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The Financial Case for Net-Zero Energy Schools

Background

Every year, states and local governments invest approximately $110 billion in constructing, modernizing, operating, and maintaining school buildings. Investments in school facilities deliver proven and profound benefits to student health, thinking, and performance. Decision-makers guiding investment in school facilities require an up-to-date understanding of building technology, evolving building standards, and the cost of delivering the school facilities needed for the 21st century. This brief presents the available evidence on the cost associated with net-zero energy schools (see Glossary).

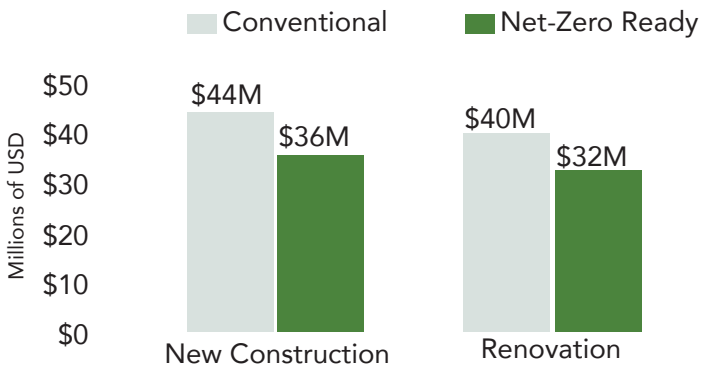
Key Takeaways

Districts and states can save money by pursuing "net-zero" in all new school construction and leveraging every renovation project to reduce building emissions and enhance climate resilience.

In fact, districts and states *not* making progress toward net-zero schools are increasingly at risk of mismanaging taxpayer resources on school facilities that waste energy, are exposed to the cost of fossil fuels, and will require more costly repairs to recover from extreme weather events and comply with emergent building regulation.

Districts that do not pursue net-zero may spend 20–25% more over a 30-year life cycle based on increased energy and maintenance costs alone ***(see Figure 1).***

Fig 1. Life Cycle Cost of Net-Zero Ready and Conventional School
30 years of costs (in millions) for a typical elementary school



Source: Perkins Eastman et. al. 2020. "Net-Zero Energy Schools", pg. 43.
Note: Estimates are for a school designed to accommodate 800 students.

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How net-zero energy schools can cost less

New net-zero schools can cost less to build.

New schools can be built to achieve net-zero at no cost premium. In fact, they can cost less. This finding, from study authors at the National Renewable Energy Lab is based on analysis of the costs of 88 net-zero energy or net-zero energy "ready" schools built during the last 15 years across the United States. An integrated design and construction process allows for right-sized mechanical systems that reduce both life cycle and first costs. By investing upfront in insulation, high-performance windows, and a carefully constructed building envelope, HVAC systems can be reduced in size, saving in equipment cost.

New and renovated net-zero schools typically cost less to operate.

Net-zero schools typically require 65-80% less energy to operate and are likely to require less HVAC maintenance. An analysis of schools in Fairfax County Virginia found that annual energy costs and annual HVAC maintenance costs in a net-zero school are expected to be $0.68 per sq. ft as opposed to $1.77 per sq. ft. for a conventional school building.[1] For a typically-sized school building, this equates to about $110,000 of savings annually (in today's dollars.)[2]

Net-zero schools comply with emerging regulation of building emissions.

Regulation of building emissions using so-called "building performance standards" is now in effect in a number of states and cities such as St. Louis, Boston, Washington DC, New York City, and Colorado. This approach is under active consideration among a number of jurisdictions across the United States including Orlando, FL, Columbus, OH, Los Angeles, and Chicago.[3] Schools can minimize the future costs of compliance by ensuring all renovation projects pursue opportunities to reduce building emissions. For example, a school installing a new gas-fired boiler today will likely need to replace that equipment far in advance of the end of its useful life in order to comply with emerging regulations.

Net-zero schools have reduced exposure to rising and volatile energy costs.

There is an emerging consensus that in order to achieve the science-based target of net-zero global emissions by 2050, societies will need to internalize the true cost of fossil fuels. Given this context, districts that reduce their reliance on fossil fuels are reducing their exposure to future potential price increases. Conversely, dramatic reductions in the cost of renewable energy have made it the lowest cost fuel in many contexts. As an added benefit, districts that install solar energy systems have locked in their long-term energy costs which allows for more certainty in budgeting.

Net-zero schools can reduce costs related to extreme weather events.

According to the National Oceanic and Atmospheric Administration, the incidence and severity of extreme weather events are both increasing.[4] Districts that do not invest in resilience will have to spend more taxpayer resources to recover from damage. Because net-zero schools are constructed to require less energy and rely more on "passive" systems like insulation, they are better equipped to handle short-term power outages without significant damage to the building.[5] For example, a school with better insulation is less likely to experience burst pipes and costly water damage during extreme cold. The National Institute of Building Sciences reports that for every $1 of preventative spending, building owners save $6 in post-disaster recovery.[6]

Photo by Allison Shelley for EDUimages.

Other benefits of net-zero energy schools

Compared to a conventional school modernization project, a net-zero school provides added benefits to students and the community. Students that attend net-zero schools have the opportunity for hands-on learning about clean energy solutions as teachers can use the school itself as a learning lab. These additional student opportunities may be supported by the operational savings generated by net-zero energy schools.

