From the Classroom to the Construction Site: Packing the Pipeline with Energy Efficiency

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ABSTRACT

In 2009 ComEd developed their *Smart Ideas for Your Business*® New Construction Service and broke ground by integrating technical education and training into a technical assistance and financial incentive program. The goal of this strategy was to support achieving short-term savings goals while also encouraging building owners, designers and architects to exceed standard new construction, renovation and lighting practices. The ComEd New Construction Service has been successful in meeting and exceeding its short-term savings goals with its technical assistance and incentives, but how successful has its training component been on changing building practices?

To begin to answer that question, the Energy Center of Wisconsin collaborated with ComEd to conduct targeted research exploring the impact of individual training workshops on the implementation of energy efficiency strategies on new commercial construction and/or major renovation projects. Attempting to quantify these impacts is important as energy efficiency program managers face increasing pressure to deliver energy savings. Being able to tie training directly to possible energy savings gives program managers support for continuing to include training in resource acquisition programs.

Results of this research show that a small group of training attendees have had both the opportunity to work on projects since attending the training and have implemented some of what they learned on those projects. While the sample in the research is small, it is encouraging to see the connections between training and implementation of energy efficiency technologies and strategies. This research represents a small step in showing the value of training in a resource acquisition program and highlights areas for further research as well as presents suggestions for tying training more directly to the savings component of an energy efficiency program.

Introduction

In 2009 ComEd launched the New Construction Service as part of its *Smart Ideas for Your Business*® program. The service provides a combination of education, financial incentives and technical assistance to commercial building owners and design teams to exceed standard energy efficiency practices in the utility's northern Illinois service area. ComEd selected the Energy Center of Wisconsin's building team to implement the service and its education unit to deliver the education component. In the two years since the service started, it has provided assistance on 187 new construction and major renovation projects encompassing nearly 24 million square feet of commercial space with estimated energy savings of 49 million kilowatt hours of annual energy savings.

Like most utility energy efficiency programs, *Smart Ideas*® is required to cost effectively meet specific energy savings goals. However, the program design for the New Construction

Service intentionally goes beyond resource acquisition. ComEd is attempting to drive long-term market change by complementing traditional project-specific new construction program offerings such as whole building energy modeling, design services and technology incentives with a strong educational program that trains market actors to change their practices and achieve impacts that extend beyond the life and scope of the New Construction Service. The program theory is that design team education, when complemented with support to overcome immediate barriers to implementing more efficient designs and technologies, will lead to market transformation.

The New Construction Service also uses training workshops to drive market actors to participate in the technical assistance and incentive components of the service by taking advantage of a critical element of the building design profession: the need to maintain professional credentials by attending continuing education programs.[1] Thus, training workshops are offered to reinforce concepts used in the technical assistance component of the service, complement the technology incentives and provide critical continuing education credits for practitioners. Providing the continuing education credits draws the audience most likely to provide potential projects to fill the New Construction Service's pipeline helping ensure it meets its short-term savings goals. However, participants in the New Construction Service are not required to attend these trainings to be eligible for the incentives offered. Nor are attendees of the training program required to have projects enrolled in the New Construction Service.

Five full-day training sessions are offered each year on topics such as energy efficient lighting design, daylighting design, passive thermal design techniques and designing high performance buildings using an integrative design process. The workshops are presented by a combination of local and national industry experts and target building professionals who can potentially make energy-related decisions or influence the use of energy in commercial buildings. In general, the content for the training sessions is structured to present concrete actions that building design professionals can take on their next project. Attendees were charged $169 for each of the five trainings offered in program year 2011. In the first two program years, a total of 637 building professionals attended the trainings, ranging from 40-100 attendees per event.

Because there is no explicit link connecting participation in the training sessions to participation in the New Construction Service, ComEd and the Energy Center of Wisconsin[2] were interested in conducting targeted research to explore the impact of the service's training component on implementation of energy efficiency strategies on new projects. The research team sought to answer the following questions: 1) are there indications that training is complementing the program and 2) does training achieve energy savings on projects that are implemented without participation in the technical assistance components of the New Construction Service and without receipt of the program's financial incentive.

