Ashland Elementary School Net Zero Project

Project Location: Ashland Elementary School, 16 Education Drive, Ashland, NH 03217
Lead Organization: Air Cleaners Inc., Project Management, Design Oversight, and Financing

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Project Team

Ashland Elementary School Board	Project Member	
Windy Hill Associates	Architectural Design	David Ely
Design Day Mechanical	HVAC and Energy Design	Andrew Arsenault

Note: Only Phase 1 has been funded at this time from Senator Shaheen via a Congressional Spending Grant in the amount of $1.35 Million.

Project Description.

Overview

The town of Ashland is an economically challenged community of 1,959 (2021 census) residents located 38 miles north of the capital of Concord. Ashland Elementary School (AES) ranks as the 1st most needy school district of 175 in NH and is designated a Rural District 42 community. It has the tenth lowest per capita income in the state out of the 234 towns in New Hampshire. New Hampshire schools obtain almost all their funding from local property taxes because the state has no income tax or sales tax. NH is last in the nation in providing state level support to its schools. Small NH towns are challenged to meet the cost of public education. They typically do not have the fiscal capacity to increase taxes or float bonds to carry out energy improvements to their school facilities and therefore often need federal support to design, build and finance these improvements. A primary issue with all these small schools is the increasing cost of energy related to heating and cooling the buildings. The current Energy Utilization Intensity (EUI) of 171 is well above the NH state average of 42%. The high cost of oil contributes to excessive operational costs for the school, taking resources away from the community's primary goal of education. This project aims to eliminate this cost by implementing a three-phase project plan to restructure the buildings to eliminate their dependence on "offsite" energy sources and transitioning them to "Net Zero". When completed, this project will provide the following benefits:

- The elimination of energy costs to heat, cool, and light the school building will significantly reduce the cost to operate the building(s) and thereby reducing the local tax burden. It also will eliminate the "guess work" associated with budgeting energy costs for future years.
- The creation of an enhanced learning environment for students consisting of superior thermal comfort and sufficient clean fresh air to promote student health and optimize cognitive behavior.
- A highly resilient school building that can be utilized by the town as an emergency shelter in the case of a major electrical grid outage. Because the building will generate much of its own power, emergency workers and residents will be able to utilize it as a safety building.
- The project will extend the life of the building by an estimated 30 years.
- The elimination of carbon based heating and cooling fuels sources, thereby reducing the impact on global warming.
- An example of how the elimination of fossil fuels and dependence on offsite energy sources can be a "win-win" for residents, students, and taxpayers that can be replicated by every small town in NH and the US.

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Project Description

The Ashland Elementary School consists of two buildings, the main classroom/cafeteria building, and the gymnasium. The focus of this project is the main classroom building, a 39,600-square-foot single-level structure constructed in phases beginning in 1955. The building is constructed utilizing masonry exteriors with no insulation and is heated by oil. The oldest section of the building is referred to as the "Ober Wing" and was built in 1955. The "Glidden" wing was added in 1965, the "Vocational Wing" added in 1970, and the "Middle School Wing" added in 1994. Modest improvements to the building have been made over the years, including the replacement of the original windows in 1996. An aerial view of the main classroom building can be seen in Figure 1 below:

Figure1
Arial view of Ashland Elementary School

The project consists of a 3-phase deep energy retrofit of the main classroom building with air sealing, roof insulation, exterior wall insulation, high-performance energy recovery ventilation (ERV), and LED lighting. It replaces fossil fuels with efficient cold-weather heat pumps. This all-electric project includes a microgrid with solar generation, energy storage for resilience, and an advanced machine-learning Energy Resource Management System to optimize energy use. This project will be implemented in three phases:

- Phase 1: This initial phase will focus on the building envelope by adding sufficient insulation and air sealing to provide a very low air change rate (1 ACH @ 50 PA) to the main classroom building.
- Phase 2: After the building is properly insulated and sealed, the replacement of the existing oil-based fossil fuel heating system will be replaced by heat pumps. A rooftop solar array will also be added in this phase to offset the additional electrical load created by the heat pumps.
- Phase 3: The addition of local electrical storage and an intelligent control system to manage the electrical loads in the building and store excess energy for use during non-solar generating periods.

