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Four Ways Energy Efficiency Helps Businesses Mitigate the Burden of Unexpected Maintenance and Costs



One of the biggest challenges businesses face is preparing for the unexpected. Uncertainty can take many forms, and all can pose a great risk to a business. While some events, such as swings in the economy, changes in regulations, and a moving political landscape, are beyond the scope of control for most businesses, there are other areas of risk where business preparedness can mitigate an unforeseen event and the financial burden that comes with it. One area in which businesses can exercise control is their energy usage.



Energy efficiency initiatives, such as the installation of high-efficiency lighting,* HVAC, and operational equipment systems, are an excellent way to regain control over some of the unexpected costs to a business. Here are some ways that implementing energy-efficient systems can help your business experience a smoother ride for the long haul.

Mitigate high energy bills

Inefficient lighting, HVAC, and operational equipment can surprise you with an unexpectedly high bill at the wrong time. Upgrading to high-efficiency alternatives not only will reduce a business' energy usage by 10% on average, but will concurrently save money and reduce spikes in energy bills, making budgeting more successful.

Reduce unanticipated equipment maintenance

On average, 5% of production time is lost to unplanned shutdowns due to equipment failure. Energy-efficient equipment doesn't work as hard because it uses less energy to operate. The result is less failure, less maintenance, and less downtime.

Reduce safety incidents

Poor lighting and/or faulty HVAC systems increase the risk for on-the-job accidents. Upgrading to new energy-efficient systems increases security and comfort, which provides a safer working environment for employees.

Increase employee retention

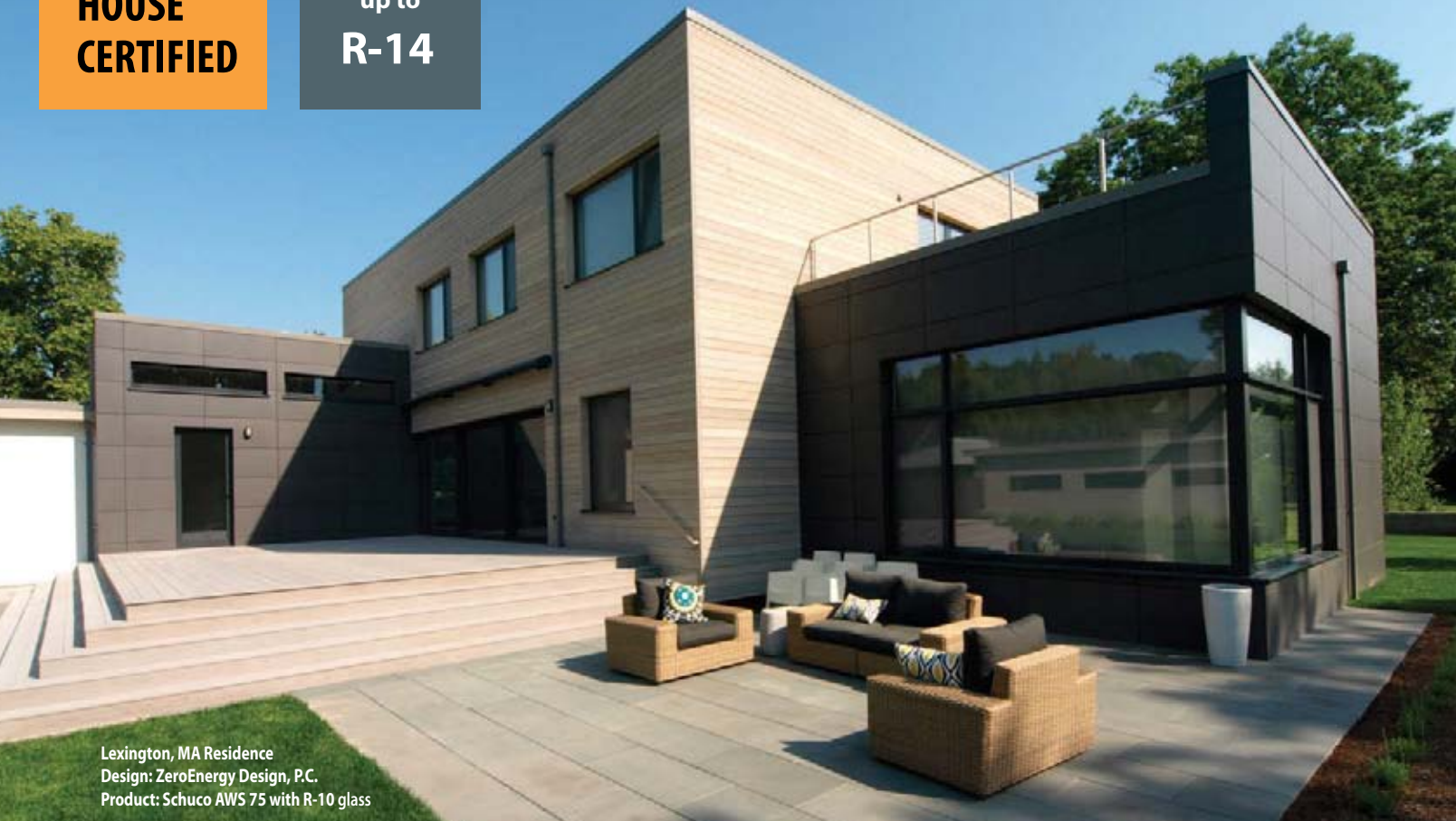
Replacing employees costs a business both time and money and can lead to unplanned job vacancies. According to a study, 21% of business owners report that increasing their facility's efficiency led to higher employee morale and reduced turnover.

Visit ngrid.com/business to learn more about how to take control over energy-related costs.

*Lighting upgrades and incentives through National Grid are not available in New York City and Long Island service territories.

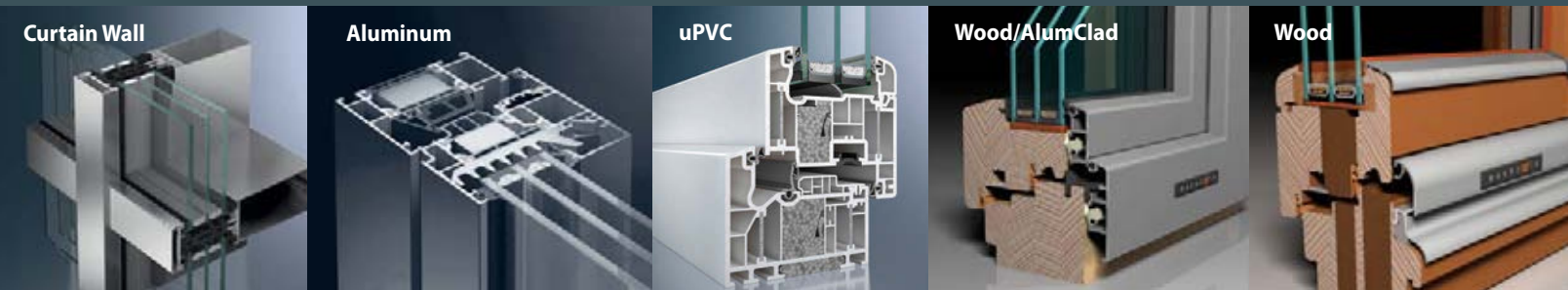
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ABOUT NESEA AND BUILDINGENERGY MAGAZINE

The Northeast Sustainable Energy Association (NESEA) is the region's leading community of professionals working in sustainable energy, whole systems thinking and clean technology. We advance the adoption of sustainable energy practices in the built environment by cultivating a community where practitioners share, collaborate and learn. The content in this magazine is selected by an Editorial Committee of NESEA members, and most articles are peer reviewed. To learn more about NESEA member benefits, contact Membership Manager Katie Schendel at kschendel@nesea.org. To learn more about writing for the magazine, serving as a peer reviewer or on the Editorial Committee contact Florence MacGregor at fmacgregor@nesea.org.



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CAPACITY CAMPAIGN DONATIONS: MORE THAN JUST MONEY



BY JENNIFER
MARRAPESE

PHOTO CREDIT:
MATTHEW CAVANAUGH

You probably know by now that NESEA launched its first-ever Capacity Campaign in December. This campaign, initiated by the NESEA Board, calls for us to raise an additional \$100,000 per year for the next three years to fuel the implementation of our strategic plan. (For context, typically NESEA raises about \$30,000 per year in donations. Through this campaign, the Board signed up for \$130,000 per year!)

Funds from the Capacity Campaign will support many of the strategic goals you told us were most important to you as NESEA members, including:

- Piloting mini-expansions of current programs (ex. Recruiting minority- and employee-owned businesses into BuildingEnergy Bottom Lines)
- Expanding the reach of our interactive online content
- Offering more programming on the borders of our current reach (ex. Pennsylvania, New Jersey, Delaware, upstate New York)
- Exploring how NESEA might support its members in weighing in on regulatory and policy matters that affect their practices
- Enhancing programming for Emerging Professionals
- Providing regional networking events and opportunities

The campaign has already inspired our community in an unprecedented way. In October, before the campaign launched, we secured pledges of almost \$63,000 from 50 lead donors, including participation from 100% of the NESEA Board. Since then, we have secured an additional \$16,000 from 20 more donors for a total of almost \$80,000 – more than double what we would typically raise in an entire year. So far, donations range in value from \$25 to \$10,000. Of the 70 donors so far:

- 29 are first-time or first-time-in-a-long-time donors
- 10 donated the same amount this year as last year
- 17 doubled their most recent donation
- 12 tripled or quadrupled their most recent donation

I know the remaining \$50,000 is likely to be much harder to raise than the first \$80,000. But I thought it might be worth sharing some early lessons learned

from this campaign ... lessons that I believe are applicable not just to NESEA as a nonprofit, but also to our members in their business development and fee negotiation. And to our emerging professionals, who will be negotiating with future employers. Maybe elsewhere too ...

If you haven't established goodwill, you haven't earned the right to ask. We have been laying the foundation for the Capacity Campaign for the eight years I've been at NESEA. We have established the trust of our community, having launched at least five new programs successfully without increasing the size of our staff. These programs, including BuildingEnergy NYC, BuildingEnergy Pro Tours, BuildingEnergy Masters Series, BuildingEnergy Bottom Lines and the Emerging Professionals program, have all come as a response to the needs our members have expressed for affordable opportunities to network with and learn from their peers. This track record of delivering great staff support for NESEA's member-driven content formed the foundation of our case – without it, we would not have had the credibility to ask for donations through our Capacity Campaign.

If you don't ask, you don't get. And if you don't ask for more, you don't get more. We started the Capacity Campaign by asking all of our Board members, lifetime members and past donors to stretch. We asked everybody who gave at least \$100 last year to double their most recent donation. Community members embraced the idea of being asked for a specific amount. Many stretched even further than we asked, donating three or four times their previous donations. And nobody took offense at being asked for too much, they simply declined or gave what they could.

We also have a few inspiring examples from first-time donors. One of note: Emerging Professional Mira Lieman-Sifry, who has been attending BuildingEnergy Conferences for the past 5 years or so, made her first-ever donation to help “pay it forward” to a community that has already been instrumental in shaping her career. In her words, “It's time to give back to the community that has given me so much ... I remember walking around at my first BuildingEnergy conference and listening to conversations that felt over my head, but also empowering. I knew right away I was among an extremely dedicated and hardworking community. As a NESEA member, the personal and professional

CONTINUED ON PAGE 8

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CONTINUED FROM PAGE 6


connections I have made have been extremely valuable in my pursuit of knowledge for creating better homes and efficient buildings.”

Many hands make light work. The Capacity Campaign is being driven by the NESEA Board of Directors. Each Board member has made a significant personal financial contribution. And each Board member is participating by meeting with and cultivating people in their networks that they believe would be interested in supporting NESEA.


It feels good to give. Devan Folts, our Communications & Development Director, refers to fundraising and development as “the transfer of enthusiasm.” It’s easy to ask somebody to support a cause you believe in. NESEA members often wear their hearts on their sleeves – they are so passionate about the work that they do, and by extension about the ways NESEA supports their work. We’re simply giving them the opportunity to be a part of something bigger.

People donate and engage in many different ways. Some members have told us that they are not in a position to make a financial contribution. Others have said that they would prefer to donate time (by mentoring an emerging professional or serving on a NESEA committee) than to donate money. Donations come in many forms: time, talent and treasure. And often people donate money to the organizations they

invest their time and talent in. It’s all good. As we build NESEA’s capacity, we hope you’ll contribute in the way that feels most impactful to you.

I close this letter with the recognition that you won’t read it for another 2 months. Things are unfolding so quickly here at NESEA that this lag seems like an eternity. But I’m hoping that the lessons we are learning in this Capacity Campaign endure long past the publication date of this magazine. And, of course, that new lessons will continue to emerge. 

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 members 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, NESEA members and other collaborators. She earned her BA in Journalism from the University of Wisconsin, her JD from the University of California, Berkeley, and her MA in Organizational Management and Development from Fielding University. She lives as close to net zero as possible in her deep energy retrofitted ranch, despite having two teenage daughters and a swimming pool. 



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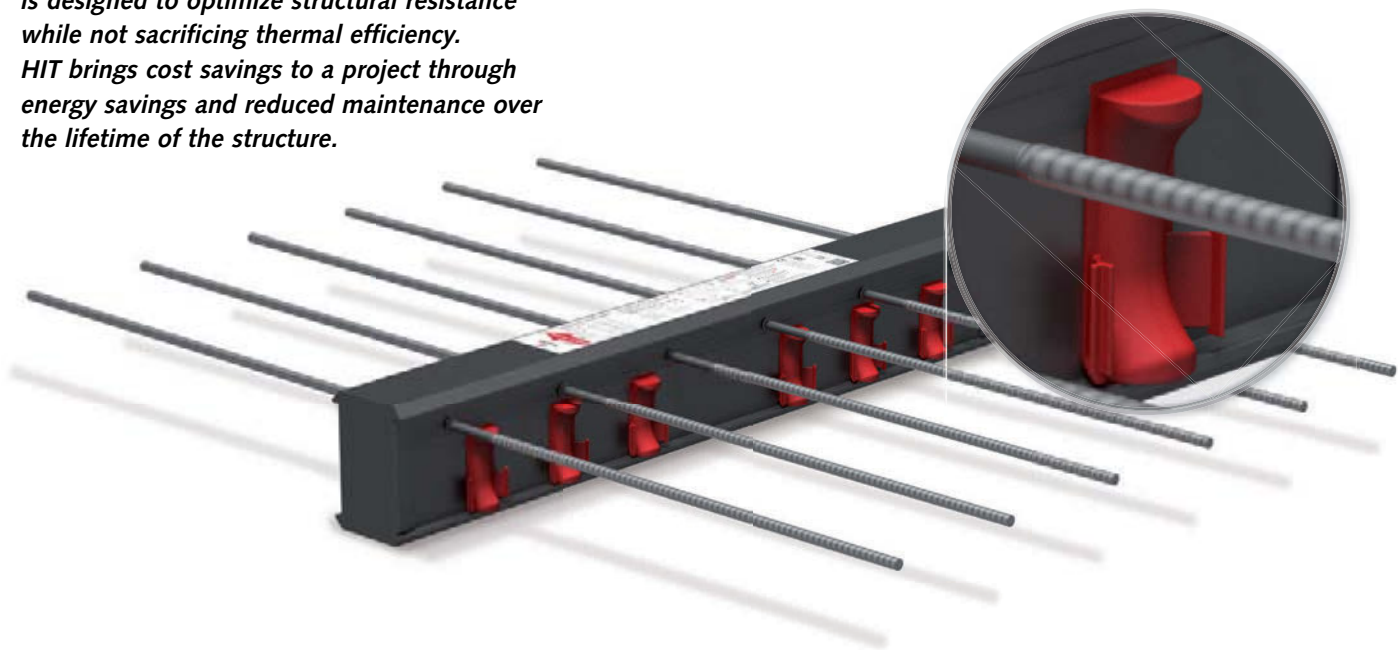
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SEEING THE FUTURE OF NESEA



BY PHIL KAPLAN

A funny thing happened to me in New York this October.


Yes, I ate some amazing food, drank even better cocktails and saw some of the best new buildings in the world. But a real eye-opener for me came while attending the BuildingEnergy NYC Conference. As a 10+ year BuildingEnergy Boston attendee, I'm pretty tuned into the vibe – it's part of what keeps me coming back. The best sessions, speakers, trade show floor and shared history, plus camaraderie with like-minded colleagues make it a never-miss event.

So what is it about the BuildingEnergy NYC conference, now in its sixth year, that has vaulted it into a resoundingly successful event? I'm not sure it's any single thing, but it definitely looks and feels like the future of NESEA to me.


For one, it's a single day. People are there to do business. There are plenty of interesting side conversations, but the intensity of attendees purely seeking knowledge is palpable. The questions are pointed and freely flowing. Compared to our Boston conference, there are a lot more suits and ties, and economics sits alongside sustainability in just about every conversation. The financial benefits of high-performance construction are a current reality in the Big Apple, not just a pipe dream, and many people who work in this much larger-scale city have caught on. There is an urgency to gaining the right information and applying it to projects in development; there's a lot at stake. People with the information get the edge. And the scale of the work allows our industry to make a bigger impact in a shorter timeframe. This is in complete alignment with the mission of our organization and it's extremely energizing.

As current Board Chair, I've had a front row seat to the formation and implementation of the new Strategic Plan. A high priority goal

of the plan is to continue to deepen NESEA's programmatic focus to include more Commercial and Institutional content. Not only is it the focus of the BuildingEnergy NYC Conference, but it's also the central theme of this issue of *BuildingEnergy* magazine. To me, it's a critical evolution of the organization, particularly for long time practitioner attendees. In the words of my friend (and fellow BuildingEnergy Bottom Lines member), Placetaylor's Declan Keefe, "There are only so many sessions on heat pumps in single family homes that one can attend." Yes, Declan, I did just give one of those heat pump presentations a few weeks ago, and no, I didn't get yawned off the podium – but I do get your point loud and clear.

The industry still has a long way to go before our job of disseminating the most current information on sustainability and the built environment to the general public is done, but the time has come for a shift in scale, scope and urgency. It's time to continue expanding the conversation, even for those in the single-family construction industry, since it's in the breadth of impact where our shared values and goals ultimately lie. 

