

B2E CONSULTING ENGINEERS

B2E Consulting Engineers, P.C. is a service oriented engineering consulting firm based in the northern Virginia metropolitan area .

b2E Consulting Engineers, P.C. | 116-N Edwards Ferry Rd., NE Leesburg, VA 20176 | Phone: 703 737 0400 | FAX: 703 737 0440



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www.b2Epc.com

Greenovation: Cooling and Heating Using the Earth and Sky

Having already been the first Virginia public school to achieve LEED® Gold in 2009 with the **T.C. Williams High School campus**, ACPS wanted to reach for even higher sustainability goals with a district wide initiative. The school board initiated policies in its Strategic Plan that set as a priority the use of best practices for energy efficiency and sustainability to help provide clean, safe and conducive learning environments.

When it came time to renovate the **T.C. Williams High School's Minnie Howard Ninth-Grade Campus**, ACPS enlisted the help of **b2E Consulting Engineers** to design one of the most energy-efficient systems in the country. Once up and running, this system would offer drastic energy savings for the school and completely pay for itself within 10 years. The geo-solar system to be designed by the team would become the precursor to an ever-evolving approach to green design within the school system.

Incorporating Sustainability Education using the Greenovation Approach



ACPS students observe the installation of the geothermal wells at James Polk ES as part of the school's philosophy of using green building initiatives as an opportunity for student education.

How It Works: Minnie Howard as the Green Prototype

Called "geo-solar" because it uses the earth ("geo") and the sun ("solar") to cool and heat the building, the system at Minnie Howard Ninth-Grade Campus involves a creative combination of solar energy (from the sun), geothermal energy (from the earth) and high-efficiency HVAC (heating, ventilation and air conditioning) system using **Variable Refrigerant Flow Ground-Source Heat Pumps** that simultaneously cool and heat the building.

A solar thermal panel array provides water heating while serving double duty as a sun shade, reducing glare and reducing on cooling costs.

THE GEO-SOLAR SYSTEM AT MINNIE HOWARD

- ***42 Solar Collector Panels (~500 MBH)***
- ***65 Wells (dug 300-feet deep, 4-pipe u-bend)***
- ***6 VRF Water-Source Units***
- ***Stratifying DHW Storage Tank***
- ***2 Solar Tube Bundles (Heat Exchanger)***
- ***2 Plate Energy Recovery Units for Outside Air***

In winter, heat energy from the solar panels is used to heat domestic water, heat ventilation air and preheat condenser water to the heat pumps. In summer, unneeded heat is re-radiated to the atmosphere at night by running the solar pump.

Using Minnie Howard as a prototype (EUI = 36 KBTU/SF year), ACPS is expanding on these initiatives in other school buildings. James K. Polk Elementary School (Polk) uses the geo-solar system in the same manner as Minnie Howard but goes a step further by implementing the use of photovoltaic cells, which use the sun to generate electricity for the school.

The new James K. Polk Elementary School, a LEED Gold rated building is ACPS' most efficient school at 28 KBTU/SF year. B2E is currently working on ACPS's newest design which could be their first net-zero energy building (NZEB).

