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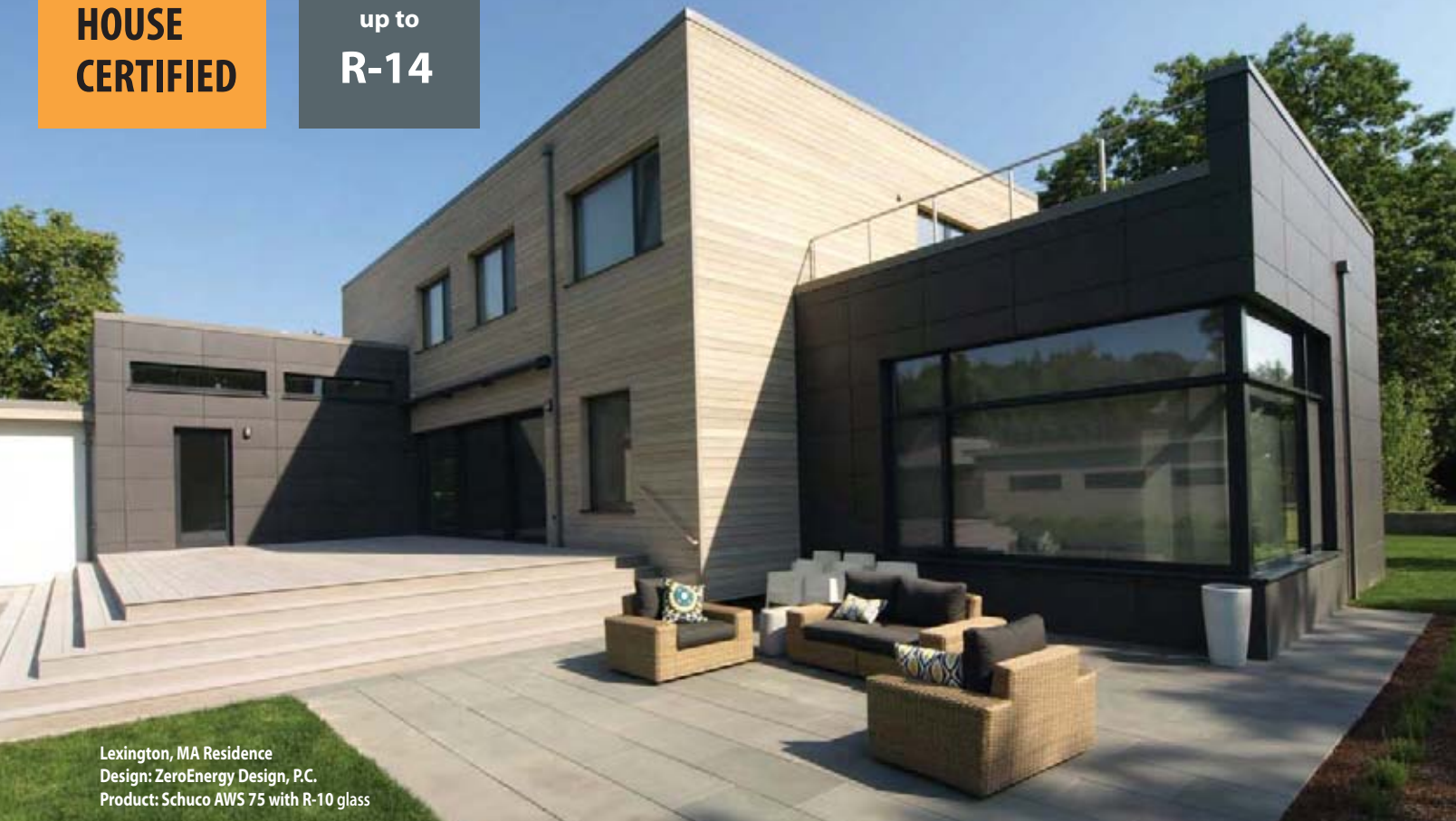
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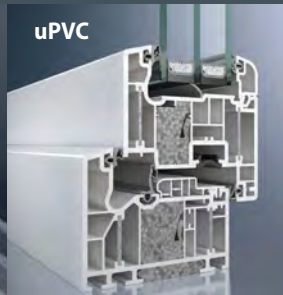
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ABOUT NESEA AND BUILDINGENERGY MAGAZINE

The Northeast Sustainable Energy Association (NESEA) is the region's leading organization of professionals working in sustainable energy, whole systems thinking, and clean technology. We advance the adoption of sustainable energy practices in the built environment through this magazine (distributed to NESEA members), our annual BuildingEnergy conferences and trade shows, professional workshops, BuildingEnergy Bottom Lines, and more. A NESEA membership is \$55/year, which includes BuildingEnergy magazine.



BUILDING THE NEXT GENERATION OF SUSTAINABLE ENERGY PROFESSIONALS



BY JENNIFER MARRAPESE

PHOTO CREDIT: MATTHEW CAVANAUGH

Some NESEA diehards refer to our community as a tribe—a group of practitioners with a common language and a set of shared experiences and values.

One of the things that sets the NESEA community apart from other professional organizations I'm familiar with is its closeknit nature. The relationships formed here are lifelong friendships and professional partnerships—many lasting several decades. To hear the long-timers talk about NESEA is to learn about the professional partnerships, the friendships, and even marriages that were cemented through years of involvement in our conference planning process and other NESEA rituals. Some NESEA diehards refer to our community as a tribe—a group of practitioners with a common language and a set of shared experiences and values.

THE VALUES OF THIS TRIBE INCLUDE

- Sharing, and even celebrating, our mistakes to ensure that others don't make the same ones. (As an aside, Paul Eldrenkamp often jokes that "NESEA" stands for the Northeast Society of Error Admissions.)
- Insisting upon data rather than relying upon modeled performance of our projects
- Telling the truth in service of advancing our practice, rather than whitewashing or tired sales pitches.

As I've come to know this community of "old timers," I've often wondered about how we might create similar glue to bond the next generation together in the name of NESEA's mission. Will the millennials find their tribe in NESEA, too? As an executive director who spends more than 40 hours each week trying to advance the adoption of sustainable energy practices in the built environment, I truly hope so. But until recently, I had little reason to believe it.

Now that's starting to change. Witness the newly launched "BE the Future" program. BE the Future was the brainchild of NESEA board member Phil Kaplan. As a board member, Phil was obligated to make a financial gift to NESEA. In addition, his firm, Kaplan Thompson Architects (KTA), was in the market for some new talent. Through "BE the Future," Phil found a way to accomplish both. He launched a student scholarship initiative, providing the architecture student of his choice from the University of Maine Augusta, with a one-day scholarship to

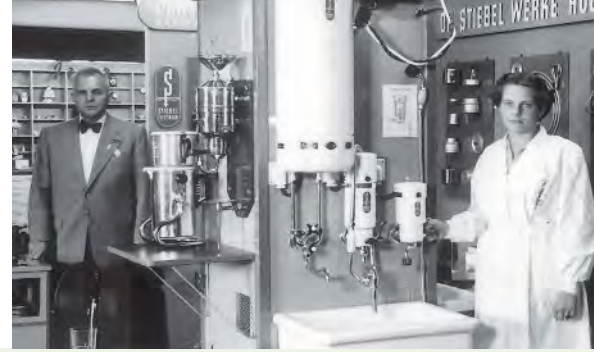
BuildingEnergy 15 in Boston, as well as a one-year NESEA membership. Applicants submitted their resumes, along with an essay detailing their interest, and KTA interviewed several finalists. In the end, they awarded an one-day scholarship to Adam Wallace. The selection process, and the commute to and from the conference, gave Phil and his crew the opportunity to get to know

CONTINUED ON PAGE 8



PHIL KAPLAN, PRINCIPAL OF KAPLAN THOMPSON ARCHITECTS, WITH ADAM WALLACE, PARTICIPANT IN THE BE THE FUTURE PROGRAM. PHOTO CREDIT: KAPLAN THOMPSON ARCHITECTS.

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Best of all, from my perspective, is the potential for this program to bring together the next generation of “NESEA rock stars.”

CONTINUED FROM PAGE 6

Adam well enough that they made him a job offer. Adam’s been working for KTA full time since last summer, and both he and KTA seem delighted with the arrangement!

This year, Phil is sharing this new model with several longstanding NESEA members board members, BuildingEnergy Bottom Liners and others. So far, more than a dozen have committed to fund their own scholarships to BuildingEnergy Boston in March.

This is a win on so many levels. The program will introduce NESEA to a dozen colleges, universities, or voc-tech schools, many that may not have previously known of us. It will give participating NESEA members an opportunity to interview the “cream of the crop” students from the participating schools, and to get to know the winner much better than they would through a normal job interviewing process. But best of all, from my perspective, is the potential for this program to bring together the next generation of “NESEA rock stars.”

We are planning a special lunch for all of this year’s BE the Future scholarship recipients. I’m hoping that this will be the first of many opportunities for this new generation to find their place in the NESEA tribe. Each winner will also receive a one-year NESEA membership, so as a staff

we’ll have the chance to try to engage them in other ways throughout the year.

If all goes well, I’m sure we’ll work to expand the program in coming years. If you are interested in offering your own BE the Future scholarship for BuildingEnergy 17, feel free to contact me at jmarrapese@nesea.org. Thanks! 🌱

ABOUT THE AUTHOR

Jennifer Marrapese takes care of the big picture: How do we make NESEA’s multidisciplinary network of practitioners bigger and better? She works with the board of directors and the membership to establish NESEA’s strategy and to ensure that the members and their staff have the resources to execute it. She practices a philosophy of openness and collaboration. She’s known for her strategic sense and for her ability to forge strong partnerships among staff teams and collaborators alike. Before joining NESEA, Jennifer served as vice president of regulatory affairs for Cox Communications and as executive director of Social Venture Partners of Rhode Island. She earned her BA in journalism from the University of Wisconsin, Madison, her JD from the University of California, Berkeley, and her MA in organizational management and development from Fielding University.



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4TH ANNUAL BUILDINGENERGY NYC CONFERENCE + TRADE SHOW HAD SOMETHING FOR EVERYONE



BY MICHAEL BRUSS
PHOTO CREDIT:
MATTHEW CAVANAUGH

The collegiality and concern for what works, and not solely one's own projects, is what typifies the NESEA community to me.

On Oct. 15, 2015, I had the good fortune to attend the 4th Annual BuildingEnergy NYC Conference + Trade Show held at the TKP Conference center in mid-town Manhattan. I live in New Hampshire and am a country boy at heart, but I definitely enjoy my visits to New York. After a brisk walk through the city, I was met at the door by smiling, attentive NESEA staff and volunteers. The day only got better from there. There's no better feeling than walking into an energized event with almost 600 participants, only four years after its initial conception. I walked into the overflowing exhibit hall that featured a rich combination of product and service providers, many already engaging curious attendees.

To see a 6-track conference after four years is a testament to the commitment of the organizers, both volunteers and staff, but also to the volume of good work that is being done in the greater New York City area. As with the BuildingEnergy Boston conference, I found myself struggling with which sessions to attend, but I was pleased with the choices I made. It's hard to go wrong!

Session One, "Old Tools, New Tricks" was a fast-paced exchange from seven designers and practitioners who gave real-life examples of solutions for problems facing multifamily buildings in the city and beyond. The collegiality amongst the panelists showed a mutual respect and appreciation

that comes from being in the trenches together. This collegiality coupled with a concern for what works and what doesn't, is what typifies the NESEA community to me.

New York City has more than its share of iconic, historic buildings and the second "Commercial and Institutional" Session showcased two prime examples of successful energy retrofit projects on classic historic buildings. The speakers started with the Jacob Javits Center and its 7-acre, state-of-the-art "green" roof, which not only provides protection from storm water runoff and heat island effect, but is a natural wildlife habitat for many species of birds. This retrofit reduced energy consumption by 26 percent overall. I was struck by the scale of these projects as the total building square footage of the Javits Center is 1.8 million square feet. In my entire career, my total work doing retrofits would cover just over half of that.

Ozgem Ornektekin, the deputy commissioner for the Office of Energy Management for NYC, discussed the implementation of the mayor's program "One City Built to Last," which has a goal to reduce greenhouse gas emissions 80 percent by 2050. I was struck by the commitment shown in the city for facing the issues of energy efficiency and climate change in a complex environment. Lessons were clearly learned from Superstorm Sandy's impact, and NESEA members have continued to be a part of the conversations with



JOHN SKIPPER OF CON EDISON, AND SAMANTHA SCHOENBERGER OF SELFHELP COMMUNITY SERVICES SERVED AS CO-CHAIRS OF THE PLANNING COMMITTEE FOR BUILDINGENERGY NYC 15. PHOTO CREDIT: NINA ROBERTS.

the city, its residents and businesses, to ensure a resilient future.

Later, I attended a session focused on project financing. I learned from these presenters that there is an important paradigm shift afoot, as we work

to finance these projects in today's challenging banking environment. The need to capture the reduced operating expenses that result from the implementation of energy saving strategies in

the financing equation, is a point that is yet to be completely accepted in the New England project financing world. New York has lessons to teach Boston bankers.

