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New and Retrofit Green Schools:

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SmartMarket Report

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New and Retrofit Green Schools: The Cost Benefits and Influence of a Green School on its Occupants SmartMarket Report

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McGraw Hill CONSTRUCTION

About McGraw-Hill Construction

McGraw-Hill Construction (MHC), part of McGraw-Hill, connects people, projects and products across the design and construction industry, serving owners, architects, engineers, general contractors, subcontractors, building product manufacturers, suppliers, dealers, distributors, and adjacent markets.

A reliable and trusted source for more than a century, MHC has remained North America's leading provider of construction project and product information, plans and specifications, industry news, market research, and industry trends and forecasts. In recent years, MHC has emerged as an industry leader in the critical areas of sustainability and interoperability as well.

In print, online, and through events, MHC offers a variety of tools, applications, and resources that embed in the workflow of our customers, providing them with the information and intelligence they need to be more productive, successful, and competitive.

Backed by the power of Dodge, Sweets, *Architectural Record*, *Engineering News-Record (ENR)*, *GreenSource* and *SNAP*, McGraw-Hill Construction serves more than one million customers within the global construction community. To learn more, visit us at www.construction.com.

Introduction

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS

Since McGraw-Hill Construction's *Education Green Building SmartMarket Report* was published in 2007, schools have been demonstrably on the vanguard of green building, and we are happy to report that our latest research confirms that they continue to be leaders in building green. In 2012, we estimate that 45% of total construction starts in the education sector will be green, a sharp increase from 15% in 2008, and that estimate does not even include the full scope of work being done to green existing buildings through retrofits and green operations and maintenance.

Therefore, this study expands on the research in 2007 by demonstrating that **over 80% of the K-12 and higher education schools surveyed have conducted at least some green retrofits and operational improvements**, and the percentage of those doing nearly all (over 90%) of these improvements green is expected to grow to just under one-third in the next three years.

So what is driving this market? Like all other sectors, schools are driven by the goal of saving money and energy. However, this sector is unique among all those studied by McGraw-Hill Construction in our series of green *SmartMarket Reports* because **the impact of green buildings on the health and well-being of their students is as important as energy in encouraging new green investments**.

In fact, the level of green work is so high in this sector because many report seeing

the financial, health and well-being, and productivity benefits that they seek.

- **Two-thirds report that their school has an enhanced reputation and ability to attract students to their green investments.**
- **91% of K-12 schools and 87% of higher education state that green schools increase health and well-being.**
- **74% of K-12 and 63% of higher education respondents report improved student productivity.**

However, only 17% of K-12 and 8% of higher education schools can currently capture these non-operational benefits in their calculations of return on investment, and few are able to directly measure these impacts.

The challenges and opportunities in capturing the full impact of green building extends to operational savings. **When looking at the impact on their ten-year operating costs, 38% in K-12 and 39% in higher education report savings, but at least half of the respondents state they don't know the impact of their green buildings.**

Given the importance of documenting benefits of green, being able to capture these benefits effectively is essential to support the case for future investments in green building and retrofits.

We would like to thank all our research partners for helping us to bring this research on green schools to the industry, and we look forward to continuing to track the progress of green schools in the future.



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Left: University of California San Francisco Neurosciences Building (see page 49).

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Executive Summary

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS

The green school market is thriving because both the K-12 and higher education sector report seeing strong financial benefits combined with positive impacts on student health and well-being.

The research results demonstrate that schools are making significant green investments and that most expect strong benefits in return. However, a significant percentage are also unsure about the benefits they are accruing, presenting an opportunity for increasing the market with better, more consistent tools for measuring.

Green is Widely Adopted in the K-12 and Higher Education Sectors

In 2012, McGraw-Hill Construction estimates that green projects will account for 45% of all construction project starts in the education sector. The research demonstrates that over 80% of the K-12 and higher education respondents have done at least some green projects. In addition, many of them are doing most of their projects green, with over one-third of K-12 and one-half of higher education respondents reporting that more than 90% of their work is green.

Third-party green certification is also being widely used, with 66% of K-12 and 84% of higher education respondents reporting achieving green certification on green projects in the last three years. Additional evidence of their commitment to green projects is the extent to which both sectors exceed the guidelines set for them on the level of LEED certification to achieve:

- 52% of K-12 respondents exceed guidelines, with more than half achieving LEED Gold.
- 75% of higher education respondents exceed guidelines, with nearly one-quarter achieving LEED Platinum.

Schools Have Made Major Green Investments in Retrofits and Operational Improvements

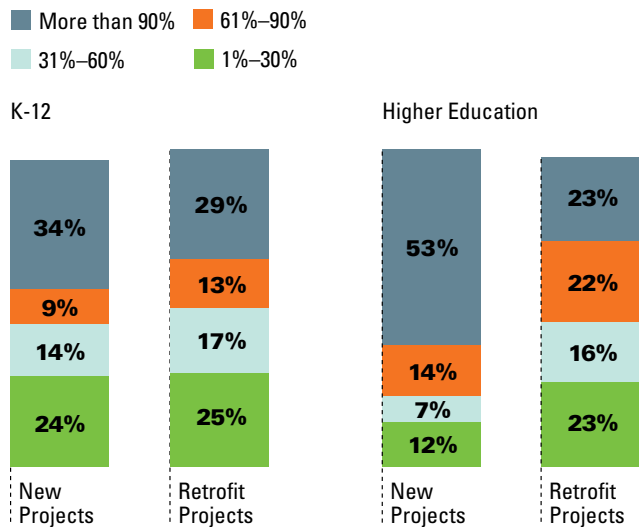
Green retrofits and operational improvements are also widely used in the education sector, with 83% in K-12 and 85% in higher education that they did at least some green retrofits or improvements in the last three years. In addition, the overall share of green retrofits among the total building improvements made by the respondents is expected to increase, including a shift up in percentage of those who report that more than 90% of their retrofits are green increasing in three years to 31% of K-12 schools and 29% of higher education.

All of the financial, health and productivity benefits reported in this research include, not just the new green buildings and major renovations, but also this ongoing improvement effort to existing buildings.

One key finding of the research is that the benefits

Percentage of Green School Projects Conducted in the Last Three Years

Source: McGraw-Hill Construction, 2013



achieved in green buildings are consistently higher among those who use green operations and maintenance. The results strongly demonstrate that greening a building is an ongoing process that is just beginning when a school builds a new green building.

Health and Well-Being is a Key Driver for Green Schools, Especially in K-12

Eighty-eight percent of K-12 respondents consider enhanced health and well-being an important trigger for the work they have done in green, roughly equivalent to energy use reductions and operating cost savings. This finding is unique to this sector, and it is consistent with the findings of the McGraw-Hill Construction 2007 *Education Green Building SmartMarket Report*, which demonstrates the important role health and well-being plays in green school construction.

Green building products and practices that improve indoor environmental quality (IEQ) are essential to

achieving this goal, and 87% of K-12 respondents rank IEQ practices as highly important, the largest percentage for any green practice. Ninety percent of higher education respondents also regard this as highly important, second only to energy and atmosphere practices at 92%.

Green Schools Deliver Strong Financial and Social Benefits, But Measuring Those Benefits Still Presents Challenges

FINANCIAL BENEFITS

Consistently, a large percentage of school respondents report achieving savings from their green investments, including energy use reductions, annual operating cost savings and ten-year cost savings (see chart at right).

However, the majority of those who do not report savings state that they do not know what impact their green buildings are having on these costs. Top challenges for gathering metrics include staff capacity for doing so and knowing the right measures to pursue. These results demonstrate that there is a major gap in capturing this data that must be addressed to see continued growth in the green schools market.

HEALTH AND PRODUCTIVITY BENEFITS

Because improved health and well-being ranks so highly as a driver for schools, their belief that green buildings have a positive impact on these factors is critical to encourage more green school construction. In fact, **91% of K-12 and 87% of higher education respondents find that green buildings improve health and well-being of students.**

Seventy-four percent in K-12 and 63% in higher education also report that green buildings help improve student productivity and test scores. About half of those who make these building improvements also link factors such as improved acoustics and daylighting with increased attentiveness and student engagement.

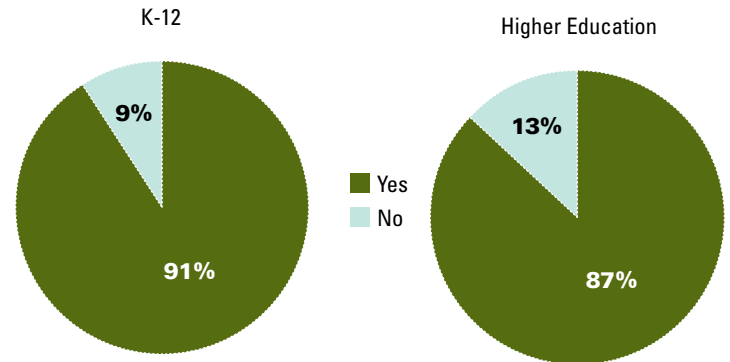
However, only a low percentage of schools are capturing measures of these benefits associated with their green school projects, and even fewer can apply them to their return on investment calculations for green building efforts. More research and investment in gathering green building metrics is needed to improve the ability of schools to achieve these benefits on future projects.

OTHER BENEFITS

Respondents are also seeing other benefits that have positive implications for their institutions:

Green Schools Improve Health and Well-Being

Source: McGraw-Hill Construction, 2013



Operating Benefits of Green School Buildings

Source: McGraw-Hill Construction, 2012

	Energy Use		Annual Operating Cost Decreases		10-Year Operating Cost Decreases	
	Expect a Decrease	Don't Know	Expect a Decrease	Don't Know	Expect a Decrease	Don't Know
K-12	58%	28%	55%	28%	39%	50%
Higher Education	55%	30%	47%	34%	38%	52%

Improved Reputation/Attractiveness to Students

- K-12: 69%
- Higher Education: 65%

Enrollment

- K-23: 23%
- Higher Education: 33%

Green Prefabricated Buildings Offer Untapped Potential to Improve Building Performance

Green prefabricated building solutions have been used by over one-third of K-12 respondents and one-quarter in higher education. While most of these report using trailers, a nearly equal percentage report using one story modular buildings, which demonstrates the evolution of the use of prefabrication in the education sector.

These results also demonstrate the opportunity offered in this market. To encourage wider adoption, the education sector needs to be convinced that prefabricated buildings are high quality, and they need to see data on building performance and cost compared with traditional building methods.

Recommendations

Despite the high level of green construction currently occurring in the education sector, these research findings demonstrate that there are still opportunities for the major players in school construction to encourage higher levels of green school investments. In addition, the results reveal strategies that can help improve the benefits gained from green school building efforts.

School Building Owner Recommendations

GATHER MORE METRICS AND DATA

A significant percentage of the respondents do not know the impact of green school buildings on building operational costs:

- 28% K-12 and 30% higher education do not know the impact on energy use.
- 28% K-12 and 34% higher education do not know the impact on annual operating costs.
- 50% K-12 and 52% higher education do not know the impact on 10-year costs.
- 41% K-12 and 49% higher education do not know the impacts of green O&M on costs.

The impacts on health, well-being and productivity are even more challenging to measure, and less than 20% of K-12 schools and 10% of higher education can include these metrics in their ROI calculations.

More research and investment in gathering metrics are essential to demonstrate the value of green school buildings.

HIRE SUSTAINABILITY STAFF

Dedicated green sustainability staff help institutions procure funding and capture the results achieved from green building investments.

- **Procure more funding:**
 - 10% more respondents at schools with sustainability staff finance their new green construction projects through gifts/donations.
 - 22% more use utility programs to finance their green retrofits.
- **Conduct more measurements of the impact of green buildings:**
 - Over 20% more schools with sustainability staff benchmark water use reduction and track emissions reductions in both sectors.
 - K-12: Over 20% more track operating cost decreases and benchmark energy reductions.

PRACTICE GREEN OPERATIONS AND MAINTENANCE

Practicing green operations and maintenance (O&M) can have as great of an impact on building performance as the way a building is built. Green O&M also allows schools to green their entire portfolio.

- Schools that practice green O&M report higher average energy use reductions than those that do not.
- 50% of schools practicing green O&M report annual cost savings, compared with 29% not practicing green O&M.

Building Product Manufacturer Recommendations

CAPITALIZE ON THE RETROFIT MARKET

Both K-12 and higher education respondents that do green retrofits and operational improvements report increasing the percentage of green projects they will undertake. Thus, while the overall volume of retrofits will stay the same, more of them will be green, which offers stronger market opportunities for green retrofit products and services.

EMPHASIZE THE HEALTH AND WELL-BEING IMPACTS OF YOUR GREEN PRODUCTS

Improved indoor environmental quality is considered important by a high percentage of K-12 and higher education

respondents compared to other green building practices and compared with results from other building sectors in previous McGraw-Hill Construction research.

Improved health and well-being is a particularly important trigger for the K-12 sector to build green, with the percentage that consider it important equivalent to those who select operating cost savings.

Building product manufacturers will benefit if they can demonstrate how their products can impact health and well-being.

Architect and Contractor Recommendation

CONSIDER OWNERS' USE OF METRICS

The results reveal a gap between architect and contractor expectations about the level of use of green building metrics in schools and the levels of use actually reported by schools. Understanding the metrics used and getting feedback on building performance can help produce better buildings in the future. ■

Data: Green School Market

Share of Green Grows Dramatically in the Education Sector¹

McGraw-Hill Construction Green Project Definition

In this and all of our U.S.-based green building research, McGraw-Hill Construction uses the following definition for a green project.

According to McGraw-Hill Construction, a project can be considered green if it is either:

- Built to LEED or another recognized green building standard, or
- A project that is energy efficient and water efficient, and address improved indoor air quality and/or material resource conservation

Factors Impacting the Education Market

In Dodge Analytics' *Construction Market Forecasting Service (CMFS)*, two factors are cited as impacting the education market in K-12 and higher education.

- Strong demographic demand in both sectors
- Tight fiscal conditions at the state and local level

Recovering economic conditions are expected to eventually impact fiscal concerns, but that impact will be gradual, leading to expectations that the education market will continue to decline in 2013, but should gain ground in the following years.

One factor cited in the CMFS as a source of optimism, especially for K-12 schools, is a wave of bond approvals from the recent elections in November 2012.¹

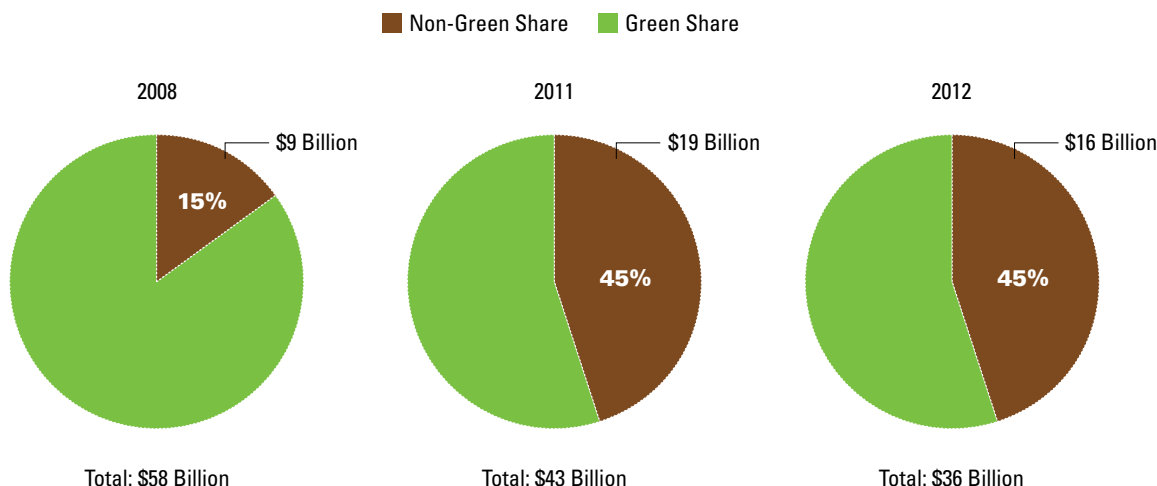
Green Share of the Education Market

In 2008, construction starts in the education sector totalled \$58 billion, according to McGraw-Hill Construction Dodge's forecast data, and green construction made up only 15% of that total. **By 2012, despite a 39% decline in education overall, the growth in the total green share is estimated to be \$16 billion, almost double the 2008 green education market.**

For more information on the triggers that have encouraged market growth in the K-12 and higher education sectors and the drivers that can increase that growth in the future, see pages 37-40.

EDUCATION: Green Share of Construction Activity by Value Over Time

Source: 2013 Dodge Construction Green Outlook, October 2012



1. McGraw-Hill Construction Research and Analytics, Construction Market Forecasting Service: Fourth Quarter 2012 Report, December 2012

Percentage of Total Education Projects That Are Green According to K-12 and Higher Education Respondents

K-12

NEW GREEN CONSTRUCTION AND MAJOR RENOVATIONS

The results demonstrate a high penetration of green work in the last three years among the K-12 respondents:

- **82% report doing at least some green projects**
- **Of the remaining 18%, half (9%) have not conducted any construction work at all in the last three years.**

While this high level of green activity may be influenced in part by the survey pool used (see page 7 for McGraw-Hill Construction's sizing of the overall green market), the results demonstrate strong experience with green, which lends greater credence to their expectations about the benefits of green as well as the obstacles they face.

Seventy-three percent report expecting to do at least some green work in the future. However, this decline is largely due to **the increase in those expecting not to do any construction work at all, from 9% to 16%**. The impact of the extended economic downturn has been strongly felt in local and state budgets, and funding for construction in schools has been reduced. Also bond issues for new school construction may face greater opposition as people still feel the impact of the recession in their personal finances.

Twenty-five percent more of the schools with a dedicated green staff report having 90% or more projects compared with schools with no dedicated staff.

GREEN RETROFITS AND OPERATIONAL IMPROVEMENTS

Eighty-three percent report that at least some of their retrofit and operational improvement activity was green. However, unlike the major capital projects, nearly all of the respondents have done some of this work in the last three years, so the percentage that has done non-green activity is much higher, at 15% compared with 9%.

In the next three years, 80% expect to do some green retrofit or operational improvements, a slight decline. Again, the decline is due to those who do not expect to do any work at all, which increases from 1% to 7%.

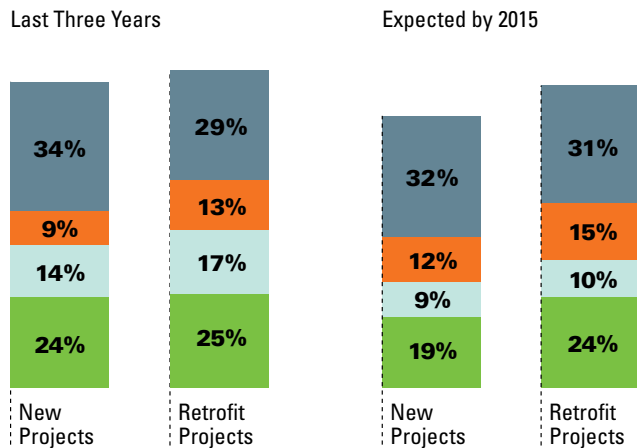
LEVEL OF GREEN ACTIVITY

While the level of new and renovation green project activity remains steady, the next three years will see growth in the level of green retrofit and operational activity. The percentage of respondents who report that almost all (greater than 90%) of their new and major renovation projects in the last three years were green

Percentage of K-12 Projects That Are Green (Last Three Years and Next Three Years)

Source: McGraw-Hill Construction, 2013

- More than 90% of Projects
- 61%–90% of Projects
- 31%–60% of Projects
- 1%–30% of Projects



(34%) is higher than those whose retrofits and operational improvements were more than 90% green (29%). However, in the next three years, they will be about equivalent at 32% and 31% respectively.

Again, this difference may be most directly related to concerns about budget. While it is necessary to find funding for any new green work, many green retrofits and operational improvements can be done at little additional cost or even within existing budgets.

Higher Education

NEW CONSTRUCTION AND MAJOR RENOVATIONS

Eighty-six percent report that at least some of the projects that they have done in the last three years have been green. However, with only a small percentage (5%) of higher education reporting that they have had no construction activity in the last three years and even fewer (3%) expecting none in the next three years, even the 86% share is predicted to grow to 90%.

Green School Market

Percentage of Total Education Projects

That Are Green According to K-12 and Higher Education Respondents

CONTINUED

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

As with the K-12 sector, this very high level of activity implies that they have strong experience with green and can accurately represent the benefits, drivers and obstacles for green work.

Thirty-one percent more schools with a dedicated green staff report 90% or more green projects compared with schools with no dedicated staff.

RETROFITS AND OPERATIONAL IMPROVEMENTS

An equally high percentage are involved in green retrofits and operational improvements.

- Last 3 Years: 85%
- Next 3 Years: 87%

This slight increase occurs despite a small uptick in those who say they have no retrofit or operational improvement activities planned, from 3% to 4%.

LEVEL OF GREEN ACTIVITY

The growth in the degree of green activity undertaken by higher education institutions is equivalent to the growth in involvement with green.

- **More than 90% New Green Construction:**
 - Last Three Years: 53%
 - Next Three Years: 56%
- **More than 90% Green Retrofit and Operational Improvements**
 - Last Three Years: 23%
 - Next Three Years: 29%

While the percentage of growth may be small, it suggests that despite the high degree of commitment to green by the higher education survey respondents, they are still finding new ways to incorporate green into their building and operational practices.

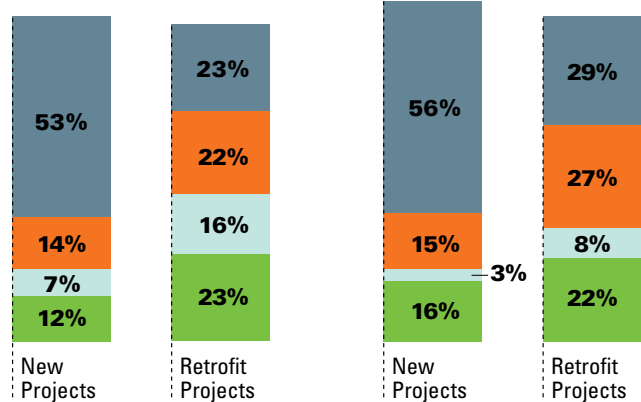
Percentage of Higher Education Projects That Are Green (Last Three Years and Next Three Years)

Source: McGraw-Hill Construction, 2013

- More than 90% of Projects
- 61%–90% of Projects
- 31%–60% of Projects
- 1%–30% of Projects

Percentage of Green Higher Education Projects in the Last Three Years

Percentage of Green Higher Education Projects Expected by 2015



Share of Education Projects That Are Green According to Architects and Contractors

By far, the largest percentage of architects who do education projects report that more than 60% of their projects are green. This finding suggests a trend toward architectural firms specializing specifically in green schools. It could also indicate that for architects who become familiar with the green elements most important to school construction, there are opportunities to transfer green approaches developed on one school to others. The increase expected in the future—from 43% doing a high level of green work in the last three years to 55% in the next three years—reinforces both of these conclusions.

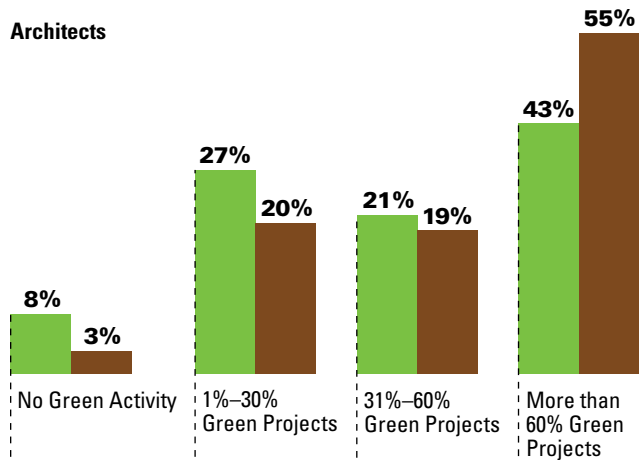
On the other hand, the largest percentage of general contractors report that green projects account for 30% or less of their education projects. Contractors have less influence than architects on whether education projects are green (see page 43 for more information), so they may find it harder to transfer green knowledge from current projects to future ones. Also, their involvement in the construction phase may lead them to see more green elements removed due to cost concerns, which would account for a lower overall percentage of green work.

Percentage of Education Projects that are Green

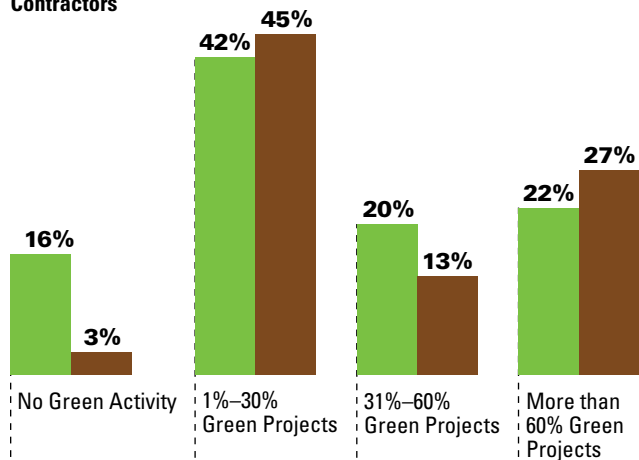
Source: McGraw-Hill Construction, 2013

■ Last Three Years ■ Next Three Years

Architects



Contractors



Percentage of Green Schools

That Have Been and Expect to be Certified by Third-Party Review

Sixty-six percent of K-12 and 84% of higher education respondents have achieved third-party certification on at least some of their green projects in the last three years. About the same percentage expect to do the same on their projects in the next three years.

However, the data do suggest a slight shift toward a higher level of certification within the institutions surveyed. While those with no certification and those with a very high level of certification remain relatively the same, there is a general movement in both K-12 and higher education to slightly higher levels among those in the middle.

- **K-12: The 10% decrease by 2015 in those who certify 1%–30% of their projects is shifted nearly evenly to those doing 31%–60% and 61%–90%.**
- **Higher Education: The 5% decrease by 2015 in those who certify 31%–60% has shifted to those certifying 61%–90%.**

The high level of certification suggests that the respondents are a mature green audience, widely aware of certification, but the shifts in the percentage of projects certified demonstrate that these institutions see enough value in certification to increase their investments in it.

Third-Party Certification of Projects by Architects and Contractors

Like the school respondents, architects and contractors expect to see an increase in certified green school projects in the next three years.

