# The New Era

**As occupant health begins to rival energy efficiency in building design, the glass industry finds itself in a unique position to offer solutions. How it's taking on the challenge...**

*Katy Devlin*
*September 30, 2013*
COMMERCIAL, RETAIL, FABRICATION

Energy efficiency has dominated conversation in the building community during the last decade, but the conversation could be changing as architecture enters a "new era focused on human-centered design," says Whitney Austin Gray, research and innovation director for international architecture firm, **Cannon Design**.

In this new era, "energy versus health should not be a tradeoff," Gray says. Building occupant health and performance will top design goals, alongside energy efficiency and sustainability, she explains. Those goals cannot be achieved without the glass industry.

"In this discussion, I would define performance at three levels: occupant comfort and task performance, building owner lifecycle cost, and societal environmental impact, mainly energy," says Stephen Selkowitz, senior advisor for Building Science, and leader of the Windows and Daylighting Group, **Lawrence Berkeley National Laboratory**.

As multi-tiered performance expectations grow, the glass industry finds itself in a unique position to provide the building community with solutions that address energy performance, human health and occupant productivity, provided it pushes the envelope of product development, and advocates for intelligently and holistically designed facades that use glass appropriately.

## The human half of the performance equation

The glass industry has worked hard in recent years to prove itself as an energy efficient performer.

In 2010, industry groups and companies successfully overturned a proposal to reduce allowable glass and glazing by 25 percent within the ASHRAE 90.1 prescriptive building code. The industry appears to have stalled a similar proposal for the **ASHRAE 189.1 energy code**. In both code battles, the industry argued that glass is crucial to buildings' energy performance, allowing for natural daylighting and offsetting lighting costs with the use of automated controls.

Daylighting's role in energy savings has led the discussion regarding glass performance in recent years, while human health and performance has played little part. That is about to change, due in part to a growing push at the design level, sources say. The topic is a burgeoning focus for numerous organizations across the building community, including the American Institute of Architects, the General Services Administration and the U.S. Green Building Council.

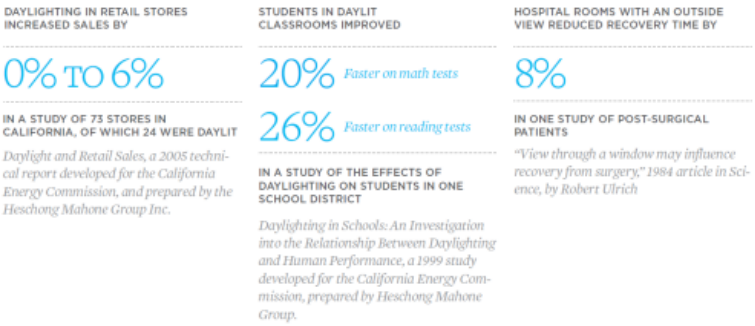


**Fig. 1**

"The primary reason we are building is not to save energy. Our primary goal is to provide a high-quality, special and comfortable environment for people," says Christopher Meek, research assistant professor, Department of Architecture, University of Washington. "Energy savings is, of course, paramount. But, people, occupants, are higher on the totem pole."

Designing for human health and productivity means designing with glass to provide daylighting and views, according to decades of study across nonresidential building sectors. (See Fig. 1)

"Numerous studies have shown the benefits of daylight on the health of the human body—reduction of stress, depression and even mortality rates, among others," says Stephen Weidner, vice president of **NSG/Pilkington**. "I believe this message is beginning to resonate within the architectural community, and is now one of the prime areas of focus in building design, and the building regulation process."

The translated savings for employers, hospitals and other parties could be major. According to a 2012 study from Terrapin Bright Green LLC, a New York-based consulting and strategic planning group, "Integrating quality daylighting schemes into an office space can save over $2,000 per employee per year in office costs, whereas over $93 million could be saved annually in healthcare costs as a result of providing patients with views to nature."

Looking at the office sector specifically, studies indicate that daylit, healthy spaces can reduce absenteeism and "presenteeism": when workers are present but not productive. Absenteeism and presenteeism represent 4 percent of annual operating costs for U.S. companies, while energy costs only represent 0.8 percent, according to the Terrapin study. "Productivity costs are 112 times greater than energy costs in the workplace," according to the study.