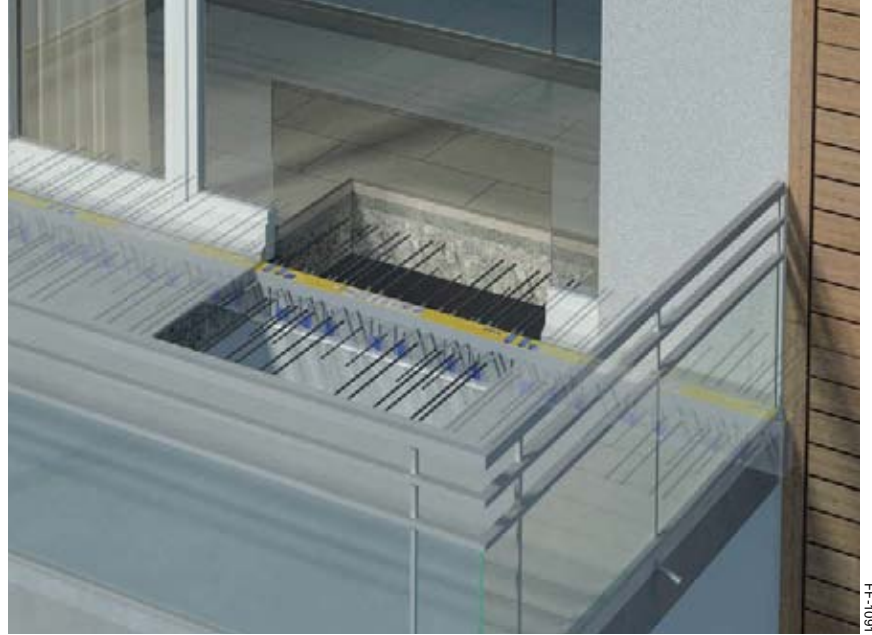
ABOUT THE AUTHOR

Phil Kaplan's firm, *Kaplan Thompson Architects*, has received numerous accolades in the world of design and high-performance building. The firm's motto, "Beautiful Sustainable Attainable," reflects a commitment to creating vibrant, healthy and durable buildings for all. Phil's other venture, *BrightBuilt Home*, aims to provide more affordable, modular net-zero homes throughout the Northeast and Mid-Atlantic. Phil's 'edutainment' podcast, *Green Architects' Lounge*, is a topical blog on the popular website, *Green Building Advisor*. 

The industry still has a long way to go before our job of disseminating the most current information on sustainability and the built environment to the general public is done, but the time has come for a shift in scale, scope and urgency.

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PRODUCT CHOICES FOR HIGH-PERFORMING BUILDING: MATERIALS MATTER



WILLIAMS COLLEGE ENVIRONMENTAL CENTER.
CREDIT: NICK NOYES

BY CHARLEY STEVENSON
AND MATT ROOT

PEER REVIEWED BY
JASON J. JEWHRUST

A recent article in *Co.Design*, “Are ‘Green’ Buildings Killing Us?”, starkly underscored the wide-range of potential outcomes of the movement toward sustainable structures, particularly in regards to health. Results range from spectacular success to falling well short of the mark. But always, opportunities abound.

The article highlights findings of the nonprofit research institution Silent Spring, which discovered dozens of harmful chemicals in newly renovated, LEED-certified low-income public housing in Boston.

Some of these chemicals came from typical products and furnishings brought in by residents. Sadly, however, many unhealthy contaminants emanated from the building materials themselves.

Ironically, these products often relate to sustainability or are chosen to enhance energy efficiency. Although findings such as those from Silent Spring seem to undercut the value of green building, they are better viewed as a prime opportunity to raise the materials standards for manufacturers and positively move the market towards healthier goods.

With the advent of regenerative design frameworks such as the Living Building Challenge (LBC), administered by the nonprofit International Living Future Institute (ILFI), creating beneficial built environments has become a progressively

sophisticated undertaking. Although the LBC process (whose materials standards we consider here) moves us in the right direction on diverse fronts, attempting to address each of the imperatives and solve all the inherent problems at once can be overwhelming.

It is easy to lose focus and concentrate on some design aspects, such as energy and water, while giving short shrift to others, such as materials. Such thinking can lead to single variable optimization: carbon dioxide emissions are a problem, so efficiency is the solution. Of course, carbon dioxide emissions from building operation are a significant problem, but not the only problem.

The best sustainable practices consider all. As NESEA members, we are constantly examining many decisions that affect the performance of our projects in our quest to build better buildings. Responsible teams will seek to address as many issues as possible in design and construction, minimizing harm and impact whenever possible.

Adding materials health considerations to the mix can be done incrementally and it adds a new dimension to a building’s performance. Many of the decisions we make while specifying products for our projects have hidden expenses:

- Poorly chosen products place building occupants in an environment of known toxins.
- The negative effects of toxins on worker productivity and sick time are well-documented.

- Building with ingredients we know are hazardous potentially increases future remediation costs. Project teams can choose a different path, opting to select and procure products while applying the precautionary principle: if in doubt, avoid chemicals of concern whenever possible. We know how to build energy efficient buildings. It is now time for us to employ a healthy materials filter in selecting the products that make up our buildings.

their products and use the marketplace to reward those manufacturers that do so. We should begin with the premise that product users have a *right to know* what they are buying and that manufacturers should not withhold ingredient names as proprietary.

Our third step, once the full list of ingredients is known, is to screen those ingredients against any number of lists: LBC Red List, EPA Chemicals of Concern, Green Policy Research Institute's Six Classes



WILLIAMS COLLEGE ENVIRONMENTAL CENTER.
CREDIT: NICK NOYES

Products and building materials have health impacts in the communities where they are produced, on the workers who install them, on the occupants who use the building and on the planet in terms of what happens to the product at the end of its first life. The question is how best to proceed in minimizing the burden on these three constituents: factory communities, trades persons and installers, and occupants?

The short answer is that right now, it is not easy. Product manufacturers are not used to being asked what goes into their products and supply chains for the various components that make up any given product are complex and opaque. But we need to start somewhere.

The first step is demanding transparency when it comes to the ingredients that go into a product. We then need to guide our material selection using the precautionary principle. We should require proof of safety first, rather than the current paradigm, which waits until proof of harm before action is taken.

Health Product Declarations (HPDs) can provide a starting point for useful ingredient information, but may offer inadequate disclosure for LBC. An HPD usually requires follow up with the manufacturer; other "green" documents supply comparable information, but often feature similar gaps.

Our next step is to urge product manufacturers to be transparent with the materials that go into

TIPS FOR STRENGTHENING YOUR SPECIFICATIONS

1. Provide specific products.

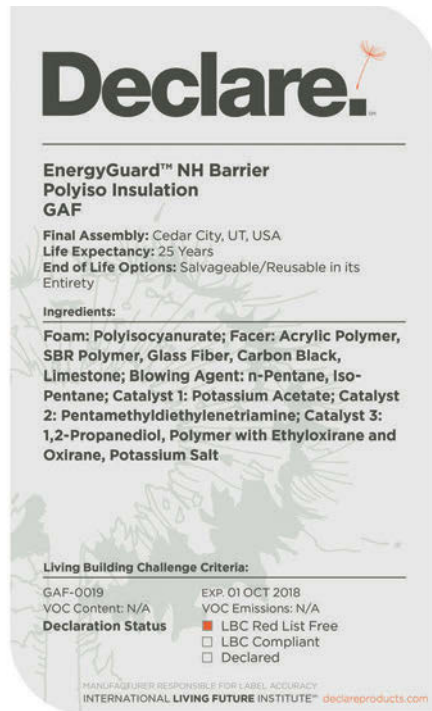
Do not rely on performance language. Material transparency is a murky world. Don't put the burden on your contractor to become a materials expert.

2. Pick your spots.

Focus on the products the occupants come in contact with the most. Start with one division (e.g., Finish - Division 09) and develop a strong specification filled with durable, healthy products. Don't try to do everything at once.

3. Select Declare labeled products

(www.living-future.org/declare). The Declare label answers three essential questions: Where does it come from? What is it made of? Where does it go at the end of its life?



DECLARE IS THE NUTRITION LABEL FOR PRODUCTS.
CREDIT: THE INTERNATIONAL LIVING FUTURE INSTITUTE

or Healthy Hospitals Initiative. There is no complete list of chemicals of concern, but any screening is preferable to no screening.

KEY CONSIDERATIONS FOR IMPROVING PRODUCT SELECTION

- Even without scientific study of indoor air quality impacts, there are some rules of thumb that can help guide your team to make the best use of its product selection efforts. Ask: “Can you touch it? Does it smell when you install it? Is there a lot of it?”
- Prioritize interior finishes in your efforts to avoid toxins. Paints, wallboard, flooring and carpet are product types for which benign options exist. Batt insulation and wallboard are ubiquitous, so they warrant attention as well.
- Likewise, there is value in signaling to manufacturers that toxins in exterior products should also be eliminated. It will take time for those markets to mature in response to increasing consumer demand.
- In our experience, the only way to achieve cost-effective success in a project with specifications is to name exact products that *can* be used. Vague performance language such as “Avoid formaldehyde in batt insulation products” is either ineffective or expensive because it represents uncertainty and confusion to any potential bidder.
- It is more cost effective for the design team to research one or more products that meet the project’s goals. Once the documentation is complete, that product can be reused in any number of future projects. Know that the ultimate goal of achieving benign materials will happen through iteration: accept imperfection.

The market, as a rule, is not ready to embrace benign materials for conventional construction. Choose the best option that is available now, but make it clear you will demand better in the future. Each slightly healthier project eases the work for future projects

SELECTING BEST-IN-CLASS MATERIALS

Manufacturers are increasingly responsive to ingredient concerns as health imperatives dovetail with sales opportunities. To that end, ILFI has established the Declare program. Essentially a “Nutrition label” for products, Declare provides transparency that is changing the materials marketplace.

Declare products enjoy preferential access to Living Building projects: every Living Building must contain at least one Declare product per 5,000 square feet of building area.

Client resistance is likewise eroding. We like to ask, “Given a choice, which bioaccumulative toxins, carcinogens and endocrine disruptors do you like to have in your buildings?” The usual answer – and the one we like the best, of course – is “none.”

Contractors, builders and subcontractors need clear direction and assistance throughout the process. Writing sustainability specifications that encourage healthy product choices is an essential component to encourage builder buy-in.

For example, below are a few guidelines and suggestions on insulation. Some of these comments should be recognized as operating on the leading edge and should not be taken as full product endorsements.

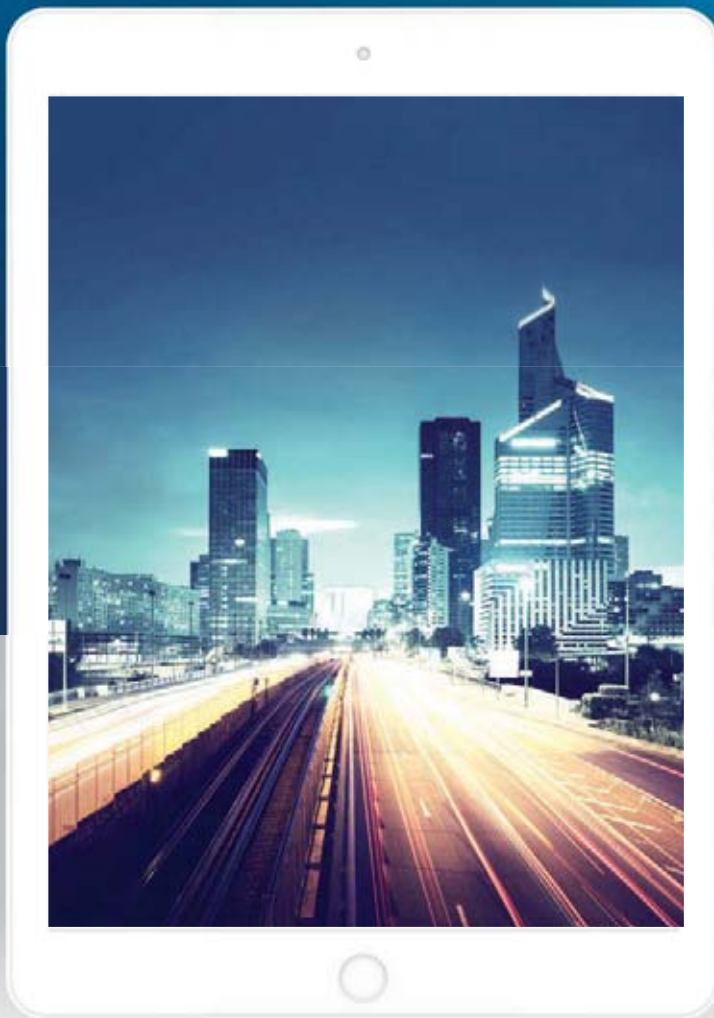
The reality is that we need more advancements in “green” chemistry, which will create better molecules. We must learn the lessons of the past and be cognizant of regrettable substitutions. The switch from BPA to BPS did not make us safer, it simply replaced one toxin with another toxin we know even less about.

- **Spray Foam Insulation (two part):** Best to avoid due to flame retardants, but when you must use it, look at the blowing agents. Demilec Heatlok HFO and Lapolla FOAM-LOK 200-4G are closed cell spray foams that both use Honeywell’s Solstice Liquid Blowing Agent, which has a Global Warming Potential of 1 and an Ozone Depletion Potential of zero. Icynene’s ProSeal Eco is a water-blown closed cell spray foam.
- **Polyisocyanurate Board Insulation:** Two Declare listed products that are Red List-free are GAF’s EnergyGuard NH series from and Carlisle Syntec Systems’ SecurShield NH series.
- **Fiberglass Batts:** Most major manufacturers offer a formaldehyde-free fiberglass batt option.
- **Cellulose:** Greenfiber has a Declare labeled Red List-free cellulose. It has Ammonium sulfate, which is considered safe for humans, but it can be corrosive to metal and may produce an ammonia smell. Cellulose products with boron based flame retardants do not have these issues.

CONTINUED ON PAGE 16

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CONTINUED FROM PAGE 14


- **Pipe Insulation:** Aerocel EPDM is Red List-free; Knauf has formaldehyde-free insulations.
- **Duct Insulation** (inside the ductwork): Knauf's Atmosphere is Declare labeled Red List-free.
- **Duct Insulation** (outside the ductwork): Most major manufacturers carry a formaldehyde-free product.

Materials selection is the next frontier for designers and builders seeking to build a better project. Involvement, investment and leadership in this effort during these early days is a generous act, but it need not be a sacrifice. Pay it forward. 

ABOUT THE AUTHORS

Charley Stevenson is the principal consultant at Integrated Eco Strategy in North Adams, MA. IES supports regenerative design projects nationwide. With the team at www.integratedecostrategy.com, he has collaborated on ten LBC projects, with a particular focus on Materials Petal compliance. Their software development team will release the Red2Green material selection software platform in 2018, enabling a wide range of project teams to achieve the LBC Materials Petal confidently and efficiently. He was named an LBC Hero in 2015. 

Matt Root is Senior Project Manager for Integrated Eco Strategy (IES), managing healthy materials- and energy-related projects in the Boston region for projects pursuing Living Building Challenge certification or

inspired by the program's intent. He also develops new projects and represent IES at regional and national conferences. Matt joined the IES team after serving as a building performance consultant for more than 13 years on large multifamily and commercial projects. His experience spans mechanical systems, enclosure detailing and performance testing. Matt is an active NESEA member, having served as Co-Vice Chair of BuildingEnergy Boston 2014 and then Conference Chair for BuildingEnergy Boston 2015. 

ABOUT THE PEER REVIEWER

Jason J. Jewhurst, AIA, Principal at the architecture firm Bruner/Cott Architects in Cambridge, MA, was born and raised among the lakes of New England. Jason welcomes design challenges that demand innovative, sustainable, regenerative solutions. His passion for connecting with the natural environment informs all of his work as a specialist in sustainable and high-performance building design. He recently completed the R.W. Kern Center at Hampshire College, designed to meet the LBC. Jason is committed to sharing knowledge and inspiring others. He speaks frequently at regional and national conferences on high-performance design, transparency & healthy materials, net positive design, campus transformation and is a member of the International Living Future Institute's (ILFI) East Coast Congress, a think tank for sustainable policy and advocacy. 



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DESIGNING SOLAR FOR HIGH-DENSITY AREAS

BY ERIC WALLACE AND ALEX MIRABILE

PEER REVIEWED BY STEVEN STRONG

Humans have been trying to harness the power of the sun for millennia. The advent and popularization of photovoltaics in the latter half of the twentieth century made doing so accessible to the masses. Today, solar arrays are commonly seen adorning the roofs of suburban homes, “big-box” retailers and landscapes including expansive solar farms and capped landfills. Until recently, the common thread between these locations has been open space. Solar applications have historically been reserved for use in areas of low-to-moderate building density.

By the end of 2050, solar energy is projected to be the world’s largest source of electricity. While utility-scale solar will account for the majority of this capacity, there will also be significant growth in the commercial and residential sectors – particularly in cities. Industry influencers are increasingly focused on creating opportunities for solar applications in high-density areas, where much of the demand lies.

By the end of 2015, 20 U.S. cities accounted for six percent of the country’s solar photovoltaic (PV) capacity. This is particularly impressive given that these cities combined account for merely 0.1% of U.S. land area. According to “Shining Cities 2016,” Environmental America’s report regarding the status of solar power in the United States, 64 of America’s cities have installed

over 1,700 MW of cumulative solar PV capacity – almost as much as the entire country had installed by the end of 2010.

HOW ARE THESE CITIES DOING IT?

System costs across all sectors are rapidly decreasing due to an explosion in demand, pushing the industry further along its experience curve and leading to technological advances in modules, among other improvements. As costs continue to drop, solar power development becomes feasible in more challenging locations, including high-density areas. Many cities have established green initiatives in order to increase the public visibility of renewable energy, pursue their own sustainable goals and save money on operational costs. For example, 37 public buildings in Las Vegas have reached a solar capacity of 6.2 MW. This includes fire stations, community centers and parks, as well as a 3.3 MW generating station at the city’s wastewater treatment plant. Tampa, Raleigh, New York City and Atlanta are also at the forefront of incorporating solar power into their government and public facilities.

