



VOL. 36 NO. 1 | SPRING 2017

# BUILDINGENERGY

*The Magazine of the Northeast Sustainable Energy Association*

USING WHOLE  
SYSTEMS THINKING  
IN HIGH PERFORMANCE  
DESIGN:

## THE NEW MACARTHUR ELEMENTARY SCHOOL

### ALSO INSIDE:

THE ROLE OF OCCUPANT  
ENGAGEMENT  
IN ACHIEVING  
NET ZERO ENERGY

TURNING ENERGY  
GOALS INTO REALITY:  
PERFORMANCE-BASED  
PROCUREMENT

BREAKING DOWN  
GENDER BIAS IN  
THE CONSTRUCTION  
INDUSTRY

*Solar Carports • RV/Boat Storage • Standard Carports*

**WE'VE GOT YOU COVERED**



**DESIGN | ENGINEER | SUPPLY | INSTALL**

**baja** CARPORTS™

[www.bajacarports.com](http://www.bajacarports.com)

**800-366-9600**

[Info@bajacarports.com](mailto:Info@bajacarports.com)



**nationalgrid**

HERE WITH YOU. HERE FOR YOU.

**We can help you meet  
clients' energy needs  
and realize your vision.**

See how to increase building  
performance at [ngrid.com/trade](http://ngrid.com/trade)

**That's business on the grid**



FOR ELIGIBLE PROJECTS within National Grid's electric and/or gas service territories in Massachusetts, New York and Rhode Island. National Grid does not guarantee savings. Savings and energy efficiency experiences may vary. Terms and conditions apply. In Rhode Island: These programs are funded by the energy efficiency charge on all customers' utility bills, in accordance with Rhode Island law.

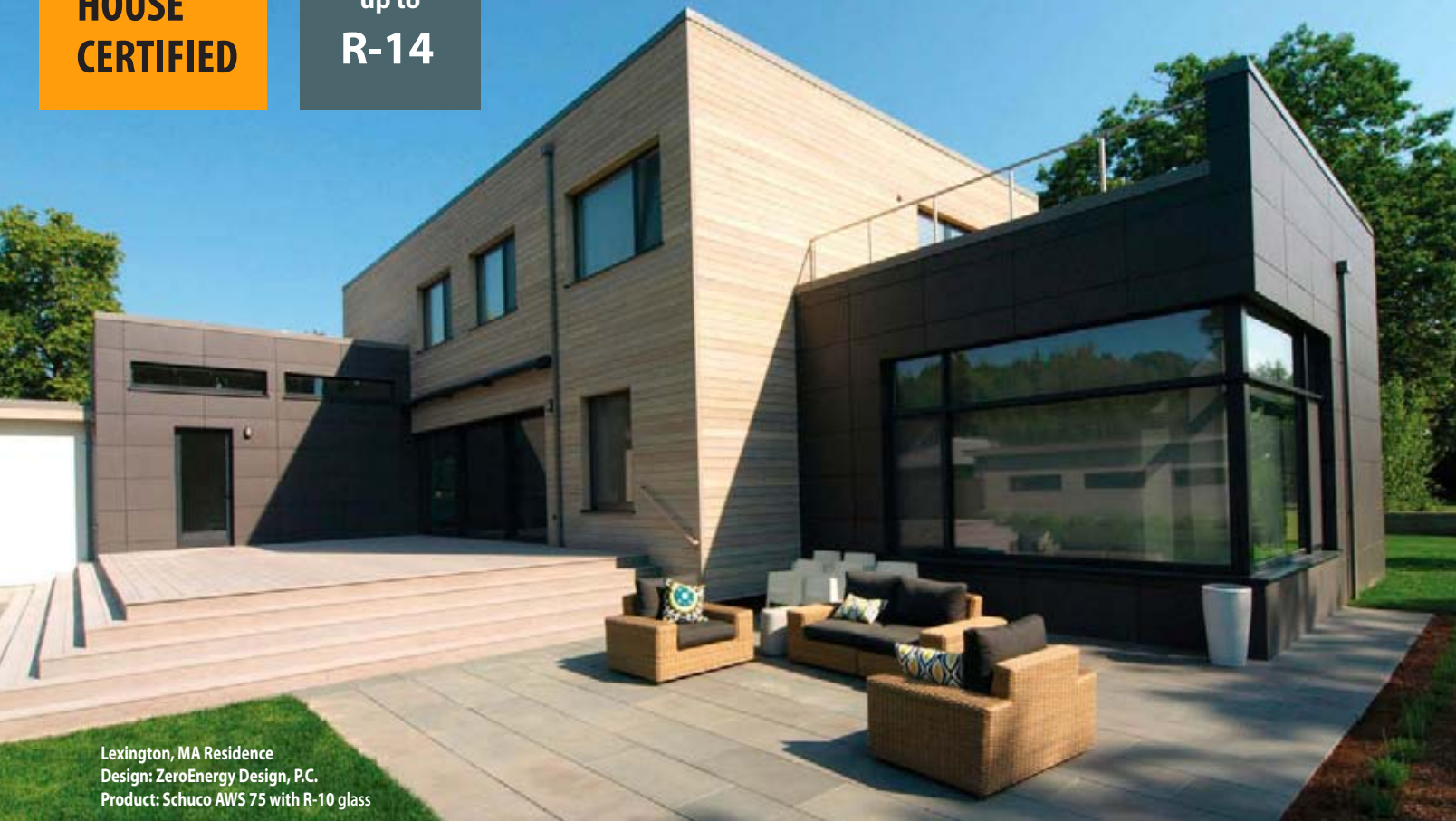
©2017 National Grid USA Service Company, Inc.



National Grid is a proud  
sponsor of Mass Save.

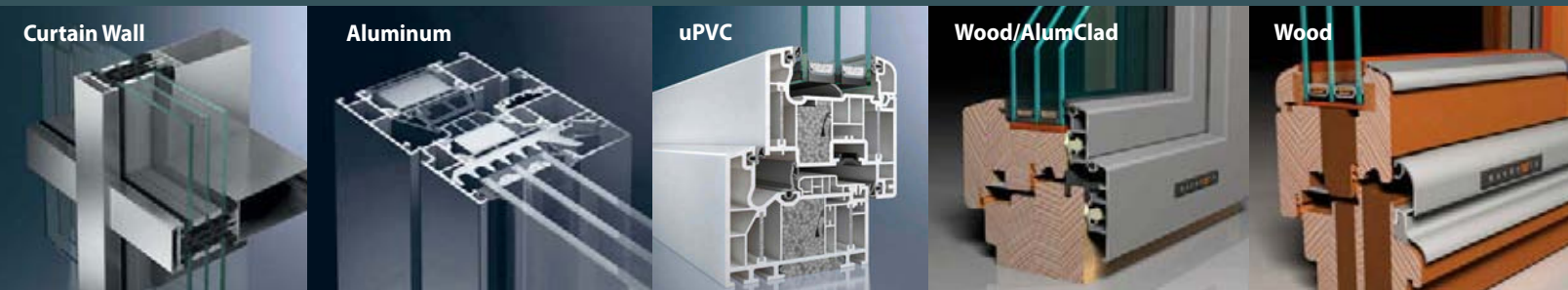
**PASSIVE  
HOUSE  
CERTIFIED**

**Glass**  
up to  
**R-14**



Lexington, MA Residence  
Design: ZeroEnergy Design, P.C.  
Product: Schuco AWS 75 with R-10 glass

## Celebrating Our 14<sup>th</sup> Year as New England's Leading Supplier of Residential and Commercial Advanced Fenestration Systems



**Window and Door Sponsor  
Winner of 2015 Solar Decathlon**



144 North Road Suite 2500  
Sudbury, MA 01776  
1.781.647.4432

[www.FineWindows.com](http://www.FineWindows.com)

SUPERVISED DELIVERY | TRAINING | INSTALLATION | SERVICE



# BUILDINGENERGY

**BUILDINGENERGY MAGAZINE**  
is published for:  
**THE NORTHEAST SUSTAINABLE ENERGY ASSOCIATION**  
50 MILES STREET  
GREENFIELD, MA 01301  
413-774-6051  
**NESEA.ORG**  
**PUBLISHER AND EDITOR-IN-CHIEF**  
JENNIFER MARRAPESE  
**COPY EDITOR**  
FLORENCE MACGREGOR



Magazine printed on 10 percent PCR, triple certified FSC, SFI and green-e paper with 70% text weight made and 70% cover.

**PUBLISHED BY**

**NAYLOR**

ASSOCIATION SOLUTIONS  
5950 NW FIRST PLACE  
GAINESVILLE, FL 32607  
P: 352-332-1252 OR  
800-369-6220  
F: 352-331-3525  
[www.naylor.com](http://www.naylor.com)

**GROUP PUBLISHER**  
MARCUS WESTON

**CONTENT STRATEGIST**  
RACHAEL RYALS

**PROJECT MANAGER**  
MIKE ROSS

© 2017 NESEA. All rights reserved. The contents of this publication may not be reproduced in whole or in part without the prior consent of the association.

PUBLISHED JANUARY 2017  
ENE-B0117/9350

COVER PHOTO CREDIT: JOHN GRIEBSCH PHOTOGRAPHY

**NESEA STAFF**  
**DIRECTOR OF PROGRAM DEVELOPMENT**  
MIRIAM AYLWARD  
**DEVELOPMENT COORDINATOR**  
ZACH BITZER  
**CONFERENCE COORDINATOR**  
SUSAN FARBER  
**DIRECTOR OF OPERATIONS**  
BETH FRASER  
**MARKETING MANAGER**  
JENNY GOLDBERG  
**IT & DATABASE MANAGER**  
ELI LISSECK  
**PROGRAM MANAGER**  
FLORENCE MACGREGOR  
**EXECUTIVE DIRECTOR**  
JENNIFER MARRAPESE  
**MEMBERSHIP MANAGER**  
KATIE SCHENDEL  
**BUSINESS MANAGER**  
GINA SIEBER

**MARKETING MANAGER**  
KAYDEE CURRIE

**ADVERTISING DIRECTOR**  
MARJORIE PEDRICK

**ADVERTISING SALES SPECIALISTS**

NATHAN BURGMAN  
ANTHONY LAND  
SCOTT MCKENZIE  
MATTHEW YATES  
CHRIS ZABEL

**DESIGNER**  
GORDON KLASSEN

## TABLE OF CONTENTS

6

### From the Executive Director

Net zero schools, cities, occupants and builders.  
*By Jennifer Marrassese*

10

### From the Board Chair

Election should unite, not divide.  
*By Michael Bruss*

12

### Using Whole Systems Thinking in High Performance Design: The New MacArthur Elementary School

Contaminated floodwaters created a total loss for this school, but with the help of federal and state funding, there was opportunity to rethink and create a new school for the 21st Century.  
*By Ed McGraw and Matthew Braderick*

22

### The Role of Occupant Engagement in Achieving Net Zero Energy

Designers, architects and engineers only have so much control over energy use. Even in a perfectly designed, state-of-the-art, efficient building, the building occupants play a large role in energy consumption.  
*By Kate Bubriski*

28

### High Performance Cities: The 2030 District Model

An update on the 2030 District, a network that has grown to 15 cities, both large and small, across North America.  
*By Megan Saunders*

34

### From Red List to ReadyList™

A detailed list of Living Building Challenge-compliant materials and the story of the three-way collaboration between architect, construction manager and materials consultant that yielded it  
*By Jonathan A. Wright*

41

### My Net Zero Conundrum

A look at net zero and why it may be time to think bigger.  
*By Jean Carroon*

44

### Turning Energy Goals into Reality: Performance-Based Procurement

Learn how the design team and contractors work together to achieve superior energy performance at the same cost as a traditional building  
*By Paul Torcellini, Connor Jansen and Dave Vigliotta*

50

### Room-Side Low-E Coating: As Good As It Sounds?

Is this technology the best solution for every project?  
*By Alejandra Menchaca*

53

### Breaking Down Gender Bias in the Construction Industry

Women, transgender and gender non-conforming people are unrepresented in the building trades. Learn how business owners and managers can recruit and support this untapped talent.  
*By Kate Stephenson*

55

### Untapped Synergies: Building Buildings that Work with their Surroundings, their Users and Themselves

We need to start building buildings for people again. Instead of "keeping up with the Joneses," let's strive to make all elements in a building usable and engage occupants in running the building.  
*By Jodi Smits Anderson*

58

### The Minergy House: A Bit of NESEA History

See what lessons can be learned from a 35-year-old home designed in the late 1970s to obtain energy efficiency.  
*By Marc Rosenbaum*

61

### Index to Advertisers / Ad.com

## 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, BuildingEnergy Pro Tours, BuildingEnergy Bottom Lines and more. To learn about NESEA member benefits, contact Membership Manager Katie Schendel at [kschendel@nesea.org](mailto:kschendel@nesea.org) or visit [nesea.org/membership](http://nesea.org/membership).



## NET ZERO SCHOOLS, CITIES, OCCUPANTS AND BUILDERS



BY JENNIFER  
MARRAPESE

PHOTO CREDIT:  
MATTHEW CAVANAUGH

**T**his issue of *BuildingEnergy* is chock-full of all things net zero, from our cover story, which features the integrated design process used to build the MacArthur Elementary School, to Kate Bubriski's article on the role of occupant behavior in net zero buildings, to Jonathan Wright's rundown of products that are "ready-listed" for Living Building Challenge projects, to the 2030 model for carbon neutral, net zero cities by Megan Saunders. We've even featured an editorial from one of our favorite contrarians, Jean Carroon of Goody Clancy Architects, querying whether net zero should really be the goal.

In keeping with this net zero theme, my letter features an interview with Reggie Lebel, President of Emerald Builders in Bowdoinham, Maine. Emerald Builders is a residential building company serving mid-coast Maine that primarily focuses on building highly energy efficient homes. When I caught up with Reggie, he was on the roof of a near net-zero home he is building in Brunswick, Maine. This interview is the first in what I hope will be a regular series of interviews with members of NESEA's BuildingEnergy Bottom Lines networks. To learn more about our BuildingEnergy Bottom Lines program, visit

[nesea.org/buildingenergy-bottom-lines](http://nesea.org/buildingenergy-bottom-lines)

### **How long ago did you start Emerald Builders? Can you describe your business to me?**

My wife, Rachel, and I started in 2006, when the "green construction" movement was getting off the ground in a bigger way. I was working as a carpenter on bigger projects with lots of inefficiencies and waste. We wanted to do it a bit differently. A friend of mine who works for Greenpeace turned me on to NESEA members like South Mountain Company and a few others. From there, we decided to launch our own thing.

Things took off for us in 2009. Ever since, we've been lucky never to have built a code compliant house. I've been lucky to have customers who really want what we have to offer.

As we've grown, we've gone from using captured subcontractors to hiring our own employees. We try to offer the best experience for our employees – offering health care, a modest vacation plan and fair pay.

### **What are the biggest challenges you face as the owner of a small company?**

Finding qualified help is definitely our top challenge. A new "subchallenge" is persuading our customers that what we offer is worth the price. Because we offer benefits to our employees, we end up having to charge a bit more for our work.

### **When did you join BuildingEnergy Bottom Lines? What drove your decision to join?**

We joined when the program first launched, almost three years ago. We had hit a point in our business where things weren't progressing as easily as in the past, and we wanted more input from other businesses to help make our business better. I didn't know how to phrase it at the time, but one thing that was really important to me was the triple bottom line focus on people, planet and profitability.

### **You hosted your Bottom Lines group, Wolfpack, in October 2015. What was it like to host a meeting?**

I felt fortunate to have watched a few other network members, Mark Boudreau and Ben Kelley, go before us. We didn't know exactly what to expect. It was a bit scary, no doubt, but it came at a wonderful time for our company, and we were really excited to integrate some of the suggestions we received.

The meeting was informative and went really well. We certainly weren't perfect, but we got a lot of great input that helped us focus in more on our mission.

### **What's been the biggest surprise about Bottom Lines so far?**

My biggest surprise? The turnover that came out of our meeting. I would love to see a chart on people who host Bottom Lines meetings, and what their turnover is like. We had a lot of turnover right away. The big takeaway for our whole company was a much clearer message on what we value, and where we wanted to head. The real plus was that it let everyone in the company know better where I wanted to go. The Bottom Lines process helped make clear where there were misalignments between us and employees who had different priorities and needs. We are dedicated to a specific craft. Our Bottom Lines group helped jump start us toward that goal.

I've also been surprised by how much better prepared I am to move forward in more business-minded way. I came from a background in carpentry. I had an idea of the type of place I wanted to work in, and the type of work I wanted to do. When I couldn't find it, I decided to create it. But it's been very helpful for me to think much more with a business mind. Bottom Lines has helped me develop systems for my financials, benefits packages and other policies. I have become more literate in the business world.

One of the biggest benefits of the program is how open everybody is about their businesses. Not just their successes, but also problems they've faced and the solutions that have worked. The online

CONTINUED ON PAGE 8

# Welcome to the new solar hot water

- › Accelera® Heat Pump Water Heater is a cost-effective and green alternative to solar thermal hot water
- › Estimated yearly cost savings \$250-\$370 for 2-3 people or \$490-\$740 for 4-6 people\*
- › Extremely low standby losses from industry-best 3" insulation
- › Quiet 52 dB sound pressure level
- › Only 3.8 kWh per day of solar electric would offset annual hot water energy needs
- › Low carbon footprint
- › Superior design from decades of experience

\*Based on Energy Star cost savings for heat pump water heaters

See us in Boston March 7-9 at Building Energy 17 or call for more information or where to buy.



**Accelera® 220 E**  
58-gallon  
heat pump water heater

**Accelera® 300 E**  
80-gallon  
heat pump water heater



**800.582.8423**

[www.stiebel-eltron-usa.com](http://www.stiebel-eltron-usa.com)

Engineering & manufacturing  
excellence **since 1924**


**STIEBEL ELTRON**

**Simply the Best**


## FROM THE EXECUTIVE DIRECTOR

CONTINUED FROM PAGE 6

forum has opened up conversations that I've never seen take place in any other business environment.

It's also been interesting to see that many of the problems we face as company owners are universal, and not based on the size company we operate. Learning how differently people approach their own businesses has been really useful. The Bottom Lines group makes clear that there's no one right answer. People find their own way. The Bottom Lines community is not prescriptive, but they serve as a sounding board to be sure that you choose the way that works best for you. 

### 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 board and staff have the resources to execute it. Jennifer is known for her strategic sense and for her ability to forge strong partnerships among staff teams, NESEA members and other collaborators. 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. She lives in South Deerfield, Massachusetts, where she and her family completed a deep energy retrofit of their 1977 ranch house and are living as close to net zero as possible with two teenage girls and a swimming pool. 



## Career Training for Clean Energy Management



The number of clean and renewable energy employment opportunities will boom during the next decade. Earn a marketable blend of technical skills and business management abilities at Hudson Valley Community College.

### ENROLL NOW IN THE NEW CLEAN ENERGY MANAGEMENT AAS DEGREE PROGRAM

Learn electrical theory and explore photovoltaic, geothermal, wind and fuel cell energies as well as finance, marketing and business. The program also provides technical training in PV installation and maintenance.

Tuition for New York residents is only \$2,150 per semester, and students can take courses at Hudson Valley's main campus in Troy and at the TEC-SMART extension center in Malta. Several courses also may be completed online.



**Apply today or learn more at  
[www.hvcc.edu](http://www.hvcc.edu) or (518) 629-4663.**



URBAN HABITAT  
INITIATIVES INC.

**Green Strategic Planning  
and Implementation  
Support from the Building  
to the District Scale**

**Kimberly Vermeer, LEED AP Homes**

p: (617) 423-5566 • e: [kim.vermeer@urbanhabitatinitiatives.com](mailto:kim.vermeer@urbanhabitatinitiatives.com)



**Commercial & Residential Installers  
for Southeastern MA, Cape Cod & The Islands**

**Photovoltaic Solar Installations**



P.O. Box 89 Cotuit, MA • 508-428-8442 • [www.cotuitsolar.com](http://www.cotuitsolar.com)





# BUILDINGENERGY NYC

OCTOBER 12, 2017 • TKP CONFERENCE CENTER • [NESEA.ORG/BENYC17](http://NESEA.ORG/BENYC17)

Conference + Trade Show of the Northeast Sustainable Energy Association (NESEA)



## LEARN

Choose from 24 fully-accredited sessions on energy efficiency, building science, energy policy and infrastructure, and more.

## NETWORK

Engage with over 500 established and emerging professionals to discuss sustainability in the built environment.

## IMPROVE

Visit the trade show floor to hear directly from product experts, develop professional partnerships, and discover industry best-practices.

Learn more at: [NESEA.ORG/BENYC17](http://NESEA.ORG/BENYC17)

## ELECTION SHOULD UNITE, NOT DIVIDE



BY MICHAEL BRUSS

PHOTO CREDIT:  
MATTHEW CAVANAUGH

**A**s you may know by now, the NESEA staff and board has embarked upon a strategic planning process with the help of organizational development consultant Jeanette Millard. We hope to finalize this work and to endorse our 5-year plan early in 2017. I recently had the opportunity to speak with a few board members, including **Fortunat Mueller**, of ReVision Energy (FM); **Phil Kaplan**, of Kaplan Thompson Architects (PK); **Jenna Ide**, of the City of Salem, Massachusetts (JI); and **Rick Renner**, of Richard Renner Architects (RR), about the process and would like to share their points of view.

**As part of the strategic planning process, we looked at NESEA past, present and future. What's the most significant thing you've learned about NESEA through the process?**

**FM:** "The board, staff and membership are strongly aligned with respect to mission, purpose and values. That allows us to move forward well with strategies and tactics. It reflects well on what we've been doing for the past few years and makes it likely that we'll move forward successfully."

**PK:** "We are a different organization than we were even 10 years ago. We really have changed. We're doing more commercial and institutional work, looking at whole systems. We are less insular, more inclusive. Our offerings have gotten broader but more focused."

**RR:** "The sense that I didn't have before this process was insight on the organization's ability to renew – not reinvent, but find ways to make itself stronger, more relevant and to grow."

**Jenna Ide** felt that the planning process got a little messy at times, but **Fortunat** responded that "It's healthy to have debates. We don't want a board of 'yes-people.'"

**In the face of the election results and the political landscape that likely will evolve over the next few years, how best can NESEA serve its community, and how will the strategic plan help?**

**PK:** "We shouldn't forget the environment in which NESEA was born. There was great struggle then. Because of that there was incredible passion that pulled this community together. We're together

in this struggle. There's a power in this that brings us back to our roots."

**Jl:** "The like-minded need to start bringing in the the not-so-like-minded – it's a real opportunity. Our regional focus will help. We can't assume alignment within our own region. The thing that will be hard for us to overcome is all the misinformation, straight-out lies and bad news. We need to address that in our strategic plan. We can't just trust people to listen to the good people and to do the right thing. The reality now is different than when NESEA started. The people we are trying to convince are being influenced by widespread misinformation

Diversity is more important than ever. I've been through a lot of elections before. I've lost many times. I've never cried before. This was a first. The alienation is unprecedented. There are so many disadvantaged groups. I hope that there's a process for the board to come together on a statement about what diversity means to us, especially in these times. We need to maintain this as an emphasis. We also need to recognize that there are communities that think differently than us and engage them in a meaningful way."

Jenna's words struck a chord in me: in these times, it will be important to engage with the whole community. Alienation is a deterrent to progress and will not allow for meaningful conversation. Let's use the election as a springboard for what unites us, not what divides us. 🌐

### ABOUT THE AUTHOR

**Michael Bruss** is the president of Bruss Project Management and is wrapping up his term as NESEA's board chair. Prior to founding Bruss Project Management, he served as president of Bruss Construction and Integrated Building Energy Associates, LLC. Michael's passion and drive focuses on building with green technologies, reuse of historic structures, energy efficiency and preparing today's buildings for future generations. With more than 30 years of experience in project development and management with a diverse group of building projects, Michael brings unmatched collaboration, innovation and craftsmanship to every project that he is involved in. He has recently been tapped to facilitate NESEA's newest BuildingEnergy Bottom Lines network. 



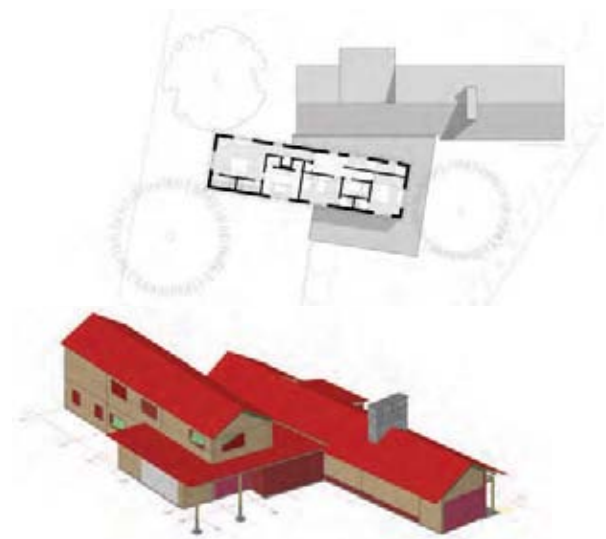
BENSONWOOD. Where high performance is BEAUTIFUL.



