

1. Reconstruction: ‘The 99% Solution’ for Energy Savings in Buildings

In the last few years, reconstruction has been on the rise as a share of total construction in the U.S. and Canadian commercial, institutional, industrial, and multifamily market sector. With the exception of a few anomalous hot spots—for example, the Washington, D.C., metro area, which benefits from federal spending, and North Dakota, where the energy boom is fueling growth—new construction in the United States has been hobbled by the downturn in the U.S. economy since 2008. Meanwhile, reconstruction in its various forms—tenant improvements, office fitouts, retail renovations, adaptive reuse, renovations with additions, historic preservation, even gut rehabilitation—has, quite frankly, been keeping many architects, engineers, and construction professionals off the unemployment lines.

Reconstruction is, indeed, of increasing importance to many firms, notably those in our “Giants 300” rankings—the 300 or so largest firms, which perform the great bulk of the dollar volume of all design and construction work in the U.S. and Canada. AEC firms that used to do 10–20% of their revenues in reconstruction now see that figure more in the 30–40% range—again, largely due to the downturn in new construction. In the current climate, many firms are seeing reconstruction as the bulk of their business—and they’re glad to have the work.

This publication has long been an advocate for reconstruction. For nearly three decades, we have honored those Building Teams whose reconstruction projects represent the very best in the field with our annual Reconstruction Awards—the only such recognition program in the AEC industry.¹ Through technical articles and AIA CES-approved continuing education courses, we continue to focus on reconstruction; in fact, we have proclaimed 2012 to be “The Year of Reconstruction.”

Data supporting the importance of reconstruction also comes from the U.S. Green Building Council. The USGBC’s LEED for Existing Buildings: Operations + Maintenance rating program has, in the last few years, surpassed LEED for New Construction in total project registrations and, more recently, in total square footage. The Green Building Initiative’s Green Globes rating system has experienced a shift toward reconstruction.

It is by no means a stretch to say that reconstruction is, if not the lifeblood of the U.S./Canadian design and construction industry, at least a significant factor in the

success of thousands of AEC firms, large and small.

But what, then, do we mean when we refer to reconstruction as “the 99% solution”? To grasp the meaning of that phrase, we need to do a little math.

According to the U.S. Energy Information Administration (Green Building Facts, USDOE, 2009), operations for buildings of all types account for 41% of U.S. primary energy consumption, as well as 72% of electricity consumption, 38% of CO₂ emissions, and 13% of potable water use. Single-family residences account for 22% of total energy consumption, with nonresidential commercial buildings responsible for 19%. In other words, energy use from commercial buildings accounts for nearly half (46%) of the total energy use attributable to buildings in the U.S.

Commercial, institutional, and industrial buildings comprise about 71.6 billion square feet of space, according to the Energy Information Administration.² In a good year—pre-2008, that is—new construction would have added perhaps two percent to the total square footage of commercial buildings in the U.S. and Canada, but that figure has been more like one percent in recent years. Thus, the nonresidential structures that are already in the ground constitute 99% of the commercial space in any single year and, theoretically at least, contribute 99% of energy and water waste and GHG emissions associated with buildings.

Therefore, to launch an effective attack on the environmental problems associated with commercial buildings—energy and water consumption, electricity use, carbon emissions—the primary target has to be *existing* buildings, not new buildings, even though new buildings usually garner the lion’s share of publicity in the popular media and in AEC industry professional publications (including, we must admit, this one). If 99% of the commercial space in any one year is already consuming energy and spewing greenhouse gases, it makes sense that any appreciable reduction in energy use and GHGs—say, a 15–20% cut across 15–20% of the vast stock of existing buildings—would have a much greater overall impact than trying to push all new commercial buildings toward the 60–70% range in energy reduction.

