



Celebrating Our 25th Year

Pest Prevention: Steps Designers Can Take

Integrated pest management (IPM) design strategies can reduce structural damage and unsanitary conditions, and improve our community's health.

by Brent Ehrlich

Design professionals imagine their shiny new green buildings as welcoming, comfortable, interesting, energy-efficient, healthy spaces full of light and clean air that will stay that way for years to come. No one wants to think about rats, mice, bedbugs, and cockroaches. Those are problems for old buildings, inner cities, and affordable housing. Maintenance staff and pest control services can handle them.

But pests can get into any building, whether a five-star hotel, a LEED Platinum office, a restaurant, apartment complex, or your child's school. Once in, they are often out of sight, out of mind—until they erupt as a serious problem. Pests can damage structures, decrease a building's value, and introduce disease and asthmagens into the building. And getting rid of pests often requires expensive remediation and repeated pesticide treatments—turning that once green building into an unsustainable, unhealthy, unwelcoming space with a shortened lifespan.

The design community can greatly reduce the risk of pest and chemical exposure by taking some simple steps at the design stage. Many of these overlap with best design practices, but others constitute an extra step as part of an integrated pest management (IPM) strategy.

This article covers design elements that building professionals can

implement to help keep pests out of buildings, reduce their ability to spread if they do get inside, and minimize the use of pesticides. We'll also look at some common green building practices that can either control or potentially exacerbate a building's pest problem, as well as certifications that address how pests will be controlled throughout the building's lifespan.

Pests: Why Should We Care?

Pests will flourish wherever they can find food, water, shelter, and entryways into buildings. They climb in through cracks, burrow underneath foundations, or simply walk through

the front door. Poor design choices and renovations invite pests in and create ideal conditions that allow them to thrive in our buildings. In urban environments, keeping pests out (known as exclusion) is especially challenging. Cracks ¼" and smaller can let pests into housing and schools, where pest prevention is often an afterthought. And pest populations can explode as temperatures climb, so as the climate warms and human population density increases, pests are likely to become more of a problem for all of us.

Health risks from pests

Asthma affects 25%–40% of the U.S. population, according to the World Health Organization (WHO). And those with asthma symptoms are more likely to miss school or work. Though there are a number of possible asthma triggers, including air pollution and tobacco smoke, both rodents and



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Sure, mice are cute, but they are also linked to allergies and can spread pathogens throughout buildings. We can keep them out and control their spread using design strategies and diligence.

cockroaches (and their residues) are known sensitizers.

Mouse and cockroach allergens are found in 82% and 63% of U.S. homes, respectively, according to the National Center for Healthy Housing, and the National Institutes of Health National Cooperative Inner-City Asthma Study shows 77% of inner city kids ages 4–9 who are mild or moderate asthmatics test positive for one or more pest allergens on their skin. The problems are not isolated to homes either; in [a study of 11 schools](#) in the Northeast, mouse and cockroach allergens were found in 81% and 71%, respectively, of the classroom samples collected. Pigeons, flies, and other common pests also carry disease.

Commercial kitchens, office kitchenettes, and hospital and school cafeterias are ideal habitats for pests—and infestations can be found in as many as 70% of food-handling establishments, according to the WHO. Kitchens are one of the last places we want them. Cockroaches alone can carry salmonella, E. coli,

and many other disease-causing pathogens.

Even if pests don't carry disease they can be a nuisance and affect our mental health, as well as damage the reputation of buildings. Pesticide-resistant bedbugs have spread dramatically in the last ten years, and though their bites are not necessarily harmful, they cause significant stress and have been a public relations nightmare for retailers, hotels, and property management companies.

Structural problems

Wood-framed structures are ideal habitats for termites and carpenter ants and both can do significant damage before they are detected. Wood-eating termites are particularly destructive, causing \$5 billion in property damage annually in the U.S., according to the National Pest Management Association. Carpenter ants are less destructive (they don't eat wood; they only nest in it), but left untreated their extensive burrowing can still weaken structural members.

Birds are nuisances not just because they deface beautiful buildings; their droppings are acidic and can eat into paint and stone, causing expensive damage. Mice and rats do chew through walls, just like in cartoons, only the damage that they can do—including fires caused by chewing through wires—is not funny.

Risks from pesticides and poor practices

When pests get in, the building is usually treated with pesticides. These can range in toxicity from the relatively benign—vitamin D treatments for rats, and borate traps for termites, cockroaches, and ants; to the powerful—rodenticides, such as bromadiolone

that kills rats via internal bleeding, and bromethalin that damages the central nervous system.

Some pesticides have been linked to cancer, poor cognitive development, and learning disabilities in humans, and can linger in buildings for years. And children—whose systems are most vulnerable—are most likely to come in contact with these chemicals as they crawl and play on floors, and put toys and objects in their mouths. In 2014, there were 80,000 cases of significant pesticide exposure or death in the U.S., according to the American Association of Poison Control Centers. But, the full health and environmental impact of these chemicals is difficult to gauge since occupants may not even know they have been exposed.

Pesticides used indoors for structural applications can end up in the environment at any point in a product's life-cycle: manufacturing, installation, use, and disposal. They are also carried outdoors by contaminated pests that become prey, harming both predators and our ecosystem.

“When making decisions on whether or not to use a pesticide one must first ask a few simple questions, such as what are the pest-conducive conditions contributing to the pest population and what are the threats from the pest?” says Lee Tanner, who works for the U.S. Environmental Protection Agency (EPA) Pesticide Environmental Stewardship Program. Pesticide application is a “balancing act,” he says, requiring an assessment of the level of infestation and implementing the appropriate action. Properly trained pest management companies use chemicals in baits and targeted treatments that minimize occupant exposure while maximizing effectiveness. However, less responsible companies, residents, and untrained maintenance staff may use ineffective, potentially harmful “spray and pray” methods with no knowledge of risk or effectiveness. (More on this later.)



Photo: Thomas Green

Gaps in doors from missing door sweeps or poorly designed or installed entrances, waste energy and allow mice, rats, and insects to walk through the front door.

IPM in LEED

LEED supports integrated pest management plans in operations and maintenance under the [Integrated Pest Management credit](#) in LEED for Existing Buildings v4, as well as a similar credit in LEED 2009. Chris Geiger, the IPM program manager and green purchasing program manager for the San Francisco Department of the Environment, along with a group of industry experts, is developing a pilot credit focusing on IPM at the design stage. The group hopes to make it available in the next year.

Design to Keep Pests Out

Rather than relying on pesticides, pests can be better controlled using structural integrated pest management, also known as urban or community IPM. Structural IPM controls pests in our buildings through prevention, keeping them out of the building through exclusion methods. But structural IPM is also a method for managing pest infestations inside buildings, with a focus on denying them food, shelter (harborage), and travel routes. When necessary, IPM resorts to pesticide application practices with the lowest possible hazard.