These questions are of interest because program implementers must maximize cost-effective energy savings through direct impact programs while also searching for new sources of

[1] For our detailed discussion see: Henry, S et al. 2010. "Integrating Technical Education and Training into Energy Efficiency Program Delivery: A Strategy to Drive Program Participation and Create Short Term Impact and Long Term Market Effects"

[2] The Energy Center's education unit provided the training component of ComEd's program. The evaluation and follow-up research, however, was completed independently by the Energy Center's research group.

energy savings. With the increased interest in behavior-based energy savings, education and training deserves consideration for delivering energy savings impacts.

There are past studies indicating that some training provides energy-saving impacts. For example, an evaluation of the U.S. Department of Energy's *Compressed Air Challenge* program showed 149 MWh/year average project savings per attendee (Lawrence Berkeley National Laboratory and Xenergy 2004) and the Energy Center of Wisconsin's evaluation of the impact of the *Better Buildings: Better Business* Residential Conference estimated $0.5 - $2 million in energy savings. (Bensch, 2006) To achieve such impacts, training needs to overcome primary barriers to energy-saving actions. Often, that means building awareness and technical skills among motivated individuals who are in a position to influence the energy usage of the buildings and systems with which they work. Architects and engineers who design new commercial buildings—the target audience for much of ComEd's New Construction Service training—fit this paradigm well.

Energy Center staff built on these past studies to understand whether training activities for architects and engineers designing new commercial buildings actually provide impacts independently of traditional incentive programs and whether training provides measurable additions to the energy savings impacts routinely credited to the traditional financial incentives (e.g., for the inclusion of particular technologies and designs) in commercial new construction programs.

This research study focused on training workshops offered in October 2010, December 2010, February 2011, April 2011 and June 2011. Two workshops covered energy efficient lighting and daylighting. Topics for the other three were: the integrative design process, passive thermal design and direct digital controls. The target audience for these workshops was building designers (architects and design-build teams) and engineers as well as building developers and building owners. In addition, staff from organizations implementing energy efficiency programs, sales representatives from companies selling energy efficiency products, university students and other educators often attended these programs.

Four of the workshops were skills-based programs that taught concrete actions a building design professional could apply on a project. These (lighting, daylighting, integrative design and passive thermal design) were the training events of interest for the targeted research to determine their impact on implementation. One of the workshops (direct digital controls) was an information-based presentation and was excluded from the study. All were developed based on "Best Practices" for adult learners. (Laurel, D. 2003)

Approach

One goal of the ComEd training sessions is to drive long-term change in the market, thus it was important to get trainees' reactions to the training program and to determine if their participation resulted in changed practices on their projects. Thus, the Energy Center developed customized evaluation methods to meet ComEd's needs. Customization ensured that the outcomes of education and training events were captured and documented.

To determine the effectiveness of integrating an education and training component into ComEd's *Smart Ideas*® New Construction Service, the research team:

- Reviewed post-training evaluations (immediately after event)
- Conducted and analyzed follow-up surveys of attendees that focused on post-event implementation of training concepts (5-6 months after each event)
- Identified barriers to quantifying energy savings
- Examined value beyond energy savings

Post-Training Evaluations

The Energy Center has used a consistent evaluation protocol to measure the quality of training programs for more than 12 years. This standard program evaluation measures several dimensions of customer satisfaction (e.g. overall satisfaction, faculty, amount learned, etc.). At a minimum the following categories are evaluated:

- Training objectives
- Overall grade
- Training content
- Presentation of content
- Training logistics
- Learning satisfaction
- Implementation of ideas presented

The evaluations for two of the skills-based training events held in program year 2011 were sent out electronically[3] the day after the training event with a reminder to non-respondents approximately a week later. All online evaluation responses were collected within ten calendar days of the training event. Online response rates ranged from 52 percent to 56 percent, somewhat lower than typical response rates for in-person training events. As a result, Energy Center staff administered paper evaluations and collected them on-site for the other two skills-based events to increase response rates to an effort to capture more complete feedback from attendees. As a result the response rate increased to 88 percent and 100 percent, respectively.