In fact, we can—and should—have it both ways: that is, we should be striving for the highest possible energy performance in new buildings, even to venture as far as “net-zero” energy use, while at the same time

1 See “28th Annual Reconstruction Awards,” at: <http://www.bdcnetwork.com/bdcs-28th-annual-reconstruction-awards>.

2 See “The Greenest Building,” Fig. 8, p 19. Source: U.S. Energy Information Administration.

3 At: <http://www.bdcnetwork.com/2011-zero-and-net-zero-energy-buildings-homes>.

4 See the Summary Report of the September 2011 Deep Energy Retrofit Summit. Download a PDF at: <http://newbuildings.org/deep-energy-savings-existing-buildings-summit-summary>.

5 The EPA Office of Solid Waste estimated 925 million sf of residential and nonresidential space were demolished in 1998. “Characterization of Building-Related Construction and Demolition Debris in the United States,” EPA1530-R-98-010, June 1998, at: <http://www.epa.gov/osw/conserve/rrr/imm/cdm/pubs.htm>.

6 See Arthur C. Nelson, PhD, FAICP, “Toward a New Metropolis: The Opportunity to Rebuild America,” at: http://www.brookings.edu/reports/2004/12metropolitianpolicy_nelson.aspx. See also “Building ‘Second America’ for the Next 100 Million,” at: <http://www.bdcnetwork.com/building-second-america-next-100-million>.

7 “The Greenest Building: Quantifying the Environmental Value of Building Reuse,” Preservation Green Lab, 24 January 2012. Download PDF at: <http://www.preservationnation.org/information-center/sustainable-communities/sustainability/green-lab/valuing-building-reuse.html>.

squeezing the most resource waste—energy, water, and materials—out of as many existing and reconstructed buildings as possible. Our 2011 White Paper, “Zero and Net-Zero Energy Buildings + Homes,” made a strong case that “NZEBS” can be financially feasible, using today’s off-the-shelf technology, the example par excellence being the Research Support Facility at the U.S. Department of Energy’s National Renewable Energy Lab, in Golden, Colo., which came in at a cost/sf lower than many comparable LEED Platinum buildings with significantly less energy reduction.³ Similarly, numerous cases of so-called “deep energy retrofits,” with energy and GHG reductions of 40-60% or more—including those seeking net-zero status—are being reported by forward-looking practitioners in the reconstruction arena.⁴

However, just as a new net-zero building or a deep energy retrofit of an existing building might not be to every developer or property owner’s taste—the “business case” in their favor depends a lot on how long the owner intends to hold onto the property—we are by no means advocating a strategy of preservation for preservation’s sake. Not all old buildings can be “saved” from demolition; in fact, every year, something on the order of a billion square feet of buildings in the U.S. is demolished, according to an estimate based on a 1998 EPA study.⁵ The truth is, we have little reliable data on the amount of demolition, nor do we know if we are demolishing buildings at a greater or lesser rate today than in the past. (Arthur C. Nelson, of the Brookings Institution, has stated that 82 billion sf of buildings will have to be demolished and rebuilt by 2030 to accommodate the next 100 million Americans—but that’s another story.)⁶

What is undeniable is that, every year, thousands and thousands of unsafe or uninhabitable buildings have to be torn down, and that thousands more buildings that should have been preserved or reused are demolished as well. That leaves a huge group of structures that lie somewhere between preservation heaven and the wrecking ball, thousands of buildings that constitute a golden opportunity for potential environmental savings.

ARE EXISTING BUILDINGS THE GREENEST BUILDINGS?

This discussion brings us to the recent report by the Preservation Green Lab, a unit of the National Trust for Historic Preservation. In “The Greenest Building: Quantifying the Environmental Value of Building Reuse,” the Lab and its research project team analyzed six different building types across four diverse climate zones—Atlanta, Chicago, Phoenix, and Portland, Ore. The team—which included Cascadia Green Building Council, Green Building Services, Skanska USA, and Quantis, a life cycle analysis (LCA) consultant—used

LCA to measure four environmental impact categories—climate change, human health, ecosystem quality, and resource depletion—for new and existing buildings over a 75-year lifetime.⁷

The report’s chief conclusion: “Building reuse almost always offers environmental savings over demolition and new construction,” when comparing buildings of similar size and functionality. Savings from reused buildings range between 4% and 46% versus newly constructed buildings with the same energy performance level. The exception: converting a warehouse to multifamily use generates 1-6% greater environmental impact over new construction in two categories, ecosystem quality and human health impact.

