



BALA

INSIGHTS

Using Controls Optimization to Enable Belmont Middle & High School to Outperform Energy Use Intensity Goals

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Creating a New, Net Zero School

Belmont Middle and High School in Massachusetts is a 445,100 SF - \$256M new building that created a combined hub of education for students from 7 - 12th grade. The two-phase project created the new high school first. Once completed, the high school students moved to the new building, and the previous building was demolished for the development of a new middle school. "The four-floor structure included new academic and science wings, media facilities, administrative and health suites and a new common dining area¹."

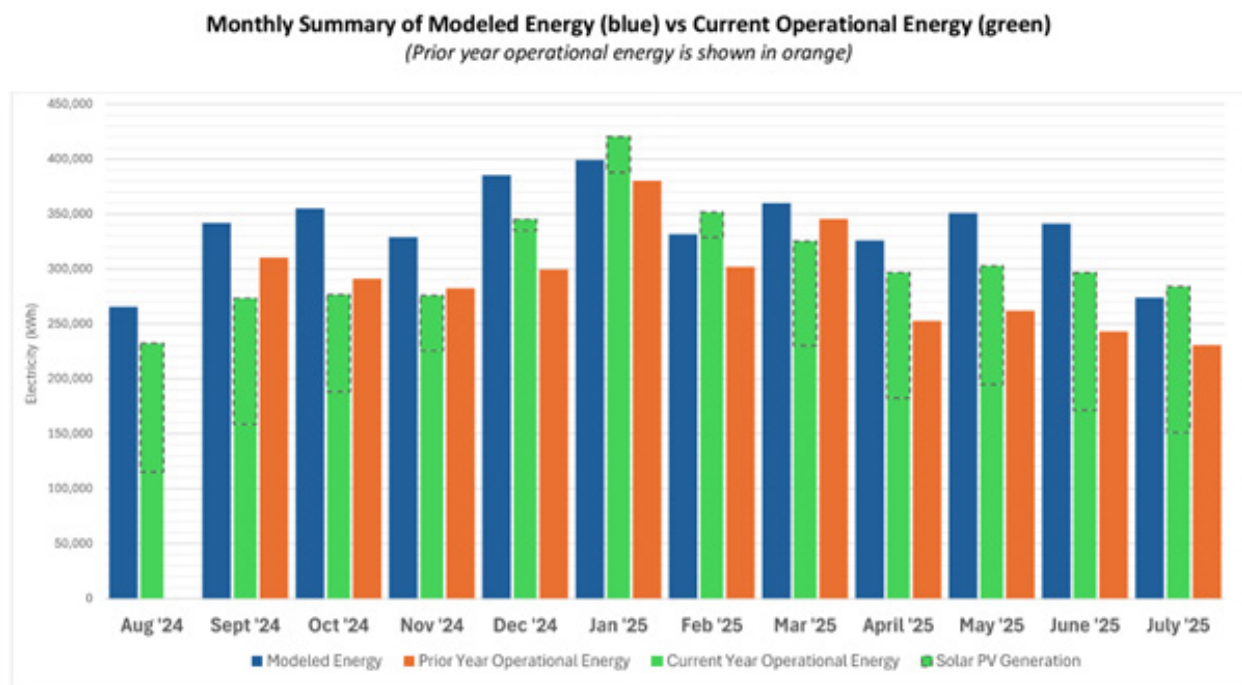


The building harnessed the benefits of sustainable design focused on Zero Net Energy -- where the energy used throughout the course of a year is offset by renewable energy sources. The first step in achieving net zero energy for a project is to reduce the building energy use as much as possible. A widely used method to measure the energy efficiency of a building is Energy Use Intensity (EUI). This metric shows total energy per square foot per year. EUI allows for the comparison of buildings of the same type, regardless of size. The targeted EUI for this project was 31 kBTU/SF/Yr at the completion of the design phase. The EUI was reduced by designing a high performing building envelope and highly efficient mechanical systems. **Two years later the building is seeing even better operation at 26 kBTU/SF/Yr.** Knowing that Owners can be skeptical of energy modeling results this project turned out to be a case study in energy savings being realized through good design and controls optimization.

