

A Comprehensive Approach to Energy Code Education and Training

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ABSTRACT

Education and training (E&T) for energy codes refers almost invariably to classroom-based sessions generally offered in a small number of locations across a state during the first year of new code implementation and only a small fraction of the people affected by the new code (building officials, design/construction professionals, subcontractors) attend the sessions. Many presentations tend to be mind-numbing: 200+ slides (for a full day session) containing many text changes, and few photos, for each amended section of the code. These “overview” sessions are important, but they do not prepare attendees to implement a new code; learning to apply a code at the computer (design phase) and in the field (construction phase) requires repetition and a variety of teaching methods.

This paper describes a multi-tiered approach to energy code E&T used in the Pacific Northwest. Overview sessions are followed by focused trainings that address in-depth areas of the code which are predicted to have low compliance. These classroom-based experiences are supplemented by visits to both building departments and industry firms in which trainers sit with department or firm staff to do plan reviews and then visit buildings with field inspection staff and builders to provide real-time feedback. There is no punitive aspect to these visits; participants understand that they are not being judged or reported on, which makes them receptive to accepting help. Finally, telephone technical assistance is always available, generally from the same people who conduct the trainings.

The paper also discusses the supporting infrastructure, including political support, stakeholder collaboratives and compliance tools, which need to be in place to motivate and facilitate people to enforce and comply with the energy code and touches on the cost-effectiveness of providing energy code education.

Background

Building energy codes have dramatically increased in both complexity and required levels of efficiency in the past five years. In the face of these large, rapid changes, building officials, designers and builders are in need of improved education and training (E&T) so they can comply with and enforce the codes after they are adopted. Without such improvements the potential energy savings available through the new codes will not be realized. This paper discusses the role of E&T in ensuring those savings and presents a framework for E&T which is much broader than what has traditionally been offered.

When people speak of education and training for energy codes they are almost invariably referring to classroom-based sessions generally offered in a small number of locations across a state during the first year of new code implementation¹. These sessions have two distinguishing characteristics. First, they are slide presentations in which a large majority of the slides contain

¹ This description of typical energy code E&T reflects the author’s personal experience and was reviewed and validated by the energy code program managers of three regional energy efficiency organizations representing 30 states and three energy code training professionals each with more than 20 years of experience.

only a section or description of code text with the changes from the previous code highlighted. Figure 1 gives two typical examples:

Figure 1. Two Examples of Energy Code Training Slides

Exhaust Air Energy Recovery Exceptions

- Lab systems meeting 6.5.7.2
- Systems serving uncooled spaces that are heated to < 60°F
- Systems exhausting toxic, flammable, paint or corrosive fumes or dust
- Commercial kitchen hoods used for collecting grease or smoke
- Where > 60% of outdoor heating energy is provided from site-recovered or site solar energy
- Heating systems in climate zones 1 through 3
- Cooling systems in climate zones 3c, 4c, 5b, 5c, 6b, 7, and 8
- Where largest exhaust source is < 75% of the design outdoor airflow
- Systems requiring dehumidification that employ energy recovery in series with the cooling coil

Section 6.5.7.1

HVAC - P

Table C402.1.2
Opaque Thermal Envelope Assembly Requirements *

Climate Zone	1		2		3		4 except marine		5 and marine 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Walls Above Grade																
Mass	U-0.142	U-0.142	U-0.142	U-0.123	U-0.110	U-0.104	U-0.104	U-0.090	U-0.078	U-0.078	U-0.071	U-0.061	U-0.061	U-0.061	U-0.061	U-0.061
Metal Building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039	U-0.039	U-0.052	U-0.039
Metal Framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.052	U-0.045	U-0.045	U-0.045
Wood Framed and other	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.036	U-0.036	U-0.036

Second, each presentation covers the entirety of the new code. If the new code is a significant change from the previous version, this means there will be 200 or more slides which take several hours to go through even with a bare-bones presentation that simply describes the change without discussing why it was made or how to comply with it. Because there is insufficient time to go in-depth on any one slide, there is a necessary monotony which makes it hard for attendees to retain information on individual items afterward. Everything is covered, but nothing stands out.

Usually only a small number of these sessions are held in a given state and they are offered only once every three years when a new code is adopted. Most important, however, is that only a tiny fraction of the people who need training receive it. As an example, Colorado in 2011 conducted an amazing 94 trainings but reached only 1085 people². Considering that even in a small state thousands of people are responsible for enforcing or complying with the energy code – building department reviewers and inspectors, architects, engineers, lighting designers and insulation/ HVAC/controls/lighting contractors – that is a very small number.