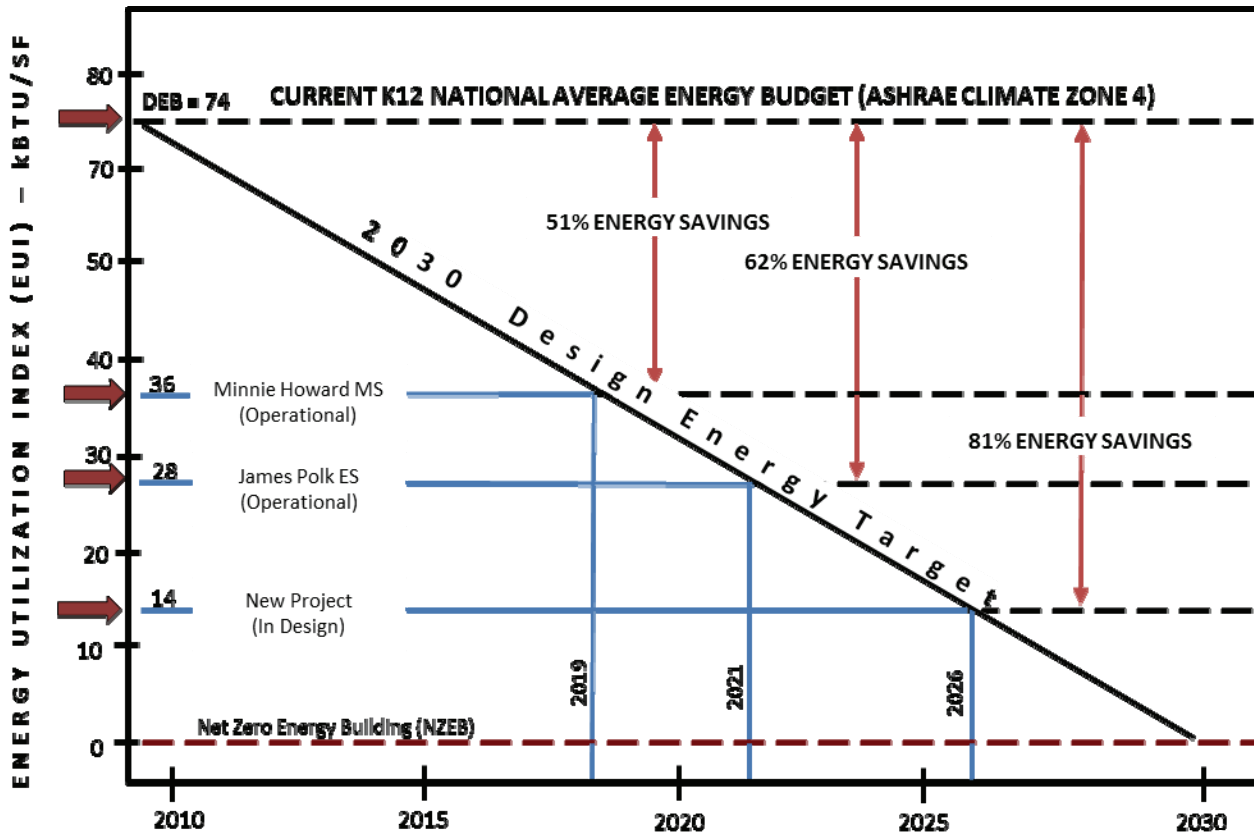
The geo-solar system uses 60% less non-renewable energy than a conventional system, it reduces electricity consumption by 40%, and reduces natural gas consumption by 80%. Utility costs are reduced by 50-60% annually.

THE OLD CHILLER AND BOILER SYSTEM IN MINNIE HOWARD WAS REPLACED WITH MITSUBISHI ELECTRIC VRF WATER-SOURCE HEAT PUMPS CONNECTED TO THE GEO-SOLAR PLANT



B2E Consulting Engineers, PC recognizes the need to reduce energy consumption. Our previous projects demonstrate that we have the know-how to show building owners how to reduce the operating budget by saving energy.

The following graph shows how we are reducing cost for our clients. Using the Executive Order #13514 as our target to be carbon neutral by 2030, we have developed the following timeline. The graph below indicates how building efficiency for schools must change quickly to achieve this target. It shows projects b2E is currently working on and how we are progressing toward the carbon-neutral challenge.



Note: EUI provided by ASHRAE for Climatic Zone 4. The graph can be custom to fit for federal or local municipal clients specific projects. As buildings become more efficient they move further to the right on the timeline. The potential energy cost savings for school districts is really significant. The technology exists today to achieve much better design energy targets and improve sustainability. We are not just thinking about it, we are making it happen

SUMMARY

B2E is leading the industry for K12 design to reduce energy consumption in schools. We achieve greatly reduced energy cost while making the following improvements while saving energy and reducing emissions.

1. Improve lighting.
2. Improve ventilation.
3. Reduce classroom noise levels (<NC35).
4. Reduce facility maintenance costs.
5. Reduce operating utility costs.

B2E is an extremely diverse and flexible engineering firm offering full, in-house services in the fields of:

| | |
|---------------------------------------|-------------------------------------|
| Mechanical Engineering | Quality Assurance Program |
| Plumbing Engineering | Life-Cycle Cost Economic Analysis |
| Fire Protection Engineering | Construction Administration |
| Technology Infrastructure Engineering | EMS Controls & Commissioning |
| Building Automation and Controls | LEED Accredited Professional Design |
| Energy Audit/Analysis | Certified Energy Managers |