The session on "Resiliency, Energy, and Affordability" brought home the point that New York City is on the front lines in the conversation about human vulnerability in the face of climate change. There was robust discussion on best practices that are being put in play in response to the extremes in temperature and storm events that are a part of our everyday reality.

Most importantly, as I drifted through the hall between sessions I saw attendees engaged in animated conversation and making connections that will help them integrate new solutions into their work. The energy was one of old friends reuniting, new possibilities sprouting, and a mutual appreciation of great work done across many fields for a more sustainable future.

Everyone associated with the conference, including the sponsors, NESEA staff and planning committee, volunteers, attendees and exhibitors, has my sincere appreciation for pulling together for such a memorable event. Most of all, my hat is off to the co-chairs of the planning committee, Samantha Schoenberger and John Skipper, for their leadership and hard work. I am already looking forward to next year's conference, and hope to see you there! 🍷



TOP PHOTO:
APPROXIMATELY 600 PARTICIPANTS, 100 PRESENTERS, AND 50 EXHIBITORS GATHERED TO SHARE WHAT WORKS AND WHAT DOESN'T IN THE EFFORT TO MAKE NYC SUSTAINABLE. PHOTO CREDIT: NINA ROBERTS.



BOTTOM PHOTO:
IN ITS 4TH EDITION, AFTER GROWING BY ROUGHLY 30% EACH YEAR, THE BUILDINGENERGY NYC CONFERENCE + TRADE SHOW WAS ENTIRELY SOLD-OUT THIS YEAR. PHOTO CREDIT: NINA ROBERTS.

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BUILDINGENERGY BOTTOM LINES REACHES THE SUMMIT

JOHN ABRAMS, PAUL ELDRENKAMP,
AND JAMIE WOLF EACH FACILITATE
ONE COHORT GROUP FOR THIS
PROGRAM, HERE THEY ARE WELCOMING
ATTENDEES TO THE SUMMIT EVENT.
PHOTO CREDIT: JENNY GOLDBERG.



BY JOHN ABRAMS

On a beautiful fall day in November, more than 110 NESEA members gathered at Smith College to celebrate two years of BuildingEnergy Bottom Lines.

NESEA's first BuildingEnergy Bottom Lines Business Summit is over. It will not be the last.

On a beautiful fall day in November, more than 110 NESEA members gathered at Smith College to celebrate two years of BuildingEnergy Bottom Lines, to hone business skills, and to consider the future of this exciting endeavor.

Bottom Lines is a new NESEA program launched in 2014. The premise: the NESEA community has done a superb job of sharing technical and policy information for decades, but we have done less to promote and inform the craft of business.

Today, the BuildingEnergy Bottom Lines program consists of three peer group networks; each includes +/- 10 Northeast architecture, building, design/build, and renewable energy businesses. A fourth group is currently in formation.

In the opening plenary session Heather Thompson, of Thompson Johnson Woodworks in Maine, grilled my two fellow Bottom Lines founders - Paul Eldrenkamp and Jamie Wolf - and me. She

asked us "What was the longing - the need - that led you to commit time and energy to the creation of Bottom Lines?" The three of us agreed that it was a sense of urgency - the notion that if we are serious about making positive change, we must elevate the craft of Triple Bottom Line (people, planet, profit) business practice and distribute business know-how to the next generation.

Business is a force. We ought to pay equal attention to the craft of business as to technology and building science. We need to build strong businesses as well as great buildings; in fact, we are unlikely to succeed at one without the other. The intention of BuildingEnergy Bottom Lines is to offer a place for deep business introspection with trusted peers to expand the leadership skills and capacities of every member.

Attendee Kevin Ireton, former editor of Fine Homebuilding and now a contractor and freelance writer, summarized it well, "It seems only appropriate that NESEA should help those who care so passionately about sustainable buildings to stay in business. The first rule of lifesaving is: 'Don't



PARTICIPANT BUSINESSES FROM THE 3 CURRENT BUILDINGENERGY BOTTOM LINES PROGRAM LISTEN TO THE OPENING REMARKS OF THE PROGRAM ON NOV. 4TH AT SMITH COLLEGE. PHOTO CREDIT: JENNY GOLDBERG.

We can't help anybody if we can't stay in business... Business is a force.

down.' You could say the same thing about NESEA members trying to save the planet. We can't help anybody if we can't stay in business."

The Bottom Lines program aspires to do more than keep us afloat. It inspires us to rise above the surface of day-to-day business necessities to help each other navigate the complexities of effective business practice that serves all stakeholders, that minimizes environmental impact, and that produces sufficient profits to allow us to do these things well.

Back to the Summit. As the day unfolded, participants attended the following workshops:

- Amy Glasmeir, a professor of Economic Geography and Regional Planning at MIT, teamed with builders Dan Kolbert and Paul Eldrenkamp for "What's a Living Wage?" Participants used a prepared spreadsheet to determine the impact of true living wages on the cost of a project.
- Peter Taggart of Taggart Construction led "Accounting and Financial Management for Building Professionals" and came at accounting as a "creative endeavor" that's not so dry as we often make it out to be.
- Mel Baiser, Ben Kelley, and Brad Morse tackled "Technology to Help Operate and Manage Your Business". They pointed out that "technology is, at best, a facilitation tool and not a savior" that "systems can engage people by externalizing that which often remains internal to one person or a

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AUTHOR JOHN ABRAMS WORKING IN A SMALL GROUP ALONGSIDE JENNIFER MARRAPESE, EXECUTIVE DIRECTOR FOR NESEA. NESEA ITSELF IS A PARTICIPANT IN THE BOTTOM LINES PROGRAM. PHOTO CREDIT: JENNY GOLDBERG.



BEN KELLY OF BUILDING SHELTER INC. LEADS A CONVERSATION ON THE CHALLENGES AND SUCCESSES INVOLVED IN LEADERSHIP OF A SUSTAINABLE BUSINESS. PHOTO CREDIT: JENNY GOLDBERG.



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- Invitation to participate in BuildingEnergy Bottom Lines **B**
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CONTINUED FROM PAGE 14

It is tribal. It is a culture of sharing. It's also a big investment – of time, money, courage, and commitment to transparency. But Bottom Liners seem to agree that the value far outstrips the investment; the risk is low.

few” that “technology is key to bringing young people into our industry” and that “tech tools for our industry need to seriously evolve – there are great development opportunities.”

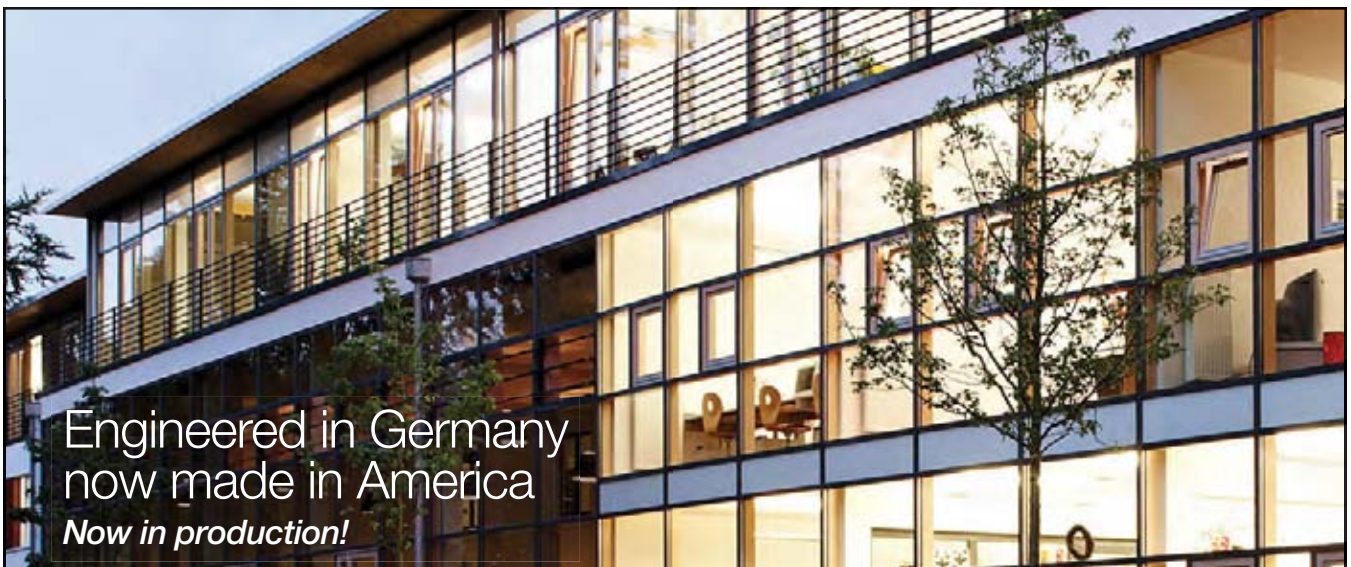
- In my “Big Transitions” workshop I pointed out that change is situational but that transitions are psychological – if transitions are to be rewarding rather than stressful they must be consciously and effectively managed. People shared their own business transition experiences – in the realms of ownership, succession, rapid growth, job changes, management structure, and new endeavors.
- Jamie Wolf and Bruce Coldham led the Design/Build Workshop participants through the entire beginning-to-end project workflow process – to help us improve project delivery methods, communication, understanding of the various roles of participants, and optimization of service to clients.
- The Carbon Footprint workshop leaders – Kate Stephenson, Declan Keefe, Jacob Deva Racusin, Rachel White, and Marc Rosenbaum – examined different ways of quantifying environmental impact in our businesses and projects. They demonstrated the difficulty of measuring impact, but stressed that the things that we measure are the things we can manage – and improve.

The closing session was a series of Pecha Kucha presentations by four companies – Lewis Creek Builders, Building Shelter, Quigley Builders, and Steveworks – who have hosted Bottom Lines gatherings at their places of business. Their images and commentary conveyed the complexity of the experience – the sense of accountability, the generosity of their peers, the fear of exposure and subsequent joy of learning, the unlimited potential for progress in our enterprises.

Steve Silverman of Valley Home Improvement chaired the conference. He spoke about what BuildingEnergy Bottom Lines means to him: “It means I am surrounded by kindred spirits; smart, passionate, caring people who share a common thread of craft, small business and beyond. It means I have trusted companions in the often lonely world of a sole proprietor. Bottom Lines accelerates my rate of business and personal development. It fosters openness and sharing. And it gives me a measuring stick.”

And Kate Stephenson, former executive director of Yestermorrow Design/Build School (NESEA’s partner in Bottom Lines), had this to say “After a great day at the Summit, I ran into an acquaintance on the way out the door who I had invited to come. He looked at me and said ‘Kate, this is exactly what I have been seeking for the past ten years.’ To me,

CONTINUED ON PAGE 18



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We ought to pay equal attention to the craft of business as to technology and building science. We need to build strong businesses as well as great buildings; in fact, we are unlikely to succeed at one without the other.



RACHEL WHITE OF BYGGMEISTER PRESENTS DURING A WORKSHOP ON HOW HER ORGANIZATION HANDLES HOME ENERGY PERFORMANCE REPORTING. PHOTO CREDIT: JENNY GOLDBERG.

CONTINUED FROM PAGE 16

it was a great example of what Jamie calls “finding your tribe” and the opportunity Bottom Lines can offer to practitioners who often feel they are alone in the wilderness.”

It is tribal. It is a culture of sharing. It’s also a big investment – of time, money, courage, and commitment to transparency. But Bottom Liners seem to agree that the value far outstrips the investment; the risk is low.

The Summit marked the end of the beginning of the BuildingEnergy Bottom Lines program. The

future is bright. I was recently at the national conference of the North American Timber Framers Guild. I spoke about the Bottom Lines program. A Seattle architect who works with the Northwest Eco-Building Guild (a Northwest version of NESEA) approached me after I spoke about Bottom Lines. “Do you imagine that this is something we could do regionally, here in the Northwest?” he asked.

“Absolutely,” I responded. “The template for success has been created. It can be used anywhere, by any group of people who want to

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explore the art and craft of business, and what it takes to be a truly effective Triple Bottom Lines business in today's world."

Ultimately, this is about increasing our capacity to do work that matters. Someone recently said that the best young minds of our current generation are devoting themselves to figuring out better ways to get people to click on ads. We need these people to be doing work that matters. BuildingEnergy Bottom Lines promotes that philosophy and ability.

One of those groups may, at some point, include you. Have a look on the NESEA website. Talk to a Bottom Liner. It may be the business tribe you're looking for, too. 🌱

ABOUT THE AUTHOR

John Abrams is cofounder and CEO of South Mountain Company, a 37-year-old employee owned design/build and renewable energy company in West Tisbury, Massachusetts. John's book - Companies We Keep: Employee Ownership and the Business of Community and Place - was published by Chelsea Green Publishing in 2008.

renovation of garman house amherst college

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LEARN THE REAL (HARD) WORK OF RESIDENTIAL DESIGN AT BUILDINGENERGY BOSTON

BY ANDREW WEBSTER

I don't sit in a hotel room in Boston for two days in the middle of winter, just to have someone tell me how everything worked out just as they planned. The truth is much more entertaining, a lot more flawed, and a lot more useful to me as a professional.