Each of the three phases is designed to "stand on its own" from a functional point of view. For example, if only Phase 1 is completed, the benefits of improved indoor air quality, occupant thermal comfort and reduced energy consumption will still be realized. By segmenting the project in this manner, each of the phases will add incremental benefits, but are not necessary if future funding is not secured.

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This project is an example of integrated design, balancing energy efficiency, thermal comfort, superior ventilation, improved indoor air quality (IAQ), electric production, and storage. It demonstrates that older schools can be successfully and economically brought to modern thermal standards and eliminate fossil fuels. The project will also explore creative financing combining investment tax credits (ITC), federal energy rebates, and bank financing to monetize the energy efficiency/generation savings, covering some of the project financings within existing Operational Expenses (OPEX). The aim is to make the project cash flow positive to the school district.

By integrating a whole-system approach and balancing improvements across the building envelope, ventilation, power generation, system controls, and innovative financing, the project provides value to this school campus, its students, and demonstrates applicability to other schools. The project is designed to maximize the benefits of the technologies integrated as a whole, to form a resilient integrated system providing high energy performance and good return on investment.

Phase 1 Statement of Work

Funding has been secured through a Congressional Directed Spending Grant to implement Phase 1 of the plan described above. The focus of this phase will be the important work of improving the building envelope to reduce thermal loss and improve the indoor air quality. Fortunately, three Energy Recovery Ventilation (ERV) systems were added to the school recently, so the focus of the Phase 1 effort is an improved building envelope. Elements of Phase 1 improvements include:

1. Information gathering. This information will be gathered during Phase I and available for all subsequent phases.
    a. Develop required documents including Drawings, Specifications, Submittals, etc.
    b. Research historic photos to trace the progression of construction.
    c. Architect, Engineer and Estimator to visit the sites to familiarize ourselves with existing conditions.
        i. Photographic record
        ii. Thermal Images (must be minimum 30° temp differential, 40° is better)
        iii. Identify cavity insulation by borescope or small test holes.
        iv. Flat roof cores for insulation type and thickness.
        v. Identify thermal bridges.
    d. Scan the buildings using LIDAR and have the point cloud interpreted into REVIT and AutoCAD Plans and Elevations.
    e. Test air infiltration – Blower Door Test.
    f. Produce a baseline energy model of existing conditions and identify the Energy Use Intensity (EUI).
2. Develop a Preliminary Report
    a. Document existing conditions.
        i. Prepare existing Plans and Elevations.
        ii. Floor, wall, window, door and roof existing R and U values and thermal bridges.
        iii. Siding and Roof condition assessment.
        iv. Air infiltration quantities.
    b. Proposed envelope upgrades
        i. Description of upgrades with detailed drawings, details and specifications.
    c. Produce thermal images, archive details, observed conditions.
    d. Update the energy model for estimated Energy Utilization Index (EUI) after improvements to predict energy savings.

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    e. Produce detailed cost estimates of improvements.

3. Construction Manager (CM) Selection
    a. Prepare RFQ and one revision after review by Owner and Rural Development representatives.
    b. Meet virtually with Owner and Rural Development to identify and invite 3 bidders.
    c. Meet virtually with Owner and Rural Development to interview bidders.
    d. Evaluate submissions in report format and meet virtually with Owner and Rural Development representatives one time to make CM selection.
    e. Notify all bidders of the results of the selection.
    f. Review CM contract between Owner and CM.
4. Design and Construction Documents
    a. Provide the Owner and Rural Development representatives with evidence of required insurance - Liability, CGL, Workers Comp, etc as required.
    b. Perform necessary design surveys.
    c. Accomplish the detailed design of the project (Design Development).
    d. Prepare Construction Drawings, Specifications and Contract Documents, and provide 10 copies. Additional copies will be provided in PDF format.
    e. Coordinate with CM through the design process construction costs to stay within allocated funds, and review CM's Guaranteed Maximum Price Addendum to the CM contract.
    f. Coordinate testing as required at no additional expense to owner, testing to be paid for by the Owner.
5. Construction Administration
    a. Establish with CM and Owner baseline schedule of construction and benchmarks for phased completion.
    b. Visit the site on regular intervals to meet with CM, observe construction progress to ascertain that the CM is generally conforming with the design concept.
    c. Review all Submittals, Requests for Information, CO Requests, and Pay Requisitions.
    d. Issue Statement of Substantial Completion after final review and submit written report in pdf format to the Owner and Rural Development representatives.
    e. Prepare Statement of Final Completion and obtain the written acceptance of the facility from the Owner and Rural Development representative.
    f. Ensure the CM provides record (as-built) drawings, 2 sets of prints and one PDF.
    g. Ensure the CM provides instruction for the Owner in initial project operation and maintenance, not to include supervision of normal operation of the systems.