IPM is the best approach we have for maintenance, but experts argue that it addresses the issue too late. "IPM too often translates into to having a (pesticide) spray schedule or putting out bait and not addressing the problem," says Geiger, "But design is where a lot of the pest problems start and continue." In 2009, after speaking with other stakeholders about reducing pesticide use, Geiger says, "We committed to doing a better job with IPM and went out looking for guidelines that architects could use—and found nothing." So with funding from the U.S. Centers for Disease Control, Geiger and a multidisciplinary team of experts drafted the [Pest Prevention by Design Guidelines](#) as a reference for architects and building professionals. The guide provides detailed examples of how to prevent

common pest problems based on ten IPM design principles:

1. Understand your climate and local pests. Design and material considerations are different depending on pests, i.e., regions with termites require different materials and design choices than regions where cockroaches are a primary concern.
2. Understand physical surroundings. Buildings in crowded urban centers warrant specific rodent, roach, termite, or bird considerations.
3. Design for pest tolerance levels depending on building's use. A couple of ants in a home are not a concern; in a surgical ward, they are.
4. Use pest-resistant materials, such as pest-resistant wood species or [treatments](#).
5. Design for easy inspection. Early detection prevents infestations and damage, and reduces the need for pesticides. Inaccessible spaces provide ideal habitat and pathways for pests, so build in access, such as crawl spaces, to susceptible areas.
6. Minimize moisture getting into the building. Managing moisture is not only critical to building science, but is also critical for pest management since moisture promotes infestations.
7. Seal off openings to the exterior and between interior rooms, trim, and cabinets. A ¼" gap is enough for rodents to enter, and

insects only need an opening as thick as a credit card (0.8 mm), so controlling pests requires sealing and diligence.

8. Eliminate places pests can live. False ceilings, bottoms under cabinets, and uncapped concrete blocks are all common places to find pests.
9. Engineer slabs and foundations against pest entry. Separate wood from the ground; avoid cracks or unprotected expansion joints that pests can crawl through.
10. Make buildings unattractive to pests. Use lighting that doesn't attract flying insects, remove plants and tree limbs that are too close to the building, and secure garbage and compost so pests can't gain access and multiply.

Preventing pests is a sustainability practice

Many of these pest-proofing principles mirror proven sustainable design methods and some may even be required by local codes. "IPM is not a new idea," says Geiger. "HUD has recognized this for years," but IPM is rarely practiced at the design stage and requires additional planning.

Gelfand Partners Architects has been using IPM strategies for years and it is now standard practice at the firm, according to owner Chris Duncan. Gelfand Partners is one of a handful of B Corporation design firms in the country, and works in the public interest to design and renovate



Photos: Thomas Green

Expensive protective netting did not deter birds from nesting (left). A well-designed/selected canopy is not a home for birds and doesn't require post-construction remediation (right).



Photo: Chris Geiger

Unsealed openings between rooms, such as this electrical outlet in a kitchen where food and water are prevalent, provide an ideal entryway for cockroaches and other pests.

affordable housing and schools sustainably. “IPM is just one small niche in our green design,” he says. “We came to it from the standpoint of doing good buildings. We want buildings that are energy-efficient and easy to maintain, and are great to be in.”

Duncan’s focus on the firm’s sustainability and IPM strategies were validated by its work on the Georgina Blach Intermediate School in Los Altos—one of the first Collaborative for High Performance Schools (CHPS) certified projects. According to Duncan, “When they did their initial analysis, they said we didn’t have to change anything,” reiterating that IPM practices such as sealing and least-toxic pesticide use was part of good, sustainable design and not just “extra stuff.”

The housing complexes his company is hired to renovate are not, when they start out, energy-efficient, easy to maintain, or great to be in. Along with rooting out existing pests, retrofits like these pose challenges because shoddy renovations, old cable and pipe entries, and moisture damage provide ideal pest habitat. “In renovations we see all the problems that come with years of neglected maintenance, bad design, and social issues,” he said. “We see a lot of pests.”

Over the years Gelfand Partners has developed IPM specifications that they now implement on all their projects and that are publicly available. Some of these practices are simple and align with conventional green building practices, such as adding proper fitting

door sweeps, and sealing cracks and ductwork; others happen at the design phase, such as designing foundations that keep termites and rats from burrowing in, or eliminating areas where birds can easily perch and nest (more on this later).

There are a lot of standard details in their drawings that highlight extra steps for contractors, according to Duncan. Training contractors to do the work and verifying it

was completed properly can be a challenge, he acknowledges, but housing contractors in the San Francisco Bay Area are now familiar with the process. And they’re on board. “They have an extra line item for the laborers to go around with a caulk gun toward the end of each phase and seal, seal, seal,” Duncan says.

Duncan stresses that IPM is not difficult, but it takes a lot of vigilance. “We can’t be there to clean and maintain, but we can design buildings to make them easier to deal with over the long term.”

Challenges to Doing IPM

With evidence regarding the potential health dangers of pesticide and pest exposure, and the common sense notion that keeping them out is a good thing, IPM seems like it should be a no-brainer, but IPM hasn’t been a priority for many in the design community. Why is that?

Data gaps and SCOPE

“I can’t see how pest control is not important to designers, but I understand that it is the last thing on their mind,” said Jody Gangloff-Kaufmann, an urban entomologist at Cornell University who specializes in structural IPM. “Unless you have pests, you don’t care.”

Sealing gaps and other exclusion methods will keep pests out, but IPM is complicated and lack of solid

data on the effectiveness of various methods makes it harder to engage with the design community. To address this concern, researchers and industry experts formed the Scientific Coalition of Pest Exclusion (SCOPE 2020) in 2013. One of its goals is to gather data so they can answer basic questions such as “Is there any evidence that what we do is worth the money?” “What is effective?” and “What gaps are there in our understanding?”

Along with research, SCOPE’s other goal is to change the mindset of the pest control industry from “spray and run” (or “spray and pray”) to long-term thinking and a focus on exclusion. That is, “Things we know that work,” says Gangloff-Kaufmann.

Costs of structural IPM

With little structural IPM data, it is difficult to quantify its return on investment. Even in public housing where IPM is mandated (though not necessarily done), there is little money to pay for it and there are often much larger problems, such as replacing faulty heating systems. Schools are much more focused on energy and IAQ, says Duncan; pest reduction initiatives are often limited to cafeterias.

Gelfand Partners rolls IPM into its projects, but the firm has streamlined the process over the past 20 years to reduce the costs. The group now treats IPM as a necessity similar to commissioning.

For privately owned apartment buildings, paying for structural IPM is harder to do. In some cases pest control is a Band-Aid, with pesticide treatment applied only as the result of infestations, and tenants may even have pay for it. If property owners are paying, they usually want it as cheap as possible, says Gangloff-Kaufmann. “They have no interest or motivation to pay more because pests are assumed,” but you should never get used to having pests, she says.

Aesthetics and the unknown

“It has been tough to discuss (IPM) with architects,” according to Stephen Kells, an entomology professor at the University of Minnesota, as well as an IPM expert and SCOPE co-founder. Concurring with other experts, he agrees that IPM is not typically considered at the design scale. “It should be, but it is left to operations three to five years down the road.”

Kells suggests that architects might not be engaged with pests because they don’t want another design constraint. Managing pests might require changing a slope to make the building resistant to birds, changing the lighting, avoiding new materials that could support or harbor pests, or changing ingrained work approaches.

Many architects are simply unfamiliar with structural IPM and pests in general, according to Kells. “We have a building on site that is as secure as you could get it,” he says. The building is used for pest research, and it’s programmatically necessary to keep research pests in and wild pests out. But before construction Kells took the time to physically show the architect the pests the university researches, so the design team knew what they were up against and could take appropriate steps.