## HOW DO WE APPROACH HIGH PERFORMANCE?

Bensonwood employs a unique off-site fabrication/on-site assembly process, coupled with our renowned panelized roof, wall and enclosure systems. This allows us to build to very close tolerances and high standards under tightly controlled conditions. Typically our weather tight shells are fully completed on site in a week to ten days. The result: beautifully designed, ultra-tight, highly insulated homes, schools and buildings, requiring little energy to operate. Most of our buildings are built to “net-zero ready”, LEED, Passive House or Living Building Challenge standards.

---



## LASTING ELEGANCE IS POSSIBLE.

Our approach to building unites craft, wise material use, a systems approach, 40 years of building experience, and new technologies. We first build every project in its entirety in 3D. Then computer cut and fabricate the core shell components and the large, flat sections of the building envelope in our controlled environment. We then assemble these sections on site. The results speak for themselves: rapid build times, lower construction footprints, high durability and quality, and incredible building performance.



Design by Aamodt-Plumb Architects

## SMARTER PATHS.

Bensonwood is a comprehensive design-engineering-build firm, specializing in ultra high-performance and timber frame building. For over 40 years, we've become internationally known for our abilities to design and build to the most stringent standards. Each of our architects, engineers, project managers and builders bring the highest level of dedication and technical expertise to every custom challenge. We can help you meet or exceed the sustainability requirements on your next assignment.

## LET'S TALK.

Contact one of our Senior Project Development Leads to ensure your next project delivers durable excellence:

For Residential – Dick Struthers, [dstruthers@bensonwood.com](mailto:dstruthers@bensonwood.com)

For Commercial – Doug Reitmeyer, [doug@bensonwood.com](mailto:doug@bensonwood.com)



[www.bensonwood.com](http://www.bensonwood.com)  
6 Blackjack Crossing, Walpole, NH 03608  
877.203.3562





## SMARTER. From the ground up.

Bensonwood designs and builds durable, LEED and high-performance buildings throughout North America. Our craftsmanship and off-site fabrication ensure that every Bensonwood structure delivers lasting elegance and value.

Let us help you rethink wood.

Learn More: [bensonwood.com](http://bensonwood.com) or (603) 756-3600.



# USING WHOLE SYSTEMS THINKING IN HIGH PERFORMANCE DESIGN: THE NEW MacARTHUR ELEMENTARY SCHOOL

BY  
**ED McGRAW,**  
AIA, LEED AP BD+C  
AND  
**MATTHEW BRODERICK,**  
AIA, NCARB,  
LEED AP BD+C

PEER-REVIEWED BY  
**PHIL KAPLAN**

**O**ur technical ability to create high performing buildings has increased significantly, but the potential transformative power of our industry will only be fully realized when we master the ability to incorporate systems thinking into our design processes, and consistently employ optimal construction techniques. In this case study, we share how a traumatic event led to a unique opportunity to explore creative visioning, high performance construction and systems thinking in the design of a new, 125,000-square-foot elementary school.

In 2011, Hurricane Irene and Tropical Storm Lee caused the Susquehanna River to flood the City of Binghamton. The MacArthur Elementary School was inundated with contaminated floodwaters and declared a total loss. With the help of federal and state funding, the Binghamton City School District had the opportunity to rethink and create a new school for the 21st Century.

The result is a high performance elementary school, with an Energy Use Intensity (EUI) of 10, which embodies new models of educational engagement. The project team combined state-of-the-art systems, materials and site development to create a LEED Platinum (pending) product that incorporates both the quantitative and qualitative aspects of sustainable, high-performance building.

This article will highlight aspects of the integrated design process used for this project. We start with a description of the visioning process and our approach to translating broader visions into more specific design approach. We'll then focus on one specific aspect of the design process, the building's energy usage. Due to state requirements, the project followed a traditional design-bid-build approach, but the design process was highly integrated, bringing together not just the various design consultants, but the many different community stakeholders.

## ENGAGING THE COMMUNITY IN VISIONING

MacArthur Elementary had long been at the heart of a vibrant community; its loss, along with the displacement of students and staff to two temporary schools, was a significant blow. The community needed more than just a new school: it needed to heal. Community involvement in the building process had tremendous potential to help the healing process.

After initial discussions with the Board of Education the design team at Ashley McGraw Architects, DPC, set up three separate visioning workshops: one with teachers and staff, one with students (grades 3 through 5) and one with the public. The workshops were structured specifically to match the needs and character of the respective groups.

The visioning session with the students was particularly memorable and enlightening. Each grade level met separately, and after a warm-up exercise, the students were engaged in a drawing activity. Eighty-foot-long sheets of paper were laid out on the floor. Students gathered along both sides of the paper and spent ten minutes drawing their ideas related to three different questions:

- If you could imagine a school any way YOU want to, what would it be like?
- What does a "living school" look like to you?
- What is your favorite memory of MacArthur School?

## These separate visioning sessions resulted in the creation of five key vision statements for the project:

- We will respect the energy of the site.
- We will heal our relationship with the river.
- We will create a net zero, fossil fuel-free building.
- We will teach.
- We will create a safe and welcoming place for students and the community.

An effective vision statement is inclusive rather than prescriptive. These statements are not solutions. Each stakeholder can bring their own ideas to each vision, and those ideas can be quite different from each other. This helps to keep everyone engaged in the process. For





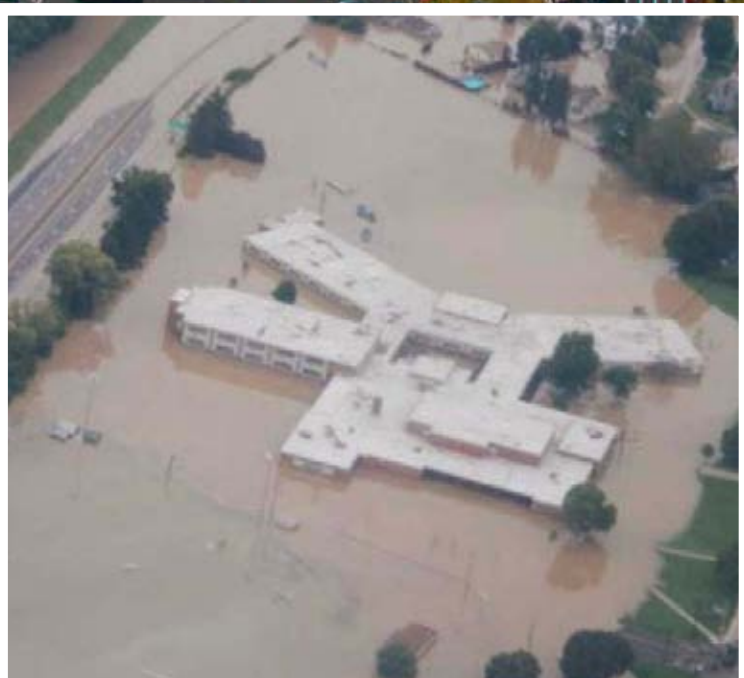
AERIAL OF OVERALL SITE.  
PHOTO CREDIT: JOHN GRIEBSCH PHOTOGRAPHY.

example, “healing the relationship with the river” could be interpreted as protecting the building from flooding, helping the occupants feel safe, or allowing the river to safely inundate parts of the site rather than trying to wall it off.

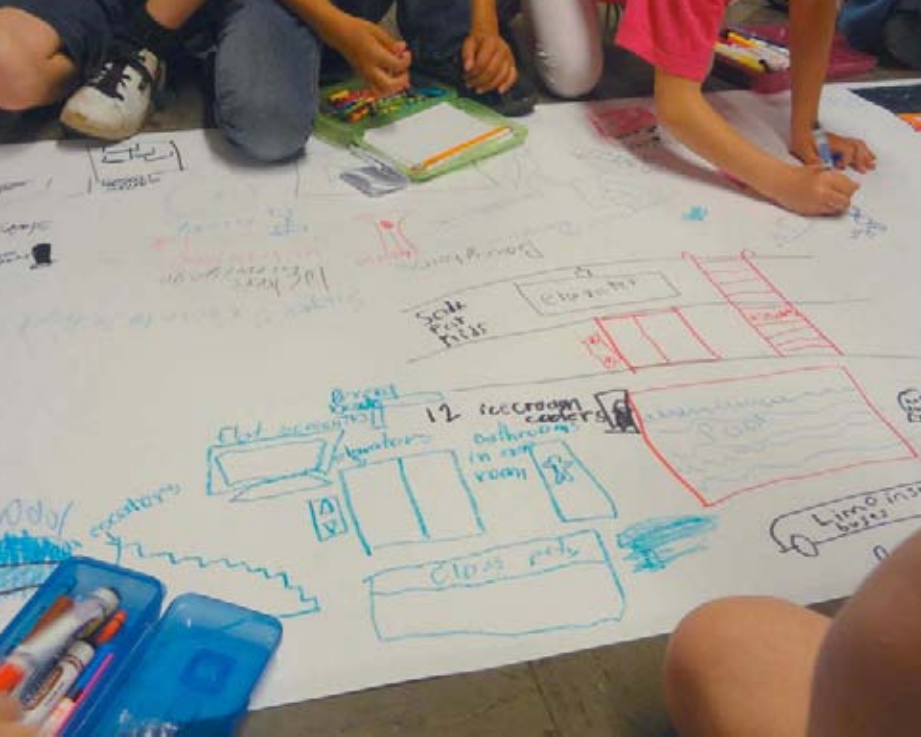
Because vision statements are not solution-oriented, another step is required to transition to actual design solutions. We call this step “mediation.”

### MEDIATING THE VISION

The architectural design team worked with the landscape architect, Appel Osborne Landscape Architecture, in a diagramming exercise to begin to translate the visions into a variety of concrete ideas and concepts. These concepts were wide ranging in nature, from physical to social to psychological. Each concept had to be translated into physical form through diagrams drawn over the existing site plan.



FLOODING OF PREVIOUS MACARTHUR ELEMENTARY SCHOOL (RIVER TO THE LEFT OF SCHOOL). PHOTO CREDIT: BREAKINGNEWS.COM.



STUDENTS DRAWING ON LONG SCROLL OF PAPER AS PART OF VISIONING EXERCISE FOR THEIR NEW SCHOOL. PHOTO CREDIT: ASHLEY McGRW ARCHITECTS.

As the diagrams were developed and refined, they were laid over one another in what the design team referred to as “the stack.” The stack began to suggest a physical form for both the building and the site. Through this method, the design of the site and building became a manifestation of the visions of all the stakeholders. Throughout the design process,

the team was able to tie each decision back to the original vision statements. During the long process of designing and building a large school, this helped keep everyone aligned despite various challenges and changes in stakeholders.

### STRIVING FOR ENERGY PERFORMANCE

One specific vision statement, “we will create a net zero, fossil fuel-free building,” established the design team with a tremendous challenge. They began the design process by making strategic, best-practice moves based on previous net zero design experience, all the while balancing other key visions and goals. This began with establishing the basic form of the school, which built off of the stack analysis developed during the mediation phase.

We utilized a methodology we called “conserve, capture and create” to work towards a net zero building. “Conserve” focuses on high performing building envelopes and effective HVAC systems. “Capture” uses the direct energy of the sun to offset building energy use, including effective daylighting and passive energy strategies. Finally, when the energy load has been reduced significantly by the first two strategies, “create” strategies introduce renewable energy, primarily photovoltaics, to balance the remaining energy usage.

CONTINUED ON PAGE 16



PINNACLEWINDOWSOLUTIONS.NET | 207.588.6590



Project: Artist Retreat | Architect: Briburn | Builder: Taggart Construction

# YARDI® Smart Energy Suite



## Maximize Energy Efficiency

Reduce energy consumption while keeping tenants comfortable. Achieve paperless invoice processing with full visibility into utility costs, consumption and recovery. Automate tenant submetering and utility billing. Leverage easy ENERGY STAR® submissions.

To learn more, call **800.866.1144**  
Or visit [www.yardi.com/energy](http://www.yardi.com/energy)

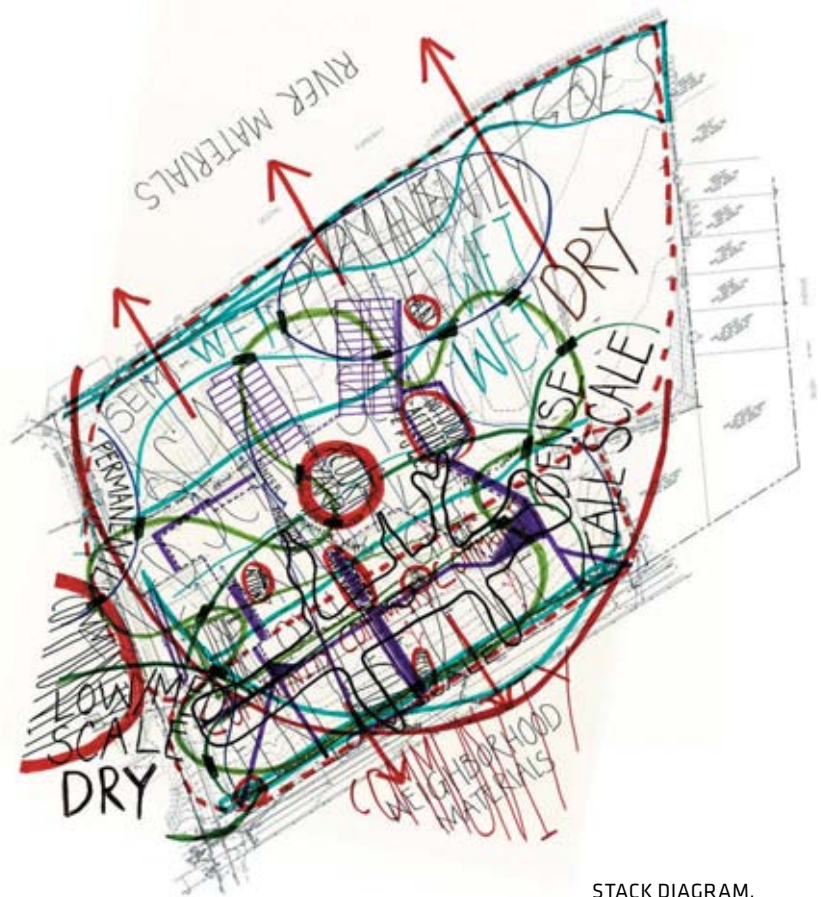
CONTINUED FROM PAGE 14

The team began by benchmarking against the CBECs (Commercial Building Energy Consumption Survey). The Energy Star Target Finder showed a typical site Energy Use Intensity (EUI, measured in kBtu/ft<sup>2</sup>) for K-12 schools in this region to be 81. The goal of the project was to reduce that by 75 percent, to 20 percent, through “conserve” and “capture” strategies before the integration of renewable energy.

Maximizing solar resources and effective flood mitigation strategies were key drivers of the building form and orientation. The large volumes, such as the gymnasium, cafeteria and library, were arranged parallel to the street on high ground outside of the area of potential flooding. This was not the optimal solar orientation, but it was optimal in terms of the relationship to the neighborhood and responsiveness to site flows and flood mitigation. Three two-story classroom wings, built above the flood zone on tall columns, were given more ideal solar orientation, with primary façades facing north and south.

Once orientation was established, maximizing effective daylighting of spaces drove the façade development. Often in high performance buildings, the goals of maximizing both daylighting and the thermal performance of the envelope can conflict. Because this building is a school, the team focused first on achieving optimal daylighting and views in order to provide the most effective learning environment. The architectural

CONTINUED ON PAGE 19



STACK DIAGRAM.  
DIAGRAM BY ASHLEY MCGRAW ARCHITECTS.

• Passive House Project Certifications  
 • Component Certifications  
 • Professional Certifications & Trainings  
[www.phius.org](http://www.phius.org)

RMI Innovation Center 2016 PHIUS Best Overall Passive Project



**95% of all certified passive construction in North America is PHIUS+ Certified**  
**Over 95% of all certified passive buildings in North America have engaged PHIUS-trained professionals**  
**PHIUS+ Certified and Pre-Certified projects now total 1.1 million sq ft across 1200 units**  
**LEARN MORE: [info@passivehouse.us](mailto:info@passivehouse.us) or 312.561.4588**

**AEROSEAL**  
 Duct Sealing From The Inside

Central Cooling & Heating Inc.  
 9 North Maple Street  
 Woburn, MA 01801  
 P:781-933-8288

The EPA's Duct Investor calculator\* states that sealing ductwork with **30%** leakage down to **2%** in a 3-ton system, can save **300** trees a year.

We found considerable duct leakage and arosealed your neighbor's home. They sealed the leaks, saving precious energy and doing their part to create a greener neighborhood.

**SIMPLY PUT, THE LESS ENERGY WE USE IN OUR HOMES, THE MORE WE CAN SAVE.**

Let us help you create a greener earth, reduce air pollution and enjoy savings on your heating and cooling bill.

**Central Home Energy Experts**  
 A Division of Central Cooling & Heating Inc.



**STEPHEN TURNER INC.**  
Building Better Performance

**NEW  
BUILDING  
COMMISSIONING,**



**EXISTING  
BUILDING  
COMMISSIONING**

**FACILITY  
ASSESSMENT,**



**ENHANCED  
OPERATIONS &  
MAINTENANCE  
PLANNING**

**ENERGY  
AUDITING,**



**HIGH  
PERFORMANCE  
BUILDING  
TRAINING**

## Stephen Turner Inc.

is dedicated to providing comprehensive commissioning services. The firm provides commissioning services in all forms – new building **commissioning**, renovation commissioning, retrocommissioning, ongoing commissioning of existing buildings, and commissioning of system retrofits. Clients who trust us with their building projects include U.S.-based companies and institutions, such as Brown University, Massachusetts Institute of Technology, Gillette Stadium, Bristol Fire Department, the Rhode Island Department of Education, and the City of Cambridge, MA, as well as international companies, such as KEO International Consultants.

Our experience includes some of the most exciting high-performance building projects in the world, including Net Zero, LEED® Platinum, LEED® Gold, and Northeast CHPS-rated facilities. Our client assignments are typically complex buildings with extensive building automation systems, projects incorporating sustainability strategies, **high-performance** building projects, and critical facilities such as research labs, vivarium, and archival storage.

Stephen Turner Inc. specializes in tailoring our approach to each client assignment to yield the highest possible return on your investment in our services. Our strength is deep **hands-on experience**; our inspiration is listening to clients and understanding building occupants' needs; our focus is optimizing building tuning using building automation systems and controls.

Stephen Turner Inc.  
317 Hope Street  
Providence, RI 02906  
United States  
+ 1.401.273.1935  
info@sturnerinc.com  
www.greenbuildingcommissioning.com



# **BUILDINGENERGY BOSTON**

**MARCH 7-9, 2017 • SEAPORT WORLD TRADE CENTER • [NESEA.ORG/BE17](http://NESEA.ORG/BE17)**

Conference + Trade Show of the Northeast Sustainable Energy Association (NESEA)



Connect with thousands of high-performance building and renewable energy professionals.  
See cutting-edge technology and grow your client base on the trade show floor.  
Choose from over 50 accredited sessions and workshops to attend.

**Register by January 19 to Receive up to \$150 Off**

**[NESEA.ORG/BE17](http://NESEA.ORG/BE17)**

CONTINUED FROM PAGE 16

team performed extensive daylight modeling to ensure that natural light was allowed into most spaces in the building. The building envelope was designed with a focus on thermal performance and air tightness.

We collaborated with our engineer, BuroHappold, to settle on key HVAC strategies. We used a ground-coupled, ground-source heat pump that moves heat and cold throughout the building with liquid instead of air, which is more energy efficient. Only the minimum amount of air required for ventilation was moved through the building, although in schools the fresh air required is still substantial. In classrooms, Displacement Induction Units were incorporated for improved health and comfort. Radiant flooring in classrooms helped with peak load reduction, storing heat in the thermal mass, and increasing student comfort. Finally, control gradients were established throughout the building to increase efficiency. This allows spaces like classrooms to be tightly controlled from a thermal standpoint while other spaces, like corridors and stairwells, are allowed to vary more in their set points.

Starting in the design development phase, BuroHappold developed detailed energy models of the building. The first round of modeling, late in design development, showed a site EUI of 34 kBtu/ft<sup>2</sup>. Further design and modeling refinements during the construction documents phase brought that down to 24.5 kBtu/ft<sup>2</sup>.

Pathfinder Engineers & Architects performed independent modeling to verify LEED compliance and qualification for New York State financial incentives. The modeling started during design development and continued through construction documents. This work showed a projected site EUI of 21.7 kBtu/SF, close to the 20 targeted at the start of design.

We decided to install only as many photovoltaic panels as could fit on the roof of the building. This resulted in a system capable of producing 411,730 kWh/yr. This amount of PV brought the site EUI down to 10 kBtu/ft<sup>2</sup>, shy of the net zero energy goal, but still a significant achievement. LEED Modeling showed an 83-percent energy cost savings over the ASHRAE

90.1 2007 baseline. The building achieved 10 site EUI, an 88-percent reduction in energy consumption compared to the CBECS benchmark of 81 EUI. Net zero could have been achieved by doubling the amount of PV, but that would have required a larger financial investment and mounting the additional panels on separate structures around the site, as the roof area was fully utilized.

Partial occupancy of the building started in late November of 2015. As of October 2016, systems are still being refined. Building commissioning is largely complete.

The community needed more than just a new school: it needed to heal.



## Advancing Window Performance

Menck Windows combines the best practices of American manufacturing and German engineering to design and build unrivaled performance windows with greater value.

We design and manufacture custom, finely crafted, high-performance windows, doors and curtain walls for architects and builders throughout North America, from our state-of-the-art facility in Chicopee, Massachusetts.

**menck  
windows**


*A better world inside and out.™*

1.866.29MENCK • [www.menckwindows.com](http://www.menckwindows.com) • 77 Champion Drive, Chicopee, MA, USA 01020

## WHAT'S NEXT?


Since it reopened, MacArthur Elementary is once again a vibrant anchor for the surrounding community. The original vision statements are reflected in the final building and, most importantly, those visions are communicated to the students, staff and community as they interact with the facility.

This design process is an example of a whole-building, regenerative design process. It relies on deep stakeholder involvement and the weaving of both quantitative and qualitative goals. As we move forward with other projects, we look to those critical early stakeholder engagements to refine our approach and to deepen our analysis of ecological and social flows. Ultimately, regenerative design is about shifting from a goal of "doing less bad" to "doing good."


This is a significant shift in thinking that requires everyone involved in design and construction to deepen their skills. We have a relatively short time frame in which to make deep, systemic change. The good news is that as an industry, we have the knowledge necessary to do that. We just need to spread that knowledge to others and improve our processes for doing so. 

## ABOUT THE AUTHORS

**Ed McGraw**, *Founding Partner and CEO of Ashley McGraw Architects, understands the importance of relationships - between clients and architects, of course - but also between seemingly oppositional forces, such as nature and technology. Ed champions a collaborative creative process in which clients and designers can together conceive of educational design that achieves deep sustainability. Ed has created the space for new philosophies and implementation strategies that reimagine the relationship of nature, technology and resources in the K-12 and higher education markets. Don't miss his session on the new MacArthur Elementary School project at the BuildingEnergy Boston Conference + Trade Show, March 7-9, 2017 at the Seaport World Trade Center.*

**Matt Broderick** works with colleges and universities on new construction and major renovations that are truly sustainable additions to campus. Matt creates designs that respect the history of each college campus, while bringing a holistic view to each project that helps keep clients and project staff aligned on the broader vision for the future. With his knowledge of the complex educational and operational challenges facing higher education today, Matt helps his clients find harmonious solutions to seemingly competing goals. Recognizing that the current educational paradigm is much more collaborative than ever before, Matt is committed to the design of college buildings that provide rich, vibrant learning and research environments. 

## ABOUT THE PEER REVIEWER

**Phil Kaplan** and his firm, Kaplan Thompson Architects, founded in 2004, have emerged rapidly. His firm's motto, 'Beautiful Sustainable Attainable,' reinforces their commitment to creating vibrant, healthy and durable buildings for all. His newest venture is BrightBuilt Home, which provides affordable, modular net-zero homes throughout the Northeast and Mid-Atlantic. 

# FRED DAVIS CORPORATION

Efficient Lighting Wholesaler Since 1983

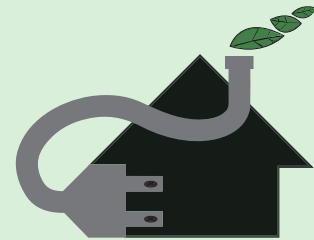
## Superior LED Lighting Expertise



free e-newsletter: text LIGHTVOLT to 22828

Info@FredDavisCorp.com | 800-497-2970

## Stress-Free Energy Code Compliance



**POWERHOUSE**  
ENERGY CONSULTING

HERS Ratings  
Blower Door Testing  
Duct Testing  
Energy Audits

Matt Turcotte, Energy Analyst  
413-835-5162  
matt.turcotte@gmail.com

Ask about Mass Save rebates!