The NTHP study goes on to say, “[I]t can take between 10 to 80 years for a new, energy-efficient building to overcome, through more efficient operations, the negative climate change impacts that were created during the construction process.”

The researchers note further that “it is often assumed that new construction will operate more efficiently than an existing building. Indeed, in many cases, this holds true.” They state, however, that “when a renovated building that meets a Base Case level of energy performance is compared to a new building operating at a more advanced level of efficiency, the [rehabilitation and retrofit] scenario offers immediate environmental savings for the majority of building types tested ... In particular, renovated buildings with fewer material inputs have the potential to realize the greatest short-term carbon savings.”

On this matter of materials, the study states that “the quantity and types of material used in a reuse scenario can reduce or even eliminate the environmental advantage associated with reuse ... Therefore, care must be taken to select construction materials that minimize environmental impacts.”

“The Greenest Building” represents a giant step forward in quantifying the value of building reuse, but the report

Table 1.1
Energy-conservation measures available for retrofits

Controls	Estimated payback (years)
Controls retrofits and control strategies	3-4
Demand control ventilation	2-5
Mechanical	
Variable flow primary/secondary systems with controls, VFDs	2-4
HVAC	
Change constant-speed air handlers to variable air volume	2-4
VAV boxes, control setpoints, boxflow minimums	5 or more
Convert boilers from steam to hot water	5-8
High-efficiency fully condensing boilers	6-8
High-efficiency VFD chiller system	8-12
Lighting	
Install controls to schedule interior systems	2-4
Convert incandescent lighting to CFL	1-3
Replace exit signs with LED kits	<2
Convert T12s to high-efficiency T8s with electronic ballasts	2-5

Source: “United States Building Energy Efficiency Retrofits: Market Sizing and Financing Models,” March 2012, p. 8, at: <http://www.dbcca.com/research>. Based on an analysis by DB Climate Change Advisors and Transcend Equity, 2011; EIA and DOE Building Data Book, 2010; DBCCA Analysis 2011.

The estimated simple payback for various retrofit strategies. Simple payback is defined as the period of time required to recover the initial capital investment from the savings generated by reduced energy use, without additional return. On a simple basis, a five-year payback translates to about a 15% internal rate of return over a 10-year period, if cash flows are relatively consistent through the project term.

* See our White Papers on these topics, “Life Cycle Assessment and Sustainability” and “Green Buildings + Climate Change,” which can be accessed (along with our other White Papers) at: <http://www.bdcnetwork.com/whitepapers>.

8 “A Profitable and Resource Efficient Future: Catalysing Retrofit Finance and Investing in Commercial Real Estate – A Multistakeholder Position,” World Economic Forum (Retrofit Finance & Investing Project), October 2011, page 8, at: <http://www.weforum.org/reports/profitable-and-resource-efficient-future-catalysing-retrofit-finance-and-investing-commercial>.

9 <http://www.pikerresearch.com/newsroom/energy-efficiency-retrofits-for-commercial-buildings-could-save-41-1-billion-per-year-in-energy-costs>, 22 July 2010.

10 http://www.mckinsey.com/en/Client_Service/Electric_Power_and_Natural_Gas/Latest_thinking/Unlocking_energy_efficiency_in_the_US_economy.aspx, July 2009.

11 “United States Building Energy Efficiency Retrofits: Market Sizing and Financing Models,” March 2012, page 13, at: <http://www.dbcca.com/research>.

12 “Financing Energy Efficiency in European Buildings: How to Boost Large-Scale Retrofit? Conclusions of the Buildings Performance Institute Europe European Roundtable,” 16 November 2010, at: http://www.ectp.org/cws/params/ectp/download_files/36D1497v1_BPIE_Chairman_Conclusi.pdf.