Social issues

No matter how well implemented, IPM cannot protect against some human behaviors. Leaving windows or doors open without their screens can allow pests in, for example, and unsanitary conditions in one unit can create a problem for an entire building. According to Duncan, “There is a small population of hoarders, and from those places bugs radiate.”

Challenging our definitions of sustainable

Though designing a pest-resistant building shares common traits with sustainable design, there are areas where the two systems clash. Properly selected and installed, some products—such as stone and



Photos: Thomas Green

Direct lighting above entryways attracts insects and other pests (left), allowing them easier access through openings. Indirect lighting installed away from the building (right) reduces these risks.

FSC-certified heartwood cedars—can be both sustainable and pest-resistant. Other materials, like concrete and steel, are pest-resistant but with their high embodied energy and carbon are not typically considered “green.”

The green building community touts the use of wood and biobased materials because of their lower carbon footprint (see [Engineering a Wood Revolution](#)) and lifecycle. But untreated wood and agfiber products are especially vulnerable to termites and carpenter ants. They may be a great use of resources, but if not selected and used wisely, they can provide food source or lodging for pests, and in some cases products may even bring pests into a building. Wool is an example: there are instances where wool carpeting and wool insulation, chosen for health and sustainability reasons, has led to moth infestations that both wasted the materials and required expensive remediation.

It’s not just biobased materials that can be a problem. Though rigid foam boards provide excellent thermal protection, mounted on foundations they can also provide perfect conditions for termite tunnels. And “There are plenty of pests that will make spray foam their home,”

Gangloff-Kaufmann said, including yellow jackets and carpenter ants that create pathways underneath. Spray polyurethane foam (SPF) also makes inspection difficult, is a barrier against applying pesticides when pests are detected, and makes remediation harder. Foam products will not keep rodents out, either. Gangloff-Kaufmann said, “We don’t recommend it [SPF], though for a long time we did.”

Vegetated roofs are a signature sustainable design practice, with numerous benefits including providing a connection to nature in an urban environment. But that connection can get a little too close, with vegetated habitat providing habitat for rats and other pests. Those animals could get into the building, but even outside they can destroy plant life, requiring pesticides for landscape maintenance. Maintenance and pest control professionals need to cut off pest access, monitor these spaces, use pesticide-free remediation when possible, and select pesticides with care to avoid contaminating rainwater runoff.

Even lighting can be an issue. Pest professionals typically suggest using inefficient sodium vapor lighting because insects are not attracted to its

yellow light. However, warm color temperature LEDs can be a good compromise between these and cooler color temperature LEDs that are more efficient but attract insects.

Design Hints from the Ground Up

The Pest Prevention by Design guide provides specific IPM design strategies covering the entire building. Along with detailed explanations of where to seal and why, the guide looks at other simple steps design professionals can take to keep pests out.

Foundations and slabs

Without careful detailing, foundations can provide entry points for subterranean termites, rats, cockroaches, and other pests. You have to go beyond code requirements for drainage and ventilation to keep them out.

- Keep the upper 4" of the slab exposed and allow a minimum 18" clearance between beams and joists and ground to guard against pests (or 36" where termites are active), and to make it easier to inspect.
- Minimize cracks in concrete of more than a credit card thickness (0.8 mm), since 83% of subterranean termites come in through expansion joints in concrete slabs. That includes concrete joints and expansion joints when possible, though minimizing these

can conflict with engineering requirements. Protect joints and cracks with mesh or sand/stone barriers.

- Use termite shields or barriers.
- To keep rats from burrowing under the foundation, use a vertical curtain wall with an L-shaped flange along the foundation 2' below the surface. This can be made from iron, concrete, brick, or other rodent- and rot-resistant material.
- Where utilities come through slabs, seal gaps using epoxy and make them accessible for inspection.
- Use steel posts for posts and beam foundations and seal their ends.

Cladding, roofing, and exterior

Siding protects buildings from the elements but can allow pests in through cracks and encourage their spread through rotting wood. Rodents and other pests are also good climbers, so restricting access from the ground should be a priority.

- For siding, use heartwood cedars, redwood, black locust, or fiber cement; provide clearance between siding and soil; minimize gaps from warping and cracking; and seal gaps, openings, and penetrations using lots of low-VOC caulk.
- To limit rodent access to siding and roofs, use flap valves or leaf guards on downspouts, and use cones or discs and high gloss paint to discourage climbing.

- For roofs, use screens and bird exclusion devices on vents, chimneys, or other openings.

Lighting

Exterior point-source white light attracts insects to buildings, so designers should do what they can to reduce its impact, while maintaining safety.

- The guide recommends yellow sodium vapor lighting, though warm/yellow LED lighting is a more energy-efficient substitute.
- Use motion detectors or timers on lighting, especially if using white light.
- Light fixtures should have bird-resistant features that discourage roosting and nesting, such as slopes, or bird exclusion systems, though the latter are not always effective, according to the guide.
- Use reflected light around doors rather than point-source lighting that attracts insects more strongly.

Landscaping

Landscaping can support a variety of pests, and poor planning can result in an increased risk that they will enter your building.

- Keep tree branches 6' away from roofs to deter rats, squirrels, and other vertebrates; keep plants away from the foundation.
- Decks, patios, fences and other structures should be kept away from the building or be removable or allow disassembly to enable inspection.
- Eliminate animal access under sheds, decks, and porches using galvanized hardware cloth, which can be covered with lattice for aesthetics.
- Keep bark mulch away from the foundation for termite prevention.
- Don't use climbing ivy or other plants on buildings.

Interiors

Pests inevitably get inside, but by eliminating access to areas where they might nest, and reducing pathways between rooms, they can be kept from spreading and multiplying.

- Gaps behind baseboards or cheap cove molding is a highway for roaches and a harbor for bedbugs. Use straight base rather than cove,



Photo: Thomas Green

All exterior wall penetrations should be sealed for energy and moisture management, but gaps like this one also allow mice and rats in.



Photos: Thomas Green

Unsealed escutcheons (left) are potential harborage for cockroaches that then require pesticide treatment (brown streaks in image). Properly sealed escutcheons keep roaches out and remove the need for treatment at these openings.

or cove with no gap. Ideally make molding removable for inspection.

- Floors should be crack-free and cleanable, and any gaps between wall and flooring or bottom plates should be sealed.
- Use tight-fitting door sweeps. In areas with heavy rodent traffic, use exterior doors with sheet metal kick plates 12" high and mounted no more than ¼" mounted from the bottom of the door.
- Minimize bedbug hiding places by caulking molding, using hard flooring materials, and making built-in furniture inspectable.
- Avoid headboards and upholstered furniture in bedrooms.
- Seal openings between units to prevent insect movement. (This practice, called compartmentalization, is also a good practice for preventing unwanted movement of tobacco smoke and noise, as well as air movement contributing to the stack effect.)
- Seal well around cabinets in kitchens to prevent pests from making homes under or behind them.
- Make kitchens easy to clean, especially drains in commercial kitchens, which are easily missed and can be a source of roach and fly infestations.

HVAC

HVAC systems penetrate walls and can provide an ideal space for pests. Keeping pests out is critical for maintaining indoor air quality.

- Seal around larger penetrations with rodent-resistant materials such as copper mesh, and use caulk for smaller cracks.
- Use screens on outside air intakes and foam gaskets behind electrical cover plates.

Waste and recycling

Trash and recycling areas are ideal spaces for pests. They provide all the essentials—food, moisture, and nesting places—and are usually located near a building entrance, providing easy access.

