

Hood River Middle School Music and Science | Hood River, OR
Credit: Michael Mathers

Zero Energy Schools Improve Outcomes

A zero energy school is an ultra-low energy building with a renewable energy system that produces as much energy as the building consumes over the course of the year.

Schools, colleges, and other educational buildings are leading the zero energy (ZE) movement. They represent almost 40% of all verified and emerging ZE buildings being tracked by New Buildings Institute. Educational buildings offer key opportunities to advance ultra-low and zero energy policies and practices while significantly improving the learning environment for students.

Zero energy goals can complement existing certification programs used by many school districts including Leadership in Energy and Environmental Design (LEED) or the Collaborative for High Performance Schools (CHPS). ZE is the next step in the evolution of high-performance schools.

Early examples of ultra-low and zero energy educational facilities demonstrate the buildings' feasibility and benefits. These schools are hubs to educate the broader community



Bishop O'Dowd High School, Environmental Science Center | Oakland, CA
Credit: David Wakely Photography

and empower our next generation of environmental leaders.

High-Performance ZE Schools Have Many Benefits

LOWER OPERATING COST: K-12 schools spend an estimated \$8 billion per year on energy,¹ more than what is spent on computers and textbooks combined. Getting to ZE results in cost avoidance on utility bills that can be spent on facilities and educating students, and reduces exposure of school budgets to the volatility of shifting energy prices.

¹ U.S. Department of Energy, EnergySmart Schools Program. (2008). Guide to Financing EnergySmart Schools. eere.energy.gov/buildings/publications/pdfs/energysmartschools/ess_financeguide_0708.pdf

INCREASED STUDENT PERFORMANCE:

Occupants of ZE schools benefit from heightened student performance, increased attendance, better occupant health, and improved teacher satisfaction and retention.

EDUCATIONAL BENEFITS:

ZE schools are living laboratories, stimulating learning and innovation. Occupant engagement promotes use of the building as a teaching tool for students, for STEM programs, and for the larger community. This greater understanding and deeper knowledge of concepts like science, math, and technology in relation to their surroundings give students the confidence to take leadership roles in their schools, as advocates for environmental sustainability and their own learning needs.

RESILIENT COMMUNITIES:

ZE schools are more resilient in severe weather events. They can continue to provide light and fresh air during a power outage, because of superior daylighting and natural ventilation. They can also create safe havens for the community during emergencies when building energy generation systems remain functional.

School Fast Facts

- The classroom environment can affect a student's academic progress over a year by as much 25%.²
- Occupants in well-ventilated spaces with low carbon dioxide and low volatile organic compounds (VOCs) had improved scores in crisis response, information usage, and strategy ranging from 100% to 300%.³
- Students in daylit environments showed a 20-26% improvement on test scores compared to traditionally lit environments.²
- Students with operable windows progressed 7-8% faster than those without operable windows.²
- Students with access to daylighting performed 7-18% better in math and reading than those without.²
- Students exposed to daylight attended school 3.2–3.8 more days per year.⁴

2 Heshong Mahone Group. (1999). Daylighting in Schools: An Investigation into the Relationship Between Daylighting and Human Performance. h-m-g.com/downloads/Daylighting/schoolc.pdf

3 Bakó-Biró, Zs., Kochhar, N., Clements-Croome, D.J., Awbi, H.B. & Williams, M. (2007). Ventilation Rates in Schools and Learning Performance. [researchgate.net/publication/242261403_Ventilation_Rates_in_Schools_and_Learning_Performance](https://www.researchgate.net/publication/242261403_Ventilation_Rates_in_Schools_and_Learning_Performance)

4 Healthy Schools Network, Inc. (2012). Daylighting. [healthyschools.org/data/files/Daylighting.pdf](https://www.healthyschools.org/data/files/Daylighting.pdf)

STEPS FOR GETTING TO ZE IN SCHOOLS

Research has uncovered commonalities in successful zero energy buildings.

While zero energy is a realistic end game, the path to sustainable, ZE schools is a process that will take time to accomplish. School districts can start now with benchmarking, energy targets, policies, plans, and practices to get on the path to ZE.

1

Get stakeholder support

2

Make a commitment

3

Set energy targets

4

Use an integrated design process

5

Design and construct to the target

6

Optimize operations

7

Measure and verify

Learn more with NBI's [Zero Energy Project Guide.](#)



PROJECT PROFILE

DISCOVERY ELEMENTARY SCHOOL

ARLINGTON, VA

GRADE LEVELS: Pre-K-5

GROSS AREA: 98,000 square feet

NUMBER OF OCCUPANTS: 630 students, 715 total

DATE COMPLETED: August 2016

COST: \$32,305,800

ARCHITECT: VMDO Architects

ENGINEER: CMTA

Discovery Elementary in Arlington, Virginia, is a ZE school that was constructed under budget, on time, and now uses over 75% less energy than a typical school in the area. The building is routinely used as a learning tool. With the interactive dashboard, students and teachers have embraced their own sense of stewardship and utilize the building in the class curriculum.

	SITE EUI (kBtu/sf/yr)	ENERGY COST (Cost/sf)	NET EUI (kBtu/sf/yr) (includes solar if applicable)
Average School in District ⁵ (2015-2016)	69.0	\$1.21	69.0
Discovery Modeled Data	21.2	N/A	-0.85
Actual Usage	16.2	\$0.18	-0.65

⁵ U.S. Department of Energy. (2017). Zero Energy Is an A+ for Education: Discovery Elementary. <https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/ZeroDiscovery.pdf>

RESOURCES

To access NBI's collection of ZE resources, including case studies, research, and tools and guides for getting your project to ZE, visit gettingtozeroforum.org.



New Buildings Institute (NBI) is a nonprofit organization driving better energy performance in commercial buildings. We work collaboratively with industry market players—governments, utilities, energy efficiency advocates and building professionals—to promote advanced design practices, innovative technologies, public policies and programs that improve energy efficiency. We also develop and offer guidance and tools to support the design and construction of energy efficient buildings.

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