In addition to the reduced costs and increased supply of solar PV, demand is being bolstered by the availability of incentives. The Federal Investment Tax Credit (ITC) offers up to a 30 percent rebate for installation costs through 2019 and continues the

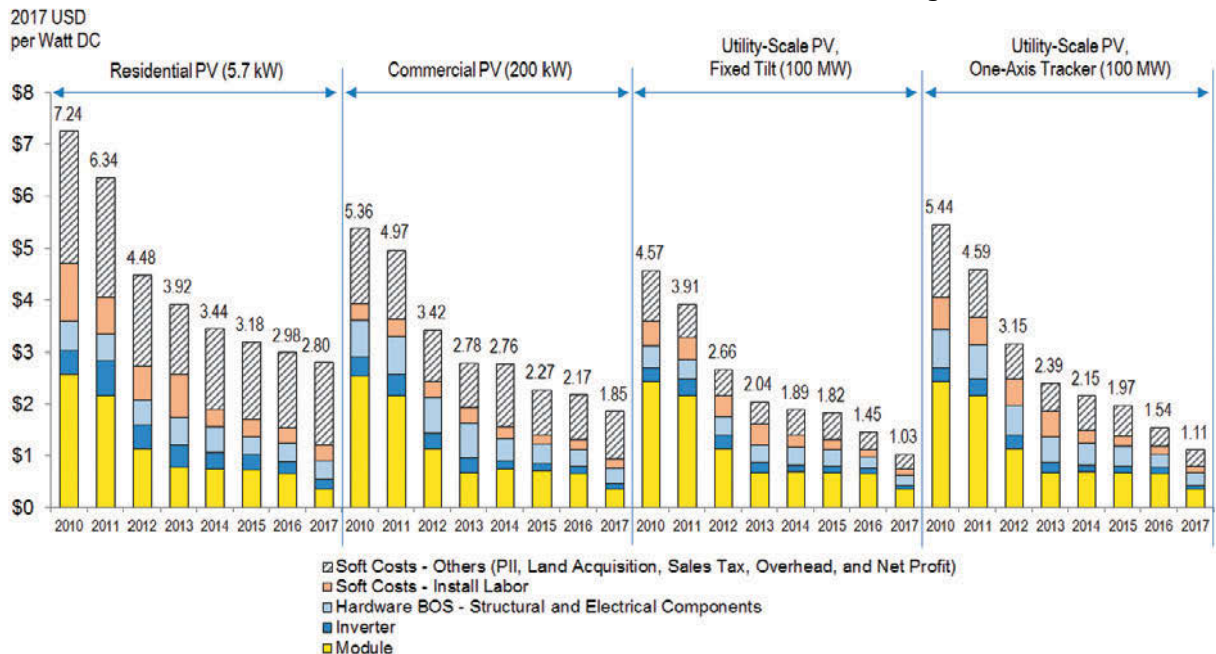
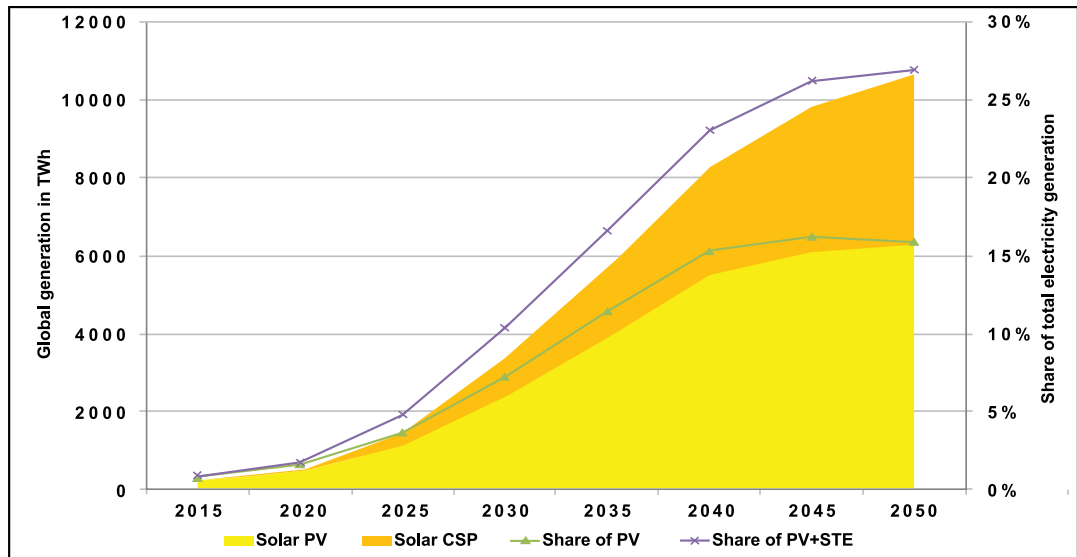


Figure ES-1. NREL PV system cost benchmark summary (inflation adjusted), 2010–2017

CREDIT: NATIONAL RENEWABLE ENERGY LABORATORY
 CITATION: FU, RAN, ET AL. U.S. SOLAR PHOTOVOLTAIC SYSTEM COST BENCHMARK: Q1 2017. NATIONAL RENEWABLE ENERGY LABORATORY, 2017, U.S. SOLAR PHOTOVOLTAIC SYSTEM COST BENCHMARK: Q1 2017, WWW.NREL.GOV/DOCS/FY1705TI/68925.PDF.

IN THEIR 2014 TECHNOLOGICAL ROADMAPS FOR SOLAR PV AND SOLAR THERMAL ELECTRICITY (STE), THE INTERNATIONAL ENERGY AGENCY (IEA) PREDICTS SOLAR PV AND STE TO REPRESENT OVER 25% OF GLOBAL ELECTRICITY GENERATION BY 2050.

CREDIT: INTERNATIONAL ENERGY AGENCY
 CITATION: VAN DER HOEVEN, MARIA, "IEA TECHNOLOGY ROADMAPS FOR SOLAR ELECTRICITY - 2014 EDITIONS." PUBLICATION: INTERNATIONAL ENERGY AGENCY, ONLINE: [HTTPS://WWW.SCRIBD.COM/DOCUMENT/256403173/140929-SOLARROADMAPS-SLIDES](https://www.scribd.com/document/256403173/140929-SOLARROADMAPS-SLIDES)



offer at regularly diminishing levels through 2022. The ITC was renewed and the staged reductions were established at the end of 2016 with bipartisan support. However, the future of these credits is unclear given new House and Senate tax bills. For businesses, the federal government also allows Modified Accelerated Cost Recovery System (MACRS) depreciation of solar PV systems with a special bonus for certain energy assets through 2019. Local and state programs across the country offer similar rebates, tax credits, deductions and performance-based incentives that not only improve the affordability of solar installation, but also drastically shorten the payback period. The state of New York offers upfront cash rebates through NYSERDA and Solar Renewable Energy Credit programs exist in eight states plus the District of Columbia.

While state and federal incentives are widely available now, they are either currently on the decline, or are planned to be phased out over the next five-to-ten years. Local policy and incentives will then become the key to keeping building owners and residents engaged in continuing solar's growth in urban environments. Solarize campaigns are locally organized community outreach efforts that leverage group purchasing power to encourage homes and businesses to go solar over an established period of time. Solarize NYC, one of the largest and most successful campaigns of its type, is aimed at energizing citizens to take personal responsibility for the city's goal of reducing greenhouse gas emissions 80% by 2050.

Urban environments can offer opportunity for solar, but they also pose significant challenges. Tall buildings mean a much smaller ratio of available roof area to conditioned space; there are higher wind loads on the arrays; and the installation logistics become significantly more difficult. The close proximity of other tall buildings, plus roof space being taken up by bulkheads and large mechanical equipment, often leads to many sources of shade and a reduction of usable roof space. Some buildings may have complicated ownership structures which lead to

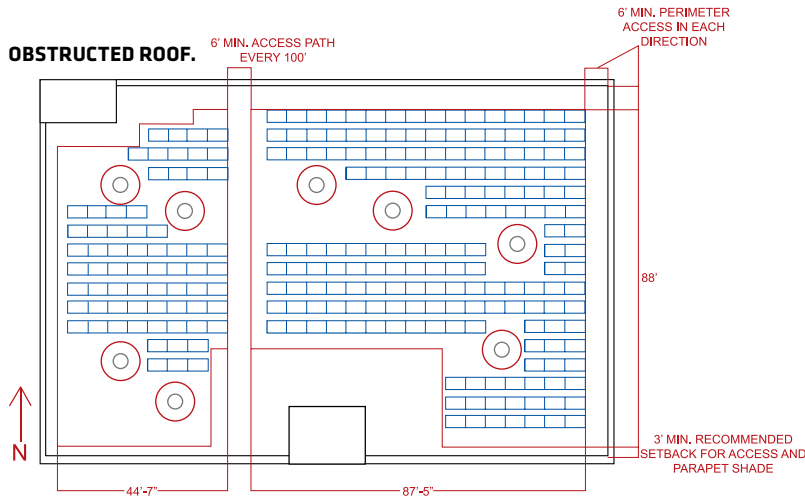
greater legal complexities, particularly when it comes to tax-based incentives.

Because of these challenges, the addition of solar PV usually offsets only the common area loads of a large building, not tenant loads. However, it can still be a financially attractive solution for developers and property managers: many newly constructed and renovated city buildings are opting for solar power even if most of the building's electricity demand is still supplied by the grid. When combined with other distributed energy resources, such as energy storage, energy efficiency and demand management, distributed solar can also help provide benefits to the distribution grid. New York State's Renewing the Energy Vision initiative is seeking to establish a market for these benefits through its Value of Distributed Energy Resources program.

From a policy perspective, a city's most immediate solution would be to update local building codes to require solar-ready roofs and incorporate other sustainable best practices. For instance, Cambridge, MA requires all new construction or existing building rehabilitation projects over 25,000 SF to meet at least LEED® Certified or LEED Silver standards; solar is a popular contributing factor for these standards. Washington, DC assigns a favorable weight to on-site renewable energy systems for compliance with its Green Area Ratio requirements. The 2016 Energy Conservation Codes for both New York State and New York City include requirements for solar-ready roofs on new residential buildings. Similarly, states can adopt standard permitting and interconnection requirements, providing greater consistency for installers.

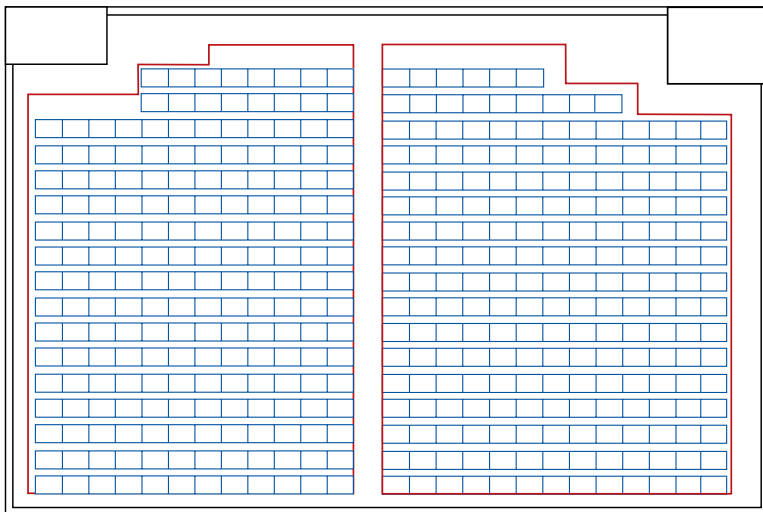
HOW ARE BUILDINGS DESIGNED FOR OPTIMUM PV PERFORMANCE?

A number of simple steps can be taken to optimize for solar when designing buildings for an urban environment. The roof should be designed to provide the greatest amount of roof space and least amount of shading for the solar array. Designing a building with unitized ventilation (i.e. in-line fans) eliminates the



TYPICAL ROOF LAYOUT FOR MULTIFAMILY BUILDING, INCLUDING NECESSARY SETBACKS FOR FIRE ACCESS, MECHANICAL EQUIPMENT ACCESS, AND SHADING FROM BULKHEADS. FIRE ACCESS IS BASED ON FDNY GUIDELINES.
CREDIT: ERIC WALLACE

OPTIMIZED ROOF.



OPTIMIZED ROOF LAYOUT FOR MULTIFAMILY BUILDING, WITH BULKHEADS SHIFTED TO NORTH SIDE OF ROOF AND ALL MECHANICAL EQUIPMENT UNITIZED OR MOVED OFF OF MAIN ROOF.
CREDIT: ERIC WALLACE

need for many central exhaust fans on a rooftop. This not only frees up the specific space taken by the fans, but also the access pathways required for equipment maintenance.

Any large equipment that must be placed on the roof and any other rooftop obstructions, namely stairwell and elevator bulkheads, should be placed as far to the north end of the roof as possible. Clear, unobstructed sun access to the south of the array is essential for systems in the northern hemisphere. When obstructions cannot be placed to the far north end, they should be placed strategically to allow for the largest single area for an array. The simplest and least expensive racking system for a solar array is a ballasted system, which benefits immensely from a simple, rectangular array. These arrays allow the outer modules to effectively shield the inner modules from high wind loads, reducing the overall weight of the array as well as the cost of the system.

Some simple structural and electrical engineering considerations should be included in the building design to optimize for solar. Including 5-10 psf of dead load in the structural calculations can go a long way in justifying the addition of a solar array in the future. Electrically, providing a dedicated breaker space in the main switchgear at the opposite end of the bus from the main breaker, a dedicated conduit run from the roof to the electrical room and interior wall space in a rooftop mechanical room for mounting the inverters will all greatly simplify the design and installation, reduce the costs and improve the aesthetics of the system.

As U.S. citizens and local governments take the reins in the country's commitment to a clean energy future, solutions such as high-density solar are important industry advancements that provide more accessible and widespread opportunity for change. The urban environment provides a number of unique challenges to the development of solar, but a few key considerations in the design phase of new buildings as well as the adoption of intelligent local policy can help overcome these obstacles.

ABOUT THE AUTHORS

Eric Wallace is an Energy Engineer at Steven Winter Associates, providing consulting, design and inspection services for solar energy as well as a variety of programs, including Energy Star Multifamily High Rise, Enterprise Green Communities, New York Energy Conservation Code and ASHRAE Standard 90.1. Prior to joining SWA, Eric spent four years designing commercial-scale solar power systems. He holds a B.S. in Mechanical Engineering from California Polytechnic State University in San Luis Obispo and an M.S. in Mechanical Engineering from the University of Colorado Boulder. BUSINESS MEMBER

Alex Mirabile is a Marketing Coordinator at Steven Winter Associates (SWA) and a recent graduate from the University of New Hampshire. His responsibilities at SWA span a wide range of the company's marketing efforts including social media management, event planning, brand maintenance, and writing for external publications. Alex graduated with a B.S. in Environmental Conservation and Sustainability and served as a member of the New Hampshire Sustainable Energy Association while at UNH. BUSINESS MEMBER

ABOUT THE PEER REVIEWER

Steven Strong is the President of Solar Design Associates, Inc., of Harvard, MA, an Engineering and Architectural firm dedicated to environmentally responsive buildings and the engineering and integration of renewable energy systems to power them. Over the past 4 decades, he's earned the firm an international reputation for the pioneering integration of renewable energy systems with environmentally responsive building design, completing projects in Europe, Asia, Africa, the Middle East, Canada, the Caribbean, Latin America and across the US from Maine to Hawaii. BUSINESS MEMBER



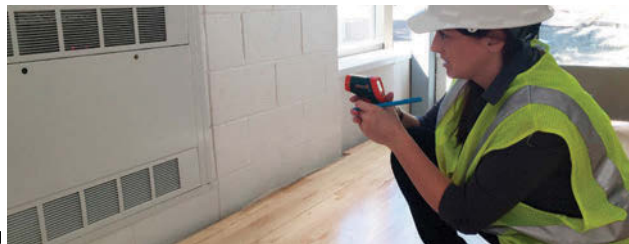
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HIGH PERFORMANCE BUILDING VALUATION TECHNIQUES

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BY JAMES F. FINLAY
MRICS, WITH SUPPORT
FROM BRUCE WILEY

PEER REVIEWED BY
BRIAN BUTLER

The appraisal and financing process for owners of high performance (HP) real estate that has been upgraded with energy generation (like solar PV), energy efficiency (EE) or other design features can be disappointing if the upgrades are not sufficiently recognized in the appraisal. This article will give an overview of the process and recommend “dos and don’ts” to get the best chance at a fair valuation. Savings via lower utility costs is often what motivates an owner to invest in building performance upgrades, so proving these savings to the appraiser is paramount. My focus will be on commercial/ investment real estate, but many comments also apply to residential (1-4 units) property.

DIFFERENTIATE BETWEEN “MARKET VALUE” AND “INVESTMENT VALUE”

The word “value” to investors and appraisers is like the word “cheese” to Wisconsinites. There are lots of versions and to proceed safely, clarity is needed. “Market value” is a statutory definition for appraisal reports used with bank loans and is the “value in exchange” to the next typical buyer. “Investment value” on the other hand is specific to an individual owner and property and is used by investors in feasibility studies. It includes short term benefits like accelerated depreciation, income tax deductions or the reputation value of “green” to the business/occupant. The difference between market value and investment value can be significant because they use different assumptions.

EARLY DELIVERY OF DOCUMENTS AND INFORMATION

The key to a credible valuation hangs substantially on the quantity and quality of data provided by the owner documenting net annual savings. Ideally, the appraisal process mimics the actions used by typical buyers and sellers to determine a fair price. An owner should prepare

for an appraisal as they would for the building sale. Thinking that the “appraiser can figure it out” is like selling a car and assuming the car buyer will “figure out” that you spent \$5,800 on a new transmission three weeks ago. Owners should recognize their unique knowledge of their property and pass it on, embracing the “help them help you” credo.

ACTORS IN THE “MORTGAGE CHAIN”

There are many handoffs and participants involved between the initial loan application and a loan getting funded. The process is highly regulated and policy driven, putting atypical loan collateral at a disadvantage – but ultimately, banks do want to lend money. So the property owner needs to make it easy for those in the mortgage chain to understand the advantages of HP easily and quickly. The good news is that valuing HP building features involves no “new” or “creative” valuation techniques; it is just old school, sharp pencil cash flow with a data density twist.

THE PROPERTY OWNER - IT’S ALL ABOUT THE DATA

Documenting utility cost savings can involve many pages, so for quick digestion by those in the mortgage chain, include a cover page “quick read” list briefly summarizing upgrades with the when, what, cost and, ideally, the net annual expense saving per item. It is also helpful to list titles of supporting documents such as an energy audit, solar PV installation contract and financial/ payback analysis, LEED¹ point list, recent utility bills or the payback analysis of an LED lighting retrofit. In this approach, the key number is the annual net dollar savings for use (after appraiser verification). Also important are any expenditures that prospective buyers would recognize as desirable, that lower the overall property risk even if it’s difficult to demonstrate an annual net income impact, like durability, resilience or improved interior environmental quality.

QUANTITATIVE AND QUALITATIVE UPGRADES

Federal bank regulators expect credible proof of loan collateral value, so not all upgrades have the same opportunity to fit into the appraisal process, which is constrained by both dollars and time. “Green”/HP upgrades fall into three basic categories. My focus will be on “hard,” easily measured benefits impacting net operating income (NOI), like the annual “solar NOI” from a solar PV system. The next type of upgrade, which can be more difficult to track, includes calculating energy conservation measures (ECMs), like insulation or HVAC upgrades, each of which might produce an annual “EE NOI.” This NOI requires not one, but two measures, so the impact of EE is the net present value today for a stream of future benefits of events that do not happen (the delta between what happened and what did not). Determining this typically requires an investment grade energy audit (money well spent).