- Areas used for waste recycling need durable, pest-resistant receptacles with tight lids, and the entire space needs to be designed to be easy to clean and to keep pests out.
- Waste areas holding dumpsters and recycling should also use concrete pads so rodents can't burrow in.
- Round garbage chutes are better than square because there are no corners to trap dirt.

Over the Lifetime of the Building

With careful planning and a team effort, architects, engineers, facility managers, and building owners

can minimize the potential health and environmental impacts of these unwanted guests.

Integrating pest managers

According to Allison Taisey Allen, director of certifications at the National Pest Management Association (NPMA), a trade group for structural pest management companies, "Integrated pest management is an established and expected practice based on science. It works."

IPM relies on inspecting and monitoring for pests, identifying the pest and infestation level, scaling the appropriate response, assessing its effectiveness, and following up to ensure that pests are under control, she says. But there is a strong emphasis on exclusion among NPMA members, as well as practitioners and pesticide companies. "Pest management professionals are usually seen as those who protect the structure after it is built," she says, "but there is a great opportunity to see them as consultants and advisors in the construction process."

According to Tanner, at the EPA, "It is not enough to just hire a pest management professional, because IPM is a team effort." In areas with known pest problems, structural IPM consultants should be brought in early in the design phase. Santa Clara, California recommends using IPM experts throughout the entire building life-cycle to assess the design, materials, and equipment, and to oversee pest management from construction through occupancy.

Finding a professional

Pests will get into a building eventually, and how they are managed can affect the health, comfort, and safety of building occupants, as well as how the building is perceived. IPM consultants brought into the process early can recommend a pest management company trained in IPM and will help minimize the risks associated with pests and pesticides. There are a lot of substandard pest control companies out there, so to

ensure proper pest control using best practices look for those with IPM certifications offered through EcoWise, QualityPro/GreenPro, and Green Shield/IPM STAR.

IPM focused on minimizing pesticide use got its start in 1979 at the non-profit Bio Integral Resource Center (BIRC) and that organization now offers the [EcoWise Certified](#) course for pest management companies and practitioners in California. It also publishes the *IPM Practitioner*, a Directory of Least-Toxic Pest Control Products. EcoWise Certification focuses on standard IPM practices combined with the least toxic pesticides. Bill Quarles, BIRC's executive director, said, "We are concerned about pesticide exposure, and try to find the best methods to avoid using them." EcoWise does not allow certain practices such as spraying standard pesticides around the foundation perimeter, and relies on a signed pledge as verification of follow through.

National Pest Management Association (NPMA) offers two certifications: QualityPro certifies pest management companies for professionalism, establishing policies for background checks, workplace policies, dress code, and other personnel issues. GreenPro certifies based on knowledge of IPM principles. QualityPro is a prerequisite to earning GreenPro certification. GreenPro uses facility maintenance service records to verify performance.

Taisey Allen, who oversees NPMA's certifications, says GreenPro does not restrict chemical use. She acknowledges that lists like these can be reassuring, but "We look at all the tools in the tool box and make sure the person is really well trained so they make decisions in an informed, educated way," she says. "If they used a product considered to have higher toxicity, it has to be justified by the level of infestation and have one application, versus multiple applications of another product." She says, "We want people looking at monitoring devices, exclusion, and repairs. A pesticide list will never get you to that level of service."

The IPM Institute of North America, an independent nonprofit that promotes IPM in agriculture, communities, and schools, offers Green Shield certification for pest management professionals and facilities, and IPM STAR for schools and daycare facilities. These are the only certifications verified through onsite evaluations, and Green Shield is recognized by the Natural Resources Defense Council, the Environmental Working Group, Green Restaurant Association, and others.

"We do a top-to-bottom evaluation," says Thomas Green, the organization's president. That includes interviewing staff; reviewing records from pest complaint logs, pest applications or pest management they've had; conducting a walk-through of the building; documenting through pictures and creating a report; and outlining future steps and prioritizing recommendations. To help ensure success, Green says, "We work with [pest management] providers and suggest they come with us" on evaluations. According to Green, the organization also helps improve IPM cooperation by coordinating relationships with pest management professionals, facility managers, and contractors when structural changes are recommended.

Pests Will Always Be with Us

Pests will always be with us, and though they have long been an afterthought to the design community, cities such as Boston, New York, and San Francisco are beginning to take pest management seriously. With the spread of urban pests into colder climates, the rise of pesticide-resistant bedbugs and other pests, and significant socioeconomic ramifications, we are getting a wake-up call to deal with pests earlier at the design stage. Green building professionals can play an important role in controlling—or helping spread—these pests, and they should not hit the snooze button.



NEWS ANALYSIS

Smog Outdoors Saps Worker Productivity Indoors

75% of small particulates in outdoor air pollution come indoors and cause workers to be less productive, putting a \$2 billion dent in China's service sector.

by Candace Pearson

A [recent study](#) conducted in two call centers in China found that air pollution significantly hampered worker productivity. Pollution zaps mental processing abilities, the researchers found, causing employees to take longer breaks on bad air quality days.

Dog days in the call center

The study analyzed data from almost 5,000 employees that worked in call centers for Ctrip, China's largest travel agency. Because each worker is compensated in part based on the volume of calls and orders, each worker tracks the number of calls handled per shift and the amount of time that he or she spent on breaks. Researchers compared this productivity data to daily air pollution levels and found that workers were 5%–6% more productive when air pollution levels are rated as good (defined as an air pollution index, or API, of 0–50) versus when they are rated as unhealthy (API of 150–200).

What's more, some measures of productivity took a hit when air quality levels exceeded just 100 API, contradicting current guidance that suggests impacts to the general population (as opposed to sensitive populations, such as asthmatics) don't occur until the API is over 150.

As the researchers deconstructed the data, they found that the productivity hits were mainly caused by workers taking longer breaks, not because they spent longer on each phone call.

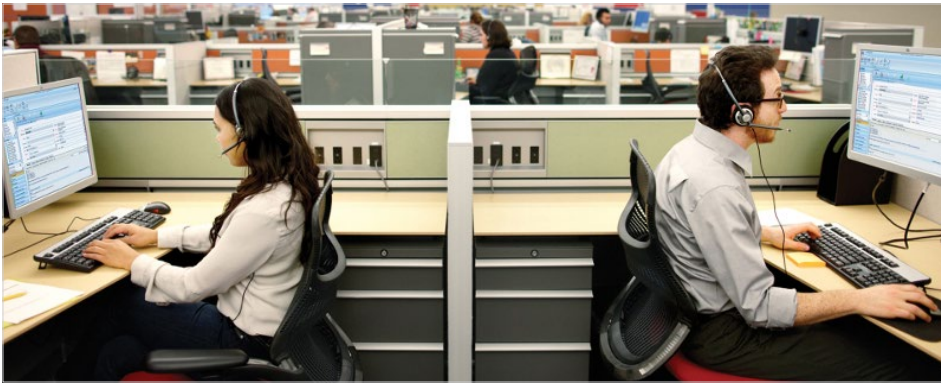


Photo: Diana Varisova. License: [CC BY 3.0](https://creativecommons.org/licenses/by/3.0/).

A study of worker productivity in a call center finds a strong link between levels of outdoor air pollution and workers taking longer breaks.