In summary, typical energy code E&T offers only high-level overviews of code changes, provides very little practical information on how to comply with new requirements, and reaches

² Data from Shaunna Mozingo, former building official and the person who conducted most of these trainings.

only a tiny fraction of the target audience. If increased compliance is the goal, clearly these shortcomings need to be addressed.

A More Comprehensive Approach

The Northwest Energy Efficiency Alliance (NEEA) funds a large majority of the energy code implementation support in the four Pacific Northwest states³. Over time, NEEA has become increasingly aware that the just-described approach to E&T is inadequate, particularly in light of the increasing complexity and scope of energy codes. We have experimented with many approaches over the past ten years and these have slowly evolved into a more comprehensive alternative approach. However, there remain gaps between concept and practice: all of the elements described in this paper exist but they are not present in all states or at all appropriate times. The following four types of E&T comprise the direct educational support for energy codes in our regional approach.

1. *Overviews.* As described above, these are classroom presentations which cover all code changes and build general awareness of the scope and magnitude of changes in the new code. Overviews are most effective when focused on specific market segments/trades and the biggest changes to the code. They can also be effectively used to promote the other types of trainings described below. While these have generally been done live in the Northwest we have also experimented with online presentations with some success. The main limitation to electronic learning is the amount of time required to convey the information. Very few people will stay through 4-6 hours of online information in one sitting. Electronic formats make it easy to break the content into shorter pieces but getting people to commit to watching multiple segments can be problematic.
2. *Targeted.* Not all areas of the code are equal in terms of either the likelihood that people will comply with them or the amount of potential energy savings they provide. Identifying areas with low compliance and significant energy impacts and crafting curricula to address them maximizes the impact of available program funding. The best method for identifying low compliance areas is a statistically representative field study, but these are expensive and therefore have been done infrequently. In the absence of such a study, anecdotal information can be gathered from building department staff and design and construction professionals. We have found that people are not shy about pointing out which sections of the code they find confusing or inane. At the common sense level, compliance is also likely to be low for new categories of requirements in which people have no background, such as the recent inclusion of air and duct leakage testing in the residential code. Energy impacts are generally easy to determine through technical experts, analyses already conducted by other organizations or modeling.

Targeted trainings should allow time to present context, theory and applications. Depending on the complexity of the topic, these sessions can last anywhere from an hour (appropriate for brown bag lunch sessions) to an entire day. A great example of this approach is a training created by the Washington State University Energy Program

³ NEEA is a non-profit organization working to maximize energy efficiency to meet the Northwest's future energy needs. NEEA is supported by, and works in collaboration with, the Bonneville Power Administration, Energy Trust of Oregon and more than 100 Northwest utilities on behalf of more than 12 million energy consumers.

(NEEA's contractor) to preemptively address a completely new Washington State Energy Code requirement that all new homes have their ducts tested. Many building officials and homebuilders did not even know what duct testing was when this went into effect, so it was decided that a large educational push would be necessary to achieve any reasonable level of compliance.

This particular training lasts most of a day, starting with a 2-3 hour classroom session in which attendees learn the new testing standard and how to operate the testing equipment. The second half of the day is spent in the field, where participants have the opportunity to operate the equipment and demonstrate their ability to run the test in a new construction scenario. Attendees receive a certificate documenting completion of the minimum requirement necessary to test ducts for 2009 WSEC compliance. The training was offered 77 times between June 2009 and December 2011; 1730 people attended and it can be confidently stated that over the course of that period duct testing became an accepted and established practice across the state.

Targeted training is another area where the Northwest has experimented with online education and because these are generally shorter than the Overview trainings they are a better fit for this approach.

3. *Site Visits.* The predetermined content of the Overview and Targeted E&T sessions severely limits the time that can be spent addressing specific applications or problems which individuals confront when attempting to apply the code. Site visits are designed to overcome this limitation by sending trainers directly to local building departments and the firms of design and construction professionals. These visits are more conversational in nature, with an emphasis on the needs and concerns of the participants rather than a predetermined topic. At building departments, trainers (better thought of as mentors in this context) work with staff on plan reviews, both asking and answering questions; they then accompany inspectors to building sites, observing typical inspections of both residential and commercial buildings and making recommendations for improvements. When visiting design and construction firms, trainers can review individual blueprints or specs as well as provide clarity on confusing sections of code. An extremely effective hybrid strategy we have experimented with is to hold the site visit trainings at a local building department and have building officials invite trade professionals to attend. This has the dual advantage of ensuring that information is communicated consistently across audiences and it sends a strong signal from the building official to builders and designers – “Here is what we are going to be looking for, be sure you do it right!”