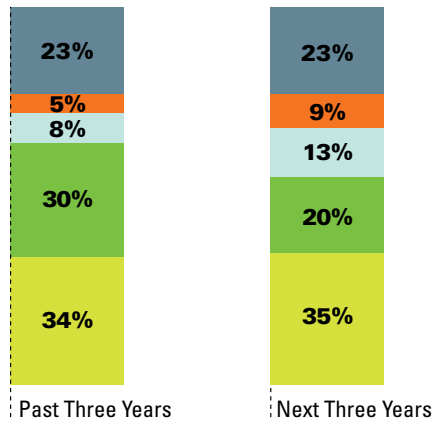
- **Architects:**
 - The percentage not certifying their green education projects shrank from 25% in the last three years to 14% through 2015.
 - The percentage who certify over 90% remains consistent at 14%.
- **Contractors:**
 - The percentage not certifying their green education projects shrank by half from 14% in the last three years to 7% through 2015.
 - The percentage who certify over 90% drops marginally from 9% to 7%.

This shift may be due to several reasons. Firms may recognize that schools are increasing their percentage of certified projects. Also, some may be planning to do more higher education projects, which generally have a higher level of certification, in the next three years due to stronger anticipated growth in that sector.

Percentage of Green K-12 Projects Certified by Third Party Review

Source: McGraw-Hill Construction, 2013

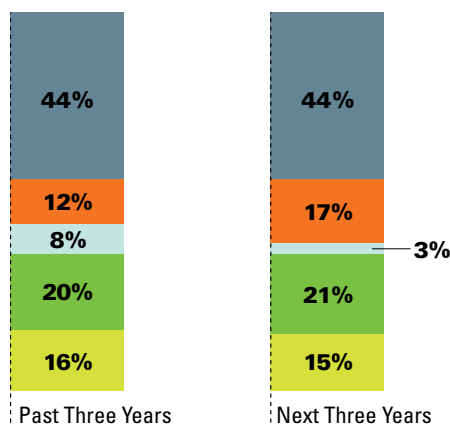
- More than 90% of Projects
- 61%–90% of Projects
- 31%–60% of Projects
- 1%–30% of Projects
- None



Percentage of Green Higher Education Projects Certified by Third Party Review

Source: McGraw-Hill Construction, 2013

- More than 90% of Projects
- 61%–90% of Projects
- 31%–60% of Projects
- 1%–30% of Projects
- None



Data: Financial Benefits of Green Schools

Reductions in Traditional Energy Use Due to Green Schools

While the majority of school respondents see decreases in energy use, a significant percentage are also not sure about their energy use reduction. The level of uncertainty may appear surprising, but in fact, energy use reduction can be difficult to track. For some higher education institutions, individual buildings are not metered. Also, K-12 and higher education schools may also have missing or inconsistent information provided in their utility bills.

K-12

Fifty-eight percent of K-12 respondents find that the energy use in their green buildings is less than in buildings built with traditional methods, with 28% reporting uncertainty about the energy use of their buildings.

Strikingly, among those who have achieved energy savings in this sector, the largest percentage (35%) see savings of 20% or more. However, over half also range from savings of 5% to less than 15%, suggesting that a variety of factors may impact energy use, including occupant behavior and equipment maintenance.

VARIATION BY BUILDING DESIGN, CONSTRUCTION AND OPERATIONS STAFF

Sixty-three percent of the K-12 respondents involved directly in building operations, design or construction find reduced energy use in green buildings. This group is also more certain about energy use impacts than the general K-12 respondents, with only 21% who don't know the impact of their green buildings.

The largest percentage also report decreases that fall into three ranges: 5% to less than 10%; 10% to less than 15% and 20% or more, but they are roughly evenly split between these three levels, at 28%, 30% and 30% respectively.

Higher Education

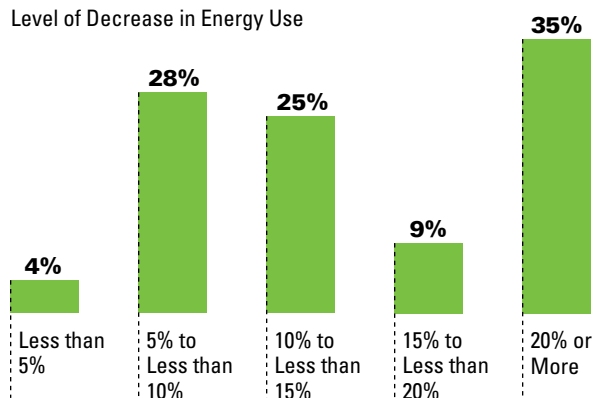
Fifty-five percent of higher education respondents report reduced energy use in their green buildings, but 30% in this sector are uncertain about the impact of green buildings. The energy savings reported in higher education are more evenly distributed than those in the K-12 sector, but 72% find a sizable decrease of 10% or more in their energy use.

VARIATION BY BUILDING DESIGN, CONSTRUCTION AND OPERATIONS STAFF

Sixty-seven percent of those involved directly in building operations, design or construction find reduced energy

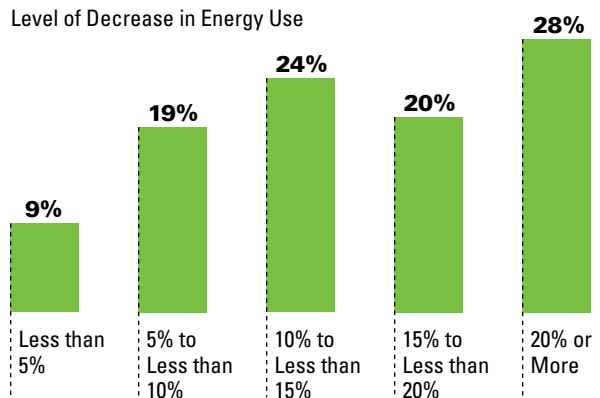
K-12 Change in Energy Use Compared to Non-Green Buildings

Source: McGraw-Hill Construction, 2013



Higher Education Change in Energy Use Compared to Non-Green Buildings

Source: McGraw-Hill Construction, 2013



NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Financial Benefits of Green Schools

Reductions in Traditional Energy Use Due to Green Schools CONTINUED

use in their green buildings, with only 22% uncertain about the impact. Their findings on the level of savings mostly parallel those of the general higher education respondents, although slightly fewer report savings in the 15% to less than 20% range and slightly more report savings of less than 5%.

Variation by Use of Green Operations and Maintenance

The results reported by those who practice green operations and maintenance (O&M) in their buildings demonstrate the efficacy of those measures on reducing energy use.

- Practice green O&M: 46% report energy savings of 15% or more, with nearly three quarters of them finding savings of 20% or more.
- Do not practice green O&M: 25% report energy savings of 15% to less than 20%, and none report energy savings of 20% or more.

These results demonstrate that the full potential of green building can only be realized when paired with green operations and maintenance.

Variation Over Time From 2007

A comparison between the energy savings expected by the CEFPI members surveyed in 2007 to the energy savings reported by CEFPI members in this survey demonstrates that greater experience with green buildings has helped improve potential savings, with those predicting savings of 10% or more increasing from 66% in 2007 to 80% in 2012.

Annual Operating Costs Decrease Due to Green Schools

A higher percentage of K–12 respondents state that they have lower annual operating costs on their green buildings than higher education respondents. The difference is split between a greater percentage of higher education respondents who do not know the impact of green on their annual costs and who believe that there is no impact.

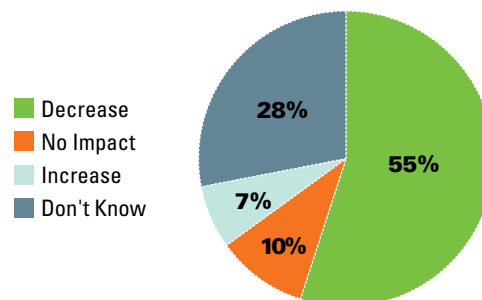
One possible reason for the higher response rate in the K–12 sector is that they are more likely to keep track of the performance of individual buildings than higher education, who sometimes track performance campus-wide, making it harder to gauge the impact of individual buildings.

K–12

Fifty-five percent of K–12 respondents find decreased annual operating costs due to their green buildings, with 28% uncertain about the impact of green buildings on annual operating costs.

Impact of Green K–12 Buildings on Annual Operating Costs

Source: McGraw-Hill Construction, 2013



The largest percentage of those experiencing decreases (30%) report relatively conservative savings, from 5% to less than 10%. However, 28%, the next largest group, see savings of over 20%. Again, many factors beyond building design can impact operating costs, and the approach to operations and maintenance of schools can influence the savings achieved.

VARIATION BY BUILDING DESIGN, CONSTRUCTION AND OPERATIONS STAFF

On the whole, the responses of the staff working directly on building design, construction and operations correspond to the general respondents. Fifty-three percent report decreases in operating costs, compared with 56% of the total respondents.

The results they expect are more tempered. Only 6% expect savings of less than 5%, half of the level of overall respondents, but 22% also expect savings of 20% or more compared to 28% of the total. Fifty-eight percent report savings in the range of 5% to less than 15%.

Higher Education

Thirty-four percent are uncertain whether green buildings yield annual operating costs savings. This lowers the percentage of those who report seeing savings to 47%.

Almost three quarters fall evenly between the three categories between savings of 5% to less than 20%, again affirming that a relatively wide range of savings are being experienced, reinforcing the importance of other influences.

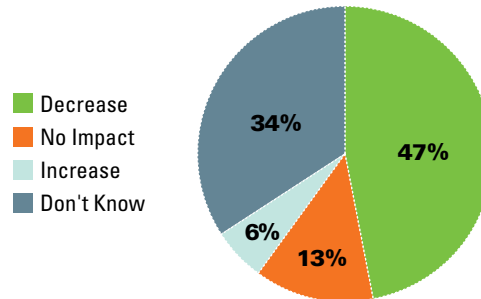
VARIATION BY BUILDING DESIGN, CONSTRUCTION AND OPERATIONS STAFF

Sixty percent of the staff that work directly on building design, construction and operations in higher education find decreases in the annual operating costs of green buildings. This group is also more certain about their findings than the rest of the higher education respondents, with only 20% uncertain about the impact of green buildings.

None of these respondents expect savings of greater than 20%, but 30% do expect savings of 15% to less than 20%. On the other hand, 26% expect savings of less than 5%, a far greater percentage than the general respondents.

Impact of Green Higher Education Buildings on Annual Operating Costs

Source: McGraw-Hill Construction, 2013



Variation by Use of Green Operations and Maintenance

Fifty-three percent of those practicing green operations and maintenance (O&M) believe green buildings reduce annual operating costs, compared to 29% of those who do not.

One reason for that gap is that green O&M practitioners know more about the performance of their buildings. **Fifty percent of those not practicing green O&M do not know the impact of green on annual operating costs, 20% more than those practicing green O&M.** Tracking performance and adjusting building management strategies is often a key part of a green O&M approach.

Annual Cost Savings According to Architects and Contractors

Contractors are more conservative than architects in their estimation of the impact of green buildings on annual cost savings. Sixty-one percent of contractors expect savings of less than 10%, compared with 38% of architects, and 8% of contractors expect savings of 20% or more, compared with 20% of architects. Architects may be basing their cost savings estimates on the modeling that they do, which cannot take into account the influence of the building occupants or the O&M staff on operating costs.

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Impact on Ten-Year Operating Costs of Green Schools

More than half of the K–12 and higher education respondents do not know the impact of their green building projects on their ten-year operating costs.

Part of the reason for this high level of uncertainty is that many institutions have less than a ten-year history with large-scale green investments. Owners may need more data before they can state with confidence what their ten-year savings expectations can be.

However, knowing ten-year savings is critical to drive higher levels of green investment in education. In the 2012 *Determining the Value of Green Building Investments SmartMarket Executive Brief* (available for free download at analyticsstore.construction.com), one of the most important factors in higher education for determining the level and type of green building investments is the building’s life cycle cost impact. Long-term building ownership could make this factor critical for K–12 schools as well. Understanding impacts across a ten-year cycle is an important part of gauging overall life cycle cost.

K–12

Thirty-nine percent expect to see ten-year costs decrease for their green buildings compared with traditional buildings. A smaller percentage expect either no impact or an increase in ten-year costs compared with those reporting the annual cost impacts, suggesting that nearly all expect green buildings to pay off over time. However, the largest percentage (50%) do not know what the impact of their green buildings will be.

Over half of the respondents expect the savings to be in the 5% to less than 15% range, and one-third expect them in the 5% to less than 10% range.

VARIATION BY BUILDING DESIGN, CONSTRUCTION AND OPERATIONS STAFF

Even among those who directly work on buildings in the K–12 sector, there is still a high level of uncertainty about the ten-year operating cost impact, with 44% reporting that they don’t know. The percentage expecting ten-year cost decreases is only 1% higher than the general total, and 4% more of the design, construction and operations staff believe that there will be no impact.

Higher Education

Thirty-eight percent expect their ten-year costs to decrease for green buildings, roughly equivalent to the K–12 sector. Just over half (52%) also report that they do not know what the impact on their ten-year operating costs will be for their green buildings. Notably, only 1% think that the costs will increase, and the rest expect the costs to be the same as those of a traditional building.

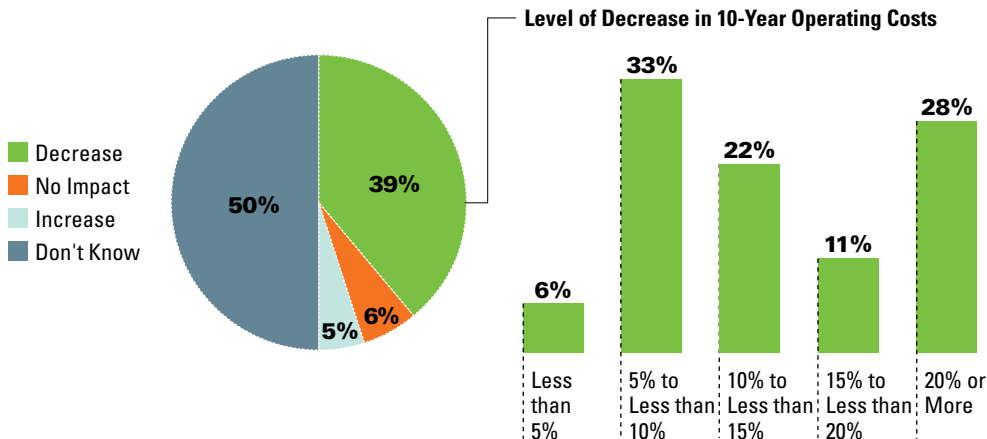
Thirty-nine percent believe the cost savings will be in the 5% to less than 10% range, more than double any other level of cost savings.

VARIATION BY BUILDING DESIGN, CONSTRUCTION AND OPERATIONS STAFF

Those who work directly on buildings are roughly in agreement with the overall higher education

Impact of K–12 Green Buildings on 10 Year Operating Costs

Source: McGraw-Hill Construction, 2013



NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

respondents, with 40% who find decreases in ten-year operating costs and 47% uncertain about the impact.

This group also reinforces the overall expectation of cost savings in the 5% to less than 10% range, with 44% selecting that category. The next highest category for this group, though, is less than 5% savings, selected by 33% of the design, construction and operations staff respondents, making their average expected savings lower than the rest of the higher education respondents.

Variation by Use of Green Operations and Maintenance

While the schools using green O&M have more knowledge about annual operating costs, they align with the rest of the respondents on ten-year operating cost impacts, with 40% expecting a decrease and 50% reporting that they do not know the impact.

Variation Over Time According to CEFPI Members

A comparison of the CEFPI members surveyed in 2012 to the CEFPI members surveyed for the 2007 *Green Schools SmartMarket Report* demonstrates that the expectation of ten-year costs savings has increased since 2007.

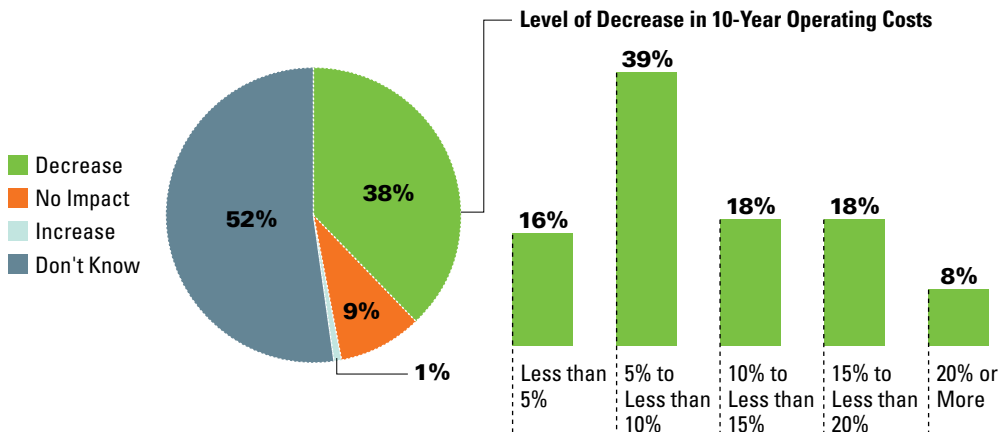
- 2007: 56% expect savings of 10% or more
- 2012: 64% expect savings of 10% or more

10-Year Cost Savings According to Architects and Contractors

Architects are nearly evenly split between less than 10% and 10% to less than 20% cost savings, while over half of the contractors expect the savings to be less than 10% and one-third expect savings between 10% and less than 20%. Few architects or contractors expect savings over 20%.

Impact of Higher Education Green Buildings on 10-Year Operating Costs

Source: McGraw-Hill Construction, 2013



NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Impact of Green Retrofits and Operational Improvements on Annual and Ten-Year Costs

The impact reported by K–12 and higher education respondents of green retrofits and operational improvements is notably close, so these will be discussed in total, except for where interesting differences occur.

Overall, 45% note a decrease in annual operating costs and 37% expect a decrease in ten-year operating costs. Consistent with the findings on green projects, a higher percentage (49%) are not sure about the impact on ten-year costs, but the percentage that are not sure about the impact on annual costs (41%) is still quite large.

The highest percentage expect the savings annually and in ten-year operating costs to be in the range of 5% to less than 10%.

- **Annual Operating Cost Savings of 5% to Less than 10%**
 - K–12: 35%
 - Higher Education: 38%
- **Ten-Year Operating Cost Savings of 5% to Less than 10%**
 - K–12: 32%
 - Higher Education: 51%

In addition to the large gap between K–12 and higher education respondents in their estimation of ten-year operating costs listed above, a few key differences lead the K–12 sector to expect slightly greater savings overall.

- **Annual Operating Cost Savings:**
 - 21% of higher education respondents expect savings of 15% to less than 20%, compared with 11% of the K–12 respondents.
 - 20% of the K–12 respondents expect savings greater than 20%, compared with 2% of the higher education respondents.

■ Ten-Year Operating Cost Savings:

- 18% of the K–12 respondents expect savings greater than 20%, compared with 3% of the higher education respondents.

Variation by Building Design, Construction and Operations Staff

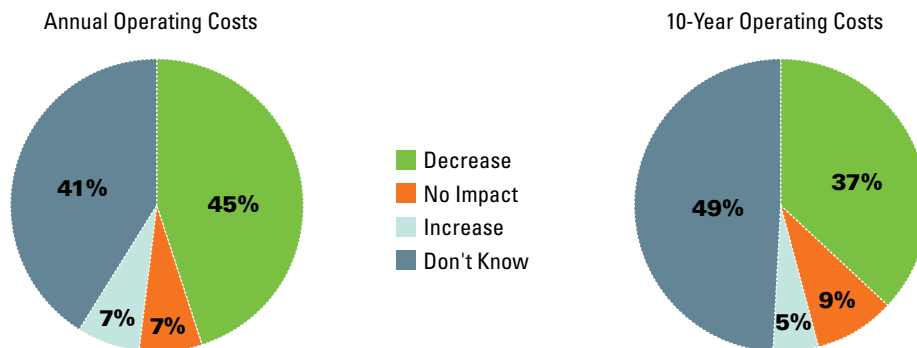
The K–12 staff who work directly on buildings report roughly the same percentage expecting decreases and lack of knowledge as the general respondents for both annual and ten-year operating cost impacts. The same is true for the higher education staff reporting on the ten-year impacts.

However, the higher education staff who work directly on buildings do have some significant differences in their expectations on the impact of annual costs.

- **Decrease: 55%**
- **No Impact: 14%**
- **Increase: 4%**
- **Don't Know: 27%**

Impact of Green Building Operations and Maintenance Improvements on Operations Costs (According to K–12 and Higher Education Respondents)

Source: McGraw-Hill Construction, 2013



Green Retrofits Enhance the Learning Environment at Three K-12 Schools

Thurgood Marshall Elementary, Jackson Elementary, Denver Green School
PHILADELPHIA, HILLSBORO AND DENVER

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS
Image courtesy of The Sheward Partnership LLC

Thurgood Marshall Elementary School

In 2008, the U.S. Green Building Council (USGBC) accepted the School District of Philadelphia as a participant of its LEED in Existing Schools Pilot Program, and the district selected Thurgood Marshall Elementary School to pursue certification under the LEED for Existing Buildings: Operations & Maintenance 2009 rating system. Thurgood Marshall successfully achieved certification in 2009, the first K-12 school in Pennsylvania to do so and the fifth in the United States.

A primary goal of the LEED process was to provide a healthy learning, teaching and working environment for the students, faculty and staff. It was discovered in 2005, after a screening of over 5,000 students from several schools in the area, including Thurgood Marshall, that 1 in 4 students was diagnosed with either asthma and/or admitted to the hospital for wheezing, compared with the national average of 1 in 10.

To address the indoor environmental quality issue, the building underwent ventilation testing, which comprised testing of 60 separate air handling units. All these units were adjusted to bring in more outside air to meet standard requirements. According to Michael Pavelsky, the project's sustainability and LEED consultant from the Sheward Partnership, "This process proved to be particularly challenging because an outside consultant had to be hired, and since each of the 60 systems had to be tested, it ended up being one of the project's greatest expenses and took several weeks to complete." In addition, while this process ensured better indoor air

quality for occupants, it also required more energy to condition increased amounts of outside air. As a result, the building's energy performance decreased slightly, and the project team is now implementing other energy-saving strategies so that the project can maintain its Energy Star rating.

An industrial hygienist also conducted an indoor air quality review. Chloe Bendistis, the sustainability project manager from Sheward says, "Several issues were identified and fixed, such as roof leaks causing water damage to ceilings and walls; unit ventilators being blocked with clutter and not effectively ventilating classrooms; unit ventilator drain pans needing cleaning; and filters requiring replacement."

Other activities included revamping the entire building automation system, and upgrading the heating, air-conditioning, lighting and lighting controls to ensure more energy efficient operations. To increase water efficiency, low-flow aerators were installed in all lavatory faucets,

and all existing showerheads were replaced with low-flow models.

The outcomes of all upgrades, repairs and maintenance has been significant. The building now enjoys better indoor air quality, uses 17% less water than a comparable school and has achieved an Energy Star label with a superior rating of 81, which equates to 28% energy savings when compared with a typical school nationwide.

Jackson Elementary School

In firm belief that greening schools can save money for districts with tight budgets through operational cost savings and by minimizing staff, teacher and student sick days, the Hillsboro School District in Oregon chose LEED: EBOM as a tool to make its portfolio of 35 existing schools more sustainable. Hillsboro decided to select one pilot school to build the LEED: EBOM capacity of its facilities team, distinguish costs and benefits and use lessons learned for potential implementation to its other schools.



Ample daylight fills the atrium, a central gathering place, at Thurgood Marshall Elementary School.

CONTINUED

Thurgood Marshall Elementary, Jackson Elementary, Denver Green School

PHILADELPHIA, HILLSBORO AND DENVER

After benchmarking the performance of all its elementary schools on Energy Star Portfolio Manager, the school district selected Jackson Elementary School as their pilot case.

The pilot project has allowed Hillsboro to view the process as an investment to assess its current practices and identify opportunities for financial savings, healthier learning environments and more sustainable practices. After undergoing the LEED process, in April 2011, Jackson Elementary became the nation's first K-12 school to achieve LEED Gold certification under USGBC's LEED: EBOM 2009.

Strategies that led to successful certification include an energy audit and retro-commissioning of the school's HVAC, lighting and hot water systems to identify no- and low-cost operations and maintenance improvements. The school found savings in cost-effective plumbing fixture retrofits and enhanced recycling programs. In addition, a comprehensive green cleaning program based on non-toxic standards, minimizing pesticide use, and testing and adjusting ventilation systems to ensure ample fresh air distribution have resulted in a healthier indoor environment at the school.

One element unique to Jackson Elementary has been the simple change made to the order of lunch and recess. By moving recess before lunch, the school was able to cut down on food waste. Rather than rushing through their lunch and throwing food away in their hurry to get to play time, students instead worked up an appetite, ate at a slower pace and ultimately consumed more of their food.



Built in 1997, the 114,000 square-foot, LEED:EBOM certified, Thurgood Marshall Elementary School, serves more than 700 students, grades pre-K through 8, with over 100 teachers and staff members.

Overall, Jackson Elementary has achieved a 92 Energy Star performance rating, saved 300,000 gallons of water annually and saved \$200,000 in energy cost between October 2009 and November 2011.

Denver Green School

The Denver Green School is a public elementary and middle school focused on environmental and social sustainability through a hands-on, project-based approach to learning. The school implements its own unique program design, approved through a rigorous process by the Denver Public School Board.

In 2009, the school convened a charrette led by a professor and team of graduate students from the Institute for the Built Environment at the Colorado State University. According to Jeff Buck, founding partner and sustainability coordinator at Denver Green Schools, "The team identified specific strategies for the renovation of the school, including design strategies that incorporated sustainability and operational efficiency in the building, site and curriculum." Buck says, "That process started a lot of the thinking around our green retrofits."

Since then the school has undertaken several green retrofits. All the water fixtures have been replaced

with more efficient ones, including low-flow toilets and aerators on the sinks. They have also retrofitted all the lighting with T5s or T8s and placed solar tubes down hallways, which have allowed more daylighting and cut down on lighting requirements. All carpets are now recycled and only non-toxic, low-VOC paint has been used.

Students have taken a critical role in the process as part of their project-based learning focus. For example, the 2nd graders conducted a school-wide light and energy audit. They counted every light fixture in the school, and using light meters they determined that 50% of the bulbs could be removed. They presented the finding to administrators and worked with the facilities team in their removal. The project has saved the school about \$1,500 a year. The 6th graders are currently involved in conducting a school-wide water audit to find even more savings.