13 This section is based largely on the World Economic Forum report, pp. 13-15, and “Deep Savings in Existing Buildings: Summit Snapshot,” New Buildings Institute, February 2012. See link at: <http://newbuildings.org/deep-energy-savings-existing-buildings-summit-summary>.

does have its shortcomings. While it is encouraging to see a major contractor like Skanska on the team, having a mainstream financial or real estate player on board—say, Jones Lang LaSalle, CBRE, Transwestern, or Davis Langdon—might have resulted in certain unfortunate statements being edited out.

For example, there’s the assertion that, if the city of Portland, Ore., retrofitted and reused all buildings slated for demolition over the next 10 years, it could meet 15% of its surrounding county’s greenhouse gas emissions target—as if it would be possible, or even wise, to save every dilapidated home and building in Portland. The authors do state that not every existing building can be reused, and that new construction is necessary, but over-the-top assertions like this damage the report’s credibility.

The use of life cycle assessment is also problematic. To their credit, the authors explain their LCA methodology carefully, and the LCA experts involved have excellent credentials. But LCA is as much art as science. There can be hundreds, even thousands of variables; how the relative value of each is weighted is often a subjective judgment that can lead to heated discussion.

Similarly, focusing the report on greenhouse gas reduction rather than the bottom-line financial considerations of reconstruction, while noble, is a sure turnoff for many in the real estate industry.*

Still, there is much to praise in “The Greenest Building,” not least that it provides a sounding board to open up discussion of reconstruction’s benefits among a wide group of stakeholders. The research team acknowledges that relative energy rates, especially those based on coal, are a crucial factor. Their findings about the importance of the quantity and choice of materials will open the eyes of many architects, engineers, contractors, and building owners. The admission that one of the case studies—the warehouse-to-multifamily example—proved not to save GHG emissions in two categories adds to the credibility of the overall findings.

The report’s main finding—that rehabilitation and reuse of existing buildings is almost always more beneficial than demolition and new construction—will be quoted extensively and stir welcome debate in the real estate sector. The NTHP report will provide preservationists and green builders with plenty of ammunition to support the case for saving existing buildings.

But what are others saying about the “quantification” issue? For that analysis, we turn to several recent studies.

THE ECONOMIC CONSTRAINTS ON RECONSTRUCTION

In October 2011, the World Economic Forum issued a report stating that 50% of today’s existing building stock will still be in use in 2050, and that the available energy

savings within this building stock are 20-40%.⁸ The report cited several other findings of interest:

- U.S.-based economic consultant Pike Research has projected that energy-efficiency retrofits of commercial buildings in the U.S. could save \$41.1 billion a year in energy costs.⁹
- The highly respected consultancy McKinsey & Co. has put a figure of 600,000 to 900,000 green jobs coming from energy-efficiency measures, including retrofits.¹⁰
- A March 2012 report by the Rockefeller Foundation and Deutsche Bank projected that scaling building energy-efficiency retrofits in the U.S. could open up a \$279 billion investment opportunity, with \$72 billion coming from commercial real estate and \$25 billion from institutional projects. Total potential energy savings over 10 years: \$1 trillion.¹¹

These forecasts seem to posit a strong case for the economic viability of reconstruction. However, based on experience in the United Kingdom, a good guess is that less than 1% of existing buildings in the U.S. are retrofitted every year.¹² If reconstruction is potentially so lucrative, why isn’t it occurring at a greater scale?

It turns out there are many obstacles to reconstruction.¹³ Lack of scale is a major factor. In the U.S., nearly three-fourths (73%) of existing commercial buildings are less than 10,000 sf in size, and 95% of all commercial buildings are less than 50,000 sf. Owners of small properties are reluctant to put up the cash for renovation, particularly if it negatively impacts their individual or corporate balance sheets.

Furthermore, owning the building is often not the small building owner’s primary business, so property improvements are low priority. Repairing a burst water pipe is one thing; installing a new high-efficiency furnace just to save energy (or, worse, “to save the planet”) is quite another. As the World Economic Forum report puts it, “Building owners will rarely make retrofitting a priority unless government makes it a priority and businesses see it as a clear return on investment.”