I don't go to NESEA's BuildingEnergy conference every year to be sweet-talked. I don't sit in a hotel room in Boston for two days in the middle of winter, just to have someone tell me how everything worked out just as they planned. The truth is much more entertaining, a lot more flawed and a lot more useful to me as a professional.

Residential design is difficult work. With few exceptions, every client is an amateur. Every design is a testament to who the client thinks she ought to be. Every project is a wrestling match between the things he always wanted and the ones he can afford. The work is not easy. This year at BuildingEnergy Boston, a collection of sessions will focus on the difficult parts of residential design, where no one will pretend it always goes perfectly. Let me tell you about them:

WHEN YOU COME TO A FORK IN THE ROAD... TAKE IT

Architect Chris Briley (BRIBURN, Portland, ME) will share the stories of two projects, in parallel, with two clients, two sets of challenges, and two completed Passive Houses. One client didn't want it to "look like a passivhaus" and had a pretty strong idea of what it was like before the process even started, the kind of client who "just needs a little help with the floor plans." The other wanted a model home, a showcase of the possible, but with "turnkey" design that didn't consume too much client time. One would be certified with PHIUS, using the newly minted WUFI Passive, while the other pursued PHI certification with PHPP. But at their root, these projects shared a target, shared a climate, shared an architect. Chris will walk us through the process of each, and explain the whys of residential passive design in southern Maine.

When architect Jesse Selman (CGH Architects, Amherst, MA) and builder Kent Hicks (Kent Hicks Construction, Chesterfield, MA) began a project together in Savoy, MA, it was simple enough: a Deep Energy Retrofit of an existing home. The clients were committed to the property, owned a functioning house, and had decided to bring it up to modern standards for energy efficiency. What followed was

anything but simple. It became a process spanning three years, in which this team explored every branch of the residential decision tree. Would they keep the original house, or knock it down, maybe they'd build on the same foundation, or use the old stone square as a garden plot? They explored factory-built and stick framed new construction. With energy consultant Mike Duclos, of DEAP Energy Group, they pursued Passive House until the compromises in the view became too great, and they tested every material against the client's extremely sensitive nose, which would not tolerate a chemical-laden environment. With a good-hearted client (the process can be unbearable without this saving grace), they pursued this ornate process to its elegantly simple end.

WIDENING THE CIRCLE: HIGH PERFORMANCE HOME DESIGN

Builder Mark Doughty (Thoughtforms) has made a living creating custom homes for others in the Greater Boston area, and when it came to creating a home for himself, he sought out engineer Jordan Goldman (Zero Energy Design). Together, they worked to design a high performance home that, more than a year after completion, is producing more energy than it consumes. But what happened when Mark went back to business, creating homes to satisfy other people's dreams? "High performance is just not that hard to do, if you start talking early enough - between the design team and the construction team. The client expects their team to integrate all of the best practice details up front, and if that happens, they're happy. But if coordination begins after everything is drawn and detailed, the team can be left choosing between the uncomfortable "why wasn't it designed this way in the first place?" conversation and compromising the design."

"We've done blower door testing for a long time - measurement is in our DNA. We targeted 'less the 1.0 ACH50' and hit 0.27 without any incremental costs over our typical custom work"



TOM HARTMAN'S 1910 SEARS KIT HOUSE AFTER ITS DEEP ENERGY MAKEOVER. PHOTO CREDIT: TOM HARTMAN.

Architect Hank Keating (Trinity Development) works for a development company which focuses on urban neighborhoods, but he is not afraid of a challenge. He'd seen Passive House Consultant Mike Duclos (DEAP Energy Group) present on Passive House at the BSA, and brought him on when he started a Passive project of his own. The scope was large: one primary residence, one guest residence, an apartment for the interns and a working farm. It's not clear that he knew exactly what they were in for together, but Hank was undaunted by the process. With Mike as his guide through the thorns of PHPP, he had to come to grips with the consequences of design choices like large amounts of North-facing glass. They'll talk together about the challenges and the compromises of an architect's first foray into Passive House, and what they learned from the process.



ONE OF TWO PASSIVE HOUSE PROJECTS TO BE SHARED BY ARCHITECT CHRIS BRILEY AT BUILDINGENERGY 2016. PHOTO CREDIT: TRENT BELL.

RESIDENTIAL RETROFIT IN TRICKY SITUATIONS

Architect David Foley (Holland and Foley Architecture) and builder Paul Eldrenkamp (Byggmeister Design Build) ought to know better. Residential Deep Energy Retrofits – bringing a home's heating energy consumption down by 70 percent or more – are hard enough in normal circumstances. Renovations in historic districts are also notoriously fraught with perils, both financial and regulatory. Who in their right minds would combine the two? No one, including this team, who had been assured by code enforcement previously that the building was just **outside** the Historic District. By the time the permitting process revealed that they'd be required to use all wood windows to comply with Historic requirements, the project was already too developed to give up on. David and Paul will discuss the



A HIGH PERFORMANCE TEAM AT THE C&H/KENT HICKS S VOY HOUSE.



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challenges, technical and otherwise, which faced this renovation of a 1928 Boston area home. The most expensive part of this project for David Foley himself? That it pushed him further along the road to Net Zero in his own thinking – and engendered a new round of renovations at his own home.

C&H Architects (formerly Coldham & Hartman Architects) has been doing Deep Energy Retrofits for years now, but when the tables turn, and it's time for his own house renovation, architect Tom Hartman has to sell the idea to his wife and family, who would really rather plan a long family vacation. On a building he's been working on and monitoring for more than a decade, Tom pushes through the (nearly) last round of retrofits at his 1911 Sears kit home—new siding and insulation to the outside, and a new heat pump for heating. He'll walk through the calculations that got him there, the window details that saved his interior trim, the financial justifications, which finally earned him the green light, and the compromises we all make when it's our own money on the line.


I come to NESEA every year to hear stories like these—real people doing real, hard work, and coming back with real battle scars to tell the rest of us the results. I'm looking forward this winter to sitting back and listening to somebody else's horror stories, as well as enjoying somebody else's hard-earned successes. I hope you'll join us this March 8-10, 2016 at the Seaport World Trade Center in Boston for BuildingEnergy 16. 🌱

ABOUT THE AUTHOR

Andrew Webster is a Designer and Project Manager at Coldham-Hartman Architects and a Certified Passive House Consultant. He loves his high performance residential clients, and comes to Building Energy to get recharged for the next challenging year.



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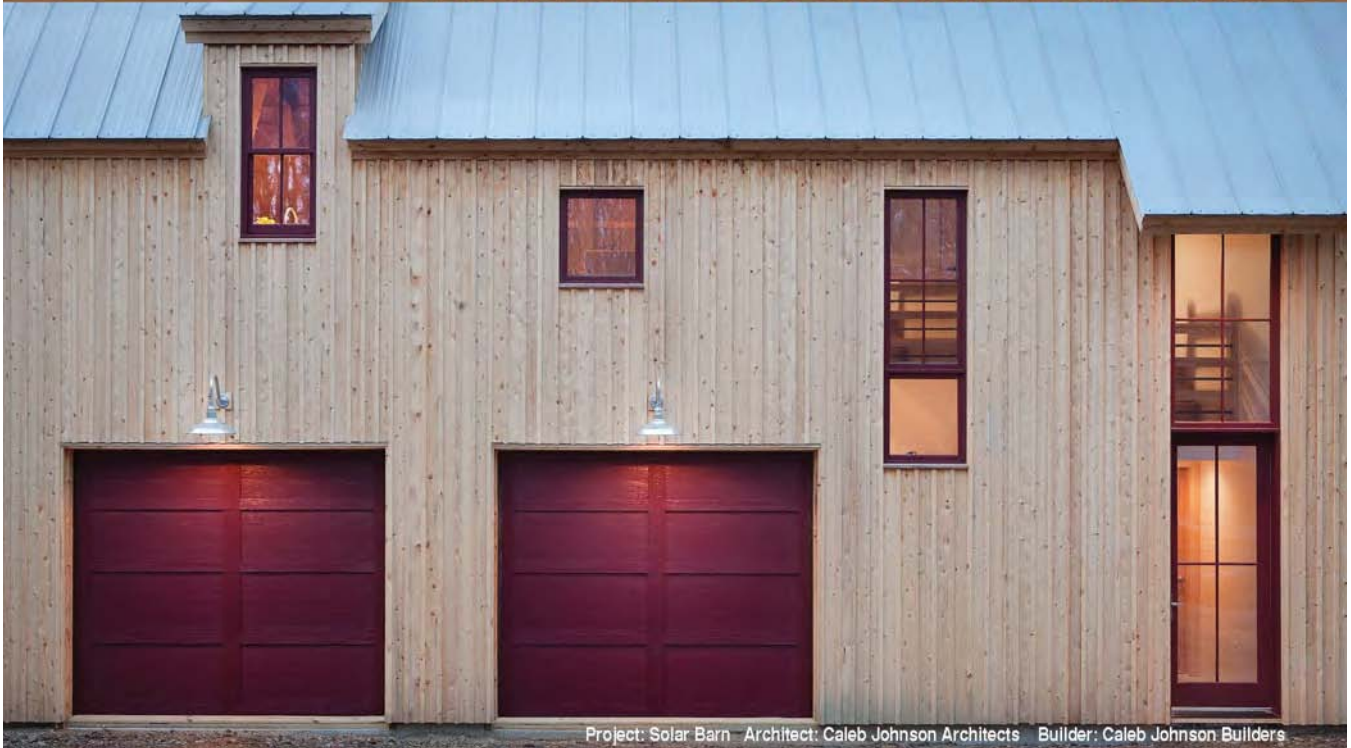


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STAMFORD CONNECTICUT: A CITY ON THE CUTTING EDGE OF SUSTAINABLE DEVELOPMENT

BY CHRIS LOTSPEICH

The goal is for new construction and major renovations to attain carbon neutrality by 2030, along with emissions reductions in existing buildings.

Stamford is the second largest and fastest growing city in Connecticut. Over the last decade, the city has been steadily expanding a series of innovative initiatives at the intersection of economic development, sustainability and resilience. The city was a first mover in creating an Energy Improvement District (EID) with the ability to make investments in distributed energy resources and infrastructure city-wide. Stamford's 2030 District is among a few public/private partnerships in designated urban areas across North America committed to reducing energy use, water use, and transport emissions from buildings. The city is using an Energy Savings Performance Contract (ESPC) that is developing a microgrid at its Government Center and making resilience enhancements to emergency shelter public schools in addition to energy and water saving upgrades, the first U.S. municipality to apply this self-funding retrofit approach in this way. These efforts are being taken by the city and its nonprofit and private sector partners, combined in their shared visions and plans for the future.

THE ENERGY IMPROVEMENT DISTRICT

Founded in 1641, Stamford is home to more than 125,000 residents governed by an elected Board of Representatives and a mayor who serves as chief administrator. Most city offices are located downtown in Stamford Government Center (SGC), a 10-story office building with an attached 4-level parking garage. Built in 1985 as a corporate headquarters, but never occupied, the 272,000-square-foot building was bought by the city and used as a "city hall" seat of government. SGC hosts critical facilities that it was not designed to support, including data centers, the 911 dispatch Emergency Communications Center (ECC) and the Emergency Operations Center (EOC),

which is the mayor's interagency emergency command post. These internal loads grew over time, taxing the building's cooling system and backup power generation, spurring modifications and upgrades.

Stamford is located in southwestern Connecticut that is a recognized area of constrained electrical grid capacity. In the early 2000s the aging, congested downtown grid was overtaxed and suffered repeated interruptions, including a downtown outage in 2006 involving explosions and fires in underground vaults that blacked out SGC and disrupted emergency communications. This situation spurred the utility Connecticut Light and Power (now Eversource) to increase investment in system upgrades.

The administration of then-Mayor Dannel Malloy began considering enhancements of its own. Engagement with the U.S. Council of Mayors led to Stamford deciding to take the lead with a pilot microgrid development, working with private developer a private developer. The original concept involved a microgrid located at SGC and included a neighboring housing authority apartment building. The microgrid was to include a cogeneration or combined heat and power (CHP) system with a fuel cell and reciprocating engine supplied by natural gas.

Simultaneously, the city helped draft state legislation (PA 07-242) that enabled municipalities to create an Energy Improvement District (EID), and Stamford became the second community to establish one in 2007. An EID is a tax exempt entity with a municipally-chartered board comprising both private and public sector members. An EID can develop and operate distributed energy resources, such as generation up to 65 MW in capacity, and energy efficiency projects; issue revenue bonds; and charge fees for energy. Legislation in 2013 (PA 13-298) enabled EIDs to own and operate microgrids



STAMFORD GOVERNMENT CENTER. PHOTO CREDIT: OFFICE OF CONGRESSMAN JIM HINES.



THE STAMFORD METRO-NORTH RAILROAD STATION AS SEEN ON APRIL 25, 2013 IN CONNECTICUT, USA. IT SERVES COMMUTERS LEAVING & ENTERING STAMFORD VIA THE NEW HAVEN LINE. EDITORIAL CREDIT: RITU MANOJ JETHANI / SHUTTERSTOCK.COM.