Through these retrofits, Denver Green Schools has reduced electrical energy use by 47% in 2011 and cut water use by 50% in the last three years. The school also recycles or composts 63% of its waste. As a result of these achievements, in 2012 the school was awarded the U.S. Department of Education's Green Ribbon School status. ■

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Improved Reputation and Increased Attractiveness to Students Due to Green Building

Roughly two-thirds of the overall K-12 and higher education respondents find that green building enhances their institution's reputation and/or increases its appeal to prospective students, but the administrators from each sector report very different conclusions.

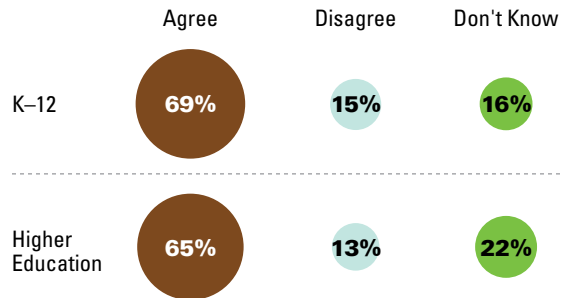
- **K-12: Eighty-six percent of administrators agree that green building benefits their reputation/ability to attract students, and none state that they do not know the impact.**
- **Higher Education: Fifty-five percent of administrators agree that they have an enhanced reputation/ability to attract students, and nearly one-third (30%) state that they do not know.**

One factor that could contribute to this finding is the high level of green building currently practiced on higher education campuses, which may encourage administrators to believe that students now expect green campuses, diminishing its impact as a differentiator.

18% more K-12 respondents and 40% more higher education respondents that have achieved LEED certification report this benefit compared to those that have not achieved LEED. Achieving LEED certification may make it easier for schools to demonstrate to prospective students that they are a green institution.

Green Building Improvements Improve Institution's Reputation or Attractiveness to Students

Source: McGraw-Hill Construction, 2013



Impact on Enrollment Due to Green Schools

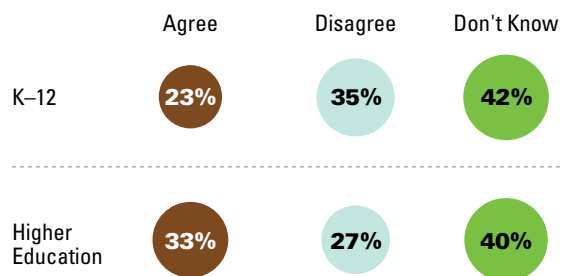
One-third of higher education respondents see increased enrollment due to their green building improvements, compared with one-quarter of K-12 respondents. Given the importance of attracting students as a trigger for building green, especially in the higher education sector (see page 37), the impact of green building on enrollment is critical to help further grow the market.

However, 40% or more of the respondents in both sectors are also uncertain about the impact of green on enrollment. With this factor carrying such weight, the industry as a whole needs to invest in gathering more data on these impacts.

In both K-12 and higher education, a higher percentage of administrators credit green building improvements with increasing enrollment than the general group of respondents.

Green Building Improvements Increase Enrollment

Source: McGraw-Hill Construction, 2013



Key Findings of Research

on the Impact of School Buildings on Student Health and Learning

Significant research has been undertaken over the years to make the connection between schools and their impact on the health and performance of students and teachers. However more research is needed to be able to quantify the health and learning benefits of green schools.

A school designed to reduce its environmental impact on the world can also have a big impact on the health and learning abilities of its students in such ways as reducing respiratory illnesses and absenteeism, and improving test scores. However, given the complexity of interactions between people and their environments, establishing cause-and-effect relationships between an attribute of a green school and its occupants has been a challenge.

Key Research Findings

INDOOR AIR

A significant amount of research shows that the health of children and adults can be affected by indoor air quality. Increased particulate matter, volatile organic compounds (VOCs), toxins, irritants and allergens from mold can lead to respiratory illnesses and asthma.

Key factors in providing good indoor air quality are appropriate ventilation rates; ventilation effectiveness; filter efficiency; the control of temperature and humidity; and operations, maintenance and cleaning practices.¹ In a 2002 study in Finland, researchers identified an average 15% reduction in the incidence of the common cold in schools that had no moisture or mold problems.²

While there is not enough evidence

to indisputably link air pollutants to a direct impact on learning, a growing amount of recent research suggests that teacher productivity and student learning may be affected by indoor air quality. According to researchers at Lawrence Berkely National Laboratories, when ventilation rates drop below minimum standards, there is an associated drop in student performance tests by 5%-10%.³

LIGHTING

Most recent research has focused on the impact of daylight on student health and learning and why it has had good results in schools. While this seems pretty straightforward, research conducted in the 1970s and 1980s found that lack of daylight had no discernible impact on test scores.⁴ Despite students expressing dissatisfaction, the researchers did not consider it critical at the time.

Since then, studies have shown that daylight can have an impact on student health and learning. One study found that students without access to natural light showed an association with decreased concentration abilities. And in a more recent study, it was found that a lack of daylight can contribute to sleep problems in adolescents. A well-known study by the Hescong Mahone Group in 1999 showed that students in day-lit classrooms had 7%-26% higher test scores over the course of a year, compared with students in windowless classrooms.⁵

THERMAL COMFORT

Recent research has started questioning the prevailing thinking that keeping indoor temperature within a narrow band of 68 to 74 degrees year round is preferable. For example, researchers found that in a hot and humid environment, students attending naturally ventilated child care centers had lower levels of asthma symptoms and allergies than those in air-conditioned child care centers.⁶

However, the understanding that it is better to stay within a relatively constant band of temperature for optimum comfort still holds strong. A recent study showed that student speed on the same test increased as a result of lowering the temperature from 77 to 68 degrees.⁷

Recent research conducted in the 1990s and onward show that teachers have a strong preference for personal control over temperature and see it as having an impact on student and teacher performance.

ACOUSTICS

Significant research has been undertaken to show that classrooms can have an impact on the ability of students to hear, to pay attention and to absorb information. Studies show excessive background noise can be an impediment to their ability to pay attention. Outdoor noise can be a negative factor as well, as a recent study shows students in a school under a regular flight path of an airport performed up to 20% lower

1-National Research Council. (2007). Green Schools: Attributes for Health and Learning: National Academies Press; 2- Loftness, Vivan (2009). Edutopia. Student health and performance bloom in environmentally conscious schools. <http://www.edutopia.org/green-schools> ; 3-Lawrence Berkely National Laboratories Indoor Air Quality Resource Bank; 4-Bernstein, Harvey and Baker Lindsay. (2012). The Impact of School Buildings on Student Health Performance: A Call for Research. McGraw-Hill Foundation and Center for Green Schools.; 5-Ibid; 6-Ibid; 7-Ibid

on a reading test than children in a nearby school.⁸

Research also reveals that there is a clear connection between acoustic design and acoustical performance, and that acoustical performance has a direct effect on speech intelligibility and consequently on student learning. Many studies have measured how poorly many classrooms perform acoustically, exposing the severity of the problem.⁹

OTHER RESEARCH

A majority of the research done in the area of a school building’s impact on cognitive functioning comes from observational studies. For example, a recent study in one school district in Connecticut found that test scores across all schools went up noticeably after school construction projects were undertaken by the district. Studies like this are helpful because they are able to account for differences in socioeconomic statuses and other confounding factors.¹⁰

When it comes to making the connection between physical activity and health, more is known about the extent of the problem. Studies show that 15% of school-age children are overweight and that this number is three times higher than it was in the late 1970s. Unfortunately there is insufficient data to attribute success to any particular solution that relates to school buildings.¹¹

What Research is Still Needed

In 2012, the McGraw-Hill Research Foundation, in partnership with the Center for Green Schools, published the whitepaper, *The Impact of School Buildings on Student Health*

and Performance: A Call for Research where it laid out the gaps that still exist in our current understanding of what impacts school buildings can have on student and teacher health and performance. The whitepaper recommends several areas where more research is needed:

INDOOR AIR

- More research is needed on the lack of adequate ventilation in America’s classrooms even though codes and practices of the HVAC industry have been around for a long time.
- More information is needed on how HVAC system designs and maintenance procedures impact air quality. Also more research is necessary on how materials selection, such as those that include VOCs, affect student health and learning.

LIGHTING

- There is a need for more performance-based design guidelines that can reliably produce excellent visual environments.
- As a new emerging technology that has started making its way into school buildings, Light Emitting Diodes (LEDs) may warrant more intensive research.

THERMAL COMFORT

A remaining challenge is figuring out how our accumulated knowledge on thermal comfort is best applied to enhance student health.

- As new technology is developed and low-energy heating and cooling methods become prevalent in high-performance buildings, their potential impacts

on student health and well-being need to be researched.

- Also more information is being demanded on what the ideal level of control over temperature and ventilation should be in a classroom.

ACOUSTICS

Educators need more information on the state of existing classrooms today in order to understand how much acoustical improvement is needed.

- More information is needed on the factors behind occupant dissatisfaction with acoustics in newer high-performance buildings and how they can be designed better.
- Also more information is needed to understand how best to provide for the needs of hearing impaired children in classrooms.

OTHER RESEARCH

More interdisciplinary research is needed in the area of cognitive functioning that brings together educational researchers and building research. Specifically more studies are needed in the following areas:

- Studies that look at the effects of building systems on average daily attendance (ADA), using ADA as a proxy for student learning.
- Comparisons of nearly identical school buildings that have one different building component.

More research is also needed to test theories about how school designs can ensure high levels of physical activity. One area of opportunity is:

- The demand for more data that supports the connection between school siting and walkability, and the health of students. ■

8-Bernstein, Harvey and Baker Lindsay.(2012). The Impact of School Buildings on Student Health Performance: A Call for Research. McGraw-Hill Foundation and Center for Green Schools.; 9-Ibid.; 10-Ibid.; 11-Ibid.

Data: Human/Performance Factors

Impacted by Green Schools

Impact on Student Health and Well-Being Due to Green Schools

Nearly all the school respondents (91% of K-12 and 87% of higher education) believe that green buildings have a positive impact on student health and well-being. This finding is critical to understanding the level of penetration of green in the education sector. Consideration of health is a top driver for over 70% of the school respondents, and pursuing green through improved indoor environmental air quality is considered as important as energy reductions to make a building green by an equivalent percentage of school respondents, an unusual finding not matched in any other sector in McGraw-Hill Construction's studies on green.

For more information on how schools are measuring these impacts, please see pages 26 and 27.

Variation by School Administrators

These findings are even stronger when looking solely at the responses of the school administrators. All (100%) of the K-12 administrators and 90% in higher education believe that green schools improve student health and well-being.

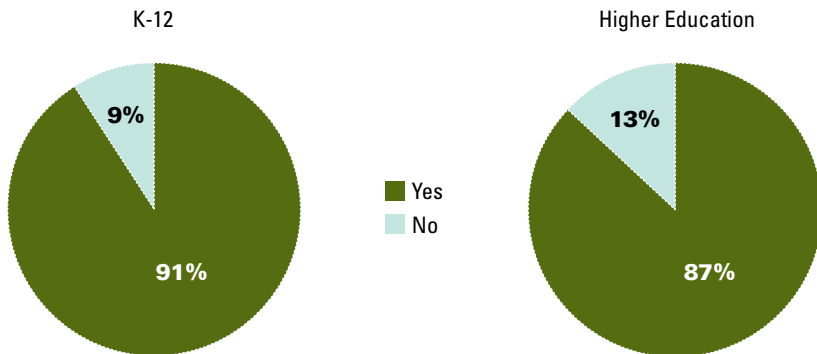
Impact on Student Health and Well-Being According to Architects and Contractors

Architect's expectations about the impact of schools on health and well-being align closely with those of the schools, with 85% reporting a positive impact. Contractors, on the other hand, are less convinced, with only about half expecting positive impacts and one-third who state they do not know.

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Green Schools Improve Health and Well-Being

Source: McGraw-Hill Construction, 2013



Designing a Healthy School Environment in a Rural Setting

Buckingham County Primary and Elementary Schools

DILLWYN, VIRGINIA



The Dining Room features abundant natural light, local materials, and non-traditional dining furniture. The furniture is moveable and stackable, and it lends itself to multiple rapid reconfigurations.

The new Carter G. Woodson Center Education Complex located in Buckingham County, in central, rural Virginia, has been designed and renovated as a modern learning campus for K–5 students with the intent to promote connectivity, creativity, physical activity, health and well-being for students and for the Buckingham County district community.

The design for the school renovation was developed using novel theory-based guidelines created collaboratively by the design team and health research teams from the University of Nebraska and the University of Virginia. The project involved renovating two former schools built in 1954 and 1962, and connecting them through newly built structures to form one

new school. The architectural firm VMDO oversaw and supported the designs for architecture, interior spaces, graphics and wayfinding, and landscaping.

Sustainable Features Create an Ideal Learning Environment

The campus design supports the health of students and the environment by incorporating many sustainable features. Solatube® high-performance daylighting systems were used in ceilings and light louvers in classrooms to supplement the natural daylight from windows. Non-toxic materials and low-emissions products were used throughout the construction process. According to Steve Davis, director of sustainable design at VMDO, “Special attention was paid to the

use of sustainable materials from the local area such as Buckingham slate and kyanite, which are mined locally.” Additionally, a water-source heat pump system supports energy efficient heating and cooling of the school, and innovative stormwater strategies integrate green space, native landscaping and natural hydrologic functions to generate less runoff on the site.

The design team employed several strategies to increase engagement, concentration and health among students. The design elements include creating flexible, customizable spaces to accommodate movement and encourage learning. Circulation hallways, open gathering spaces, and outdoor gardens and play terraces were other design elements to encourage physical activity and interaction among the school community. Additionally, the use of newly developed flexible furniture allowing for easy arrangement and adjustment is supporting the movement and enhancing the learning experience for students. “The furniture enables the kids to have the wiggles, and it helps them keep their focus for longer stretches of time or to get the wiggles out”, says Davis.

Design Strategies Encourage Healthy Eating

As one of the primary goals of the school district, design team and health research teams, the K–5 campus incorporates several strategies to facilitate healthy eating among children to help prevent and reduce childhood obesity. The dining commons area, one of the newly

Buckingham County Primary and Elementary Schools DILLWYN, VIRGINIA

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS

Image courtesy of VMDO Architects and Tom Daly



View of the Woodland Hub (an extended learning area) featuring recycled forest products and wood species native to Virginia. Forest products are an important part of the local economy, in addition to farming and mining.

constructed spaces, is an enriched learning environment that serves as a shared space, connecting the primary and elementary schools. The commons includes a teaching kitchen, innovative food and nutritional displays, open areas that promote demonstration cooking, a food lab, a scratch bakery, dehydrating food composter, natural daylight, flexible seating arrangements, an outdoor student dining terrace and kitchen gardens.

The commercial kitchen in particular was designed to provide an important educational experience – retaining key food service functions

Project Facts and Figures

Owner Buckingham County Schools	Completed August 2012
Architect VMDO	Grades Primary School: K-2 Elementary School: 3-5
Type of Project New Construction & Renovation	Student Capacity Primary School: 500 Elementary School: 500
Size 135,000 sq. ft.	LEED Pursuing LEED Silver
Total Cost \$17,332,000	

while allowing students visual access to the kitchen as they move through the serving lines. Davis says, “As designers, where and how we design a fruit display could affect a child’s selection as they go through the lunch line.” The special attention given to food preparation, from the gardens to the open serving stations, gives students a new appreciation of their food. Students gain awareness about how their food grows, how it is prepared in the kitchen and how it fuels them in their activity and learning. These educational opportunities can create shifts in food culture and improve student health and well-being. Davis says, “The kitchen can also be used to do targeted interventions to help parents understand how to prepare quick, home cooked, healthy meals. So it helps support and educate not only the students but the broader community as well.”

Site Design Promotes Environmental Stewardship

The site design strategies promote the importance of the

natural environment and highlight the local natural resources. The gardens feature plant species that are local to the Piedmont region of Virginia, native grasses and wildflowers replace grass lawns, and Buckingham slate and local kyanite appear prominently in the campus’ exterior details. For example, slate is used in the channel for stormwater runoff, which cuts through the school’s entry plaza, revealing the stone beneath the earth’s surface. The channel measures the size of storm events, allowing students to understand the occurrence and volume of water associated with each storm.

The landscape offers a bounty of educational opportunities, particularly in the vegetable and herb gardens. Students are able to learn firsthand about the growth of edible plants and other food and become more familiar with the science of horticulture. The garden also allows and supports the lunch menu with nutritious options. A pollinator garden teaches students about native pollinating insects and animals vital to our ecosystem and agriculture. ■

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Student Mobility and Health Concerns

Reflected in Design and Construction of Green Schools

Eighty-five percent of architects reflect student mobility and health concerns in the design of their green buildings. Increasingly, obesity among children has been identified as a major health issue, and designing schools to increase student mobility may be one strategy to help address this concern.

Only 49% of contractors are taking the same factors into account when they build schools. Still, this figure is relatively high, given the fact that the design phase offers more opportunities to impact student mobility than after design is complete. Greater involvement by the contractor community in the final phases of design may account for why almost half the contractors are also able to reflect this concern.

Variation by Level of Green Involvement

The higher the percentage of green work conducted by an architect or contractor, the more frequently they report including mobility and health concerns in their design and construction of green schools.

- 1%–30% of green projects: 60%
- 31%–60% of green projects: 74%
- 61%–90% of green projects: 73%
- More than 90% of green projects: 83%

Student Health and Productivity Measures

Less than one-quarter of the school respondents are using any health metrics to gauge the performance of their green buildings. Health measures are impacted by many factors, of which green building improvements is only one, and they are difficult to directly correlate to green building efforts.

K–12 schools are most commonly using absenteeism (which was not asked of higher education), with 21% using this metric. However, since it is likely that nearly all K–12 schools are tracking attendance on a regular basis, the challenge is encouraging them to associate the performance they observe with the green improvements they make. It is likely that the student test score and annual yearly progress measures are similarly tracked but not correlated with green efforts.

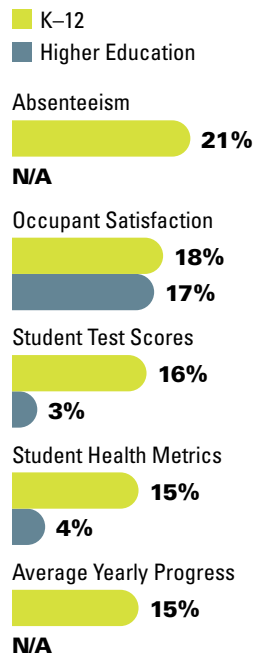
The only measure tracked by a notable percentage of higher education respondents to gauge the performance of their green buildings is student and staff satisfaction.

Variation by Dedicated Sustainability Staff (K–12)

About double the K–12 respondents with a dedicated green staff track occupant satisfaction, student health metrics and average yearly progress compared with schools with no dedicated staff.

Percentage Using Social/Health/Productivity Metrics to Evaluate the Impact of Green Projects

Source: McGraw-Hill Construction, 2013



NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Use of Health Metrics to Evaluate Green School Building Performance

Seventy-four percent of K–12 schools are tracking a measurement of student health in their green schools, but only 47% in higher education do the same. K–12 schools can access many of these metrics more easily, such as the number of visits to a school nurse and absenteeism, and many public schools may have metrics required in order to assess their overall performance that are not required in the higher education sector.

The only metric used more frequently in the higher education sector is student and staff surveys. This is consistent with findings that demonstrate the importance of green to higher education institutions to attract students (see pages 37-38 for more information).

11% more K–12 schools with dedicated sustainability staff use metrics on visits to the school nurse and 18% more use asthma measures than those who do not have a dedicated staff. 12% more higher education schools with dedicated staff use student and staff surveys.

Decreased Absenteeism in K–12 Schools Due to Green Building

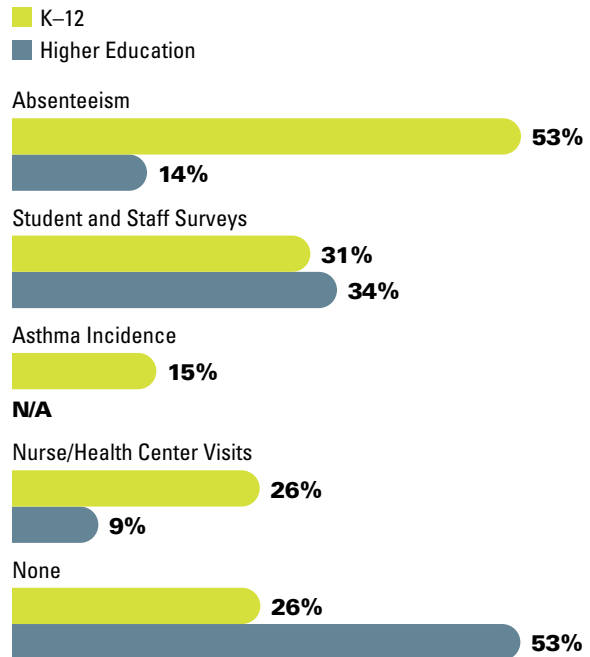
Thirty-two percent of K–12 respondents find that their green building efforts have reduced absenteeism, with over half reporting the reductions fall in the 1% to less than 5% range. The disparity between this finding and the 91% who believe that schools improve health and well-being suggest that this measure is influenced by other factors than health, including student engagement.

Interestingly, there is no meaningful difference between administrators’ responses and those of the school staff involved with the design, construction and operation of the buildings. Absenteeism is the most common metric tracked to gauge the health and well-being effects of green building in the K–12 sector, and information on attendance may be a metric shared across divisions.

Forty-five percent of those who achieve LEED certification and 44% whose buildings received an Energy Star label report decreased absenteeism. Again, this suggests that schools that seek the rigor of a third-party analysis of green achieve better results.

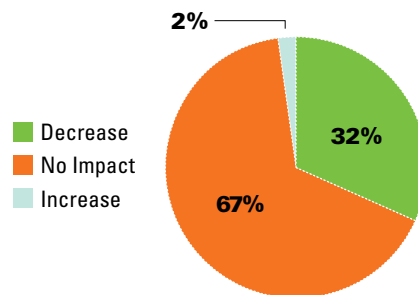
Measures Used to Gauge Effects of Green Buildings on Health and Well-Being

Source: McGraw-Hill Construction, 2013



Impact of Green Building Efforts on Student Absenteeism (According to K–12 Respondents)

Source: McGraw-Hill Construction, 2013



Impact of Improved Acoustics on Attentiveness

Inclusion of Improved Acoustics in Green School Projects

Sixty-five percent of K-12 and 43% of higher education respondents have included improved acoustics as part of the green projects they have undertaken.

88% of architects and 63% of contractors have also included improved acoustics as part of their green school projects. However, only 41% of architects and 7% of contractors include improved acoustics on more than half of the green school projects they design and build, which suggests that acoustics are not necessarily considered a required green feature like energy savings or improved indoor air quality for a school project to be considered green.

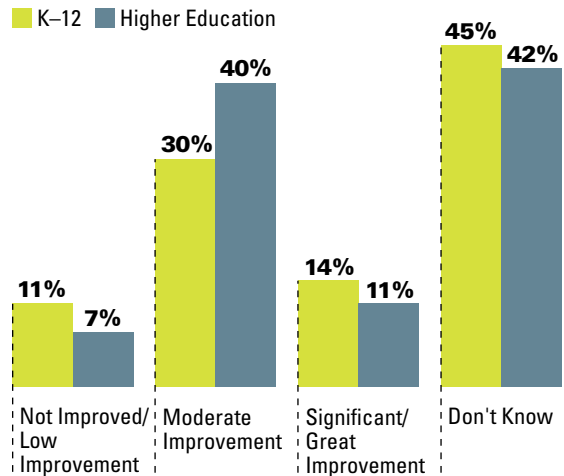
Impact of Improved Acoustics on Attentiveness

Among the schools that report improving acoustics in their green school buildings, the largest percentage are not sure about the impact of these improvements on attentiveness. This may be due to the challenge in measuring attentiveness, a far more subjective area than test scores or absenteeism.

Among those who do see improved attentiveness, the largest percentage note a moderate improvement, with 30% of K-12 and 40% of higher education respondents

Level of Increased Student Attentiveness Due to Improved Acoustics

Source: McGraw-Hill Construction, 2012



finding this increase. While further data is needed to confirm the exact impact, this result does suggest that including acoustics in a green building program can contribute to the productivity improvements sought.

Impact of Daylighting and Views on Student Engagement

Inclusion of Daylighting and Views in Green School Projects

Eighty percent in K-12 and 86% in higher education include increased daylighting and views in their green projects. In addition, 76% of architects incorporate increased daylighting and views on over 50% of their green school projects. This demonstrates that attention to daylighting and views is widely adopted on green school projects.

While only 23% of contractors report the same inclusion, this may be because they are less likely to be involved in decisions about window placement and may not view increased daylighting as part of their contribution to the project, even if it has been designed into the building.

Impact of Increased Daylighting and Views on Student Engagement

Forty-eight percent of K-12 respondents and 56% from higher education find that the increased daylighting and views they have included in their green projects have at least moderately increased student engagement. The positive impact of daylighting in schools has been demonstrated in studies looking at student engagement, and these results confirm the positive impact. For more information on the studies on linking green school features and student health an productivity, see page 21.

Encouraging and Measuring Student Engagement

Activities to Encourage Student and Staff Engagement in Green Building

K-12

One key strategy at the K-12 level indicated by the findings is the use of the faculty to help engage the students.

Staff professional development is the most common activity, with 75% using this as a means to increase engagement in green. The curriculum also plays an important role, with 65% creating new green curricula and 64% adding green to existing programs.

K-12 schools also encourage direct student participation in green building, with 65% using student clubs and committees focused on sustainability and 62% allowing students to be involved in the building design process.

The other activity selected by over 60% of K-12 respondents is signage devoted to green features, selected by 63%.

HIGHER EDUCATION

A larger percentage of respondents at the higher education level encourage direct student participation in green than at the K-12 level:

- 80% have student clubs
- 70% allow active participation in building design

This finding is consistent with the use of green to engage students by higher education reported throughout this study.

The higher education respondents are also interested in keeping the students well informed about their green efforts:

- 72% have signage devoted to green features
- 65% use dashboards that provide data on green building performance

The curriculum is also of importance to higher education respondents as a way to increase engagement with green building, with 67% reporting new green curricula and the same percentage reporting the addition of green to existing programs.

