

New Energy Codes: Emerging Initiatives to Aggressively Support Compliance

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Abstract

As a result of national and international efforts toward aggressive new energy codes, architects and engineers are struggling to understand and comply with the new requirements. This paper addresses some of the newer initiatives and programs that support new construction market actors in their efforts to better understand and comply with the new generation of energy codes.

Typically, states provide assistance through classroom training for design professionals on updated energy code mandates. In Massachusetts, however, more comprehensive services have been offered, initially through a publicly sponsored pilot project and then a broader based program, to bring energy code training directly to architects' or engineers' offices. The assumption is that such services will improve energy code understanding and result in higher compliance levels.

This paper first presents a summary of commercial energy code requirements, focusing on misunderstood or difficult to comply with elements as viewed by design professionals. Information includes comparisons to the latest International Energy Code (IECC Chapter 8) and ASHRAE 90.1 – 1999.

We then focus on the Massachusetts technical assistance program (TAP) as a case study for compliance support. Over the course of the program, more than 150 no-cost, on-site consultations were conducted with A/E firms to address updated MA commercial energy code issues. Three-hour sessions were held in the design firm's office, facilitating open discussion about specific questions or project plans. Typically, sessions were attended by 15-20 design professionals. Sessions would address compliant design solutions for: envelope details (insulation, air, and vapor barriers); HVAC system sizing, equipment, and controls; and lighting technologies and control applications.

This paper also presents details on the next generation of support services and initiatives to support code compliance and beyond code designs for new buildings. Specifically, we discuss new developments in online, website-based services that provide an integrated combination of e-learning and expert technical assistance.

Introduction to Recent Trends with Energy Codes

During the past several years, a considerable broad-based effort has taken place to introduce new, more aggressive building energy codes. For commercial buildings (the focus of this paper) in general, the new energy codes are primarily based on ANSI/ASHRAE/IESNA Standard 90.1, and Chapter 8 of the 2000 International Energy Conservation Code (IECC). The IECC has become a model to which many states interested in new energy codes modify to create a code suitable for their jurisdictions. Several states have already adopted new energy codes, and many others are in the process of making modifications to ASHRAE 90.1 or the IECC as they develop their specific code.

New energy codes present a number of new requirements for buildings and building systems that will result in a higher level of energy performance.

Technically, most of the new state energy codes have a number of requirements that many in the design community believe will be a challenge for compliance. Commercial code requirements address building envelope, HVAC systems, and electrical /lighting systems.

In Massachusetts, a new energy code was adopted on July 13, 1999 and became effective on July 1, 2001. The code is based on ASHRAE/IESNA Standard 90.1-1989R and the IECC, with some elements that are far more aggressive than energy codes being adopted by most other states. Specifically for the building envelope, the Massachusetts energy code has unique requirements that call for both air and vapor barriers in all new commercial buildings.

Regardless of whether we focus on Massachusetts or other states, the new energy code requirements are far more challenging than previous mandates. A variety of services have been and will be required in order to support design professionals, building contractors, and others to effectively comply with the codes.

Formal Classroom Training

When a state introduces a new energy code, a common practice is to offer no cost classroom style training to members of the design and building community. Such training sessions are intended to introduce participants to the code requirements, both technical and administrative.

In the Massachusetts, for example, dozens of code training sessions have been offered with modules focused on the building envelope, HVAC, or electrical sections of their new code, or on the *COMcheck-EZ*TM compliance software. The various modules each last four hours and are formal PowerPoint type presentations. While some opportunity exists for questions, these training sessions are intended to address the more general needs of a large audience. While sessions are very valuable, the format limits the ability to address detailed specific issues that an attendee or their firm may have.

Technical Assistance Consulting: Discussion of Benefits and Process

Energy code technical assistance consulting services described in this paper are intended to be an additional important element in moving the building community to higher levels of energy code compliance. In contrast to formal training, these services are focused on serving the specific needs of a participating firm. The technical assistance sessions are informal and without a structured agenda. It is the participant's responsibility to define their needs, to bring up specific points related to the code for clarification, and to have specific projects ready for discussion. (Attendees are made aware of this responsibility ahead of time.) Additionally, the sessions are conducted at the participating firm's office, thereby simplifying and encouraging attendance of a larger percentage of their organization.