Optimally, site visits are part of a circuit rider strategy where an individual visits the same sites on an on-going basis and is available by phone or email in the interims. Appropriate intervals for the visits may vary from 2-3 times per year to once every 18-24 months depending on the knowledge, needs and interest of the participants. The intent is to have the trainer/circuit rider(s) establish long-term relationships in which they come to be regarded as reliable and credible information sources for questions concerning energy codes. Above all, to develop trust it is crucial that the circuit riders' mission is solely educational; participants understand that they are not being judged or reported on which makes them willing to discuss shortcomings and receptive to accepting help.

4. *Technical Assistance.* People obligated to enforce and comply with the energy code need answers to questions whenever they arise. Acquiring information is almost always time-

sensitive and delays may have significant, direct financial impacts on projects. Because of this, any E&T framework must include telephone and email “hotlines” with dependably quick turnarounds. Establishing universal awareness of these resources and how to access them requires a serious, consistent communications effort. A necessary adjunct to these services is a website which is well advertised and contains official energy code documents, supporting tools and materials, contact information for technical support, and a calendar of classes are all available.

Ideally, all of the above activities would be delivered by a small, stable team of people from a single organization who live within a state⁴. Over time, this creates name recognition, ensuring that every time a person has a question about the energy code they automatically know who to call and have the contact information at hand. The current situation in many states is substantially different, with E&T (again, almost always Overviews) being contracted out to firms or individuals who come to a state specifically to deliver a series of sessions, leave immediately after they finish, and have no contractual obligation and often little availability to provide follow-up to attendees. In contrast, in-state trainers provide important continuity and if they do not exist it should be a priority to develop them.

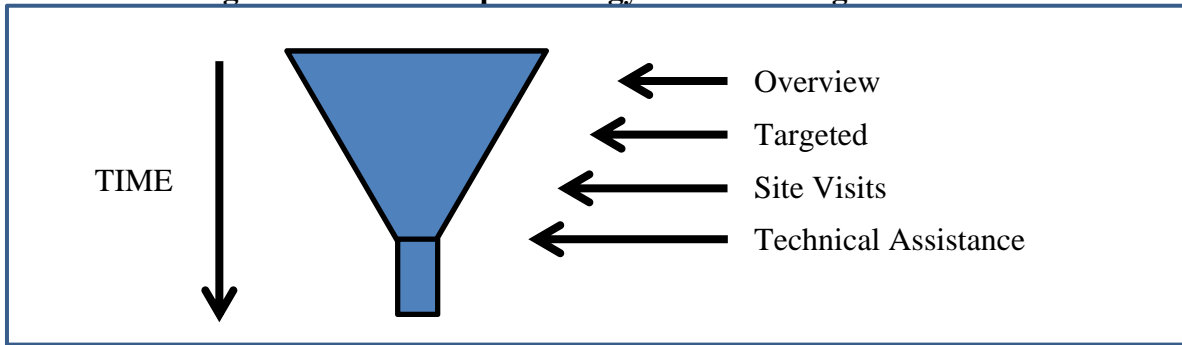
The best possible situation is for E&T to be provided by a state agency with official responsibility and adequate budget to support the energy code. This is because state agencies are known entities, generally exist forever, and are inherently associated with their statutory responsibilities in people’s minds. (e.g. you don’t have to think to know that car registration is done through the Department of Motor Vehicles.) Other organizations can deliver E&T (in the Northwest, non-profits, universities and trade associations play this role) but whoever has the responsibility must have long-term stability, because building the above-mentioned name recognition takes many years.

Relationship of the Four Types of E&T Activities

The Overview, Targeted, Site Visit and Technical Assistance elements can be thought of as a funnel which starts with broad, theoretical information at its widest point and then provides increasingly specific, practical information as it narrows (as shown in Figure 2). The comprehensive approach is necessary because most people need to hear information multiple times in multiple forms before they can confidently apply it on their own.

⁴ Having more than one person keeps things fresh for audiences and ensures continuity when individuals come and go.