Your brain on air pollution

The culprit, the researchers suggest, is likely very small particulate matter (PM₁₀). Although the API in China takes into account three criteria pollutants, the pollutant with the highest index on a given day determines the score. In Shanghai and Nantong where the study was conducted, PM₁₀ is the pollutant with the highest index 95% of the time, according to the researchers.

This outdoor air pollutant is formed when airborne solid and liquid particles emitted from power plants, industries, and automobiles react together, but it can easily penetrate indoors. One [report](#) from JLL and PureLiving estimates that 75% of PM₁₀ finds its way into our buildings from the outside. And then, it is so small that it can pass beyond the lung barrier, enter the bloodstream, and become embedded deep in the brain stem. Greater exposure to these particles is associated with lower intelligence and diminished performance over a range of cognitive domains, so it makes sense that short-term exposures might cause the mind to grow weary faster, say the researchers. That explains why productivity so closely correlated with air quality—the workers weren't being lazy; they physically needed more breaks for their brains.

Claiming causality

The authors argue that their study setup allows them to “credibly isolate the causal effect” that air pollution has

on worker productivity—something that previous study authors have been reluctant to claim. That's because this study takes into account potential confounders like:

- Discretion over labor supply—the workers have little control over which days they come to work, so the possibility that the most productive chose not to work on high pollution days can be ruled out.
- Variation in demand—the firm serves clients throughout China, so it is not likely that pollution levels local to the call center influence client demand for services.
- Stress of traffic—traffic is potentially a strong confounder because it can directly reduce productivity by creating emotional stress and making employees late for work—and it also may coincide with bad air quality days. The researchers discounted this possibility by consulting a previous experiment at Ctrip that measured productivity when employees worked from home. The correlation between avoiding traffic and productivity was negative and statistically significant at conventional levels, indicating traffic was not likely confounding the productivity effects the researchers had observed.

Adding up the cost

This lost productivity comes at a cost, according to the researchers. If the

same effect is applied to all service-sector workers in China, for example, a 10-unit reduction in national pollution levels would bring in US\$2.2 billion per year. Or, applied to Los Angeles, bringing air quality into compliance (API of 0–50) would grow service sector productivity by \$374 million.



New Tech Startup, arc, to Support USGBC, GBCI with Data

Performance data supporting “quality of life” is the focus of USGBC and GBCI's new for-profit subsidiary, which will work with the LEED Dynamic Plaque.

by Tristan Roberts

Green Business Certification Inc. (GBCI), the sister nonprofit to the U.S. Green Building Council (USGBC), recently announced the launch of wholly-owned subsidiary. The new for-profit company, arc, is a tech startup with the job of providing data-heavy tools supporting the missions of GBCI and USGBC.

The company will be led by Scot Horst, who is moving to become arc's CEO from his role as chief product officer at USGBC. At USGBC, Horst has been instrumental in bringing LEED v4 to market, as well as in developing and launching the LEED Dynamic Plaque.



Photo courtesy USGBC

Scot Horst is moving from chief product officer at USGBC, where he has led LEED development and created the LEED Dynamic Plaque, to CEO of arc, which will continue to develop the plaque and related data-driven tools.



Photo courtesy USGBC

Mahesh Ramanujan, CEO of USGBC and GBCI, which owns arc, will play a leadership role in the fledgling company.

The LEED Dynamic Plaque factors heavily into arc. According to a USGBC press release, “Arc is a state of the art platform that will allow any building to participate and immediately start measuring performance, make improvements and benchmark against itself. Buildings that have not certified yet will be able to use arc to make incremental sustainability improvements and eventually achieve LEED certification.”

These statements essentially describe the function of the LEED Dynamic Plaque and its underlying data platform, LEEDon. According to Horst, arc is taking control of the development of those platforms, as well as (gradually) LEED Online, the platform that LEED projects use to compile and submit documentation.

In the future, expect these LEED platforms to shed their distinct identities: USGBC is promoting a pilot announced earlier this year (see [Dynamic Plaque Piloted as LEED Performance Path](#)) where buildings can enter performance data into LEEDon as a way of satisfying key prerequisites and credits that would normally be documented through LEED Online templates.

Connecting rating systems

In addition, expect arc to provide a platform that makes different rating systems more accessible to projects.

In an interview with BuildingGreen, Horst clarified the respective roles of USGBC, GBCI, and arc. Horst

refers to each organization’s “core competencies”:

- USGBC maintains and owns standards.
- GBCI administers certifications and credentials. (Although GBCI currently owns a number of standards that it acquired, Mahesh Ramanujan, president and CEO of USGBC and GBCI, recently told BuildingGreen that those would, over time, shift to USGBC.)
- Arc develops and invests in technology supporting both organizations. “The mission of arc is to connect all actions in a single platform that support a higher quality of life,” Horst told BuildingGreen.

A current project at arc is to allow projects to generate scorecards for rating systems they’re not even registered for. Using compatibilities and formally recognized “cross-walks” between rating systems, a LEED project in arc could see an automatically generated scorecard for the WELL Building Standard. That might encourage projects to look at additional programs, and ultimately to improve the health and wellness of projects from different angles. Horst noted that arc could also build performance scoring systems for rating systems other than LEED—in other words, a WELL Dynamic Plaque, or the equivalent, could arrive in the future.

Corporate structure

Horst acknowledged that it is unusual for a for-profit company to be spun off from a nonprofit. He pointed to National Geographic Partners as a recent example, which is a for-profit media company owned jointly by the nonprofit National Geographic Society and 21st Century Fox. The for-profit venture was spun off from the nonprofit just last year, with a massive investment from Fox.

Horst emphasized that GBCI is the sole owner and investor for now. Spinning arc off into a separate

venture provides a more natural environment for investing in technology than the nonprofit environment, where significant technology investments can face headwinds. Asked about whether outside investment was expected, Horst said, “If we needed a significant amount of rocket fuel to build something bigger, we have the structure to be able to do that. It’s not the goal.”

Use arc for data reporting

In another announcement with arc implications, USGBC announced [new pricing for LEED registration and certification](#) effective December 1, 2016. Key changes include:

- \$300 increase for project registration
- New residential pricing
- New minimum thresholds for fees
- Optimized pricing for large-scale projects

In addition, currently registered and certified LEED projects will have automatic access to arc as of Dec. 1, 2016.

As USGBC noted in [its announcement](#), this is the first price increase since [2010](#) (which came on the heels the last new LEED version deployment).

In making arc available free to any registered or certified project, USGBC and GBCI are accomplishing a couple of things, according to Horst. LEED 2009 projects required to track and report energy and water data can use arc. “Hopefully we’ll see a big uptake for people just using it for that,” says Horst.

Additionally, projects can enter data and generate scoring without an immediate commitment to certification. “You’re setting up your own benchmark against yourself,” says Horst. “People improve when they benchmark against themselves.” And in addition, “We want buildings to benchmark themselves against LEED buildings to see how far away

they are, and then hopefully pull them in to do more to get certified.”

Not an e.e. cummings poem

In an email, Chris Schaffner, P.E., founder and president of The Green Engineer, Inc., and a current USGBC Advisory Council member, lauded arc. “I think it has the potential to fix three things that we struggle with,” he said:

1. “LEED has always been about recognizing the market leaders. Arc has the potential to engage the entire market.
2. “LEED-EBOM has been a success only in a relatively narrow subset of the commercial office buildings market. Arc may reach a broader market.
3. “With all new BD+C [Building Design and Construction] projects getting access to arc, it can help bridge the gap between predictions and performance that we have struggled with for so long.”