Metrics Measuring Student Engagement in Green Building

Thirty-five percent of K-12 and 48% of higher education respondents use metrics for measuring student engagement. Similar to several other green building metrics in this study, 16% more of the schools with dedicated sustainability staff report measuring student engagement than those that do not have dedicated staff.

In response to an open question about which metrics they use, the most common answers by the K-12 and higher education respondents included the following:

K-12

- Participation in classroom and curricular activities
- Participation in sustainability clubs
- Student-led activities

HIGHER EDUCATION

- Surveys
- Participation in sustainability clubs/organizations
- Participation in and activities of student government and student-formed committees on green
- Participation in sustainability events or programs
- Participation in classes focused on sustainability

Embedding Sustainability Into Every Facet of University Life

Furman University
GREENVILLE, SOUTH CAROLINA

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS

For more than a decade, Furman University, a private liberal arts university located in Greenville, South Carolina, with 2,650 students, has made sustainability and environmental education an institutional priority. As early as 2001, the university's Board of Trustees endorsed its President David E. Shi's recommendation to include sustainability as one of the university's five strategic goals. Six years later, the university became a charter member of the American College & University Presidents' Climate Commitment (ACUPCC). Soon thereafter in 2009, the Sustainability Planning Council (SPC), consisting of 124 members, including faculty, staff, trustees, students and community leaders, helped develop a comprehensive sustainability master plan that addresses sustainability throughout the university and includes an embedded climate action plan with the goal of reaching carbon neutrality by 2026.

The whole effort is coordinated under the leadership of Angela Halfacre, the director of the David E. Shi Center for Sustainability, which was established in 2008 and has four full-time staff and faculty. Halfacre says, "The center is a first of its kind sustainability think tank charged with promoting sustainability education and research, stimulating student and faculty participation in campus sustainability projects, and cultivating partnerships and collaborations." Shi Center staff, along with student fellows, work with departments to monitor progress on the university's sustainability master plan.



Built in 2008, the LEED Gold certified Cliffs Cottage, which houses the David E. Shi Center for Sustainability, was Southern Living magazine's first "green" Showcase Home.

Infusing Sustainability Into the Curriculum

Furman has developed a wide range of curricular options to study sustainability, from a general education requirement that students take at least one course focused on humans and the natural environment, to the infusion of sustainability concepts in existing courses, to a new and distinctive major in sustainability science. To foster continued innovation and sustainability curriculum development, along with interdisciplinary research, the Shi Center created an Affiliate Faculty program to connect faculty across the university with interests in sustainability teaching and research. According to Halfacre, "The Shi Center now has 50 faculty affiliates from 19 of the university's 24 academic departments, one-fifth of the entire faculty."

To achieve Furman's ambitious sustainability goals, the Shi Center has forged a rich array of community partnerships. The Shi Center has partnered with nearly 20 community organizations since the Center's inception in 2008. Its student Fellows program includes a division devoted to student-community research/internship projects. The focus is on applied research and service related to sustainability, and the sponsoring organizations range from the City of Greenville's Green Ribbon Advisory Committee, which is responsible for creating and implementing the City's sustainability plan, to Greenville Forward, the organization responsible for implementing Greenville's Vision 2025 Plan, to Gardening for Good, an organization creating a network of community gardens in Greenville.

CONTINUED

Furman University GREENVILLE, SOUTH CAROLINA

A Strong Focus on Community Engagement

In addition to students' involvement in the community through fellowships, Furman as a whole was involved in the Greening of Greenville, an initiative sponsored by Duke Energy, General Electric and others to make Greenville a more energy efficient place to live, including an emphasis on plug-in stations for electric cars. Halfacre says, "The Greening of Greenville provided a uniting front for the campus and community to rally around building a more sustainable community." To address Furman's community responsibilities and to partner with utility providers, Furman created the Community Conservation Corps (CCC), a weatherization program for low-income homeowners. Primarily funded by Piedmont Natural Gas, the CCC has weatherized 34 low-income homes in Greenville since 2010. In 2013, the CCC is expected to receive the Clear Skies Champion Award from Upstate Forever.

Good Progress in Energy Efficiency Improvements

As part of its efforts to reduce its greenhouse gas emissions and overall carbon footprint, Furman has also aggressively focused on requiring high-performance and energy efficient facilities and operations—for both new construction and major renovations. Strategies being employed include completing upgrades to the campus utility systems, implementing projects that decrease water usage, improving the operating efficiency of lighting systems, heating, ventilating and air conditioning, and re-commissioning

building systems to ensure maximum operational efficiencies.

In 2001, the trustees of Furman announced that all new and renovated construction projects had to meet or exceed USGBC's LEED Silver standards. In 2003, the university built Hipp Hall, a LEED Gold certified building, which was also the first LEED certified building in the state of South Carolina. Since then, the university has added five other LEED certified buildings and two others that are up to LEED standards but are not certified.

Furman is also in the process of replacing aging heat pumps at 11 on-campus apartment buildings with highly efficient geothermal ground-source heat pumps. These new heat pumps will take advantage of the constant temperature of the earth to pre-heat or pre-cool air for ventilation and demonstrate the feasibility of retrofitting a traditional system with an innovative renewable energy resource.

Furman has been able to secure funding mainly from private foundations as well as from DOE and state energy grant money to fund its initiatives. The university has garnered over \$12 million in grants, gifts and pledges since 2007.

The university participates in the Sustainability Tracking Assessment and Ratings System (STARS) developed by the Association for the Advancement of Sustainability in Higher Education (AASHE) and has received a Silver rating with its submission in January 2011.

Implementing these sustainability initiatives have not been without some challenges. A key challenge that Halfacre finds is, "Cheap energy in the Southeast makes it more



Charles H. Townes Center for Science at Furman University uses an energy-efficient cooling system using chilled beams, a technology widely used in Europe. At the time of construction in 2009, there were only two such cooling systems in use in the United States.

challenging to try to change behavior of use but it also makes it more challenging in terms of how you are going to put money into addressing some of the things that you would like to do." She states, "Our payback periods no matter what initiative we might pursue, are always going to be longer than they would be in the Northeast because our cost is significantly less."

Halfacre thinks sustainability is the one area in which being more collaborative rather than competitive is critical. "We've really benefited quite a bit from our longstanding connections with our sister schools to find collaborative opportunities related to renewable energy, curricular innovations, purchasing, research, climate action planning and carbon offset projects in local communities." ■

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Improved Student Productivity/Test Scores Due to Being In Green Schools

Nearly three-quarters of K-12 respondents and two-thirds of higher education respondents report improved student productivity/test scores in green schools. One factor that may contribute to the higher K-12 scores is the emphasis in that sector on standardized testing. While grades are still an important measure in higher education, test scores are critical to the evaluation of school performance in the K-12 sector, which may lead to more data and more emphasis on tracking.

Among those that find improved productivity and test scores, the level of improvement noted is similar between both sectors. Most find only modest improvements, with only 6% noting significant improvement. This is to be expected given the number of factors that impact student test performance beyond the impact of buildings. However, even modest improvements are notable as an investment in fulfilling their mission as educational institutions, especially when combined with the proven financial benefits of green.

Variation by School Administrators

A slightly lower percentage of school administrators in both sectors report improved productivity and test scores:

- **K-12 Administrators: 68%**
- **Higher Education Administrators: 40%**

Also, no administrators from either sector report significant productivity or test score improvements, again reinforcing the fact that only modest benefits are expected on this front from green building efforts.

Variation by Schools Achieving LEED Certification

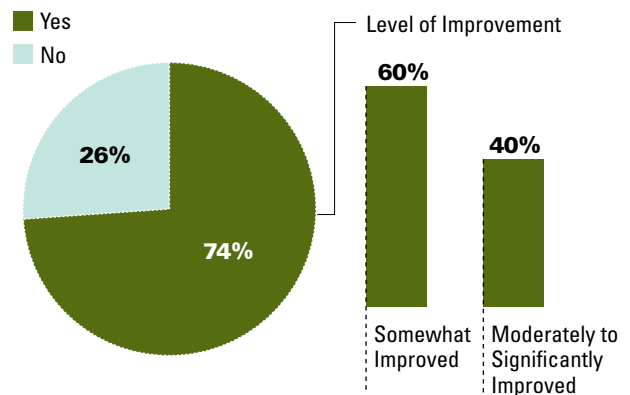
A higher percentage of schools that have achieved LEED certification for their green building improvements report productivity/test score improvements in green buildings:

- **K-12: 89% compared with 68% who have not achieved LEED certification**
- **Higher education: 67% compared with 53%**

Further research is required to determine whether this indicates better productivity results due to greener projects when seeking third-party certification, or if this finding is influenced by higher expectations of green results by those who are willing to invest in third-party certification.

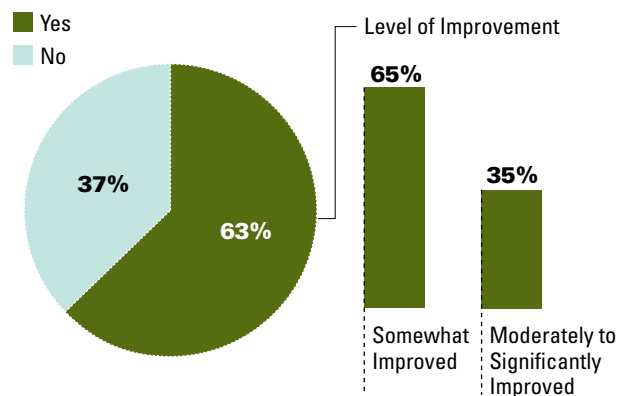
Improved Student Productivity/Test Scores Due to Being in a Green Building (According to K-12 Respondents)

Source: McGraw-Hill Construction, 2013



Improved Student Productivity/Test Scores Due to Being in a Green Building (According to Higher Education Respondents)

Source: McGraw-Hill Construction, 2013



NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

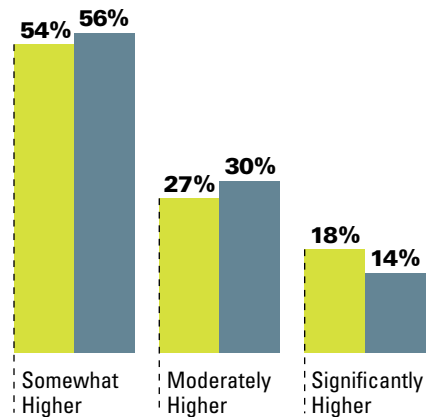
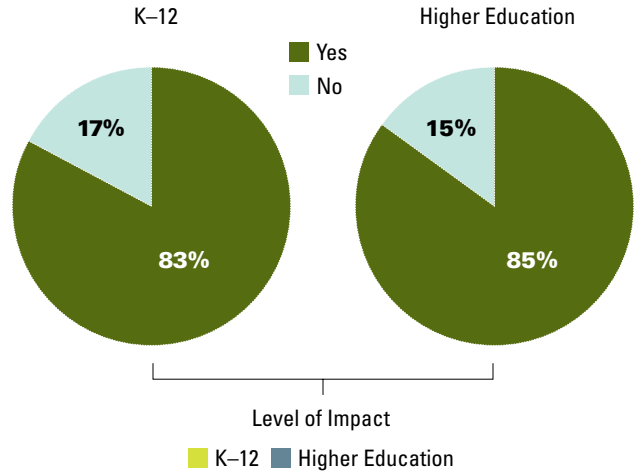
Faculty Satisfaction Increase Due to Teaching in a Green Building

Eighty-three percent of K-12 and 85% of higher education respondents find that teacher satisfaction increases as a result of being in a green building. The level of impact they report is roughly equivalent as well, with 45% of K-12 respondents finding satisfaction is at least moderately higher in a green building than a traditional one and 44% from the higher education sector.

However, this figure is in marked contrast to the relatively low percentage of those that find that green buildings help with staff or faculty recruitment. Again, this suggests that while teachers greatly value green, they are not making employment decisions based largely on this factor. However, higher employee satisfaction can have a positive impact on productivity, a more likely benefit to arise from the increased satisfaction with green buildings than stronger recruitment.

Faculty Satisfaction Increases as a Result of Teaching in a Green Building

Source: McGraw-Hill Construction, 2013



Data: Measuring the Impact of Green Schools

Use of Financial/Building Performance Metrics to Evaluate Green Schools

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

A larger percentage of higher education respondents use more of the financial/building performance metrics than K-12 respondents. Also, schools with dedicated sustainability staffs use these measures more frequently, with over 20% more benchmarking water use reduction and using emissions footprint reduction in both sectors; tracking operating cost decreases and benchmarking energy reductions in K-12; and using ROI in higher education.

Even operating cost decreases, a measure that is relatively easy to determine and to apply to ROI, is used by less than two-thirds, demonstrating the challenge of capturing the impact of green schools.

Most Important Metrics

OPERATING COST DECREASES

Thirty-six percent of K-12 and 21% of higher education respondents selected this as the top metric when asked to rank them.

ENERGY USE REDUCTION BENCHMARKS

The percentage of higher education respondents who consider this the most important metric (21%) is equal to operating cost decreases, despite the fact that energy use reduction is used by 10% fewer respondents. This high level of importance may be due to higher education's focus on reducing greenhouse gas emissions—a factor often linked to energy use. Sixteen percent of K-12 respondents also selected this as the most important measure, demonstrating its weight in that sector as well.

AMOUNT OF LEED SPACE

Despite low use of this metric, amount of LEED space ranks third in higher education among the metrics selected as most important (13%). In contrast, no K-12 respondents selected it as the most important.

REDUCTION OF EMISSIONS FOOTPRINT

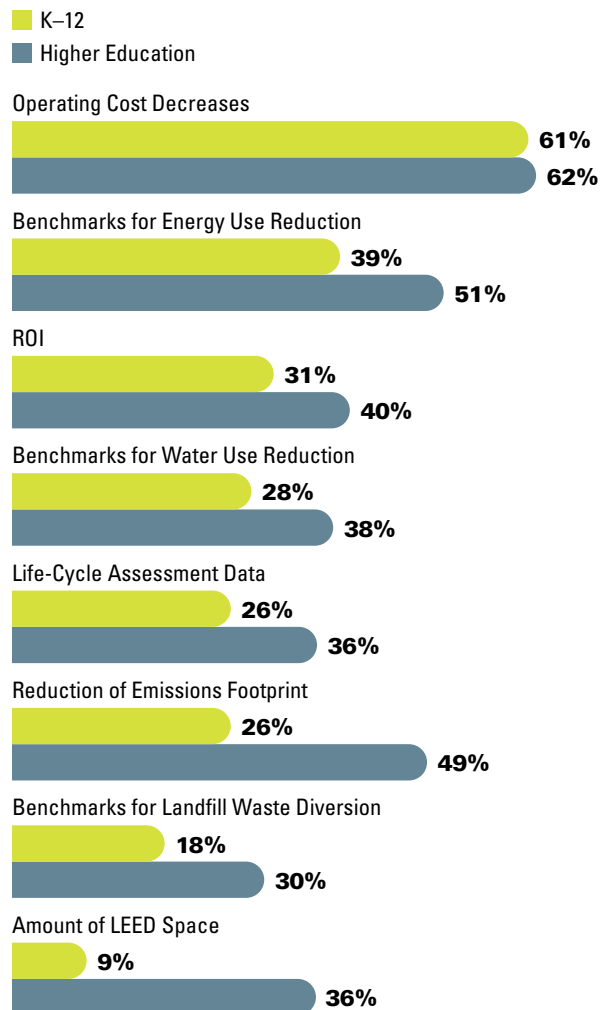
While about as many higher education respondents use this measure that use energy reduction benchmarks, only 10% select it as the most important. Only 2% in the K-12 sector rank it as the most important metric.

RETURN ON INVESTMENT

Eight percent of K-12 and higher education respondents select return on investment as the most important metric. It is critical to help make the business case for greater green investment in the future.

Percentage Using Financial/Building Performance-Related Metrics to Evaluate the Impact of Green Building

Source: McGraw-Hill Construction, 2013



Metrics Used According to Architects and Contractors

Architects and contractors do not fully know what their clients are measuring. A higher percentage of contractors (50%) think ROI is being used, but a lower percentage think schools use energy use reduction benchmarks (24%) and emissions footprint reductions (18%). Architects also underestimate use of emissions footprint reductions. Greater awareness of the metrics used by schools could help them gather feedback on building performance to improve their performance calculations.

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Factors Used to Calculate ROI for Green Projects

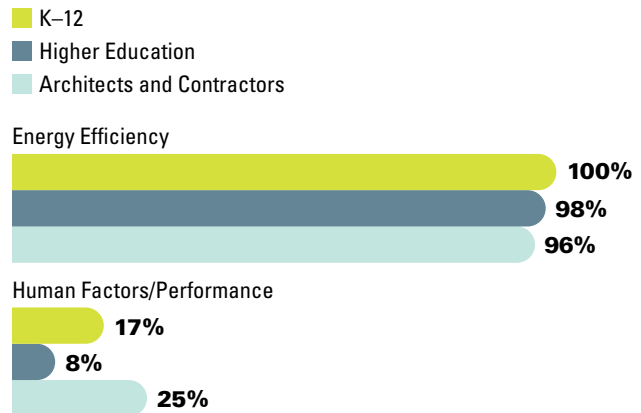
Nearly all the respondents use energy efficiency to calculate the ROI on green projects. Improved energy efficiency not only contributes to operating cost savings, but also can be used to indicate progress on greenhouse gas emissions reductions.

On the other hand, only 17% of K-12 and 8% of higher education respondents use human and performance factors—such as health and well-being—in their ROI calculations. Given the greater number of these soft metrics tracked by K-12 schools (see page 26) it is not surprising that they are able to use them more than higher education respondents in ROI calculations, but the K-12 percentage is low due to the challenge of gathering these metrics (see page 36).

Schools with dedicated sustainability staff also report a much higher percentage (15%) using human and performance factors for ROI than those with no staff (5%). Given their consistently higher performance in tracking metrics, they would have more data to draw from.

ROI Metrics Used (According to K-12, Higher Education, Architect and Contractor Respondents)

Source: McGraw-Hill Construction, 2013



Energy Measurement and Verification Programs

Fifty-nine percent of K-12 and 70% of higher education respondents use some kind of energy measurement and verification program. Energy use reduction is not only a source of operating cost savings, but it is a common strategy to reduce greenhouse gas emissions.

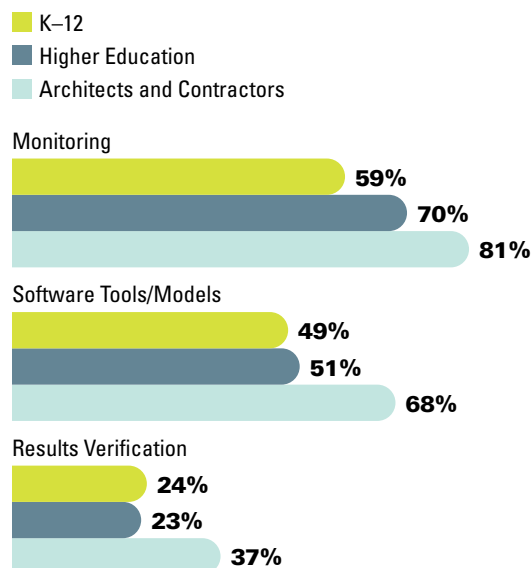
Monitoring is the most frequently employed strategy in the K-12 and higher education sectors. Seventy-three percent with a dedicated green staff employ monitoring, 28% more than those who do not.

Software models and tools are also employed by a high percentage of schools respondents. Sixty percent with a dedicated green staff include this in their energy measurement and verification programs, compared to 29% with no dedicated staff.

Architects and contractors have a higher expectation of use of each element of these programs than the level of use reported by the schools, revealing a gap in understanding the level of measurement occurring.

Types of Energy Measurement Used In Green Schools

Source: McGraw-Hill Construction, 2013



Challenges to Measuring Sustainable Performance

For both the K-12 and higher education sectors, the highest percentage of respondents find that their staff's capacity to gather data is the biggest challenge they face. In the SmartMarket Executive Brief *Determining the Value of Green Building Investments* (free report available at analyticsstore.construction.com), staff time and the cost of measuring and gathering data were frequently mentioned challenges to measuring sustainable building performance, with at least one respondent highlighting the challenge of getting staff to prioritize metrics among the multiple directives on which they are expected to deliver. This concern about staff recognition of the importance of these measures is also reflected in the 37% of K-12 and 40% of higher education respondents who find engaging employees to be an obstacle.

Among higher education respondents, issues with the kind of data available also present challenges, with 56% struggling to find the right metrics and 47% concerned about whether the data is available. Making direct correlations between factors like improved attendance or test scores and green buildings is challenging since a number of factors impact these measures of student performance.

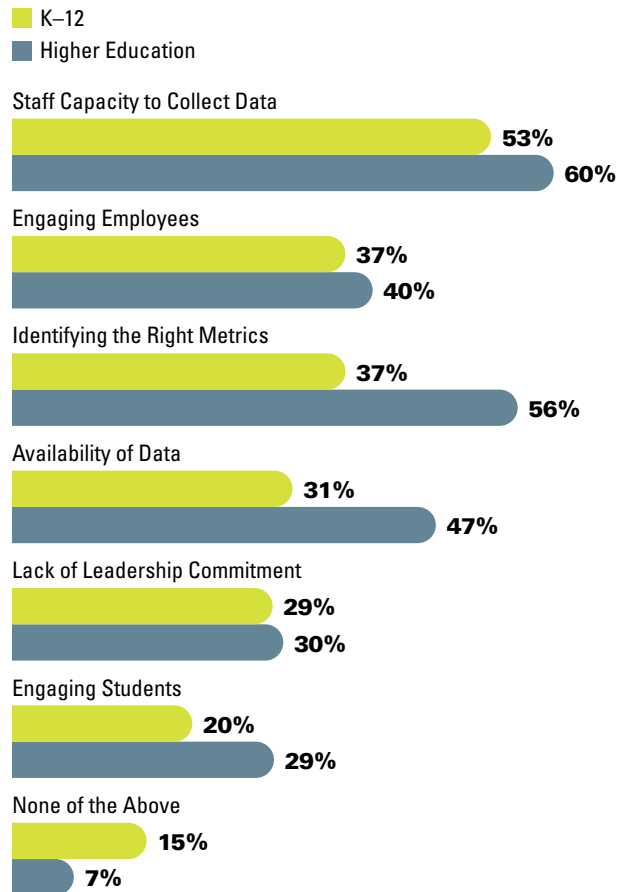
Variation by Schools That Have Achieved LEED Certification

The most recent version of LEED includes a requirement to report on building performance. Respondents who have achieved LEED may have greater experience with conducting building performance measurements because of this requirement. Therefore they may be more familiar with the challenges of gathering the data than those who have not achieved LEED certification.

- **Staff capacity to collect data**
 - LEED: K-12 73% and Higher Education 67%
 - Non-LEED: K-12 44% and Higher Education 43%
- **Identifying the right metrics**
 - LEED: K-12 43% and Higher Education 57%
 - Non-LEED: K-12 34% and Higher Education 53%
- **Data availability (K-12 Only)**
 - LEED: 41%
 - Non-LEED 27%

Biggest Challenges in Measuring Sustainable Performance

Source: McGraw-Hill Construction, 2013



Data: Triggers, Drivers and Obstacles

Triggers for the Decision to Build, Retrofit or Operate a Green School Building

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Green building activities at schools are influenced by a wide range of factors, with over 50% of the respondents rating 12 factors as important or very important in their decision to build green or undertake green retrofits and operational improvements. **In fact, for K-12 respondents, 8 factors were perceived to be important by over 70%, and, strikingly, 10 factors by over 70% in higher education.**

This finding is particularly notable given the high level of green involvement of the survey respondents (see page 8 for more information), and the type of factors listed reveal the high expectations that this audience has for the impact of their green building efforts, even if they have not been able to consistently measure these results.

For all school respondents, the most important triggers are reducing energy use and operating cost savings, with each selected by over 90% of the respondents.

These findings are consistent with other green studies conducted by McGraw-Hill Construction over the last five years in which energy use and operations cost savings are critical reasons for undertaking green projects.

K-12

The most striking K-12 finding is that the percentage of those who consider enhancing health and well-being important (89%) is roughly equivalent to those selecting energy use reductions and operating cost savings. Improved air quality, a related factor, follows closely behind at 87%.

While other McGraw-Hill studies have seen a rise in the importance of this measure in recent years, its importance as a trigger for K-12 is particularly notable. In part, this may be due to an active campaign on the part of the U.S. Green Building Council to promote green schools because of the health and well-being impacts, as well as several well-publicized studies looking at these impacts. (See page 21 for more information).

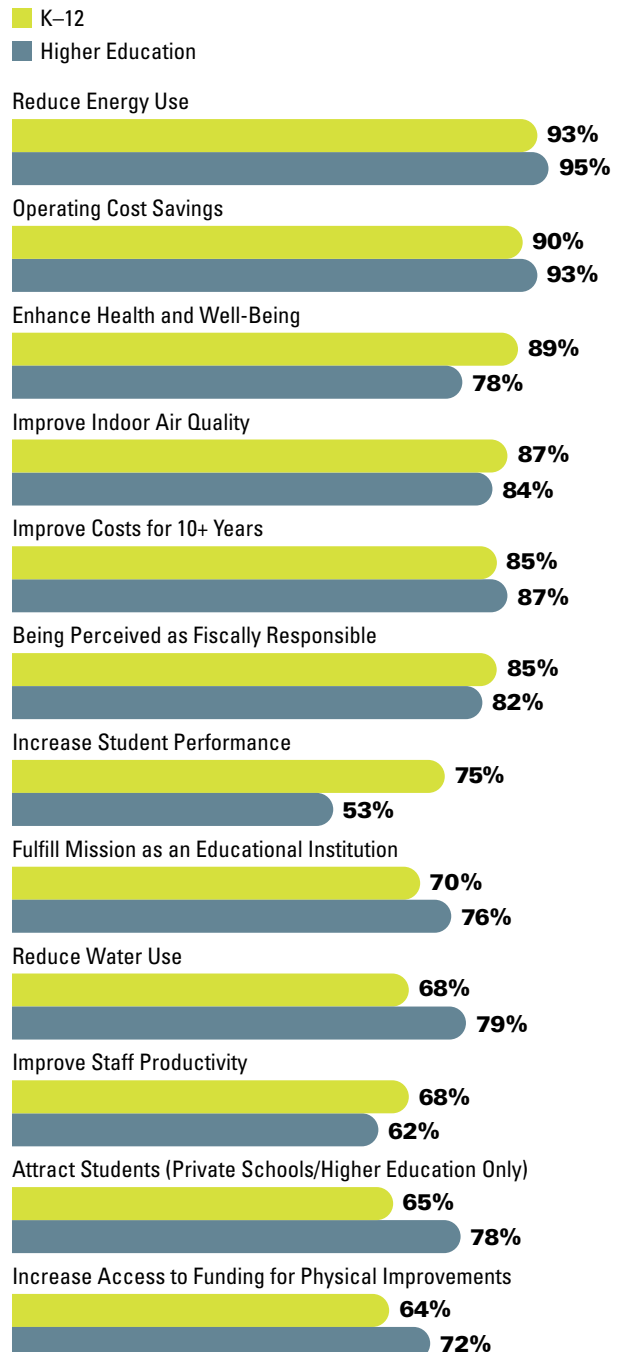
The K-12 and higher education sectors largely agree on the importance of cost savings and healthy buildings, but one factor that is more important to K-12 respondents is increasing student performance. K-12 respondents also track more performance measures than higher education like test scores, underscoring the importance of student performance in this sector.