SOUTHWESTERN CONNECTICUT IS A RECOGNIZED AREA OF CONSTRAINED ELECTRICAL GRID CAPACITY. PHOTO CREDIT: ORAN VIRIYINCY.

An Energy Improvement District can develop and operate distributed energy resources, such as generation up to 65 MW in capacity, and energy efficiency projects; issue revenue bonds, and charge fees for energy.

or enter in long-term contracts with energy project developers.

Stamford's mayor appoints five or more EID Board members. Chairman Hank Ashforth is a commercial real estate developer and manager who is active in the Urban Land Institute and was involved in creating the Portland, Oregon Lloyd Ecodistrict, which focuses on economic development through sustainable practices. Other members include one person from a local financial services

firm, another real estate developer, a member of the Board of Education, and the city's Director of Economic Development serving as the mayor's representative.

That last representative is telling, as Stamford's EID has had an economic development motive as well as energy surety from the start. A strategic objective is to develop microgrids that provide high power quality and reliability at low cost to continue Stamford's history as a destination for corporate



A SOLAR DECATHLON TEAM MEMBER SURVEYS MICROGRID EQUIPMENT THAT WILL BE USED TO POWER THEIR HOUSE. PHOTO CREDIT: AMY VAUGHN/U.S. DEPARTMENT OF ENERGY.

Over the last decade, the city has been steadily expanding a series of innovative initiatives at the intersection of economic development, sustainability and resilience.

headquarters and facilities, less than one hour by commuter rail from New York City.

The microgrid project stalled for a variety of reasons after Malloy was elected governor and a new administration came in. The EID retained its interest in microgrid development and soon events caught up with the city's trailblazing efforts.

CONNECTICUT'S MICROGRIDS PROGRAM

In 2011, a pair of storms caused prolonged blackouts across Connecticut. In August, Hurricane Irene knocked out power for roughly half of the state, with many towns not restored to full service for a week or more. Just before Halloween, an early-season Nor'easter dumped snow on trees that still had many of their leaves. Branches and trunks that could not take the weight fell, downing power lines and causing even more widespread and longer power outages. Subsequently Governor Malloy formed the Two Storms Panel, co-chaired by Stamford's Joseph McGee of the Business Council of Fairfield County. One of the Panel's recommendations was that the state foster microgrid development for local energy resilience.

The Connecticut Department of Energy and Environmental Protection (DEEP) worked with the state's two electricity distribution companies to launch the nation's first microgrids grants and loans program in the fall of 2012. The objective was to help provide energy surety to clusters of two or more critical facilities that could produce energy onsite and operate independent of the

electric power system or "grid" in a microgrid configuration. The program provides funding for microgrid electrical infrastructure such as controls, wires, switchgear and the point of common coupling with the grid, as well as some engineering costs; distributed generation has to be funded via other means.

Stamford's EID submitted a DEEP grant application similar to the initial microgrid concept, working with consultant Celtic Energy Inc. (CEI). Time and resource constraints contributed to the failure to secure an award, although DEEP encouraged the city to try again in a subsequent round of funding.

THE ENERGY SAVINGS PERFORMANCE CONTRACT

CEI proposed that the city develop the microgrid project via an Energy Savings Performance Contract (ESPC), the first time a municipality has used an ESPC to retrofit for resilience in this way. An ESPC is a public-private partnership for implementing energy improvements in existing facilities (or new construction). The city engages an Energy Services Company (ESCO) to perform an investment-grade audit (IGA) of energy and water saving opportunities, and recommends upgrades. The ESCO guarantees a given level of utility cost reductions (e.g., 20 percent) that result from the proposed suite of energy conservation measures (ECMs) in a portfolio of municipal buildings. The city secures third-party financing such as a tax exempt lease purchase or loan, or a bond. The ESCO implements the improvements and monitors the results. The guaranteed savings yield positive cash flow sufficient to cover repayment of the financing over the project term (e.g., 15 years). An ESPC can include a certain amount of capital investment that does not directly produce energy cost savings, such as microgrid infrastructure. Supplemental funds such as grants and utility incentives can support project investment, but if no grants are obtained then the ESPC can still fund the microgrid. The city realizes a turnkey project with guaranteed savings, no money down and off-book financing that is repaid from the savings resulting from the project itself—in effect a self-funding endeavor. CEI serves as the City's Owner's Representative to support issuance of an RFP for ESCO selection and provides quality assurance on the chosen ESCO.

In late 2014, Stamford selected the ESCO ConEdison Solutions (CES) to perform the ESPC. CES proposed a roughly \$20 million project with a 15-year term. The project includes installation of a microgrid at SGC based on natural gas fired reciprocating engines, plus resilience enhancements to the emergency shelter functionality of public schools, in addition to typical energy and water efficiency upgrades. The ESPC provides an integrative framework that first leverages energy efficiency to reduce building loads and upgrade cooling and other systems, and then it sizes CHP to serve those loads. The CHP systems operate 24-hours-a-day, seven-days-a week under normal conditions and can serve a subset of critical loads in grid-independent

“island” mode. The SGC microgrid is planned to provide power, heat and cooling to the ECC, EOC, cafeteria and more, as well as backup power to adjacent housing authority multifamily buildings to enable residents to shelter in place. Two of the five schools in the project are also planned to host CHP that can enable island mode operation. The ESPC also includes a solar power purchase agreements at three schools.

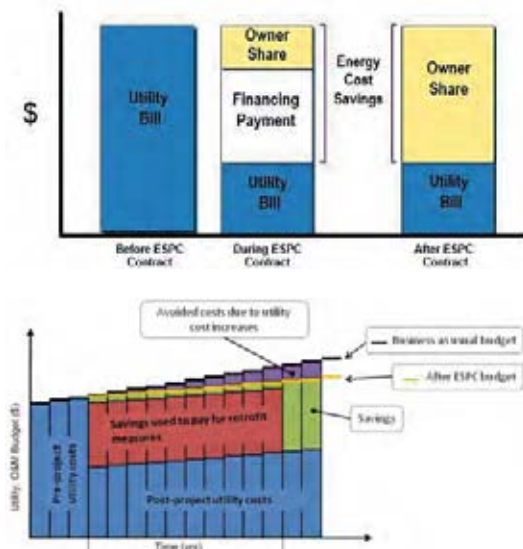
Future phases of the ESPC can include additional municipal and school facilities. These investments simultaneously mitigate the risks of climate change by reducing the city’s carbon footprint and helping adapt to those risks with more resilient infrastructure.

THE 2030 DISTRICT

In October 2014, Stamford launched the sixth 2030 District in the country, headed by Executive Director Megan Saunders as a joint effort of the Business Council of Fairfield County and Connecticut Fund for the Environment with support from the Kresge and Tremaine Foundations, among others. Its 36 members include private property owners and managers plus community and professional partners who together provide a business model for urban sustainability through collaboration, leveraged financing, and shared resources. The goal is for new construction and major renovations to attain carbon neutrality by 2030, along with a 50 percent reduction in existing buildings, following the Architecture 2030 Challenge for Planning. The 2030 District and its partners provide training, practical consulting and other support for members to benchmark and reduce their energy and water use as well as transportation emissions, lower operating costs and environmental impacts, increase property value, and strengthen the resilience of the community and local economy to storms and sea level rise. Stamford is the only 2030 District to include resiliency as one of its stated goals.

VISION FOR THE FUTURE

Stamford’s EID and 2030 District reflect the city’s vision for a sustainable and flourishing future. The Administration of Mayor David Martin is represented on the EID by Director of Economic Development Thomas Madden, who serves as the city’s project manager for the ESPC along with Energy and Utilities Manager Nancy Pipicelli. Madden has extensive experience in sustainable development, including helping create an industrial ecosystem in Nova Scotia. He sees “waste” flows in the city as a resource to be harnessed, for example by diverting organic waste into anaerobic digesters to generate both compost and biogas for local energy production. The EID sees the potential for further microgrid development and has recently expanded its boundaries to encompass the entire city. The city has signed an agreement with Eversource to set municipal and community energy efficiency goals, pursue them with the utility’s support, and become eligible for incentive bonuses for



ESPC FINANCIAL STRUCTURE. (IMAGE: CELTIC ENERGY INC. / BEST PRACTICES GUIDE FOR ENERGY SAVINGS PERFORMANCE CONTRACTING)

comprehensive achievement. Building on its 2005 Local Action Plan for greenhouse gas reductions, Stamford joined with nearby coastal cities Bridgeport and New Haven to apply for participation in the Clinton Global Initiative’s 100 Resilient Cities program.

Stamford is planning and investing for the future by leveraging public-private partnerships and repurposing inefficient energy spending into a down payment on a future that is leaner, greener, less risky and more prosperous.

ABOUT THE AUTHOR

Chris Lotspeich is Director of Sustainability Services at Celtic Energy Inc. Recent projects include microgrid planning for the State of Rhode Island; work with Arup on solar power plus energy storage for San Francisco critical facilities; and resilience consulting for the City of Stamford, Connecticut and the FBI. At Rocky Mountain Institute he worked on 6 continents. Chris earned management and environmental studies master’s degrees from Yale and was a firefighter/EMT.

A strategic objective is to develop microgrids that provide high power, quality and reliability at low cost to continue Stamford’s history as a destination for corporate headquarters and facilities, less than one hour by commuter rail from New York City.

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BY MARC ROSENBAUM

PUBLISHER'S NOTE: THIS PARTICULAR PROJECT WAS FEATURED IN AN EARLIER ISSUE OF BUILDINGENERGY MAGAZINE.

Many of our most used public and institutional buildings are in great need of improvements—not only to energy and resource efficiency, but comfort, indoor air quality and durability.

Deep Energy Retrofits (DER) are not just for homes. In fact, many of our most-used public and institutional buildings are in great need of improvements—not only to energy and resource efficiency, but comfort, indoor air quality and durability. In the DER online course being offered in the fall NESEA Building Energy Masters Series we'll look at how the same principles underpin the retrofitting task for both homes and nonresidential buildings.

The town where I lived for 31 years, Plainfield, NH, experienced the 2008 oil price shock especially hard as an overage in our K-8 school budget. In the fall of 2008, I worked with the volunteer Facilities Committee to develop an approach for the school that would demonstrate profound energy savings and remediation of serious deficiencies at the same time. Our extraordinary results there are completely replicable all across our region.

The 35,000-square-foot Plainfield Elementary School was built in 1972 and enlarged in 1989 and 2000. The 1972 building is a slab-on-grade, single-story building with a flat roof. Much of its steel structure effectively bridges the little thermal insulation it has. Due to concerns about structural adequacy to meet current codes, insulation has not been added to the building during reroofs. The 1989 wing is a wood frame construction with pitched roof trusses. It also is slab-on-grade and single level. Significant ice dams prompted an attic level air sealing effort and, at that time, blown-in cellulose was added. In 2000, the last wing was added with construction similar to the 1989 wing—although a somewhat more complex design contributes to air leakage issues. The gym, which was part of the original construction, is uninsulated block with a steel structure above. It is extremely leaky—my blower door was able to depressurize the space to only 13 Pascals, a far cry from the standard testing level of 50 Pascals. A few hours with the blower door and a theatrical fog machine showed a school with varying amounts of air leakage, yet all unacceptably high. The bottom of the wall where it sat on the foundation was a consistent leakage zone.

Before the Facilities Committee became actively involved, the school was using about 21,000 gallons of fuel oil annually and 215,000 kWh/year in electricity. The attic repair work in the 1989 wing, some mechanical and control system repairs, and operational and behavioral changes contributed to energy savings of 6,000 gallons of oil and 34,000 kWh annually. These gains cost little and built awareness that significant improvements were possible and desirable. However, in addition to high energy usage, the Plainfield School suffered from a plethora of other problems. The mechanical systems in the 1972 and 1989 portions of the building were beyond their useful service life and have always functioned poorly, while making a racket. A teacher could choose to have ventilation or to be heard in their classroom, but they couldn't have both at the same time. The school experienced drafts and wide temperature variations.

Some envelope issues resulted in water leakage and subsequent decay and mold. Many windows were in poor condition and functionally inoperable. The T111 siding near grade warped and delaminated. The Facilities Committee proposed to the School Board to take one 900-square-foot corner classroom in the 1989 wing and disconnect it from the oil-fired heating system, remove the noisy ventilator, and replace these with an air source minisplit heat pump to provide heating (and cooling occasionally) and a residential scale energy recovery ventilator (ERV) to supply fresh air.

We proposed a radical insulation upgrade, adding 3 inches of foam insulation to the foundation, 61/2 inches of foam insulation to the walls, and replacing the windows with quadglazed windows that have double the insulating value of typical new windows. The roof insulation had been previously addressed. In the process of this Deep Energy Retrofit (DER), we would also make this room far more airtight, and install new, durable siding on the walls. With the Board's blessing, we asked the School District voters to approve a warrant article to fund what we called the "Prototype Classroom," as a model of what we might achieve across the entire school in years ahead,

CONTINUED ON PAGE 31



THE EXTERIOR OF PLAINFIELD SCHOOL AT DIFFERENT PHASES OF THE TRANSITION, AS IT UNDERWENT ITS DEEP ENERGY RETROFIT.
PHOTO CREDIT: MARC ROSENBAUM.