Figure 2. Relationship of Energy Code Training Elements



NEEA's interest in Overview sessions has shifted several times. Initially we accepted them as a given since they seemed to be the standard way energy codes were taught. Subsequently, there was less interest as it became clear that they covered far too much information for anyone to meaningfully absorb, and presented it at such a superficial level that it would be difficult to apply even if one could remember it. Worse yet, it uses a teacher-centric format which in modern educational theory is associated with pedagogy (teaching children) rather than andragogy (adult education). Malcom Knowles, known as the father of andragogy, focused on the notion of adult education material being very learner centered and the learner being very self-directed, neither of which is true in typical Overview sessions⁵.

NEEA's ultimate acceptance of Overview sessions (i.e. willingness to fund them) came from the realization that while they are very poor at giving participants actionable information, they are an efficient way of creating general awareness about where important changes in the code have occurred. That awareness then provides an excellent basis for more targeted future learning.

The Targeted sessions retain some of the faults of Overview training (generally still a fixed curriculum in a lecture format) but because the focus is very narrow, instructors have more time to provide context and examples in addition to the technical content. Research by the Northwest Energy Efficiency Coalition found that context is particularly valuable in gaining acceptance of energy code changes: "It has been stated by many industry professionals that if more information about the purpose of these requirements were provided to the industry, those in the position of complying with and enforcing these requirements would be more likely to embrace them".⁶ Additionally, the narrow focus lends itself more easily to using physical props and field trips to construction sites, both of which help to engage the audience and increase the impact of the learning experience.

Site Visits and Technical Assistance are the activities best aligned with adult learning. Site Visits, in particular, are extremely valuable because in addition to being directly tied to participants' actual work they are flexible enough to accommodate different learning styles. This is critical in energy code E&T because, in addition to normal individual variation, the target audiences range from engineers and architects, who come from extensive formal education

⁵ Julie Conlan, Sarah Grabowski, Katie Smith. Department of Educational Psychology and Instructional Technology, University of Georgia. Review of Adult Learning. http://projects.coe.uga.edu/epltt/index.php?title=Adult_Learning#Training_strategies

⁶ Energy Code Compliance Barriers: Survey Of Building And Construction Industry Professionals. July 2011. Northwest Energy Efficiency Council. Seattle, WA.

backgrounds, to tradespeople, who may have attained most of their knowledge from hands-on experience.

Supporting E&T Activities

The focus of the paper to this point has been on efforts aimed at the audiences who interact directly with the energy code. Without complementary efforts that motivate and facilitate people to enforce and comply with the energy code, however, it is unlikely that even the best direct E&T efforts will succeed.

One of the largest barriers to achieving high energy code compliance is that many building department staff responsible for enforcement do not consider it a critical component of their job. The ambivalent and/or negative attitude of building officials towards the energy code has been extensively documented. As an example, the 2008 *Residential Building Energy Codes - Enforcement & Compliance Study* included this key finding: “Because it does not qualify as a life-health safety code, the energy code was reported to be a lower priority, receiving less attention from inspectors resulting in a lower likelihood of compliance.”⁷

A more recent example comes from the Washington Association of Building Officials, who published an official position statement on the energy code. Its third item states: “While the energy code supports important societal priorities, the enforcement of this code must not detract from a building department’s core mission of assuring a safe built environment through enforcement of minimum fire and life safety codes”.⁸

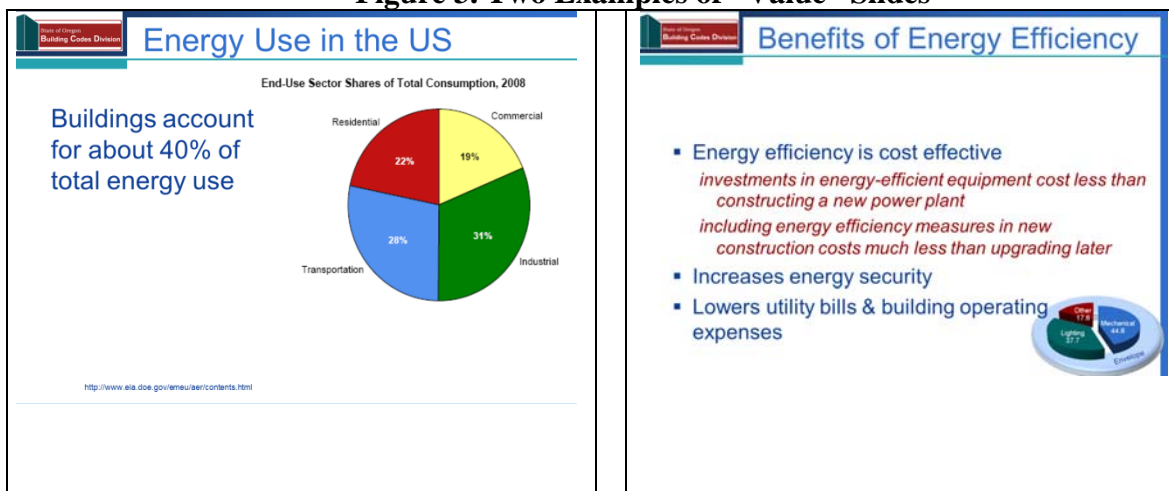
Ultimately, achieving high levels of compliance depends on all people involved placing a value on the energy code. Building departments must believe that it provides an important public benefit, and design and construction professionals must believe in the goals of the code or, at a minimum, believe that building officials will enforce it⁹. At the most abstract level, society itself has to evolve an ethos that saving energy is important and the recurring and increasingly prominent presence of energy efficiency in the mainstream media supports the idea that this is occurring. In the Northwest, we pragmatically address this in two ways. First, we try to include “value” slides at the beginning of direct trainings to answer the unstated question: “Why should I care?” The Overview session created by the Oregon Building Codes Division for its 2010 commercial code had a series of slides that addressed this. Figure 3 gives two examples.