The third and most challenging upgrade group are features whose benefits are very hard to quantify, like occupant health related to improved interior environmental quality (air quality, daylighting, nature views), the impact of using sustainable materials or benefits that flow outside the property line (i.e. social/political benefits, stormwater control). This last group contains large potential wins and progress is being made to quantify them. Research on healthful design shows huge worker health and productivity impacts, helped by certifications like Well Building Standard² or Passive House.³ But proving the specific dollar impact flowing to the building (not business) and long term durability is complex. One option I have used is to settle on a “not less than” value (like 50% discount of expected savings) that can hit a reliability and ease-of-execution sweet spot banks can get behind.

THE BANKER, INITIAL LOAN APPLICATION

At the initial loan meeting the owner should deliver a hard copy document pack to the banker, and follow up with digital versions. Digital documents allow easy delivery to those along the mortgage chain. Specifically, the owner should ask the banker (in person and repeat via email) to include the most vital HP property information when posting for bids to select a qualified appraiser. Banker comments such as, “The appraiser will take care of gathering that information later” are a recipe for disaster as the appraiser bids received and appraiser selection will be based on incomplete property knowledge.

POSTING THE APPRAISAL ASSIGNMENT FOR BID

After the loan application has been accepted, the next step is engaging the appraiser. Typically, an online RFP about the property is posted to the bank’s approved appraiser list. Because the RFP postings are often done by loan processor staff, specific property details may be omitted. Far too often appraisal assignment postings do not include references to HP building features, which, when discovered later, can trigger a host of bid revisions, alternative appraiser selection and delays.

APPRAISER SELECTION

After the RFP closes, the bank selects the “best” appraiser from the submitted bids. Ideally, this involves weighing fee, timing and ability rather than just going to the lowest cost option “to save the borrower money.” This entire process of posting the RFP, appraiser replies and appraiser selection, is a rapid-fire affair. An owner should emphasize to the banker at an early stage that they are happy to pay extra and allow more time (typically a 10%-15% fee premium and an extra few days to a week) to obtain a competent valuation from an appraiser experienced with HP features.

APPRAISER CONTACT WITH OWNER

When the appraiser contacts the owner for the property inspection, the owner should immediately confirm that the appraiser was aware of the property’s HP features at the time of the bid and can competently consider the HP features in the value. If the appraiser is unaware of the performance upgrades or is lacking the skills, the owner should immediately go back to the bank and insist on a new, qualified appraiser. A revised appraisal fee and slight delay may result, but it is far better to start over now, rather than trying to resolve later in the process.

SUBJECT PROPERTY INSPECTION

The owner (or his knowledgeable representative) should plan to accompany the appraiser during the inspection, at least at locations where HP features are at the property. Check that the appraiser has the **entire** property document pack. Don’t assume that all the information you supplied to the banker was forwarded to the appraiser. Get the appraiser’s business card to email the info package as digital files to be on the safe side.

THE REVIEW APPRAISER

Once delivered, all appraisals are read by a second pair of eyes during the appraisal review.

The key to a credible valuation hangs substantially on the quantity and quality of data provided by the owner documenting net annual savings.

The review appraiser checks math, the analysis logic and determines if the conclusion is credible. A review appraiser not familiar with HP building features can be a potential hurdle during this step. Reviewers and appraisers both work on production schedules so accurate, clearly laid out support from the owner for the annual net cost savings as credible (“worthy of belief”) is once again essential.

THE FINAL APPRAISAL DELIVERY TO THE PROPERTY OWNER

After the appraisal review, the final report is released, and, in most jurisdictions, the property owner has a right to a copy. The report should discuss upgrades, include an analysis and conclude the value impact for the HP features, supported by market data. A survey of local real estate professionals might have been done, which is a valid way to support the conclusion. The appraisal is typically final at this point unless there is an obvious error or the report is incomplete (or completely ignored the HP features).

ISSUES WITH THE APPRAISAL

A report containing no meaningful discussion or value analysis of the HP features is cause for concern. If the report discusses the performance features, but states that there are no comparable sales to establish value, the report is most likely applying the Sales Comparison Approach, which is the wrong appraisal methodology.

Lack of discussion or emphasis on the Sales Comparison Approach indicates a possible competency violation of the Uniform Standards of Professional Appraisal Practice (USPAP)⁴. USPAP compliance is required for all appraisals used in federally guaranteed loans. Be sure to exercise tact and caution when discussing a potential USPAP violation, a serious matter that no banker wants flagged.

FINAL THOUGHTS

Delivering solid documentation of reliable utility savings and being proactive at the initial appraisal stages are the best ways to get a fair and competent valuation. For additional insight into the appraisal process, two recent documents to consider are *The Valuation of Green Commercial Real Estate*, by Timothy Runde MAI and Stacey Thoyre, published by the Appraisal Institute, and *Valuation of Green and the High-*

Performance Property, Commercial, Multifamily and Institutional Properties, one of several free advisories on green building valuations distributed by The Appraisal Foundation. 

ABOUT THE AUTHORS

James Finlay MRICS was a review appraiser at Wells Fargo Bank for 15 years and became active in the US Green Building Council in 2001. In 2006 he joined the newly formed Wells Fargo Environmental Affairs group as valuation specialist, becoming the bank's principal appraisal reviewer for HP real estate loan collateral. Since 2014 he freelances, helping banks and investors recognize the value impact of solar PV and distributed energy systems. He recently joined Bruce Wiley at US Solar Value, specializing in utility scale solar PV appraisal. James is an advisor to the National Institute of Building Science, Yale Clean Energy Finance Forum and The Appraisal Foundation.

Bruce Wiley is an MAI member of the Appraisal Institute and has been appraising commercial real estate for over 40 years. He has specialized in appraising Green, HP commercial buildings and renewable energy assets including over 100 solar and wind farms. 

ABOUT THE PEER REVIEWER

Brian Butler is a MA licensed Construction Supervisor for Boston Green Realty. An auto mechanic for most of the 1990s, he also worked part time in the building trades. In the late '90s he moved full time into carpentry and in 2003 became a Construction Supervisor. In 2007 he founded Boston Green Building with a focus on high performance buildings and Deep Energy Retrofits. From 2014 to 2017 he joined Good Energy Construction, Natick, MA. As of August 2017, he joined Boston Green Realty to oversee construction Mission Hills Flats, a 40-unit mixed-use Passive House development at Roxbury Crossing.

END NOTES

¹ US Green Building Council, Leadership in Energy and Environmental Design

² International Well Building Institute; <https://www.wellcertified.com>

³ Passive House Alliance United States; <http://www.phius.org/home-page>

⁴ Uniform Standards of Professional Appraisal Practice (USPAP), The Appraisal Foundation, Washington, DC.

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STARTING WITH THE END IN MIND: ENHANCED TURNOVER FOR EFFICIENT BUILDING OPERATIONS

BY NATHAN GAUTHIER

PEER REVIEWED BY STEPHEN TURNER

Anybody involved in building construction knows that project turnover doesn't always prepare building owners for long term, efficient operations and maintenance (O&M). In order to save energy and deliver a healthy, comfortable and productive environment for occupants, new buildings have become increasingly complex, yet many projects still end with poor quality and incomplete transition from construction to facilities management (FM). Turnover deliverables are late, illegible, poorly organized and often in formats inconvenient to the building operator. Some projects still end with poorly scanned O&M manuals in 3-ring binders, inaccurate and unorganized as-built drawings and unwatchable training videos on CD delivered months after substantial completion. An enhanced construction turnover process can improve building performance by giving owners and operators the tools necessary to optimize energy performance and indoor air quality.

In theory, building commissioning (Cx) should adequately address these concerns. ASHRAE and others define Cx as the process of verifying that buildings are designed, built and able to be operated per the owner's project requirements (OPR). Facilities management needs are meant to be included in the OPR, at the outset of and throughout the design process, during construction and at turnover. The reality is that not all buildings are commissioned and not all commissioning authorities (CxA) follow the full ASHRAE Guideline 0 commissioning process. Few project teams understand or apply ASHRAE Guideline 1.4 or other best practices for developing systems manuals and often doing so is not explicitly included in contracts. The common result is last-minute, frantic efforts to pull together minimal amounts of contractually-required content with little emphasis on quality or usability and facilities teams are left ill-prepared to operate their new buildings.

A promising development in building turnover is the option to leverage the building information

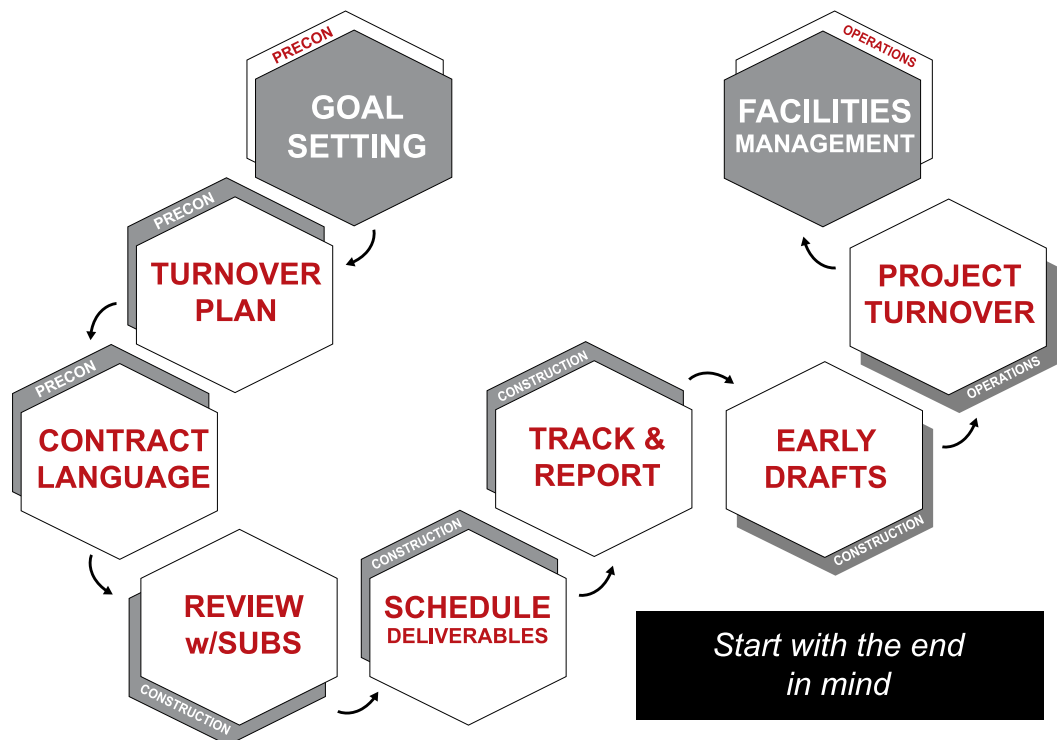


FIGURE 1: AN ENHANCED TURNOVER PROCESS STARTS WITH SETTING FACILITIES MANAGEMENT GOALS EARLY IN PRECONSTRUCTION.
CREDIT: NATHAN GAUTHIER

model (BIM) to improve operations. If set up properly at the beginning, information can originate in BIM during design, be added to during construction and turned over for use during operations. Many BIM-to-FM options can be customized to communicate with existing maintenance programs, scheduling programs, building automation systems, etc. These can be a great solution for large or mission-critical facilities with sophisticated FM staffs, but the initial cost and complexity currently prevents many clients from requesting these programs, which can't be easily delivered by contractors without client demand and design team support. Even with sophisticated BIM-to-FM solutions, there is need for more holistic turnover planning to support efficient operations.

So how can construction turnover best support high performance building operations? How can we improve project closeout and better prepare for FM? Perhaps most importantly, how can contractors provide better value to their clients without significantly adding to general conditions? To be successful, we need a process to define and deliver turnover programs that match client needs and to offer enhanced deliverables that more effectively support operations.

An enhanced turnover process should:

- 1. Assess the client's abilities and needs:** Meet early in preconstruction to discuss how the building will be operated. Ask about the client's

FM staff, their technologies, their existing protocols and programs, etc.

- 2. Develop a project-specific turnover plan:** Customize a plan to address the client needs for efficient operations. Include the format, quality, content, etc. of product and service deliverables. Identify what information is needed, where it is needed, and how it will be used by the client.
- 3. Incorporate turnover into contracts:** Include deliverables in contract riders when bringing sub-contractors on board. It is important to include this from the beginning so there is minimal price impact.
- 4. Track progress during construction:** Identify turnover milestones and include in the project schedule. Assign submittals in the project management software with due dates and responsible parties and regularly report on progress.
- 5. Submit in a timely manner:** Most turnover deliverables need to be ready before substantial completion and available for use during operator training. Handle turnover documents like other formal submittals, requiring owner (including FM staff) and design team review, comments, and acceptance.
- 6. Support transition to facility management:** Ensure all turnover commitments are honored and include review as part of the warranty process.

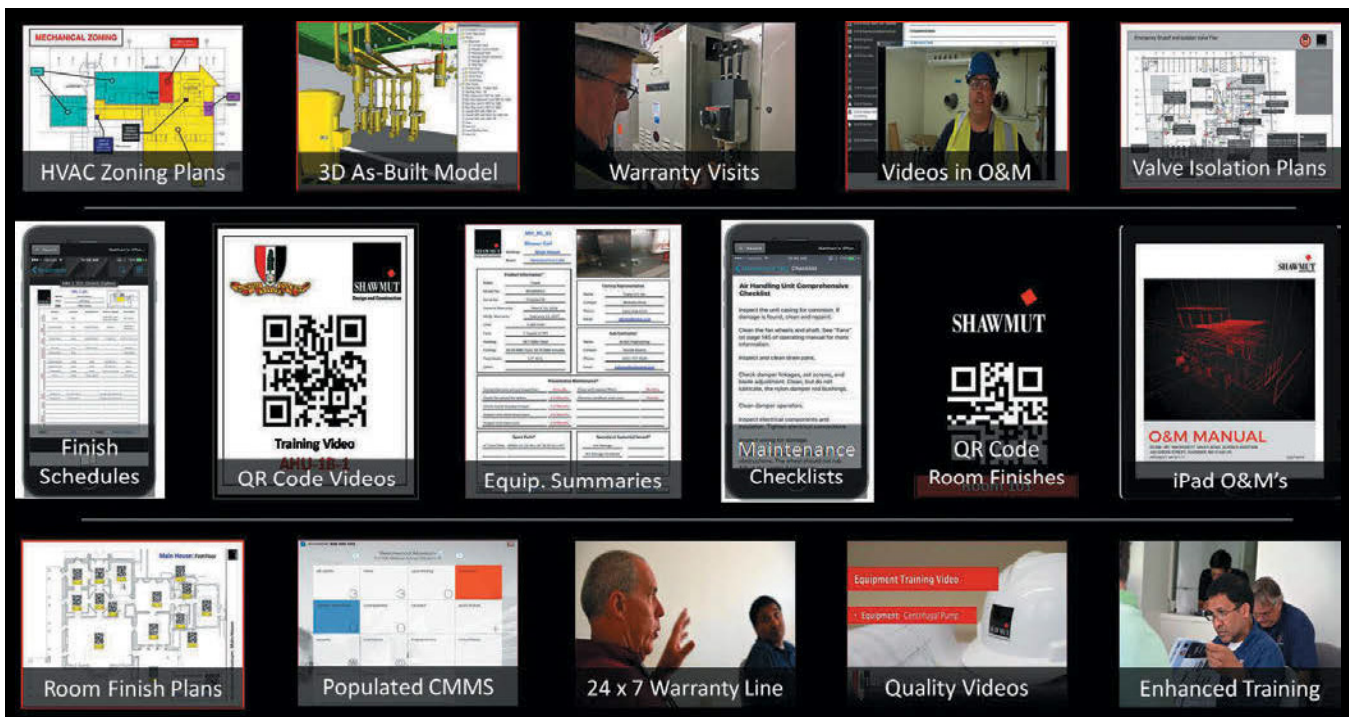


FIGURE 2: SAMPLE ENHANCED TURNOVER DELIVERABLES THAT MAY BE APPROPRIATE FOR SOME PROJECTS.
CREDIT: NATHAN GAUTHIER

Schedule warranty walkthrough at 10 months and confirm off-season training, service contracts, etc. Consider updating turnover documentation to reflect changes during first year of operations.

While the process for developing a turnover plan will be similar for all projects, the specific elements included in the plan can – and should – vary from project-to-project. The plan will meet the client and building-specific needs. The following are a few examples of enhanced turnover deliverables:

IMPROVED BUSINESS AS USUAL: FOCUS ON USABILITY

- **As-Built Drawings:** Align room numbers and asset tags with other documents and what's in the field. Provide in PDF fully bookmarked with hyperlinks. Consider linking to O&M materials. Deliver at substantial completion before staff training.
- **Operations & Maintenance Manuals:** Provide digital, searchable, easy-to-navigate, mobile-friendly O&M manuals. Consider cloud based solutions. Deliver at substantial completion before staff training. Have mechanism for client to update throughout building operations.
- **Sub-Contractor FM Staff Training:** Define what training will occur, who will attend and agenda for each. Explain drawings, O&M manuals, warranty, etc. Evaluate effectiveness after training. Consider off-season and follow-up training.
- **Training Videos:** Define and follow agenda for each video. Record training separate from live staff training. Use external microphone for better sound quality. Host online, make available at equipment via QR code, and include in digital O&M manual.

EASY EXTRAS: LOW-COST, HIGH IMPACT ENHANCEMENTS

- **Summary Drawings:** Determine what information is most valuable to FM staff and create summary documents for this purpose. Examples include HVAC zoning plans, emergency shut-off and isolation plans, finish plans, single line diagrams with control sequence and setpoints, etc.
- **As-Built Coordination Models (3D):** Update the coordination model to as-built conditions. Add equipment labels and link to O&M materials. Upload models to tablets and demonstrate how they can be used in the field to see what's behind walls or under floors.
- **Equipment Summary Sheets:** Have subcontractors submit equipment summaries for major MEP/FP equipment. Include the most valuable information (make, model, serial, warranty date, contact, etc.). Add to O&M manual, link to model, host online and making available via QR codes, etc.
- **Room Finish Schedules:** Create room-by-room finish schedules so FM staff can easily find room-specific finishes. Add to O&M manual, link to drawings and model, host online and making available via QR codes on door frames, etc.
- **Enhanced Owner Training:** Include FM staff in Cx meetings, equipment startup, BAS alarm list development, Cx witness testing, etc. Offer summary owner trainings with CxA, design team, general contractor, etc. Review OPR, BOD, as-built drawings, O&M manuals, and planned. Consider separate trainings for operators and occupants.
- **10-Month Checkup / Post Occupancy Evaluations:** Schedule follow up visits to address outstanding warranty information and confirm deliverables. Offer post occupancy evaluations per industry standards or customized for the project to assess effectiveness. Include assessment of O&M activities during first year of operations.
- **QR Codes and Information On-Demand:** Leverage cloud-based storage and mobile connectivity to make information accessible where needed. QR codes are easy ways to tag equipment or rooms and link to videos, O&M, schedules, etc.