Net-zero energy schools are better prepared for extreme heat when they upgrade to heat pumps since the technology incorporates air-conditioning. Schools that install solar are well-positioned to maintain continuity of service and serve as an emergency shelter in the case of power outages since they can produce their own power.[7]

Lastly, schools that achieve net-zero contribute to our national goal of reducing greenhouse gas emissions by 50% from 2005 levels by 2030 and to net-zero emissions by 2050. In pursuing net-zero schools, states and districts are modeling accountability and climate solutions. Pursuing net-zero schools responds to young people's call to action and is a component of creating a livable future for the next generation.

Conclusion

School districts should pursue net-zero in all new construction projects and set goals to substantially reduce energy use intensity (i.e. 20-50% against a 2019 baseline) in all major renovations. In many cases, schools are expected to recover the incremental first costs of achieving net-zero during the 30-year life cycle of a school building through reduced operating and maintenance costs. Moreover, net-zero schools also provide a wide variety of other benefits including improved climate resilience, reduced greenhouse gas emissions, and environments that support hands-on student learning about climate solutions.

There are over 90 K-12 schools spread across 20 states plus DC that are enjoying the benefits of net-zero with many more net-zero school projects underway.[8] Experience to date proves that net-zero schools can be achieved in all climate zones.

Schools have a variety of options when it comes to financing net-zero schools. In addition to state funding, districts may also be eligible for utility incentives, new federal infrastructure funding opportunities, as well as private sector financing. One-time funding such as COVID relief funds is a particularly good match for facilities investments; these investments do not create recurring obligations and, in fact, can lower on-going operating costs.

Referenced Materials

Perkins Eastman, CMTA, and Downey & Scott. 2020. "Net Zero Energy Schools: A Study Prepared for Fairfax County Public Schools" https://www.fcps.edu/sites/default/files/Net-Zero-Energy-Study.pdf

Torcellini, Paul A., Nathaniel Allen, and Maureen McIntyre. 2020. Plowing through the Cost Barrier: Zero Energy K-12 Schools for Less: Preprint. Golden, CO: National Renewable Energy Laboratory. NREL/CP-5500-77414. https://www.nrel.gov/docs/fy20osti/77414.pdf.

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The Climate Jobs National Resource Center (CJNRC) is a labor-led organization that works to combat climate change, create good union jobs, and reverse racial and economic inequality by building a worker-centered renewable economy.

UNDAUNTEDK12

UndauntedK12 is a national nonprofit working to support America's K-12 public schools to make an equitable transition to zero carbon emissions while preparing our youth to build a sustainable future in a rapidly changing climate.

Glossary of Terms

Building emissions - The greenhouse gasses emissions associated with the operation of buildings. These emissions may occur at the building through the on-site burning of fossil fuels for space and water heating. Building emissions also occur remote from the site when a building consumes energy delivered by the electricity grid that is generated using fossil fuels.

Energy use intensity - A measure of how much energy a building requires in its operation and expressed as the total annual energy consumption per year divided by the gross building square footage (or kBtu/sf/year). Districts pursuing net-zero building set EUI targets that are set by building type and climate zone.[9]

First cost - The upfront cost associated with the design and construction or renovation of a building.

Life cycle cost - The life cycle cost of a building includes the first cost as well as the cost of energy and the cost of maintenance over the life of the building.

Net-zero energy school - A school that produces enough renewable energy to meet its own energy needs.

Net-zero energy ready school - A school that is designed and constructed to achieve aggressive reductions in energy use intensity (EUI), but which has not yet invested in on-site renewable energy.

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1 Author calculations based on data in Figure 20 on page 42 of Perkins Eastman et. al. 2020.

2 For other examples of energy savings associated with net-zero schools, see the Case Studies available at The Department of Energy's Better Buildings Zero Energy Schools Accelerator. These energy savings will vary depending on the local conditions including the cost of electricity and the cost of the fuels that would be otherwise by consumed by the school building (e.g. natural gas, heating oil). As of September 2021, the U.S. Energy Information Administration reported that the average price of electricity for commercial customers in Virginia was $0.08 per kilowatt hour compared to the national average of $0.12 per kilowatt hour (see Table 5.6.A. Average Price of Electricity to Ultimate Customers by End-Use Sector). In other words, energy savings estimates for Virginia schools reflect a low-cost electricity price environment.

3 Additional examples of current jurisdictions with building performance standards in place include Washington state, Denver, CO, and Chila Vista, CA. See the Institute for Market Transformation's up-to-date list. Additional examples of jurisdictions actively considering building performance standards include Portland, OR, Montgomery County, MD, Seattle, San Francisco, and Cambridge, MA.

4 According to NOAA, the number of "billion-dollar disasters" doubled in the decade ending in 2020 compared with the previous decade.

5 Conversation with Anisa Heming, The Center for Green Schools, US Green Building Council.

6 Federal Emergency Management Agency. 2018. "Natural Hazard Mitigation Saves Interim Report." Fact Sheet. https://www.fema.gov/sites/default/files/2020-07/fema_mit-saves-factsheet_2018.pdf

7 Leveraging the ability to produce solar power when there is a grid outage requires an additional investment in energy storage. Schools districts in Santa Barbara, California and Acton-Boxborough, Massachusetts are leveraging energy storage.

8 The states with existing net-zero schools include but are not limited to North Dakota, California, Florida, New York, Kentucky, Massachusetts, Texas, and Missouri.

9 See Table 4 on pg 8 of Pless S et al. 2018. "Moving K–12 Zero Energy Schools to the Mainstream: Establishing Design Guidelines and Energy Targets" National Renewable Energy Labs, Golden, CO. Available here: https://www.nrel.gov/docs/fy18osti/71700.pdf