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THE RENEWAIRE EV200 ERV UNIT RECOVERS BOTH SENSIBLE HEAT AND MOISTURE FROM THE EXHAUST AIR AND TRANSFERS THEM TO THE FRESH AIR. PHOTO CREDIT: MARC ROSENBAUM.

and as a path to improving the users' experience while ultimately freeing the town's largest asset from the unpredictability of oil prices. In March 2009, the voters approved the expenditure. During the summer of 2009 the work was done, and the Prototype Classroom was ready when school reopened.

The perimeter of the foundation was dug out to a depth of 2 feet, and 3 inches of Type IX expanded polystyrene (EPS), treated with a borate compound to increase insect pest resistance, was added down the foundation wall and out horizontally 2 feet. The bottom 2 feet of the T111 was stripped from the frame wall and replaced with new oriented strand board (OSB) and all joints were sealed with either caulk or peelandstick tape as appropriate to act as an air barrier. Then a layer of 3-inch-thick polyisocyanurate foam insulation was installed, with a layer of 3.5-inch thick Nudura EPS and integral wood nailers on top. Over that was a layer of housewrap and polypropylene drainage mesh, then local pine tongue and groove horizontal siding.

Window rough openings were extended with TimberStrand bucks fastened with long screws to the existing rough opening. New Serious Materials (now Alpen) 925 series windows were installed (Serious Windows donated the windows and provided shop drawings and technical support). These windows are made from hollow fiberglass

pultrusions filled with polyurethane foam insulation. The glazing suspends two layers of Heat Mirror lowe film inside of two layers of clear glass, with krypton gas fill and warm edge spacers. The windows are a combination of fixed and operable sash, and they have an overall insulating value of about R6.

The air source heat pump was installed is a Mitsubishi Hyperheat, which retains 75 percent of its rated capacity at 13°F, and operates down to 30°F. No backup heat was installed. Minisplits are much less costly than ground source heat pumps, enabling us to shift mechanical costs to envelope improvements, while providing a much simpler and more reliable system. We choose to install a Renewaire EV200 ERV unit. It recovers both sensible heat and moisture from the exhaust air and transfers them to the fresh air. I measured 85 percent effectiveness from this unit—on a morning that was 3°F, the exhaust air was 70°F and the incoming air was slightly above 59°F. This worked without postheating because we used a soft fabric duct with many small holes to distribute the air with rapid entrainment of room air to prevent drafts.

The classroom was equipped with energy meters to measure the energy used by the ventilation system and the heat pump, and Onset Computer Hobo data loggers to track classroom temperature and relative humidity, as well as carbon dioxide (CO₂) levels as a surrogate for indoor air quality. We also

We asked the School District voters to approve a warrant article to fund what we called the Prototype Classroom, as a model of what we might achieve across the entire school in years ahead.

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kept close contact with the room's users. The differences, both measured and experienced, were profound. The room was dramatically more comfortable, quiet and well-ventilated than its counterparts. Relative humidity was in the comfort zone of 30-35 percent, much higher than the rest of the school. CO₂ levels during occupancy were usually in the 1,000 – 1,200 ppm range. After hours teacher meetings tended to gravitate to the Prototype Classroom because it was quiet and comfortable. We noted that even though the temperature was set back over the weekends, the Prototype Classroom cooled much more slowly than other rooms.

The measured data showed that the heating cost per square foot for the Prototype classroom was about 90 percent less than the rest of the school! From Jan. 8 through June 18, the heat pump used 347 kWh during a period consisting of 3,576 heating degree days, slightly below half of a typical heating season. The lights averaged 2526 hours on per week, and the ERV averaged 33 run hours weekly. Total annual energy usage for heating, cooling, ventilation, lighting and plug loads was projected to be under \$0.30 per square foot annually. It appeared that the Prototype Classroom could achieve Zero Net Energy – all energy used annually offset with onsite renewable energy – with a two kilowatt solar electric system. If we imagine extending these savings to the rest of the Plainfield School, it's possible this school could achieve Zero Annual Net Energy with a 75-100 kilowatt solar electric system, costing perhaps \$350,000 to \$450,000. This seems like a big number, yet compare this to an annual energy cost of about \$80,000 for the school—a number that no one believes is likely to go down in the future.

Based on the success of the Prototype Classroom, the Facilities Committee and the School Board went back to the voters in March of 2010 for a \$275,000 bond to extend the Prototype Classroom approach to the balance of the 1989 building in summer of 2010, a total of about 8,000 square feet. The bond vote was passed with 77 percent voting in favor.

This project included a portion of flat roof building, providing an opportunity to remedy an improperly pitched roof that had leaked water into the building for 20 years. Because of the previous reluctance to add insulation to the flat roofs, we included funds to have a structural



A WORK CREW DELIVERS A HIGH-EFFICIENCY WINDOW TO BE INSTALLED IN A RESIDENTIAL DEEP ENERGY RETROFIT PROJECT IN UPSTATE NEW YORK. PHOTO CREDIT: US DEPT. OF ENERGY.

There are commonalities about how we approach these projects, and the techniques and processes used are converging at the same time that new products and systems continue to appear.

engineer review the entire steel structure and recommend needed upgrades. Some beams required a certified welder to weld additional steel plate on the bottom, which we did in some instances. The portion of flat roof that was part of the 1989 wing upgrade received 12-inch-thick stress skin panels with an EPS core (which provided an overhang for the added wall thickness below) and a tapered foam layer above to properly pitch the roof to drains.

The mechanical system for the rest of the wing was a roof mounted, eight-ton Mitsubishi Hyperheat with 11 indoor zones, plus a slightly larger ERV, the EV300, from Renewaire. At this point in 2015, almost the entire school, save the gym, has been super-insulated and retrofitted with heat pumps and ERVs. The oil boiler and underground oil tank are gone, and the gym is being heated by modular propane boilers. Electrical usage has not increased with the switch to heat pumps, holding steady at about 160,000 kWh/year, along with 4,500 gallons of propane. It has a 100 rating from the EPA Energy Star program, up from 33 when we began.

The example of the Plainfield School DER is garnering attention due to its radical energy savings, but focusing only on energy loses sight of the integrated solution that addressed energy, noise, air quality, moisture, durability and comfort together. The approach used was accomplished in phases, as the town could afford it. A key benefit is that Bill Knight, the Facilities Director, acted as the construction manager for the project and hired local builders and tradesmen to implement the work. This kept the spending local, while dispersing

the skills and knowledge and enthusiasm to do more DERs in our community. The educational value for the students is immense, and the performance has become a source of pride in the town. People's understanding of what is possible has been greatly expanded. A community has come together to upgrade its school and secure its benefit to the town for the future.

We can do this all around the NESEA region, too, upgrading our existing buildings, and building new ones to meet similar high-performance standards that ensure a long and beneficial service life to our community. At this point, we have numerous examples of both homes and nonresidential buildings in which dramatic energy reductions, as well as significantly improved comfort and air quality, have been proven. There are commonalities about how we approach these projects, and the techniques and processes used are converging at the same time that new products and systems continue to appear. The BuildingEnergy Master Series Deep Energy Retrofit online course pulls all this hard won knowledge and experience together in one easy-to-understand, self-paced, interactive course. I hope you can join us! 🌱

ABOUT THE AUTHOR

Marc Rosenbaum, of South Mountain Company, is well known in NESEA circles as one who never lets ignorance stand in the way of expressing a firmly held opinion. He is a long time student of making good buildings and continues to be amazed that his clients put up with him.


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AVOID THE TRAPS (TRANSPORTATION RELATED AIR POLLUTIONS) AND SAVE ENERGY

BY JIM NEWMAN,
WITH THANKS TO
CONTRIBUTORS
DR. DOUG BRUGGE
AND WIG ZAGMORE

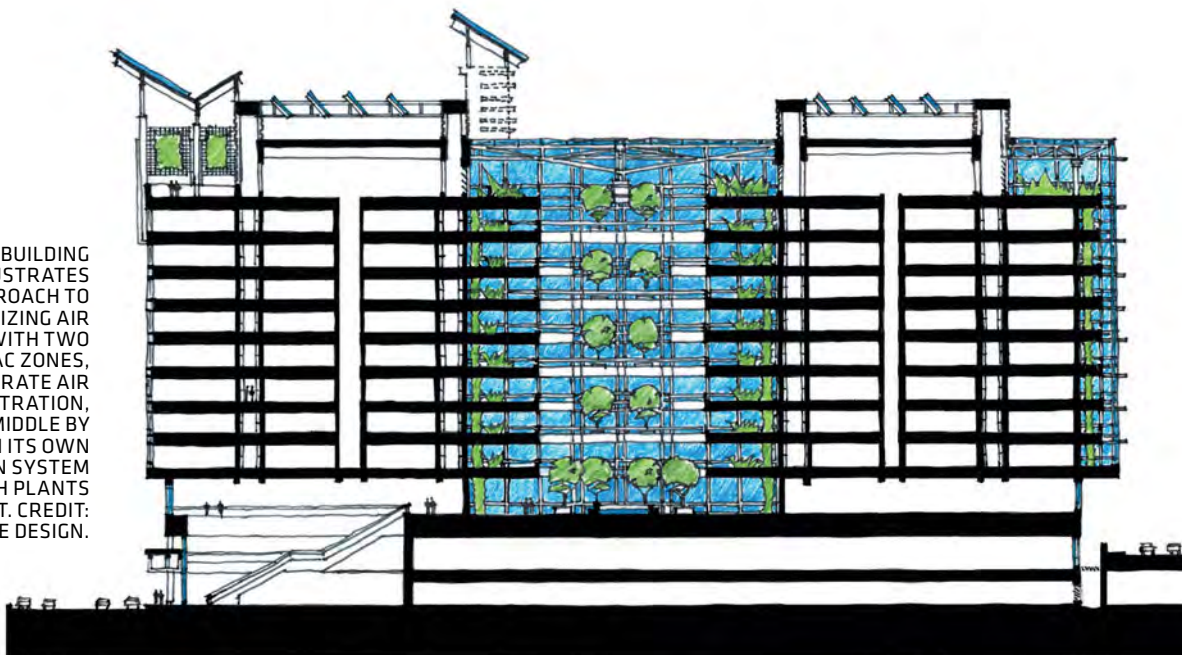
Community Assessment of Freeway Exposure and Health (CAFEH): Even the name of the project says enough to get your attention. The goal of this project, run out of the Tufts School of Public Health and the Tufts University Department of Civil and Environmental Engineering, with important help from the Somerville Transportation Equity Partnership and the Chinese Progressive Association is to help people be healthier... especially in the face of pollution loads from roads and vehicles. We know that living near a freeway can be detrimental to human health. We also know that a large percentage of poorer and more vulnerable families live or learn very close to freeways. This work aims to help our most vulnerable people living and playing near freeway pollution.

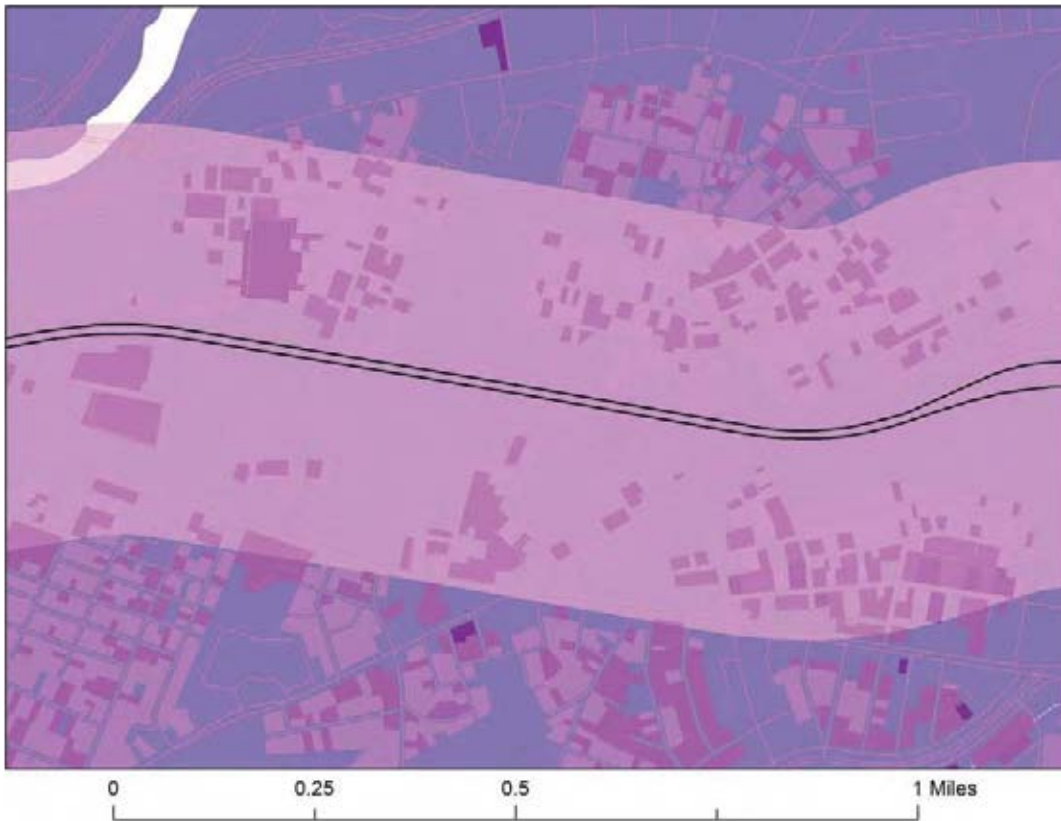
THE SCIENCE OF NEAR-FREEWAY AIR POLLUTION

Particulate Matter (PM), like what shows up in pollution near freeways, comes in different sizes; coarse PM is 10 microns or smaller, fine PM is 2.5 microns or smaller, and Ultrafine Particles (UFP), which CAFEH is studying, are 0.1 microns or smaller. There is a large body of scientific literature about the health effects on fine PM that include strong evidence of associations with cardiovascular disease, lung cancer, asthma and lung function. Coarse and fine PM are currently regulated by the Environmental Protection Agency (EPA); UFP is not regulated.