WHITE GLOVE TURNOVER: CLIENT PEACE OF MIND

- **Computerized Maintenance Management System (CMMS):** Provide fully populated CMMS or equipment data in CSV format ready to be uploaded to client CMMS. Create work order for equipment startup as first record for each asset. Provide similar data for capital forecasting and other FM support programs. Consider mobile first solutions.
- **Extended Warranties:** Price extended warranties from key subs. Include as part of initial sub-contractor buyout for best pricing. Offer multiple warranty packages to owner to meet their needs and budget.
- **Service Contracts:** Price service contracts from key subs. Include as part of initial sub-contractor buyout for best pricing. Offer multi-year preventative maintenance packages with goal of

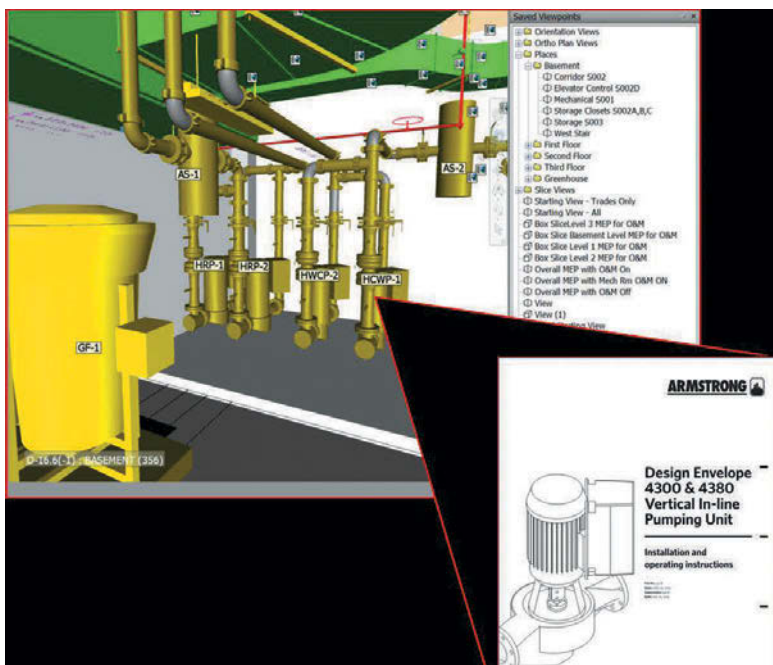



FIGURE 3: AS-BUILT COORDINATION MODELS CAN BE EXTREMELY VALUABLE TO CLIENTS DURING OPERATIONS.
CREDIT: NATHAN GAUTHIER

continued outsourcing or temporary support so in-house technicians can shadow service providers during first year of occupancy.

Each client will have different facility management needs but for all projects valuable information is created during construction that can support operations and maintenance. By summarizing and simplifying this information, making it available to the client where it is needed in an easy-to-use format and making sure deliverables are complete and of high quality, contractors can prepare clients for long term facilities management success. Not only will this be good for the environment and building occupants, but it will reduce warranty calls and increase the likelihood of repeat business. By improving the project closeout process and starting with the end in mind,

contractors will provide more value to their clients and deliver higher performing buildings. 

ABOUT THE AUTHOR

Nathan Gauthier is Director of FM Integration and Sustainability at Shawmut Design and Construction. He supports the transition from construction to efficient operations. Nathan also teaches at two universities. He has previously built daycares for UNICEF Rwanda, was energy manager for Phillips, and led the Green Building Services for Harvard. Nathan chaired the EA TAG during development of LEED v4 and is a LEED Fellow, CEM, and CFM. He has consulted on more than 100 projects across 5 continents. <https://www.linkedin.com/in/nathangauthier>

ABOUT THE PEER REVIEWER

Stephen Turner is a commissioning expert with over 30 years' experience engineering, constructing, commissioning, operating, and maintaining buildings and systems. He brings deep engineering understanding and hands-on perspective to diagnosing problems and optimizing buildings. Stephen uses his extensive experience with high performance design, testing and balancing, energy efficient equipment design, control strategy optimization, and life cycle costing to assist project owners in meeting their project specific design goals. As a LEED Accredited Professional, Stephen has worked on dozens of projects that successfully achieved LEED certification, including Platinum, Gold, & Silver. Stephen excels at listening to clients' requirements and translating them into achievable project and program goals that are verified through efficient, effective commissioning processes. 



FIGURE 4: CLIENTS BENEFIT IF CONTRACTORS CAN COLLECT RELEVANT INFORMATION AND MAKE IT AVAILABLE WHERE IT IS NEEDED.
CREDIT: NATHAN GAUTHIER

Pre-Conversion			Post-Conversion			
As Modeled						
EUI:	57.4	kBtu/sq ft-yr	EUI:	19.7	kBtu/sq ft-yr	66% Reduction
Fans:	9.5	kBtu/sq ft-yr	Fans:	1.0	kBtu/sq ft-yr	89% Reduction
Heating:	37.6	kBtu/sq ft-yr	Heating:	9.2	kBtu/sq ft-yr	76% Reduction
Cooling:	3.6	kBtu/sq ft-yr	Cooling:	2.8	kBtu/sq ft-yr	22% Reduction
HVAC:	50.7	kBtu/sq ft-yr	HVAC:	13.0	kBtu/sq ft-yr	75% Reduction
EUI:	No data	kBtu/sq ft-yr	EUI:	19.4	kBtu/sq ft-yr	65% Reduction
HVAC:		kBtu/sq ft-yr	HVAC:	14.6	kBtu/sq ft-yr	71% Reduction
Pre- and post-conversion energy consumption are based on a typical meteorological year (TMY).						
Models updated based on a full year of sub-metered energy end-use data.						

FIGURE 5: PROVIDING AN ENHANCED TURNOVER PROCESS WILL BE APPRECIATED BY CLIENTS AND IMPROVE BUILDING PERFORMANCE.
CREDIT: NATHAN GAUTHIER

Increasing Our Impact: NESEA's Capacity Campaign

Thank you to all those in the NESEA community who have made a gift to our Capacity Campaign!

This campaign is the first of its kind in NESEA's history. Our Board of Directors has committed to raising \$130,000 in each of the next three fiscal years to add to our operating budget. These funds will enable us to follow through on the goals of our strategic plan and ensure access to all those who can benefit from our content and our community. We are pleased to report that we have raised over \$85,000 toward our year one goal!

We are grateful to the following individuals and businesses who stepped up as Lead Donors and enabled us to kick-off our campaign with over \$50,000.

To learn more about the Capacity Campaign, visit www.nesea.org/capacity-campaign.

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BEHAVIOR BASED STRATEGIES AND ORGANIZATIONAL CHANGE IN COMMERCIAL & PUBLIC BUILDINGS: THE HUMAN COMPONENT OF ENERGY EFFICIENCY

BY TEMUR AKHMEDOV,
LEED AP, CEM
AND DR. MARK MEO

PEER REVIEWED BY
SAHEEL CHANDRANI

In the last three decades, energy efficiency gains in the U.S. have been impressive: energy intensity has decreased by 50% since 1980, industrial energy use is down by 40% and the energy use in new homes has declined by nearly 20% (Nadel et al. 2015). Despite these achievements, much remains to be done. Not only are gains in energy efficiency unevenly distributed across the nation, understanding of the roles of behavior and organizational learning is not widespread (Ruparathna et al. 2016).

Efficiency-gap studies that focused primarily on economic rationality led to the recognition of the multi-disciplinary character of energy efficiency research (Martin-Rubio et al. 2016). Factors such as leadership, credibility, understanding, values and trust, which are often omitted in economic and technical studies, have been explored in greater detail around the world (Curtis et al. 2017, Fresner et al. 2017, Reyna et al. 2012). Organizational learning has also become the focus of study (Arnold 2008). Behavioral-based and organizational change research on energy efficiency has progressed through case study analysis, cross-sectional analyses and the use of change agents who both catalyze and facilitate efficiency improvements. This latter approach is championed by the Environmental Defense Fund through its Climate Corps (Reyna et al. 2012). Consequently, the potential for improving energy use efficiency with a behavioral-based approach appears attractive, especially in states that have not made efficiency improvement a policy priority.

In this article, we will share some observations and examples from our work on the Oklahoma State Facilities Energy Conservation Program (20x2020). 20x2020 was a behavior based energy efficiency program, with target energy savings of over \$100 million by 2020. The program covered over 5,000 buildings, engaging close to 70 state agencies and state colleges. More info is available at <http://20x2020.ok.gov/>.

BEHAVIOR BASED PROGRAM DESIGN

In the vast majority of projects, energy efficiency efforts are confined to engineers and senior administration. At best, general staff participates in a basic awareness campaign. Some entities around the country have gone a bit further with competitions and

more proactive communication. However, some major challenges remain: how to ensure sustainable savings over the years, how to instill good behaviors and, above all, how to ensure long-term success of energy efficiency programs. Organizations often lean on punitive measures by penalizing those using more energy than some arbitrarily pre-set limits. Those efforts backfire, creating a negative atmosphere. There is a better way.

Let's explore five strategic components for a successful behavior based program:

- Focus on benefits, minimizing waste vs. lowering use
- Clear, simple, fun and engaging message
- Challenging, exciting and sensible goals
- Positive approach
- Broad organizational change

FOCUS ON BENEFITS, MINIMIZING WASTE VS. LOWERING USE

A fundamental concept for any successful and sustainable behavior-based program is a focus on maximizing human benefit while minimizing energy waste. Buildings are ultimately for people. If buildings do not work for people, then they are not truly sustainable and efficient. We define energy efficiency as an ability to provide the same benefit for occupants using less energy. When energy is used without benefiting occupants or the broader community, that energy is wasted. For example, lights of Manhattan skyscrapers create a unique skyline, known around the world, benefitting a broader community. To provide that benefit, some of the lights in the peripheral offices could stay on with lights further inside the building being off or at the minimum levels to ensure safety and security. Working with the Oklahoma Department of Human Services, we addressed "phantom loads," energy used by plugged in document scanners. A simple measurement showed that scanners were drawing 10W in off position, while still being plugged in. The energy used by the scanners in off position delivered no benefit, thus representing a waste.

CLEAR, SIMPLE, FUN & ENGAGING MESSAGE

The need for a simple and inspiring message cannot be overemphasized; any communication and management professional would agree. Messaging

also has to be fun and engaging. Energy efficiency is a seemingly boring subject. Many sustainability professionals and engineers struggle with creating messages that will keep people engaged after the initial excitement wears off.

A message needs to be clear and simple enough for people without technical backgrounds to understand the points you are trying to make. My favorite example is Energy Star scores. Most people intuitively understand that a score of 75 is better than a score of 37. Without presenting any technical details, an organization can communicate its clear, sensible goal as some target Energy Star score. Within the designs of the Oklahoma State Facilities Energy Conservation Program, we have set goals of obtaining Energy Star certification. When we held our first Energy Star plaque ceremony, employees were quite excited to be recognized for their efforts, not just by the department leadership, but also by a national organization. Having coffee and pastries during the ceremony was very helpful as well!

Energy efficiency, especially the behavioral component, is about education. The focus should be on optimizing usage of existing resources. Better use of existing equipment assumes developing or learning new processes. In Oklahoma, we have promoted the utilization of Building Operator

Certification (BOC), a competency-based training and certification program for building operators.

At the same time, you should be able to get your point across quickly. If people struggle to understand what you are asking them to do, where they are and where they need to go, then it will be hard for them to take action. Even if you convince building occupants to take action, lack of clarity will lead to people abandoning the desired behavior when the pressure of incentives is gone.

A behavior based program and its components need to be fun and engaging. When trying to get people to change their behavior, consider engaging them in competitions, which can be meaningful, measurable and fun.

CHALLENGING, EXCITING AND SENSIBLE GOALS

In his famous space speech, John F. Kennedy, the 35th President of the United States, said, "I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth."

Imagine if JFK instead proposed a "bold" goal of going 20% of the way and coming back! Alternatively, using modern "formulas" JFK could have proposed to fly 70% by 1970, a so-called 70x70 program. Do you think he could have energized entire country for such a mission? Probably not.

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Goals need to be exciting and challenging, yet perceived as feasible. 30% by 2030 maybe a challenging goal. 100% by 2050 could be too far-off to matter if there are no intermediate steps. Thus, ability to set up meaningful, measurable milestones is critical to the overall success of the effort. The goal of becoming a Net Zero Energy Facility might fit the bill in terms of all these criteria. To reach Net Zero you have to address efficiency, unless you have deep pockets for investments in massive power generation.

A less-quoted part of JFK's speech had some somber words: "If we are to go only halfway, or reduce our sights in the face of difficulty, in my judgment it would be better not to go at all." A less ambitious goal could be specific to systems, buildings or various other components. For example, an organization could set a goal of getting rid of all desktop printers or all space heaters as a strategy for conserving energy. These two items are highly visible and systematic to the overall operations of any organization and by looking at them through a sustainable lens, they can serve as examples for further education, communication and program expansion.

POSITIVE APPROACH

The principles of the nudge theory were popularized by Nudge: Improving Decisions About Health, Wealth, and Happiness, by Richard H. Thaler, winner of the 2017 Nobel Memorial Prize in Economics, and Cass R. Sunstein. These principles are widely used by professionals when setting up behavior based programs: the idea is to nudge people towards desired, good behavior, and nudge them away from undesired, bad behaviors. Special reminder notes left in offices, when occupants leave lights or other items on typically represent this approach. Organizations not engaging behavioral experts tend to focus on putting together and posting internal policies for people to follow.

We propose to use only positive nudges, i.e. to focus on supporting good desired behaviors. The goal of the organization would be to provide easy ways for occupants to engage in good behaviors. Offering options to participate and making participation voluntary will help to keep things positive. One of the key components of this positive approach is recognition of the efforts and results achieved. If people are using stairs instead of elevators, they need to be recognized. The recognition

does not have to be in the form of a material benefit. Mentioning participants at staff meetings, in newsletters and at company events could go a long way.

BROAD ORGANIZATIONAL CHANGE

Organizational structure and decision-making procedures may work counter to your efforts to instill good energy efficient habits: a successful behavior based energy efficiency program has to be part of a broader organizational change. Cross-

organizational review will identify key directions for improvements. This broad organizational change is often described as a cultural shift in energy use within organizations.

Organizational change should start with leadership buy-in. A bottom-up approach is possible, but it is also very challenging. When leadership supports, even reluctantly, big things can happen. This support must be expressed in the form of a public commitment to the cultural shift

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in energy use, the broader organizational change and the support of energy champions.

The success of behavior based energy efficiency programs and the long-term sustainability of the savings depends not only on making the right decisions, but also on having a positive and flexible approach to address the unknowns. We are working with people, an infinitely complex variable that could make our task of saving energy seemingly unreachable. At the same time, people are the most potent resource your buildings have. With the support of occupants and operations, buildings can be efficient, comfortable, safe, healthy and practical.


At the end of the day, we should not forget, that if it were not for people, we would not need our buildings! 

Editor's Note: For a complete bibliography of sources cited in this article, please visit nesea.org/bibliography.

ABOUT THE AUTHORS


Temur Akhmedov is a Director of Energy Solutions at Warren Energy Engineering. He is an expert in energy efficiency, renewable energy and sustainability with over 12 years of experience. One of his signature achievements is a successful bid, design and implementation of the first in the country statewide behavior based energy efficiency program, Oklahoma State Facilities Energy Conservation Program. The program encompassed over 70 state agencies and

state colleges, covering over 5,000 buildings and target savings of \$100 million.

<https://www.warren-energy.com/> 

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Saheel Chandrani is currently Senior Account Executive at Johnson Controls, Inc. and has been in the building efficiency & HVAC industry for nearly 10 years. His expertise includes applying cutting edge technology to new and existing facilities with the goal of achieving operational excellence. Saheel currently serves on the NESEA Board of Directors. He holds a B.S. in Mechanical Engineering and a B.A. in Business, both from the New Jersey Institute of Technology. 

Establishing an Innovative Approach to Sustainability

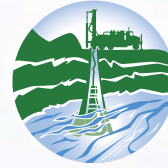
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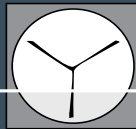
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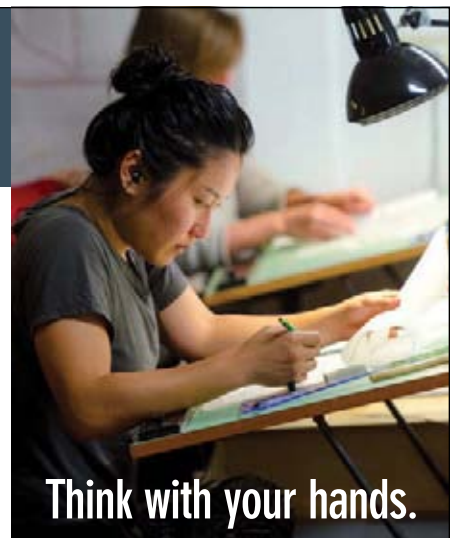
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COMMERCIAL HVAC RETROFITS THAT WORK

BY BARRY STEPHENS

PEER REVIEWED BY MARGO VALDES

Commercial buildings and energy efficiency: there has been a lot of talk about the concept, but not a lot of real progress, especially for existing commercial buildings as candidates for deep energy retrofits. That is changing, and there are efficiency organizations and utilities leading the way. This story is about a commercial HVAC retrofit model that was developed at the Northwest Energy Efficiency Alliance (NEEA) and about the great results that are being realized with that model.

HVAC energy use, and you will find that the “energy penalty” for outside air (OA) is significant.

Taking that into account the NEEA team, led by Charlie Stephens, Senior Energy Codes and Standards Engineer, developed a model to replace existing packaged rooftop units (RTUs) with efficient heat pumps for heating and cooling, and high performance heat recovery ventilation for a dedicated outdoor air system (DOAS). The model was developed several years ago, and there was a missing piece; H/ERVs that could replace the ventilation formerly performed by RTUs and achieve the high efficiency needed to make the model work. Conventional commercial H/ERVs have sensible efficiencies of 60-70% or less, which does not reduce the heating and cooling loads enough to make the payback for the incremental cost of the retrofit work.

