documents in January 2017, construction is expected to begin in June 2017, with student move-in December 2018. Although still subject to change, it appears this school will include 565 kW of roof mounted solar photovoltaics, 400 MBtu/hr (120 kW) of heat pump power, R-25 walls (ICF with exterior masonry cladding), and R-30 roof and many of the same kitchen and IT modifications used by Howard County



**Figure 2: Artist conception of Graceland Park Elementary/Middle School**  
Architect of Record: Grimm & Parker  
(Graphic provided by and used with the permission of Grimm & Parker, LLC)

Baltimore City will use this same design to replace another school (Holabird Academy - Elementary/Middle School) only three blocks away. This school will be Net Zero Energy Ready. Unfortunately, due to site layout consideration, this school must be rotated 180 degrees from the Graceland/O'Donnell orientation so a direct comparison of construction and school procedures will not be possible. Still, with both schools being so close together and using the same basic design, many comparisons will be possible.

The site for the third Net Zero Energy School has yet to be selected. Outside of Howard County and Baltimore City, none of the other counties in the BGE service territory have a new school under construction during the timeframe of this grant. Baltimore City has a number of new schools being built in the next few years, and at least three sites are under active consideration. Site selection is expected for August of this year.

## 8. Lessons Learned

Although the grant is nowhere near complete, and we haven't even finished one school, there are a few lessons learned from this project:

- 1) Ensure the Grant instrument is signed before the Architect of Record is selected if it is desired to have a design charrette before the Schematic Design is complete.
- 2) SHORT, weekly meetings with the school districts tend to work to keep track of status. Short prevents disruption of a lot of the workday for the school district manager. Weekly allows the occasional missed or cancelled meeting without losing track of status.
- 3) It is better to have a Point of Contact who can be reached, even if that person is not the supervisor, than to

have a supervisor level Point of Contact who cannot be reached.

## 9. References

Public Service Commission of Maryland case #9271Order 84698 Issues February 17, 2012, *In the Matter of the Merger of Exelon Corporation and Constellation Energy Group, INC.*, [https://archive.org/stream/293295-exelon-constellation-merger-opinion/293295-exelon-constellation-merger-opinion\\_djvu.txt](https://archive.org/stream/293295-exelon-constellation-merger-opinion/293295-exelon-constellation-merger-opinion_djvu.txt) , accessed June 20, 2016.