Green Pays Its Way—Performance-Based Fees

Giving building and design professionals a financial incentive to create high-efficiency schools proves to be a winning strategy for both the firms that design and build schools and the students who learn in them.

by Cameron M. Burns and Huston Eubank, AIA

Photos by Michael Mathers

The 265,000-square-foot, 1800-seat North Clackamas High School, near Portland, Oregon, opened in April 2002. The school's energy-efficiency features will reduce its energy bills by $75,000 to $80,000 annually compared to a conventional school.

Phenomenal!" exclaimed Rocky Mountain Institute's (RMI's) co-CEO (Research) Amory Lovins when architect Heinz Rudolf told him about the newly-opened North Clackamas High School's likely future energy savings.

Lovins had good reason to be excited. Computer and physical modeling of the school indicate that it is one of the greenest" schools in the nation. The total energy savings are expected to be 44 percent better than the Oregon Energy Building Code requires (and much better than the American Society of Heating Refrigeration and Air Conditioning Engineers, Inc. energy code recommendations). The school will save roughly $75,000 to $80,000 annually on its energy bills, and the total capital cost was a mere $118.70 per square foot. And now that it's open, the structure itself is drawing rave reviews.

Photos by Michael Mathers

Light shelves on classroom windows direct daylight deeper into the classrooms and help reduce glare.

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The cafeteria at North Clackamas High School uses so much natural light that it needs very few light fixtures on the ceiling.

"This is an incredible building for students and staff," said Principal Dean Winder. "The natural light and ventilation brighten everyone's day. The students have more bounce in their step and smiles on their faces. The parents and community are very proud of what they have done for this generation and generations to come."

Promise of Profits

The North Clackamas High School is unique not only because it is one of the greenest schools in the nation, but also because of the use of performance-based fees (PBF). In fact, the school was one of four projects chosen by RMI to demonstrate the use of PBFs. As the name implies, PBFs link a portion of the compensation of project architects and engineers to the savings derived from high efficiency designs. The greater the savings in electricity, natural gas, liquid fuels and other resources, the more these professionals earn.

The North Clackamas High School project began in the mid-1990s and involved numerous entities, including RMI, BOORA Architects, CBG Engineers, Eley Associates, ENSAR Group, Portland General Electric, the Energy Foundation and, of course, the school district. North Clackamas educators had heard about the effects of natural lighting and ventilation on student and teacher performance, and investigated.

"The district was not interested in green design for it's own sake," said Bill Dierdorff, Business Manager with the North Clackamas School District. "The district was interested in an excellent educational environment that would be cost-effective over the 75 to 100 year life of the facility. Green was not a goal, it was a solution!"

With funding from the Energy Foundation, RMI worked closely with Eley Associates to create set of PBF guidelines. PBFs aren't rocket science, but using them requires considerable foresight and planning.

"The value of starting early cannot be overemphasized," wrote Charles Eley of Eley Associates in the primer on Energy Performance Contracting for New Buildings. "Retrofits and late design changes are usually limited to HVAC equipment selection, lighting equipment changes and possibly glass type. These measures

save energy, but they have a relatively low rate of return. The most cost-effective measures happen early on, and affect characteristics like building orientation, window size and placement, shading, space planning. Many of these measures cost nearly nothing—sometimes they even cost less than the base case—but each has the potential of saving a lot of energy."

Benefits of Performance Contracting

OWNER
- Reduce total building lifecycle cost
- Increase rent revenue or sale price due to lower operating costs
- Green building image helps marketing
- Efficient systems tend to be higher quality (maintenance and replacement cost savings)

ARCHITECT/ENGINEER
- Incentive for a low energy cost design
- High performance, "green" building in portfolio
- Clearly stated performance goal before work begins helps streamline process

CONTRACTOR
- Additional design work generally creates clearer and more specific construction plans
- Source of compensation for nonstandard components and energy-saving designs
- Possible influence and input during design process
- Incentives for proper commissioning (fewer callbacks)

OCCUPANT
- Energy-efficient, productive and enjoyable workspaces

Green by Design

The 265,355-square-foot school opened April 3, 2002, after spring break, so that North Clackamas seniors will be able to enjoy the school before they graduate. Organized into building "bars" along an east-west axis for optimum natural lighting and ventilation, the school employs natural and recycled content materials—such as natural linoleum, ceramic and quarry tile, brick, recycled rubber flooring, recycled upholstery and recycled acoustical tiles—that follow principles of environmental sensitivity, simplicity and efficiency. Divided into four academic houses, the building provides small-scale learning environments with emphasis on flexibility, integration of instruction, technology as well as spaces for social interaction and community use.

"Because of a tight budget (roughly $29 million), building orientation, massing, bay-depth and microclimate had to be considered from the beginning," said architect Rudolf, a principal of BOORA Architects of Portland. "The emphasis on high performance glass and skin permitted a reduction of the mechanical system."

A DOE-2 computer energy model anticipates savings over typical designs of 275,000 kilowatt hours in lighting, 315,000 kilowatt hours in fans and pumps, 150,000 kilowatt hours in cooling and roughly 27,000 therms (27 billion Btus) in heating. An indigenous landscaping design that includes preserving and enhancing an existing six-acre wetlands area complements the building. The wetlands will be used to retain and purify stormwater runoff.

Photos by Michael Mathers

Daylighting in the gym at North Clackamas High School provides adequate light for student activities, saving the school money that would have been spend on electricity for lighting.

To test their design ideas about lighting and natural ventilation, the architects and students built two full-scale classroom mockups. The first of these was at the Seattle City Light's Lighting Design Laboratory, where they were able to hone critical aspects of their daylighting and electric lighting design. The second was built by the students on the site of the new school and used to test natural ventilation components of the heating and cooling design.