In the example in Figure 2, very high efficiency heat recovery ventilation has a significant impact on the heating and cooling load. A 20% difference in sensible recovery efficiency results in the need for 100% more energy to temper the OA to room temperature, with the outside temperature at a modest 40 degrees Fahrenheit and the inside temperature at 70 degrees Fahrenheit. Most of the RTUs that have been replaced in the NEEA pilots had no heat recovery; as a result, their capacity was calculated to both heat or cool the spaces in the buildings and to temper incoming OA to room temperature. Figure 3 shows both the impact of

AGGRESSIVE TARGETS FOR BUILDINGS 80x50 X

80 x 50 Roadmap (MtCO₂e)

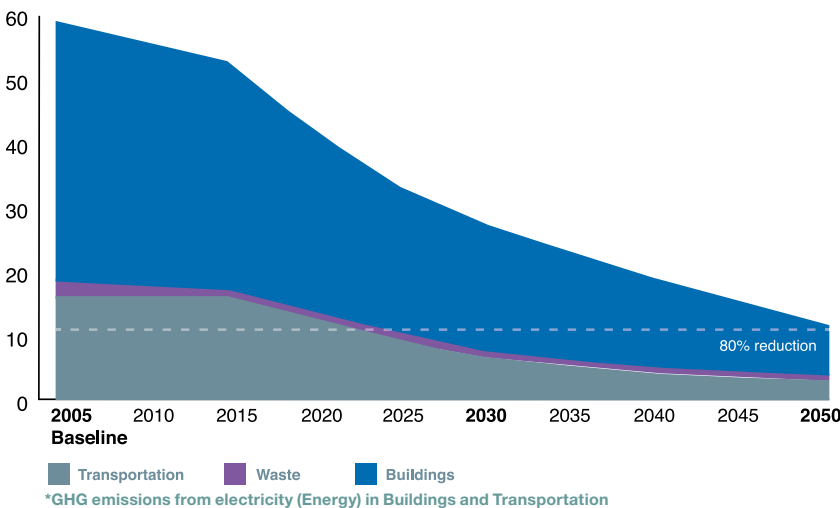


FIGURE 1: NYC 80 X 50 TARGETS - BUILDINGS ARE IT
CREDIT: NYC MAYOR'S OFFICE

Led primarily by cities across North America, there has been a big push to reduce energy use in buildings. New York City is leading the charge in the United States with the 80 x 50 initiative (see Fig. 1), while Vancouver, BC is leading the way in Canada. Adoption of the Passive House standard as a guide is a shared element for both cities, and there has been significant progress with developers adopting the standard for new build projects in New York City and in Vancouver. But the real challenge for these cities and others across the continent is with existing buildings.

At the heart of the NEEA model is the recognition of high performance heat recovery ventilation as a core principle of efficiency. Look at any modeled pie chart for energy use in buildings, and HVAC energy is a big piece. Drill down into the details of

EFFICIENCY & COMFORT

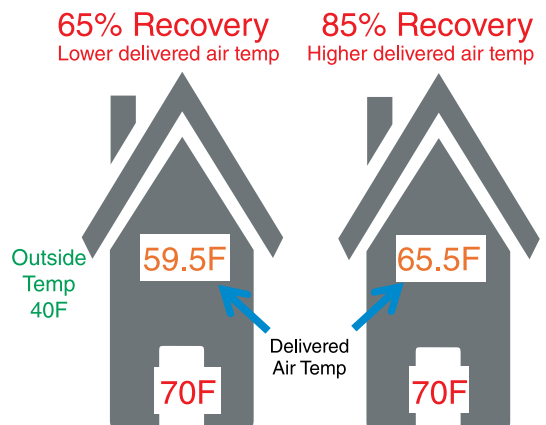


FIGURE 2: EFFICIENCY MATTERS
CREDIT: BARRY STEPHENS



	1060 cfm	1100 cfm	1550 cfm
Recovery Efficiency	85% Recovery	70% Recovery	72% Recovery
Motor Efficiency	2.9 cfm / watt	1.3 cfm / watt	1.6 cfm / watt
Power Draw	172 watts	384 watts	312 watts
Yearly Power Usage	1,507 kWh / Yr	3,364 kWh / Yr	2,733 kWh / Yr
Incoming Air Temp	IA = 65.5F	IA = 61F	IA = 61.6F
Energy for Conditioning	2,430 BTUs / Hr	4,860 BTUs / Hr	4,536 BTUs / Hr
Yearly Conditioning Energy	21,286 kBtu / Year	42,573 kBtu / Year	39,735 kBtu / Year
Total Yearly Energy	6,238 kWh / Year	12,477 kWh / Year	11,654 kWh / Year
Yearly Cost	\$774.50 / Year	\$1,584 / Year	\$1,439 / Year

Assuming 500 cfm & .25 inches water column OA 40F / IA 70F; \$.10 / kw

FIGURE 3: ENERGY SAVINGS WITH VERY HIGH EFFICIENCY HRVs
CREDIT: BARRY STEPHENS

better sensible heat recovery and higher cfm/watt fan efficiency on total efficiency. What many view as modest improvements in efficiency translate into very significant energy reductions.

The development of Passive House certified commercial HRVs finally allowed NEEA to roll out its model the end of 2015. The first pilot was commissioned in early 2016, and that project has garnered a full year of data. The NEEA “Very High Efficiency Dedicated Outside Air System” (VHE DOAS) demonstration projects were under way. The results are impressive: significant energy savings while also showing consistently improved indoor air quality as demonstrated with pre-retrofit monitoring and post-retrofit data.

The project highlighted here started with nine gas pack RTUs on the roof of a two-story historic brick building located in Portland, OR. Pre-conversion energy modeling was done with the assumption that those nine RTUs would be replaced with four 1,000 cfm HRVs and a 16 ton VRF heat pump system. This represented a reduction in capacity for the heating and cooling system of more than 50%. The VRF system allows for better distribution and modulating of heating and cooling to individual spaces, resulting in significantly reduced energy use and improved comfort.

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System Conversion Details

Existing System Type	Make / Model / Number of Units	Cooling Capacity	Heating Capacity ¹	Zones
RTUs	(8) Carrier 4-ton (1) York 3-ton	35 tons	43 tons	9
Conversion System				
VRF w/ heat rec.	(1) Mitsubishi PURY-192	16 tons	18 tons	8
Packaged HRVs	(4) Ventacity VS1000RT	1,025 cfm max. each		4

¹ Net heating to the building

FIGURE 4: LOAD REDUCTIONS ARE SIGNIFICANT
CREDIT: NEEA - "LAW OFFICE PROJECT CASE STUDY" 2017


The nine RTUs were inspected prior to the retrofit and were determined to be operating well below specified requirements for ventilation and IAQ. For the most part, the dampers were closed. This was consistent with most of the projects across the Northwest and California. By providing full time high efficiency ventilation, the IAQ has improved while also saving lots of energy. Because the retrofitted space was unoccupied for several years prior to this project, pre-conversion data were not available for modeling. The model assumed 57.4 kBtu/ft² based on new, replacement RTUs for the nine units existing prior to the retrofit. As pictured in Figure 5, these EUI reductions are the result of: high efficiency heat recovery, resulting in lower load requirements for the heating and cooling; significant reductions in fan power due to very efficient fans and lower overall air volume requirements with DOAS; and the use of heat pumps with very good COP performance.

The time to perform this retrofit is at the end-of-life of existing RTUs, and there are incremental costs associated with this approach. Replacement RTUs are easy, usually seamless and provide in the range of 5% improvement in energy efficiency. Retrofitting a high-efficiency rooftop HRV and re-purposing the existing ductwork for dedicated ventilation has worked well in several pilots, while substantial ductwork has been needed in other projects. Costs are impacted by the options available. Meanwhile, the VRF heat pump installation has proven to be very doable, efficient and – for the most part – effective, but not without a caveat or two. Design is important, including understanding how to heat and cool the spaces in an efficient and cost effective manner. It was not uncommon to have a wide range of both pricing and design approaches on several of these projects. As always, the low bidder is not always the best option. (There are many nice boats – and a few yachts – out there named "Change Order!")

Pre-Conversion			Post-Conversion			
As Modeled						
EUI:	57.4	kBtu/sq ft-yr	EUI:	19.7	kBtu/sq ft-yr	66% Reduction
Fans:	9.5	kBtu/sq ft-yr	Fans:	1.0	kBtu/sq ft-yr	89% Reduction
Heating:	37.6	kBtu/sq ft-yr	Heating:	9.2	kBtu/sq ft-yr	76% Reduction
Cooling:	3.6	kBtu/sq ft-yr	Cooling:	2.8	kBtu/sq ft-yr	22% Reduction
HVAC:	50.7	kBtu/sq ft-yr	HVAC:	13.0	kBtu/sq ft-yr	75% Reduction
EUI:	No data	kBtu/sq ft-yr	EUI:	19.4	kBtu/sq ft-yr	65% Reduction
HVAC:		kBtu/sq ft-yr	HVAC:	14.6	kBtu/sq ft-yr	71% Reduction
Pre- and post-conversion energy consumption are based on a typical meteorological year (TMY).						
Models updated based on a full year of sub-metered energy end-use data.						

FIGURE 5: ENERGY REDUCTIONS ARE IMPRESSIVE
CREDIT: NEEA - "LAW OFFICE PROJECT CASE STUDY" 2017

Done well, we have seen these pilot projects model 2-8 year paybacks, and in the case of those that were closer to eight years, the reasons became clear as the projects progressed. Properly designed and managed, this model is very viable for PACE financing and other options for energy efficiency retrofits. Additionally, there are incentives for these levels of energy efficiency. Heat pumps are commonly eligible for prescriptive incentives, whereas projects involving heat recovery ventilation typically fall into custom programs and require a bit more time and effort to present and gain approval.


More projects are in the works, with New York, Maine and British Columbia utilities and efficiency organizations developing pilots and/or programs to harness these very significant savings and benefits for small to medium commercial buildings. NEEA is compiling case studies with relevant data on a number of building types in a full range of climates. As these pilots turn into programs, there is significant opportunity to meet aggressive goals of reducing energy in existing buildings. 

ABOUT THE AUTHOR

Barry Stephens is the Northeast Regional Sales Manager for Ventacity Systems, Inc. Prior to joining Ventacity in March 2016 he spent 15 years at Zehnder America as the National Sales & Marketing Manager,

and later as Business Development & Technology Director. He has been involved with projects across North America, including Solar Decathlons, NZE homes, Passive House projects, schools, multi-family and other very high performance buildings. He has presented at conferences across North America since 2010. 

ABOUT THE PEER REVIEWER

Margo Valdes is the Director of Sustainable Development for Sustainable Comfort in Worcester, MA. Margo has worked as a building performance consultant since 2008 on projects across New England and New York. Her experience includes energy audits, energy and water physical needs assessments, and HERS ratings under the ENERGY STAR Homes, LEED for Homes, and Enterprise Green Communities certification programs. She worked in New York City performing energy audits on large multifamily buildings under NYC's Local Law 87. In 2015 Margo worked on a research study measuring the effectiveness of rooftop Energy Recovery Ventilators. Margo presents at local and regional professional conferences. Her educational background includes a B.A. in Economics with a minor in Physics from Clark University in Worcester, MA, coursework in Life Cycle Analysis of Building Materials at the Boston Architectural College and the BuildingEnergy Masters Series Zero Net Energy Homes Course. 



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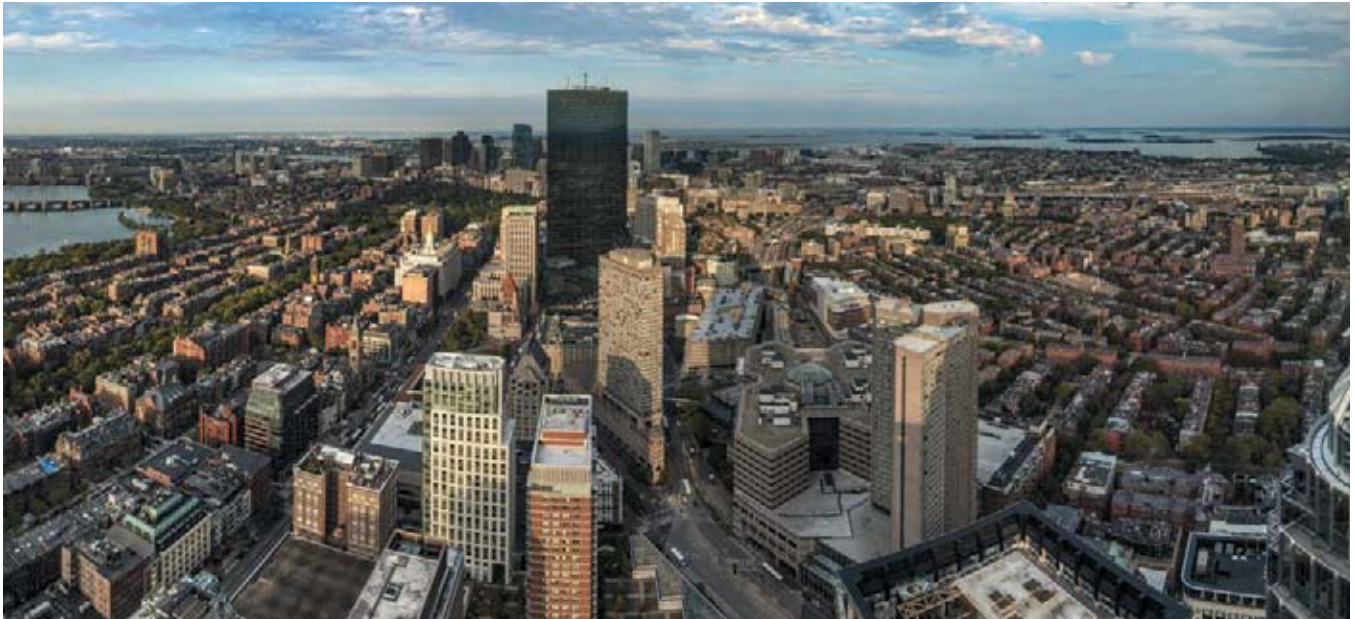
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STRETCH CODES EMERGE AS A HIGH IMPACT STRATEGY FOR ENERGY SAVINGS



ROUGHLY 215 MASSACHUSETTS CITIES AND TOWNS, INCLUDING BOSTON, ARE PARTICIPATING IN MASSACHUSETTS' GREEN COMMUNITIES PROGRAM.
CREDIT: TRAVELVIEW/SHUTTERSTOCK.COM

BY MARK FRANKEL
AND STACEY HOBART

PEER REVIEWED BY
DARREN PORT

For decades, local energy codes have defined the least efficient structure that could be legally built. Although codes have become stricter, they still fall short of industry experts' recommendations towards zero-net energy. For projects that cannot offset energy use on site, the goal should be creating standards for ultra-low energy homes and commercial spaces on par with ZNE.

Intensifying pressure to meet energy reduction and climate action goals has some policymakers rethinking the role of energy codes and their potential to dramatically reshape the efficiency outcomes for local building stock. As a result, broader application of "stretch codes" has emerged as a promising solution that jurisdictions can use to set a long-term vision for efficiency stringency far into the future.

Stretch codes represent a wholesale disruption of the current paradigm for energy code development. Incremental improvements to the current version of the two national model energy codes – ASHRAE 90.1 and the International Energy Conservation Code (IECC) – happen every three years and traditionally address provisions such as increasing insulation values or equipment standards. But these

prescriptive standards can only go so far towards achieving higher levels of efficiency in building design and construction.

Alternatively, stretch codes require jurisdictions to set goals for achieving zero or ultra-low energy use in new construction by an end date – 2030 is a common target – and to provide a plan to increase requirements incrementally until the goals are met. The Northeast currently leads the country in energy stringency in codes and a new study by the Northeast Energy Efficiency Partnerships (NEEP) finds that the majority of states in the region could achieve ZNE requirements by 2040.

Stretch codes (sometimes referred to as 'step' or 'reach' codes) are proving to be a critical policy lever for local governments that understand they must accelerate the pace of progress in order to mitigate the effects of climate change. U.S. commercial buildings and residential households consume over 40% of the nation's total primary energy and contribute roughly 40% of the carbon emissions. To date, hundreds of entities across the country have adopted goals to reduce these carbon emissions and meet the 2030 Challenge, which aims to make all new buildings and major renovations carbon-neutral

by 2030, or the COP21 Paris Agreement, which targets an 80% reduction in carbon emissions from the building sector by 2050.

Stretch codes provide a pathway that states such as Massachusetts, California, New York, Washington, Vermont, and British Columbia, Canada are already following. Some cities, like Santa Monica, CA, Boulder, CO and Washington, DC also have the ability to set local requirements and are implementing stretch codes.

For example, British Columbia aims to:

1. Reduce greenhouse gas emissions to 33% below 2007 levels by 2020
2. Achieve zero energy-ready status in all new construction by 2032
3. Reduce greenhouse gas emissions 80% below 2017 levels by 2050

To help cities understand and actualize these goals, government officials published the BC Energy Step Code in April 2017. The code includes multiple steps, the first being just above code minimum and the final being zero energy-ready. Jurisdictions may choose to replace the performance section of the Building Code with the Energy Step Code.

“We have a clear commitment from our government, so we know where we’re headed on buildings,” explains Zachary May, Director of Policy and Codes Development for British Columbia. “Cities are mandated to take action on climate change, and adoption of the step code is one of the best actions local governments can take,” he said.

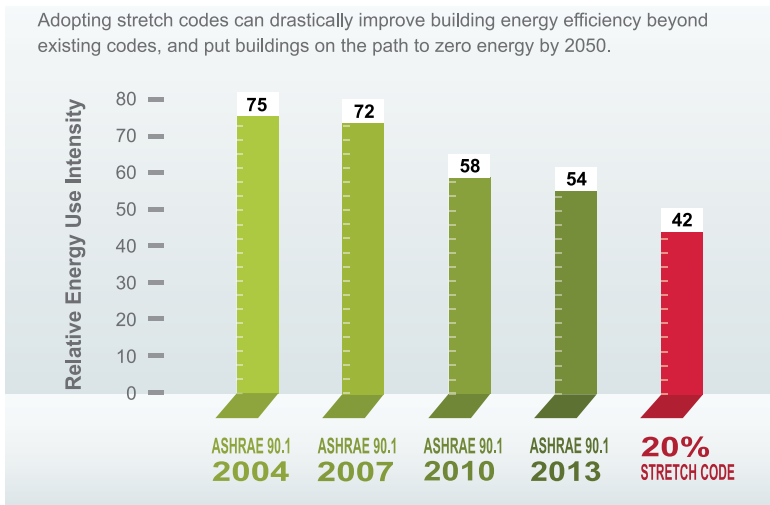
Adopting more aggressive policies is also expected to give a boost to the energy efficiency industry by increasing demand for its products and services in new construction and major renovations. “Industry says, ‘if we know we’re going to high performance, we just want a single standard,’” said May. “The step codes map out a path that lets manufacturers know what’s coming.”