# Masonry has a New Edge.

And it's called HALFEN FK4.

Introducing a new adjustable shelf angle with a thermal break.

**H**ALFEN FK4 brickwork supports transfer the dead load of the outer brick veneer to the building's load-bearing structure: an efficient construction principle developed with the experience of over 80 years of lasting technology.

## Efficient Design

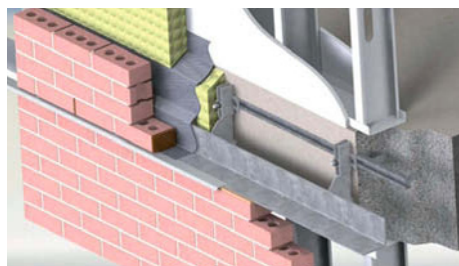
As the demand for higher energy efficiency in commercial buildings continues to increase, the cavity between the brick veneer and the substrate is getting larger to allow for more insulation and air space. Along with this increased cavity size, the traditional masonry shelf angle, used to support the brick veneer at the slab edge, is also getting larger and subsequently heavier and more expensive to install. Architects & Engineer are looking for a more efficient support solution. The HALFEN FK4 brickwork supports use a thinner light weight shelf angle, eliminating brick notching while also providing a wider cavity.

## Adjustability

HALFEN FK4 brickwork supports provide continuous height adjustment of +/- 1 3/8" which compensates for existing tolerances of the structure as well as installation inaccuracies of wall anchors.

## Structural Efficiency

From load capacities starting at 785 lbs up to 2,360 lbs, the HALFEN FK4 brickwork supports allow efficient anchoring of brickwork facades in connection with HALFEN cast-in channels.



## Reduced Thermal Bridging

The HALFEN FK4 brickwork supports are off set from the edge of slab. Minimal contact with the building structure means reduced thermal bridging and lower energy loss.

## Quality

By using HALFEN FK4 brickwork supports, you profit from an approved anchoring system, excellent adjustment options and a complete product program covering all aspects of brickwork facing.

*Many advantages with one result: HALFEN provides safety, reliability and efficiency for you and your customers.*



HALFEN USA Inc. · PO Box 547 Converse · TX 78109

Phone: +1 800.423.9140 · [www.halfen.com](http://www.halfen.com) · [www.halfenusa.com](http://www.halfenusa.com) · [info@halfenusa.com](mailto:info@halfenusa.com)

# THE ROLE OF OCCUPANT ENGAGEMENT IN ACHIEVING NET ZERO ENERGY

BY KATE BUBRISKI,  
AIA, LEED AP BD+C

PEER-REVIEWED BY  
ELLEN WATTS, AIA,  
LEED AP

If buildings continue using as much energy as they do now, global energy demand will outpace expanding renewable energy production, and carbon neutrality will remain an elusive goal. We often hear the first step toward net zero energy (NZE) is load reduction. There is much that can be done on the system technology side to improve our energy outlook. However, designers, architects and engineers only have so much control over energy use; they can design efficient building envelopes and efficient heating, cooling, ventilation and lighting systems, but the building occupants have a large role in energy consumption. Occupants of identical buildings can affect annual energy consumption by as much as 300-to-400 percent. The conventional wisdom that NZE should start with load reduction, while true, tends to overlook the most important energy reduction strategy – instilling the commitment of the occupant to achieve NZE performance.

When mechanical, electrical, and plumbing (MEP) systems are optimized, occupant behavior represents a much greater percentage of the energy used. Occupants impact energy use directly in many ways, from cooking, to use of electronics, to hot water consumption, to how high or low they choose to set the thermostat. I've visited multiple buildings that were designed to be net zero that do not operate that way. What these buildings have in common is that the occupants were not consulted in the design process or educated on how the building needs to function as a net zero environment. Sometimes the occupants are given incentives by the developer/owner to use the building as it was designed to be used, but when the design does not support the needs of the occupants, no incentive can fix the problem. When you fully engage occupants in the process and design to support their needs while reducing energy use, you can create a successful net zero project. Occupants become invested in the performance of the building and committed to the net zero goal.

The good news is that there are simple techniques that design teams can use to effectively engage occupants. The most effective methods

seem like common sense, but they are not typically part of the designer's process or approach.

We employed methods of user engagement in the design process for the King Open and Cambridge Street Upper School & Community Complex (KOCUSUSCC), a project for the city of Cambridge, MA. The project is now in the final stages of design, and construction will begin in July 2017. The steps we used to design the KOCUSUSCC can serve as a model for the user engagement process.

The City of Cambridge had been working on a net zero action plan and wanted city-owned buildings to lead the way. KOCUSUSCC would become the first building with a goal of net zero energy under this new city ordinance.

The KOCUSUSCC project began in January 2015 with a year-long feasibility phase. The building will house an elementary school, a middle school, a public library, school district administration, human service programs and a community pool. The diverse uses for this large building require it to accommodate high hours of operation, making NZE a challenging goal. This project incorporates both active and passive energy efficient systems, including daylighting, geothermal heat pumps, displacement ventilation and addressable lighting controls. The target Proposed Energy Use Intensity (pEUI) for the project is 30 kBtu/ft<sup>2</sup>. The energy efficiency systems achieved a pEUI of 40. The user engagement process is the last hurdle to overcome to reach the target (see page 23).

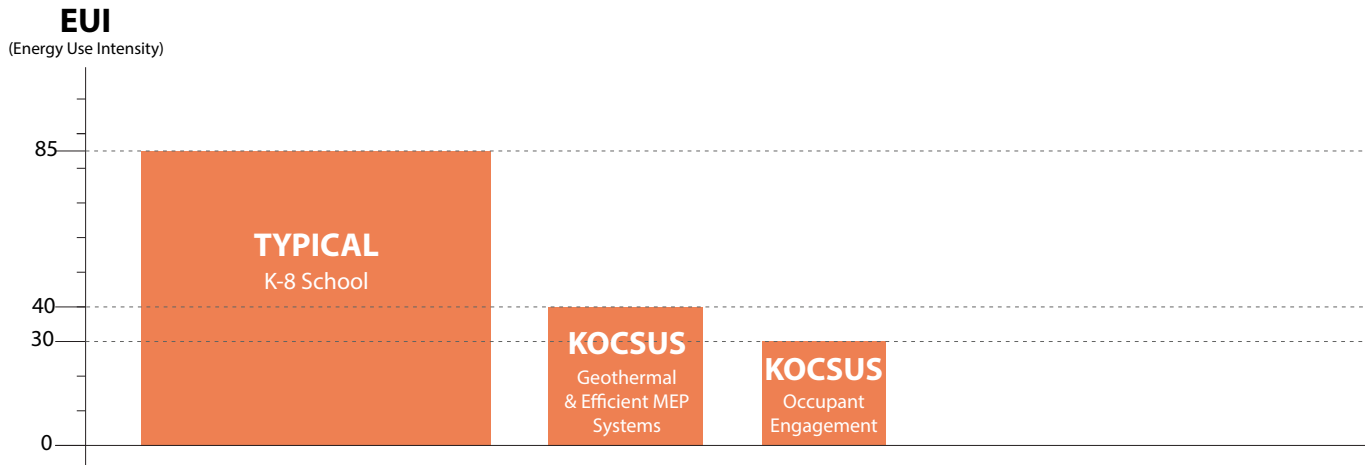
## Step 1: Plan

The first step is to create a plan of engagement. This plan should cover not only the pre-design and design phases, but construction and post-occupancy as well. Be sure your plan is flexible, able to be adapted during the course of the project should you meet unexpected challenges or have to modify timelines.

For the KOCUSUSCC project, we planned a lengthy feasibility phase. During this phase, we met with members of more than 30 stakeholder groups, meeting with each group at least twice. This allowed us to introduce discussion about energy use from the start.

We walked through steps 2-5 of the process (see image of five steps on page 23) with all future

## Energy Use Intensity of a Typical School, KOCUS, and KOCUS + Occupant Engagement



### KOCUS Engagement Process



occupants. As we moved into design phases of the project, it was not logistically possible to continue meeting with so many groups. In the schematic design, we established a smaller NZE Champions group to represent each of the programs in the building. Their task was two-fold. First, they provided insights about what would work for the group they represented. Next, they shared information with their peers to build enthusiasm and achieve total group buy-in. In the first NZE Champions workshop, the most surprising question we heard from a user was “Why don’t we start doing these things in our existing space now? We have a couple of years to work out the kinks and get everyone used to it so it won’t feel so unfamiliar in the new building.”

#### Step 2: Educate

The engagement of the occupants continues once the design is in place. It is necessary to educate them with background details on NZE and develop common language for discussions. This education should include a definition of NZE and an explanation for why NZE is important for both the project and the global community.

#### Step 3: Know, Step 4: Ask, Step 5: Listen

These steps are grouped together because they are not linear. All three of these steps will be used in an iterative way throughout your discussions

with the occupants. Getting to know the occupants starts with an understanding of the different types of people and groups that will use the building. For the KOCUSCC project, occupants include teachers, students, staff, administrators and public users of the pool, library and community programs. It is important to really get to know the occupants, rather than trying to categorize or define them. For instance, designers may have a preconceived notion of what teachers will want, but the needs of each school are unique, so keeping an open mind will allow the designers to truly understand these specific occupants.

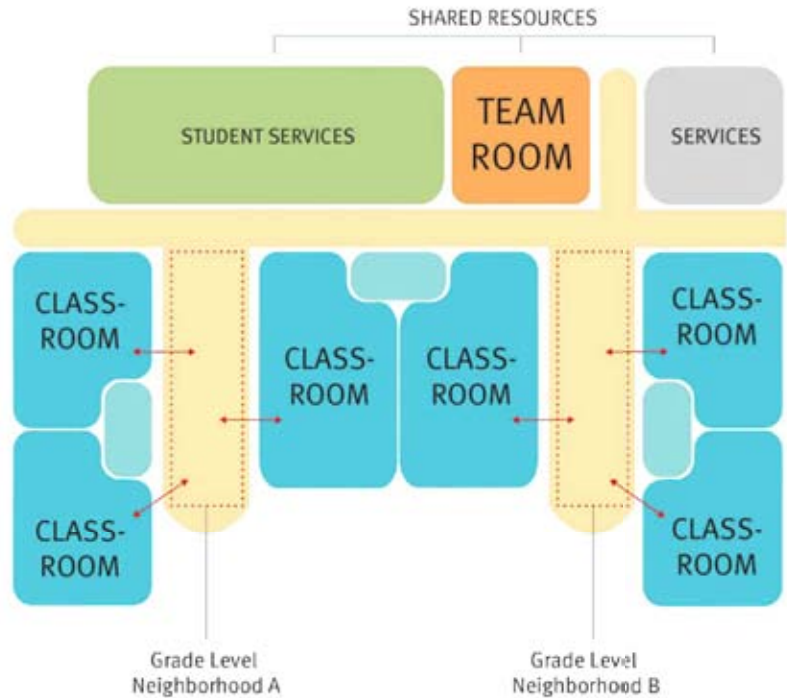
The things you need to know about the occupants include how they do their jobs, what equipment they use and what they are looking for in the new space. My technique for getting answers to these questions includes observing, storytelling and visioning. First, observe the use of the existing space. This provides a frame of reference for when you meet with the occupants. In the first user meeting, use storytelling, asking each user to describe their day from the moment that they arrive at the site to the time they leave.

After the existing environment is understood, ask the participants to imagine the possibilities for the new space. The answers will include solutions for challenges they face in the existing space as well as visions of new things that they want to do in a



(LEFT) A STUDENT AND PARENT VIEW A DESIGN MODEL OF THE SCHOOL AND IMAGINE THE POSSIBILITIES FOR THE NEW SPACE  
PHOTO CREDIT: ARROWSTREET.

(RIGHT) THE DESIGN WAS ADAPTED TO INCORPORATE SHARED RESOURCES, IN CLOSE PROXIMITY TO THE CLASSROOMS, TO PROMOTE COLLABORATION AMONG KOCUSCC FACULTY AND STAFF



new building. Throughout the user meetings, you are applying steps 4 and 5. Ask direct questions, and be sure to listen to the answers. Sometimes it helps to repeat back what you heard to be sure feedback was clearly understood. Do not be afraid to ask the same question in different ways until you feel that you have teased out the root of the answer.

The most effective way to perform steps 3-5 is through face-to-face interactions with the occupants. If in-person meetings are not possible you can also use written surveys to gather information. When speaking to occupants be sure your phrasing has a positive tone. Talk about improvements that they will benefit from instead of highlighting things they have to give up.

Here's an example from the KOCUSCC project. In the existing schools almost every classroom had its own mini-kitchenette including a microwave, coffee maker, mini fridge, etc. We wanted to eliminate all of this excess equipment because it uses so much energy, but we couldn't just tell the users "Sorry, you will no longer have this amenity." We asked the teachers why they felt they needed all that equipment and listened to the answer: there was only one staff room and it was too far away – up to 700 feet in some cases. The teachers needed to be near the classrooms to supervise, and the schedule did not allow them to get to the one staff room.

One of the main things we heard when asked what they imagined for their new school was a building that fostered collaboration among the staff despite working in different classrooms. To meet this vision, we developed a design that includes small clusters of classrooms with a single staff room within the cluster. This room provides a kitchenette that is close-by and easily accessible for all staff in that cluster.

The district administration had a similar condition in their existing building, with multiple kitchens as well as many copiers, printers, etc. because the existing space is divided up into small departments. The district staff wanted a space that was more conducive to collaboration between departments. We designed an open office, which allows for the collaboration and centralized support areas that eliminate excess equipment.

#### Step 6: Respond

After you have met with the occupants or used surveys to collect information, it is important to let the occupants know what you learned and what the design implications might be. You may want to present this in person or summarize it into a "digestible" document that can be shared. This keeps the occupants engaged in the process because they can see the direct impact and result from the conversation or survey

#### Step 7: Prioritize

Of course, there are site constraints, construction budgets and other factors that may limit how many of the design solutions can be incorporated into the project. My tip would be to understand what the energy impact of each solution is, and how closely the solution aligns with the occupants' other goals. This will help the design team prioritize which elements to implement.

Because there are many different uses in the KOCUSCC project, the occupants wanted to be able to use the building during school hours, nights, weekends and summers. Year-round and full day/night access, with several zones of the building operating at any given time, could require a lot of energy. Through the user group discussions we were able to tease out what they really wanted to

CONTINUED ON PAGE 27



# WAGNER DEVELOPMENT

LICENSED & INSURED

---

## Building a name you can Trust

---

978-954-7663

[www.wagnerdevelopmentcorp.com](http://www.wagnerdevelopmentcorp.com)



# NESEA Emerging Professionals & Students

In our efforts to create on-ramps into the NESEA community, we currently provide the following to emerging professionals and students:

- Special pricing to BuildingEnergy conferences
- Special pricing for student memberships
- An annual career forum
- Scholarships to NESEA conferences & courses
- BuildingEnergy Jobs Board

NESEA is creating opportunities for enrichment and engagement that will ultimately further our mission — advancing the adoption of sustainable energy practices in the built environment — over the long term. By supporting people early in their careers, we can ensure a thriving NESEA community when today's students and emerging professionals become tomorrow's industry leaders.

## BE the Future: NESEA's Student Scholarship

In 2016, NESEA launched the "BE the Future" initiative. In this program, participating sponsors directly fund current students' full-day passes to BuildingEnergy conferences and one-year NESEA memberships. Learn more at [nesea.org/be-the-future](http://nesea.org/be-the-future).

If you are interested in sponsoring a student for this opportunity, please contact Jennifer Marrapese at [jmarrapese@nesea.org](mailto:jmarrapese@nesea.org) for more information.



## The Kate Goldstein Fund for Emerging Professionals

The Kate Goldstein Fund for Emerging Professionals provides scholarships to BuildingEnergy conferences for individuals who have been working in renewable energy, high-performance building, or a related industry for less than five years.

To learn more about the Kate Goldstein Fund for Emerging Professionals, or to make a contribution, visit [nesea.org/kate-fund](http://nesea.org/kate-fund).



CONTINUED FROM PAGE 24

do in the building, which spaces they needed and when they needed them. Ultimately, we used this feedback to split the building into two wings with separate air handling units (AHUs) for each similarly operated area. This design reflects the way the building will be used, while also reducing energy and planning for future flexibility. This solution resulted in almost 14 percent energy savings!

**Step 8: Repeat**

Construction is about to start on the KOCUSCC, but engagement does not stop after design. We plan to take advantage of the two years of construction to work with staff and students to create training and operation tools and to continue the conversation. Of course, once the building is occupied, communication needs to be ongoing to ensure everyone knows how to use their space.

It is especially challenging to engage occupants who will only inhabit buildings for a short time, as they tend to have a short-term perspective that rarely aids energy performance. These temporary denizens include students, apartment dwellers and office workers. Real-time energy displays can be used to promote mindfulness; the King Open and Cambridge Street Upper Schools plan on using energy data to design problem solving exercises. Frequent re-training is also essential, whether at the beginning of every school year, residential tenancy or business cycle. 🌱

**ABOUT THE AUTHOR**

**Kate Bubriski, AIA, LEED AP BD+C**, Senior Associate at Arrowstreet, has spent the past decade working with non-profit clients on K-12 education and healthcare projects. Her work enhances clients' missions, services and environments. Kate strives to make sustainability an integral part of every project, and is experienced in integrated design and LEED certification and administration. Kate is the co-chair of the USGBC Massachusetts Advocacy Committee, which works to promote federal, state and local legislation supporting the implementation of sustainable communities and green building.

**ABOUT THE PEER-REVIEWER**

**Ellen Watts, AIA, LEED AP** is a driving force behind Architerra's innovative sustainable design practice, a focused, multi-disciplinary approach to Architerra's creative enterprise. In addition to her role as Architerra co-founder and co-manager, Ellen shares responsibility for designing and delivering award-winning projects. Ellen is recognized for her depth and breadth as an architect. Her "whatever it takes" approach is valued by owners and collaborators alike. With degrees in architecture, real estate development, and government, Ellen offers experience with more than 20 building types, including academic facilities, offices and laboratories, totaling more than 3-million-square-feet.



**EFI now carries  
Venmar ERVs  
and HRVs!**

EFI is now stocking and selling Venmar Heat and Energy Recovery Ventilators (HRVs and ERVs). In typical installations, fresh outside air is supplied to bedrooms and home offices while indoor air is exhausted from bathrooms, exercise rooms and kitchens.

ERVs transfer heat and humidity.  
HRVs transfer heat only.

**800-876-0660 x1**  
**shopEFI.org**



Your Solutions Provider  
for Energy Efficiency

7/16

# HIGH PERFORMANCE CITIES: THE 2030 DISTRICT MODEL

BY MEGAN SAUNDERS

PEER-REVIEWED BY  
HANK ASHFORTH III

Imagine a city where all of the buildings are carbon neutral: where buildings can meet their own energy needs, while dramatically reducing water consumption and emissions from transportation, keeping properties and businesses competitive and reducing costs. As members of the 2030 Districts Network, more than 15 cities across North America are already committed to making the drastic changes necessary to make this vision a reality.

## THE 2030 DISTRICT MOVEMENT

The 2030 District movement is young, rapidly growing and deeply rooted in research on the sustainable built environment. The criteria were created in 2002 by Architecture 2030 visionary Ed Mazria. Early on, Mazria recognized that, as a major user of energy and producer of emissions, the built environment had to become part of the climate change solution. He developed goals for reducing transportation emissions, energy consumption and water usage that were intended to be used by the global architecture and planning community and applied to both new construction and existing buildings. The 2030 Challenge was subsequently adopted by the U.S. Conference of Mayors and the American Institute of Architects (AIA) in 2006.

The first District started in Seattle in 2011, using the targets developed by Architecture 2030 known as the 2030 Challenge for Planning.<sup>1</sup> In 2009, the City of Seattle was faced with declines in the commercial real estate market and increasing energy costs. At the same time, there was a pending building benchmarking disclosure law, and a group formed to establish common goals for building owners to work toward. They realized that together they could go much further toward their goals than on their own. The Seattle 2030 District, the first private sector-led, high-performance building District, was created almost two years later as a result.<sup>2</sup> The 2030 District anonymously provided goals and assistance with benchmarking for all of the building owners within the downtown boundary. The tiered goals for existing buildings ultimately target a 50 percent reduction in energy, water use and transportation emissions, while new construction goals aim for carbon neutrality. The Seattle model set the stage for the beginning of the 2030 Districts movement.

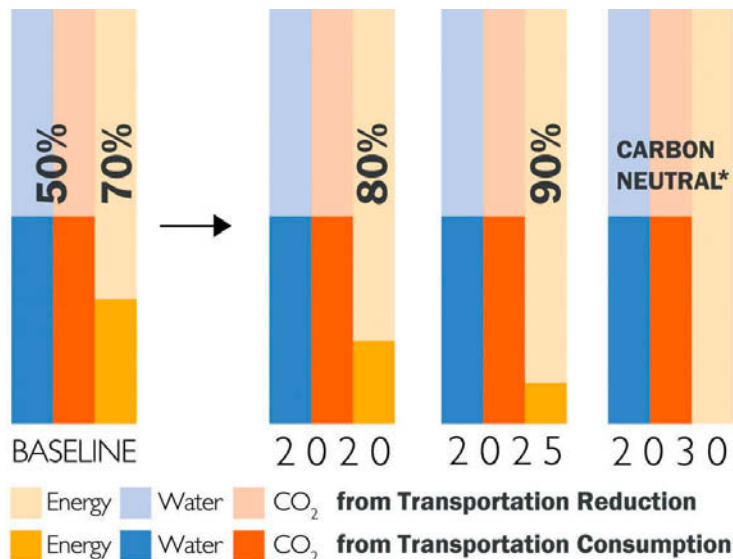
## DISTRICT GROWTH

Over the last five years, the 2030 District network has grown to 15 cities, both large and small, across North America. There are also several cities who are considering starting 2030 Districts and are listed as Emerging Districts, including: Ann Arbor, MI; Burlington, VT; Detroit, MI; Tucson, AZ; and New York City. These cities have all committed at least five buildings to the challenge and are working to advance the District model. Beyond the United States, cities in several Canadian provinces, Mexico, Europe and China have expressed interest in creating 2030 districts. To date, almost 1,200 properties representing 294 million square feet of commercial building space have been committed to 2030 Districts throughout North America.

## DISTRICT OPERATIONS

Each of the 2030 Districts operates as a public-private partnership, bringing together local building industry leaders, community groups and government. Because the 2030 organization model is driven by the private sector rather than government, it is not as vulnerable to changing administrations and priorities, allowing for greater stability and longevity.

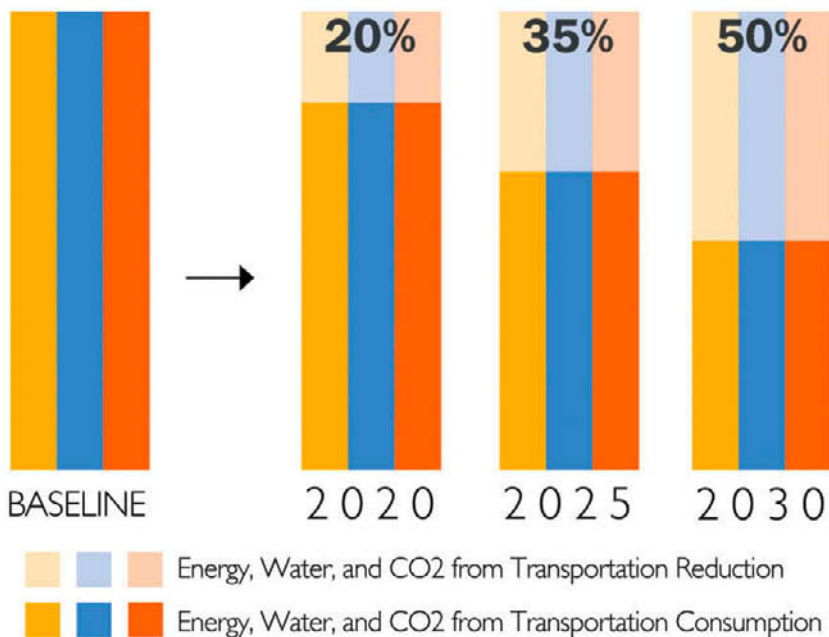
Education is a key component of the 2030 District model. Many Districts provide opportunities for their members to share best practices on a regular



## The 2030 Challenge for Planning: New Buildings & Major Renovations

Source: © 2015 2030, Inc. / Architecture 2030. All Rights Reserved.  
\*Using no fossil fuel GHG-emitting energy to operate.





Because the 2030 organization model is driven by the private sector rather than government, it is not as vulnerable to changing administrations and priorities, allowing for greater stability and longevity.