Evaluations were sent out electronically the day after the training event to attendees of:

- Lighting and Daylighting with Efficiency
- Passive Thermal Design for Energy Efficiency and Indoor Comfort

Evaluations were handed out on paper the day of the training event to attendees of:

- Designing High Performance Buildings Using an Integrative Design Process
- Lighting and Daylighting Design: Beyond Footcandles

[3] Electronic surveys were administered using Vovici, an online survey software program.

Table 1 summarizes the number of attendees at each of the trainings, the number who completed the evaluation of the training event (post-training evaluation) and the overall evaluation score[4] given to the training event.

Table 1. Training Attendance and Evaluation Summary

Training event	Training date	Attendees	Respondents	Evaluation Score*
Lighting and Daylighting with Efficiency	October 6, 2010	69	38	4.62
Passive Thermal Design for Energy Efficiency and Indoor Comfort	February 10, 2011	45	25	4.59
Designing High Performance Buildings Using an Integrative Design Process	April 14, 2011	25	22	4.62
Lighting and Daylighting Design: Beyond Footcandles	June 2, 2011	29	29	4.65

*On a 1-5 point scale, with a 5 being the highest score.

The evaluation asked training attendees two questions designed to measure their intent to explore or implement the ideas they learned from the training program. Their answers provided critical information that served as a baseline for future evaluations and explorations in measuring the effectiveness of the training workshop. Table 2 summarizes their responses.

Table 2. Intention to Implement Training Ideas

Training event	I picked up ideas my business will explore further.	I picked up ideas my business will implement.
Lighting and Daylighting with Efficiency	84%	66%
Passive Thermal Design for Energy Efficiency and Indoor Comfort	78%	74%
Designing High Performance Buildings Using an Integrative Design Process	86%	67%
Lighting and Daylighting Design: Beyond Footcandles	86%	57%

These results suggested optimism about attendees' intent to implement ideas they picked up during training. The follow-up research was designed to take a deeper-dive into the data in the hopes it would show that attendees were actually implementing new ideas. The following sections summarize the results of the follow-up research.

Follow-up Evaluations

In order to determine whether training attendees implemented what they learned as a result of the training, Energy Center staff conducted follow-up surveys with those attendees who were most likely to work on projects in which they could implement what they learned (architects, engineers and other building design professionals—based on the attendees self-selected job title on the registration form). A request to complete an online survey was sent to

[4] Scores are actual numbers, they have not been weighted.

this group of attendees five to six months following each workshop. The online survey was kept open for nine days and a follow-up reminder was sent after four days to those who had not yet completed it.

The survey comprised between 18 and 22 questions and included specific close-ended implementation questions tailored to the content in each training workshop. These questions were based on the training objectives and were refined by speaking with the instructor to obtain a list of strategies, actions and/or measures that attendees would be able to apply on their projects as a result of attending the training. For example, we asked attendees from the Lighting and Daylighting with Efficiency workshop who had worked on a project since attending this workshop[5] the following two questions:

- What is the installed lighting power density for this project?
- How does the lighting power density on this project compare to what you've done in the past on other projects of a similar nature?

Reducing lighting power density in commercial buildings can be a highly effective method of conserving energy and was a primary strategy presented in the workshop. Asking such specific questions (in conjunction with other project-related questions tied to the concepts presented in the workshop) provided a means for assessing the impact a workshop had on the attendee. The list of possible implementation items from the four workshops included changes to the design process (i.e. utilizing an integrative design process) as well as technology choices (i.e. daylighting strategies and lighting equipment).

Table 3 summarizes the number of attendees at each training event, the number of attendees in the target audience for the follow-up surveys, and the number of targeted attendees who completed the follow-up survey.