Schaffner also noted three areas to improve:

1. “We now have three separate metrics for energy. BD+C uses percentage improvement in energy cost against a code baseline. LEED-EBOM uses site energy compared to the CBECS data through Energy Star. Arc apparently uses some normalized version of CO₂ emissions per building occupant. All three have their issues, but we really need to pick one.
2. “The USGBC has done a terrible job at explaining the long-term vision for arc, while still managing to upset many of the consultants doing EBOM work. USGBC should let us see the entire vision—many of us, once we understand the whole thing, will become strong supporters.
3. “The no capital letter thing is frustrating. What is it -with designers and fonts? It’s a green building tool not an e.e. cummings poem.”



A Short History of GBCI and Its Roster of Rating Systems

No longer just the USGBC spinoff that supports LEED certification, Green Business Certification, Inc. has a hand in a long and growing list of green certifications.

by *Tristan Roberts*

GBCI started life as the Green Building Certification Institute, a nonprofit sister organization to the U.S. Green Building Council (USGBC). Created in 2008, GBCI’s first responsibility was to administer everything involved in the LEED credentials, from writing exams to defining continuing education requirements.

In 2009 GBCI took over LEED certification from USGBC (see [USGBC to Outsource LEED Certification](#)), while USGBC retained ownership of the LEED rating system standards and responsibility for their development. In both cases, GBCI acts as a third-party certifier, independent from USGBC as the standard developer.

In 2015 GBCI became Green Business Certification, Inc. Announcing the change, Rick Fedrizzi, then CEO of GBCI, said, “GBCI’s name change is a true reflection of our direction and vision for the organization, which is to extend its core competencies of certification and credentialing services to organizations that want to advance green business and sustainability practices. Third-party validation has become a highly regarded value across the globe and GBCI is well-positioned to fulfill that need.”

In keeping with that vision, GBCI has invested in a stable of green certifications that it either owns or provides certification services for in partnership with other organizations:

- [LEED](#) (for Leadership in Energy and Environmental Design) was launched in 2000 by the U.S. Green Building Council (USGBC), with LEED certification managed since 2009 by GBCI.



Image courtesy of GBCI

- [WELL Building Standard](#): GBCI provides certification in partnership with the International Well Building Institute (IWBI).
- GRESB: [GBCI acquired](#) the Global Real Estate Sustainability Benchmark (GRESB), a system that scores real estate portfolios, in 2014.
- The Sustainable Sites Initiative (SITES), was previously owned and operated as a partnership between the University of Texas–Austin, the Lady Bird Johnson Wildflower Center, the American Society of Landscape Architects (ASLA), and the United States Botanic Garden. The groups became embroiled in a trademark dispute, during which GBCI stepped in to provide project certification. [That led to full acquisition](#), which has settled those past feuds.
- PEER, or Performance Excellence in Energy Renewal, is administered by GBCI. [PEER](#) is “a comprehensive, consumer-centric, data-driven system for evaluating power system performance.”
- Created by the International Finance Corporation (IFC), a member of the World Bank Group, EDGE is a [quick-start sustainable design tool](#) meant for developing countries. GBCI is a global certification provider for EDGE and the exclusive certification provider for EDGE projects in India.
- Parksmart (formerly known as Green Garage Certification), was created by the International Parking Institute and other groups, and is administered by GBCI. [Parksmart](#) is “the world’s only rating system that defines, measures, and recognizes high-performing, sustainable garages.”

- Zero Waste Facility Certification and Zero Waste Business Associate programs were created by the U.S. Zero Waste Business Council (USZWBC). [GBCI recently assumed responsibility](#) for the ongoing management and evolution of both programs.
- The Investor Confidence Project (ICP) [was announced in October 2016](#) as a joint project of GBCI and the Environmental Defense Fund (EDF). The groups aim for ICP to be the “premier global underwriting standard for energy efficiency projects.”

Expect this roster of programs to grow. Rumors have pointed to products and materials certification as a high priority. Asked to confirm them, Mahesh Ramanujan, CEO of both USGBC and GBCI, said, “We are still exploring our options and are very interested in key partnerships or acquisitions.”

Ramanujan also told BuildingGreen that in addition to products, GBCI is strongly interested in a water-related program, as well as infrastructure. [GRESB Infrastructure](#) was announced in 2015 and completed its [first assessment in 2016](#). GBCI is also rolling out LEED for Cities, which, says Ramanujan, “will leverage arc to deliver a score and benchmarking” at the district scale. LEED for Cities is expected to draw on multiple programs to take LEED beyond buildings.

As the programs owned *and* administered by GBCI have piled up, observers, including BuildingGreen, have asked what differentiates GBCI and USGBC. Ramanujan told BuildingGreen to expect that over time, and with board approval, USGBC will settle in as the standard-owner, while GBCI will be the certifier. He said the mixing of their roles was part of the acquisition process. (Also see [New Tech Startup, arc, to Support USGBC, GBCI with Data](#), which discusses the separate “core competencies” of GBCI, USGBC, and their new startup, arc.)



NEWSBRIEFS

Canada: Green Building Can Help Meet Emissions Commitments

A report describes how Canada can realize its 2030 carbon emissions targets, while growing the country’s green building industry.

by Sarah Lozanova

The Vancouver Declaration on Clean Growth and Climate Change requires Canada to meet or exceed its international greenhouse gas (GHG) emission reduction target of 30% below 2005 levels by 2030—but how is still being worked out. A new Canada Green Building Council (CaGBC) report, [Building Solutions to Climate Change: How Green Buildings Can Help Meet Canada’s 2030 Emissions Targets](#), describes one potential path that focuses on building efficiency.

“Building on a culture of innovation in Canada’s green building sector, this report demonstrates how we can achieve real results in the battle against climate change by investing in the building sector,” said Thomas Mueller, president and CEO of the CaGBC. “Buildings represent the most cost-effective way to reduce GHG emissions, generate positive returns on investment, and stimulate the economy.”

The report finds that re-commissioning, performing deep energy-saving retrofits, installing onsite renewable energy systems, and switching to renewable energy sources in all existing institutional, commercial, and high-rise residential projects of over 25,000 ft² would enable Canada to surpass its reduction targets, ultimately reducing GHG emissions by an estimated 44% from 2005 levels. This would lower GHG emissions by 19.4 million tons, while having a \$35.2 billion direct and indirect impact on gross domestic product (GDP).