¹ Skanska Press Release - 9/7/2023 "Skanska completes \$256 Million Belmont Middle and High School in Belmont, MA"

How Was 26 kBTU Achieved?

The fact that the project was built in two phases profoundly impacted the efficiency of the installed systems which were operating as if the full building was in place. This is impressive because the building systems were operating at part load conditions while the middle school was being constructed. Typically, mechanical systems are less efficient at part load conditions. This was overcome based on proactive and consistent monitoring of the control systems described herein. A collaboration between Bala Consulting Engineers, Interval Data Systems (IDS), and the facilities team for the Town of Belmont allowed the team to evaluate operational inefficiencies and develop strategies to improve them.

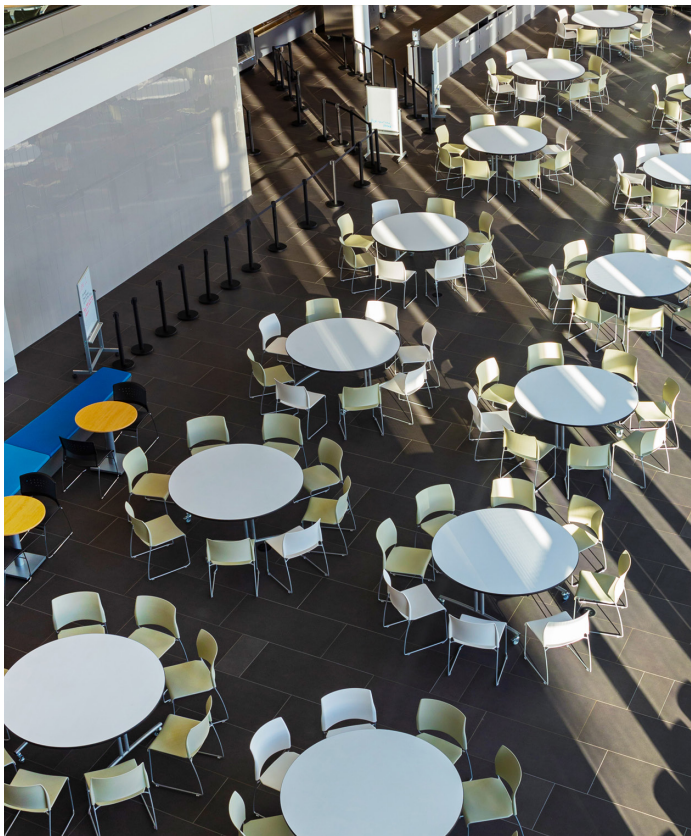


SCHEDULING

- Following initial performance reviews, zone groups were added to allow for systems operational scheduling of similar space types. These were developed in conjunction with the town based on how they intended to use the building over the course of a year.

OPERATIONAL SETPOINTS

- Ensured that setpoints were consistent with design documents. If variations needed to be made, based on certain space utilization, they were implemented and maintained consistently.
- We also looked at setback temperatures and refined optimized start sequences to minimize energy use when transitioning from scheduled unoccupied and occupied modes.



PROACTIVE TRENDING OF SYSTEMS

- Systems were trended proactively to allow for the team to be able to quickly identify when energy use was outside of the expected values or when operating setpoints were not being maintained.
- When something was identified the team was able to pull trend data to perform a deeper dive into systems operation down to the component level to determine the root cause
- By consistently monitoring and trending systems it allowed the team to react quickly to any issues that would arise instead of waiting for the data to become available.

PHOTOVOLTAIC SYSTEMS

- A photovoltaic array was implemented on the roof to provide on-site renewable energy. This system provides approximately 30% of the annual energy consumed by the building.
- The remainder of the energy is procured via power purchase agreements to make this building a Net Zero Energy building.



Belmont Middle High School is an example of how proactive monitoring and optimization of systems can provide significant energy use reduction benefits. This is something that we recommend discussing with building Owners and Operators at the beginning of every major construction project.



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