⁷ Developed by the Building Codes Assistance Project. Prepared for and funded by the North American Insulation Manufacturers Association. October 2008.

⁸ WABO Position on Energy Code, adopted February 2012. <http://www.wabo.org/energy-code>. The sixth position item is: “WABO opposes unfunded legislative code enforcement mandates which place additional implementation burdens on local governments”. While understandable at a very broad level, this is a truly astounding attitude when it is focused solely on the energy code.

⁹ One of the most compelling reasons for the design and construction industry to attend trainings is a strong and integrated jurisdictional plan review and inspection program. If designers know that insufficient or incorrect energy code data submittal elicits a jurisdictional call for resubmittal, they are more likely to attend classes. And red tag corrections for energy code non-compliance at inspection gain the attention of builders and trades.

Figure 3. Two Examples of “Value” Slides



Second, we take the message beyond the building community. Obtaining the support of elected officials is critical at the city and county level, where they are in charge of building departments where the energy code will be enforced, and at the state level, where legislators often have a major role in determining whether an energy code will be adopted. (In the past three years in the Northwest, all four states have had energy code legislation introduced or have had legislative committees propose policies affecting energy codes, most of it negative.) Many national groups have recognized the link between elected officials and energy codes and have developed educational material targeted at gaining their support.¹⁰ In the Northwest, NEEA currently works with the Association of Idaho Cities, a “trade association” for municipalities, and historically has worked with the Association’s sister organizations in Washington, Montana and Oregon to reach out to and educate elected officials. These groups are directly connected to city mayors and state legislators and are generally extremely influential in the politics of a state.

Another excellent strategy for broadening understanding and support for energy codes is the creation of stakeholder collaboratives. This concept was pioneered in Idaho ten years ago with support from NEEA. The Idaho Energy Codes Collaborative includes state agencies, building officials, homebuilders, utilities, trade associations, universities and advocates. It serves as an on-going forum for discussion and an effective launching pad for action since its members are part of or have connections to virtually every organization in the state that works with or influences energy codes. The concept of collaboratives is now being recognized more broadly; the Building Codes Assistance Project recently solicited state partners to receive assistance in creating collaboratives, noting that, “Many states have adopted more modern energy codes, but are struggling to provide the requisite training, enforcement, and other support needed to fully implement and enforce the code. BCAP has funding to work with up to six states to develop statewide “Compliance Coalitions” to assist states in their effort to implement and enforce their newly adopted energy codes.”¹¹

¹⁰ See the resolution for mayors created and promoted by the Energy Efficient Codes Coalition (http://www.thirtypercentsolution.org/solution/Resolution_49.pdf) and the *Building Energy Codes Resource Guide: Policy Maker Edition* created by US DOE’s Building Energy Codes Program (<http://www.energycodes.gov/publications/resourceguides/policymaker.stm>)

¹¹ <http://www.bcaph-ocean.org/resource/new-opportunities-states-receive-assistance>

Beyond these education-oriented activities, maximizing the benefits of E&T requires many structural elements to be in place. Three critical ones are:

- *Measuring Compliance Rates.* Since this is the metric everyone ultimately cares about it needs to be measured on a periodic (every 3-5 years) basis using state-wide, statistically valid compliance studies. These studies provide a benchmark to establish or trend compliance rates and identify areas of the code with low compliance. They are also required for states to meet their legal obligations to achieve a 90% compliance rate under the American Recovery and Reinvestment Act. NEEA has appropriated funding to conduct residential and commercial compliance studies in each of the four states in its region.
- *Providing Tools and Materials.* Code support organizations need to make it as easy as possible for building officials and design and construction professionals to use the code. U.S. DOE's REScheck™ and COMcheck™ are good examples of this but field guides, templates for submittals, calculation/sizing spreadsheets and others may be helpful. All of these items become ongoing training tools for both the applicant and building department staff.
- *Effective Administrative Practices.* A study of building department data collection practices found many areas where code compliance could be improved¹², including the following two examples:
 1. A record review of one large building department showed a number of discrepancies between the REScheck and the Writesoftware for a specific submittal. When staff was asked about the differences it turned out that one person reviewed the REScheck and another reviewed the Writesoftware, but no one compared the two to see if they matched.
 2. A building official was not sure if the building inspector or the electrical inspector was supposed to look at the lighting in a new residence. Further questioning determined that the electrical inspector had not received any training on the 2009 IECC and he did not believe that the local electrical contractors had either.

Building department administration should become an important element of a comprehensive education and training program. In addition, it would be very beneficial to create a program where building departments could have a qualified individual assist them in assessing their administrative policies and procedures.

Costs and Benefits

Comprehensive energy code education and training at the level described in this paper costs far more than most states appropriate in their budgets. NEEA currently spends approximately \$750,000 per year on E&T for the four Northwest states combined; fully implementing the four-tiered vision described in this paper would require \$1-1.2 million dollars annually. NEEA is extremely fortunate to have support for this level of investment from utilities that understand the substantial long-term benefits that derive from high compliance rates.

¹² Balance of the text in this bullet taken from *Energy Code-Related Data Collection Practices in Northwest Building Jurisdictions*. July 5, 2011. This report contained findings from research conducted by a variety of NEEA contractors. It was compiled by NEEA and submitted to Pacific Northwest National Labs under an ARRA contract. Report is available from David Cohan at NEEA. (dcohan@neea.org).

While a serious benefit-cost analysis is beyond the scope of this paper, to show the logic of investing in E&T we have estimated, using conservative numbers, one scenario for the residential portion of the 2009 Washington State Energy Code. A technical analysis performed for NEEA calculated savings of approximately 900 kWh and 100 therms per home per year relative to the 2006 version of the code; at retail rates of 8¢/kWh and \$1.10 per therm this equals \$182/year. Just over 11,000 single family homes were built in Washington in 2011 so total consumer savings are a little over \$2,000,000 per year. Assuming utility avoided costs are approximately 40% of retail rates, the utility cost to supply this energy was \$800,000.

If we then assume – very conservatively – that a serious E&T campaign could raise compliance by just 10% and that the homes last just 20 years this justifies an investment of $\$80,000 \times 20 = \$1,600,000$ for the homes built in one year. (The E&T efforts affect all homes built in the three-year code cycle, however, so this could be tripled to \$4,800,000.) The actual amount NEEA spent on this code requirement was well under \$1,000,000 over 2½ years, so this was an extremely cost-effective investment on the part of our utility funders.¹³

Conclusion

A comprehensive approach to education and training for energy codes is a significant departure from the status quo which typically consists of high-level “overview” classes which make attendees aware of the type and magnitude of new code requirements but do not prepare them to implement the code. Adding different levels and types of E&T which target difficult areas of the code and offer help on the specific problems faced by individuals will help building officials, designers and builders properly apply the code and should lead to increased levels of compliance. Along with direct E&T activities there are a variety of activities which need to be undertaken to ensure a supportive atmosphere for energy codes and to provide tools which facilitate compliance.

Expanding E&T activities for energy codes will require far greater levels of funding than are currently available in most states but the benefits more than justify the investment, both for building and home owners and for utilities. NEEA plans to continue its pursuit of more comprehensive energy code E&T and will document results through both evaluation efforts and compliance studies.

¹³ Note that if one did compliance studies to validate an increase in compliance rate from E&T a more serious analysis of this sort could be conducted which could conceivably be used to convince regulators to give cost recovery to utilities who provide energy code support. Historically, regulators (and many utilities) have argued that ratepayer money should not be used for energy code support because the code, as a law, had to be complied with anyway. Proving that compliance rates are less than 100% and that E&T efforts can improve it opens the door to discussions of utility investment in this arena.