Higher Education

Two factors are selected by at least 10% more higher education than K-12 respondents as important or highly

Top Ten Triggers for Green Building Programs (K-12 and Higher Education)

Source: McGraw-Hill Construction, 2013



important in their decision to build green or do green retrofits/operational improvements.

- **Reduce water use: While cost savings are of primary importance to both higher education and K-12, the greater emphasis on reducing water use suggests that the higher education institutions may be more engaged by broader green goals than in the K-12 sector.**
- **Attract students: Throughout the study, higher education consistently reports more interest in student response to green. While green may not be a factor for younger students, college students have green expectations that they seek in the schools they attend, and higher education schools need to respond to those expectations to stay competitive with a wide range of potential students.**

Variation Over Time Since 2007

A comparison of the research with CEFPI members published in the 2007 *Education Green Building Smart-Market Report* and the CEFPI respondents from the current study demonstrates **the increased importance of enhanced health and well-being as a trigger for building green or investing in green retrofits and operational improvements by schools.**

While the importance of reducing operating costs and energy use has remained consistent over the last five years, improved student performance/test scores has seen a significant decline in the percentage who consider it important or very important since 2007. One factor that may contribute to this decline is the difficulty in measuring the impact of green, isolated from other factors, on productivity and test scores. Greater experience with the difficulty of making a direct correlation may have led a higher percentage to no longer reflect that as an important trigger.

Factors Influencing Decision to Build a New Building or Renovate an Existing Building to Accomplish Green Goals

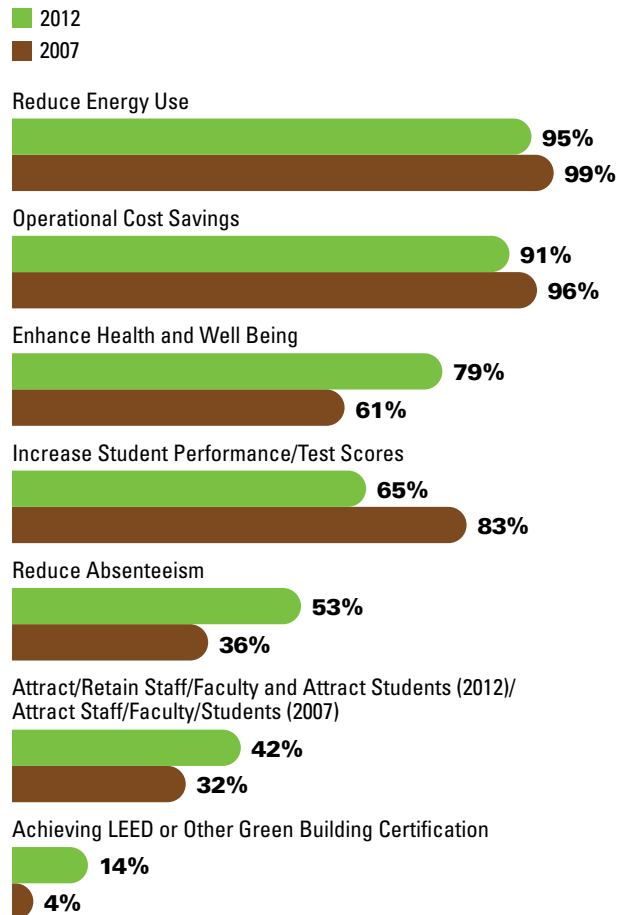
K-12

Over 50% of K-12 respondents find factors that favor new buildings over renovations to have a high/very high impact on their decision about whether to build new or renovate to accomplish green goals.

- **New buildings make maintenance/operations easier: 59%**
- **Better environmental performance achieved in a new building: 58%**
- **Cost of renovations exceeds cost of new building: 57%**

Top Triggers for Green Building Program (CEFPI Members 2007 and 2012)

Source: McGraw-Hill Construction, 2013



By contrast, only 36% are impacted by the historical significance of the existing building.

HIGHER EDUCATION

Fifty-eight percent of higher education respondents are highly impacted by the cost of renovations exceeding the cost of building new when they make decisions about how to achieve their green building goals, and 57% are influenced by the belief that a new building can achieve better environmental performance.

However, 43% are influenced by the historical significance of their existing buildings, an equal percentage to those who are influenced by the idea that new buildings make maintenance and operations easier.

Drivers That Will Encourage Increased Levels of Green Building Activity

Over 65% of the higher education respondents selected ten different factors as having a strong impact on increasing green building activity, and six factors were selected by the same percentage of K-12 respondents. The high level of green building already practiced by these respondents increases their familiarity with the benefits green can provide, and their numerous expectations about drivers for growth demonstrates that.

K-12

As with the triggers, the top drivers for this sector are cost savings and improving health and well-being.

Eighty-five percent of K-12 respondents also note the importance of improving the learning space. This factor, combined with the concern about health, reveals that this sector is largely mission-driven in its green goals. Further data on factors like daylighting and improved indoor air quality and their impact on the learning space will be beneficial in encouraging more schools to pursue green.

Higher Education

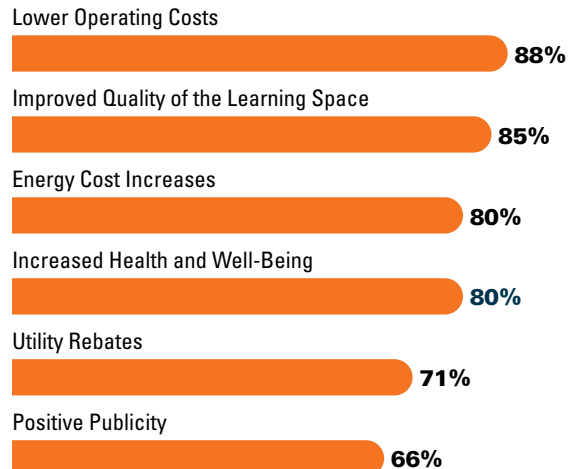
All of the factors that are expected to have a large impact on increasing future green building by 65% or more of the K-12 respondents are also expected by a similar percentage of higher education respondents to have the same impact. **This demonstrates that the issues driving green in the K-12 sector like cost savings, improved health and well-being and improved environment for learning are also critical in higher education.**

However, a few other factors also carry great impact in increasing the amount of green work at higher education institutions.

- **Mission is important enough to equal energy cost increases, and should therefore be considered a powerful force in greater green adoption for this sector.**
- **The demands of stakeholders is also a critical factor, from greater leadership from above to greater student demand.**
- **Greater government regulation is a bigger driver in higher education than in K-12. One trend that could impact this sector is required reporting of building energy use, which could impact schools that do not separately meter their buildings.**

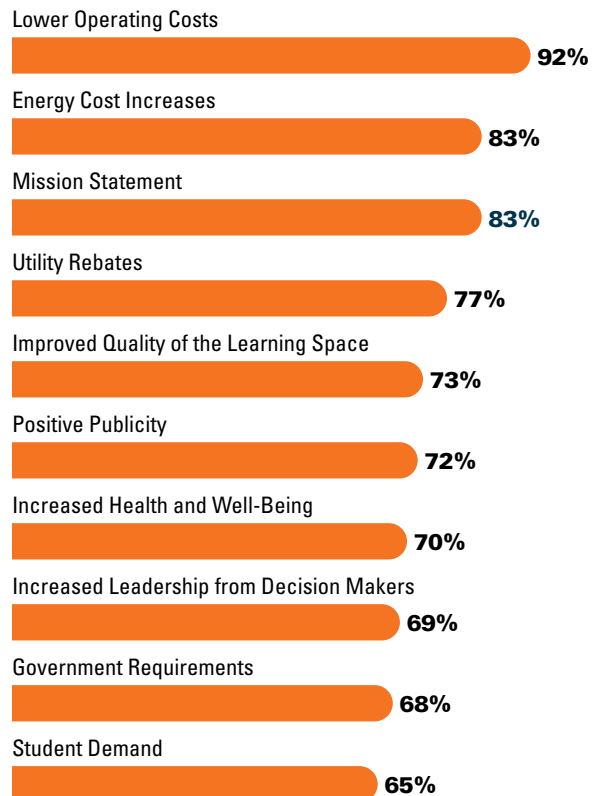
Top Drivers to Increase Green Building (K-12 Schools)

Source: McGraw-Hill Construction, 2013



Top Drivers to Increase Green Building (Higher Education)

Source: McGraw-Hill Construction, 2013



Variation Over Time From 2007

Among the top drivers selected in both 2007 and 2012 by the CEFPI survey respondents, the pattern closely follows that of the triggers. **Cost factors like operating cost decreases and increased energy costs not only rank highest, but the percentage of those who think they are highly impactful remains relatively consistent from the levels in 2007.**

Interestingly, though, one major difference in the top factors is a decline in the impact of health and well-being, from 88% in 2007 to 74% in 2012. This decline did not change its overall ranking as the third most important factor, and it may be due to the challenge some organizations have experienced in measuring the impact of green buildings on health and well-being, which reduces their opportunity to use it to persuade leadership of the need for larger green building investments.

Several factors are also recognized as highly impactful by a much larger percentage in 2012 than they were in 2007.

■ Government Requirements

- 2012: 64%
- 2007: 33%

■ Mission statement

- 2012: 51%
- 2007: 28%

■ Parent demand

- 2012: 43%
- 2007: 13%

■ Student demand

- 2012: 38%
- 2007: 8%

Top Drivers According to Architects and Contractors

For design and building professionals to impact whether their projects are green, they need to understand the drivers that will influence schools to do more green work.

Architects and contractors recognize the importance schools place on lowering operating costs and energy cost increases to drive their future green work. However, they appear to underestimate the importance of health and well-being, which was only selected by 60% of architects and contractors, as opposed to over 70% of the school respondents.

Architects also underestimate the importance of utility rebates, with only 57% regarding this as highly impactful, and positive publicity, only recognized by 52%.

Obstacles That Reduce the Ability to Engage in Green Building Activity

While the importance of specific triggers for green projects and drivers for accelerating green work at schools varies between the K–12 and higher education sectors, there is great agreement overall on the importance of the obstacles. With just one exception, a similar percentage of K–12 and higher education respondents find the obstacles important.

This suggests that while there are many ways in which to encourage green building on the positive side, focusing on reducing the impact of a few key obstacles could strongly encourage growth in the market.

BUDGET CONSTRAINTS

Budget constraints were selected by the largest percentage of respondents as the factor that has a high impact on reducing green activity. In addition, when asked to select the top factors that are the most impactful, this was the top factor selected by K–12 respondents and the third most important factor selected by higher education respondents.

Budgets of public K–12 schools have been severely impacted by the recent recession, and these impacts can show up, not only in the reduced ability to undertake new projects (see page 8 for more information), but in the ability to have enough staff to track the benefits accrued by green buildings, which creates challenges for justifying further green investments.

HIGHER FIRST COSTS

Higher first costs ranks second in overall selection, but it also ranks second in the ranking of the most important obstacles for higher education respondents and third for K–12. The impact of the perception of higher first costs for green is connected to the high level of concern about budget constraints. Even if green is recognized to bring long-term value, short-term financial concerns exacerbate the impact of a perceived higher initial investment.

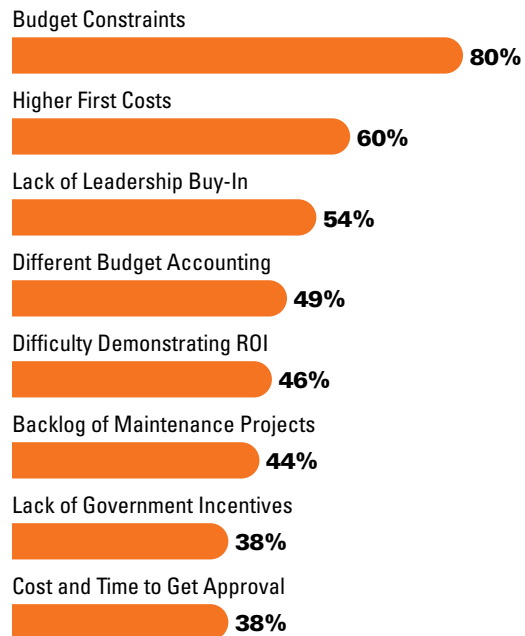
However, studies have shown that green can be achieved at little or no additional cost, especially if the green goals are clearly established before design begins and an integrated design approach is taken.

LACK OF LEADERSHIP BUY-IN

This is the only factor with a notable difference in the percentage of K–12 and higher education respondents who consider it to have a high impact. Sixty-one percent from higher education find this a major concern versus 49% from K–12. This factor ranks first for higher education respondents when they are asked to select the most

Top Factors Reducing Ability to Engage in Green Activities (for K–12 and Higher Education)

Source: McGraw-Hill Construction, 2013



important factors, but it also ranks second among K–12, suggesting that if it is a problem at all, it is usually a serious problem in that sector.

Leadership buy-in is essential for green projects to receive appropriate funding. Gaining buy-in is one reason why the ability to capture all the benefits of green in ROI calculations, rather than just operational savings, is so important to continue to encourage the market.

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Variation Over Time Since 2007

Several shifts have occurred in the importance of obstacles according to CEFPI members in 2007 and in 2012. (Please note that not all the topics covered in the 2012 survey were included in 2007.)

- **Higher first costs:** Although it still tops the list, a lower percentage of respondents find it to have a major impact in 2012 than in 2007. This may be due to greater familiarity with green in the industry along with more availability of green products and practices.
- **Different budget accounting:** It is worth noting that this is a consistent problem for schools that has not changed substantially since 2007.
- **Lack of government incentives:** Concerns about state and federal budgets have reduced the level of incentives available, causing the percentage of those who find this to have an impact to more than double.
- **Cost and time to get approvals:** Greater public awareness of green may have reduced the percentage of those since 2007 who find this obstacle highly impactful.
- **Liability:** While still a major concern for only a small percentage, it is notable that the percentage of those who find liability an important obstacle has more than tripled since 2007.

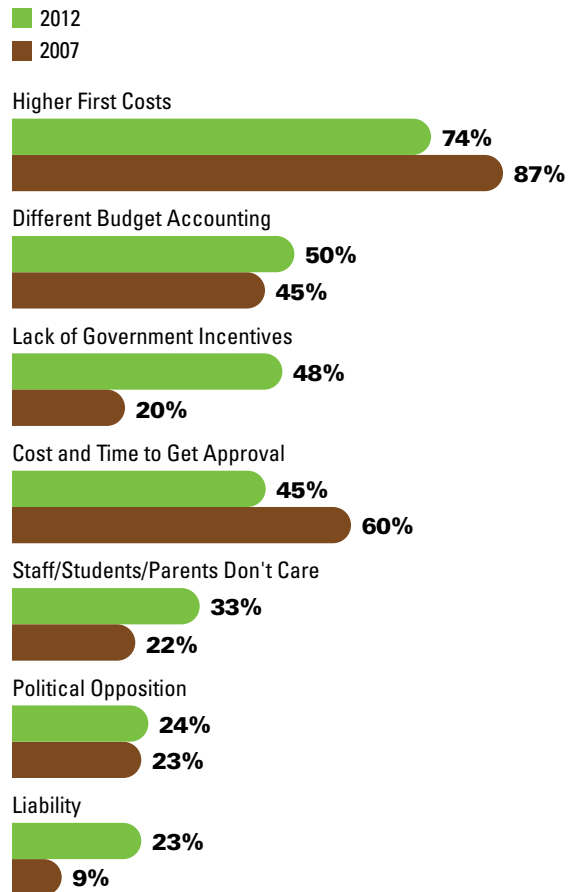
Obstacles According to Architects and Contractors

The top three obstacles considered by the largest percentage of architects and contractors to have a high impact on reducing green work at schools parallels the top three reported by schools, demonstrating a strong familiarity with the challenges faced by their clients. However, a higher percentage of architects and contractors consider many obstacles impactful compared with the schools respondents, in contrast with the triggers and drivers, which were generally cited by a lower percentage of architects and contractors.

One example is the concern about higher first costs, 87% of architects and 75% of contractors are concerned about this factor. Given the emphasis on cost reduction in construction industry projects in general, including the competitive bidding process used for most K-12 schools, this response is not surprising. It corresponds to additional findings where a higher percentage of architects and contractors find financial impediments a concern than the percentage of schools respondents.

Factors with Major Impact on Reducing Green Building Activity in Education (According to CEFPI Members 2007 and 2012)

Source: McGraw-Hill Construction, 2013



■ Difficulty Demonstrating ROI

- Architects: 65%
- Contractors: 64%
- Schools: 46%

■ Lack of Government Incentives

- Architects: 67%
- Contractors: 63%
- Schools: 38%

Key People and Positions that Drive Increased Green School Building Activity

K-12

One-third report that executive management is the most important driver of green for this sector.

Executive management in this sector includes school board presidents and school superintendents. Engaging executive management is necessary to provide adequate funding for new green projects as well as green building operations.

Facilities and sustainability staff are nearly tied with designers/architects/engineers in the percentage who consider them highly influential in driving green work, but that percentage is almost half that of executive management. Once you have executive approval, those with the greatest technical expertise on green would be important to see projects move forward. Interestingly, contractors are only selected as important drivers by 1% in this sector, probably because by the time contractors are involved on many projects, most of the green strategies have already been determined.

Higher Education

Facilities and sustainability staff are considered the most influential on increasing green by the largest percentage in this sector, but they are closely followed by executive management. This suggests that there is more flexibility within the capital and operating budgets at the higher education level to pursue green work than at the K-12 level, since those actively engaged in building work can drive green effectively.

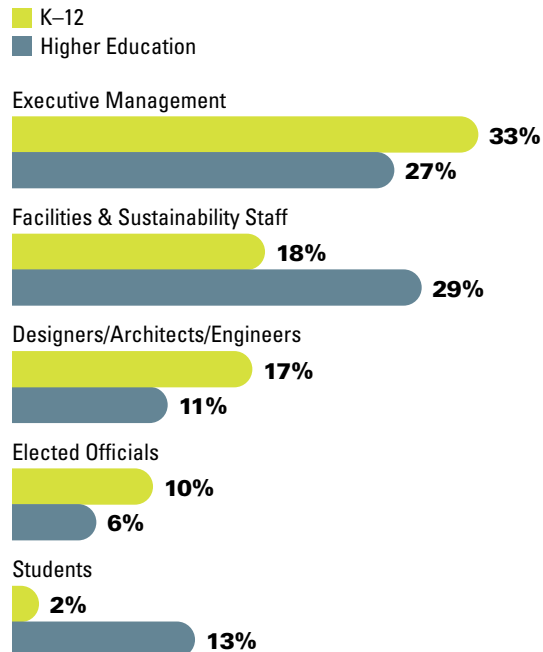
Thirteen percent in this sector also consider students an important driver, even more than those who find designers/architects/engineers influential (11%). Consistently the findings demonstrate that students have great influence on the greening of colleges and universities. High awareness of green issues and strong activism among current students help drive this trend.

Key People/Positions Influencing Increasing Green Work According to Architects and Contractors

Thirty percent of architects consider executive management the most important, aligning them with the K-12 respondents. They also have close rankings between design/architects/engineers and facilities and sustainability staff for the second and third positions, again similar to the K-12 responses.

Top Influencers Driving Increased Green Building

Source: McGraw-Hill Construction, 2013



Thirty-two percent of contractors find that designers/architects/engineers are the most influential. With architects typically setting the green agenda in design, this contractor perspective is not surprising.

The other two groups selected as primary by a large percentage of contractors are executive management (21%) and elected officials (18%).

Students Help Green Their Institutions

A rise in green curricula at the K-12 and higher education level matches growing interest by students in sustainability. Many schools and programs have found ways to harness that engagement to improve their institution.

Earlier this year, 13-year-old Abby Goldberg collected 175,000 signatures to allow bans on plastic bags in Illinois. Another petition, started by 10-year-old Mia Hansen, compelled Jamba Juice to switch to environmentally friendly containers. Fifteen-year old Javier Fernández-Han won the 2012 Invent Your World Challenge scholarship with an algae-powered energy system.

Headline makers are not the only youngsters doing good for the planet. The first Green Apple Day of Service, an initiative of the Center for Green Schools at the U.S. Green Building Council, shows that K-12 students value sustainability as the rule. More than 1,250 service projects to improve schools environmentally—including seminars, cleanup activities and garden plantings—kicked off the initiative in 49 countries in late September.

K-12 Schools

Schools are capitalizing on students' green aspirations in turn, with private schools leading the integration of sustainability and pedagogy. The elite Hotchkiss School and Philips Academy list courses in limnology, environmental ethics, and even a class regarding ecological thinking in Shakespeare; Sidwell Friends School's youngest students study performance data patterns of campus photovoltaic arrays. For all three schools, green curricula are part of comprehensive sustainability

missions that also encompass daily operations, capital improvements, and long-term planning.

According to Collaborative for High Performance Schools Executive Director Bill Orr, the Sacramento, CA based nonprofit helps K-12 public schools bridge from sustainable behavior to operations and capital planning, and it is deploying students in this shift. CHPS's Operations Report Card benchmarks energy efficiency via Energy Star Portfolio Manager and includes assessments in thermal and visual comfort, indoor air quality, water efficiency, acoustics and waste reduction.

"We found it's natural to connect a green curriculum's service learning component to the use of the school facility," Orr says, adding, "Facility maintenance has been drastically cut over the last couple of years, so the report card really gives students a voice in making important decisions." Students need preapproval to conduct a report card assessment, since it requires conducting conditions measurements in classrooms as well as occupant surveys. An algorithm determines a score and green improvements according to the resulting quantitative data and responses. Currently CHPS is piloting a student-teacher guidebook that can more formally incorporate these activities into school curricula.

Higher Education

In higher education, sustainability interests run even deeper. Indeed,

environmental initiatives on college campuses entered the mainstream, by most accounts, 15 years ago. This year, 68 percent of 7,445 college applicants reported to The Princeton Review that "having information about a school's commitment to the environment would influence their decision to apply to or attend the school." Other examples of widespread advocacy of sustainability include the burgeoning of USGBC student chapters, which top 200.

Moreover, investments at the college level reflect the vast support for sustainability. The Association for the Advancement of Sustainability in Higher Education reported the creation of 100 new sustainability majors, minors or certificate programs in 2009, for example, and more than 1,000 campuses have hired sustainability officers to green everything from capital investments to supply chains. Often, dedicated student fees pay for sustainability officers' salaries or high-performing building technologies.

In higher education, community college students have been slower to adopt the cause, although the prospect of green employment, which came to light particularly after adoption of the American Recovery and Reinvestment Act, has propelled catching up. In response, earlier this year USGBC and the Center for Green Schools launched a support program for these learning centers, called Community Green. ■

Title I Schools Green Building Trends

The different responses in the research from respondents from schools receiving Title I funding versus those that do not helps demonstrate the impact of the economic status of a community on its green school building efforts and priorities.

Title I of the Elementary and Secondary Education Act provides federal funding to K–12 schools with economically disadvantaged children. While there are multiple formulas for qualification, for a school to qualify for system-wide use of Title I funds, low-income families must make up 40% of the school enrollment.

Over half of the schools surveyed identified themselves as receiving Title I funding, but a significant percentage were also unsure about their Title I status. There were sufficient respondents, however, to reveal key trends in how Title I schools approach green.

Level of Green Projects

In the last three years, Title I schools have roughly the same level of green projects and retrofits as non-Title I schools, with the percentages of those doing green work and the level of green work being done both at comparable amounts. In fact, these schools report overall higher levels of construction than non-Title I schools, probably because the federal government funding has not been impacted by the recession in the way that state and local funding has been.

This finding is important because it demonstrates that green building, even at the level where over 90% of the projects undertaken are green, takes place in communities across the income spectrum.

However, in the next three years, Title I schools do predict doing

less new green construction than the non-Title I schools. Concerns about federal funding continuing at the same level due to increasing concerns about reducing the federal budget no doubt play a role in this reduction. Green retrofit levels, on the other hand, stay about equivalent between the two types of schools.

Information on the overall findings for these factors is on pages 8–9.

Factors Impacting Green Building

The percentage of respondents who consider the factors motivating them to build green important is largely consistent between Title I and non-Title I schools, but there are a few differences. **Title I schools in general find immediate, practical, measurable concerns like access to financing, obtaining LEED certification and meeting regulations more important to their decision to build green** than non-Title I schools.

However, the Title I school respondents were notably more concerned about four obstacles that prevent them from building green. Two are likely directly related to limited funds from the community: backlog of deferred maintenance projects and lack of government incentives. The other two suggest concerns about the external support for their green building efforts: lack of leadership buy-in and political opposition to green. Leadership at the K–12 level typically includes school boards, which are frequently manned by

members of the community. Support from community stakeholders may be strained due to the perception of limited funds for many school needs.

Information on the overall findings on triggers, drivers and obstacles is on pages 37–42.

Use of Metrics

Title I school respondents report significantly lower use of nine metrics that help determine the impact of green building efforts.

■ Six Building Performance/

Financial Measures:

- Return on investment
- Decreased operating cost
- Life cycle assessment data
- Number of LEED buildings
- Energy use reduction
- Waste diversion

■ Three Student Productivity/Health Measures:

- Average yearly progress
- Student test scores
- Student health metrics, such as asthma incidence

The impact of the lack of measurement can be seen in the responses about operating benefits. For all categories, energy use reduction, annual and 10-year operating costs and impact of operations and maintenance on cost, a much higher percentage of Title I schools stated that they did not know the impact of their green building improvements. This trend also extends into productivity and health benefits.