Staying the Course

Performance-based fees can get lost in the complexities of building and development project processes, especially when there are many change orders. In this project, however, the PBFs survived and even helped steer the process. The money saved through energy efficiency will be split between the designers and the school fifty-fifty for the first two years, with the school's share going into the general fund to offset the increasing cost of energy, according to Physical Plant Director David Church.

"The PBFs were important simply because they allowed us to spend the extra time and effort required to create a first-class school," said Rudolf. "The extra compensation allows us to do extra research, evaluations and testing so that we can develop cost-effective systems, especially passive systems. What is equally important is the fact that once a contract for the extra compensation is in place, it serves as a tool to commit everyone to accomplish specific goals, as opposed to slightly increasing the professional fees without the specific expectations." In an aside, Heinz chuckled about how the run-up in energy prices last summer might have a very positive effect on the performance- based fees, and how this has highlighted the importance of energy savings for this project.

The school has been a hit locally as well as regionally. Several other school districts are working on high schools that will use similar technology, including the Salem-Keizer School District and the City of Oregon School District.

"I was surprised at how a building can be so functional and yet beautiful at the same time," says Church. "My impression

in talking with both students and members of the community is that they are very pleased with the school. The School Board is pleased as they know this facility was a great bargain and will continue to save operating costs due to its low energy consumption. The press was very positive and did several stories on the school and its 'green' aspects."

Green or sustainable buildings like the North Clackamas High School aren't just getting noticed in Oregon. Across the country and around the globe they are becoming the norm, not the exception. Recently, Australian architect Glenn Murcutt won

Photos by Michael Mathers

Small high windows reduce the need for electric lighting during the day.

the Pritzker Prize for his beautiful and sustainable designs. In his *New York Times* article about the award, architecture critic Herbert Muschamp—by no means a champion of green design—noted, "Mr. Murcutt's selection by the Pritzker jury can be seen as an acknowledgement that sustainability now overrides aesthetic criteria in the urbanizing world."

While we agree, the new North Clackamas High School project demonstrates very elegantly, as do Mr. Murcutt's buildings, that sustainability and aesthetics can be quite complementary. ✲

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Dazzling Daylighting

Just one aspect of a "green school"—daylighting—can have extraordinary effects on students. In 2000, researchers evaluated the test scores of 21,000 students in three school districts in California, Colorado and Washington. They found that in one district, the students in classrooms with good daylight progressed 20 percent faster on math tests and 26 percent faster on reading tests when compared with students in classrooms with poor quality or no daylight. In the other two districts, "students in classrooms with the most daylighting were found to have 7–18 percent higher scores than those in classrooms with the least daylighting."

In the past year and a half, the Summit Foundation has funded the Rocky Mountain Institute (RMI) to do some very important work in the Brazilian city of Curitiba, and we are now on the verge of seeing some remarkable results. While RMI's work covered a number of topic areas (wastewater treatment, executive training in natural captalism, etc.), it's in the realm of green school design that we've seen the biggest return on investment.

Both Curitiba and the state of Parana are in the process of planning for many new schools. RMI's studies of existing schools and presentations of what's possible with green buildings caught the attention of both state officials and Curitiba's mayor. Over the course of three trips to South America, we have worked with state and city officials to design a new model school that uses 75 percent less energy than their current design, but performs at much higher levels of comfort and productivity.

The design is funded by the mayor for construction and will be finished in about a year. Then, we are planning a year-long period of monitoring during which we will examine the building's energy and resources consumption, but more importantly, the performance of the students. Because the school is funded by the mayor, we are able to experiment with and implement RMI's green building recommendations. Once the new school's performance is verified, it will become the new prototype for schools funded by Brazil's Federal government.

Leading the Way

The Brazilians are very excited about this. Although relatively modest to start, our work in green school design could one day make Brazil a world leader in green school design.

RMI's work with schools in Brazil is not just for Brazil. All over the world, both developing and developed nations are struggling to develop good educational practices.

Even Japan, with its very high scholastic achievements, undertook education reform in 2001. Japan is now experimenting with a broadly revised approach to education and curricula nicknamed "the Rainbow Plan," that addresses concerns about stress, learning and discipline in Japanese schools. This effort could begin with very simple daylighting and natural ventilation strategies.

Researchers have demonstrated that daylighting is already proven to reduces stress levels in students. In studies of 90 Swedish elementary (primary) school students, researchers looked at behavior, health and cortisol (a stress hormone) for a one-year period in four separate classrooms, each with different amounts of daylight. "The results indicate work in classrooms without daylight may upset the basic hormone pattern, and this in turn may influence the children's ability to concentrate or cooperate, and also eventually have an impact on annual body growth and absenteeism," according to the *Journal of Environmental Psychology*.

In the U.S., the federal government estimates that between 2000 and 2007, "at least 5000 new schools will be designed and constructed to meet the needs of American students in kindergarten through grade 12." The U.S. Department of Energy (DOE) estimates that schools in the U.S. spend more than $6 billion each year on energy. And, according to DOE, 25 percent of that money—$1.5 billion nationally—could easily be saved through "better building design, widely available energy-efficient and renewable energy technologies and improvements to operations and maintenance."

RMI's work in Brazil with Curitiba's model green school is obviously in its infancy, but could have tremendous potential. Around the globe, more and more schools are expanding their hours of operation, reducing class size and employing other measures—such as one-on-one tutoring—to improve learning. Such improvements put big demands on physical learning space and energy requirements, ironically leaving less money for books and other resources that directly affect education. In the coming years, high performance school design will become one of the single most important aspects of education, alongside quality books, quality teachers and quality curricula.

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