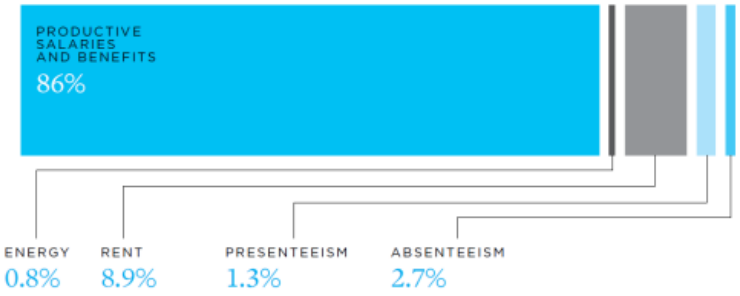


**Fig. 2—Company Operating Costs**
*Absenteeism and presenteeism represent 4 percent of annual operating costs for U.S. companies, while energy costs only represent 0.8 percent, according to a 2012 study from consulting firm Terrapin Bright Green LLC.*

*Source: U.S. Department of Labor 2010, BLS 2011, BOMA 2010, presented by Terrapin Bright Green LLC.*

To promote the health performance benefits of using glass in building design, the industry must focus on education. "There is now a critical mass of research in the area of daylight and view, and the impact of that on health and productivity," says Helen Sanders, vice president of technical business development for **Sage Electrochromics**. As an industry, "we can find those papers and point them out, and make them relevant. Ultimately, we can do our own studies."

Building occupant performance could also become a critical selling point for glass, particularly as the energy cost savings from daylighting are offset by the increased use of super-efficient LED lighting. "We, as an industry, need to focus on the human side of the equation," Sanders says. "We have to start focusing on the research that is out there and package it in a way that

[argues for the use of more] fenestration. This is an education process."

## Energy efficiency still key

Going forward, energy efficiency and sustainability will remain crucial to successful building design, and the glass industry will need to continue battling perceptions that it is a poor energy performer.

*Architects and owners of the Center for Sustainable Landscapes at the Phipps Conservatory in Pittsburgh emphasized biophilic design when they planned the center. "That is a relatively new field that is focused on improving the comfort and productivity of [occupants] by giving them greater access to nature," says Glenn Miner, director, construction, PPG Flat Glass. The project is aiming for certification in the Living Building Challenge sustainability rating program, and features PPG's ultra-clear glass and low-emissivity coatings, "because their ability to transmit light and trap heat is critical to supporting plant life," Miner says. Photos by Jim Schafer.*

"It is a challenge to change these perceptions, many of which were formed years or even decades ago when, in all honesty, glass was a fairly poor performer in terms of energy efficiency compared to other wall materials," says Glenn Miner, director, construction, **PPG Flat Glass**. "However, if you look at the strides that have been made by the industry in the last 10 years, I feel glass has acquitted itself quite well in providing exceptional solar control, insulating capability and harvesting the benefits of natural daylighting."

Weidner agrees. "The industry has made great strides since the oil shock of the '70s, when energy performance first became a real issue. Up until that time, with energy … being relatively abundant and cheap, the energy efficiency of building products was not an issue. Glass, in particular, was mostly monolithic, and compared to current technologies, extremely energy inefficient," he says. "I believe this perception in the architectural community lingers to this day, even with the various advances in coatings, [insulating glass units], etc., that have been developed over the course of the last couple decades."

While the industry so far has avoided the latest moves at ASHRAE to outright reduce the amount of glass permissible within the built environment, overall code stringency will continue to rise, experts say. "High performance expectations are going to continue to go up; code requirements are going to continue to tighten up. That's going to require and demand better performing products," says Keith Boswell, technical director of the San Francisco office for **Skidmore, Owings & Merrill LLP**.

## The next generation of glass

To keep up with tightening codes, glass and glazing companies need to promote existing products, develop new and even better-performing products, and educate the building community about the energy-saving potential of glass when used in conjunction with other building elements, industry sources say.