This is great news for green-minded business and building owners as well, since the stretch codes offer a view into the future of building code requirements that wouldn’t be available otherwise. Businesses can look ahead 10 or even 20 years to future-proof current building designs and construction practices and plan for technology and operational needs well before new codes take effect. Incentive programs will likely track future code requirements, giving businesses greater opportunities to receive financial help.

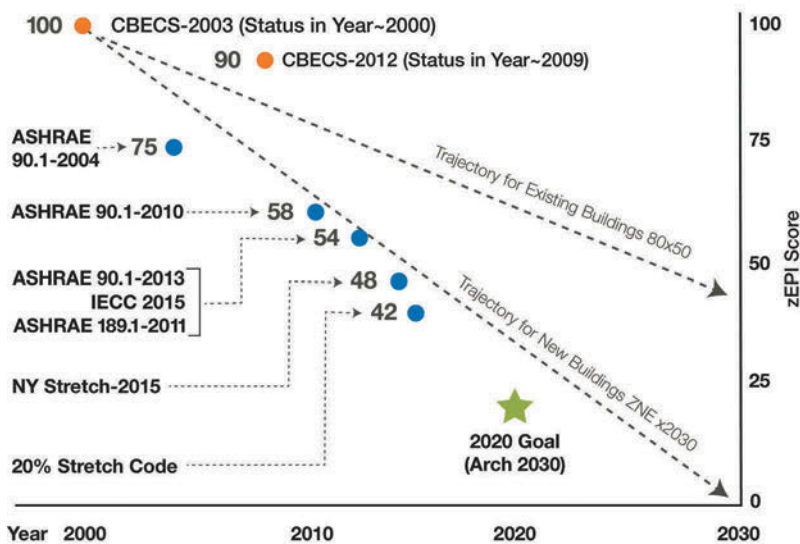
In Massachusetts, the Green Communities program is a statewide initiative that provides technical and financial assistance to municipalities that commit to following the state’s stretch code for new construction. Massachusetts has an advanced base energy code which is required to be updated every three years to reflect changes to the IECC. Utility rebates and other incentives help the building community comply with the standards. To date, roughly 215 Massachusetts cities and towns are participating. Studies have demonstrated the cost effectiveness of the stretch code for jurisdictions; the estimated payback period on efficiency measures necessary to meet the stretch code is a maximum of three years.

These examples of stretch code implementation serve as guideposts for others, but developing such an energy policy from scratch requires resources. To make stretch code adoption more accessible, New Buildings Institute (NBI) has developed a set of stretch code measures that target 20% better efficiency than ASHRAE 90.1-2013.

The 20% Stretch Code provisions can be adopted in conjunction with both ASHRAE 90.1 and the IECC and offers states and eligible cities a set of energy-saving building strategies that cover design aspects such as envelope, mechanical, water heating, lighting and plug loads. Jurisdictions can choose to



zEPI: The Path to Zero Energy in Building Energy Codes



ADOPTING STRETCH CODES CAN DRASTICALLY IMPROVE BUILDING ENERGY EFFICIENCY BEYOND EXISTING CODES, AND PUT BUILDINGS ON THE PATH TO ZERO BY 2050.
CREDIT: NEW BUILDINGS INSTITUTE





BRITISH COLUMBIA'S ENERGY STEP CODE INCLUDES MULTIPLE STEPS, THE FIRST BEING JUST ABOVE CODE MINIMUM, AND THE FINAL BEING ZERO ENERGY-READY.
CREDIT: SONGQUAN DENG/SHUTTERSTOCK.COM

adopt all provisions of the stretch code or parts of it through their existing code review process. They can also make the stretch code provisions voluntary and provide incentive for owners and builders to follow the requirements. The energy savings estimates for the measures have been analyzed by the Pacific Northwest National Lab (PNNL) with support from the U.S. Department of Energy.

For jurisdictions that are not able to adopt codes outside of a state process, the stretch code strategies could be used as part of a zoning policy or in conjunction with utility or other incentives. NBI is also working on the next step in the stretch code progression – a set of strategies for saving 40% more than ASHRAE 90.1-2013 is due out in 2018.

After adoption, when cities must implement the code, optimized administration helps manage costs and improve compliance. “Getting to zero energy codes is the first important step, but ensuring that the desired performance levels are realized in buildings is clearly critical,” said Darren Port, Buildings & Community Solutions Manager at NEEP. “There are many initiatives that jurisdictions can undertake to ease the way for building markets to comply with codes, from online inspection requests to aligning utility incentives with stretch code measures,” he said. NEEP’s new report cites several ways jurisdictions can improve processes for better outcomes.

Codes have consistently proven to be a highly effective policy strategy for reducing building energy use. For local governments pressed to hit the fast-forward button on curbing energy use in the building sector, adopting a stretch code can be a high impact approach that’s bound to drive higher building efficiency and lower environmental impact in local building stock. 🌱

ABOUT THE AUTHORS

Mark Frankel is the Technical Director at New Buildings Institute. Currently, Mark is involved

in national coalitions to improve building performance feedback, market adoption strategies for net zero energy and deep energy retrofits, and in the development and implementation of innovative codes and programs focused on building performance outcome and benchmarking. Mark has been consulting on energy efficiency and sustainable design for over 20 years. He is a LEED Fellow and a licensed architect.

Stacey Hobart is the Communications Director at New Buildings Institute working to spotlight advancements driving better energy performance in commercial buildings. With over 20 years of experience working in energy efficiency, Stacey has supported the progression of the green building movement, commercialization of new technologies such as CFLs and LEDs, the creation of new market segments including zero energy buildings, and expanding and amplifying the conversation around what’s next for commercial building efficiency.

ABOUT THE PEER REVIEWER

Darren Port develops and advocates for the implementation of policy strategies that advance the Northeast and the Mid-Atlantic States adoption of, and compliance with, progressive market transformation initiatives including energy codes, stretch codes, zero energy building policy, rating and disclosure of building energy performance and multifamily retrofits. Darren has served on national code development committees creating new editions of the IGCC, ASHRAE 189.1 and ICC-700. Before NEEP Darren worked 13 years for the State of New Jersey, within the Division of Housing as the Founding Director of the NJ Green Homes Office and the Division of Code and Standards as State of New Jersey Green Building Administrator.

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SCALE IT UP: MONITORING-BASED DEMAND-SIDE OPERATIONS FOR NYC AGENCIES

BY SUSAN COHEN AND
TAREK M. ARAFAT

On a Saturday in early October, on an open meadow at the Chafee National Wildlife Refuge in Narragansett, Rhode Island, a long bank of bushes intertwined with vines hung heavy with Concord grapes. Their aroma was divine, but they were high out of reach. At eye level, nothing was visible at first. Moving aside some leaves revealed grapes deep inside the bushes behind a different kind of vine with steel-like thorns, no doubt evolution’s way of giving birds some edge over foraging mammals. But then simply by bending down a bit, one could see, thrillingly, prized bunches within easy reach: low hanging fruit.

In the energy world, we hear this metaphor all the time. It seems there are always 10% to 20% energy savings possible if easy steps are taken to get “low hanging fruit.” This is perplexing: does it mean that people are irrational, engaging in obviously wasteful practices that could be easily changed? Does it mean that savings are achieved but keep dissipating and have to be re-harvested every year? These descriptions do not accurately describe the world of public sector energy management – at least not unilaterally. To stay with the metaphor, the fruit may be low but that meadow is far away.

Our office, the Division of Energy Management (DEM) within New York City’s Department of Citywide Administrative Services, pays for the energy consumed in operating city government facilities. The facilities themselves – approximately 4,000 in all – are managed by the agencies that occupy them: departments of education, police, fire, sanitation, hospitals, water treatment plants, libraries and cultural institutions. With the passage of New York City’s first sustainability plan, PlaNYC, and its successor, One City Built to Last, DEM was provided with a program budget to help agencies meet the energy and greenhouse gas (GHG) emissions reduction goals of these plans. The City has a long-term GHG emissions reduction goal of 80% by 2050 (relative to 2005), or “80 x 50”, for all sectors; DEM has a nearer-term “35 x 25” goal to help agencies reduce facilities-related

emissions from city government operations. That goal that was recently reinforced as part of Mayor de Blasio’s Executive Order 26 (EO26), which commits the City to the Paris Climate Accord goals. Meeting EO26 will require agencies to reduce energy usage by 20% from current levels.

Much of DEM’s original program focus was on investments ranging from standard lighting and boiler upgrades to solar installations and demonstrations of new technologies. However, it was always understood that operations-focused programs, along with staffing and analysis, would also be required. DEM now provides energy support staff in larger agencies, oversees energy

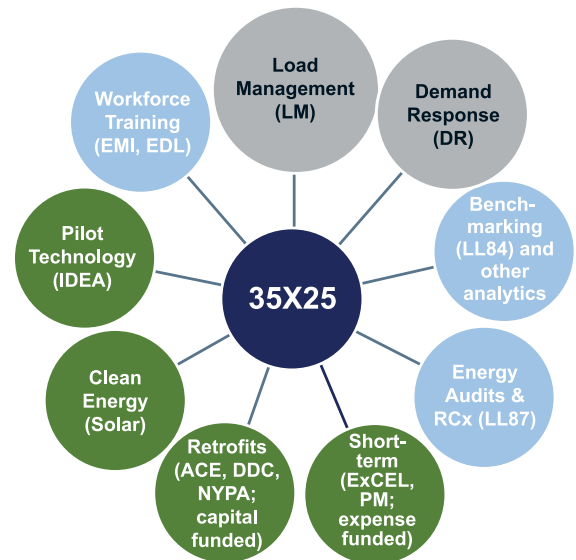


FIGURE 1: DCAS ENERGY MANAGEMENT PROGRAMS TOWARD MUNICIPAL 35 X 25 GOAL
CREDIT: DIVISION OF ENERGY MANAGEMENT, CITY OF NEW YORK

audits and retro-commissioning and benchmarks buildings’ energy performance. The operations focus includes training and more robust preventative maintenance initiatives. (Figure 1)

Another component of our portfolio is a rigorous Demand Response (DR) program that includes real-time metering (RTM) capabilities, with near-real-time display, for many of the

participating facilities. By 2017, 400-plus qualified locations were enrolled in New York State's grid-run and/or local utility demand response programs, committing up to 75 MW of electric demand reduction and earning an annual total of just over \$10 million. For 300 of those locations, facility staff and their managers can see current electricity usage information in a clear and easily-accessed web platform and can set alerts to help them monitor. Notably, these achievements were not instantaneous. First there was an RFP and contracting process;

the process began in 2011, and it was 2015 before all service elements were in place. Next, the DR program had to be introduced to agencies and facility participation had to be solicited. Each interested location required a site visit, and most needed some kind of work for utility meter add-ons and communication infrastructure. While this groundwork was being laid site-by-site and participation in DR events was growing, DEM made the case to the City's budget office for modest staff expansion to adapt DR capabilities into a focus on day-to-day energy savings that could work

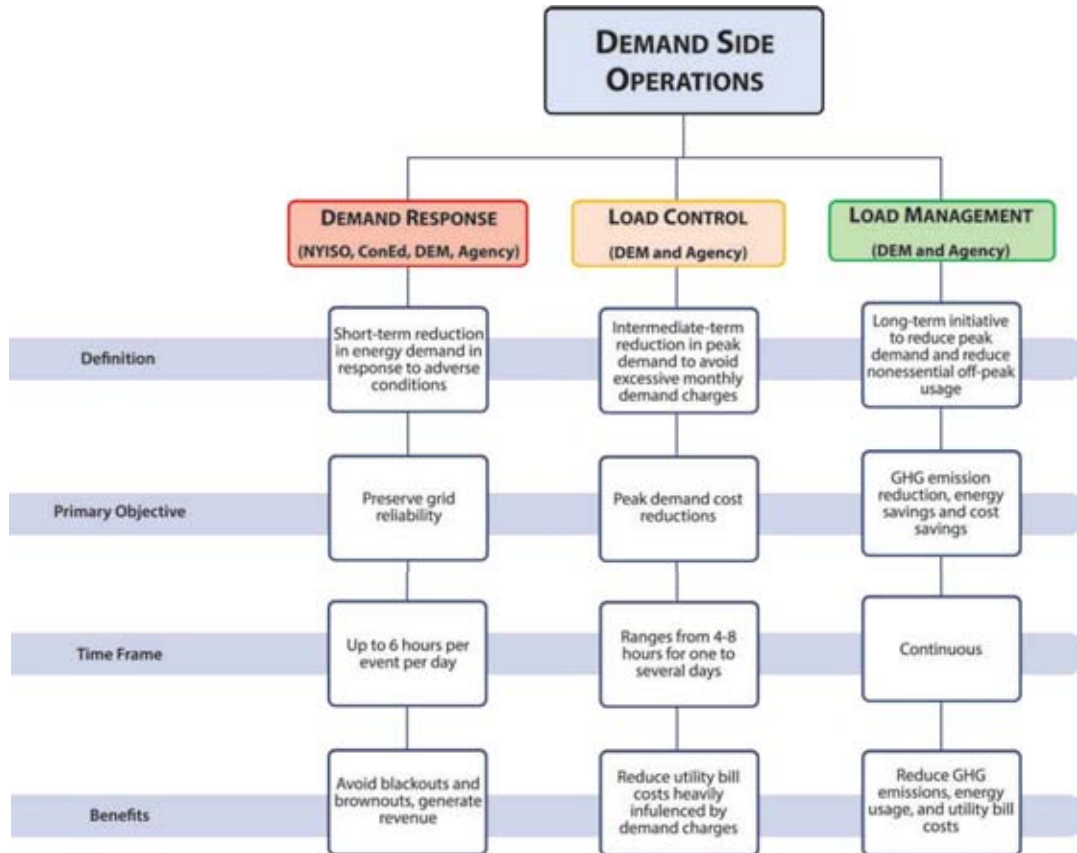


FIGURE 2: DCAS ENERGY MANAGEMENT DEMAND SIDE OPERATIONS
CREDIT: DIVISION OF ENERGY MANAGEMENT, CITY OF NEW YORK

across different agencies and organizational structures, each with its own facility types and needs. Finally, we gave that focus a name: Monitoring-based Load Management. (Figure 2)

Monitoring-based Load Management (MBLN or simply LM) is the consistent practice of optimizing a building's energy load through operational improvements that in themselves are low- or no-cost. In DEM's terms, LM integrates real-time data visualization and data analysis with buy-in from staff who have knowledge of building operations and management who need to support the initial time for this integration. The effort

is facility-focused and contingent on active participation from agency personnel, using real-time monitoring to inform decisions about controlling energy use. Successful LM may reduce peak demand, but it could also reduce nonessential base load during peak or off-peak times (Figure 3), reducing both utility costs and GHG emissions in the near term. It also positions facility personnel for efficient long-term oversight of electricity usage.

An initial pilot with one agency explored a number of possible actions in a large building complex, but yielded no clear savings and provided proof of the need for staff commitment. The first successful application

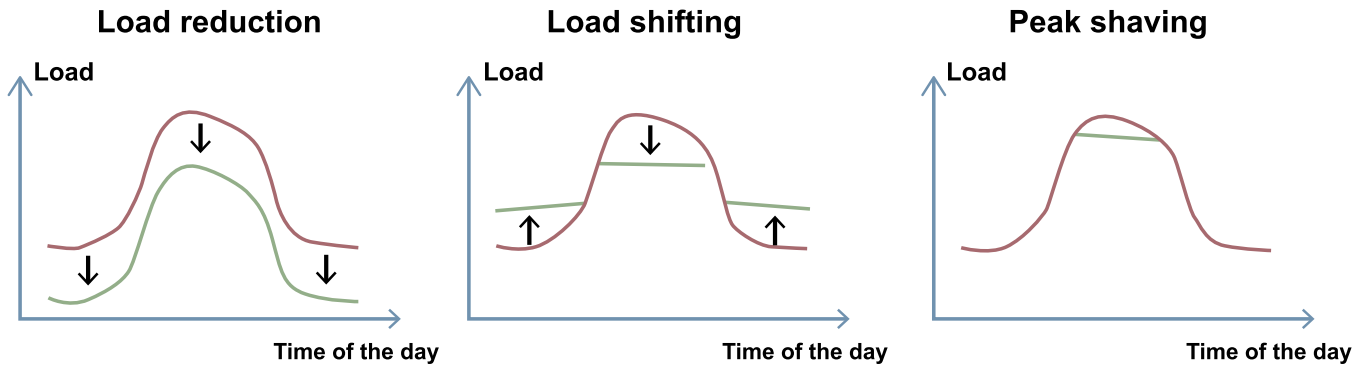


FIGURE 3: GENERIC LOAD PROFILE SAVINGS OPPORTUNITIES
 CREDIT: 2014 FUTURE CITIES CONFERENCE / KARL HENRIK JOHANSSON "SMART INFRASTRUCTURES FOR A SUSTAINABLE CITY: STOCKHOLM CASE STUDIES"

grew out of an unlikely moment at a meeting DEM held with the Office of the Chief Medical Examiner (OCME) in September 2016. The OCME has a few facilities, of which the largest is the Hirsch Forensics Laboratory. This is a 15-story, 330,000 square foot mixed-use building in midtown Manhattan, heated by Con Edison's large district steam system, that includes laboratory space serving public health and criminal justice needs. OCME had enrolled the facility in DR in 2014 and had real-time metering installed in 2015. A review of RTM load profiles and utility bills showed that the lab put this building at the high end

of the energy-use spectrum. DEM chose to be provocative at a meeting that September, saying, "This building is an energy hog. The site EUI is 330." The chief engineer picked his head up from reading emails on his work phone; he told us later that was the moment the agency decided to work on LM.