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Schedule of Phase 1 Work

Phase 1 design work will begin in July of 2024. It is anticipated the design effort will continue through the fall and winter as the detailed design documents develop. The goal is to have the design complete in early 2025 so a construction team can be selected, and implementation can begin when classes are dismissed in the summer of 2025. A summary of the overall schedule for the Phase 1 implementation can be seen in Figure 1 below:

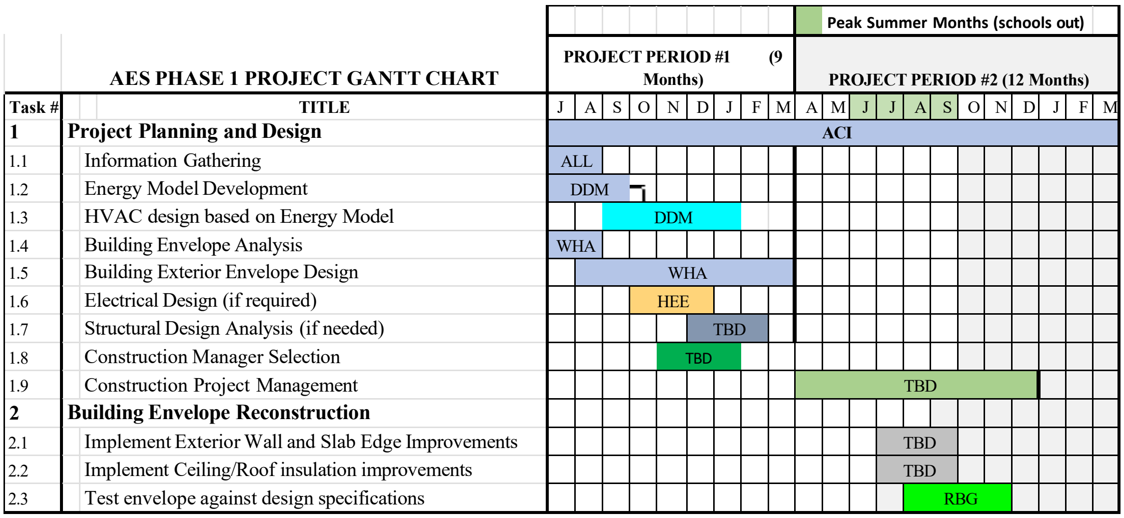

Figure 2
Overall Phase 1 Project Schedule

Conclusion

The Ashland Elementary School is in a rural, under-resourced, low-income community without the fiscal capacity to implement much needed energy improvements. It is representative of well over 300 elementary schools in New Hampshire with the same issues, and largely the same design. This project is the first phase of a 3-phase project to restructure the Ashland Elementary School to be self-sufficient from external sources of energy thereby reducing energy related costs to Ashland taxpayers. It will also yield a superior learning environment for students, enhancing cognitive performance while reducing the transmission of airborne pathogens. This project is intended to be a demonstration and “proof point” for other schools in New Hampshire to illustrate projects like can be successful and yield significant benefits, as well as a process that can be successfully scaled to other small towns and communities throughout the state of New Hampshire.

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