The strong evidence base for health hazards from fine PM suggests we should also be concerned with UFP since they are included in fine PM but

THIS BUILDING SECTION ILLUSTRATES ONE APPROACH TO MAXIMIZING AIR FILTRATION, WITH TWO ENCLOSED HVAC ZONES, WITH SEPARATE AIR INTAKES AND FILTRATION, JOINED IN THE MIDDLE BY AN ATRIUM WITH ITS OWN VENTILATION SYSTEM AND FILLED WITH PLANTS AND LIGHT. CREDIT: GIAMPORONE DESIGN.





MANY URBAN AREAS HAVE FREEWAYS IN CLOSE PROXIMITY TO DENSE RESIDENTIAL NEIGHBORHOODS, LEADING TO HIGH LEVELS OF EXPOSURE TO ULTRA FINE PARTICULATE POLLUTION FOR RESIDENTS THAT LIVE WITHIN THE 500 FOOT BUFFER ZONE AROUND THE FREEWAYS. PHOTO CREDIT: DIAGRAM BY JOHN GRAVELIN, LINNEAN SOLUTIONS.

show different behavior. For example, the presence of UFP is elevated near major roadways and highways, while fine PM is spread more evenly across large metropolitan areas.

The CAFEH project is a series of ongoing scientific investigations into pollution exposure levels and health effects for people living near freeways in Somerville and Boston. Through this study, we have learned some important lessons. (See sidebar)

CAFEH recruited about 700 participants, some living near Interstate 93, and other farther away, to measure the risk of adverse health impacts caused by TRAP. In order to include people with different levels of exposure to UFP, some participants lived near Interstate-93 (I-93) and others lived further away from it. Of these 700 participants, about 450 provided blood samples. The conclusion from this study is that UFP are associated with biomarkers which, in turn, are associated with cardiovascular disease risk.

INTERVENTIONS FOR HEALTHIER PEOPLE

The goal of the second part of the CAFEH project (funded by the Kresge Foundation), and that led to the session we will offer at BuildingEnergy 16, is to influence both projects and municipal policies to reduce exposure to UFP near highways and busy roadways in Somerville and Boston and improve human cardiovascular health. This article is part of the dissemination of CAFEH's earlier work, with the intent to spur changes in other near highway communities and other projects. The upcoming BE16 presentation is designed to engage a multi-

10 LESSONS ABOUT TRAFFIC RELATED AIR POLLUTION (TRAPs)

- 1. VEHICLES ON HIGHWAYS EMIT HIGH LEVELS OF GASES AND PARTICLES.**
Consider both gases and particles
- 2. TRAPS BEHAVE IN DIFFERENT WAYS.**
Interventions should be for specific pollutants of concern
- 3. HIGHWAY TRAFFIC PATTERNS ARE PREDICTABLE.**
Consider the 'worst case' for estimating pollution exposure
- 4. WIND DIRECTION AFFECTS EXPOSURE.**
Locate interventions relative to predominant wind direction
- 5. WIND SPEED AFFECTS EXPOSURE.**
Size interventions appropriately
- 6. DISTANCE FROM HIGHWAYS AFFECTS EXPOSURE.**
Site interventions appropriately
- 7. TIME OF DAY AFFECTS EXPOSURE.**
Consider the 'worst case' in terms of diurnal effects
- 8. TIME OF YEAR AFFECTS EXPOSURE.**
Consider the 'worst case' in terms of annual effects
- 9. TRAPs CAN PENETRATE INSIDE BUILDINGS.**
Consider airflow patterns for near-highway buildings
- 10. EXPOSURE TO TRAPs CAN BE ESTIMATED.**
Be quantitative in your thinking!

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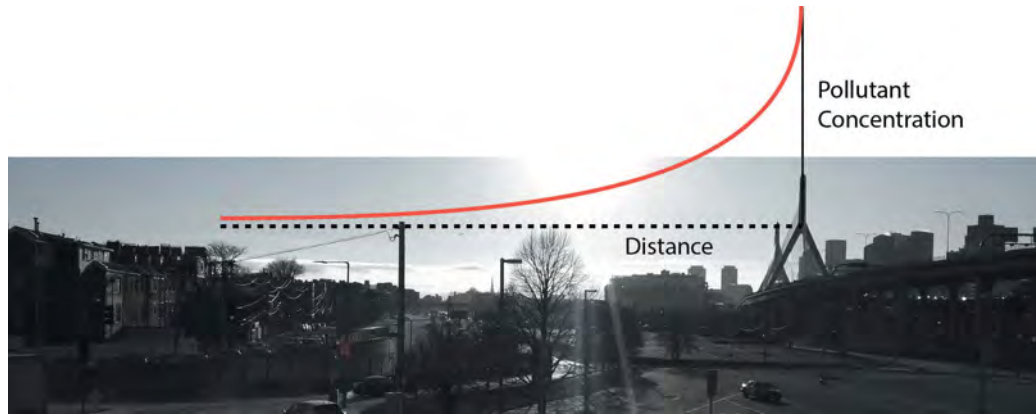


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MEASURED ULTRA FINE PARTICULATE LEVELS NEAR I 93. MEASUREMENTS BY CAFEH PROJECT TEAM. PHOTO CREDIT: DR. JOHN DURANT AND DR. ALLISON PATTON.

disciplinary group of attendees in a conversation in which the group first learns about near highway pollution, health effects, and possible mitigation solutions, and then explores design ideas aimed at real locations and real problems in our communities specifically considering air filtration as a highly effective mitigation strategy.

EFFECTIVE FILTRATION: WHAT DOES THAT MEAN?

Air filtration is an effective method for improving indoor air quality with reductions of PM and UFP of up to 50-90 percent (excluding indoor sources). Filters for residences and schools near busy roadways should be Minimum Efficiency Reporting Value (MERV) 14 or above, mainly because

the ultrafine particle removal efficiencies of filters with lower MERV ratings are not reported. Although existing standards are variable, a higher MERV rating seems to be preferable, as long as the unit meets noise requirements. Filters with electrostatic precipitation need to be carefully evaluated prior to use to avoid removing particulate pollution at the expense of increased ozone levels. Maintenance is also important for maintaining the removal of any filtration system.

However, the real question is how to design and detail highly efficient filtration systems in both new and existing buildings with an eye to minimizing energy efficiency losses. Beginning to answer this question is the main goal of the BE16 presentation. There are a large number of buildings that

Pollutant Map: PNC (1/16/2008 6:00AM to 7:00AM)



ULTRA FINE PARTICULATE POLLUTION CONCENTRATIONS GO UP DRAMATICALLY AS YOU GET CLOSER TO HEAVILY TRAFFICKED ROADWAYS. PHOTO CREDIT JOHN GRAVELIN.

are either one-to-three family residential, multi-family residential, or schools that are within 500 feet of either freeways or other heavily trafficked roadways. How can we best protect the inhabitants of these buildings? Can we protect people while reducing energy use? These are the big questions for BE16 attendees. 🌍

ABOUT THE AUTHOR

Jim Newman transforms complex environmental performance information into valuable tools for decision-makers. His experience includes over two decades in strategic planning and operational efficiency management with educational institutions and real estate firms. As Director of Strategy and Business Development at BuildingGreen, LLC – the ‘go-to’ green building resource for North America – Jim was a driver of green design into the standard practices of design and construction firms. He led the development of the BuildingGreen Suite, through funding from NYSERDA, and a research and writing project to create Green Guideline Specifications, funded by EPA. Jim also led the development of the recently launched LEEDuser information resource. Jim serves on the Boards of the USGBC Massachusetts Chapter and the Green Resources Institute. He is a regular speaker at numerous conferences and seminars around the US, including SXSW Eco. Jim was educated at Lehigh University and the Massachusetts Institute of Technology (MIT).

ABOUT THE CONTRIBUTORS

Dr. Doug Brugge is professor in the Department of Public Health and Community Medicine at Tufts University School of Medicine in Boston, Massachusetts. Dr. Brugge leads the CAFEH project and oversaw the community charrette that led to this presentation and article.

Wig Zagmore is at the Somerville Transportation Equity Partnership in Somerville, Massachusetts. Mr. Zagmore is an urban planner and developer who has worked tirelessly as an advocate for transportation equity, and was a key instigator of the CAFEH project, as a community advocate.

The real question is how to design and detail highly efficient filtration systems.

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HIGHLIGHTS: LARGE BUILDINGS AT BUILDINGENERGY 16

CONFERENCE CRITICAL FOR BOTH RESIDENTIAL
AND COMMERCIAL PROFESSIONALS

A key feature of all these sessions is that BE speakers know the details and share their failures, and successes.

BUILDING SCIENTIST AND EDUCATOR, TERRY BRENNAN, PRESENTING AT BUILDINGENERGY 15 ON THE TOPIC "H₂-UH-OH: MOISTURE RISKS AND HOW TO MANAGE THEM. PHOTO CREDIT: MATT CAVANAUGH.



BY MATT ROOT

BuildingEnergy Boston has the reputation of being a residentially focused conference. Given NESEA's roots of solar installers and single family home builders this image is understandable. However, we have long since expanded to larger buildings, or as one session this year focused on net zero energy put it, to projects that are "bigger than a breadbox." Attending this conference has become a critical experience for commercial and institutional professionals committed to improving the end product they deliver and as a result work on bigger and better projects in the future. More and more owners, developers, and building operators want better buildings, and BuildingEnergy Boston is

there for them. To meet the growing interest, a crack team of practitioners, possessing an extraordinary knowledge base around sustainability, is willing to share their experiences and expertise.

The name of the conference maybe BuildingEnergy, but it is not only about energy. People need buildings that are healthy, comfortable, low maintenance and beautiful. Three of these concepts are deeply intertwined with energy. (As for the fourth, be careful which NESEA member you ask, as beauty is definitely in the eye of the beholder). These concepts apply to **all** buildings types and NESEA members have time-tested expertise to improve building performance for all types of projects. Attendees at BuildingEnergy benefit

CONTINUED ON PAGE 41



Net Zero Passive House: Guilford, CT

Cayrn B. Davis Photography

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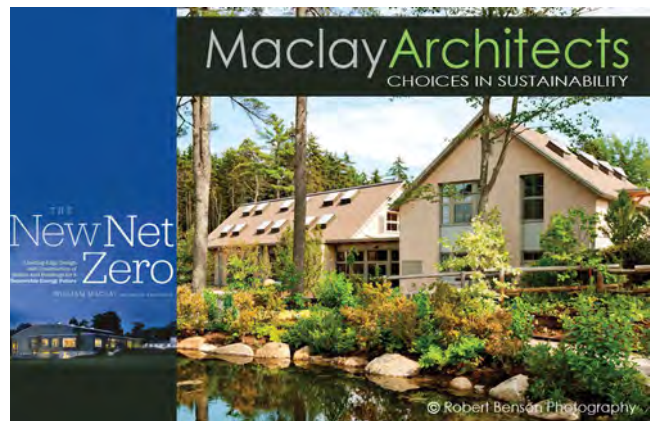
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CONTINUED FROM PAGE 39

from this experience. They learn critical design and construction strategies that successfully achieve the goal of a better building, and also find products on the trade show floor to serve as tools for even greater performance.

One of the greatest draws is the community. I do not emphasize this aspect in a Kumbaya way. I use the word in the framework of a professional network that is committed to excellence. No single person can know everything that must be done to make a job successful. We all need trustworthy partners with different skill sets who are committed to building better buildings. That community is at BuildingEnergy, and grows incredibly over the course of the three days.

Net Zero Energy (NZE) is a hot topic, and as a general concept, seems relatively easy, but if it were that easy, everyone would be doing it. Multiple sessions this year are addressing NZE in commercial buildings. I am excited about these sessions because they are delivered by practitioners struggling with the same issues I am struggling with in my projects:

- **“The Challenges of Net Zero Energy When It’s Bigger than a Breadbox”** will employ a case study of a 190,000-square-foot public school to explore what worked, what didn’t, and why.
- **“Getting to Zero: User Engagement in Achieving Net Zero Energy Buildings”** will address how design teams can include occupants to drive down energy consumption and support the NZE target.