## The 2030 Challenge for Planning: Existing Buildings

Source: © 2015 2030, Inc. / Architecture 2030. All Rights Reserved.

basis so that they can stay up-to-date with the latest tools, technologies and financing practices in the industry. Beyond sharing information, the meetings serve as a locus where property owners can learn from each other about solutions being deployed in their buildings in a private setting. District membership generally includes: building owners; property managers; professional partners, such as energy advisors and utilities; and community members, including local nonprofits with shared interests. Members share resources to meet collective goals. As an example, professional members provide a benefit or service, such as an energy audit, which can be used by any building owner member to assess their property for potential areas for improvement.

### THE CLIMATE MITIGATION-ADAPTATION NEXUS

As the Districts have progressed and evolved, several cities have adopted goals and metrics beyond the Architecture 2030 Challenge for Planning criteria. The 2030 model provides a framework that is flexible enough to provide Districts with the ability to pilot initiatives that can define and address needs specific to their local geographies. Seattle and Pittsburgh, both 2030 Districts, have created additional goals beyond the 2030 criteria: they will be addressing stormwater and health challenges, respectively.

The Stamford (Connecticut) 2030 District's approach to resiliency was highlighted at NESEA's BuildingEnergy Boston Conference + Trade Show in 2016. In recent years, this small, coastal city was impacted by Superstorm Sandy and Hurricane Irene, necessitating the development of goals that incorporate both emissions reduction and climate adaptation. With the creation of the 2030 District in 2014, Stamford began working to connect energy efficiency, sustainability and resiliency.

Stamford is the second largest energy market in New England – Boston is first – and the fastest growing. The city is home to Fortune 500 companies as well as a broad network of small and medium-

sized businesses. Based on early research by the founding partners of the District, companies are facing increased calls to address resiliency; however, few have methods or systems for doing so. As a result, the resiliency goals of the Stamford 2030 District are shaped by the business community's focus in that area, including reduced vulnerability to energy disruption by extreme weather events, supply constraints and price volatility.

In 2015 the Stamford 2030 District worked with leaders from IBM and AECOM to conduct a one-day workshop with city staff, major business representatives and the utilities using the UN Disaster Resilience Scorecard for Cities.<sup>3</sup> Based on their findings, the team prioritized the needs of the city, including: creating financing and incentives, enhancing and protecting ecosystem services and creating long-term resilience plans that include engagement.

In order to move these resiliency priorities forward, the District will be conducting a study with researchers at the University of Connecticut and Columbia University. The study, funded by the National Oceanic and Atmospheric Administration (NOAA), will use precipitation thresholds from municipal and climate station data to predict how flooding may change with future events and sea-level rise. This data will be used to inform the city's long-term planning and the results will be shared with other coastal towns in Connecticut in order to help the region better prepare for climate change. The Stamford 2030 District will continue to work with the city and building owners to develop technical solutions to meet the resiliency goals.

### ADDITIONAL INDICATORS

The Seattle 2030 District added stormwater as a key goal in order to address issues related to the high amount of precipitation that occurs in the region. Given the density of the city, the ground is unable to absorb and filter excess rainwater, which can cause combined sewer overflows that contaminate water bodies. This

CONTINUED ON PAGE 31

# Enjoying the Magazine? Become a NESEA Member.



## BuildingEnergy Magazine is Curated by NESEA Members

The opportunity to contribute and curate content for this magazine is just one of the great benefits of being a NESEA member. Here are a few others:

- Member pricing on BuildingEnergy conferences, Pro Tours, and NESEA's online courses
- Access to and listing in NESEA's members-only directory
- Invitation to volunteer at NESEA conferences and events
- Listing in NESEA's BuildingEnergy Green Pages Business Directory, including company description and logo
- Invitation to participate in planning committees for BuildingEnergy conferences
- Member pricing for advertising in *BuildingEnergy Magazine*
- Member pricing for exhibit space at BuildingEnergy conferences
- Invitation to participate in BuildingEnergy Bottom Lines
- Ability to advertise job vacancies on NESEA's online jobs board
- Invitation to host a BuildingEnergy Pro Tour
- Access to a community of building science experts

**Interested?** Learn more about the benefits of becoming a NESEA member at [nesea.org/membership](https://nesea.org/membership), or contact Katie Schendel, Membership Manager, at [kschendel@nesea.org](mailto:kschendel@nesea.org) or (413) 774-6061 ext. 20. To apply to next issue's editorial committee, contact Jennifer Marrapese, Executive Director, at [jmarrapese@nesea.org](mailto:jmarrapese@nesea.org) or (413) 774-6051 ext. 23.

CONTINUED FROM PAGE 29

is a growing issue in many cities. In order to address this problem, the Seattle District expanded their 50 percent water reduction goal to include stormwater runoff, and created a tool that allows their members to measure the amount of stormwater they are managing on-site. The tool also helps owners to understand how they can achieve their goals using approaches such as bio-retention, permeable pavement, green roofs, rainwater harvesting and detention vaults.

While outdoor air quality is partially addressed by the 2030 District's transportation goals (CO<sup>2</sup> reduction), indoor air quality (IAQ) is specifically addressed by the 2030 District in Pittsburgh, a post-industrial city. A 2015 Harvard University study found that occupants in well-ventilated offices that had below-average levels of indoor air pollutants, including carbon dioxide, had significantly higher cognitive functioning scores.<sup>4</sup> IAQ is also tied to building energy performance through an increased demand on HVAC systems. In order to identify IAQ indicators, the Pittsburgh 2030 District has partnered with the University of Pittsburgh's Mascaro Center for Sustainable Innovation. The District ultimately hopes to develop a scalable IAQ protocol against which progress can be measured.

#### FUTURE OF 2030 DISTRICTS

With the growth in the number of Districts, Architecture 2030 has established a 2030 Districts



Network, a formal structure that guides Emerging Districts. The vision for the 2030 Districts Network is to create a global brand integral in developing solutions to help the built environment mitigate and resolve global climate change. The network plans continued growth and will remain a leader in helping the built environment battle climate change by

# Foard PANEL

A Full Service Panel Company:  
Design, Manufacturing, Precutting,  
Technical Support, Installation

### SIPA Building Excellence Award Winner:

1st in energy efficiency out of 40+ projects nationwide

- Blower door tested 0.37 ACH<sub>50</sub>, 199 CFM<sub>50</sub>
- Panels installed in 1 week mid-winter
- R-57 NEO Roof, R-38 EPS walls
- HERS score of 1



www.foardpanel.com • pete@foardpanel.com

## 1-800-644-8885

53 Stow Drive / PO Box 185 • West Chesterfield, NH 03466

To date, almost 1,200 properties representing 294 million square feet of commercial building space have been committed to 2030 Districts throughout North America.

focusing on the key goals of energy, water and transportation emissions reductions, while also allowing cities to focus on their local sustainability needs. 🌱

**ABOUT THE AUTHOR**

**Megan Saunders** is Executive Director of the Stamford 2030 District, where she creates partnerships with property owners, local government, businesses and community stakeholders to meet measurable sustainability goals (energy, water, transportation) through collaboration, leveraged financing, and shared resources. Prior to joining Stamford 2030, Megan served for five years as a Project Manager at Vidaris (formerly Viridian Energy & Environmental), where she led design and construction teams in meeting their sustainability goals through LEED and other certification systems for projects ranging from 5,000 to 13 million square feet. She is a LEED Accredited professional specializing in both Building Design and Construction and Neighborhood Development, a Green Globes Professional and a Licensed Real Estate Agent.

**ABOUT THE PEER-REVIEWER**

**Hank Ashforth III** is Executive Vice President of The Ashforth Company. He concentrates on providing strategic direction and sales for the company's third party service subsidiaries and serves on the company's investment committee. Hank was formerly Chairman

of Ashforth Pacific, Inc., the West Coast affiliate of The Ashforth Company, located in Portland, OR. He created Ashforth Pacific in 1995 and helped grow the portfolio from 600,000 square feet to over 3 million square feet. While Chairman of Ashforth Pacific, Mr. Ashforth developed and still maintains a strong working relationship with the city of Portland. He helped spearhead the development of the Lloyd EcoDistrict, a partnership with the city of Portland, which focuses on economic development through sustainable practices. He currently serves as Chairman of the Stamford, CT Energy Improvement District.

**ENDNOTES**

- <sup>1</sup> Architecture 2030. "The 2030 Challenge for Planning." Architecture 2030, 2015. Web. 21 Nov. 2016. <[http://architecture2030.org/2030\\_challenges/2030\\_challenge\\_planning/](http://architecture2030.org/2030_challenges/2030_challenge_planning/)>.
- <sup>2</sup> Kalousdian, Aram. "Seattle Creates High-Performance Building District." Blog post. Sustainable City Network. N.p., 15 June 2011. Web. 21 Nov. 2016. <[http://www.sustainablecitynetwork.com/topic\\_channels/building\\_housing/article\\_4b77db52-939e-11e0-aa0a-0019bb30f31a.html](http://www.sustainablecitynetwork.com/topic_channels/building_housing/article_4b77db52-939e-11e0-aa0a-0019bb30f31a.html)>.
- <sup>3</sup> IBM and AECOM. Disaster Resilience Scorecard for Cities. Disaster Resilience Scorecard for Cities. UNISDR, 10 Mar. 2014. Web. <<http://www.unisdr.org/2014/campaign-cities/Resilience%20Scorecard%20V1.5.pdf>>.
- <sup>4</sup> Allen, Joseph G., Piers Macnaughton, Usha Satish, Suresh Santanam, Jose Vallarino, and John D. Spengler. "Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments." EHP Environmental Health Perspectives 124.6 (2015): n. pag. Web.



Parsons Village - Easthampton, MA

David Ryan Photography



Housing • Historic • Education  
Healthcare • Institutional • Commercial

17 Hampden Street Springfield, MA 01103  
(413) 733-6798 [www.dietzarch.com](http://www.dietzarch.com)

DIETZ & COMPANY ARCHITECTS DESIGN THAT LOOKS GOOD, DOES GOOD

667 sawmill brook parkway  
newton, MA 02459  
617.527.7871  
[www.deapgroup.com](http://www.deapgroup.com)



Complete consulting & design services  
for  
passive house  
deep energy retrofits  
zero net energy



We provide solar photovoltaic and electrical products from the top manufacturers, along with outstanding customer service. With many locations throughout the Northeast, we are able to help with all residential and commercial projects... wherever you are!



CED Greentech East has seven stocking locations, full with entire lines of solar products. Our knowledgeable team can assist you every step of the way, from designing the solar project to a quick delivery.

**WE KNOW SOLAR!**  
SERVICE. INTEGRITY. RELIABILITY.  
[www.cedgreentecheast.com](http://www.cedgreentecheast.com)



### Training Program

Talented young leaders go through a series of trainings while simultaneously getting paid to earn their M.B.A. Once completed, they are able to manage their own CED location.

### Internship Program

College juniors and seniors have the incredible opportunity to see the company inside-out from eight different perspectives.



### Custom Hardwood Ductless A/C Cover

Before

After

PATENT PENDING

### Custom Hardwood Baseboard Heaters

Before

After

**“Make your HVAC products beautiful.”**

---

**CUSTOM CRAFTED FROM 100% PREMIUM HARDWOODS:**  
Cherry, Mahogany, Maple, Red Oak, Sapele, Walnut, White Oak

---

## CMF Engineering, Inc.

Curt M. Freedman, PE, CEM, CEA, LEED AP  
24 Ridge Road | Longmeadow, MA 01106

tel: 413-567-1175  
web: [www.CustomBaseboardHeat.com](http://www.CustomBaseboardHeat.com)  
email: [CMF.Freedman@gmail.com](mailto:CMF.Freedman@gmail.com)

# FROM RED LIST TO READYLIST™

*“Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it’s the only thing that ever has.” Margaret Mead*

BY JONATHAN A. WRIGHT

PEER-REVIEWED BY  
BILL MACLAY

One of the primary goals of the Living Building Challenge (LBC) is to eliminate the use of known toxins in products installed in the built environment. If it is harmful to life – human, animal or anything else – do not use it if at all possible. In 2016, Wright Builders Inc. completed two Living Buildings, which will be evaluated for certification over the next 18-to-24 months. These projects gave us a unique opportunity to work inside the largely unexplored new world of materials research, vetting, documentation and advocacy.

The International Living Futures Institute has developed a list of worst-in-class chemicals and compounds that are widely used in construction products. We know that the course from first discernment to total ban for DDT took about 15 years; the Red List approach is a quicker, more responsive, advisory process based on a path to better health results. Many of us remember when asbestos was the all-purpose additive in many construction products and have followed its gradual removal with no ill effect on product performance. There are many cases where toxic products are simply not needed.

The Hitchcock Center for the Environment and the R.W. Kern Center at Hampshire College are within a quarter-mile of each other in Amherst, Massachusetts. As the construction manager for both buildings, Wright Builders learned quickly what a complex process this is. More than 1,400 submittals and products were vetted by the teams. We also learned that with good communication systems, persistence and

careful record-keeping, the teams could advance the knowledge base significantly. The vetting process for the Hitchcock Center occurred just enough after the first project to fully benefit from the lessons learned during construction of the Kern Center, bypassing some blind alleys in favor of proven materials that would pass vetting.

Fundamentally, the vetting process is a continuous, three-way collaboration between architect, construction manager and materials consultant. Early on, I asked Charley Stevenson of Integrated EcoStrategies, who would actually be accountable for securing materials documentation, and he said we would collaborate. Hmmm. Who, and how, exactly? The process evolved through months of weekly calls, hot lists and dead ends. Together with Kern Center architects Bruner/Cott and the Hitchcock Center’s DesignLab, we all lent significant effort and creativity to the process. Charley was so right – everyone has to get under the weight of it to avoid wasting time and resources.

From the first days of concept design, the design teams looked at the available materials within 500 km, evaluated these potential palettes, and developed the building designs using materials highly likely to be accepted. This drove us toward regional and local sourcing of all material, especially timber, lumber and stone.

The materials and substances that must be eliminated or reduced are on the LBC Red List. They include known carcinogens, endocrine disrupters and contributors to a wide variety of diseases and conditions, the effects of which have been largely borne by the manufacturing and skilled trade workforce for centuries.

Wright Builders Inc. and the teams worked under the Red List 2.1 (now augmented and supplanted by later versions), which identifies the following material and chemical classes:

- Asbestos
- Cadmium
- Chlorinated Polyethylene
- Chlorosulfonated Polyethylene
- Chlorofluorocarbons (CFCs)
- Chloroprene (Neoprene)
- Formaldehyde (added)
- Halogenated Flame Retardants
- Hydrochlorofluorocarbons (HCFCs)
- Lead (added)
- Mercury
- Petrochemical Fertilizers and Pesticides
- Phthalates
- Polyvinyl Chloride (PVC)
- Wood treatments containing Creosote, Arsenic or Pentachlorophenol

Derived from these are hundreds of other compounds and ingredients, which in turn are being modified and incorporated into still more chemicals – perhaps as many as 200 every day – in American industry.

The purpose of the Living Building Challenge is not to keep us up at night, but to change the way products are made and used so that we may build and experience our world in a healthier, more resilient and environmentally responsible way. To that end, even if we are not building our next project for LBC certification, we can still choose to use better products in lieu of our old standbys. These everyday decisions will lessen toxin loads and support companies that are trying to make positive change and grow their influence in the marketplace.

Enter stage right: not the Red List but its country cousin the Ready List – a specialized private list developed by Wright Builders to answer the question: What can we do today? It is an eclectic range of off-the-shelf products that professionals in our industry can examine and adopt right away to make incremental but meaningful change.

The following suggestions from Wright Builders Inc., reviewed by the design and materials collaborators on these projects, are based on our 30-month intensive LBC odyssey. Many of these we have already included in our more conventional projects. We are not vouching for perfection here – only indicating that these are best-in-class for now, and a great place to start.

#### DOOR HARDWARE

### ASSA ABLOY

#### MANUFACTURED BY ASSA ABLOY

Before the Living Building Challenge, many of the products made by ASSA ABLOY were already compliant. ASSA ABLOY was very diligent with transparency and is constantly working on improving their products. They are based in New Haven, CT.

#### R-GUARD PRODUCTS CONSOLIDECK PRODUCTS



#### MANUFACTURED BY PROSOCO

Prosoco is a company that focuses on clean construction products. The Kern Center includes products from Prosoco's R-Guard line: Cat 5 and AirDam. The Hitchcock Center used the Consolideck product line: ColorHard and PolishGuard and LS/CS. Prosoco products are in some ways the poster child for LBC, in that the entire line of products was stripped of Red List components as a result of the company's involvement with the Bullitt Center in Seattle. The company is very forthcoming, offers great support and generates keen interest.

#### CARPET TILE

### shaw contract®

#### MANUFACTURED BY SHAW CONTRACT GROUP

Shaw has created a carpet tile that is 100% recyclable. Wright Builders worked with Shaw to identify a good solution for recycling the installer's carpet scrap. They arranged to send what little scrap was generated back to a facility capable of making new backing and new fiber from the returned materials.

#### INTERIOR SHADES



#### MANUFACTURED BY MECHOSHADE SYSTEMS

When these projects were coming to a close, interior shades rose to the top of the priority list. MechoShade offers a Declared shade, meaning that any LBC project team can easily document and use it, along with other options for Red List-free shades.

#### ELECTRIC ELEVATOR



#### MANUFACTURED BY KONE

The hydraulic fluid used in traditional elevators is full of Red List chemicals. KONE manufactures an electric elevator which performs just as well as a hydraulic elevator. This product uses 40 percent less power than a hydraulic unit, and its mechanisms free up some of the space usually allocated to a machine room. It provides equal performance without harmful chemicals.

#### LIGHTING FIXTURES

### FLUXWERX.

#### MANUFACTURED BY FLUXWERX

Light fixtures can be some of the most difficult products to vet for an LBC project. Every single part of the fixture needs to be accounted for, from powder coating to the coating on the lenses inside the fixture. FLUXWERX was engaged with the vetting team to break down components of the fixtures. This new generation of lighting specifically designed for LEDs is versatile, efficient and beautiful.

#### WIRES AND CABLES



#### MANUFACTURED BY GENERAL CABLE AND BELDEN

General Cable and Belden succeeded where others have failed. Although they are not the only companies who make LBC compliant wires and cables, they were both able to supply the required amount of LBC compliant wire and cable needed for the Kern Center and Hitchcock Center.

#### WINDOWS AND DOORS



#### MANUFACTURED BY ALPEN

These exterior windows and doors used at the Hitchcock Center are now Declare-labeled products. They have a low U-value, which makes them attractive to designers aiming for a high performance building. Alpen has a pultruded fiberglass frame system, lots of custom options and good design support. We have used the 725 series in three different applications with great results. Check out the 925 series and their other products.

#### MAIN ELECTRIC



by Schneider Electric

#### MANUFACTURED BY SQUARE D, SCHNEIDER ELECTRIC

The biggest hurdle with electrical components is confirming that they are Reduction of Hazardous Substances (RoHS) compliant. RoHS was developed in Europe and is the highest standard worldwide, for lowering hazardous content, including mercury and lead. American specifiers and manufacturers do not generally require their products to comply. Square D is a company that has already changed its manufacturing process so that some of its products meet the RoHS standard. They also have constructed a timeline for when their non-compliant products will be ready for RoHS certification.

#### SOLAR PANELS



#### MANUFACTURED BY SUNPOWER

The project teams chose to use panels from SunPower because they have proven themselves as a company fighting for sustainability. The high output, longevity, solid warranty and durability of the panels all contribute to the value. These panels have Cradle to Cradle Certification at the Silver level, giving the project teams confidence in their selection.

## ECOBATTS



### DUCT BOARD WITH ECOSE TECHNOLOGY MANUFACTURED BY KNAUF INSULATION

The project team came across an acoustical issue at the Kern Center. Wright Builders and Integrated Eco Strategy researched and found Knauf Insulation, a company with a proprietary formula which excludes formaldehyde from their insulation.

## DECLARE LABELED PAINT



### MANUFACTURED BY ECOS PAINTS AND BENJAMIN MOORE PAINTS

ECOS Paints was one of the first options for Declare labeled paint, leading to its use at the Hitchcock Center. We also vetted several Benjamin Moore paints for the Kern Center. The Benjamin Moore paints, which are readily available nationwide, have recently been added to the Declare list of pre-approved products. However, in order to avoid using Red List products, careful attention should be paid to the contents of tints.

## EXPANDING FOAM SEALANT



### MANUFACTURED BY PREMIER BUILDING SOLUTIONS

In any industry, it's normal for products to be discontinued. In our case, the approved expanded foam sealant was no longer available. Premier Building Solutions was able to provide a Red List-free product with the transparency needed to be approved on extremely short notice.

## FIREBLOCKING FOAM



### MANUFACTURED BY HANDI-FOAM

This is a common product in most building supply stores. Having widely available, LBC-compliant product is great for the everyday buyer.

## SPECTREM 1, SPECTREM 2



### MANUFACTURED BY TREMCO SEALANTS

With the newest addition of Red List chemicals, LBC 3.1, it has become very difficult to find compliant sealants and adhesives. Fortunately, Tremco has taken the initiative to push and create LBC-compliant products.

## LIQUID NAILS 903



### MANUFACTURED BY LIQUID NAILS

This common product can be found in nearly every home improvement store across the country. Having been vetted under LBC 2.1, homeowners can be confident in the safety of the chemicals used in this adhesive product. It is no small achievement that this product is LBC 2.1 compliant.

## PL 300 FOAM BOARD ADHESIVE H2U WINDOW, SIDING, DOOR, TRIM ADHESIVE F-38 DRYWALL AND PANEL ADHESIVE SF-450 SUBFLOOR ADHESIVE SC-175 DRAFT AND ACOUSTICAL SOUND SEALANT



### MANUFACTURED BY HENKEL - LOCTITE/OSI

Both of these companies have demonstrated excellence in the Living Building Challenge. The vetting teams for both the Kern Center and Hitchcock Center found success when vetting products from these manufacturers.

CONTINUED ON PAGE 38

**Cheese & Trackers**

Valley Solar  
MASS Solar Loan Partner

A Division of Valley Home Improvement  
584.8844 • [valleysolar.solar](http://valleysolar.solar)  
northampton, ma



Experience this home first-hand!  
Available for rent in  
Wellfleet, MA



0.27ACH50 Air Leakage

13.8kBtu/sf/yr Predicted Energy Use Intensity

70% Better Than Code



ZeroEnergy  
DESIGN

ARCHITECTURE & CONSULTING

PASSIVE HOUSE | NET ZERO

617.720.5002

ZEROENERGY.COM

**Burrington's**  
*Solar Edge* 

6 Reed Circle  
Windsor Locks, CT  
06096-1214

(860) 623-0159  
[www.solaredge.biz](http://www.solaredge.biz)  
[solaredge@yahoo.com](mailto:solaredge@yahoo.com)

**Gail Burrington**  
ELC #0195608-PV1 HIC #568720

 PV Installation Professional

*Energy Engineering & Green Advising Services for  
Buildings & Facilities in Massachusetts & the Northeast*

 **BALES ENERGY ASSOCIATES**

**Bart Bales PE, MSME**  
[bart.bales@balesenergy.com](mailto:bart.bales@balesenergy.com)  
413-863-5020 | 50 Miles Street, Greenfield, MA  
[www.BalesEnergy.com](http://www.BalesEnergy.com)

**Solar Hot Water**  
*The best choice for your home or business.*

*Up to 80% of costs reimbursed through tax credits  
and the new MA state rebate*

*Less investment, less roof space,  
and higher production than PV*

*3-5 year payback*

*Easy to retrofit into existing  
construction*

*Silent operation without cooling  
the building.*

*Built to last 25 years*



When looking for a high quality solar hot water installer, choose

 **Spartan SOLAR**  
[goSpartanSolar.com](http://goSpartanSolar.com)  
(413) 768 - 0095  
Greenfield, Massachusetts

**New England SOLAR hotwater**  
HOME | SCHOOL | BUSINESS  
[www.NESHW.com](http://www.NESHW.com)  
(781) 536-8633

**STONETECH  
BULLETPROOF SEALANT**



**MANUFACTURED BY LATICRETE**

There are multiple LBC and Red List compliant stone sealers on the market. What sets Laticrete’s Stonetech Bulletproof apart is the extremely low VOC. A total of 12g/l makes this a smart choice when thinking about off gassing.

**POLYWHEY**



**MANUFACTURED BY  
VERMONT NATURAL COATINGS**

Vermont Natural Coatings is a small regional company that makes great finishes using local whey by-product generated during the cheese-manufacturing process. We like this product for its low stink, local availability, ease of application and durability. Our teams could sit down in the building for coffee or lunch near these applications and experience no smells. Almost weird – and of course, wonderful!

**GLUE-LAMINATED POST AND BEAM**



**MANUFACTURED BY  
NORDIC STRUCTURES**

The post and beam structures inside the Kern Center and the Hitchcock Center are made from black spruce lamination sustainably harvested in Canada. This company can make a structure in any shape as long as it can fit on the bed of a truck. Both buildings took advantage of this sustainable and beautiful product. Design, fabrication and installation were done by Bensonwood for the Kern Center and Architectural Timber and Millwork for the Hitchcock Center.