Table 3. Training Attendance and Follow-up Survey Summary

Training event	Dates of Follow-up	Training Attendees	Target Audience	Respondents
Lighting and Daylighting with Efficiency	April 26, 2011	69	65	36
Passive Thermal Design for Energy Efficiency and Indoor Comfort	August 3, 2011	45	35	23
Designing High Performance Buildings Using an Integrative Design Process	September 12, 2011	25	15	10
Lighting and Daylighting Design: Beyond Footcandles	November 16, 2011	29	17	10

Results

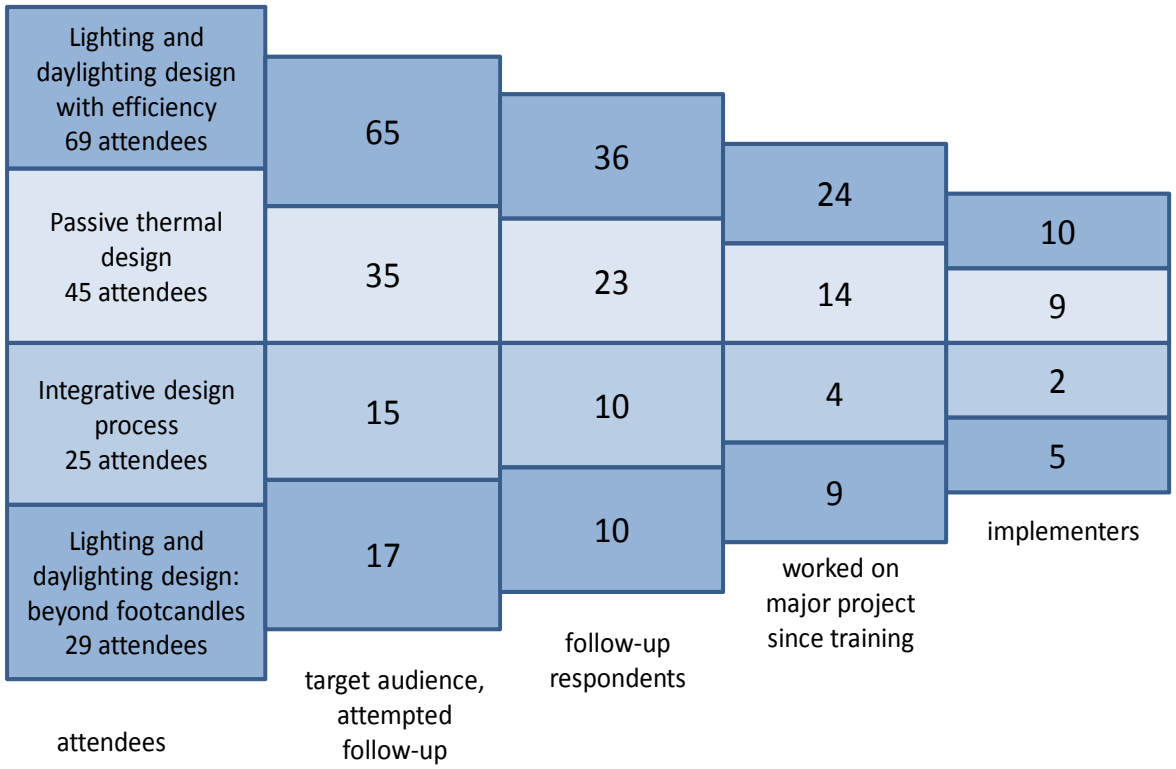
As seen in Table 2, when asked immediately after the training event, a high percentage of attendees indicated they intended to implement something learned from the training program.

[5] All of the follow-up evaluations asked implementation questions only of those attendees who had worked on new construction or major renovation projects since attending the workshop.

While this result shows enthusiasm for the training topic and a desire to change existing practices in some way, it does not communicate whether intention became reality. The follow-up survey was intended to uncover actual changes in design practices.

As noted in Table 3, 79 of 132 target audience attendees receiving the follow-up survey completed it. To give attendees an opportunity to work on projects incorporating skills learned in training, the follow-up survey was administered five to six months after attending the workshop. Sixty-four percent of the follow-up respondents worked on a new building, major renovation, or major project since attending a training program. Of these 51 target audience attendees, 26 (defined as "implementers") reported doing something different on a project as a result of the training session they attended (see Figure 1).