As far as architects go, when asked what they are looking for from the next generation of glass products, most agree: better performance, more light.

“When it comes to glass, I think the design community would like to have its cake and eat it too: expansive glass facades that let in light and limit heat transfer,” Meek says.

“We are always [searching] for an alignment of maximizing transparency with high performance,” says Boswell, who says he’s looking for the next breakthrough product similar to low-E. “When you look back to the ‘80s, when low-E coatings entered the market, that was a huge breakthrough for glass performance. I don’t know if there is a next generation low-E that will achieve higher transparency and performance. But, it might take a breakthrough [product] like that,” he says.

The industry has heard the call for increased efficiency, and glass manufacturers have been focused on improving coatings and existing products, while developing next generation solutions. “There is a compelling story to tell about the innovation in our industry and how the latest glass products can be used to enhance energy efficiency in buildings, whether they have a low window-to-wall ratio or a higher WWR,” says Chris Dolan, director, commercial glass, marketing for **Guardian Industries**. “We must continue to educate key audiences about these facts.”

Miner adds, “I think the exciting days are really just now coming upon us. The advances over the last 10 years have been building on a developed technology base that is now approaching the theoretical limits for static coating designs.” Glass manufacturers have worked to develop products that meet both the energy and light demands of customers.

“We at PPG, as well as other glass suppliers, have introduced new products such as Solarban R100, Solarban 72 and Solarban 67 to provide aesthetic options, manage light and incrementally improve solar performance,” Miner says. “But we are now at the point where breakthrough technologies are going to be needed to take us to the next level. The development of integrated coating systems utilizing interior surface coatings, such as Sungate 600, and dynamic glazing products that respond to changes in the environment are the first wave, and we are also looking into new manufacturing process technologies that will enable a new generation of glass products.”

Guardian recently launched several new commercial coatings, including SunGuard IS 20, an interior surface coating that lowers U-factors for doubleglazed [insulating] units to levels near those of triple-glazed units, according to the company. The product can also be used to enhance triple-glazed U-factor performance. In addition, the manufacturer launched a high light transmitting coating called SunGuard Neutral 78/65 for double- and triple-glazed IGUs, and later this year it will introduce a nextgeneration triple-silver low-E called SunGuard SNX 52/23. “This product will set a new standard for combining light transmission with low solar heat gain in one coating,” Dolan says.

NSG/Pilkington has also “been working on several fronts in improving the energy efficiency of various glass technologies,” Weidner reports. “In Europe, we offer an extremely wide range of sputtered solar and thermal performance products amongst the most efficient ratings the industry offers anywhere,” he says.

The company also has introduced a commercially available vacuum insulated glass, Spacia. “This product is available in the United States, and we are in the process of glazing several very large retrofit projects with this very energy-efficient technology,” Weidner says.

Many in the design community are also looking for next-generation glass products to

become more mainstream, with lower price tags. “I would like to see more products like electrochromics, thermochromics, building integrated [photovoltaics] and others coming to the market,” says Vikram Sami, associate partner, **ZGF Architects**. “But I’d like to see better performance from those products, and a reduction in cost.”

*The X-Cluster tower in Dubai features highperformance Pilkington Eclipse Advantage Arctic Blue low-emissivity glass. The glass provides high daylight transmittance, energy efficiency and a durable pyrolytic surface. Photograph courtesy of Intraco.*

Boswell agrees. “I think that materials and systems such as dynamic windows, triple-glazed units, integrated blinds, are good. But they remain add-on products,” he says. “A lot of architects in the [United States] haven’t been able to implement these strategies in order to ‘kick the tires,’ and a lot of owners either won’t, or can’t, can’t pay for it.”

Despite the reluctance of some architects and building owners to adopt dynamic glass technologies, Sage’s Sanders says awareness is there, and the market is growing. “Electrochromic glass is becoming better known in the building industry. We hear it talked about more and more by designers, talking about it not as mainstream, but as a real option,” she says. “And we are seeing an uptick in the market; it’s becoming something that people are seeing as an option for solar-control needs.”