The purpose of the Living Building Challenge is not to keep us up at night, but to change the way products are made and used.


Over the course of these two LBC projects, we at Wright Builders have found that the word is getting out, and that many manufacturers want to be able to participate in the LBC. Paint companies and carpet companies are flocking to be included in specifications. And with each project or

**PRODUCT INFORMATION AT-A-GLANCE**

PRODUCT	MANUFACTURER	WEBSITE	CONTACT #
Hardware	Assa Abloy	<a href="http://www.assaabloydss.com/en/local/dss/sustainability">www.assaabloydss.com/en/local/dss/sustainability</a>	203.603.5919
Construction Products	Prosoco	<a href="http://www.prosoco.com">www.prosoco.com</a>	860.593.3372
Carpet Tile	shaw contract group	<a href="http://www.shawcontract.com">www.shawcontract.com</a>	877.502.7429
Interior Shades	MechoShade Systems	<a href="http://www.mechoshade.com">www.mechoshade.com</a>	718.729.2020
Electric Elevator	KONE	<a href="http://www.kone.us/elevators">www.kone.us/elevators</a>	207.749.4251
Light Fixtures	FLUXWERX	<a href="http://www.fluxwerx.com">www.fluxwerx.com</a>	604.549.9379
Wires and Cables	General Cable	<a href="http://www.generalcable.com/na/us-can">www.generalcable.com/na/us-can</a>	859.572.8000
Wires and Cables	Belden	<a href="http://www.belden.com">www.belden.com</a>	765.983.5640
Ext Windows and Doors	Alpen	<a href="http://www.thinkalpen.com">www.thinkalpen.com</a>	303.834.3540
Main Electric	Square D	<a href="http://www.schneider-electric.us/en">www.schneider-electric.us/en</a>	888.778.2733
Solar Panels	Sunpower	<a href="http://www.us.sunpower.com">www.us.sunpower.com</a>	408.240.5500
Insulation Boards and Batts	Knauf Insulation	<a href="http://www.knaufinsulation.us">www.knaufinsulation.us</a>	317.398.4434
Potable and Greywater Piping	Aquatherm	<a href="http://www.aquatherm.com">www.aquatherm.com</a>	617.510.8619
PolyWhey 3500	Vermont Natural Coatings	<a href="http://www.vermontnaturalcoatings.com">www.vermontnaturalcoatings.com</a>	802.472.8700
PolyWhey Furniture Finish	Vermont Natural Coatings	<a href="http://www.vermontnaturalcoatings.com">www.vermontnaturalcoatings.com</a>	802.472.8700
Stonetech Bulletproof Sealant	Laticrete	<a href="http://www.laticrete.com">www.laticrete.com</a>	203.393.4619
Glu-laminated Post and Beam	Nordic Structures	<a href="http://www.nordic.ca">www.nordic.ca</a>	514.871.8526

consumer purchase, the values of sustainability and resilience are reinforced for those manufacturers who make the commitment.


An important connection is created between specifier, designer, builder and tradesperson around making meaningful change every day. Overall, except for the Kone elevator, none of the products reviewed here come with a significant cost premium.

Old habits die hard sometimes, but new habits can sparkle with a little hope, which is always a good thing. 

#### ABOUT THE AUTHOR

**Jonathan A. Wright** is a building company executive who traces his roots in sustainability back 42 years. Beginning in 1976, he was involved in passive solar projects, including the development of Massachusetts's first active solar industrial building for Wright Architectural Millwork. As the founder of Wright Builders Inc., Jonathan and his team continue their dogged pursuit of sustainable methods and approaches, which include two Living Building Challenge projects in planning and construction. 

#### ABOUT THE PEER REVIEWER

**Bill Maclay** is the author of *The New Net-Zero*, and founding principal of Maclay Architects of Waitsfield, VT. Bill has been recognized as a leader in innovative ecological planning and architectural design since 1971. He will lead the workshop "Getting to Net Zero: The Nitty Gritty of the Tools and the Steps" at BuildingEnergy Boston Conference + Trade Show. Maclay Architects specializes in net-zero energy design and was the recipient of the 2012 NESEA Zero Net Energy Building Award. Among the firm's net-zero, near-net-zero and net-zero-ready projects are: NRG Systems, an office and manufacturing facility; the Bennington Superior Courthouse and State Office Building; the George D. Aiken Center at the University of Vermont; the Coastal Maine Botanical Gardens Bosarge Family Education Center; and numerous homes. 



### Renovation Solutions From Dryvit



#### Reasons to Renovate Your Building with a Dryvit CI System:

- Poor Energy Performance
- Low Curb Appeal
- Energy Code Compliance

800-556-7752



[www.dryvit.com](http://www.dryvit.com)

## Most Efficient Heat and Energy Recovery Ventilation Systems



As homes are becoming more tightly built, proper ventilation is increasingly critical for optimal indoor air quality. Whether for an energy-efficient home, a Passive House, or ASHRAE 62.2 requirements, Zehnder Comfosystems ensure the highest standard for quiet operation, energy efficiency and performance.

We custom design projects, offer installation support and commission our systems.

For your next project, call us for a free HRV or ERV system design quote at (888) 778-6701.

Zehnder America, Inc • 6 Merrill Industrial Drive • Hampton, NH 03842  
T (888) 778-6701 • [www.zehnderamerica.com](http://www.zehnderamerica.com)

always  
around you





# Zehnder

## Part of the Winning Team for High Performance Homes Across North America.



<http://unityhomes.com/greenbuild/>

SUSTAINABLE DESIGN, HIGH-PERFORMANCE CONSTRUCTION, AND RAPID ASSEMBLY AT A MARKET-READY PRICE.

An air-tightness standard used by the Passive House program of 0.6 ACH50, and achieve a HERS Index of 45 (without photovoltaics), making net-zero energy a reasonable target.



<http://www.solardecathlon.gov/2015/competition-team-stevens.html>

2015 SOLAR DECATHLON WINNER! Stevens Institute of Technology won top honors overall at the U.S. Department of Energy Solar Decathlon 2015 by designing, building, and operating the most cost-effective, energy-efficient, and attractive solar powered house.



<http://www.proudgreenhome.com/articles/proud-green-home-receives-nahb-project-of-the-year-award-for-single-family-small-volume/>



NAHB 'PROJECT OF THE YEAR AWARD FOR SINGLE FAMILY-SMALL VOLUME

The Proud Green Home at Serenbe was designed to

demonstrate that an energy-efficient home could also reflect a sophisticated architectural style without compromise for the occupants.



<https://www.finehomebuilding.com/houseawards/2014/best-energy-smart-home>

ENERGY-SMART HOME 2014: COLD-CLIMATE COLLABORATION O'Malia and Pratt built this energy-smart cutting-edge home in rural Michigan.

Contemporary details characterize a high-performance home, but with the underlying essence of a traditional farmhouse.



<http://energy.gov/eere/buildings/doe-tour-zero-shenandoah-circle-mantell-hecathorn-builders>

DOE TOUR OF ZERO: SHENANDOAH CIRCLE BY MANTELL-HECATHORN BUILDERS

A 3,841-square-foot home built in Durango, California, to the performance criteria of the U.S. Department of Energy Zero Energy Ready Home (ZERH) program.



<http://energy.gov/eere/buildings/downloads/doe-zero-energy-ready-home-case-study-dwell-development-reclaimed-modern>

DOE TOUR OF ZERO: DWELL DEVELOPMENT, RECLAIMED MODERN, SEATTLE, WA

Builder Anthony Maschmedt's award winning Reclaimed Modern home is a perfect marriage of old and new, blending recycled and reclaimed materials with a modern design.



<http://energy.gov/eere/buildings/doe-tour-zero-adaptation-home-evolutionary-home-builders-llc-weiss>

DOE TOUR OF ZERO: THE ADAPTATION HOME BY EVOLUTIONARY HOME BUILDERS LLC / WEISS This 4,798-square-foot home in River Forest, Illinois, to the performance criteria of the U.S. Department of Energy Zero Energy Ready Home (ZERH) program.

# The Most Efficient Heat and Energy Recovery Ventilation Systems

**Ventilation is one of the most important considerations for good indoor air quality.**

A high quality ventilation system such as an ERV or HRV from Zehnder America can help to ensure that air quality is optimized by continuously removing stale indoor air and replacing it with fresh air from outdoors.

The ERV or HRV balanced ventilation systems from Zehnder have a lot of advantages versus an exhaust only solution. By creating negative pressure, exhaust fans are replenishing the air by sucking in uncontrollably unfiltered, often humid and unconditioned air from the outside.



## Benefits from good indoor air quality.

As homes are becoming more tightly built, proper ventilation is increasingly critical for optimal indoor air quality. Whether an energy-efficient home, Passive House, or meeting the ASHRAE 62.2 requirements, Zehnder's Comfosystems ensure the highest standard for quiet operation, energy efficiency, indoor air quality and performance.



Zehnder ComfoAir 350

### Comfort Benefits

- ✓ Feel happier
- ✓ Better sleep quality
- ✓ Higher concentration and productivity
- ✓ Optimum oxygen supply and draft-free air promote well-being

### Health Benefits

- ✓ Better Breathing
- ✓ Reduction of allergy symptoms
- ✓ Reduction of respiratory disorders
- ✓ CO2 content below max. 1000ppm

*award winning*

We custom design <sup>award winning</sup> projects, offer installation support and commission our systems.

For your next project, call us for a free HRV or ERV system design quote at (888) 778-6701.

**Zehnder America, Inc.**

6 Merrill Industrial Drive, Suite 7

Hampton, NH 03842

T (888) 778-6701

[www.zehnderamerica.com](http://www.zehnderamerica.com)

always  
around you

**zehnder**®



## BUILD GREEN

HERS Ratings  
Energy Efficiency Plans  
LEED Consultation  
Diagnostic Testing  
Passive House Rating  
Energy Modeling  
Energy Star® Certification

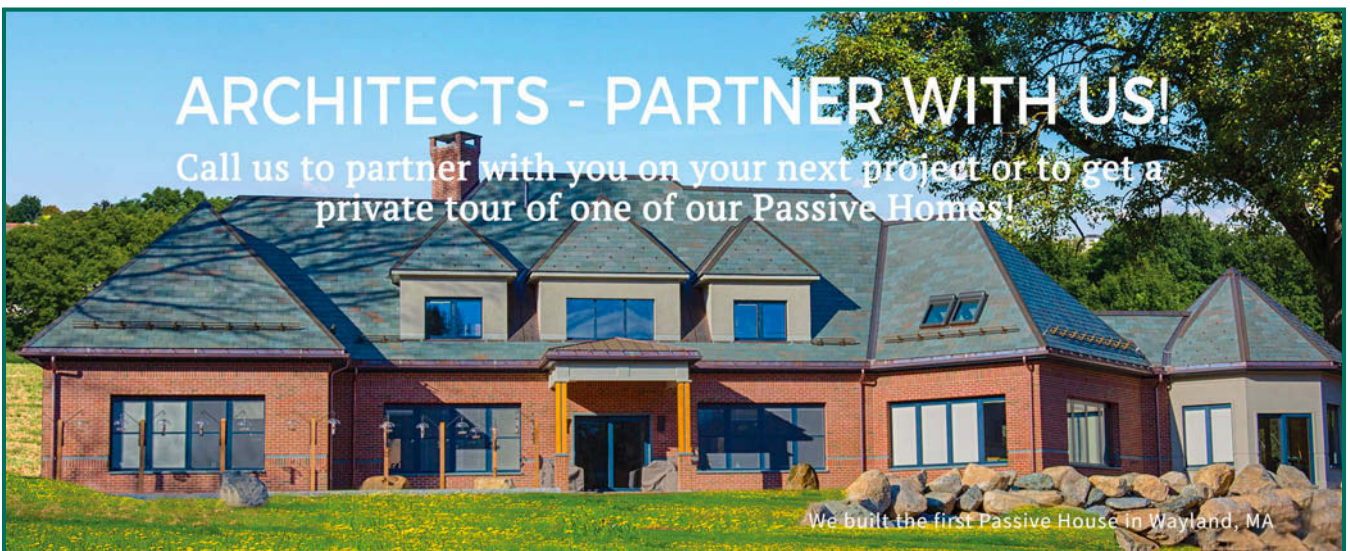
413.586.7350 x242  
[www.cetonline.org](http://www.cetonline.org)

Serving Massachusetts,  
New York, and Connecticut



## ARCHITECTS - PARTNER WITH US!

Call us to partner with you on your next project or to get a private tour of one of our Passive Homes!



We built the first Passive House in Wayland, MA

We are highly-experienced builders of:

PASSIVE HOMES | PASSIVE RETROFITS & REMODELS | NET ZERO HOMES  
HIGH-PERFORMANCE HOMES & ADDITIONS



[AUBURNDALEBUILDERS.COM](http://AUBURNDALEBUILDERS.COM)  
CALL US AT: 617.467.4171

# MY NET ZERO CONUNDRUM

BY JEAN CARROON,  
FAIA, LEED FELLOW

Rather than focus on individual building NZE, shouldn't we be considering individual building performance, before renewables, as a higher benchmark?

**W**hy would we want an individual building to be its own energy plant? This has never made sense to me. The scale seems inefficient and the potential of many existing urban buildings for Net Zero Energy (NZE) is limited.

But many people I admire seem besotted by NZE. What am I missing? To avoid sounding as naïve and uninformed as I really am, I did some research, which was limited by time and my own ability, to understand the issues. What I found substantiated some of my concerns, but definitely broadened my perspective. I concluded that NZE is appealing exactly because of its scale. It is an avenue to improving building performance that is accessible to individual building teams. It is aspirational and raises the bar for design and construction while delivering bragging rights.

However, I am still left with questions and challenges.

## STORAGE

I have seen the swooping graphs of energy use spread over a year in NZE buildings, which often show many months of using the surplus energy from other months. If all buildings in an area are on the same curve, aren't we asking either buildings or utility companies to have giant storage capacity? Are storage systems capable of meeting this need on a large scale, and are these systems good for the environment? A Rocky Mountain Institute study from 2015 partially answered these questions. Researchers examined the value and location of batteries on the electrical grid and found that behind-the-meter storage provided the largest number of services to the electricity grid at large. The 2016 BuildingEnergy Boston Conference + Trade Show featured two sessions, Lightning in a Bottle Parts I and II, that addressed these challenges. Storage is both possible and valuable in our electric system, but few seem to be addressing the impact of batteries on the environment. Aren't they material- and energy-intensive to produce? Don't all batteries need to be disposed of at some point, and isn't that a problem because of toxic metals? More questions. More worries.

## ACCOUNTING

A NZE goal is accounting, pure and simple, and while it should begin with conservation and a high quality building, it doesn't have to. Touted as the "Largest Net-Zero Energy Commercial Office Building in the U.S.," the design of the all-glass La Jolla Commons targeted an unremarkable consumption level of 41.5 kBtu/ft<sup>2</sup> and achieves NZE with directed biogas and on-site fuel cells. It's better than not being NZE, but not as good as actually making a less consumptive building. Teaming NZE with performance systems, like Passivhaus, Living Building Challenge or even LEED, is important to ensure that the Energy Use Intensity (EUI) has been reduced before renewable energy is added.

## CARBON

NZE ignores full carbon/environmental impacts by focusing only on end-use energy. Focusing only on EUI still allows oversized, transportation dependent buildings using lots of materials to be labeled "high performance." The data on what we are doing to the planet is sobering. Global extraction of raw materials has tripled since 1970, while global population has only doubled. The average material use per person grew from 6.4 tons to 10 tons between 1970 and 2010. Not once in the last 40 years has materials extraction declined even during times of recession. Efficient use of materials is essential and our aspirational goals should include whole building/life-style carbon accounting to encourage reuse, building small and freedom from carbon intensive transportation (including both construction and occupancy). We need to be confident that any carbon we spend to achieve a NZE goal has a reasonable environmental payback, which, I suggest is 10-20 years.

## EFFICIENCY

Is NZE the right scale if resource efficiency is the goal? Photovoltaic systems, wind turbines and even hydroelectric power stations are more efficient and cost effective at a larger scale than a single building. "The Future of Solar Energy," a 332-page report published by MIT in May 2015, celebrated the opportunities of solar energy, while including a recommendation away from net metering policies for distributed solar, finding that utility-scale solar rather than residential-scale is a more affordable pathway to meeting energy requirements. Needless

A NZE building is an incomplete and even simplistic metric at the wrong scale. However, it may contribute to integrated design solutions and a better overall building.

to say, this is a controversial issue, but we must be rigorous in challenging our own biases and reaching for the best solutions for the built environment.

#### MAINTAINABILITY

I question whether scattered renewables are as efficiently and effectively maintained as centralized systems. I didn't find much discussion about this in my research, other than a few papers from the United Kingdom asking the same question.

#### COMMUNITY INTERDEPENDENCE

For me, NZE buildings harken back to the Autonomous Houses of the 1970s and the appealing, but regressive, idea of being "self-sufficient." In Philip Slater's 1970 book, "The Pursuit of Loneliness," he said:

"It is easy to produce examples of the many ways in which Americans attempt to minimize, circumvent, or deny the interdependence upon which all human societies are based. We seek a private house, a private laundry, self-service stores and do-it-yourself skills of every kind."

Stewart Brand was more succinct. Commenting on self-sufficiency in *The Co-Evolution Quarterly* in 1975, he said, "It is a damn lie."

This all leads to my final conclusions and questions. Not every existing or new building in an urban setting is going to lend itself to NZE. What happens when new buildings, which may improve a community, shade an existing solar system essential to an NZE building? Rather than focus on individual building NZE, shouldn't we be considering individual building performance, before renewables, as a higher benchmark? I like the idea, found in a 2012 paper by Nick Grant of Elemental Solutions, that proposed energy demand targets be set for all buildings, new and old, independently of any renewables that may be purchasable or located on site. Even though this system doesn't address carbon accounting, wouldn't it instill higher overall performance in our building stock than a NZE moniker?

If we conclude, as we seem to, that we don't need to worry about the environmental impact of batteries or the efficiency of small-scale renewables, then let's focus more aggressively on NZE communities instead of NZE buildings. NZE communities aren't a new idea – ecodistricts have been around for almost a decade but the idea seems to be gaining traction and publicity. In March 2016, the Cambridge, MA Getting to Net Zero Action Plan was presented at the BuildingEnergy Boston Conference + Trade Show. The Architecture 2030 Challenge and The Living Future Institute now have 2030 Districts and a Living Community Challenge respectively, which imagine sharing resources from building to building. I was heartened to find a 2016 paper from

the American Council for an Energy-Efficient Economy (ACEEE) about zero energy at scale. It calls out numerous initiatives happening at the local, campus and development levels and proposes a framework - CITI2zero (Community-Scale Integrative & Transformative Infrastructure for Zero Energy).

The Citi2Zero framework proposes five components:

- 1. People** – to influence policy, behavior and investment
- 2. Renewable Infrastructure** – to optimize the grid and integrate storage, charging, controls and distribution
- 3. Buildings** – combining new and old to have a combined NZE
- 4. District Fabric** – integration of infrastructure informed by land planning and urban design
- 5. Finance** – at every level, to maximize economics and financing

This is a framework I can heartily support, although I will still harangue about moving beyond EU1 in our building evaluations.

I conclude that, like many green systems or goals, a NZE building is an incomplete and even simplistic metric at the wrong scale. However, it may contribute to integrated design solutions and a better overall building. I certainly understand the appeal and celebration of achievement on an individual project level. Although I am still not sitting on the NZE building bandwagon, I am waving more enthusiastically to my friends and mentors who are. 🌱

#### ABOUT THE AUTHOR

**Jean Carroon**, one of five principals leading the design firm of Goody Clancy, is passionate about the opportunities inherent in the stewardship and creative reuse of existing buildings to create a healthy resilient world. Goody Clancy is an architecture, planning and preservation firm serving educational, governmental and private sector clients and communities nationwide. They collaborate with clients to design and plan buildings, campuses and communities that express their aspirations, inspire creativity and collaboration, and build social, economic and environmental value. Jean's professional focus on existing buildings includes leading a team that helps clients and the public connect historic legacies to current realities and future possibilities. She combines a deep respect for and knowledge of history and building technology with a talent for transforming places-redefining their relevance, utility and flexibility while sustaining and enhancing essential beauty and value. Jean was a co-chair of the BuildingEnergy Boston Conference + Trade Show in 2016. 



The Flats at The Upper Ridge  
LEED Silver Condominiums



Kuhn Riddle Architects

R.W. Kern Center  
Hampshire College - Living Building



Bruner/Cott Architects

The Hitchcock Center  
for the Environment - Living Building



designLAB Architects

New Home - Amherst, MA



Accessory Living Space Addition  
Belchertown, MA

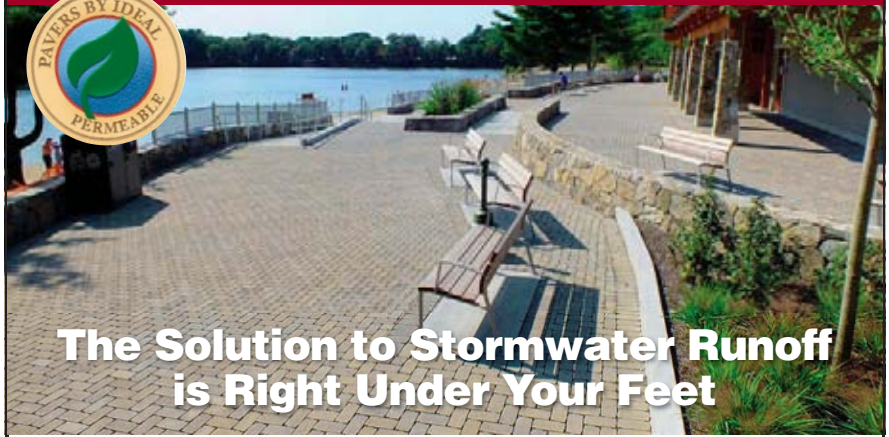


Innovation. Collaboration. Results.



(413) 586-8287 e.104  
wright-builders.com

PAVERS BY IDEAL



The Solution to Stormwater Runoff  
is Right Under Your Feet

**Aqua-Bric®, Eco-Stone® & Andover 5511™ Permeable Pavement**

Ideal permeable pavers offer built-in technology - the pavement and base act as a stormwater treatment system that reduces or eliminates runoff to reduce pollutants and improve water quality.

- High-strength 9000psi pavement
- ADA compliant
- Freeze-thaw and snow-plow safe
- Easy to clean and maintain
- Cost competitive to porous asphalt
- Qualifies for LEED® credits



**Ideal Concrete Block Co.**  
www.IdealConcreteBlock.com

CALL 1-800-24-IDEAL FOR A PERMEABLE LUNCH & LEARN



transformative design for the next hundred years  
on campus and at home

**c&h architects**  
coltham and hartman.com amherst, ma

# TURNING ENERGY GOALS INTO REALITY: PERFORMANCE-BASED PROCUREMENT

BY PAUL TORCELLINI,  
PHD, PE,

CONNOR JANSEN,  
PE, LEED AP BD+C,

DAVE VIGLIOTTA

PEER-REVIEWED BY  
JOEL MCKELLAR

**B**uilding design is often focused on adding more efficient equipment or technologies. In many cases, energy efficient equipment is lost to value engineering as budgets tighten up during late stages of design. Building owners are simply left to respond to line items for better glazing, more insulation, more efficient HVAC equipment, advanced controls and LED lighting. This reactive approach limits opportunities for integration and the advantages that come from a more collaborative process between the owner and the design team.

With value engineering in mind, it can be difficult to convince owners to pursue high performance features and invest more money up front to save money and energy later. Most owners have to work within the budget given to them up front. Additionally, owners may be concerned that their investment in innovative technologies may not pay off and achieve the savings projected in the design. For many years, this has been seen as a major barrier to energy efficiency.

To overcome this barrier, the National Renewable Energy Laboratory (NREL) piloted a methodology to competitively procure an entire building based on a list of prioritized goals, including energy efficiency. There was one catch – NREL could not spend any additional money on the project. The approach requires the design team to integrate energy efficiency so closely into the design of the building that it cannot be pulled apart. When complete, the building must meet the scope that was agreed to as part of the procurement process, including the aggressive energy goals.

## A TALE OF TWO BUILDINGS

NREL's performance-based procurement strategy was implemented during design of its Research Support Facility (RSF) in Golden, CO. A similar process was employed at the University of Chicago's new residence hall in the heart of Chicago's Hyde Park neighborhood. The teams behind both of these projects used innovative methods to achieve maximum energy use thresholds for the new buildings, with design goals tied to building energy performance.

## NREL'S COMMITMENT TO PERFECTING THE BUILDING DESIGN PROCESS

NREL is a nationally-renowned leader of research related to energy efficiency and zero energy buildings. While NREL has set energy goals for its own projects, design teams often have struggled to meet these aggressive goals within a cost target. This led NREL to develop a performance-based procurement strategy which integrated budget, program, schedule and performance on equal footing within the project Request for Qualifications (RFQ) for the RSF project.