A detailed site visit took place that November. Monthly energy bills and screen shots of real-time data were studied with both agency and facility operations staff, and together we looked at the BMS system, chillers and other major energy-using equipment. This was followed by weeks of email exchanges



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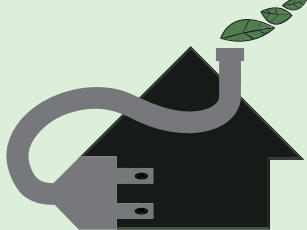
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FIGURE 4: LM MEASURE – SCHEDULING AND ZONE CONTROL
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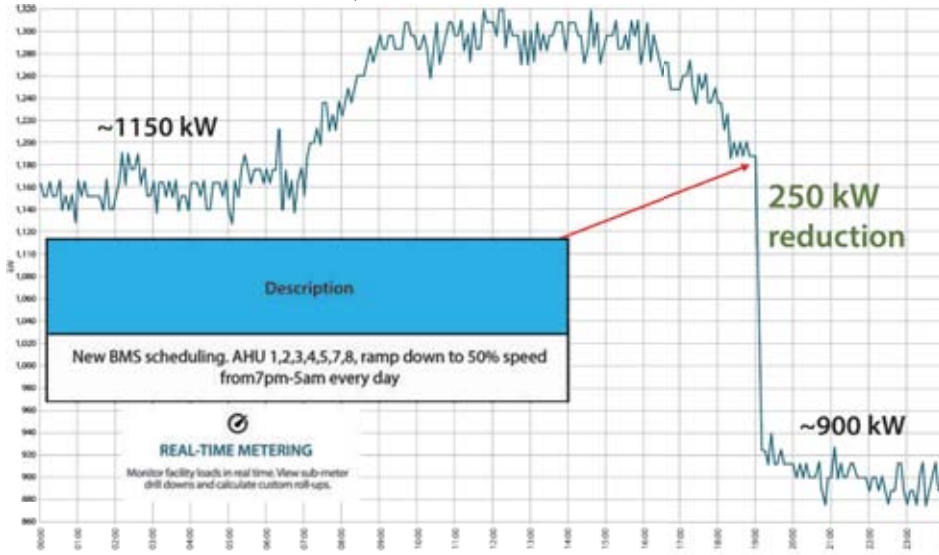


FIGURE 5A: PRE-LOAD MANAGEMENT – 4 WEEKS' LOAD
 CREDIT: DIVISION OF ENERGY MANAGEMENT, CITY OF NEW YORK

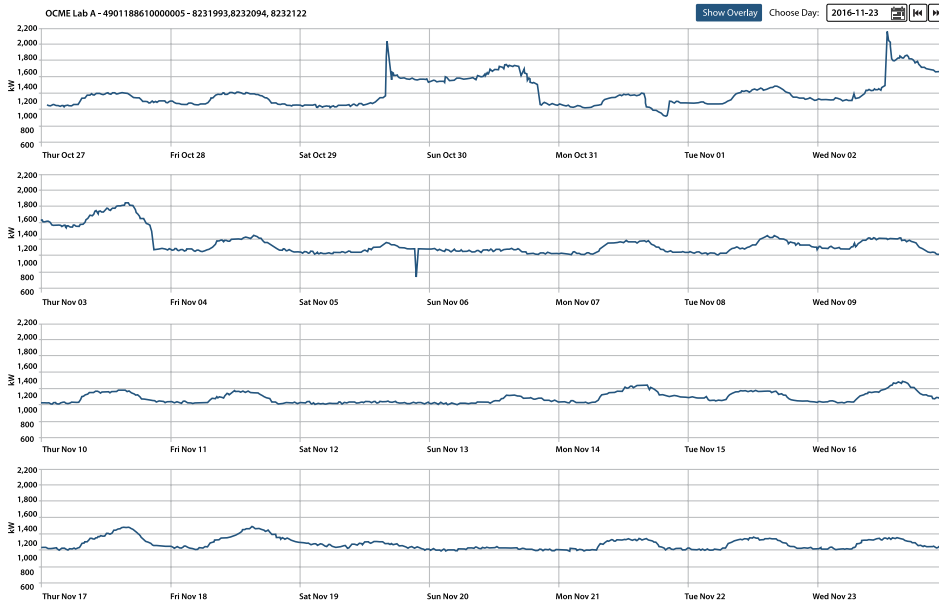
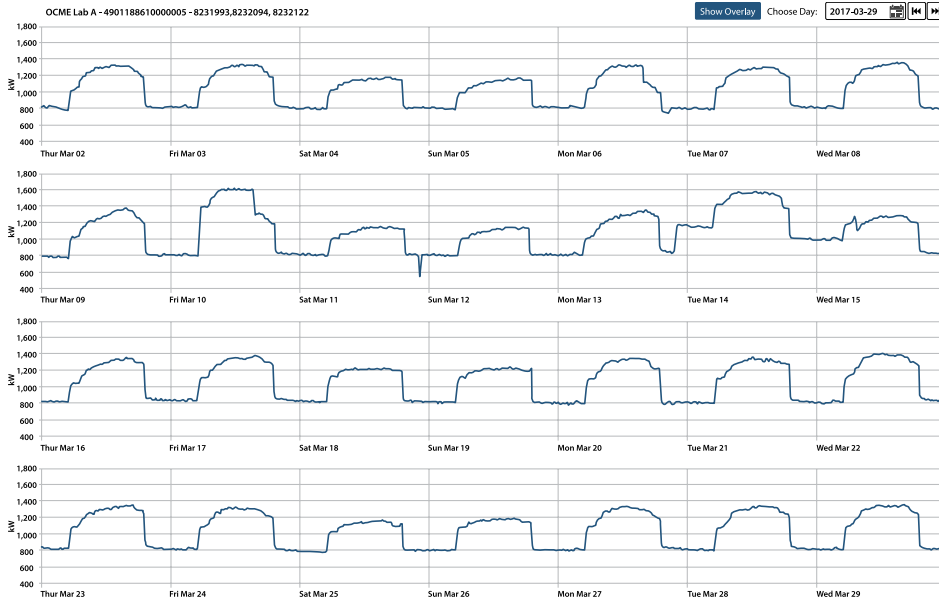


FIGURE 5B: POST-LOAD MANAGEMENT – 4 WEEKS' LOAD
 CREDIT: DIVISION OF ENERGY MANAGEMENT, CITY OF NEW YORK



that included red circles on screen captures of the real-time load profiles and calculations of potential savings based on such things as occupancy schedules and equipment name-plate horsepower. There were also phone calls with the chief stationary engineer and the agency director of technical services as we explored possibilities. By early December, air-handling unit (AHU) schedule changes were finally applied. The results were dramatic – and obvious right away with real-time metering. (Figure 4) No occupant complaints followed the energy reduction, and this built confidence that fed more experimentation over the subsequent months. For example, after a snowfall in January the system showed a usage jump that did not abate after a few days. The visualization compelled the staff to search for a cause; it was finally traced to an outside resistance heater left on after the snow.

Each step of the way, DEM and OCME benefited from having the common language of real-time metering. Its trends and charts were a shared landscape, so that reactive actions and measures could be figured out together, with a relationship built on information. By March, the energy pattern had gone from flat to a consistent and healthy daily pattern of peaks and troughs. (Figures 5a and 5b)

After almost a year, the results are savings of 10 percent better than the citywide government average: total citywide electricity usage dropped 1.5% in the eleven months ending September 2017 while the OCME Hirsch Lab had an 11.5% reduction over the same time period. (Figure 6) This was an incremental energy consumption savings of 1.5 million kwh (more than would have been saved at the citywide average reduction rate), and, on the same basis, a savings of almost 400 more metric tons of CO₂ and \$90,000.

Moving forward, the lab will look for steam savings, aided by real-time usage display expected to be operational by the end of 2017, with a focus on the set points of the AHU's variable air volume reheat coils. Meanwhile, LM tools and protocols are beginning to be applied at other City agencies. Selected City University of New York buildings are focusing on peak shaving. DCAS, as the City's general services administration, runs more than 50 public buildings; its energy manager has required that a computer screen in the engineering office be dedicated to around-the-clock display of the 31 facilities with RTMs in his portfolio.

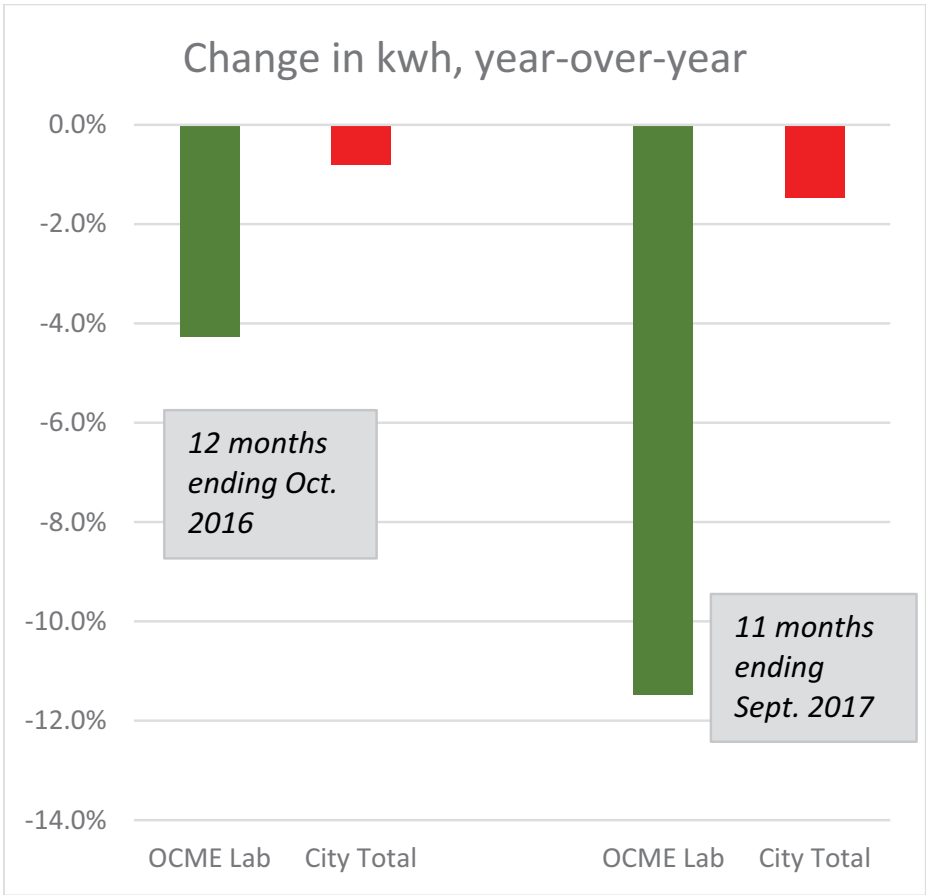


FIGURE 6: DS OPS TIMELINE – ELECTRICITY
CREDIT: DIVISION OF ENERGY MANAGEMENT, CITY OF NEW YORK

Program-wide, a mobile platform has been added, and DEM is working with the CUNY Energy Management Institute to develop a training module that will help facility managers set informed alerts and analyze data to

get the most out of the RTM system potential. In the mix, we look forward to the unexpected as people take up and make their own connections with new technologies. At some agencies there will have to be a major

change for LM to be successful; but we also see the potential for LM to seed a transformational change. All the groundwork will enable the fundamentals (good operations) to be done better, with more information (RTMs) – to harvest that low hanging fruit year after year. 🌱

ABOUT THE AUTHOR

Susan Cohen oversees the City of New York’s \$700 million annual energy budget, in her job as Assistant Commissioner, Energy Management, at the Department of Citywide Administrative Services. Her unit has brought web-based reporting to City government agencies, combining data from multiple sources and enabling the monitoring of energy cost and usage by a broad array of users. She also oversees a growing demand response and metering program. She has a PhD in economics from Columbia University. MEMBER

Tarek M. Arafat manages a GHG reduction initiative for hundreds of real-time monitored municipal buildings, as the Program Manager of the Monitoring-based Load Management Program for Energy Management, at the Department of Citywide Administrative Services. He has a BE in Mechanical Engineering, a MS in Sustainability, and a MPA from Columbia University. In the Fall of 2017 he began an Urban Informatics and Data Science Master at NYU’s Center for Urban Science and Progress.

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THE RETROFIT REVOLUTION



BY LOIC CHAPPOZ

PEER REVIEWED BY
RYAN CASSIDY

A lot of energy is required to heat or cool spaces, circulate air and operate lighting in buildings. In New York State, 60 percent of greenhouse gas emissions come from these operations. Most of these buildings – from single-family homes to skyscrapers – will likely be around for about 100 years.

New York State has 1.7 million affordable housing units and almost all of these properties will need substantial renovation over the next 20 years. This is why the state is taking bold steps to address both the need to increase energy efficiency and retrofit affordable housing.

New York recently launched RetrofitNY, a new initiative aimed at stimulating a large scale, self-sustaining market to deliver net zero energy retrofits for existing multifamily buildings. The goal is to create standardized, scalable solutions that will improve the look and comfort of residential buildings while dramatically improving their energy

performance. The initiative is the first of its kind in the United States and will revolutionize the way buildings are renovated in New York.

ABOUT RETROFITNY

RetrofitNY will create both a new market and an innovation ecosystem that will connect key energy market players (e.g., contractors, affordable building owners, architects, financiers, etc.) to collaborate on innovative solutions. Through RetrofitNY, a replicable model for retrofits will be developed, allowing New York to go from buildings being inefficient to being at or near net-zero energy performance. It will enable residents to remain in their homes during the work and create clean, energy efficient buildings.

The initiative is focusing first on affordable housing buildings being prepared for major renovation as they approach the point of refinancing or re-syndication of low-income housing tax credits.

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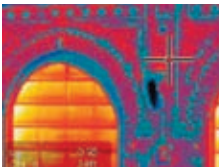
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The relative uniformity of buildings in affordable housing communities will also allow New York to rapidly activate a large market and compress cost by using similar solutions on a number of buildings. The goal is to have 100,000 units retrofitted or in the planning stages for a retrofit by 2025 and to provide new business opportunities in New York State.

NYSERDA will issue a request for proposals this year to choose pilot buildings and qualified industry teams to design retrofit solutions. NYSERDA will work with these team members to adapt existing financing models for the net zero retrofits and to identify - then remove - regulatory barriers so that the market can move toward scale as the retrofit solutions are developed.

RetrofitNY pilots will focus on two-story garden style apartment complexes and three-to-seven story multifamily buildings. Solutions are expected to be as much about innovative construction processes as they are about high-performance envelope materials and mechanical equipment. NYSERDA funding will be available to plug financing gaps on early prototypes as needed so that New York can move forward in catalyzing the industry and creating scale. It is anticipated that there will be successive rounds of the prototype design process to improve the performance and cost-effectiveness of the solutions. While the initiative is starting with the affordable housing sector, New York expects the solutions that the industry develops to spread to market rate properties as well as other states.

Businesses interested in developing high-performance retrofit solutions for New York's affordable housing sector are encouraged to tap into their partnerships and networks to form multidisciplinary teams. Companies may also want to contact affordable housing owners or developers they think might be interested in participating and alert them to the benefits this program will provide, particularly for early adopters. The challenges of bringing New York's housing stock to net-zero energy are great, but through RetrofitNY's innovative approach, it can be done.

A strong RetrofitNY team will not only be able to design an innovative solution, but also build and install it. Teams should have experience designing or creating high-performance buildings that may have achieved net-zero performance or Passive House, LEED or other high-performance

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building certification. Teams may include architects, energy engineers, mechanical, electrical and plumbing engineers, general contractors, builders, renewable energy developers and manufacturers and high-performance component manufacturers and suppliers, and Passive House and other high-performance building specialists.

RetrofitNY will create a new model for the entire housing industry and provide environmental benefits to all New Yorkers. It will help residents, building owners, the industry and communities by creating jobs and providing clean, energy efficient homes while dramatically reducing greenhouse gas emissions statewide. By lowering operational costs through energy efficiency, RetrofitNY will ultimately enable housing agencies across the state to preserve and build more units of affordable housing. These newly retrofitted homes will improve the quality of life for affordable housing residents. They will also provide critical support towards New York Governor Andrew M. Cuomo's ambitious goal to decrease energy consumption in buildings by 23 percent and reduce greenhouse gas emissions by 40 percent, all by 2030.

BUILDING ON THE MOMENTUM

RetrofitNY is based on the successful Dutch program called Energiesprong, which is responsible for thousands of two-story row houses being retrofitted to net zero energy performance. These retrofits are completed in one week while residents continue to live in their homes. Energiesprong's first prototype was done in December 2013 and cost about \$143,000. By summer 2016, installation costs dropped by half while performance improved to a 50 percent reduction in energy consumption to achieving net zero energy.

As of November 2017, about 2,000 retrofits have been completed in the Netherlands with 20,000 more in the pipeline. The renovations dramatically improve the look and comfort of these buildings, with net zero energy performance guaranteed over 20-30 years. Their goals are:

- Create a large-scale self-sustaining net zero retrofit market by generating demand for novel retrofit solutions.
- Push and support the Dutch construction industry to meet this new demand by designing and building retrofit packages that could be standardized and industrialized.



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- Create the right environment for widespread implementation of these new solutions by adapting regulations where needed and making the renovations easily financeable.

This is the path New York State is on – to revolutionize the way buildings are retrofitted so residents have clean and energy efficient homes and to develop an ecosystem where all


of the different players can collaborate and work together to standardize the retrofitting process.

Improving the efficiency of New York's affordable housing will bring value to communities, business and families across New York State.

New York is serious about advancing clean energy and making communities healthier

for all. For more information on how you can participate in RetrofitNY, visit, NYSERDA's website (www.nyserdera.ny.gov). 

ABOUT THE AUTHOR

Loic Chappoz leads the Multifamily team for the New York State Energy Research and Development Authority (NYSERDA). Prior to his work with NYSERDA, Loic worked as an independent consultant on energy efficiency policies in France, as a fuel efficiency specialist in the airline industry, and as a commercial pilot for ten years. Loic Chappoz received a Master of International Affairs in Energy and Environmental Policy from the Sciences Po Paris School of International Affairs, and was a visiting student at Columbia University in New York City. 

ABOUT THE PEER REVIEWER

Ryan Cassidy is the Director of Properties for RiseBoro Community Partnership (formerly Ridgewood Bushwick Senior Citizens Council), where he oversees the operation of over 1,800 units of affordable housing in nearly 200 buildings. Ryan has also developed and monitored construction of over 1,000 units of affordable housing. His development experience ranges from two-family home ownership programs to large multi-family complexes with retail and community facility components. He supervised the construction of the first multifamily Passive Houses in New York State and is a PHIUS Certified Passive House Consultant. 

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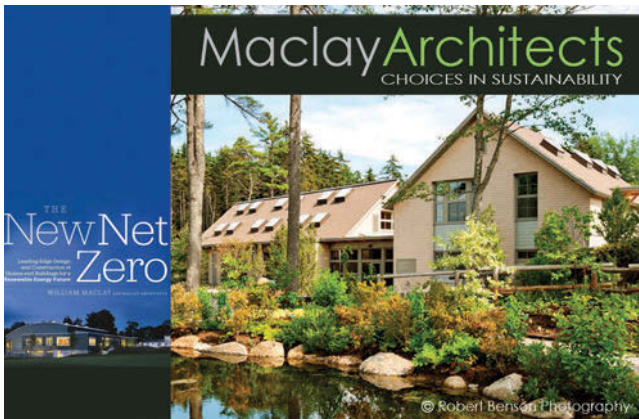
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