Such inertia is not exclusive to property owners. Key financial players also have trouble seeing the silver lining in reconstruction. Utilities, in general, will get involved only when forced to do so by government mandates for demand-side energy management. The valuation industry has been reluctant to view retrofitting as enhancing the long-term asset value of reconstructed buildings; only recently has the Appraisal Institute begun to consider giving higher valuations to sustainably designed homes—and it has not gone that far with commercial buildings.¹⁴ The disaggregated nature of commercial property ownership in the U.S. and the relatively small size of retrofit projects also make reconstruction less appealing to most banks or private investors.



The Vinyl Institute has long supported Building Design+Construction's series of white papers, which have been thought leaders on issues we all face as we try to build a better future. In an industry as fast-paced and far-reaching as this one, it is critical not only to encourage and support stimulating new ideas but also to understand how to bring them to fruition in meaningful and effective ways.

BD + C's 2012 focus on Reconstruction is timely. While so much attention is placed on new construction, most of our activity – and impact – occurs in existing buildings. A tremendous opportunity exists to overhaul and update the places in which we live and work.

Reconstruction is complex, but also full of possibilities. From landfill avoidance, life cycle assessment and energy efficiency, to product take-back programs, maintenance, and durability, professionals at every point in the process are looking for new solutions. Vinyl can offer a powerful one. Vinyl is tried and true, and yet, as the market shows over and over, adaptable to new solutions.

Many durable products can be reused, and a growing infrastructure for recycling and product take-back means products that aren't reused find a new home. Furthermore, the breadth of vinyl building products that contribute to successful reconstruction is immense. Energy-efficient replacement windows, reflective and living roofing technology, water delivery infrastructure and grey water collection systems as well as innovative fabrics, wall covering and resilient flooring all contribute to reconstructed buildings.

The Vinyl Institute is committed to moving the conversation about the built environment forward. From our support of the Green Building Initiative's programs for existing buildings, to inspiring young designers to consider innovative uses of vinyl through design competitions and materials symposia, when the goal is maintaining the characteristics old buildings are known for – durability, integrity, and comfort – vinyl is the material for reconstruction.

Richard M. Doyle
President and CEO

BREAKING THROUGH THE BARRIERS TO RECONSTRUCTION

There is, happily, a much brighter side to this scenario. The World Economic Forum sees certain “market-specific factors” accelerating demand for reconstruction: first, the sense among property owners that owning a building that has not been retrofitted for sustainability and at least minimal energy improvements will put them at a disadvantage in the marketplace; and, second, the belief that building owners, developers, banks, and appraisers are waiting for some signal from government to set a predictable policy on reconstruction before making investments. The World Economic Forum report states that “the strongest signals for demand [for retrofits] are in the Class A market.”

Despite the substantial obstacles, property owners are taking the plunge into the reconstruction pool. In a report to the Northwest Energy Efficiency Alliance, the New Buildings Institute found evidence that the real estate industry is repositioning assets, largely because improving existing buildings is an owner’s best investment—at a time when T-bills are yielding almost nothing. The NEEA report also found that public firms and “green” organizations are continuing to renovate their buildings, even during these parlous economic times.

The NEEA study found five common characteristics

in the business views of those responsible for determining a building’s energy-efficiency aspects:

1. They valued the economic and environmental benefits and market expectations that made pursuing energy efficiency essential.
2. They were goal-driven. Their buildings’ energy use intensity ranged from 32-66 kBtu/sf/year, with five below 40 kBtu/sf/year. Their projects earned 13 LEED certifications, all but one Gold or Platinum.
3. They made the best use of government, utility, and other incentives and tax credits.
4. They track energy outcomes and conduct “continuous commissioning” to improve building performance.
5. They publicized the energy improvements of their buildings as part of a conscious strategy for increasing the value of the properties.¹⁵

In the following pages, our consulting experts and contributing editors discuss the most critical issues related to high-performance reconstructed buildings. We begin with a look at a number of exemplary projects that show what enlightened property owners and innovative Building Teams are doing to make high-performance reconstruction a reality. +

14 The Appraisal Institute (<http://www.appraisalinstitute.org>) is offering its members courses in valuation practices for both residential and commercial green buildings.