- **“Aiming at Zero: The Struggle to Get There”** will focus on process and an iterative planning and design approach applied at two academic institution projects.
- **“Instructions NOT Included: lessons learned operating zero net energy”** will use real data from measurement and verification reports on a NZE bank branch to show how to create a highly functional facility management partnership.

A variety of commercial building Passive House projects are in this year’s lineup as well, ranging from a 27-story multifamily building to a school dining hall. Beyond these in-depth dives on two projects, a strong group of seasoned Passive House

THESE PICTURES FROM BUILDINGENERGY 15 STRUGGLE TO CONVEY THE DEEP SENSE OF PROFESSIONAL COMMUNITY, CAMARADERIE, AND HONESTY THAT DEFINES NESEA’S CONFERENCE + TRADE SHOW. PHOTO CREDIT: MATT CAVANAUGH.



An individual building represents only one small dial to turn to affect our impact on the environment, whereas a city represents a collection of many and much larger dials.

professionals will be gathered to discuss a wide variety of their non-single family home projects.

The theme of materials is also again well represented at this year's conference.

- **“Cradle to Grave: The Concealed Energy, Carbon and Water Impact of Buildings”** will explore the great opportunity to improve sustainability by expanding our lens to go beyond operational consumption and look at building lifecycle: material production, transport, construction waste, maintenance and disposal.

To further deconstruct the BuildingEnergy conference title, the conference is not limited to just “Buildings” either. Attendees will also learn how to build stronger communities, plan for future disruptions and understand the concept of resiliency.

- **“Buildings Are Not Enough: An Introduction to High-Performance Cities and the Next Step”** is a session that will expand our thinking beyond the lot line. Buildings work in the context of a network and this session will go beyond “high performance buildings” to “high performance municipalities.”
- **“Mainstreaming Resilience: Making Resilient Design Part Standard Practice”** will focus on resilient design in building codes, zoning bylaws, and voluntary building rating systems.

Of course, there will also be perennial speaker power houses like John Straube and rising stars

like Andrea Love. This year John is speaking on **“Air Tightness Testing in Large Buildings.”** He will review why one would invest in airtightness testing for a large building, how the testing is done, how the results are interpreted, and how this information can be used. Andrea will be following up on John's session from last year, **“Installing Commercial Windows and Curtain Walls without Thermal Bridges, Air or Water Leaks”** and speaking on thermal bridges in commercial and institutional enclosures in a session called **“Break it or Lose it.”** In this session Andrea and her co-presenter, Jeff Abramson, will present findings from a research study that sought to quantify the impacts of thermal bridges in recently completed buildings and then go on to present alternatives to the industry standards that enhance performance.

A key feature of all these sessions is that BuildingEnergy speakers know the details and share their failures, and successes. We learn best from mistakes and from those who have already gone through the growth of a hard lesson so that others don't have to. There is a lot of great commercial and institutional content delivered by leading experts who share with refreshing honesty so that all in the field might improve. I hope to see you there. 🌐

ABOUT THE AUTHOR

Matt Root is a senior project manager for CLEAResult where he leads a multi-disciplinary team of mechanical engineers, enclosure experts, and building scientists. Matt's Building Performance Consulting group provides a range of services including mechanical and enclosure assessments, design support, construction quality control, commissioning, and performance testing, all with the goal of achieving high performance buildings: healthy, durable, and energy efficient. Matt served as the conference chair for BuildingEnergy 15. He holds M.S. and B.S. degrees from Brown University in mechanical engineering.

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BUILDINGGREEN ANNOUNCES TOP 10 PRODUCTS FOR 2016

BY BRENT EHRLICH AND
ALEX WILSON

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THE AUTHORS UNVEILING THE PRODUCTS LIST AT THE
2015 GREENBUILD CONFERENCE IN WASHINGTON, D.C.
PHOTO CREDIT: STEPHEN DOTSON.

Reducing greenhouse gas emissions, conserving energy and water, and seeking durable, safe materials: for 14 years, BuildingGreen has given its Top 10 Green Building Products award to products that transform the design and construction industry by helping solve these and other significant environmental problems.

Among the BuildingGreen Approved winners this year are those that save energy and reduce carbon in completely novel ways; super-efficient, innovative heat pumps used in new applications; and lighting systems that improve performance and might just transform how we wire buildings.

NESEA's friends at BuildingGreen and Environmental Building News recently released their annual products recommendations.

BuildingEnergy Magazine was there when the Top 10 was presented at the 2015 Greenbuild Conference in Washington, D.C., and is excited to share these reviews with the NESEA community.



◀ HONEYWELL SOLSTICE

Spray polyurethane foam (SPF) has impressive insulating value and air-sealing properties—yet its high global warming potential (GWP) blowing agent, HFC-245fa, will be in our atmosphere for hundreds of years, potentially cancelling out much of the carbon-emission reductions from the energy savings.

Honeywell's Solstice Liquid Blowing Agent, based on hydrofluoroolefin (HFO) technology, replaces HFC-245fa, and has a 100-year GWP of only 1—equal to that of carbon dioxide. Although introduced to the global market several years ago, Solstice is finally getting uptake in the United States and is now used by Whirlpool in its appliances, by Lapolla in its Foam-Lok 2000 4G SPF wall insulation, and by Henry-West Development Group (a Henry subsidiary) in its 3012-EB-3 SPF roof insulation.

Made in the U.S., Solstice Liquid Blowing Agent also provides a significant performance benefit over foams made with HFC-245fa, including a 10 percent to 12 percent increase in foam yield, better compressive strength, and up to a 10 percent increase in thermal performance. Variations of Solstice are also being incorporated into rigid foam board insulation and as refrigerants, aerosols, and solvents.

WHIRLPOOL HYBRIDCARE ▶ VENTLESS CLOTHES DRYER

Most U.S. residential clothes dryers use decades-old electric-resistance heat with tumble-dry technology that vents excess heat and moisture outside, carrying conditioned air from the building at the same time.

Whirlpool's HybridCare ventless heat-pump dryer uses heat-pump technology to significantly improve the energy efficiency, and a refrigeration loop that condenses moisture from the drum and returns the excess heat energy to the process. HybridCare is gentle on clothes and does not require a vent—saving HVAC energy, eliminating the risk of fire, simplifying installation, and expanding placement options. (Condensate is drained using the same drain line as the washer.)

In order to improve the drying time to match U.S. wash-cycle times and capacity, the 7.3 ft³ HybridCare has a 1,300-watt booster heater to supplement the heat pump with three settings: Speed mode (50–60 minutes), Balance mode (60–70 minutes), and Eco mode (70–85 minutes). In Eco mode, it provides 40 percent energy savings over a standard dryer, according to the manufacturer.





SLOAN HYBRID URINAL ▲

Waterless urinals can save significant amounts of water compared with standard flushing urinals, but they also have a reputation for odor and maintenance problems, limiting their adoption. Sloan's Hybrid Urinal (with technology developed by Falcon) may just change that by using a redesigned water-free cartridge and incorporating an automatic rinsing process that prevents mineral buildup while minimizing odor and maintenance issues.

Without regular cleaning, mineral buildup from urine in waterless urinals can clog cartridges and plumbing, but the Velocity cartridge accelerates liquid through the unit and out the drainpipe, reducing opportunities for this buildup. This redesigned cartridge uses 20 percent less plastic and has no voids where bacteria and odor can form. An indicator panel turns from blue to clear so maintenance staff can see when it needs changing (typically after 7,000 uses, or three months).

What makes Sloan's Hybrid a hybrid, and unique to the industry, is the addition of supplemental water, called "Jetrinse Solution Technology." This feature uses a vigorous, one-gallon, pre-programmed rinse every 72 hours that keeps solids from forming in the housing and drain line, essentially eliminating mineral buildup problems throughout the system. It consumes only about 100 gallons a year, no matter how many uses. (The water doesn't go through the urinal itself, which still needs to be wiped down separately.) The Hybrid is available in three models and is comparable in cost to a mid-tier electronic flushometer model, according to Sloan.

GUNLOCKE SAVOR GUEST CHAIR WITH ECOVATIVE MYCOBOARD BACKING ▼

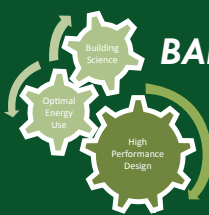
Office furniture manufacturer The Gunlocke Company uses MycoBoard – an engineered-wood alternative made from mushroom mycelium (roots) – in its Savor guest chair. Standard plywood or particleboard backing materials typically use synthetic, formaldehyde-based adhesives, but MycoBoard is grown using interlinking mycelium (think of this as mushroom roots) and agricultural waste; it contains no other binders. The board is dried and molded under heat and pressure (killing the mycelium) into an extremely strong, stable material that is not only biobased but also Cradle to Cradle Gold-certified and Living Building Challenge Red List-free.

Though Ecovative's mycelium-based products have been used for shipping and other applications, Gunlocke is the first commercial furniture company to use MycoBoard in a product, and its use is not a marketing gimmick. The material was chosen over plywood that was expensive and prone to splitting; but MycoBoard will not split, is naturally flame resistant, has almost no production waste or hazardous emissions, and can be composted at the end of its lifespan.

Most importantly, it is also cost competitive. The Savor guest chair achieved SCS Indoor Advantage Gold and can be ordered with Forest Stewardship Council-certified wood and without added flame-retardant chemicals.



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◀ DUO-GARD BIKE RACKS AND SHELTERS

The energy consumed by employees commuting to work by car often exceeds building energy use, which is one of the reasons LEED offers points for alternative commuting. Using a bike to get to work is one of the easiest – and healthiest – ways to lower a building’s overall carbon footprint. Yet

bike racks used to help achieve these points are favorite targets of green building critics, who see them as frivolous accessories.

That’s one reason the LEED rating systems have evolved over the years to require high-quality, well-placed bike storage: encouraging employees to commute by bike requires secure facilities for storing these expensive, and often beloved, bikes. BuildingGreen is honoring Duo-Gard for offering a wide range of bike storage systems and being a pioneer in the development of secure shelters that protect bikes from weather, theft, and vandalism.

Duo-Gard provides standard bike racks as well as partially and fully enclosed models, but the company also works with architects to design custom units that are incorporated into buildings. These shelters are available with roofs made from standing-seam metal or polycarbonate, and with walls made from polycarbonate, safety glass, perforated metal, or steel or aluminum mesh. Photovoltaic panels and LED lighting can also be incorporated into some models.

► NULED POWER OVER ETHERNET (POE) LOW-VOLTAGE LED LIGHTING

High-efficacy LED lighting is becoming the norm in many commercial buildings, but these systems use standard high-voltage wiring that is expensive to install and modify. The alternating current (AC) also has to be converted to direct current (DC) for use by LEDs, which limits efficiency and connectivity, and can cause flicker and other performance problems.

NuLED’s Power-over-Ethernet (PoE) LED lighting system uses low-voltage (DC) Cat 5 or Cat 6 Ethernet cables – the kind that connect to your computer – to carry both power and data to LED lighting.

NuLED’s system uses DC power from a standard PoE network and runs it through the company’s SPICEbox control module, which serves as a host for the LED lighting, controls, wall switches, and sensors. Up to 60 watts for lighting and data can be carried over low-voltage cable that creates a “plug-and-play” system that is safe, simple, and inexpensive to install and modify, often without electricians. And it can potentially provide better connectivity to HVAC, daylighting, and a variety of other building systems.

The system can monitor and control LED power consumption, color temperature, and dimming, and can connect to renewable DC power supplies directly, with less energy loss than standard AC systems. And because the system is DC, it offers better dimming and color control without a driver or other electronics interfering with LED performance.



► PERSONAL COMFORT SYSTEMS HYPERCHAIR

Since we all have different metabolisms and comfort levels, a large percentage of people are often uncomfortable in buildings, where thermostats are set at one temperature, and where there are cold and hot spots near windows or along building perimeters.

Maintaining a specific office temperature also requires the HVAC system to cycle on and off, wasting energy. You can keep the HVAC system from coming on by raising or lowering the temperature, depending on the season, but how do you do that while keeping employees comfortable and productive?

Personal Comfort Systems’ Hyperchair addresses these problems by providing personal heating and cooling that helps minimize the use of less-efficient central HVAC systems.

Developed at the University of California–Berkeley as the end result of more than six years of research into occupant comfort and energy savings, the Hyperchair office chair includes a heating element and a fan that draw 16 and 4.8 watts, respectively, along with sensors that can wirelessly connect to central HVAC systems. The heating and cooling are powered by a lithium ion phosphate battery and controlled by a small panel on the arm of the chair.

Use of the chair expands the temperature range at which HVAC is not operating, for energy savings from 7 percent to 15 percent for every degree centigrade above or below the normal setting, all while improving occupant comfort. Additional savings could be obtained in demand-response applications since the battery charges at night, when electricity costs may be lower. The chair could be particularly useful where there are slow-responding HVAC systems or naturally ventilated spaces.



UNITY HOMES HIGH-PERFORMANCE PANELIZED HOMES ▶

Most single-family and multifamily homes are still stick-built onsite using minimal insulation, poor air sealing, poor quality control, inefficient HVAC systems, and unsustainable materials. Unity Homes is changing that paradigm with its high-performance panelized home system.