The owner team developed a list of performance-based goals relating to all aspects of the building, not just energy. This team then prioritized the list and included it with the criteria for success for each item in a comprehensive RFQ. The budget for the project was fixed and all bidders had to respond to that price. The three contractors who were "short-listed" based on the the RFQ participated in a design competition. The result of the competition was a conceptual design presented to the owner. The owner evaluated the design based on the prioritized list and the contractor whose proposal most closely met the scope, in order of the owner's priority, was deemed the best value to the owner for the funding available.

The process engaged the contractor and design team as a single entity to work together to achieve shared goals. Because the contractor determined the scope, they were obligated to the items that they put into the scope, including a goal of 25 kBtu/ft<sup>2</sup> of site energy use annually. Allowances were built into the energy formulation if the design team made the building more space efficient (i.e. put more people into the building) and if the design team could integrate the campus data center. The data center was a big energy consumer, but creativity prevailed and now the data center not only serves the building, but the entire NREL campus. The creative solution was to use the waste heat to partially heat the building in the winter.

This was all spelled out in the substantiation criteria around the energy goals. The building was built at less than \$260/ft<sup>2</sup> and uses one-half the energy of a typical Class A office building operating at an EUI of under 35 kBtu/ft<sup>2</sup>. While this as-built EUI is higher than the original goal, the design team received allowances for exceeding occupant



NREL CHALLENGED ITS DESIGN AND CONTRACTOR TEAM TO DESIGN A ZERO ENERGY BUILDING AT THE SAME COST AS A TRADITIONAL OFFICE BUILDING. *PHOTO CREDIT: NATIONAL RENEWABLE ENERGY LABORATORY*

density targets and including a data center that serves the entire campus. The contractor team also provided a strategy for funding solar panels on the building to achieve a net zero energy building including the allowances. This resulted in the entire campus receiving data processing using renewable energy, expanding the building's impact. The process produced a net zero energy building at the same cost as a traditional office building. The concept was simple – motivate the design team and the contractor to achieve superior energy performance through a competitive and unambiguous RFQ and contract.

### UNIVERSITY OF CHICAGO'S ZERO ENERGY GROWTH PLAN

The University of Chicago, which had an aggressive capital plan and several new construction projects on the horizon, decided to pursue a performance-based approach. It was important for them to balance the energy usage of their 120-year-old campus with these new projects. A primary goal of their plan was to determine whether the new buildings could generate enough energy to offset use in their existing buildings – to essentially have zero energy growth for these new buildings

After years of investing in retrofitting campus buildings and successfully bringing the energy usage down, they realized that sometimes new buildings would come online and not meet the energy performance goals projected by the design. The poor performance of these new buildings negated some of the energy savings and financial investment from the retrofits. Moving forward, the University wondered if they could set a contractual limit on how much energy the new buildings will actually use.

While working with Seventhwave, a building performance consultant and research nonprofit, the University implemented a performance-based EUI requirement on its next project, the Campus North Residential Commons. The University chose a site



THE UNIVERSITY OF CHICAGO CHOSE A SITE GOAL OF 55 KBTU/FT<sup>2</sup>-YR FOR THE 390,000-SQUARE-FOOT RESIDENCE HALL AND INCLUDED THAT TARGET IN THE RFQ. *PHOTO CREDIT: THE UNIVERSITY OF CHICAGO.*

EUI goal of 55 kBtu/ft<sup>2</sup> for the 390,000 square foot residence hall and included that target in the RFQ.

After narrowing the list to four teams, a design competition was held to allow each respondent to develop a plan to meet the energy target and other performance goals. The design teams involved in the process eagerly approached the project with innovative solutions to meet the project constraints. In many ways, this method allowed teams to design a better building through a greater understanding of what the client wanted from the beginning. By having clearly defined, measurable goals they could narrow in on design solutions which needed to integrate both architecture and major building systems with the overarching goal of staying on budget. The RFQ also included a clause to create a verification plan over a predefined period when the University and designers will measure the building's actual energy performance 18 months after project completion.

*CONTINUED ON PAGE 47*



High quality commercial & industrial solutions for every type of business.

THE NORTHEAST'S LEADING COATINGS & CONCRETE COMPANY

compliance | durability | stain-resistant | value-engineered | sustainable | customized | longer-lasting



TRUST THE EXPERTS WITH OVER 30 YEARS OF EXPERIENCE  
 urethane mortars | decorative & designer epoxy | cementitious coatings  
 mitigation systems | surface restoration | polishing  
 replacement & new floor systems



[www. BLACKBEARCONCRETE.com](http://www.BLACKBEARCONCRETE.com)  
 call us at: 978.405.0017

Solar **Hot** Water

*The best choice for your home or business.*

Up to 80% of costs reimbursed through tax credits and the new MA state rebate

Less investment, less roof space, and higher production than PV

3-5 year payback

Easy to retrofit into existing construction

Silent operation without cooling the building.

Built to last 25 years



When looking for a high quality solar hot water installer, choose



goSpartanSolar.com  
 (413) 768 - 0095  
 Greenfield, Massachusetts



HOME | SCHOOL | BUSINESS  
[www.NESHW.com](http://www.NESHW.com)  
 (781) 536-8633

TIMELESS ARCHITECTURE



*Spirited beauty with award winning green design.*

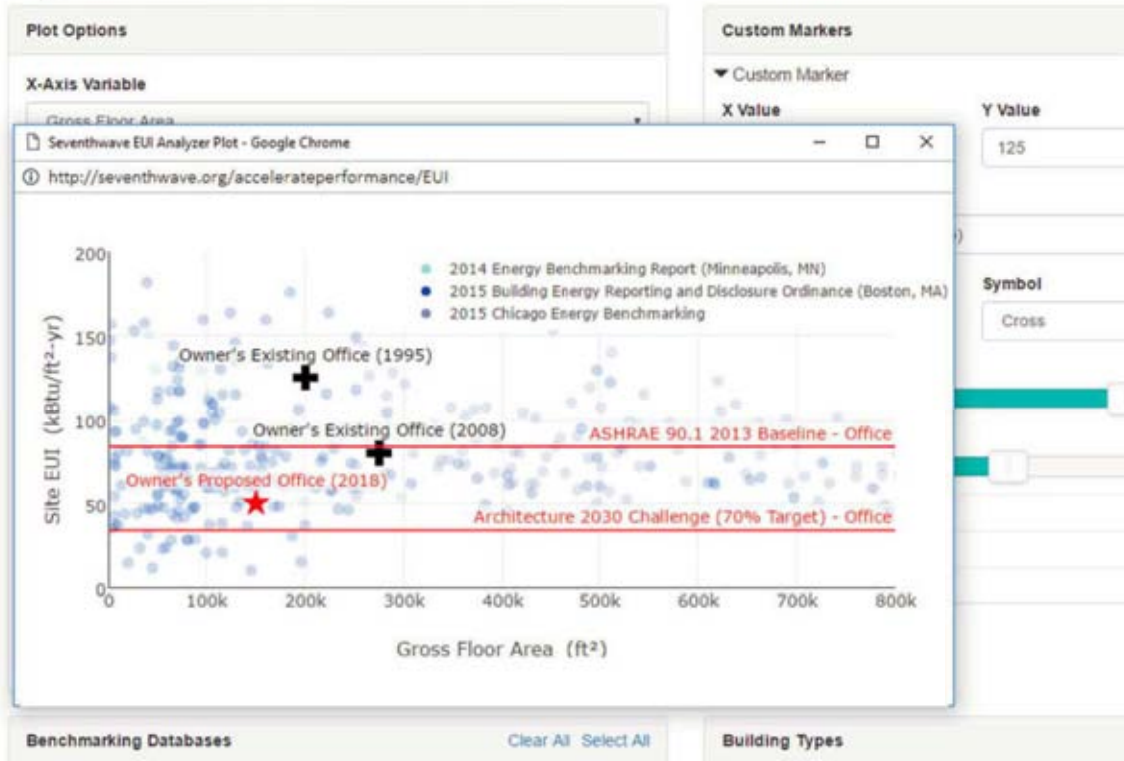
[www.TIMEARCH.com](http://www.TIMEARCH.com)

617-696-6448

MaclayArchitects  
 CHOICES IN SUSTAINABILITY



© Robert Benson Photography



**CONTINUED FROM PAGE 24**

The project was completed in the fall of 2016 and the design and contractor team have entered the year-long measurement and verification process. Starting this process early helps align building operation and design intent while continuing the link of responsibility to meet the performance targets.

The team is closely monitoring the energy end uses to confirm that the systems are operating properly and the building is on track to meet its performance goals. Another benefit of this approach is that it aligns capital planning and operations teams around the same goal. Although some owners include financial penalties or rewards in these types of procurement processes, the University decided to forego such contractual obligations on this pilot project. Based on its success, the University plans to integrate performance-based procurement into their future design and facilities standards. EUI target goals may become even more aggressive as the University's comfort level with the process increases.

**SCALING THE CONCEPT**

With support from the U.S. Department of Energy, Seventhwave is leading an effort with NREL and the Institute for Sustainable Energy at Eastern Connecticut State University to bring performance-based procurement to scale through an initiative called Accelerate Performance. The program is intended to show that performance-based procurement can work in a broader commercial real estate context.

Accelerate Performance is being demonstrated through utility energy efficiency new construction programs including ComEd in northern Illinois and Eversource and United Illuminating in Connecticut. The Minnesota Department of Commerce is also piloting Accelerate Performance through its Conservation Applied Research and Development (CARD) Grant Program for select projects throughout the state including the Xcel Energy service territory. The program is the only owner-faced initiative in the country that is centered around a procurement methodology to spur energy efficiency. It also aims to improve cost barriers associated with high performance buildings, drive focus on integrated design early in the process and facilitate post-occupancy follow through on energy targets.

Building owners can easily replicate the process by integrating the concept into their planning, design and facilities standards, or into the owner's project requirements. They simply customize the contractual language to support their project. The earlier in the process performance-based project goals are articulated, the easier they are to integrate into the final product. Accelerate Performance also serves as a cost-effective path to net zero energy buildings. After the owner pursues Accelerate Performance on a project, they could continue to lower targeted EUI goals based on the ability of market forces to deliver exceptional buildings. It also leverages the utility efficiency programs to provide technical assistance and offer financial incentives for influencing energy efficiency decisions before any design work is underway.

*CONTINUED ON PAGE 49*

SEVENTHWAVE'S EUI ANALYZER TOOL SUPPORTS OWNERS AND DESIGN TEAMS IN HELPING IDENTIFY EUI TARGETS. THE FREE TOOL CAN BE ACCESSED AT THE FOLLOWING LINK: [HTTP://WWW.SEVENTHWAVE.ORG/ACCELERATEPERFORMANCE/REGISTER-EUI-ANALYZER](http://www.seventhwave.org/accelerateperformance/register-eui-analyzer)

# YESTERMORROW

DESIGN/BUILD SCHOOL



Yestermorrow Design/Build School inspires people to create a better, more sustainable world by providing hands-on education that integrates design and craft as a creative, interactive process. Our courses are taught by top architects, builders, and craftspeople from across the country. For people of all ages and experience levels, from novice to professional.

## Offering over 80 courses in:

- Design/Build
- Natural Building
- Energy Efficiency & Renewables
- Sustainable Building & Design
- Ecosystems & Working Landscapes
- Architectural Craft & Woodworking



Think with your hands.



CALL TODAY TO REQUEST A CATALOG OR VISIT OUR WEBSITE FOR DETAILS:

CAMPUS LIVING IN THE MAD RIVER VALLEY - WHOLE FOODS MEAL PLAN  
7865 Main Street • Waitsfield, VT • [yestermorrow.org](http://yestermorrow.org) • 1.888.496.5541

VENTILATION SOLUTIONS FOR EVERY SEASON

## RENEWAIRE THE COLD WEATHER ERV

FROST-FREE OPERATION · NO DRAIN PANS  
ENERGY EFFICIENT · TEMPERS INDOOR AIR



RSTThermal.com  
781.320.9910

**INTRIGUED?**

Are your buildings performing as expected? Do you want to achieve measurable energy goals at little to no cost premium? The Accelerate Performance team is looking for building owners and developers to demonstrate the procurement approach on their next project. Owners would also receive consultation from Seventhwave and national laboratory expertise on the process. Learn more at [www.seventhwave.org/accelerateperformance](http://www.seventhwave.org/accelerateperformance).

**ABOUT THE AUTHORS**

**Paul Torcellini, PhD, PE**, is the principal engineer for the Commercial Buildings Research Group at NREL, the National Renewable Energy Lab. Paul has authored or co-authored more than 50 papers and articles related to energy efficiency and zero-energy commercial buildings. Among his many awards, Paul has received two ASHRAE Technology Awards for his energy-efficient buildings work and two Energy User News magazine's Efficient Building Awards.


**Connor Jansen, PE, LEED AP BD+C**, Senior Project Manager, Seventhwave, provides consulting, design advice, and analysis to help clients achieve exceptional performance within the built environment in the areas of energy, indoor environmental quality, and daylighting. Underpinning his technical background and creative use of proven technologies is a strong consideration of the challenges faced by architects and building engineers when working towards an integrated solution.

**Dave Vigliotta** is the Director of Marketing and Strategic Partnerships at Seventhwave. He specializes in strategic alliances with other mission-driven technical organizations as well as foundations. Dave also manages marketing and outreach for Seventhwave's technical assistance services for high performance building design including utility energy efficiency programs. He also supports Seventhwave's education team in developing training and continuing education events for building design professionals.

Don't miss the authors' session on Performance-Based Procurement at the BuildingEnergy Boston Conference + Trade Show, March 7-9, 2017, at the Seaport World Trade Center.

**ABOUT THE PEER REVIEWER**

**Joel McKellar** manages Harvard University's Green Building Services unit providing energy auditing, commissioning, LEED consultation and measurement and verification services, in addition to supporting University-wide policy initiatives such as the Harvard Green Building Standards and Green Revolving Fund. As a former researcher at a large architectural firm, he spent more than five years examining everything from the study of proxemics, environmental psychology, and biophilia to total ownership costs of buildings.

**Fossil Fuel Free**  
**High Performance Homes**  
**Low Heating Costs**  
**Exceptional Comfort**  
*Net Zero Ready*

**Zero Energy Homes**  
**Passive House (c) Homes**  
**BrightBuilt Homes (r)**  
**Deep Energy Retrofits**

**BOB IRVING** Owner/Builder

Bob@rhirvinghomebuilders.com  
 www.rhirvinghomebuilders.com  
 (603) 648-2635  
 Salisbury, NH 03268



**HEART & SOLAR**

WORKER OWNED | SOCIALLY RESPONSIBLE | SINCE 2002

**PV SQUARED**

**HEART & SOLAR**

**SUNPOWER®** | Elite Dealer  
 413-772-8788 | [PVSQUARED.COOP](http://PVSQUARED.COOP)  
 MA ELEC. LIC. A13764 MA HIC 140077

Certified Corporation

# ROOM-SIDE LOW-E COATING: AS GOOD AS IT SOUNDS?

BY ALEJANDRA MENCHACA

PEER-REVIEWED BY  
MARC ROSENBAUM

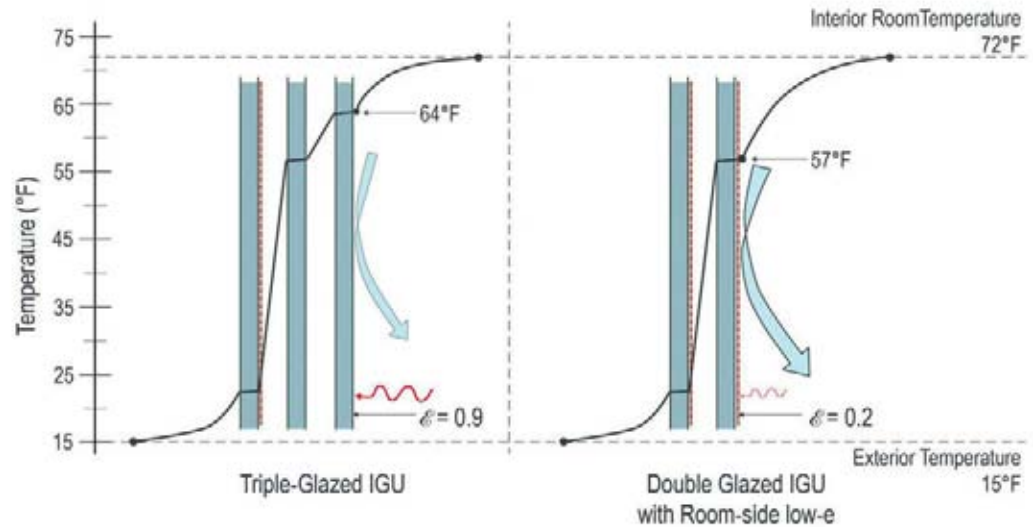


FIG. 1 - TEMPERATURE PROFILE THROUGH DIFFERENT IGU TYPES WITH A CENTER-OF-GLASS U-VALUE OF 0.20.

Windows are an invaluable aspect to façade design for building occupants. They increase an occupant’s connection to the outdoors and the right amount of daylight can lower lighting energy demands. Glazing technology has increased greatly from the single pane glass of the Mid-20<sup>th</sup> Century; however, code-compliant windows still transfer between five-to-eight times more heat than a code-compliant solid wall.

While triple pane insulated glazing units (IGUs) are becoming more popular as energy saving measures in cold American climates, they are still considered a luxury that not everyone can afford. However, an additional air cavity is not the only option for achieving high thermal performance in an IGU: adding a low-emissivity (low-e) coating to the room-side surface of a double pane window can reduce its center-of-glass U-value to comparable levels of that of an average triple pane IGU.<sup>1</sup> While low-e technology has existed for a decade, only recently have the coatings become resistant enough to scratches and cleaning products to be applied to the room-side surface as a viable product.

If one can achieve high thermal performance by adding a room-side low-e coating to a double pane IGU for a lower cost than a triple pane IGU, is this technology the best solution for every project? This article identifies which variables to keep in mind when answering this question.

## PHYSICS OF ROOM-SIDE LOW-E COATINGS

A brief physics lesson on how room heat is lost through windows: first, the warm air reaches the inner pane of glass

through convection; then the warm air from the room radiates to the cold outer pane. How much heat is lost through radiation depends, among other things, on the emissivity of the inner pane surface. The lower the emissivity, the lower the heat loss. A room-side, low-e coating (currently with emissivities ranging from 0.15 - 0.20) acts like a tin foil cover (or mirror) on the window, minimizing radiant heat transfer to the inner pane of glass by reflecting heat back into the room.

Because an IGU with a room-side low-e coating receives less heat from the interior, it is considerably colder. (See Fig. 1.) This cold surface has a significant impact on occupant comfort in the winter time.

## GLAZING, LOW-E, AND THERMAL COMFORT

When located close to a window on a cold day, an occupant can feel cold through two mechanisms: radiant thermal discomfort and downdraft discomfort. (See Fig. 2.)

Radiant thermal discomfort occurs when an occupant’s body radiates a large amount of heat to a cold surface such as a window. How uncomfortable the occupant feels depends on the mean radiant temperature of the occupant, which, in turn, depends upon the view factor and the interior surface temperature of the window. View factor is the quantification of how much an occupant’s body “sees” the window. If an occupant is three feet from a window with a given height and width, their mean radiant temperature will be more influenced by this window surface than if they were 10 feet from the window. Low performance (i.e. colder), closer and larger windows lead to higher heat loss (and hence more discomfort) from the occupant’s body



than high performance (i.e. warmer), farther or smaller windows. However, if the window has a low-emissivity inner surface, then less heat will be transferred from the person to the window; therefore the thermal discomfort will be reduced.

Downdraft discomfort is experienced when the warm indoor air hits the cold surface of the glass and cascades down to the floor, causing cold air drafts at ankle level. The thermal comfort of the occupant decreases with stronger air current speeds and colder air temperatures, caused by colder outdoor temperatures, as well as lower performing and/or taller windows. A colder inner glass pane, such as one with a room-side low-e coating, can lead to a more uncomfortable environment than a triple pane window with the same U-value.

How can we quantify the expected level of occupant discomfort in a given space, for a given location?

Radiant discomfort can be quantified by using the Predicted Mean Vote (PMV) model developed by P.O. Fanger. This model takes into account air temperature, occupant clothing and metabolic levels, and radiant temperature to quantify what percentage of the population is at risk of feeling uncomfortable, using the term Predicted Percentage Dissatisfied (PPD). A PPD of 10 percent indicates that one in ten people will feel thermally uncomfortable in a given environment. ASHRAE 55-2015 recommends PPD to fall under 10 percent for spaces of general occupancy.

Downdraft discomfort can be quantified using a model for risk of downdraft; this model was also developed by P.O. Fanger. The model indicates that discomfort is directly related to low draft temperatures and high air velocities at ankle level. The level of occupant dissatisfaction due to downdraft can also be translated into a PPD value.

Using these models for thermal comfort it is possible to portray graphically the combination of window geometries and U-values that will ensure occupant comfort, given an outdoor temperature and occupancy profile. Fig. 3 shows the critical U-value beyond which a window of a given size (represented by view factor) will cause radiant discomfort. Similarly, Fig. 4 indicates the maximum allowable U-value for a given window height to insure against downdraft discomfort. In these figures, the red and blue lines represent the limiting U-value for an IGU without and with a room-side low-e coating, respectively. Both assume a heating design outdoor temperature is 15 degrees Fahrenheit and office occupancy.

Let's consider the two glazing scenarios from Fig. 5. Scenarios 1 and 2 consist of punched windows with a sill without and with room-side low-e coating, respectively, while Scenarios 3 and 4 consist of full height glazing, also without and with room-side low-e coating, respectively. To ensure that occupants remain comfortable in either scenario, the U-value of the window must be the lower prescribed by Fig. 3 and 4. For instance, Scenario 1 requires a U-value of 0.48 to mitigate radiant discomfort, but a U-value of 0.38 to eliminate both radiant and downdraft discomfort. Similarly, Scenario 3, which has larger glazing would require a U-value of 0.23 to reduce the risk of discomfort.

Note the effect to comfort levels when a room-side low-e coating is added to an IGU. Because of its low emissivity, radiant discomfort is minimized with a coating; however, the risk of downdraft discomfort increases significantly. As such, small punched windows in Scenario 2 would require a U-value of 0.20 (achievable with a double pane IGU) to ensure occupants don't feel cold. Scenario 4, on the other hand, indicates that the room-side

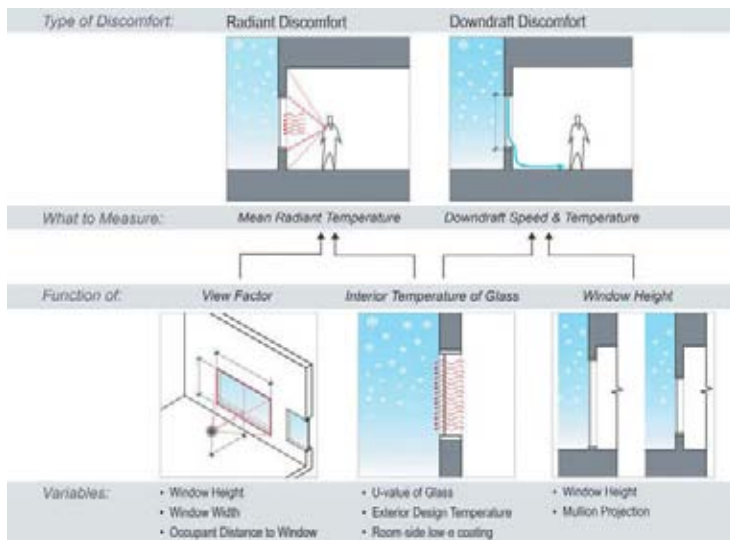


FIG. 2 – GLAZING PROPERTIES AND WINTER THERMAL COMFORT.

low-e-coated IGU would need a U-value of 0.12, a performance that is not currently achievable with a double pane IGU.

### MITIGATING DISCOMFORT THROUGH MECHANICAL MEANS: PERIMETER HEAT

When the thermal performance of a window unit is not enough to guarantee a comfortable space on the coldest winter days, perimeter heating is the default mechanical heating alternative. Although perimeter heating requires maintenance, takes up valuable square footage, and is more inefficient than other mechanical strategies, it is sometimes the most viable option for a design team.

However, perimeter heat should be avoided when using IGUs with a room-side low-e coating. Why? Remember that room-side low-e coating works by keeping the innermost pane of glass cold. By using fin tube to warm up the glass, the benefit of the room-side low-e coating on the thermal performance of the window is effectively neutralized.

Radiant panels are often proposed as an alternative to fin tube; however, they compromise the effectiveness of an IGU with room-side low-e coating for a different reason – the coating's low emissivity is precisely designed to prevent radiant heat from reaching the glass, meaning that the heat emitted by radiant panels will only minimally raise the temperature of the inner pane of glass.