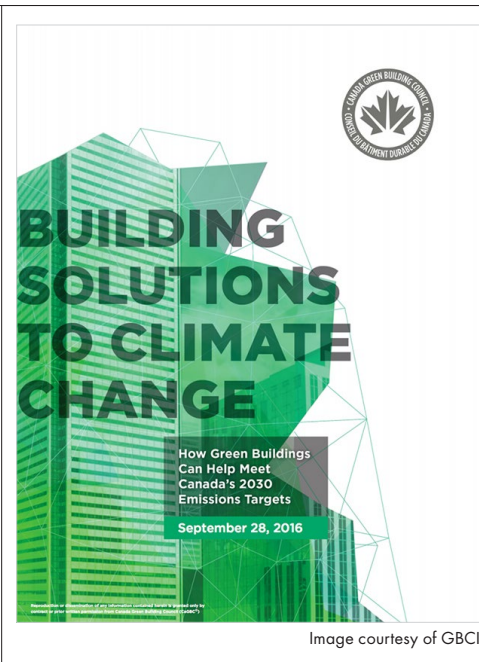


Image courtesy of GBCI

The report makes further recommendations to pave the way for such extensive building retrofits:

- Advancing green building benchmarking, reporting, and disclosure could help promote building performance. Greater investment in systems such as the Energy Star Portfolio Manager would help support a wide range of building types and enhance reporting capabilities.
- Investment is needed to establish a National Net Zero Building initiative to help guide the industry. According to the report, constructing all new buildings over 25,000 ft² to have net-zero carbon emissions would result in a 17% reduction in GHG emissions by 2030.
- The government should lead by example by using advanced green building initiatives for the renovation and new construction of its own federal buildings. Utilizing carbon-reduction measures for federal projects over 25,000 ft² would account for financial savings of \$117 million annually and a 480,000-ton reduction in GHG emissions.



R-8 Phenolic Foam Boardstock Insulation Is Back

Kingspan has re-introduced this high-R-value, flame-retardant-free rigid foam insulation to North America. It's made of formaldehyde, but emissions are low.

by Alex Wilson

Back in 1985, when I started what is now BuildingGreen and was working for a construction company part-time (yes, I had to make a living), I remember installing a type of foil-faced foam insulation that was then being promoted as the highest-R-value insulation on the market. It was Koppers' Exceltherm, which I think was advertised as providing R-8.2 per inch. It was a phenolic foam insulation material—foamed phenol formaldehyde. Adding this much insulation to the 175-year-old home we were restoring made a huge difference in improving comfort and reducing heating bills.

In early 1989, Koppers (which was also known as Beazer East, Inc.) sold its phenolic foam insulation business to Johns Manville Corporation, which manufactured phenolic foam roof insulation until 1992. By that time, problems with corrosion of metal in contact with the phenolic foam came to light, and Johns Manville and Beazer East were hit with a class-action lawsuit that ended production of the material.

Enter Kingspan and Kooltherm

Kingspan, an Irish company that produces insulated, metal-skinned panels for commercial buildings, is not well-known in the U.S. building industry, but that is likely to change. Along with having acquired the GreenGuard line of extruded polystyrene (XPS) in 2014, Kingspan introduced a phenolic foam rigid boardstock insulation, Kooltherm, to the North American market in October 2016. The company has sold this

material in the U.K. since 1992, but the only phenolic foam product Kingspan exported to North America prior to 2016 was an insulated duct board, KoolDuct, which has been available here since 2001.

What is phenolic foam?

Phenolic foam is a thermosetting, foamed, phenol formaldehyde resin. Phenol formaldehyde was the world's first plastic when it was invented in 1907 by the Belgian-American chemist Leo Baekeland. That first plastic was known as Bakelite; its many applications included electrical insulators, billiard balls, and (owing to its heat resistance) the heat-resistant handles on the Revere Ware cooking pots (introduced in the 1920s) that many of us grew up with.

As a thermoset plastic, phenol formaldehyde undergoes a chemical change during polymerization. This gives it its great thermal stability and prevents it from melting.

The process of foaming the resin entrains tiny bubbles in the material. The blowing agent is pentane, which has zero ozone-depletion potential (ODP) and a low global warming potential (GWP). Pentane is the same blowing agent used in polyisocyanurate (polyiso) insulation. Phenolic foam looks a lot like polyiso foam, but the phenolic chemistry leaves smaller cells, and this allows the foam insulation to achieve a higher R-value, about R-8 per inch (aged value).

As with Bakelite, phenol formaldehyde *foam insulation* is inherently flame resistant. This enables it to achieve Class A fire ratings without the addition of chemical flame retardants, which are needed in polystyrene and polyiso insulation. The lack of flame retardants, especially the halogenated (bromine and chlorine) flame retardants used in most other foam insulation, makes phenolic foam insulation potentially attractive from an environmental perspective.



Photo: Kingspan

Kingspan's Kooltherm phenolic foam insulation installed beneath metal building panels on a commercial building in Europe.

Solving the corrosion problems

When used as roof insulation, Koppers' phenolic foam could corrode steel decks beneath the foam. According to Kingspan, the corrosion problem stemmed from cost-cutting in the manufacturing of that earlier phenolic foam. To reduce costs and speed production, Koppers used a high level of acid catalyst. If production was rushed and curing time was insufficient, the result was damp insulation that could release an acid exudate, damaging steel decks and fasteners.

According to Kingspan, it is using an organic acid rather than a mineral acid (which was used in Koppers' phenolic foam), and acid levels are optimized to leave no excess acid in the insulation. As an added precaution, Kingspan adds a neutralizing agent to the foam to reduce acidity. The curing process also minimizes the moisture level, preventing any seepage.



Photo: Kingspan

In this parking garage ceiling installation, Kooltherm can be installed without additional finish material, such as gypsum board, and still meet relevant fire codes in this European installation.

Okay, but it's made of formaldehyde, which is bad, right?

Since it's made from phenol-formaldehyde resin, an obvious concern is whether formaldehyde might off-gas from Kooltherm.

Craig Lynch, the manager of specification and architectural sales at Kingspan, explained that the reaction between the phenol and formaldehyde results in a fully cross-linked, cellular matrix. "Unlike urea-formaldehyde chemistry, the phenol-formaldehyde reaction is non-reversible and cannot therefore degrade to give VOC or formaldehyde emissions," he told BuildingGreen. "This means that there is a vanishingly small amount of free formaldehyde in the final thermoset polymer matrix."

Extensive testing of formaldehyde and other VOC emissions from Kooltherm has been conducted in Europe. In occupational exposure tests, results were "well below" the most rigorous limits for formaldehyde (0.15 ppm) established by the Scientific Committee on Occupational Exposure Limits (SCOEL), which is the European Union's equivalent of the Occupational Safety and Health Administration (OSHA).

Indoor air emissions testing by the Fraunhofer Institute and Eurofins in Germany found formaldehyde emission levels of less than $10 \mu\text{g}/\text{m}^3$, which achieves the German A+ standard, according to Lynch. Such emissions should also achieve the Gold standard in various international standards, according to Lynch; Kingspan is currently working on indoor air quality certifications used in North America.

Cost and availability

On a dollar-per-R-value basis, Kooltherm will be priced competitively with polyiso, according to Lynch. He also notes that there are certain applications for which neither polyiso nor XPS are suitable where Kooltherm can be used, such as exposed parking garage ceilings (due to fire code issues), so even if the price is higher than polyiso there may be market demand for it.

The insulation is being distributed through the same channels that currently distribute the company's GreenGuard XPS. With the product so new, there were no U.S. installers whom BuildingGreen was able to interview about the product, but based on my prior experience with Koppers' phenolic foam, I expect that

its installation is very similar to that of polyiso. Like polyiso, phenolic foam insulation can absorb moisture; Kingspan does not recommend it for below-grade applications.

Bottom line

If formaldehyde emissions prove to be as low as claimed once U.S. certifications are obtained, Kingspan's Kooltherm phenolic foam may provide a great alternative to our more standard rigid boardstock foam insulation materials, which all require flame retardants—usually halogenated and carrying significant health hazards. With this new insulation option, the Living Building Challenge (LBC) may want to reconsider the exception it currently allows for highly toxic flame retardants, and replace it with an exception for phenol formaldehyde in rigid insulation (formaldehyde is otherwise on the LBC's Red List of banned chemicals).