Figure 1: Results of Follow-Up Study



While these are promising results, the data are based on self-reports and there are not enough specific details to make broad generalizations about the training events' effect on building design and energy usage. However, the individual implementer stories are useful indicators of the degree of change that has happened in the six months after attending the ComEd training. It is also likely that there will be additional future implementation by the attendees who haven't tried training concepts yet or for whom the right project hasn't yet been presented.

Characterizing the Implementers

Individual responses from training attendees to the questions in the follow-up surveys highlight the variability in projects, attendees' opportunities for implementing what was learned

and subsequent levels of implementation. Analyzing the responses provides valuable information on who the implementers are and how we can use that information for future training events to increase implementation to meet short-term and long-term program goals.

The majority (20 of the 26 implementers[6]) specifically classified themselves as an engineer, architect/designer, or project lead—the decision-making players on building projects. The implementers appear to be in a good position to repeat the changes they made on at least one building, as they typically work on numerous building projects annually, ranging from two to more than 100 projects a year (mean 22, median 15).

The actual changes made since the training varied from some that may or may not have any effect on energy usage, such as incorporating a lighting design to address illuminating work surfaces, to a fairly comprehensive consideration of efficient technology in one building. The size of commercial projects involved ranged from 10,000 sq. ft. to 200,000 sq. ft. and included project types such as office, education, and retail. It was encouraging to learn that implementers were able to apply what they learned to a range of building sizes and types—suggesting that some level of implementation resulted even from training events about topics that did not go into specifics by building size or type.

Three implementers also reported incorporating training concepts into their residential projects: a small 1,200 sq. ft. residential project, a 53,000 sq. ft. senior apartment project and a large 500,000 sq. ft. multifamily building. It was surprising to hear about residential projects, but discovering that training attendees are taking what they learned at a commercial training and applying it to their residential projects demonstrates additional applied knowledge and potential for energy savings.

Table 4 highlights select technologies and strategies that attendees implemented as a result of the ComEd training sessions. These examples are representative of the project types and concepts implemented. The examples included in the table draw from the most complete survey responses received and thus contained the most detail. Not all projects listed in the table implemented all of the listed concepts.

[6] The remaining six implementers included four respondents who did not identify their roles on their follow-up survey, a respondent who classified himself/herself as sales, and an energy/daylight modeler.

Table 4. Select Projects and Implemented Technologies and Strategies

Training Event	Project Description	Concepts Implemented	Comments
Lighting and Daylighting with Efficiency	• 12,000 sq. ft. education building – lighting retrofit • 10,000 sq. ft. new construction office building • 65,000 sq. ft. new construction office building	Reduced lighting power density (LPD) Daylighting techniques • Occupancy Sensors • Dimming • Harvesting • System tuning Product selection • LEDs • Reduced wattage T8s Fixture spacing	The LPD for these projects was lower than it otherwise would have been as a direct result of the concepts learned in training.
Passive Thermal Design for Energy Efficiency and Indoor Comfort	• 300,000 sq. ft. residential multi-family building • 110,000 sq. ft. recreational facility	Assessment of building materials in relation to sun and earth (massing and programming) Holistic thermal comfort evaluation Multiple, seasonal operational modes Earth coupling, stack ventilation, operable windows, active solar control	Both projects started as low-energy designs and incorporated many passive thermal design training topics to improve energy efficiency and indoor comfort.
Designing High Performance Buildings Using an Integrative Design Process	• 25,000 sq. ft. air traffic control tower • 180,000 sq. ft. airport garage	Involvement of entire design team Conducted eco-charette Established sustainability goals Included energy modeling	Projects illustrate value of employing an integrative design approach including modeling as a means of quantifying the potential energy savings attributable to the design strategies and/or concepts implemented.
Lighting and Daylighing Design Beyond Footcandles	• 200,000 sq. ft. office/warehouse retrofit • 65,000 sq. ft. office retrofit • 200,000 sq. ft. school renovation	Daylighting techniques Work surface lighting Product selection	Projects incorporated an integrative design process, advanced lighting practices and daylighting into their project designs.