In conclusion, when examining options that address the energy efficiency of a building's façade and occupant thermal comfort, room-side low-e coating offers many benefits. The technology's effectiveness, however, depends on a number of factors. The coatings are good at mitigating radiant discomfort, but increase the risk of downdraft discomfort. If used in a climate with mild winters, or with windows that are short enough to reduce the risk of downdraft discomfort, then IGUs with a room-side low-e coating can be an affordable alternative to improve the thermal performance of an envelope. In very cold climates or scenarios with very tall windows (taller than 6 feet for Boston's climate), an additional pane of glass is more effective in achieving a high performance envelope. It is challenging to identify the best design decision that improves both occupant comfort and energy

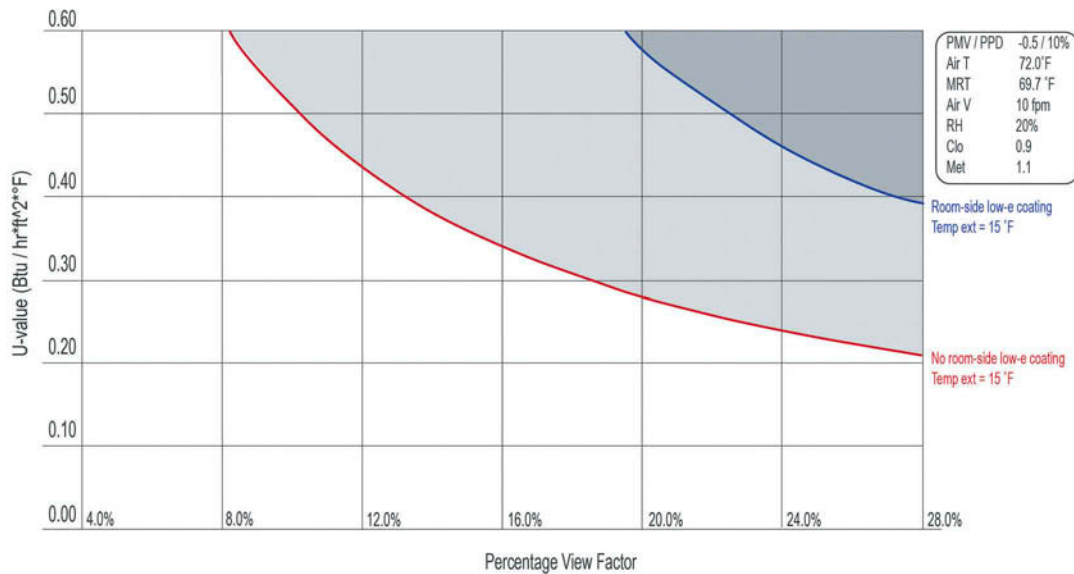


FIG. 3 - RADIANT DISCOMFORT U-VALUE VS. PER. VIEW FACTOR.

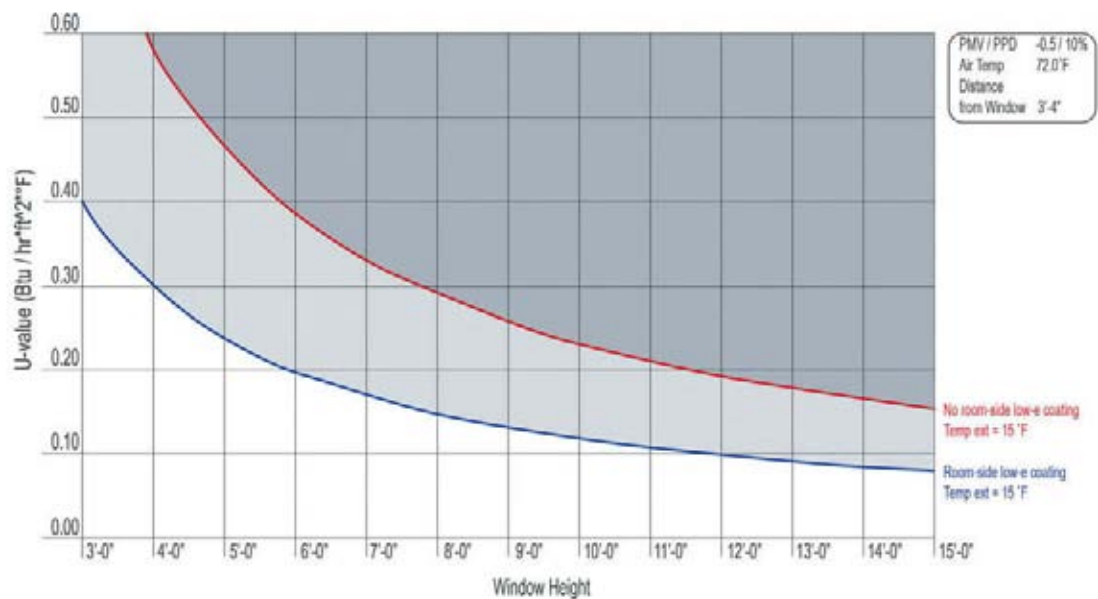


FIG. 4 - DOWNDRAFT DISCOMFORT VS. WINDOW HEIGHT.

efficiency, but an evaluation of room-side low-e coatings should be a part of that process. 🌱

**FINAL NOTE:** To evaluate the impact of a specific glazing design, climate, and use of room-side low-e coatings on occupant comfort, we encourage the reader to use the *Glazing and Winter Comfort Tool* ([payette.co/2clW104](http://payette.co/2clW104)), which was recently awarded an honorable mention at the AIA TAP Innovation Awards.


**ENDNOTE**

<sup>1</sup> An argon-filled double pane IGU with a low-e coating on surface #2 and a room-side low-e coating on surface #4 can achieve a U-value as low as 0.2 Btu / hr ft² F, which is comparable to the performance of an argon-filled triple-pane IGU a low-e coating on surface #2. U-values as low as 0.11 can be achieved with triple pane units with two low-e coatings.

**ABOUT THE AUTHOR**

**Alejandra Menchaca** is a Senior Building Scientist at Payette, where she leverages her background in mechanical engineering and building science to provide project teams with advanced sustainable design knowledge and energy modeling expertise, and improve the firm's understanding of the impact of design strategies and innovative solutions on building performance and occupant comfort. She holds a Ph.D. in Mechanical Engineering from MIT, and is a lecturer at the Harvard Graduate School of Design.

**ABOUT THE PEER REVIEWER**

**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. 

# BREAKING DOWN GENDER BIAS IN THE CONSTRUCTION INDUSTRY

BY KATE STEPHENSON

**T**he construction trades have long been among the industries with the lowest percentage of gender diversity in the workforce. As of 2015, less than 3 percent of workers in the construction and extraction trades were women – data on the percentage of lesbian, gay, bisexual, transgender and queer (LGBTQ) workers in the trades is not available – and the design field is not much better off. According to a 2012 survey of AIA member firms, only 16 percent of the AIA’s membership is female. Forty-nine percent of architecture students and 39 percent of interns are women, but just 17 percent of firm principals and partners are. And these numbers have not changed significantly in the last 30 years.

## WHY DOES IT MATTER?

We have a huge shortage of skilled labor in the trades right now. According to the Associated Builders and Contractors, 1.6 million new skilled workers will be needed between now and 2022. We can double the number of people available to fill this need by actively recruiting, supporting and creating training programs for women, transgender and gender non-conforming people.

Often, the construction trades are looked down upon by our society and our education system. The industry is not necessarily seen as a place where one can learn professional skills, experience career advancement or be compensated with a living wage and benefits. We need to change this perception of our industry: jobs in the building trades, engineering and design can be lifelong careers that support families, providing employment with relatively high wages, especially for women. According to a New York Times article from 2011, the gender wage gap in construction is lower than in any other sector, and women earn 92.2 cents on the dollar of what men earn.

With our community’s focus on high performance construction, integrated process, and building science and technology, the construction profession is becoming more sophisticated and requires a more diverse set of skills. Increasing the profile of our industry will also help attract a diverse workforce that includes more women and gender non-conforming workers.

## WHAT ARE THE BARRIERS TO INCREASING GENDER DIVERSITY?

Clearly, there is a lack of role models. Traditional gender stereotyping begins when children are very young, and is reinforced when girls are encouraged

to play with dolls and boys are encouraged to play with trucks and toy tools. Often those raised as boys gain building experience by helping their dads with projects around the house, while those raised as girls, even those who express an interest in carpentry, don’t have the same experience working with tools and building materials. This connects to ideas of leadership, “toughness” and prowess with physical or spatial problem solving. By the time kids are in high school, there may be a sharp gender-divide in confidence with these skills – one that has nothing to do with natural talent: instead, it is the result of socialization and unequal access based on stereotypes about talents correlating with gender. The end-result is that when it comes to hiring a laborer or carpenter on the crew, it’s more likely that a male will be hired over a female because they are perceived to be stronger and have more previous experience.

Gender stereotypes also frequently play into how students are “tracked” or exposed to career counseling in high school. Those raised as boys are more often encouraged to pursue vocational trades such as carpentry, welding, plumbing and electrical while those raised as girls are typically pushed towards health care, cosmetology and education. And that’s assuming they have access to vocational education at all – regardless of gender, the availability of vocational education has been decreasing steadily over the past 50 years.

## WHAT WILL IT TAKE TO CHANGE OUR FIELD?

We all know that *equality* and *equity* are not synonymous. *Equality* is treating everyone the same. *Equity* is giving everyone what they need to be successful. What we need is gender equity. On a practical level, that means putting in extra effort to attract, recruit, train and retain employees in order to increase gender diversity.

Here are a few basic ways to make your business more equitable:

- Use gender neutral language in job postings and job descriptions
- Respect everyone’s self-identification – call everyone by their preferred name and pronoun
- Ensure that adequate gender-neutral restroom facilities are available on every job site
- Ensure that all crew members have properly fitting personal protective equipment (it can often be unsafe for smaller people to use “standard” PPE)
- Develop and enforce a zero-tolerance sexual harassment policy – not only for your employees but for all subs on a jobsite

- Connect with tradeswoman organizations and post your jobs on their websites
- Be willing to challenge your assumptions about an applicant's ability to perform the work – give people a chance to prove themselves
- Make it a priority to hire and work with other subcontractors or vendors that are women- or trans-owned and/or who make it a priority to hire women, trans and gender non-conforming people

Surveys of women and LGBTQ workers in the construction industry (including engineers, architects and specialty trades) consistently show that these employees are frequently targeted with harassment and discrimination by their co-workers. Some of this treatment is explicitly sexual harassment, and some is subtler, and at times, even well-intentioned. For example, some men see it as just being polite to offer to carry something for a woman, but the offer implies that women or smaller-bodied people can't lift heavy things or perform the same tasks as their co-workers. Every female or gender non-conforming contractor I know can tell a dozen horror stories of inappropriate things said to them on a jobsite: some directed at making them feel uncomfortable, unwanted and disrespected as an authority or leader despite their skills and qualifications; and others – which are often chalked up to “locker room talk” – using vulgar or explicit language.

Changing these workplace dynamics takes a real intention on the part of business owners and managers. It's one thing to go out of your way to hire women, transgender and gender non-conforming people in your company; but you also need to do the work to change your company culture so those people feel welcome and thrive in that work environment.


#### WHAT ARE THE REWARDS?

According to cumulative Gallup Workplace Studies, companies with inclusive cultures do better on several indicators than those that are not inclusive, with:

- Customer satisfaction +39%
- Productivity +22%
- Profitability +27%
- Lower turnover -22%

**NOBLE HOME**  
High Quality  
Easy to Build  
413-623-3733  
Noble-home.net

**PASSIVE SOLAR HOUSE KITS**  
AFFORDABLE HOUSING FOR THE HOMEOWNER OR DEVELOPER

As leaders in the fields of renewable energy, green building, building science and sustainable design, the success of our industry is contingent on creating inclusive and equitable companies. To support this work, a number of NESEA members have collaborated to produce “Breaking Down Gender Bias: A Toolkit for Construction Business Owners” (<http://www.buildhelm.com/news/toolkit>) which is full of practical tips you can use to introduce these issues into your workplace, either as a business owner or an employee. 

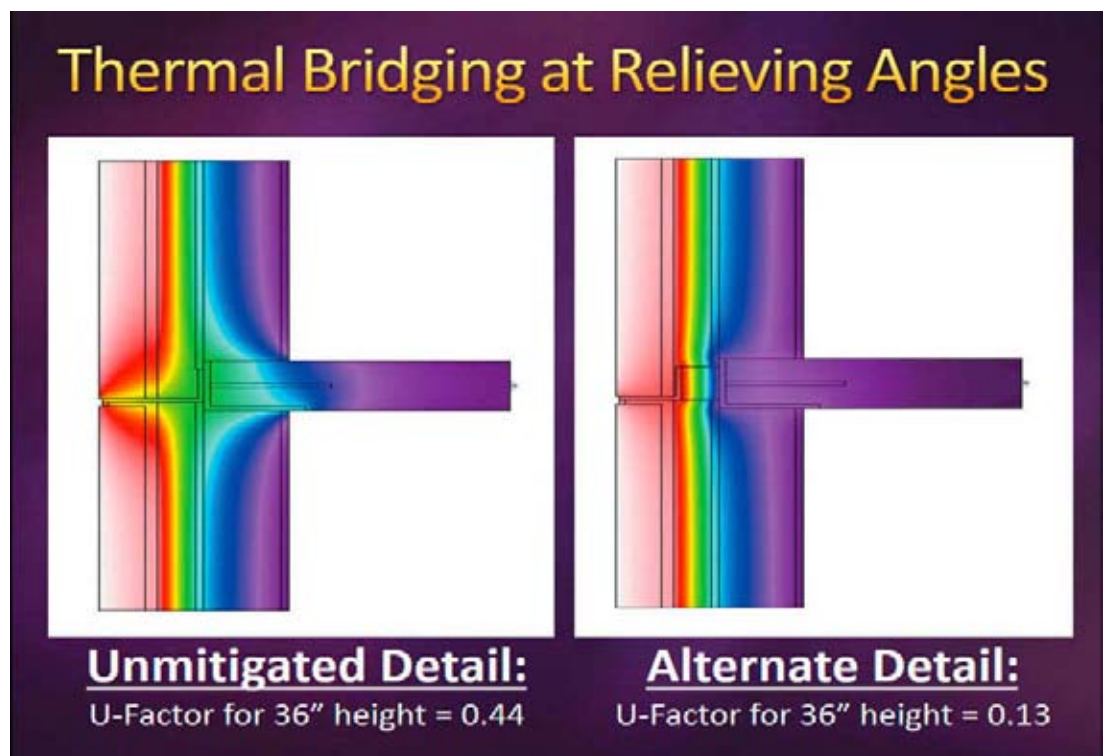
#### ABOUT THE AUTHOR

**Kate Stephenson** is a partner in HELM Construction Solutions LLC and is an experienced leader in the fields of green building, professional education, sustainability and business management. She's worked with established and emerging businesses and nonprofits to achieve triple bottom line metrics, develop business systems, and plan for a dynamic and resilient future. Kate helped to develop and is a facilitator for NESEA's BuildingEnergy Bottom Lines program.  BUSINESS MEMBER

#### Tips for Retention:

- **Sponsor and offer an apprenticeship program** to young women, trans and gender non-conforming people and promote the career opportunities available in the trades
- **Offer a buddy system** that starts from the job offer stage and assists women, trans and gender non-conforming people to form relationships, build networks and transition successfully to the company
- **End isolation** on worksites by assigning women, trans and gender non-conforming people, especially those new to the trades, in pairs or more
- **Guarantee pay equity** within your company
- **Offer flexibility** – family-friendly work schedules will make your business more attractive to all genders
- **Change the company's culture** to embrace diversity and flexibility as an ongoing commitment to the entire workforce – not just ‘special treatment’ for women, trans and gender non-conforming people

# UNTAPPED SYNERGIES: BUILDING BUILDINGS THAT WORK WITH THEIR SURROUNDINGS, THEIR USERS AND THEMSELVES



METAL SHELF ANGLES AND OTHER PENETRATIONS THROUGH INSULATION HAVE A SIGNIFICANT NEGATIVE EFFECT ON EFFICIENCY. ENERGY FUNCTION IS GREATLY IMPROVED WITH DETAILING TO REDUCE HEAT TRANSFER (RESEARCH FOR ENERGY CODE COMPLIANCE). PHOTO CREDIT: JAMES A. D'ALOISIO, P.E., SECB, LEED AP.

BY JODI SMITS ANDERSON,  
AIA, LEED AP BD+C

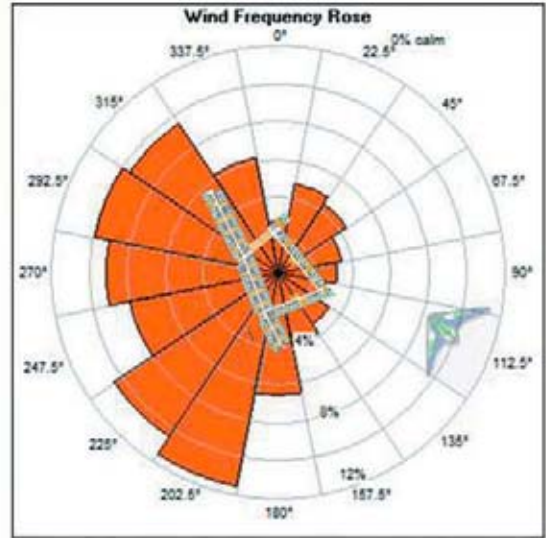
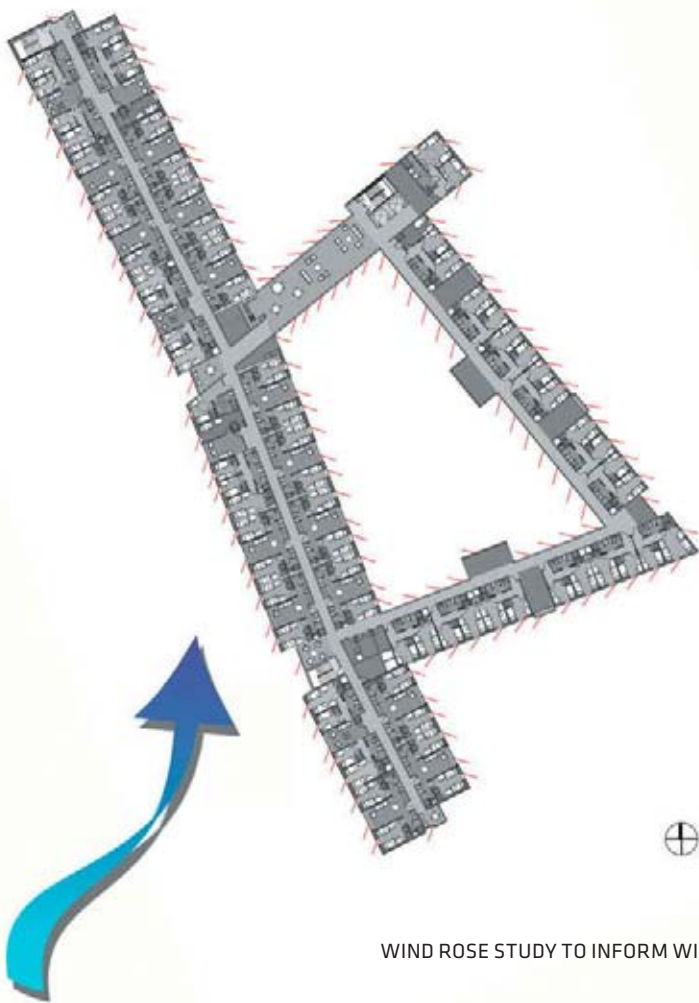
Interdependence is a strength, yet we design, construct and operate buildings without taking advantage of synergies that would yield optimal energy use, air quality and user comfort. We approach each project linearly, and quite often fall back on the old thoughts that these buildings function only to protect the occupants from nature, and that once the construction is complete, our work is done. We must do better.

- First, the building needs to work with its surroundings in order to reap benefits from wind, sun, rain, flora and fauna and soil conditions.

- Second, the building has to work with itself.
- Third, there must be interdependence between the building and its users so they know how to manage the building and benefit from its capabilities and quirks.

## HOW CAN A BUILDING WORK WITH ITS SURROUNDINGS?

The micro-climate conditions of any given site make each building a different product and experience. In the LEED v4 system, there is an optional credit for Site Assessment which I think should be mandatory because it reminds us of our professional responsibilities. We are not only



WIND ROSE STUDY TO INFORM WINDOW PLACEMENT AND OPERATIONS (BRIDGEWATER COLLEGE, MA).  
 PHOTO CREDIT: PERKINS + WILL.

translator of client desires into reality, but also of nature's gifts to the project. We need to know the site if we are to design, build and operate properly.

The site assessment requires teams to know topography, hydrology, climate, vegetation, soils, human use and human health effects (for detail, see the LEED v4 credit library on [www.USGBC.org](http://www.USGBC.org)). Loads of work, right? But this work comes with significant payoff. Every single piece of information listed above contributes to a project that supports users and energy optimization.

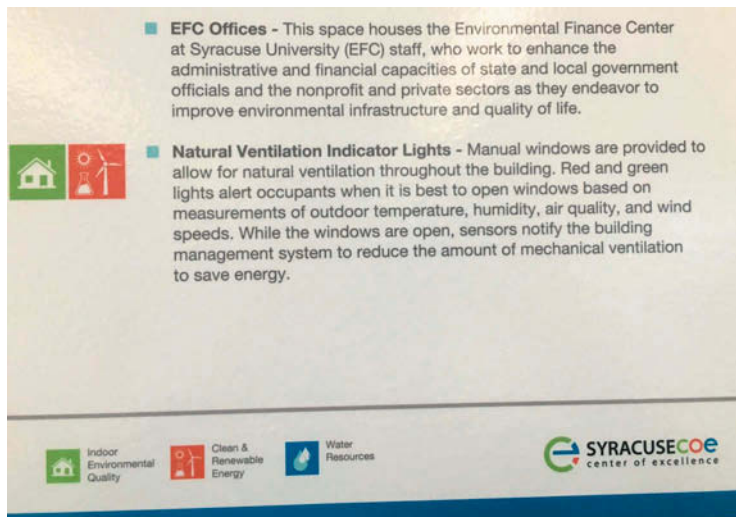
A wonderful example of a building working with its surroundings is a net zero-ready residence hall in Massachusetts, by Perkins + Will. One of the most significant aspects of the design was the onsite wind assessment and the influence that assessment had on the window choices, placement and operations. (More information here: [https://www.mscba.org/content/news/docs/59\\_newsdoc.pdf](https://www.mscba.org/content/news/docs/59_newsdoc.pdf)) Casement windows were selected based on that wind study. Casement windows, as well as awnings and hoppers, close tighter than sliders and double hung windows when wind presses up against the building. They also allow for the design of the opening face to either increase wind scoop into the building or protect the space from strong wind movement. Windows can provide much more than visible light and access to views, if we let them.

Nature gives us a ton of stuff for free. We need our brainpower to access that free stuff, such as placing windows properly to make use of airflow on the site. In some cases, we must pay to access the benefits, such as when we create electricity from sunlight. In either case, we will not benefit from nature's gifts if we don't pay attention.

### HOW DO WE MAKE THE BUILDING WORK WITH ITSELF?

Making the building work with itself, by improving our integrative design practices, should provide our easiest "synergy win." We need to conquer the barriers to collaboration that have been fostered by risk avoidance clauses in contracts. Ironically, lack of collaboration can create greater risk for poor performance, miscommunication and finger-pointing if things go wrong. New York's new residential energy code is fostering better design with testing for tightness and performance, and the commercial code contains very clear detailing requirements that lead to better buildings. Passive House creates a good example as well, by maximizing the insulation and air sealing and then properly managing the ventilation to optimize healthy air. LEED v4 now includes building envelope commissioning, recognizing, after all, that the building walls, floor and roof are part of the energy system.

Yes, you read that correctly: the envelope is part of the energy system! We need to comprehend this if we are to have any hope of net positive buildings in our future, or even non-wasteful buildings in our present. The building envelope can gain heat through proper siting of the building vis-à-vis the sun, as well as siting and selection of windows and other materials that store heat. It can also cause incredible heat losses if poorly designed. Using materials that can store heat longer lengthens the curve of heat gain and loss will help with energy control, and is as effective as any mechanical radiant system or off-peak ice storage plan. Designing the fenestrations to be very low in leakage and to optimize timing and amount of heat gain also produces energy, and can offset most of a building's heating load if done properly.



LIGHTS TO ENGAGE USERS IN ENERGY MANAGEMENT (SYRACUSE CENTER OF EXCELLENCE).  
PHOTO CREDIT: KERRIE MARSHALL, SYRACUSECOE.

Another aspect of making the building work with itself involves appropriate material selection - as recognized with passive house approaches and in selected credits in LEED. If the building is super-tight, you damned well better select clean, non-toxic, non-off gassing materials for the envelope to reduce burden to the air quality control. Avoiding energy use, in this case for added ventilation, is the best and most cost effective form of fossil fuel displacement.