For more information

Kingspan
www.trustgreenguard.com



Game-Changing Products from Greenbuild 2016

USGBC's 2016 expo showcased innovative products, including building-integrated ERV and an industry-first PV solar water heater.

by Brent Ehrlich

This year's Greenbuild expo had a surprising number of interesting products, so many in fact that we couldn't fit them all into our first [Tour of Cool Products from Greenbuild 2016](#). Well, we have saved some of the best for last. This month we look at a new solar water heater, super-efficient photovoltaic panels, a new cellular glass insulation, and an innovative energy recovery system that might just change commercial HVAC.



Photo: AirFlow Panels

AirFlow Panels energy recovery ventilators are installed directly in curtain walls or rainscreens, removing the need for ductwork and freeing up floorspace.

AirFlow Panels

[AirFlow Panels](#) are building-integrated energy recovery ventilators (ERVs) that can be installed in curtain walls or rainscreens, and are one of the most innovative products I've seen at Greenbuild in years. The 3' x 5' x 10" panels install in the exterior wall, and manage energy and moisture while exchanging 200 cubic feet of air per minute. They also offer R-17 insulation for the entire panel, according to the manufacturer.

Having the energy exchange happen in the wall assembly reduces the need for ductwork or other mechanical systems, freeing up valuable floor space. You need to use a number of panels, of course, but the company claims they can achieve 25%–50% energy savings while requiring 10%–20% smaller air-conditioning systems.

Geocell

BuildingGreen has been a fan of cellular glass insulation for many years and even gave Foamglas a [Top 10 product award in 2010](#). That's because cellular glass is inert, resistant to insects and vermin, impervious to moisture, has good compressive strength, and is fairly well-insulating with an R-value of about 3.4 per inch.

Geocell is a granular, or gravel-like, version of cellular glass made from byproducts of board insulation production. This lightweight material is made from 100% recycled glass and comes in 330-pound bags, which should make installation fairly simple. It can be used below slabs, green roofs, and other applications, and unlike the board version, Geocell can be used where drainage is required. Manufactured in plants in Austria and Germany, Geocell will be imported by [Better Building Energy Efficiency](#) in Burlington Vermont, but won't be available until late 2017.

SunPower

For those who visited Greenbuild's expo floor, Sunpower was a partner on the KB Home Projekt that showcased a number of innovative products, including SunPower's Cradle to Cradle Certified Silver photovoltaic panels. The X-22 Series Maxeon photovoltaic panels produce at an industry-leading 22.2% average efficiency, according to the company.

Sunpower's panels are available as part of the company's [Equinox system](#). The system also includes fully integrated microinverters, InvisiMount mounting hardware that keeps the panels close to the roof, and an EnergyLink communications platform. The company claims the cell technology is the same as that used on the Solar Impulse PV plane that circumnavigated the globe. As part of a fully integrated system, they generate significantly more power per square foot when compared with traditional systems: one kilowatt equals 67–70 ft² versus 100 ft² for many conventional systems. Aesthetically, Equinox provides a clean look, and it also offers some peace of mind, since the entire system—including integrated microinverters—is covered under a single 25-year warranty.



Photo: Next Generation Energy

Sun Bandit uses photovoltaic panels to power its water heater. It can be used off-grid or net-metered, depending on backup power source.

Sun Bandit

Sun Bandit, from Next Generation Energy, is now offering the first ICC-SRCC-certified, Energy Star and UL-rated solar PV water heating system. Standard solar thermal systems heat either the water or a transfer fluid (glycol) in the panels, but the [Sun Bandit](#) keeps the water in the tank, using electric-resistance elements powered by the photovoltaic panels to heat it.

Sun Bandit can be used as a stand-alone system with no net metering or utility connection, but tanks also have backup power for when the sun doesn't shine, using electric (30, 50, 80, and 119 gallon options), gas, or propane (100 gallon). If grid-tied, the Sun Bandit will maintain baseline temps and it will heat water to 160°F so it can deliver more hot water per volume. According to the company, the Sun Bandit's 80-gallon tank can supply the equivalent of 100 gallons at 120°F, perhaps allowing for a smaller 50 gallon tank.

Kingspan Kooltherm phenolic foam insulation

Though not on display at Greenbuild, Kingspan announced the release of a new R-8 rigid foam board insulation made from phenol formaldehyde that does not contain flame retardants. For more on this insulation, see [R-8 Phenolic Foam Boardstock Insulation Is Back](#).



Sand, a Surprisingly Limited Resource

Demand for the basic raw material for glass and concrete is prompting illegal mining that's leaving beaches and riverbeds bare.

by Candace Pearson

After water and air, sand is the next most-consumed natural resource in the world, according to the [United Nations Environment Programme \(UNEP\)](#). Though a visit to the beach may make this material appear abundant, this resource—used to manufacture nearly everything from plastics to microchips—is actually under serious stress worldwide, and the building industry is a main perpetrator.

The extent of the crisis is largely invisible, especially to a U.S. public used to beach vacations on glistening white sand. But, those endless shores and tall dunes you might have enjoyed in New Jersey or Miami were likely constructed out of sand trucked in from inland mines or dredged from the ocean floor just in time for summer. The reality is that [75%–90% of the world's natural sand beaches are vanishing](#), including many of those on U.S. coastlines.

Supply is the first problem. Whereas rivers would typically carry tons of new sand to the oceans every year, dams and sea walls have hampered that sediment flow. Add erosion caused by human development, sea level rise, and increasing storm activity, and the beaches lose the ability to repair themselves. Many low-lying barrier islands are already submerged, and well-meaning efforts like sea walls can reflect waves back to shore and erode beaches faster.

The second problem is demand. People use more than 40 billion tons of sand and gravel every year, 80% of which goes to the construction industry, mostly to produce concrete. Desert sand can't be used for



Photo: Sumatra Abdulai. License: [CC BY 3.0](#).

Suction pumps are being used in this river bed to completely denude this area of sand.

most industrial purposes, including concrete, because the wind makes the grains too smooth to bind together well. Instead it is taken from riverbeds, lakebeds, and beaches around the world—to the point where some are stripped bare—or vacuumed up from the ocean floor where the activity wreaks havoc on marine ecosystems, in addition to altering ocean currents that can pull beaches more rapidly out to sea.

In the United States, sand has become a billion dollar annual business, [according to *The New York Times*](#)—big enough to fight off marine protection suits when they arise and to slow down regulatory efforts. Internationally, illegal mining is not only common, but in India has led to the emergence of what is called “[sand mafias](#),” groups that have reportedly killed hundreds of people in their attempt to protect their illegal operations.

With the demand for sand only expected to increase, marine biologists have called for better conservation plans for shore and coastal areas, as well as for purchasers to extend responsible sourcing to this most basic material. “Sustainable sand” policies have been written in some countries, including India, but they are a long way from being common and enforced.

Both glass and concrete can be ground back into to sand, but the recycled waste stream doesn't come close to supplying sand at a rate or cost to compete with illegal and legal, but environmentally damaging, mining. Some U.S. companies have successfully experimented with recycled glass as a sand and cement replacement; greater awareness of the sand issue in the building community could lead to stronger interest in such products.