Glass manufacturers have embraced emerging technologies by fostering partnerships with product suppliers. Sage Electrochromics became a wholly owned subsidiary of Saint-Gobain in 2012. PPG is working with thermochromic glass maker Pleotint, and Guardian is collaborating with Pythagoras Solar on a BIPV glass product and with View on an electrochromic glass unit.

## Getting it right

Glass has the potential to help make or break a building’s energy and human health performance. Ensuring the right type and right amount of glass are used in the right places remains critical. Factors like glare and uncontrolled solar heat gain can compromise both energy savings and human comfort.

*To achieve superior energy performance, Marina Mart in Seattle features Guardian SunGuard SuperNeutral 68 and SunGuard IS 20, a fourth surface coating. The building was designed by Richert & Associates. Oldcastle BuildingEnvelope Battle Ground was the Guardian Select Fabricator and SGS Glass was the glazier. Photo by Sozinho Imagery.*

“We have to make sure that we are using glass in ways that are sensible,” Sanders says. “You can have over-glazed buildings. You can have a lot of daylight and a lot of views, and be uncomfortable and have energy problems.

“Forty percent of the projects we do [at Sage] are what we call fix-its—a building that has been built, but doesn’t work for the occupants,” she says. “There are usable faces, but they aren’t controlling heat and light appropriately.”

Boswell says orientation, environment and appropriate use of materials and systems in exterior enclosures need to be taken into careful consideration in design. “While we [specify] a lot of glass in our buildings, there are only a very few times when an all-vision glass enclosure system in an area of a building makes a lot of sense,” he says. “Designing a building in a cold climate like Minneapolis is not the same as in a hot or hot/humid climate like Miami. For each

project, we try to carefully consider environment, and design an enclosure with the appropriate glass type and extent."

"Our studies have shown that it is technically possible to design and operate fenestration systems that are 'net zero' contributors to the building energy balance—that is, they use equal or less energy than an insulated wall," Selkowitz says. "The research suggests fenestration area can be varied over a wide range while achieving these performance levels if, and only if, the right design and operating choices are made. If the glass area is small, then there are many simpler and lower cost solutions possible. If the glass area is much larger, then the performance requirements become more challenging, but are still achievable."

According to Selkowitz, achieving these aggressive net zero performance goals with larger glazed areas requires: high performance glazing and framing; reliable dynamic control of sunlight and daylight; and a means to manage electric lighting energy use. "These systems must also be maintained and work well over time," he says. "We know it is technically possible to achieve this result; but we also know from field experience that it is difficult and challenging to do this reliably and consistently with all projects."

The industry should not unequivocally advocate more glass, but rather promote glass and related systems used in appropriate ways. "We need to make sure we're putting the right amount of glass in the buildings, and putting it in the right locations," Sanders says.

Increasingly sophisticated modeling tools can help project teams identify potential problem areas. Design tools, such as COMFEN from Lawrence Berkley National Laboratory, allow users to evaluate fenestration performance in terms of visible light transmittance, solar heat gain, thermal performance and glare.

ZGF Architects' Sami specializes in design analysis for daylighting, performance and energy simulation at the Seattle-based firm. "We have a variety of programs that we work with for daylight simulations, and visual comfort simulations. … In these simulations, we are modeling light levels—how much daylight are you getting. If you are getting too much, the odds are that someone will apply the blinds, and you'll lose daylight potential."

The tools for measuring and modeling human comfort have lagged behind tools designed to measure building performance. However, the comfort simulations are improving and becoming more common, Sami says. "Thermal comfort is a less modeled type of comfort. You're measuring the flow of heat through spaces. It allows you to study the effect of sitting next to a window in the wintertime, or how hot the space might be in the summertime," he says.

Glass performance problems will be easier to identify for architectural firms that are able to perform the in-depth performance modeling and simulation. For other firms, the industry needs to educate and communicate when potential issues might arise. "It's about making sure we are helping designers identify when there are going to be comfort issues," Sanders says. "We should be asking, 'What are you going to do about glare control?' 'What about heat control?'"



*Katy Devlin is senior editor for Glass Magazine. E-mail Katy at kdevlin@glass.org.*