These self-reports suggest that ComEd's training is having an effect on the design of numerous buildings and, in some cases, that the changes being made appear to be substantial but not quantified. Additional work would need to be done before these changes can be quantified to the level that energy program evaluators would want to see, but the indicators collected are positive and encouraging. Next steps for quantifying energy savings would include determining

just what role the training played, how effectively it was implemented, and how much energy the buildings are saving over a baseline.

The Value of Training

Energy efficiency training, primarily in the form of information programs, has been included in many utility and public benefit efficiency program designs as a supporting activity. Training does support implementation by increasing the awareness, knowledge, and skill of those who implement energy efficiency measures in buildings and other venues, even if the effect of the training has not been quantified and methods to reliably attribute savings to training are still elusive. In addition, training programs deliver a number of non-energy benefits and intangible values. Some of these include:

- Enhanced customer experience – engaging a captive audience on program specifics and answering questions face-to-face builds important relationships with current customers, potential customers and trade associations.
- Increased visibility – using training events as a public relations strategy enhances the program provider's visibility with decision makers and illustrates its commitment to energy efficiency.
- Shared knowledge – engaging a diverse group of stakeholders and program users to share knowledge, best practices, and expertise helps disseminate that information to a broader audience as participants relay what they learn to their larger community of colleagues.

However, as energy efficiency program managers face increasing pressure to deliver energy savings (resource acquisition) it will be harder to justify these programs simply based on their intangible values. While we do believe that training programs have the potential to contribute significant impacts to a resource acquisition program, the art of measuring impacts from training programs is not well-developed or widely practiced (Bensch 2006). Thus, it is essential to identify other strategies that allow energy efficiency program managers to incorporate training programs within the resource acquisition structure.

In pondering this quandary, one approach would be to package training with the program incentives. Specifically, program participants receive a greater incentive if members of the design team attend training on the measures that are being rewarded, or such training is a prerequisite for participating in the incentive program.

This approach has several benefits. First, although not tied to any specific incentive or program prerequisite, the training serves to complement the incentives and makes it more likely that the savings strategies will be designed well and effectively. Second, it contributes to the market transformation goals of the program by teaching participants the strategies, skills and techniques to create more energy efficient buildings in the future, after incentives are no longer available. Third, the training program is no longer seen as an additional cost to the program that needs to achieve savings—it becomes part of the cost of the incentive and is tied to the savings achieved through the incentive. Finally, it continues to serve as a source of projects to fill the pipeline and ensure the program meets its savings goals.

Conclusion

Education and training is a potentially powerful tool that can help meet both short term energy savings goals and long term market transformation goals for utility energy efficiency programs. As with any program approach, the training needs to be well designed and implemented. In particular, training is more likely to result in energy impacts if it overcomes key barriers by imparting missing skills and know-how among those who most directly influence a building's or a system's energy use, either through design or operation.

ComEd's *Smart Ideas for Your Business*® New Construction Service appears to be driving changes in building practices. However, attendees reported a slower stream of applicable new projects on which they could have applied concepts from the training within a half-year after the training. It is possible that projects take longer to develop than was allowed for in the six-month follow-up window, that attendees' business is affected by the slower economy, or that the design professionals attending the training play a supporting role rather than a decision-making role within their design teams. There is room for improvement in marketing to drive the right audience to the training and in facilitating the sharing of training content by the attendees with the decision-makers in their firms and on their design teams. These likely are issues that other energy efficiency program designers confront when trying to deliver training programs designed to achieve savings as well as impart information.

Not only should we continually improve our approach to effectively reach the full pool of appropriate decision-makers and professionals we're trying to influence, we should develop accounting strategies that allow training to fit more comfortably in a resource acquisition model. As long as training programs are independent components of a program, there will be pressure to account for their portion of the energy savings. Developing models that incorporate them into an incentive structure could remove this burden. While we would encourage continued research on tying energy savings to training, we must recognize current barriers to the inclusion of training in program design and give utility program designers and administrators the tools they need to continue to advocate for including training in energy efficiency programs.

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