### HOW DO WE CAPITALIZE ON INTERDEPENDENCE BETWEEN THE BUILDING AND ITS USERS?

We need to start building buildings for people again. Instead of “keeping up with the Joneses,” let’s strive to make all elements in a building usable and engage building users in running the building.

I heard a piece on NPR about a smart home being the subject of a TV series. Some of the episodes show the house totally taking over, running everything wild and even harming the occupants. That is quite the opposite of the real intent: being able to influence, monitor, control and tweak home or building operations. We must design buildings to provide feedback that will make collaboration with the users possible and normal. Again, the strength of the system will depend on layers of redundancy, diversity and a nicely woven set of overlapping, reinforcing feedback and control loops.

One example of this type of strong system would be a building where the windows and HVAC system controls are connected. With this approach, when the building user opens a window, the HVAC system banks down. Helping the building user understand that they are shutting off the mechanical systems if they choose to open a window is far better than depriving them of any control over the heating system. When building users can’t control the heat, they are forced to open the windows to cool off when it gets too hot. The system reads the temperature dropping indoors and compensates by pushing out more heat. We have evolved beyond this vicious cycle.

Another truly powerful aspect of real user engagement is plug load control strategies. This strategy is as fascinating as it is underutilized, though the International Energy Conservation Code is addressing it in transient housing situations. Tie the outlet operation to the occupancy of the room. One example: the room is fully powered when the access key card is placed into a slot near the door and when you leave and take that key card with you the room powers down, except for the outlet feeding the fridge and other must-stay-on items.

Control takes commitment. I stayed in a hotel in Upstate New York that had such a system installed. After about a year of operations, hotel staff started handing patrons two key cards and instructing them to place one in the slot to power the room so they could come and go without affecting the power, thereby undermining this energy management strategy. Staff found it difficult to explain the system to guests upon arrival and to deal with the few complaints of those that didn’t understand. Thankfully, they have since returned to the one-key approach and upped their communication with hotel guests, maybe due to client feedback and building performance losses. Lesson learned.


What about achieving zero net energy college residence halls? In my experience, interest is minimal because campus officials feel they have little control over students’ behavior. Some even worry that a plug load control system or other energy control system would be (sorry for this pun) a turn-off for the student population. They have “trouble enough” keeping the finishes in good repair in dorms, how could they expect students to understand active versus passive plugs to control plug loads?

Let’s turn this on its head. Some of students’ most vivid memories of college relate to their living environments. They often identify themselves by the dorms they lived in, long after they graduate and start donating to the school. Let’s build on that. We can make energy control not a “conservation” measure, but a control measure in the sense that we are **giving the occupant control**, creating even fonder recollections and more significant engagement in campus life. Some occupants may pay loads of attention and some not-so much, but overall energy savings come to pass, and user comfort increases.

It is not, however, a “set it and forget it” approach. It takes not only feedback, but review of that feedback and adjustments as needed. Look at the first years of hybrid cars on the road and clear feedback with the leaf graphics on the dash. Feedback has changed the driving habits of many. Not all, but many.

Ultimately, we share a single common failing with respect to each of these three potential synergies: we believe in the myth of the “silver bullet – that each solution must work for everyone. However, nature is filled with redundancy and diversity. By understanding a site’s characteristics, we can design to maximize performance. By integrating the design process, we can ensure the walls, roof and ground connections help optimize energy control. By offering many points of connection, several different types of feedback and a clear safety net (e.g., the system shutting off when windows are open), we can achieve greater efficiency through user engagement. We can help building occupants understand, over time, that they are in control, that the building is there to meet their needs, and it is in their care. I think we underestimate the desire and ability of building occupants - even college students - to rise to that responsibility. 🌱

### ABOUT THE AUTHOR

**Jodi Smits Anderson** is the Director of Sustainability at DASNY, the Construction and Public Finance Authority of New York State. A member of the AIA, LEED AP BD+C and a GPRO Instructor. She has spoken throughout the region and at Greenbuild, trained contractors and has been an Albany TEDx speaker on TBL success. Don’t miss her session, “Redundancy. Diversity. Connectivity: Optimizing Your Projects, Your Business, Your Work,” at the BuildingEnergy Boston Conference + Trade Show, March 7-9, 2017 at the Seaport World Trade Center. 

# THE MINERGY HOUSE: A BIT OF NESEA HISTORY



BY MARC ROSENBAUM

**T**he late 1970s was a vibrant time in solar-driven, energy efficient housing, full of passion and innovation. NESEA was founded in 1974, and members were in the thick of this experimentation.

Multiple approaches had their own devoted adherents. One approach was active solar heating, with a firm engineering basis emerging from the University of Wisconsin Solar Energy Lab. Another approach was sun-tempered, super-insulated housing, pioneered by Wayne Schick at University of Illinois, Harold Orr at the Saskatchewan Research Council, and Gene Leger in northern Massachusetts. There was also passive solar heating, championed by Ed Mazria (of *The Passive Solar Energy Book*) and the group at Los Alamos Scientific Labs (led by Doug Balcomb) that resulted in the three-volume *Passive Solar Design Handbook*. This handbook included substantial contributions from Total Environmental Action in New Hampshire, including Peter Temple, Dan Lewis, Joe Kohler, Charles Michal and Bruce Anderson. Finally, there was the double envelope

house approach, which was advocated by architect Lee Porter Butler, with similar work occurring in Norway.

A double envelope house typically had a large greenhouse or sunspace covering the south façade, connected to a natural convection air loop formed by the roof and the north wall, and a crawl space below the house, often with bare earth. The air loop path in the frame portions of the house was between an interior insulated assembly and an outer insulated assembly. The concept was that during a sunny day, the heated air from the glazed space would circulate upward and into the roof loop, down the north wall loop, and into the crawl space before returning to the bottom of the solar space. The claim was that the bulk of the solar energy was stored in the earth below the crawl space, and that energy was re-supplied at night, keeping the solar space from freezing and also buffering the heat loss through the roof and north wall. The standard envelope house was a two-story box with an all glass south façade - these houses wouldn't be rated highly on their architecture.





The center portion is double envelope, and the wings and the second floor are direct gain passive solar.



The NESEA community played a significant role in double envelope development, with members hosting three gatherings in 1979 and 1980 to share experience. Two small books emerged in 1980 – Don Booth’s *The Double Shell Solar House*, and William Shurcliff’s *Superinsulated Houses and Double Envelope Houses*. Doug Clayton wrote the performance monitoring chapter (there’s a great photo of him with Norman Saunders and Bob Smith poring over reams of paper!). Brookhaven National Lab also did some detailed monitoring of a double envelope house and found little evidence that this reverse nighttime cycle was operating as described or that much solar energy was actually being stored in the earth beneath the house.

As a young engineer I conducted research on solar and wind renewable energy during college and graduate school. I was learning everything I

could about these technologies. I was skeptical of Butler’s claims about how double envelope houses worked. I heard about the Minergy House being built in Lexington, MA. It was a thoughtful hybrid: it featured a double envelope design that also incorporated some direct gain passive solar features with added thermal mass. Designed by architect Bill Mead for Doug Holmes and his family, it was emphatically not a simple box. Pueblo Bonito and Wright’s Solar Hemicycle House are cited as design precedents for this south-facing, chevron-shaped house. Doug, a chemical engineer, had significant design input on the performance side. Recently, I went to visit Doug, now in his 80s, and catch up on how the house has performed over the last 35 years.

The solar engine of the house is a greenhouse built by Mark Ward. It is a salvaged steel and cypress structure, glazed with double insulated glass. It is

cradled by symmetrical wings that reach out to the southeast and southwest. The center portion is double envelope, and the wings and the second floor are direct gain passive solar. Doors on both levels of the house can be opened to admit solar heated air directly from the greenhouse. Thermal mass is everywhere: in the dyed concrete floor slabs in the wings and second level, in the exposed concrete half walls in the first level wings, in a salvaged timber frame floor structure with wood decking supporting the second floor and in the multiple layers of drywall. Much of this mass doesn't receive direct solar gain, but the area exposed to the solar heated air is large, and as it absorbs and releases heat, it stabilizes temperatures significantly.

The thermal envelope is modest by today's standards. The walls and roof in the portions without the double envelope are 2x6 with batts and 2x10 with batts, each with ¾ inch of interior rigid foil-faced

foam. The loop walls add a 2x4 with batts as an inner wall. The roof loop is built of an upper roof of 2x8 with batts and an inner roof of 2x6 with batts. Windows to the exterior are triple glazed. There are a few windows into the loop, with a hinged glazed panel on the inside so the exterior window can be opened. The floor over the crawl space is insulated with R-11 batts, and the crawl space is bare earth. There are 2 inches of rigid foam on the exterior of the concrete foundation walls.

There is a solar thermal collector for domestic hot water suspended in the greenhouse which protects it from freezing. There is no fresh air ventilation system. Two small wood stoves provide back-up heat. There used to be a saying, "passive solar, active people" – and the Minergy House exemplifies this. At the end of the day, if the house hasn't been warmed by the sun, the family will light a small fire, which will burn out overnight.

In the morning, if the forecast predicts overcast skies, they might light a fire to take the chill off. Temperatures in the house range from the upper 50s to the 80s degrees Fahrenheit, which is common in these early solar homes. The thermal storage dampened the temperature excursions, and also guaranteed that this house would never freeze if left unattended.

What did we learn from the Minergy House and other houses like it? After 35 years, everything works! Nothing is automated or digitally controlled, so there have been no equipment failures. We've learned that using earth buffering to keep highly glazed buffer spaces from getting too cold is a good strategy. Sadly, in some cases, we've learned the hard way that exposing wood-framed buildings to bare earth can cause mold and decay (I helped fix a decaying, moldy double envelope house a few years ago). I think we've learned that we don't need the double envelope; in fact, it was proposed that a retrofit for these houses could involve blowing the loop full of insulation. I think the most successful of the double envelope houses were early superinsulated houses with the glazed buffer space not only providing some solar heating, but also reducing nighttime heat loss through the large south-facing glazed areas of the living space. That need has decreased with the highly-insulating glazing available to us today. We've learned that we want very airtight envelopes, and that we need fresh air ventilation. Internal gains still help us heat our houses, but the source of these gains has shifted from incandescent lighting and inefficient refrigeration to the gaggle of electronic devices that fill our homes. And finally, I think we've learned that our knowledge is only extended by pioneers, like Doug and his family, who were willing to take risks. 🌱



Garland Mill Timberframes  
273 Garland Road Lancaster, NH 03584  
tele/fax 603.788.2619 www.garlandmill.com

## High-Performance Homes



## Bryan G. Hobbs Remodeling Contractor

Blown Cellulose Insulation • Spray Foam Insulation  
Airsealing • Energy Audits • Replacement Doors & Windows

Email: [bryanhobbsremodeling@gmail.com](mailto:bryanhobbsremodeling@gmail.com)

Telephone: 413-775-9006  
Cell: 413-522-2894  
Lic # 083982 • Reg # 139564

Bryan G. Hobbs  
346 Conway St.  
Greenfield, MA 01301



### 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. 🌱 **LIFETIME MEMBER**

### EDITOR'S NOTE:

**Doug Holmes** passed away on Dec. 23, 2016. He will be remembered fondly by many in the NESEA community for his cheerful disposition and his years of service on the NESEA Board of Directors.

# INDEX TO ADVERTISERS

## AIR LEAKAGE TESTING

Retrotec ..... 62  
www.retrotec.com

## ALTERNATIVE ENERGY

CED GreenTech ..... 33  
www.cedgreentecheast.com  
Cotuit Solar, LLC ..... 8  
www.cotuitsolar.com

## ARCHITECTS

George Penniman Architects, LLC ..... 61  
www.pennimanarchitects.com

## ARCHITECTURE

Bensonwood ..... 11  
www.bensonwood.com  
Black Bear Coatings and Concrete ..... 46  
www.blackbearconcrete.com  
C & H Architects ..... 43  
www.candharchitects.com  
Dietz & Company Architects, Inc. .... 32  
www.dietzarch.com  
eco\_logic STUDIO ..... 33  
www.eco-logicsstudio.com  
Maclay Architects ..... 46  
www.maclayarchitects.com  
Maple Hill Architects ..... 61  
www.maplehillarchitects.com  
Timeless Architecture ..... 46  
www.timearch.com  
ZeroEnergy Design ..... 37  
www.zeroenergy.com

## BUILDING COMMISSIONING

Stephen Turner, Inc. .... 17  
www.greenbuildingcommissioning.com

## BUILDING DESIGN & CONSTRUCTION

Auburndale Builders ..... 40  
www.auburndalebuilders.com  
Bensonwood ..... 11  
www.bensonwood.com  
Black Bear Coatings and Concrete ..... 46  
www.blackbearconcrete.com  
Center for EcoTechnology ..... 40  
www.cetonline.org  
Garland Mill Timberframes ..... 60  
www.garlandmill.com  
RH Irving Homebuilders ..... 49  
www.rhirvinghomebuilders.com  
Valley Solar ..... 36  
www.valleysolar.solar  
Wagner Development ..... 25  
www.wagnerdevelopmentcorp.com  
Wright Builders, Inc. .... 43  
www.wright-builders.com  
Yesterday Design/Build School ..... 48  
www.yestermorrow.org

## CARPORTS/GARAGES

Baja Carports ..... Inside Front Cover  
www.bajacarports.com

## COMMERCIAL & INSTITUTIONAL

Wright Builders, Inc. .... 43  
www.wright-builders.com

## COMMISSIONING

Stephen Turner, Inc. .... 17  
www.greenbuildingcommissioning.com

## CONSULTING

Bales Energy Associates ..... 37  
www.balesenergy.com  
DEAP Energy Group, LLC ..... 32  
www.deapgroup.com  
Stephen Turner, Inc. .... 17  
www.greenbuildingcommissioning.com  
Urban Habitat Initiatives, Inc. .... 8  
www.urbanhabitatinitiatives.com

## EDUCATION/EDUCATIONAL PROGRAMS

CED GreenTech ..... 33  
www.cedgreentecheast.com  
Hudson Valley Community College ..... 8  
www.hvcc.edu/tecsmart  
Yesterday Design/Build School ..... 48  
www.yestermorrow.org

## ENERGY CONSERVATION

EFI ..... 27  
www.efi.org/wholesale  
Halfen USA Inc. .... 21  
www.halfen.com/us

## ENERGY CONSULTANTS

PowerHouse Energy ..... 20  
www.powerhouseenergyconsulting.com

## ENERGY EFFICIENCY SOLUTIONS

Dryvit Systems, Inc. .... 39  
www.dryvit.com  
National Grid ..... 3  
www.myngrid.com

## ENERGY SERVICES

Bensonwood ..... 11  
www.bensonwood.com

## ENGINEERING SERVICES

CMF Engineering Inc ..... 33  
www.custombaseboardheat.com

## ENVELOPE & ENCLOSURE

Halfen USA Inc. .... 21  
www.halfen.com/us  
Huber Engineered Woods LLC ..... Inside Back Cover  
www.zipsystem.com

## HIGH PERFORMANCE MECHANICAL SYSTEMS

Zehnder America, Inc. .... 39  
www.zehnderamerica.com

## HVAC

Central Home Energy Experts ..... 16  
www.centralhomeenergy.com  
CMF Engineering Inc ..... 33  
www.custombaseboardheat.com

**MAPLE HILL**  
ARCHITECTS

Net-zero energy Fargo Education Center for Mass Audubon, Worcester

Doug Sacra, AIA, LEED AP • Wayland, MA • 508.561.2233  
www.MapleHillArchitects.com

**CONSULTANT**  
CERTIFIED PASSIVE HOUSE CONSULTANT

Keep it cozy.

**GEORGE PENNIMAN ARCHITECTS**  
www.pennimanarchitects.com 860.767.2822

# INDEX TO ADVERTISERS

## INDOOR AIR QUALITY

Zehnder America, Inc. ....39  
www.zehnderamerica.com

## INSULATION

Foard Panel .....31  
www.foardpanel.com

Halfen USA Inc. ....21  
www.halfen.com/us

Bryan G. Hobbs Remodeling Contractor.....60  
www.bryanhobbsremodeling.com

## LIGHTING SUPPLY

Fred Davis Corporation.....20  
www.freddaviscorp.com

## MULTIFAMILY

Wright Builders, Inc. ....43  
www.wright-builders.com

## NET ZERO ENERGY

Auburndale Builders .....40  
www.auburndalebuilders.com

Bensonwood .....11  
www.bensonwood.com

Pinnacle Window Solutions .....14  
www.pinnaclewindowsolutions.net

Timeless Architecture .....46  
www.timearch.com

Yesterday Design/Build School.....48  
www.yesterday.org

## PASSIVE HOUSING

Auburndale Builders .....40  
www.auburndalebuilders.com

Bensonwood.....11  
www.bensonwood.com

Halfen USA Inc.....21  
www.halfen.com/us

Passive House Institute US (PHIUS) .....16  
www.phius.org

Wright Builders, Inc. ....43  
www.wright-builders.com

Zehnder America, Inc. ....39  
www.zehnderamerica.com

## PAVEMENT

Ideal Concrete Block.....43  
www.idealconcreteblock.com

## PHOTOVOLTAICS

Valley Solar .....36  
www.valleysolar.com

## REMODELING/DEEP ENERGY RETROFITTING

Bryan G. Hobbs Remodeling Contractor .....60  
www.bryanhobbsremodeling.com

Pinnacle Window Solutions .....14  
www.pinnaclewindowsolutions.net

RH Irving Homebuilders.....49  
www.rhirvinghomebuilders.com

Timeless Architecture .....46  
www.timearch.com

Wright Builders, Inc. ....43  
www.wright-builders.com

## RENEWABLES & THE GRID

CED GreenTech.....33  
www.cedgreentech.com

Stiebel Eltron, Inc. ....7  
www.stiebel-eltron-usa.com

Yesterday Design/Build School.....48  
www.yesterday.org

## RETRO COMMISSIONING

Stephen Turner, Inc. ....17  
www.greenbuildingcommissioning.com

## SINGLE FAMILY

Wright Builders, Inc. ....43  
www.wright-builders.com

## SOLAR POWER DESIGN & INSTALLATION SERVICES

PV Squared .....49  
www.pvsquared.com

## SOLAR THERMAL

New England Solar Hot Water .....46  
www.neshw.com

Spartan Solar.....37  
www.gospartansolar.com

Stiebel Eltron, Inc. ....7  
www.stiebel-eltron-usa.com

## SOLAR/PV DESIGN SERVICES

Burrington's Solar Edge.....37  
www.solaredge.biz

CED GreenTech .....33  
www.cedgreentech.com

## TILT TURN WINDOWS

Menck Windows .....19  
www.menckwindows.com

## UTILITY INCENTIVE PROGRAMS

Con Edison/Power Your Way .....Outside Back Cover  
www.poweryourway.com

Yardi Systems, Inc. ....15  
www.yardi.com/energy

## VENTILATION

RST Thermal.....48  
www.rstthermal.com

## VENTILATION EQUIPMENT

Zehnder America, Inc. ....39  
www.zehnderamerica.com

## WINDOWS

Architectural Openings, Inc .....33  
www.archop.com

European Architectural Supply .....4  
www.finewindows.com

Menck Windows .....19  
www.menckwindows.com

Noble Home, LLC.....54  
www.noble-home.net

Pinnacle Window Solutions .....14  
www.pinnaclewindowsolutions.net

**The Future of Testing is Here!**

Retrotec created the DM32, the first WiFi touchscreen smart gauge.



DM32 WiFi gauge



Wireless control



Universally compatible



Mobile apps

Now we're unleashing the future of testing with secure results...



**rCloud**

The world's most powerful automated testing app.

- Geolocate your test location
- Automatically perform blower door or duct tests
- Create secure compliance reports
- Share/view results immediately from anywhere

**rCloud** Available now at [Retrotec.com/rcloud](http://Retrotec.com/rcloud)

Available for iOS, Android and Windows 8 & 10

**retrotec** | [www.retrotec.com](http://www.retrotec.com) | 1-855-738-7683 (toll free) | [sales@retrotec.com](mailto:sales@retrotec.com)

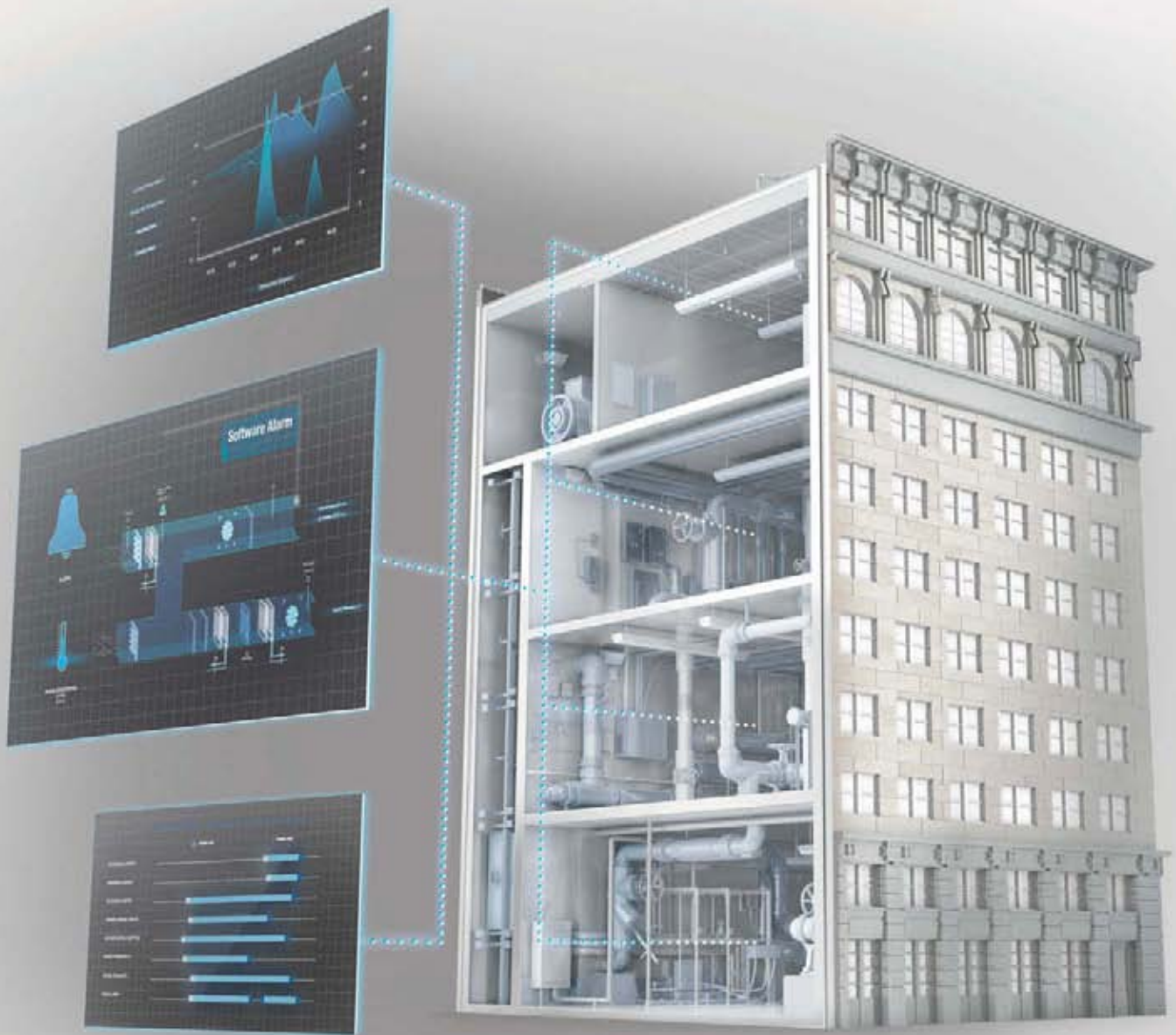
**ZIPsystem**<sup>TM</sup>  
**R-SHEATHING**

## Where Code Meets Comfort



**Structure, insulation and weather protection—all in one!** ZIP System® R-sheathing and tape provides a new all-in-one approach to sealing, protecting and insulating your building envelope. Get the benefits of a structural panel, weather-resistive barrier, air barrier and nailable wood base on the outside combined with foam insulation already attached. ZIP System® R-sheathing helps achieve the added R-Value and strict energy demands from new codes and advanced building programs—all in one easy to install system.

[ZIPSystem.com/R-Sheathing/buildingenergy23](http://ZIPSystem.com/R-Sheathing/buildingenergy23)



## USE YOUR INDEX FINGER TO KEEP A PULSE ON YOUR BUILDING.

Building Management System software lets you monitor your building's energy output through a network of sensors. So you can make real-time decisions. For a fully interactive experience designed to help you maximize control while minimizing your energy bill, visit our website. Financial incentives are also available. Just call 1-877-797-6347 to see if you qualify.

[ManageEnergy.conEd.com](https://ManageEnergy.conEd.com) #ManageEnergy



EVERYTHING  
MATTERS