Information on the overall metrics findings is on pages 26 and 34–36. ■

Data: Prefabrication

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

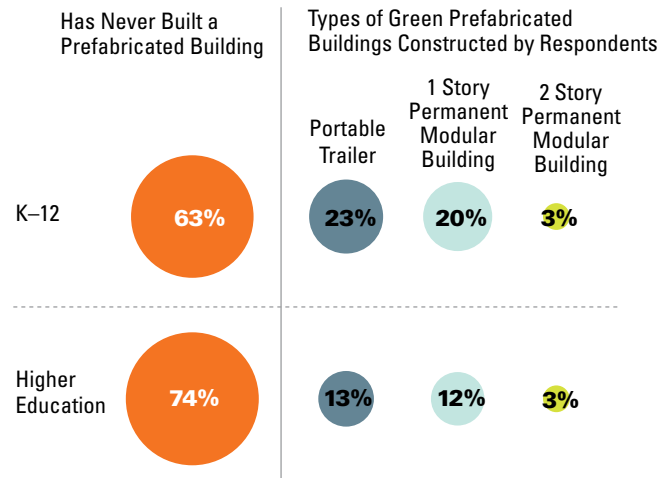
Use of Prefabricated Green Building Solutions

Over one-third of K-12 and one-quarter of higher education respondents have used a prefabricated building solution to achieve their green goals. While previously prefabrication was associated largely with portable trailers in the education sector, the results reveal nearly equal use of one-story permanent modular buildings, indicating the evolution of the perception of prefabrication in this sector. The use of two story buildings is still low, but offers opportunity for growth as the industry continues to develop.

Prefabrication is often associated in the industry with greater productivity and safety, but using a prefabricated approach can contribute to the sustainability of a building. The method of constructing these buildings helps conserve materials and resources, and greater precision in construction can allow for a tighter, more efficient envelope. For more information on how prefabrication contributes to greener buildings, please see the sidebar box below.

Use of Prefabricated Buildings in K-12 and Higher Education

Source: McGraw-Hill Construction, 2013



Prefabrication and Greening Projects

In 2011, McGraw-Hill Construction published the *Prefabrication and Modularization SmartMarket Report*, which provided insight into the use of prefabrication in the construction industry and the benefits users achieved from employing this approach. In addition to exploring benefits traditionally associated with prefabrication, such as productivity gains, cost savings and improved safety, the report also looked at the use of prefabrication for green building.

The report revealed that 88% of the architects, engineers and contractors surveyed have used prefabrication on at least one green project, but the majority of them were using it on 25% or less of the green projects they undertake.

The biggest green benefit reported by users was the elimination of construction

site waste, with 44% reporting decreases of 5% or more. In addition, 62% found that using prefabrication decreases use of construction materials. Nearly one-third (31%) also believe that the use of prefabrication enabled them to select greener materials.

These results demonstrate that prefabrication can help green the construction process, but they also reveal that it is still a project-by-project solution, rather than perceived across the industry as an important tool to achieve green goals.

The report also included a case study on a project in the education sector that demonstrated how the use of prefabricated building components can help make a project greener, the Summit at Queens College Student Residence Hall. The project team reports the following

advantages to using prefabrication to achieve their green goals:

- Waste is reduced to more efficient material use when constructed off site.
- Use of a split tile brick exterior saved 70%–80% in raw material use compared to face brick.
- Tighter envelope is due to the ability to create a better seal on the building in the factory than on the site.
- No need for scaffolding reduced the site impact.

Many of the green benefits experienced on this project would be applicable if the building as a whole was prefabricated, in particular the ability to achieve a tighter, more efficient building and the ability to reduce waste and use of raw materials.

Factors That Encourage Greater Use of Prefabrication

While the ranking of factors that could influence K-12 and higher education respondents to use prefabricated building technology is similar, the percentage who would be influenced by specific factors differs strongly by sector.

However, it is also notable that a high percentage would not be more open to using prefabrication for their green buildings based on any of these factors.

K-12

Roughly one-third of the K-12 respondents would consider using prefabrication if they could see that a prefabricated building is cost effective and high-performing, and they want to see examples of buildings to demonstrate this.

Another factor that is important to this group is speed of delivery. Due to the well-defined school year, education projects are more sensitive than other types of institutional or commercial construction to the impact of schedule delays, a factor true for both K-12 and higher education. Thus, while on most projects, reduced schedule also can have an impact on overall cost, in this sector, it has larger implications for how the schools can service their communities.

Access to financing and design tools are far less compelling reasons for this sector, with the percentage of respondents influenced by them dropping to 11% and 8%, respectively.

Higher Education

In general, higher education respondents are more open to several of these reasons, with a much higher percentage finding five out of seven of the reasons influential in their consideration of prefabrication.

Forty-one percent of higher education respondents would be influenced by the cost and performance of the buildings. Surprisingly, though, fewer seek exposure to examples of prefabricated schools, the only category in which they are in parity with the K-12 respondents at 31%.

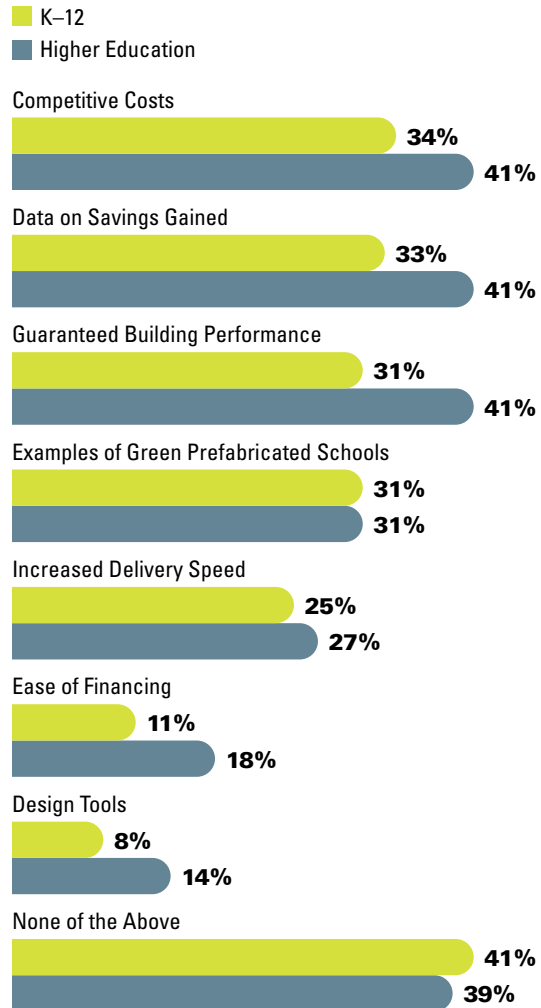
Increased delivery speed only appeals to 2% more higher education respondents than K-12 because they are faced with similar issues to those outlined above. However, ease of financing may appeal more to this sector because of the larger share of private institutions compared with K-12.

Architects and Contractors

Architects largely align with the higher education respondents, with 40% to 45% who would consider

Factors That Would Encourage Greater Use of Prefabrication for Green School Buildings

Source: McGraw-Hill Construction, 2013



prefabrication if it is demonstrated to be competitively priced, if they had sufficient data on cost savings and if the building performance is guaranteed. Forty-six percent also cite the owner requirements as influential.

Fifty-seven percent of contractors would consider prefabrication if the costs were competitive. For contractors, additional costs may impact their profit margin. After owner requirement (39%), they are most influenced by guaranteed building performance (34%) even more than by data on cost savings (29%). They may consider the guarantee of building performance by the prefabricator as reducing their liability on a green project.

Obstacles Preventing Use of Prefabricated Buildings

As with the drivers for using prefabrication, a greater percentage of higher education respondents find many of these obstacles to using prefabrication applicable than the respondents in the K-12 sector. The prefabrication industry will need to address these concerns to see wider adoption of prefabrication as a green solution.

The largest factor for both sectors is the perception that prefabrication results in low-quality buildings.

Given the fact that the broadest use of prefabrication is for portable trailers, it may take a series of examples of buildings that use this construction method and are equal to or surpass traditionally built buildings in quality to persuade schools to consider this approach.

Thirty-two percent of K-12 and 37% of higher education respondents also find the lack of data on prefabricated building performance to be an obstacle preventing their use. If they are to be considered a green strategy, prefabricators must be able to demonstrate that their buildings exceed the performance of those traditionally constructed. This may be challenging given the impact of building operations and occupants on overall performance, but in the higher education sector in particular, comparisons with more traditional buildings on campus may yield the necessary data because of similar occupant profiles and operational approaches.

Almost one-quarter of K-12 respondents and one-third of higher education respondents are also concerned that the architects and contractors may be unfamiliar with prefabrication. Given the influence that architects in particular bear on the selection of green strategies (see page 43 for more information), their lack of familiarity could restrict the use of prefabrication to achieve green goals.

Concerns about higher first costs is the one factor with a higher percentage of K-12 respondents than higher education.

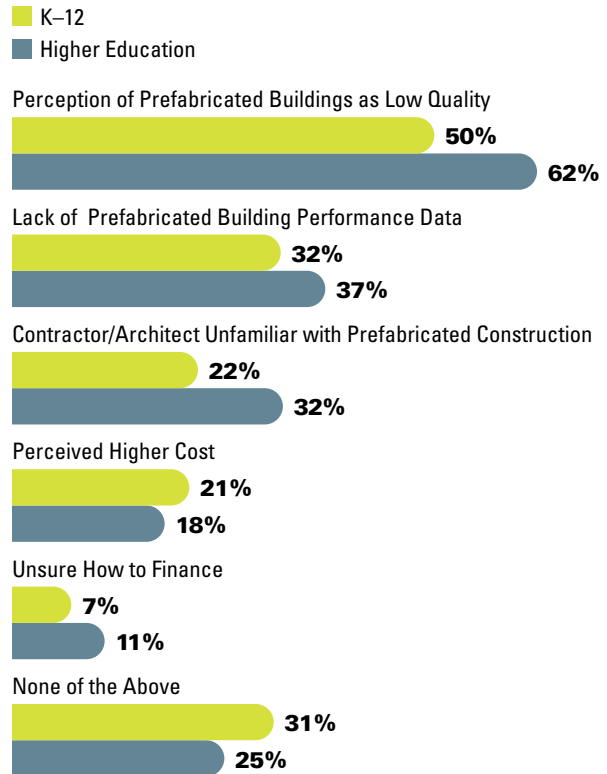
Architects and Contractors

Architects and contractors largely share the concerns that matter most to the schools respondents. **Seventy-four percent of architects and 57% of contractors are concerned about the quality of prefabricated buildings.**

The next highest percentage of architects (44%) is concerned about data on the performance of these buildings, but that is a much smaller concern for contractors (26%) than the owner's lack of familiarity with prefabrication (47%). Thirty-nine percent of architects also cite lack of owner familiarity as a key obstacle.

Obstacles Preventing Use of Prefabrication (According to K-12 and Higher Education Respondents)

Source: McGraw-Hill Construction, 2013



Implementing and Financing Green Initiatives on Campus

University of California

SANTA BARBARA AND SAN FRANCISCO, CALIFORNIA



UCSB boasts a robust green building program that emphasizes energy efficiency as well as a focus on renewable energy to meet its goal of becoming a carbon neutral campus by 2050.

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS

Although the University of California Santa Barbara (UCSB) put its first sustainability plan on paper in 2005, environmental consciousness at the institution dates back to the big oil spill off the coast in 1969, which sparked the formation of UCSB's environmental studies program in 1970. It has not lost momentum since. In 2002, the first Leadership in Energy and Environmental Design (LEED) certification in the University of California system took place on UCSB's campus. In 2004, the university began a requirement that every new facility would be at least LEED Silver Certified.

Since that time the policies have grown to cover several different dimensions of sustainability. UCSB's 2005 sustainability plan covers 11 different focus areas from energy to food to built environment. It institutes a time line for performance targets in each area and makes provisions for a practical structure of achieving them. As a result, the university has developed Change Agent Teams for each focus area consisting of a group of faculty, staff and students working together.

A History of Green Building

Through aggressive energy efficiency measures implemented in the late 1990s, such as de-lamping, HVAC upgrades, lighting retrofits, metering and building commissioning, UCSB has been able to reduce its per square foot electricity use by over 25 percent since 1998. Additionally, in 2002, Bren Hall became the first laboratory building in the U.S. to achieve Platinum-level certification in LEED for New Construction (NC). UCSB was the first UC campus to achieve a LEED for Existing Buildings (EB) certification for Girvets Hall in 2004, and to date, has successfully certified more facilities through LEED EB than any other college or university in the nation, with 12. They are about halfway to their goal, which is 25.

UCSB currently does not have a specified budget for sustainability and GHG emission reduction actions. In addition, due to the current economic state of the UC system, UCSB expects limited funds and expects a continued staff shortage over the next several years. Therefore, the majority of the funds for mitigation projects will likely

come from other sources and/or creative financing/partnerships.

According to Jordan Sager, LEED Manager UCSB Utilities and Energy Services, campus-wide lighting retrofit, commissioning and equipment replacement projects have been funded in large part by debt financing. Sager says, "We were able to get really good incentives for kilowatt hour savings and Therm Savings for projects that we're running. So we've completed about \$21 or \$22 million dollar's worth of projects since the beginning of the program in 2009."

Strong Student Engagement in Sustainability

One of the ways UCSB students are actively involved in the sustainability initiatives at UCSB is through the Green Initiative Fund. The fund works by students electing to impose per quarter fees of about \$2.50 to go toward sustainability projects. Each year there are calls for proposals, and a student majority board selects the proposals to fund on an annual basis. Last year the Green Initiative Fund was able to raise \$184,000. In

CONTINUED

University of California SANTA BARBARA AND SAN FRANCISCO, CALIFORNIA

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS



The UCSF Sandler Neurosciences Building, one of the largest neurosciences complexes in the world, employs a passive cooling system, drawing up air from the first floor up to the fifth and out the roof, through the use of controlled louvers.

2011, a third fund entered the scene called the renewable energy initiative (REI), which proposed imposing a \$6 fee. Despite a 30% tuition hike, the students voted to pass the initiative. The proceeds will be used to achieve zero net energy for the student affairs buildings on campus by designing and building photovoltaic arrays to go on different buildings.

Use of Public Private Partnership to Fund UCSF's Neurosciences Building

During these times of economic and budget uncertainty, University of California San Francisco (UCSF) was able to take advantage of a public/private contract model that has helped support the continued growth of its facilities. Edgemoor Real Estate Services and its partner McCarthy Cook & Co entered into a lease-leaseback agreement with UCSF to develop, finance, design, construct and manage the new Neurosciences Building on UCSF's Mission Bay Campus.

Edgemoor and McCarthy Cook were the co-developers of the

project, Clark Construction was the design builder and Skidmore, Owings & Merrill (SOM), was the architect.

According to Geoffrey Stricker, the managing director at Edgemoor, the project was completed in a significantly faster time frame compared to traditional project delivery. "First, the developers on the project arranged a short-term loan with a bank to fund pre-development design and engineering costs. Doing so saved the project itself at a minimum a year's worth of time, simply by accelerating design. Second, the project was done under a fast track, design-build delivery method, which allowed breaking ground and being able to complete portions of the structure and get the approvals and the building permits issued on a just-in-time basis to match the construction schedule."

When determining the risk factors involved in such a project, Stricker says, "One of the things that we find attractive is identifying all the potential risks, whether they are regulatory risk or political risk or design-related issues, construction



Bren Hall at UC Santa Barbara, is the nation's first building to earn two LEED Platinum certifications—one for LEED NC in 2002 and one for LEED: EBOM in 2009.

related issues or financing issues. And then you identify which party, the public sector or the private sector, is most appropriate to manage and handle that risk. And then that party can price it most cost effectively so that the client, the end user, gets the most cost-effective solution."

Upon completion of the building Edgemoor and McCarthy Cook, become the owners and managers of the building and UCSF enters into a 38-year lease. At the end of that term the building will revert to ownership by the University for a dollar.

The new, state of the art, 235,000 square feet building will be home to the UCSF Department of Neurology and is expected to receive LEED Silver certification. ■

Data: Financing Green Projects

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Financing New and Retrofit Green Projects

The K-12 and higher education sectors both use a wide variety of means to finance their green projects.

K-12

NEW CONSTRUCTION AND MAJOR RENOVATIONS

The largest percentage of K-12 schools use their capital budgets and bond issues to fund their green buildings and major renovations. Both of these can present challenges: projects funded by the capital budget may compete for funds against other school priorities, and projects funded by bond issues are subject to the approval of voters, a challenge in times of high unemployment.

Between one-quarter and one-third are supplementing these sources of financing with state and utility programs, including direct funding, rebates, loans and other tools. These help spur additional green work, but most of these programs need regular renewal.

Financing and gifts from the private sector and the ability to use the savings created by the green project are another option but not frequently used.

RETROFITS

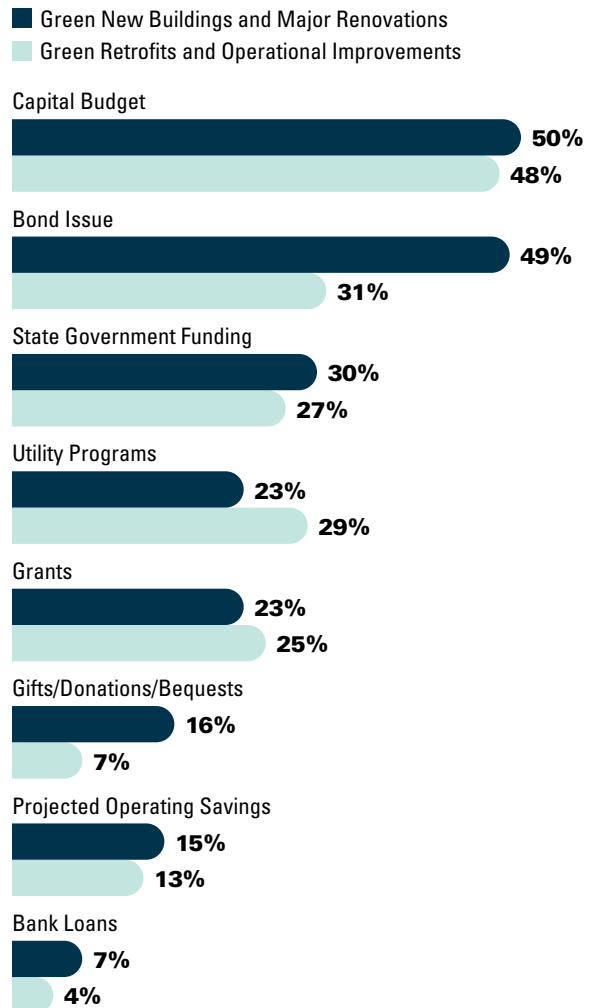
Retrofits follow the same financing pattern as new construction, although the percentage using each strategy are at times different. Capital budgets still fund projects for about half of the respondents, and bonds are still ranked second, although the frequency of using bonds drops to 31%

State and utility funding and grants are used by between 25% and 29%, although utility programs providing funding are slightly higher. Given the focus of utility programs on specific energy-saving products and technologies, as well as the higher percentage of total cost such programs can account for in a retrofit as opposed to a new building, it is not surprising the retrofit amount is slightly higher.

In addition to the shared sources for financing new and retrofit projects, over one-quarter also use their operation budgets (28%) and energy efficiency savings from the retrofit (26%). For more information on how schools use ESCOs to tap those savings, please see page 53 and 54.

K-12 Financing for Green New/Major Renovations Projects and Retrofits/Operational Improvements

Source: McGraw-Hill Construction, 2013



Financing Green Projects

Financing New and Retrofit Green Projects

CONTINUED

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Higher Education

NEW CONSTRUCTION AND MAJOR RENOVATIONS

Like the K–12 sector, capital budgets also provide the most frequently used source of funding for green new construction and major renovations. However, **gifts, donations and behests play a more prominent role in this sector, used by 38%.**

Additional sources of financing for about one-third of the respondents include bonds and state government funding, no doubt primarily at the state universities.

The percentage able to capitalize on projected operating cost savings is also higher in this sector, at 19%.

RETROFITS

The operations budget plays a more significant role in funding retrofits at the higher education level than in K–12 schools, with 48% using this source of funding, exceeding the 46% who use capital budgets. The large number of buildings on college campuses may require a more extensive operations budget, providing more potential for green retrofit funding.

Thirty-six percent use the energy efficiency savings from retrofits for financing. In addition to the use of ESCOs, some schools have instituted revolving green funds that allow the savings from previous energy efficiency projects to finance new ones.

State funding and utilities are also more frequently tapped for financing in this sector than in K–12 retrofits, with 39% using utility programs and 32% drawing on state funding.

Variation by Dedicated Green Staff

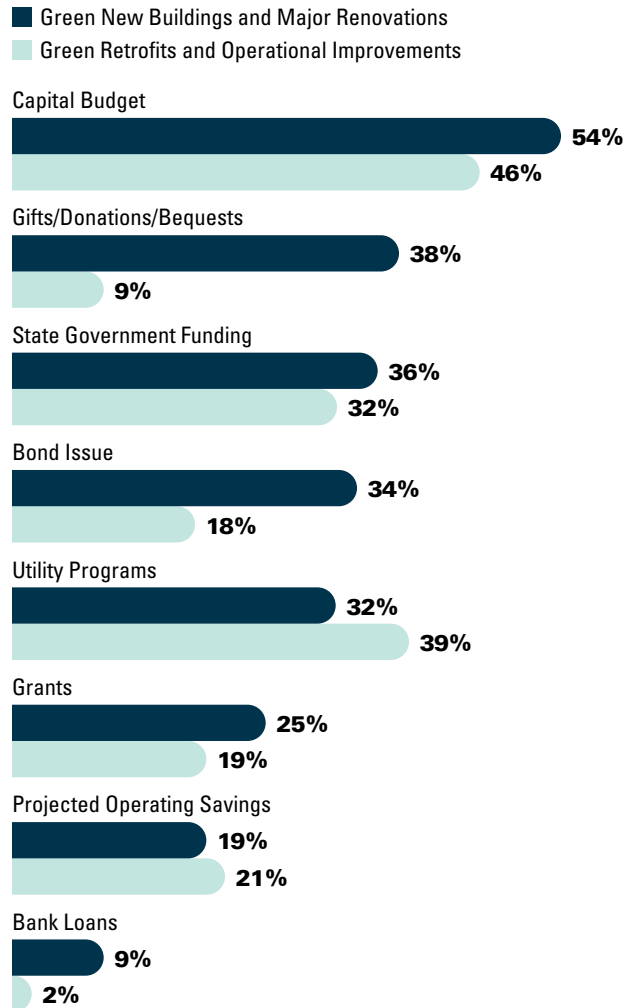
A notably higher percentage of schools with dedicated green staff used their capital budget (56%) and gifts, donations and bequests (29%) to fund their new projects.

The dedicated staff is able to make an even more significant impact on procuring financing for green retrofit projects.

- **Capital budget**
 - Dedicated staff: 51%
 - No dedicated staff: 40%
- **Operations budget**
 - Dedicated staff: 41%
 - No dedicated staff: 28%

Higher Education Financing for Green New and Major Renovations Projects and Retrofits/Operational Improvements

Source: McGraw-Hill Construction, 2013



- **Projected operations savings**
 - Dedicated staff: 21%
 - No dedicated staff: 9%
- **Utility programs**
 - Dedicated staff: 41%
 - No dedicated staff: 19%

Use of ESCos

Energy Service Companies (ESCOs) have been working with schools for decades providing performance contracts, in which the ESCo makes efficiency improvements and is paid by keeping a percentage of utility bill savings. It is not surprising that the number of those who use or have used an ESCo exceeds those who are planning to do so in the next three years. (For more information on ESCos, see page 54.)

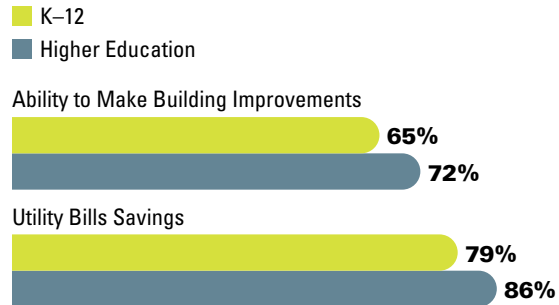
- **Uses or has used an ESCo**
 - K-12: 35%
 - Higher Education: 36%
- **Plans to use an ESCo in the next three years**
 - K-12: 23%
 - Higher education: 32%

Since ESCo contracts typically last at least a decade, much of the projected use in the next three years is not likely to include schools currently using ESCos.

Over three-quarters of the ESCo users report some to significant impact on their utility bills. This is particularly notable because the ESCo typically pockets a percentage of the savings during the contract, and savings seen by the schools indicate a high level of overall energy use reduction.

Impact of Using an ESCo (Some to Significant Impact)

Source: McGraw-Hill Construction, 2013



In addition 65% of K-12 respondents and 72% of higher education respondents who have used ESCos state that the ESCo allowed them to conduct green projects they otherwise would not be able to do. Avoiding having to use their own bonding capacity, and capital and operating budgets for energy efficiency improvements also may free up resources for other green projects.

Incentives and Alternate Financing Previously Used and Expected to Be Used in the Next Three Years

Previous Use

The K-12 and higher education sectors have had a similar pattern of use for incentives and alternative financing. The top utilized for both are utility incentives, employed by 48% of K-12 and 56% of higher education respondents. For the remaining incentives, there is only 1% difference or less in the levels of respondents, with state incentives at 27% and 28% respectively and federal government incentives at 18% in both sectors.

The most popular method of alternative financing is use of cost savings from green efforts, reported by 22% of K-12 and 23% of higher education respondents. All remaining incentives were used by only a small percentage of respondents: public private partnerships (9% and 11% respectively) and lower green project finance rates (4% and 8%)

Future Use

In the K-12 sector, those predicting future use of these methods remain largely the same, with any changes from past use ranging between 1% and 4%. The percentage predicting use of utility and federal government incentives drops slightly, while those predicting use of state incentives, cost savings, public-private partnerships and lower green project finance rates grows slightly.

In higher education, the differentials are also small, but an increased percentage ranging from 2% to 5% expect to use state and federal government incentives, as well as cost savings from green and public-private partnerships. Only the percentage using utility incentives and lower green project finance rates are expected to drop.

The Market for ESCos in K-12 Schools

The ESCo market in K-12 schools has remained steady, even as enabling legislation has been passed across the U.S. However, school budget restrictions and the sustainability movement can help drive adoption.