These homes are shop-built to the highest quality standards using materials that are milled with computer numeric control (CNC) equipment to help create panelized wall systems and "pods" (small prefab modules used for bathrooms, mechanical rooms and kitchens) with tight seals, minimal thermal bridging, and superb moisture management. The walls are insulated with cellulose to R-35, and roofs are insulated to between R-38 and R-44. Other energy-saving features include triple-pane low-e windows, custom-built insulated doors, mini-split heat pumps, HRV/ERVs for fresh air, and heat-pump water heaters—making it easy for a baseline Unity Home to meet net-zero with onsite renewables. While already minimizing material waste and operating energy, the company is also evaluating its materials in hopes of minimizing embodied carbon and other embodied impacts in the future.

Unity Homes also uses FSC-certified wood and low-VOC finishes and adhesives, yet can still offer significant cost savings over site-built homes. And though Unity Homes are built in a shop, there are four design platforms that can be customized using sophisticated CAD-CAM technology, with multifamily and "tiny" house options in the works.



NESEA TOURING THE UNITY HOMES PRODUCTION FACILITY AS PART OF A BUILDINGENERGY PRO TOUR. PHOTO CREDIT: STEPHEN DOTSON.

TESLA POWERWALL AND POWERPACK ONSITE ENERGY STORAGE ▼

The use of renewable energy is increasing at a dramatic rate, but the vast majority of grid-tied photovoltaic (PV) systems are not optimized to take advantage of this energy. They cannot store power for daily use and don't have backup systems, which limits their function and makes buildings vulnerable to power outages. Storing electricity to minimize use of utility power (and their environmental problems) or maintain functionality in the event of an outage have been challenges that limit wider adoption of PV, with current storage methods relying on complicated, difficult-to-integrate systems, most of which use toxic lead-acid batteries.

Tesla's Powerwall and Powerpack signal a significant evolution toward more resilient solar-electric systems and offer the prospect of mainstream adoption. A number of large partners, including SolarCity, plan widespread use of them with residential solar installations, and several utility companies, such as Vermont's Green Mountain Power, plan to adopt them to support a transition away from unsustainable fuels.

Powerwall is a rechargeable lithium-ion battery system used with renewable energy systems. It incorporates liquid thermal management, battery management, and a smart DC-DC converter for controlling power flow between an DC-AC inverter and the battery. There is a 10 kWh unit optimized for weekly/backup use (such as power outages or off-grid use) and a 7 kWh unit for daily use (such as providing PV energy at night),

and they can be combined into systems with total storage of 90 kWh (using 10 kWh models) and 73 kWh (using 7 kWh models).

The company's Powerpack system is intended for commercial, utility, and industrial use, with 100 kWh turnkey systems that can be scaled all the way up to more than 100 MWhs. These units can be used to increase renewable power capacity on the grid, maximize onsite solar use, or provide backup power for critical systems, but they also give companies the flexibility to purchase power at its lowest cost and avoid peak demand charges.





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SANDEN HEAT PUMP WATER HEATER WITH CO₂ REFRIGERANT

Standard heat pumps use hydrofluorocarbon (HFC) refrigerants such as R410a, which has a 100-year global warming potential (GWP) greater than 1,700. Though they work well, these refrigerants also typically do not create water temperatures high enough for hydronic heating. Sanden is now offering a residential heat-pump water heater that uses CO₂ (GWP of 1) as the refrigerant and can deliver water hot enough for domestic hot water, and even for hydronic heating in energy-efficient homes.

Available in Japan for several years, Sanden's CO₂-based heat pump is coming to the U.S. in 2016. Using low-GWP CO₂ as a refrigerant, this 4.5 kW model produces high-temperature water with very efficient heat transfer, very little pump energy, and good cold-weather performance. It is capable of delivering approximately 16,000 Btu/hr and can produce 149°F water with outdoor temperatures as low as -15°F.

Compared with other heat pump water heaters, the Sanden water heater is a split system, so it doesn't lower the air temperature in the space where it is located.

The outdoor unit is paired with storage tanks of different sizes for different applications, including an 80-gallon stainless steel tank that can supply domestic hot water, and even space heating in efficient homes (a larger 11 kW version better-suited for space heating is in the works). Because of the significantly higher operating pressure of CO₂ refrigerant (compared with HFCs), the piping and connections with this product must be more rugged than that used for standard heat pump water heaters. ⚙️



ABOUT THE AUTHORS

Brent Ehrlich is the products and materials specialist at BuildingGreen, where he researches and writes about green building products, materials, and their health and environmental impacts. He also leads a team of editors who select industry-leading products for the company's green building product database. A LEED AP BD+C, he has been researching and writing about green building for nearly a decade, but has also taught college composition, copy edited science journals, worked as a carpenter, managed a large commercial kitchen, and held various other occupations. An active runner and cross-country skier, Brent now lives in Vermont with his wife and two children.

Alex Wilson served as executive director of NESEA from 1980 to 1985 and then served two terms on the Board of Directors. After leaving his position at NESEA, he founded BuildingGreen, Inc., the Brattleboro-based publisher (since 1992) of Environmental Building News, the nation's oldest and most respected publication on green building. In 2012 he launched the nonprofit Resilient Design Institute.

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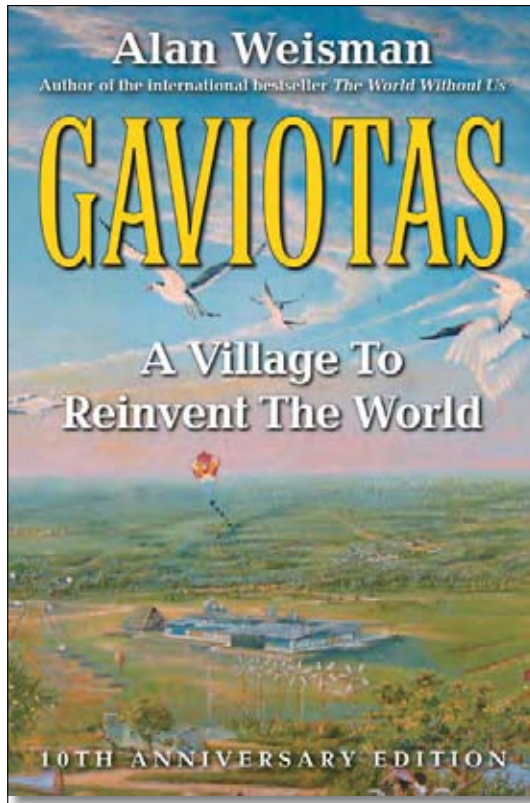
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REVIEWED BY
STEPHEN DOTSON

Years before the Living Building Challenge set requirements regarding the local sourcing of materials, Gaviotas pioneered local solutions for local problems, using the natural and human resources immediately available.



Do you agree with the following logic? If you rig an experiment to have the deck stacked against you, and still, you win, you can trust the solution you've reached is robust and resilient. If it can be done in extremely challenging situations, it must be viable in other, less disadvantaged environments, correct? This was the logic of Paolo Lugari, over 40 years ago, as he ventured out into the toxic deserts (or *llanos*) of Eastern Colombia, alongside his brother, wideeyed in search of a dream that has become the Gaviotas community since 1974. Lugari insists that, "Utopia literally means no place. We call Gaviotas a topia because it's real."

Gaviotas the village is surprising, uplifting, extraordinary. Gaviotas the nonfiction book is as compelling as a novel, as educational as a textbook, as inspirational as the biography of a great person. Lugari was determined to explore the edges of what was possible in terms of sustainable and self-reliant community development, in one of the most inhospitable places on Earth. With each success that comes through Alan Weisman's insightful study of the Gaviotas community over its first 30-plus years, the book's subtitle "A Village to Reinvent The World" becomes more and more convincing.

Years before the Living Building Challenge set requirements regarding the local sourcing of materials, Gaviotas (which translates as "the river gulls," the nickname of the local waterfowl) pioneered local solutions for local problems, using the natural and human resources immediately available.

Necessity was quite the engine for invention, as from the very beginning, simple feats for a modern community such as providing potable water, materials for building, and arable soil for growing basic foods were daunting in their enormity. Yet one by one, these obstacles fell before a concerted community effort, coordinated by Lugari, who brought in engineering, agronomic, and other experts from universities in Colombia as well as the United States.

Potable water was hard to find at normal depths in the dry llanos, so engineers fashioned a doublesleeve pump that could reach to four times the depth of a normal well pump. Then the question of how to power the pump arose, as four times the depth required more sustained force in order to flow. In perhaps one of its most creative and elegant solutions, the Gaviotans decided to harness the power of children's playfulness. They created a way for each pump be powered through a seesaw operated by the youth of that community! Doublesleeve pumps were installed not only in Gaviotas, but in rural communities throughout the country under a government program entitled, "Agua Para Todos" or "Water For Everyone".

After years of pioneering these pumping technologies along with packaging solutions that could be reused and recycled, Gaviotas now makes a significant portion of income from its bottled water, sold in recycled plastic bottles that stack and lock like legos! Ingenuity and business acumen have brought sustainability to the community's economic model with development strategies such as this.

It was once hard to find arable soil of acceptable pH, with the necessary mycorrhizal fungus growing in the substrate. Instead it was hardened, toxic, and acidic. However, after 20 years of cultivating a specific variety of Caribbean Pine, the dropped needles have decomposed and collected enough detritus to jump start a new topsoil. The last ingredient, of mycorrhizal fungus was introduced by Gaviotas scientists by dipping the roots of each new pine seedling in a bath of spores. Once they took to the soil, the fungus colonized the area and took on a critical mass that enabled the rest of the pine's growth. Twenty years later, the topsoil has created second and third miracles with the help of the pines. First, Gaviotas has established a resin industry and revenue by tapping the trees in a ongoing and sustainable way. Second, the seeds that long lay dormant in the dried crust of the llanos woke-up once covered by the topsoil generated through the maturity of the pines. After centuries, a tropical rain forest was waking up underneath the canopy of Gaviotan pines. The forest now also provides food for the community in conjunction with aquaponics operations that take advantage of their clean water resources.

Special bricks made from a combination of locally available clay, mixed with a minimal amount of cement, bagged and pressed into form were pioneered to be the literal building block of the community. After the basics were created,



AUTHOR, PROFESSOR, AND JOURNALIST ALAN WEISMAN, TRAVELLED TO COLOMBIA AND RESEARCHED GAVIOTAS FIRSTHAND TO LEARN FROM ITS SUCCESSES AND FAILURES. PHOTO CREDIT: BOB TURNHILL.



GAVIOTAS FOUNDER, PAOLO LUGARI GIVES A TOUR OF THE COMMUNITY, AND STANDS BEFORE A LARGE MURAL DETAILING THE WORK AND HISTORY OF THE PROJECT. PHOTO CREDIT: FRIENDS OF GAVIOTAS.

If you need to bolster your sense of audacity and provide inspiration to pursue the edge of what is possible, this is the right book for you.

Gaviotans immediately decided to embark on a large building project, in the form of a hospital.

The hospital was long in being developed and born, but later celebrated to great acclaim. It was the first of its kind, not simply for its design that accommodated the native Guahibo people's need to heal in an environment that was open to the outdoors, and utilized cooling techniques originally applied in desert mosques. What also garnered international attention was the willingness of the Gaviotan doctors to work with the local shamans and Guahibo people to learn of the natural remedies available in the extremely rich environment around them. Unfortunately after decades of service, it was technically decommissioned as a hospital, though research continues with the Guahibo in the area. Today it has been repurposed as a processing and packaging plant for the various industries tied to the pine resin and water generated by the community.

The people of Gaviotas today also produce other innovative technologies (solar collectors, irrigation

systems, windmills, and hydroponic gardens) that use the environment without depleting or destroying it. While some of their creative endeavors have not succeeded, even the failures tend to spawn ideas for future successes. Weisman does a fine job of detailing Gaviotas's evolution and placing it within the larger global historical context. The story he presents is wonderful testament to human creativity, commitment, and effort toward building a socially viable and environmentally sustainable future. If you need to bolster your sense of audacity and provide inspiration to pursue the edge of what is possible, this is the right book for you. It provokes thinking not in centuries instead of decades, and elaborates not only on the sustainability of applied technologies, but on the larger, and less often considered, context of the culture, materials, and other long term compatibilities that those projects need to succeed. Not just a case study, but a compelling and compassionate narrative that will keep you engaged. 🌱

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ABOUT THE REVIEWER

Stephen Dotson serves NESEA at its hub of communications, outreach, and marketing. He tries not to send you too many emails, and thrives on connecting people with opportunities to learn, grow, and help build a better future. Prior to working for NESEA, Stephen worked for a variety of non-profits, media projects, and campaigns. He is a filmmaker and videographer, and is occasionally assisted in the office by Raga, his Varlapian terrier.

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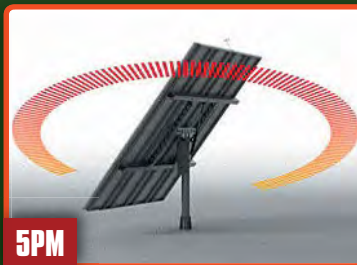
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