15 “A Search for Deep Energy Savings,” Final Report, August 2011, at: [http://www.betterbricks.com/sites/default/files/Design & Construction/final_neea_meta_report_on_deep_savings_nbi_8-3-11.pdf](http://www.betterbricks.com/sites/default/files/Design%20Construction/final_neea_meta_report_on_deep_savings_nbi_8-3-11.pdf). See also: Eleven Case Studies from: A Search for Deep Energy Savings,” at: <http://newbuildings.org/project-profiles-search-deep-energy-savings>.

- SPONSOR MESSAGE -

31-year-old Roof at UC Davis Still Going Strong

In 1981, Robbins Hall at the University of California’s Davis campus received a new Sarnafil roof that is still performing today.

The largest of 10 University of California campuses, UC Davis is internationally recognized as a premier institution for teaching and research in plant sciences and agriculture. Robbins Hall is home to laboratory space for the plant pathology, nematology, weed science, and vegetable crops departments, and also houses teaching laboratories for plant biology.

The Robbins Hall roof needed to meet stringent criteria:

- It had to have minimal maintenance costs
- It had to reflect solar radiation to minimize building cooling costs
- It had to have a long life cycle
- It needed to be high-quality to protect the contents of the laboratories

“The Robbins Hall roof is in great shape,” said Steve Schmidt, roofing supervisor for facilities. Due to the number of buildings on campus, the UC Davis Facilities Department conducts roof inspections annually. “It’s holding up really well,” said Schmidt. “By the looks of the wear, the roof appears to be about seven or eight years old. It’s hard to believe this roof is over 20 years old. Other roofing membranes usually don’t last that long — by this time, we would have at least had to coat it to extend the life.”

Roof samples were tested in the laboratory according to ASTM 4434, the standard



The Sarnafil roofing system that UC Davis chose in 1981 has been protecting critical learning spaces at Robbins Hall for more than three decades.

for new vinyl roofing membrane, after 24 years of service. The tests confirmed the outstanding condition of the Sarnafil membrane on Robbins Hall. “By selecting a durable roof that has performed exceptionally well, UC Davis demonstrated its commitment to sustainability decades ago,” said Brian Whelan, Senior Vice President at Sika Sarnafil. “When a long-lasting, energy-efficient roofing system is chosen, less energy is used, fewer raw materials are consumed, and less waste is generated. The specification of a Sarnafil roof results in the lowest life cycle costs and the lowest total environmental impact.”



We are committed to enhancing the human experience in buildings

Whether in windows, skylights or curtain walls, glass makes a building beautiful. Glass gives the people inside a visual connection to the outdoors, helping to make them happier, healthier and more productive. And when glass prevents glare and heat build-up, it adds even more to occupants' quality of life.

Glass also has its drawbacks. Historically we've used solar control devices that reduce the heat, but also block the view and impede incoming daylight, even when it's desired. The premise behind our dynamic glass, SageGlass®, which can be electronically tinted or cleared as needed, is to provide an elegant and functional solution to the window conundrum by blocking the heat when needed but always maintaining people's view and connection to the outdoors.

Since 2003, SAGE has installed SageGlass in hundreds of commercial and residential buildings, both new and retrofit. In retrofit applications, we've replaced glass in spaces where the heat gain and glare could no longer be tolerated. Retrofit applications are near and dear to our hearts because fewer resources are consumed when renovating versus building new, and this fits with our core value of conserving resources.

But whether new or retrofit, time after time customers have told us how SageGlass solved an "unsolvable" heat gain or glare issue for them. That they're now saving energy and using an unusable space again. But what makes us most happy is when the people who live, work, teach, or learn in a SageGlass building tell us how much more comfortable and productive they are.

At SAGE, we are dedicated to conserving resources and contributing to a responsible, sustainable and robust construction industry. And most of all, we are committed to enhancing the human experience in buildings. We spend so much of our lives indoors; we believe that time should be as pleasant, productive and healthful as it possibly can be.

Sincerely,

A handwritten signature in black ink, appearing to read "John Van Dine".

John Van Dine
CEO and Founder
SAGE Electrochromics, Inc.
www.sageglass.com