Despite the ebbs and flows of the overall U.S. economy over the years, energy service companies have seen steady growth in the K-12 schools market. For decades, ESCOs have installed energy-saving system upgrades in schools through a performance contracting delivery method. This procurement tool allows school districts to use future energy savings to fund the upfront costs of these upgrades.

K-12 schools represent the largest market segment for ESCOs, according to a July 2012 report by the Lawrence Berkeley National Laboratory. One-third of all projects are at K-12 schools, more than twice that of the next largest segment, state/local government (15%). Regardless of how the overall U.S. economy is doing, over the years the market has seen “gradual and steady growth,” says Donald Gilligan, president of the National Association of Energy Service Companies.

Gilligan credits the growth pattern to the ongoing adoption of performance contracting by school districts. Because the performance contracting method represents an exception to traditional public bidding laws, states have had to pass enabling legislation to allow for its use. In 2010, Georgia became the last state to allow use of performance contracting.

Still, Gilligan says that having enabling legislation is no guarantee that public entities, including schools, will use performance

contracting. “Even though it’s permissible in every state, a lot of the state laws aren’t very clear,” he says. “If a school board presents a performance contract to a town council that doesn’t know much about performance contracting, it might look at the law and find it ambiguous. That holds up projects.”

Gilligan says NAESCO is working with several states to better clarify those ambiguities.

Viability of ESCOs in a Tough Economy

Beyond legislative ambiguities, getting school districts to embrace use of performance contracting can also be a tricky proposition. Gilligan notes that ESCO projects often take 18 to 24 months to go from negotiation start to construction start. “With the fiscal pressures on school districts today, there are a lot of distractions,” Gilligan adds. “If you’re faced with laying off 100 teachers, the ESCO [negotiation] often falls off the table. That’s a big issue.”

Conversely, those financial pressures could lead to more work, says Chuck McGinnis, U.S. director of U.S. Energy Solutions at Johnson Controls. Given the budget shortfalls in many school districts, McGinnis says he sees ESCOs as an increasingly attractive proposition.

“The performance contracting value proposition plays well with those school districts that have a lack of viable options,” he says. “If you can pass a referendum and build

new schools, that’s great. But a lot of the demand for these solutions is because [districts] can’t build new schools and have to continuously work within the footprint they have. I’m working with a school district that has tried to get a referendum passed for new middle schools on three different occasions over the last six years. The last one asked for over \$80 million. That doesn’t go over well in this economy.”

ESCOs and the Sustainability Movement

The larger sustainability movement could also have an impact on adoption of performance contracting for energy upgrades. McGinnis says that as more communities embrace sustainability, he sees a greater interest in not only improving energy efficiency in schools, but also building it into the curriculum. Many schools use dashboards that enable students to monitor a building’s energy use, creating a learning opportunity.

“Schools reflect the conscience of the community,” he says. “They want to instill the values of sustainability in children, so they begin to build that into the educational curriculum. They can lead by example with the types of energy efficient systems installed in buildings. Putting solar panels on a building doesn’t just represent a good value for the school district, it’s also an opportunity for a demonstration class. That’s a growing movement that we see taking hold.” ■

Data: Green Certification Programs

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Use of Green Certification Programs

K-12

Nearly the same percentage of K-12 respondents include Energy Star and LEED for Schools in their guidelines, but a much higher percentage have achieved an Energy Star label compared with those who have earned LEED certification.

Since Energy Star is focused solely on improving energy performance, it requires less overall investment and less time. Also, since operating costs savings are the main factor calculated when determining the return on investment of green buildings, focusing more on energy savings than an overall green approach can seem to bring a high return. However, the benefits associated with other green elements, including impacts on health and well-being, are a key priority in the K-12 segment.

A critical area of growth in this sector is in LEED for Existing Buildings. With schools reporting less work planned overall (see page 8), LEED for Existing Buildings allows the opportunity to improve building performance with potentially little or no capital investment.

CHPS is also an important program for schools, but more schools are mandating self-verification (20%) than a third-party verified approach (11%). Ten percent have currently achieved self verification, but only 4% have achieved third-party verification under this system.

Higher Education

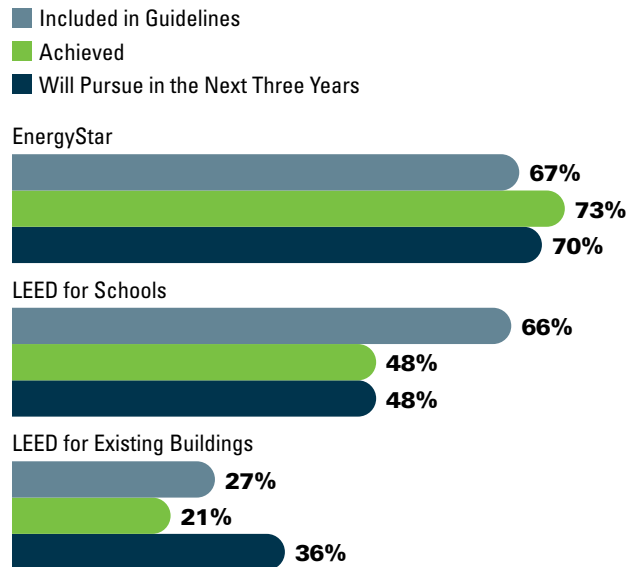
Three-quarters report requiring LEED for New Construction in their guidelines, but 88% have achieved this certification, demonstrating the extensive penetration of LEED into this sector. LEED for Existing Buildings is also popular, but unlike in K-12, expected future use (56%) roughly matches the percentage who currently require it in their guidelines (59%).

Fourteen percent of the higher education respondents report guidelines at their institution for CHPS certification as well, both self-verified and third-party verified. The same percentage (14%) have LEED for Schools in their guidelines, but 18% have achieved the LEED certification, compared with 3% in the CHPS verified program and 7% in LEED self-verified.

Twelve percent have included both AIA 2030 and the Living Building Challenge in their guidelines as well. Stringent requirements keep the levels that have achieved it at 3% and 4%, respectively, for now, but 13% expect to pursue AIA 2030 and 14% the Living Building Challenge in the next three years.

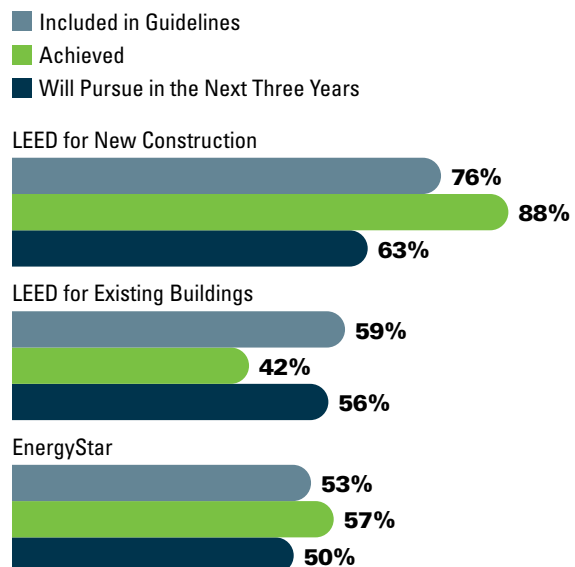
Type of Green Certification in Guidelines, Achieved and Pursued (According to K-12 Respondents)

Source: McGraw-Hill Construction, 2013



Type of Green Certification In Guidelines, Achieved and Pursued (According to Higher Education Respondents)

Source: McGraw-Hill Construction, 2013



Level of LEED Certification in School Guidelines and Percentage of Projects Exceeding Guidelines

Levels of LEED in School Guidelines

Approximately one-quarter of the respondents from K-12 (26%) and higher education (25%) report that their schools list LEED Gold as the level to be achieved in their guidelines.

Most of the remaining K-12 respondents with LEED guidelines are split evenly at 36% between requiring buildings achieve the Certified and Silver levels, while the majority of higher education respondents (59%) have the Silver level in their guidelines, with only 10% requiring Certified. This is consistent with other findings in this research that demonstrate that higher education institutions have a more intensive approach to green than K-12.

Schools That Have Exceeded the Level of LEED in the Guidelines

Over half of K-12 and three-quarters of higher education respondents exceed the level of LEED listed in their guidelines. Including LEED in school guidelines encourages project teams to consider their green strategies early in design, which helps foster a more comprehensive green approach. The finding also suggests the commitment in the schools' design, construction and operations staff to achieving green, rather than just the guidelines determined by the institution.

K-12

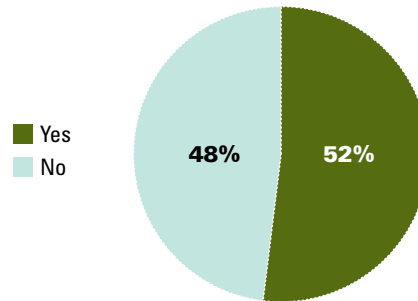
More than twice the percentage (58%) achieve LEED Gold when they exceed the guidelines than LEED Silver (27%). With about one-third of K-12 schools mandating a Certified level and one third mandating Silver, the drive to achieve LEED Gold suggests that schools are not just looking for enough points to push their projects to the next higher level, but are committed to achieving high-performing green schools. Twenty-four percent of K-12 schools with dedicated green staff achieved LEED Platinum when they exceeded guidelines, compared with none without dedicated staff.

HIGHER EDUCATION

Nearly one-quarter (24%) of the higher education respondents who exceed their guidelines achieve Platinum certification. Overall, though, the levels of LEED achieved when they exceed their LEED guidelines correspond to the next level up more closely than in the K-12 sector. This is probably due to the high level of LEED in their guidelines, making it harder to leapfrog to greater achievement. Seventy-nine percent of higher education schools with dedicated green staff have projects

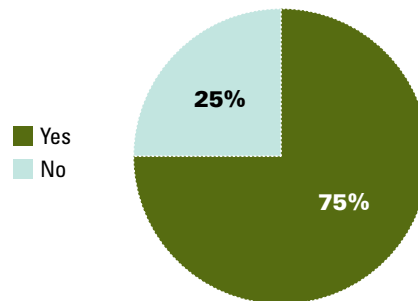
K-12 Respondents Who Have Exceeded LEED Guidelines

Source: McGraw-Hill Construction, 2013



Higher Education Respondents Who Have Exceeded LEED Guidelines

Source: McGraw-Hill Construction, 2013



that exceed the level of LEED in their school guidelines, compared with 56% of those with none.

Impact of Architects and Contractors on Helping School Clients Achieve Higher Levels of LEED Certification

Forty-one percent of architects state that they have a high to very high impact on the ability of their education clients to exceed their guidelines for LEED certification. This corresponds with the high level of influence attributed to architects on increasing green work at schools (see page 43).

Seventeen percent of contractors feel that they have the same influence. While lower than the percentage of architects, it is greater than the influence attributed to contractors on the decision to pursue green projects. Contractors have greater influence on the achievement of a higher LEED certification level because of the importance of the construction phase to earning LEED points.

Budget Challenges Impact School Certifications

Tight finances have altered the schools market, putting more emphasis on renovations and retrofits, and creating greater pressure for schools to demonstrate the effectiveness of their green improvements. Still, despite these pressures, schools remain committed to greening their facilities.

Schools have embraced certification for many reasons, including the rigor they bring to the green process. The response in the education sector to the next, fourth version of LEED is one example. Despite the potential that the new materials policy could increase project cost, Rachel Gutter, director of the Center for Green Schools at the U.S. Green Building Council, affirms, “In a lot of cases schools are the champions for holding on to these commitments because they can demonstrate that it’s creating improved learning environments.”

Focus Shifts to Renovations/Retrofits

While schools may adhere to LEED v4 more loyally than other building types, there are fewer projects applying for certification through the program. “In a handful of instances, when schools are looking to cut corners, LEED is one of the things that come up on the chopping block,” Gutter says.

Collaborative for High Performance Schools executive director Bill Orr concurs that schools are cutting third-party certification in order to meet their budgets. Yet he also advises looking at the substance of these cuts. In many cases schools are changing their relationship to LEED or CHPS because budget cuts are preventing many capital improvements from taking place. “There is an increased emphasis on

modernizations of existing schools,” Orr says, “and one of the reasons for that is schools are making different choices than they made even five years ago—improving their existing stock simply as a matter of cost cutting and meeting local need, or because their bonds have run out.”

In some places where bond measures have passed, diminished local property values prevent a school district from selling those guarantees to make improvements. CHPS is responding to the economic climate by convening a subcommittee that is making the organization’s sustainability criteria more responsive to modernizations, such as with the inclusion of green master plans.

In addition, the market for services has improved. “The smaller projects that are happening are going deeper with green improvements, because bids are coming in so much lower from architects and contractors,” Gutter reports, noting that most upgrades involve finishes and renewables. She cites recent successes in Ohio, where tobacco securitization funds were allocated before supply of labor outstripped demand. And despite recent setbacks at the federal level for LEED v4 implementation, as of July USGBC tracked 28 pieces of green schools-related legislation signed into law at the state level.

In this more localized sphere, more good news could be on the horizon—if voters pull the right lever. “There are quite a few bonds on the ballot, and we could start to see more

authorizations for renovations and some local and regional construction,” Orr says.

Alternate Funding

Schools’ current focus on upgrades is accompanied by several other trends. Creativity is being applied to funding, with implementation of revolving funds and similar mechanisms becoming more widespread in the absence of bond revenue. USGBC’s Green Apple Schools initiative is facilitating private-sector philanthropy to schools while avoiding the pitfalls of direct sponsorship.

Measuring Results

School districts and state agencies also are making sure that preexisting investments have actually yielded returns. The 2009 “Massachusetts Green Schools Post-Occupancy Study of Energy Efficiency” and last year’s State of Washington report “High Performance Public Buildings: Impact on Energy Use is Mixed” both demonstrate this commitment.

Although the metrics have focused more on energy performance than student productivity, here and elsewhere school officials are learning that operations and occupant behavior are not yet bringing power consumption down to the level of predictive forecasts. However, these measurements can improve energy savings estimates in the future and help target areas for improved performance. ■

A Multipronged Approach to Achieving Sustainability

Arizona State University
TEMPE, ARIZONA

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS

In 2007, Arizona State University (ASU) signed on to the American College & University Presidents' Climate Commitment (ACUPCC) and committed to becoming carbon neutral for emissions from buildings and grounds by 2025, and for transportation by 2035. This led the university to complete a Carbon Neutrality Action Plan in 2010, and then publish a Strategic Plan for Sustainability Practices and Operations.

The key focus areas of ASU's sustainability plan include Carbon Neutrality, which deals with all things energy and transportation; Zero Waste, which is focused right now on ASU's solid waste disposal and water waste; Active Engagement, which focuses on ways to engage a community of 80,000 to 85,000 students, faculty and staff; and Principle

to Practice, which looks at integrating sustainability practices into campus operations and functions.

A Unique Planning and Implementation Approach

The University Sustainability Practices Office housed in the Global Institute of Sustainability is responsible for guiding university-wide sustainability efforts, monitoring progress and coordinating implementation of its strategic plan. However, ASU has taken a unique approach to encourage sustainability practices in all operational areas. They have established the Sustainability Practices Network (SPN), which is organized as a collection of specialized working groups designed to engage a significant cross-section

of the university community in the planning and implementation phases of this plan. According to Ray Jensen, university sustainability operations officer, "If we were going to get to a place of carbon neutrality and build a more comprehensive sustainability program for the university, we had to ask, what would it take in your area?" The eight working groups of the SPN are Facilities Operations, Energy, Building Design and Planning, Solid Waste, Transportation, Procurement, Campus Living/Dining/Activities and Information Technology.

According to Jensen, "One of the things that makes us unique is that we're aggressive. We have made sustainability a pan-university program and a university value that I think makes a difference." Jensen says, "The second thing that makes us different, is this Sustainability Practices Network that we've developed in order to really, from an operations side, make this an institutional initiative and not just a single departmental initiative."

Key Focus on Green Buildings and Renewable Energy

A strong focus on green building design and construction and green improvements to its existing buildings demonstrates ASU's dedication to incorporating many sustainable principles into the built environment, such as water and energy conservation, and the reduction of landfill waste and greenhouse gas emissions. There are currently 36 LEED certified green buildings, which total about 13% of ASU's building space across the four campuses. Nine more buildings are awaiting certification. According to Jensen, "ASU has the



Arizona State University's newly opened LEED Gold certified Interdisciplinary Science and Technology IV (ISTB 4) research building is the single largest research building at ASU, with 298,000 square feet of premier high-technology research laboratories and office space.

Image courtesy of HDR Architecture, Inc.
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CONTINUED

Arizona State University TEMPE, ARIZONA

largest number of LEED certified buildings in Arizona and second highest in the nation, after Harvard.”

In addition to requiring LEED Silver certification or better, ASU’s Sustainable Design Policy is used as a basis for all construction and major renovation. Specific energy performance and water conservation requirements combine to assure that the highest standard is used on design and construction of ASU projects. The BioDesign Institute Building B, completed in 2010, was Arizona’s first LEED Platinum building.

Financing through Energy Savings Performance Contracts

Through ASU’s facilities management group, over \$70 million has been invested in energy savings performance contracts, which have significantly upgraded building and central plant infrastructure through new metering, controls and turbines. Jensen notes, “Over the period of seven or eight years, we’ve increased our physical plants by over 20% to 25%. And we’ve also, in that period of time, actually had a reduction of greenhouse gas emissions of about 20% to 25%. So even in the midst of growth, we continue to reduce from our baseline the amount of emissions.”

In addition, the university has a revolving fund that was set up two years ago and is being used for smaller green building projects, averaging about \$200,000 to \$300,000 a project.

ASU has benefited also from innovative power purchase agreements and marketing of renewable energy credits. Over 15.3 MW of solar photovoltaic panels have been installed on

ASU’s four campuses. A total of 17.2 MW will be installed by the end of 2012, and 20 MW are expected to be installed by 2014.

Academic Tradition of Sustainability

Arizona State University has a rich history when it comes to environmental studies and research. This focus has served as the foundation for the establishment of the Global Institute of Sustainability in 2004 and the nation’s first School of Sustainability in 2007. The Global Institute of Sustainability is the hub of Arizona State University’s sustainability initiatives and its School of Sustainability, the first of its kind in the U.S., offers transdisciplinary degree programs focused on finding practical solutions to environmental, economic and social challenges.

Since 2010, all students at ASU have had the opportunity to enroll in a minor in sustainability. The minor consists of an introductory course on sustainability principles, two lower division courses that focus on key sustainability knowledge, a 300-level course that integrates sustainability knowledge and principles, and two upper division electives relevant to the student’s major.

Jensen says, “We’ve tried to integrate sustainability throughout the curriculum so that in virtually every college, every school, there are program offerings in sustainability as it relates to that particular discipline.” Examples of sustainability education across the university include a Bachelor of Arts in Business degree with a concentration in sustainability at W. P. Carey School of Business, Sustainable Engineering degrees at the Fulton School of Engineering,

Project Facts and Figures

LEED Certified Buildings
35 LEED NC; 1 LEED CI

Percentage of LEED Space
14% of building space

Levels of LEED Certification
1 Platinum; 22 Gold; 12 Silver; 1 Certified

Energy Use
16% reduction (2008-2012)

Gross GHG Emissions
13.5% reduction (2007 - 2010)

GHG Emissions/FTE Student
20% reduction (2007 - 2010)

Volume of Landfill Material
52% reduction

Student Enrollment
11% increase (2007 - 2010)

an Interdisciplinary Studies degree with a concentration on Sustainable Tourism and a Bachelors of Science degree in Environmental Technology Management. “Our students who graduate with degrees in business or engineering are going to be able to walk into organizations, hopefully, and bring a view toward how they can operate within that industry or business more sustainably.”

Jensen has strong advice for other colleges interested in implementing a sustainability program on campus. “I think one of the most significant things about ASU’s program is the leadership we have from the top. If your chief executive officer or your chief business officer is not 100% supportive in getting out in front of something like this, it may happen, but it’s extremely difficult. If you’re going to try to lead, the leadership really has to come from the top.” ■

Data: Green Building Products and Practices

Most Important Green Building Practices

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

A higher percentage of higher education respondents consider all of the green building practices important or very important than K-12, architect and contractor respondents. This supports other findings in this study that suggest that there is a high level of commitment to green overall in the higher education sector.

These findings also confirm the importance of indoor environmental quality in education construction. The highest percentage of K-12 respondents consider indoor environmental quality the most important practice. In addition, even though practices involving energy and atmosphere are considered important/very important by the highest percentage of higher education and architect/contractor respondents, environmental quality is a close second for both of these groups as well. Architects and contractors were asked to consider these practices specifically for school construction, and the percentage who consider this category important is much higher than seen in other McGraw-Hill construction research on green.

Variation by Achievement of LEED Certification

Schools that achieve LEED certification rate the importance of all five green practices higher than those that have not. In a couple of cases, the differential exceeds 10%.

■ Energy and Atmosphere (Higher Education)

- Achieved LEED: 96%
- Has not achieved LEED: 83%

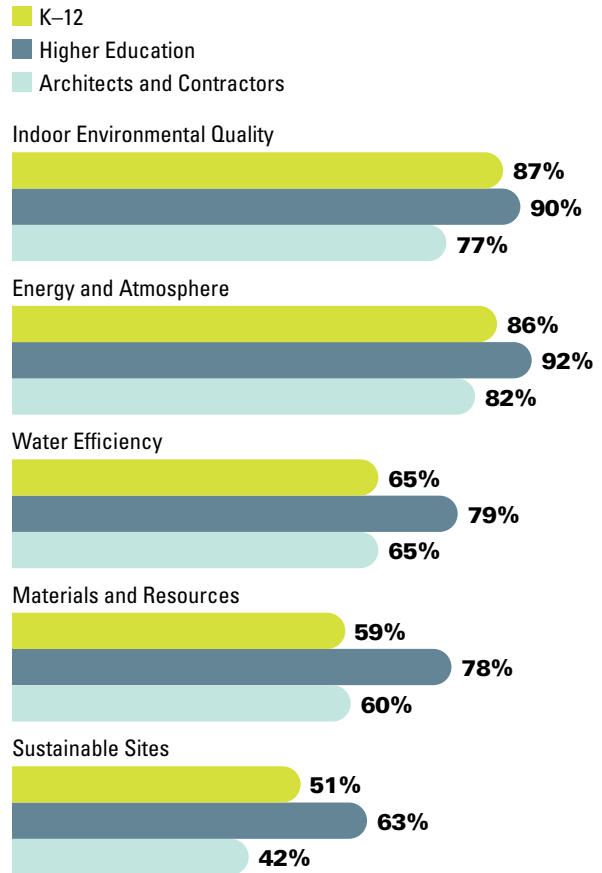
■ Sustainable Sites (K-12)

- Achieved LEED: 59%
- Has not achieved LEED: 47%

It is difficult to determine whether schools that are more engaged with green practices are more likely to pursue LEED certification or whether the pursuit of LEED increases awareness of the importance of specific green features. The differentials are likely a combination of both factors.

Green Building Practices Considered Important/Very Important

Source: McGraw-Hill Construction, 2013



Use of Green Products/Practices on Education Projects

Top Products/Practices That Impact Energy

In the next three years, the highest percentage of higher education respondents and second highest percentage of K-12 will use energy efficient lighting on their green projects. The high rate of return for lighting installation has made it consistently one of the products most frequently used for green projects, a conclusion supported by other McGraw-Hill Construction studies of this and other sectors, most recently in *A Path to Achieving Higher Building Performance* (available at analyticssstore.construction.com).

Many other products that save energy also will be widely used, including occupancy sensors, lighting controls and properly sized HVAC. The strong use of building automation systems and on-site renewable energy, which require larger investments, demonstrates their commitment to energy savings.

Products/Practices That Impact Indoor Environmental Quality

Despite the greater emphasis on health and well-being and indoor environmental quality (IEQ) in the K-12 sector compared with higher education suggested in the findings, the percentage of higher education respondents planning to use the following products that impact IEQ is higher than the percentage of K-12 respondents:

- Non-Toxic Materials: 64% in higher education versus 55% in K-12
- Air Filtration Beyond Standard Practice: 44% in higher education versus 38% in K-12

This may be due to higher levels of LEED certification in higher education (see page 55 for more information). However, the differential is less than in the last three years, suggesting that the concern over health and well-being in K-12 is impacting product choice.

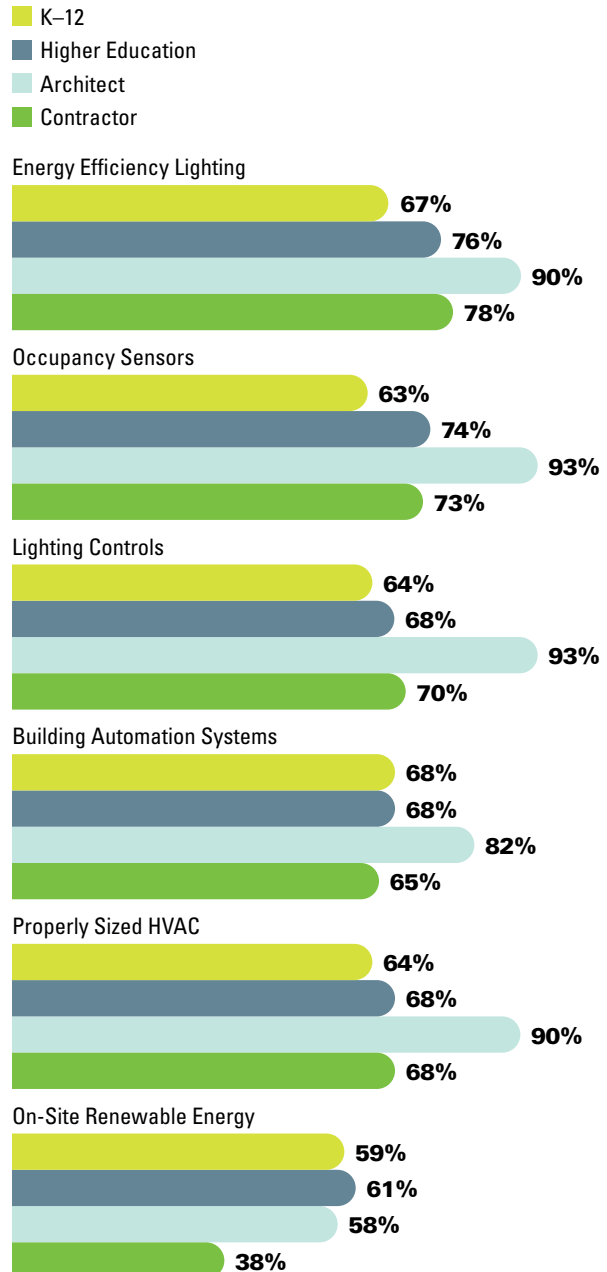
Other Green Products/Practices

An interesting pattern emerges among many of the remaining green products and practices. Those that have been in wide use (by 60% of respondents or more) typically will remain at a high level, although use drops a little due to high market penetration. This includes water-efficient fixtures, daylighting and cool roofs.

On the other hand, products used by less than half of the respondents in the last three years are expected to grow. For K-12, highest growth is expected in green roofs

Top Green Products and Practices that Impact Energy Use in the Next Three Years

Source: McGraw-Hill Construction, 2013



and prefabricated components. In higher education, highest growth is expected in school gardens and rainwater collection. Architects and contractors report increases in all four of these products/practices.

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Use of Green Products and Practices in Green Retrofits and Operational Improvements

Products/Practices That Impact Energy Use

Use of the green products and practices in retrofits and operational improvements that impact building energy use is widely extensive and roughly equivalent in the K-12 and higher education sectors for nearly all products/practices surveyed. Top products and systems include building automation systems, occupancy sensors and energy-efficient heating and cooling, all of which were used by over three-quarters of the respondents.

There were, however, a few products with differences in use in the two sectors that exceed 5%.

LED LIGHTS

Eight percent more higher education respondents use LEDs than those in K-12. This may be due to stricter budget restrictions, especially in the last two years, in the K-12 sector. While LEDs are proven to last longer and use far less energy than both traditional incandescent and fluorescent lights, they do require a greater upfront investment.

LIGHTING CONTROLS

Eight percent more higher education respondents also use lighting controls than those in K-12. This may have to do with the wider variety of spaces on higher education campuses than just classrooms. Lighting controls may be more applicable in dormitories and other spaces not commonly found at the K-12 level.

Products/Practices That Impact Indoor Environmental Quality

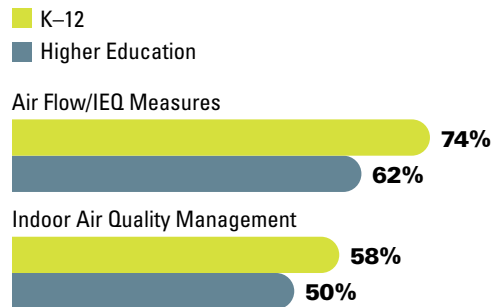
In contrast to the products used in green projects, green products/practices that improve indoor environmental quality (IEQ) are used by a higher percentage of K-12 respondents than those in higher education for their green retrofits and operational improvements. However, the high use of these two products/practices in both sectors clearly demonstrates the investment made by schools in improving IEQ, which is supported throughout this study.

Other Green Products/Practices

The top product/practice in this group is green cleaning, equally used in both education sectors by 85% of respondents. One element of green cleaning is the use of non-toxic chemicals, another factor that helps improve IEQ.

Green Features and Practices that Impact IEQ Expected to Be Employed in the Next Three Years in Operations and Management of School Buildings

Source: McGraw-Hill Construction, 2013



In higher education, three additional practices are used nearly as widely as green cleaning by 82% of respondents: recycling and/or composting, scheduled preventative maintenance and commissioning. While these are also the next most widely used practices in K-12 as well, they are not selected by as many respondents as in higher education, and there is a range in the level of use among them as well. While recycling is still quite common in K-12, the other practices involve more upfront investment, which may be why they see lower levels of adoption at the K-12 level.

A greater percentage of higher education respondents report using other products/practices for their green retrofits/operational improvements than K-12 as well, including metering and submetering, occupant education on green features and environmentally preferable purchasing. This is particularly striking with the use of metering and submetering, although in this case, the higher use may be due to a greater need to get different buildings on the same campus on their own meters, a factor that is less of a problem for K-12 schools. It would be interesting to see if the submetering differential is the same as the overall category.

In general, though, the wider use of green products and practices for retrofits and operational improvements by higher education respondents corresponds to the higher use in this sector of many products and practices in new building projects. It suggests that the larger level of green work conducted in higher education (see page 8) is not just confined to the number of projects but also to the degree of green on individual projects they are able to achieve.

Data: Climate Leadership

in Higher Education

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS DATA

Climate Leadership in Higher Education

For five years, college and university presidents have committed to provide leadership in the area of climate change by becoming signatories to the American College & University Presidents' Climate Commitment (ACUPCC). Data shared with McGraw-Hill Construction by Second Nature demonstrates the broad range of strategies they are adopting to impact climate change.

Achieving Climate Neutrality

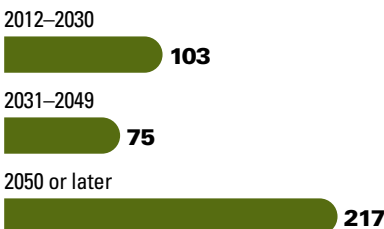
All signatories agree to develop a Climate Action Plan to help them achieve climate neutrality. To be climate neutral is to have no climate impact, usually through a broad range of strategies from increased building efficiency to offsets to use of renewable energy sources.

As of November 2012, 395 signatories have committed to a specific date by which to have their campuses achieve climate neutrality. 103 of them plan to achieve climate neutrality between 2012 and 2030. However, many see this as a long-term process, with the majority predicting that they will be climate neutral after 2050. Still by 2050, 178 schools plan to be climate neutral.

In their report on the progress of the ACUPCC published in May 2012, *Celebrating Five Years of Climate Leadership*, Second Nature explains that the network of signatories is

ACUPCC Signatories Committed to Achieving Climate Neutrality by a Specific Date

Source: McGraw-Hill Construction, 2013



“projected to reach a reduction of over 50% of its gross emissions in the next fifteen years, and will have reduced 93% of the baseline emissions by 2050.”

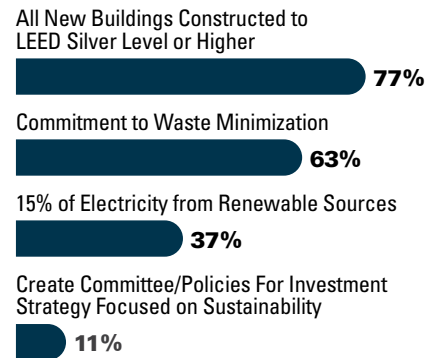
The influence of those schools will likely extend beyond their own climate impact as higher education institutions with these commitments see themselves as a model for others to follow, from their peers within the education sector to other institutional and commercial building sectors. In particular, as more private corporations create their own sustainability agendas, the example of these institutions will provide insights into approaches with the best returns.

One interesting finding emerges when comparing the commitment to climate neutrality by institutions offering associate degrees (such as community colleges), baccalaureate degrees and schools that offer advanced degrees (masters and above). Colleges offering baccalaureate degrees are the most committed to achieving climate neutrality quickly, with 33% targeting between 2012 and 2030, compared with 18% for other schools.

According to Stephen Muzzy, senior associate at Second Nature, “Baccalaureate colleges are able to select more aggressive climate neutrality dates because they have more internal expertise (energy managers, planners, architects) that allow them to assess, benchmark and plan better.” Muzzy says, “Their

Signatories Committed to Tangible Actions to Reduce Emissions

Source: McGraw-Hill Construction, 2013



operational scale is also more conducive to meeting the goal because they don't have energy intensive research buildings.”

Further research is required to see what makes these schools able to propose such aggressive targets for climate neutrality and how other types of schools can benefit from their example.

Tangible Actions to Achieve Reduced Emissions

The initial implementation profile for the signatories includes several tangible actions they can do to help support the goal of climate leadership. At least two directly impact the built environment in these institutions.

■ **77% have all new buildings constructed to LEED Silver level or higher.** The data findings in this

report also show that many schools pursue this strategy (see page 56 for more information). Eighty-four percent of schools that offer associate degrees have committed to this approach, 7% more than the overall average.

- **37% agree that within a year, 15% of their electricity will come from renewable sources.** In addition to production of energy directly from renewables on campus, schools can also achieve this commitment through the purchase of renewable energy credits (RECs).

Another action that may impact their green building strategies is a commitment to waste minimization, a popular one adopted by 63% of the signatories. Given the high level of student engagement with green at the university level (see page 44 for more information), waste minimization is appealing because it offers direct opportunities to engage students in the process of greening their schools and typically provides

tangible evidence to the student body of green efforts.

On the other hand, only 11% agree to have a committee or policies that determine an investment strategy for their endowment that takes the sustainable actions of companies they invest in into account. This strategy, although still adopted only by a few of the signatories, could have a strong impact on sustainability in many other commercial and industrial sectors in the U.S. and globally, with the largest institutions controlling substantial investments.

Use of On-Campus Renewable Energy

One-hundred thirty-six institutions report generating power from solar installations, with the total output of over 52 million kWhs. Therefore, just this one form of renewable energy at these campuses is generating the equivalent of enough power for 5,554 homes in one year.¹

The remaining forms of renewable energy, used by 67 to 79 institutions, include wind, geothermal, fuel cells and biomass. The diversity of sources used to generate renewable energy suggests that the signatories can not only reduce their own emissions through these means but provide powerful data on the performance and viability of renewable energy strategies, encouraging broader adoption of these technologies in other sectors.

RECs Purchased

After a slight drop-off between 2007 and 2009, there has been a significant increase in the average amount of RECs purchased by the ACUPCC signatories between 2009 and 2011.

The average percentage of electricity mitigated by the RECs has risen accordingly, from 6% in 2009 to 12% in 2011, and the total emissions saved has increased by an average of over 1,700 metric tons of CO₂ equivalent (MTCO₂) across that time frame as well, to just under 2,500 MTCO₂. This is the equivalent of the annual greenhouse gas emissions for 472 passenger vehicles.²

Energy Efficiency Projects

Since they have signed on to the ACUPCC, signatories have reported completing an average of 23 energy efficiency projects. Not surprisingly, the schools that are typically the largest, those that offer advanced degrees, also have the largest average of energy efficiency projects (29) and the schools that offer associate degrees have the smallest average of projects (15). Still, for all three kinds of schools, these results demonstrate that the signatories are doing frequent projects across campus to address energy efficiency.

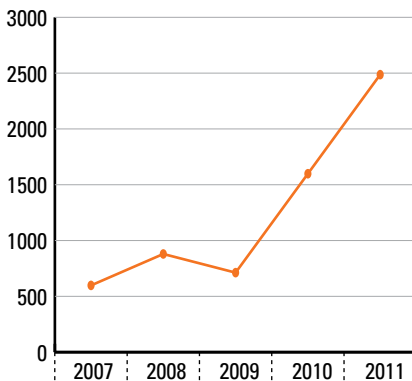
Climate Action Plan Saves Money

In addition to initial commitment, ACUPCC signatories must submit progress reports on how they are progressing on their climate goals and commitments. One question asked of them is whether their climate action plan saves them money.

This is a particularly interesting question because of the multiple ways that institutions can reduce their emissions. Some, like energy efficiency improvements to their buildings, are well documented to provide savings in a relatively short

Average Annual Emissions Reductions Due to REC Purchases (in MTCO_{2e})

Source: McGraw-Hill Construction, 2013



1- U.S. Environmental Protection Agency Green Power Equivalency Calculator, <http://www.epa.gov/greenpower/pubs/calculator.htm> 2-U.S. Environmental Protection Agency Greenhouse Gas Equivalency Calculator, <http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results>

payback period. Some, like the purchase of RECs, may result in slightly higher costs. Others, like investment in on-campus renewable energy, may have a long payback period.

Given this combination of approaches, it is striking that 61% report that pursuing their climate action plan is saving them money.

Among those who report savings, most of the savings are relatively conservative:

- 45% expect savings between \$10,000 and less than \$100,000
- 26% expect savings between \$100,000 and less than \$500,000
- Of the remaining 29%, two-thirds (18% total) shoot ahead to expect savings of between \$1 million and \$10 million

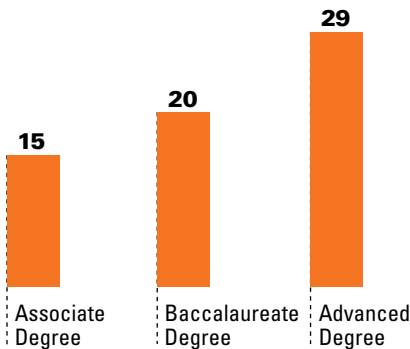
Not surprisingly, nearly all of those who report savings between \$1 million and \$10 million are schools with advanced degrees, which are typically larger and offer more opportunities for savings than the smaller associate and baccalaureate degree schools.

Financing Methods

The progress reports required of ACUPCC signatories include a request for specific information on types of financing used to support their climate action plan initiatives. Because operating and capital budgets, grants and donations were not among the nine possible financing options that they could indicate they used, it is not surprising that the largest percentage (37%) select other. The most commonly used funding sources indicated are:

Average Number of Efficiency Projects Conducted (By Type of School)

Source: McGraw-Hill Construction, 2013



- Student Green Fees and Revolving Loan Funds (tied for first at 15%)
- Power Purchase Agreements (12%)
- Efficiency Service Agreements (10%)
- Renegotiating Purchased Utility Agreements (9%)

Funding only infrequently used includes energy performance contracts, borrowing against the endowment and tax exempt lease purchase agreements, all of which were used by 2% or less of the signatories.

The high use of student green fees and revolving funds demonstrates that these institutions are seeking innovative ways to finance their investments in green, and they are not typical of the higher education sector at large. In fact, a 2011 study by the Sustainable Endowments Institute lists finds only 52 institutions with green revolving funds. ■

In 2006, twelve colleges and universities, in partnership with Second Nature, AASHE and ecoAmerica, created the American College & University Presidents' Climate Commitment (ACUPCC), and in 2007, they invited their peers to join them in committing to control climate change. Currently, there are over 650 signatory institutions to the agreement.

The signatories each commit to provide leadership in climate change and to reduce greenhouse gas emissions through a wide range of approaches, from research and curriculum commitments, to the creation of a Climate Action Plan and regular progress reports detailing their emissions reductions and use of renewables and offsets to reduce their energy use, to commitment to new green building and energy efficiency projects to reduce their impact.

While the signatories only represent a small fraction of the colleges and universities in the U.S., their efforts are crucial in demonstrating how the education sector can take the lead on reducing climate change. Data from various reports submitted by the signatories as part of the ACUPCC provided by Second Nature for this SmartMarket Report reveals the extent of their efforts to provide leadership on climate change initiatives, both in their sector and beyond.

Interview: Thought Leader

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS



Janice E. Nolen

Assistant Vice President, National Policy and Advocacy,
American Lung Association

What is the ALA doing to promote green schools? Why is this issue important to you as an organization?

NOLEN: The American Lung Association (ALA) has been a longtime activist in promoting healthy schools. We have worked with the EPA to design the Indoor Air Quality Tools for Schools program that is aimed at helping schools provide healthy air since the mid 1990s. And with green schools, the ALA is most concerned about ensuring that schools are kept healthy during the process of making schools greener. Ultimately, as an organization we want to make sure that children, teachers and staff are breathing healthy air while they are at school.

How can green schools improve the health of students?

NOLEN: One of the most important factors in a school's ability to provide good, healthy air is how effectively its ventilation system works. Also how schools use fuel to heat their buildings has implications on how lung healthy a school can be. As an example, we heard of schools that were planning to switch from burning natural gas to burning wood to heat their school buildings. While that seems like it would be a good idea since wood is a renewable and more sustainable source of fuel, it turns out to be not so good a choice for lung health. We have been trying to inform people in this way to ensure schools make decisions that keep in mind the health of students.

What aspects of green building do you think have the biggest impact on healthy air for students?

NOLEN: Good ventilation is the most impactful way to protect lung health in a green school, but reducing and preventing the source of indoor air pollutants is another key area. Indoor air pollution such as particulate matter, volatile organic compounds and irritants can originate from various sources indoors such as building equipment, furnishings, flooring and cleaning equipment. For example, it is important not to use cleaning supplies within schools that are going to cause irritations and breathing problems such as asthma or chronic lung diseases.

Do the third-party certification systems do enough to help improve air quality in schools?

NOLEN: I think what it does is it helps identify indoor air quality as a priority. For example, the LEED certification system provides the motivation that is needed to pay more attention to this matter. I think it is important to have these types of guidelines, to be able to identify what needs to be done to achieve better performance. The critical step is if someone, such as a LEED consultant, is able to evaluate the condition of the school and find out where it is falling short and be able to build a road map of how to get the school to perform better.

What do you think would have the greatest impact to encourage more investment in improved air quality in schools?

NOLEN: It is very helpful if there is a dedicated resource in the school, someone who is an advocate and has the expertise and the drive to make sure the issue is kept on the forefront and can make sure things get done. We have seen many times that a certain project gets funded, but then they go away because there isn't enough dedicated follow-through.

How can school systems with 20- to 30-year old buildings that do not have the option of new construction tackle the challenge of improving air quality for students?

NOLEN: We have the Tools for Schools kit that the EPA put together with the ALA's help in 1994. It is designed to be used by schools that aren't planning to build a new building, and addresses how schools can check their existing building operations and practices and make them work better. It has checklists and organizing plans and is all a part of the approach that there is something that every school can do. One example is doing an indoor air quality audit to make sure ventilation ducts are working and aren't blocked by clutter or unused books. ■

Interview: Thought Leader

Darryl Alexander

Health and Safety Director,
American Federation of Teachers

NEW AND RETROFIT GREEN SCHOOLS: THE COST BENEFITS AND INFLUENCE OF A GREEN SCHOOL ON ITS OCCUPANTS

What does your organization think are the most critical issues to help encourage more green schools?

ALEXANDER: We've always taken the position that government has a big role in providing the right incentives to promote these kinds of practices, which I think they've done up to a certain point, for example at the Department of Energy, the Department of Health and Human Services and the EPA. The EPA has had their Tools for Schools program for 20 years to create incentives, and to educate and train.

Another thing we really need is for our policymakers at the state and local level to understand and adopt these practices and policies at the state, municipal and school district level. I think third-party certifications, such as USGBC's LEED program, really rationalizes the process, creating standards for school buildings. We're excited about that because it really does provide a template for accelerating these kinds of changes.

What aspects of green schools do teachers care about the most?

ALEXANDER: It is really interesting to see this evolving. Teachers, whether they know much about green schools or not, once they enter one of these buildings, they are excited because these schools are quite different from conventional school buildings. The natural lighting, the acoustics, the air quality and comfort really allow them to focus on their jobs more easily. It is amazing to watch. It is even apparent

with some of our older teachers, who don't usually grasp the sustainability philosophy as much as the younger teachers.

Do you have any anecdotal information from teachers about the impact of green schools on themselves or their students? Can you describe them? Do you know of any efforts by teachers to measure those impacts?

ALEXANDER: We have stories from a number of districts. For example, from our school district in Cincinnati, several teachers have stated how the green school buildings have changed their ability to teach, mainly due to the more comfortable surroundings and student happiness and increased concentration. We've heard even from teachers in hard-hit areas like Detroit that has a school of performing arts that is green and how the building has the students more energized and boosted their performance.

We've also heard from teachers that green schools have been useful as learning tools and allowed them to incorporate sustainability into the curriculum, teaching them, for example, how to measure and track energy use. Green roofs have allowed them to explain benefits such as reduced energy use, greenhouse gas emissions and reduced stormwater runoff.

What are the ways in which teachers can help their schools become greener? And can they influence broader school decisions, at the district level or even beyond?

ALEXANDER: We've seen teachers help promote green cleaning and integrated pest management and taking on green practices that have positive impacts on the health and well-being of their schools' occupants. Teachers have also promoted green by teaching students about their environment and by holding classes outdoors. We've also seen teachers become advocates of green at the local level and work toward development of green schools in their communities.

What would your organization like to see the main focus be for green schools in the future?

ALEXANDER: Aside from standards for buildings, we want a sustained culture of operations and maintenance instilled in every school district and want them to become good building owners. If schools are not maintained and cared for, even the best and greenest schools will rapidly deteriorate, and students and teachers won't be able to take advantage of its green and health benefits.

I also think it's important to create more and better education and incentives for building owners so that they will adopt these principles and have the cash for green schools. ■

Methodology:

New and Retrofit Green Schools Study Research

McGraw-Hill Construction conducted the 2012 Green Schools Study to assess the impact of green educational facility design and construction on its occupants and building performance. The study looked at green in both new construction/major renovations and retrofits /operational improvements.

The research in this report was conducted through an Internet survey of industry professionals between August 30th and October 12th, 2012. The survey was open to architects, contractors and school personnel from both K-12 and higher

education facilities. Architects and contractors had to have some experience in school construction, either K-12, higher education or both, within the past three years. School personnel had to be familiar with their institution's recent construction projects.

The survey had 498 complete responses in categories that are defined as follows: 106 architects (21%), 114 contractors (23%), 137 K-12 (28%), 99 higher education (20%) and 42 other (8%) industry respondents. As the other group could not be classified into a specific group they were

eliminated from most analyses.

The use of a sample to represent a true population is based on the firm foundation of statistics. The sampling size and technique used in this study conform to accepted industry research standards expected to produce results with high degree of confidence and low margin of error. The total sample size (498) used in this sample benchmarks at a 95% confidence interval with a margin of error of +/- 5%.

Longitudinal Comparisons With 2007 Education Green Building Data

In 2007, McGraw-Hill Construction published the *Education Green Building SmartMarket Report (SMR)* that included both qualitative and quantitative research on green schools. The quantitative portion was a survey of members of the Council of Education Facility Planners International (CEFPI).

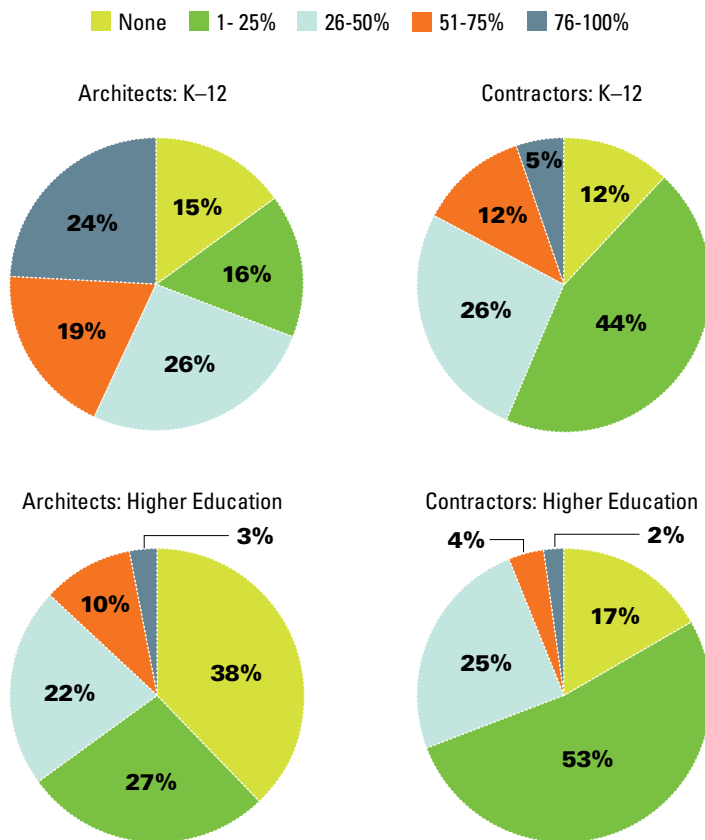
This 2012 survey included several questions that were asked in the 2007 SMR study for comparisons over time with the sample from this research (93) that were identified as CEFPI members. Therefore, whenever 2007 comparisons are made in the findings, they are based on a comparable sample from both years.

Dedicated Sustainability Staff

Sixty-one percent of the K-12 schools and 73% of higher education schools surveyed have a dedicated sustainability staff. ■

School Projects as Percentage of Total Projects

Source: McGraw-Hill Construction, 2013



Resources

Organizations, websites and publications that can help you get smarter about new and retrofit Green Schools.

McGraw Hill CONSTRUCTION

McGraw Hill Construction

Main Website: construction.com

Dodge: construction.com/dodge

Research & Analytics: construction.com/dodge/dodge-market-research

GreenSource: greensourcemag.com

Architectural Record: archrecord.com

Engineering News-Record: enr.com

Sweets: sweets.com

SmartMarket Reports: construction.com/market_research

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Research Partners

American College & University Presidents' Climate Commitment: presidentsclimatecommitment.org
AIA Committee on Architecture for Education (CAE): network.aia.org/CommitteeonArchitectureforEducation
Associated General Contractors of America (AGC): agc.org
Council of Educational Facility Planners Int'l: cefpi.org
National Association of Independent Schools (NAIS): nais.org
National Building Museum: nbm.org
Second Nature: secondnature.org
Society for College and University Planning: scup.org

Other Resources (not inclusive):

21st Century Schools Fund: 21csf.org
American Association of Community Colleges: aacc.nche.edu
American Association of School Administrators: aasa.org
American Lung Association: lung.org/healthy-air/school/
America's Schoolhouse Council: americasschoolhouse.com
Association for the Advancement of Sustainability in Higher Education: aashe.org
Collaborative for High Performance Schools (CHPS): chps.net
Healthy Schools Network: healthyschools.org
National Clearinghouse for Educational Facilities: ncef.org
National Institute of Building Sciences (NIBS): nibs.org
US Department of Education Green Ribbon Schools:
<http://www2.ed.gov/programs/green-ribbon-schools>

■ Design and Construction Intelligence

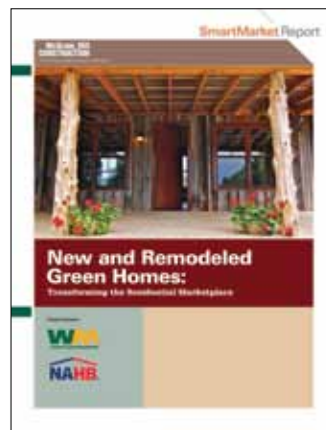
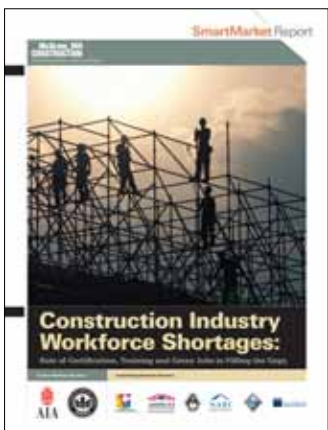
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