The goal of energy code technical assistance consulting is to clarify any confusion or misunderstanding that building design and construction professionals may have about new energy codes, and to support their efforts to better understand designs that are compliant with the codes.

Technical assistance sessions are an opportunity for peers to review designs and discuss how they satisfy or fail to satisfy new code requirements.

Energy & Resource Solutions (**ERS**) has been involved in two energy code technical assistance projects, both conducted in Massachusetts. The first was the Northeast Energy Efficiency Partnerships (NEEP) Energy Code Pilot Project. The second project consisted of the Massachusetts Board of Building Regulations and Standards (BBRS) Energy Code Technical Assistance Program (TAP). The NEEP pilot project ran from May of 2001 through November of 2001, and was comprised of 28 no-cost, on-site consultations with architectural/engineering firms. Three-hour sessions were conducted in the design firm's office, facilitating open discussion about specific questions or project plans. Sessions were typically attended by 15-20 design professionals and addressed compliant design solutions for: envelope details (insulation, air, and vapor barriers); HVAC system sizing, equipment, and controls; and lighting technologies and control applications. The Sessions allowed the design community to accomplish the following.

1. Better understand the actual requirements of the code
2. Be better versed at technical approaches for complying with the code
3. Learn state-of-the-art approaches for efficient design and construction practice
4. Think more creatively and more resourcefully

Based on verbal feedback and formal evaluation forms, the program was very favorably received. With minimal promotion, there was great interest in the sessions and the program was completed with a significant backlog of clients that could not be helped due to the budgetary limitations of the pilot effort.

Technical assistance sessions are now being sponsored directly by the Massachusetts BBRS. To date, the NEEP Pilot Project effort and the BBRS TAP have demonstrated a potential to truly improve fundamental building design practice and transform the market.

Typical Topics Addressed Through Sessions

The technical assistance sessions addressed the new Massachusetts Energy Code. Sessions addressed a broad range of energy code topics that fell into the following areas.^A

Administrative Requirements

Architects, engineers, contractors, and building owners seemed uniformly to have a need to understand the compliance process, the parties responsible for ensuring proper compliance, and consequences of non-compliance.

Building Envelope Requirements

There was considerable confusion about air and vapor barrier requirements. Session attendees also found the insulation requirement tables challenging to interpret.

^A While code-specific comments discussed at the sessions are specifically associated with the Massachusetts code, the issues general apply to most new state codes since they are based on ASHRAE 90.1 or the IECC as in Massachusetts.

Building HVAC Requirements

The largest topic of concern for mechanical systems was associated with load determination and system sizing. Other topics regularly addressed at the sessions included air economizers, heat recovery requirements, and the availability of equipment at certain efficiency levels.

Building Electrical System and Lighting Requirements

The most common lighting systems topic was how to meet control requirements. There is a general lack of familiarity with controls, and designers needed assistance with understanding code requirements. Other topics discussed were associated with lighting power density requirements for specific facility types. Many firms were unfamiliar with design techniques and technologies that would both allow adequate lighting levels and comply with the code. Most firms were unsure of the reasons for choosing to use the “space specific” or “whole building approach” to show compliance with the lighting power density requirements. Most disturbing was the fact that many firms were now beginning to make design choices based solely on code lighting power density levels, often over-lighting spaces.

Fundamentals of Energy Efficient Design Practice

It was readily apparent from most technical assistance sessions that energy efficient design practice has not been a high priority for many architects and engineers. The level of competence on the subject of energy efficiency is low compared to other architectural design subjects they address.

Attendee Perception of Codes and Compliance

While most session attendees were interested in learning what was necessary for code compliance, there was a general sentiment that the code was overly strict and that compliance would be a huge and costly burden. While architects and engineers who attended sessions would do all possible to develop compliant designs, contractors claimed they would do what was necessary in an effort to remain competitive.

Attendee Perception of Other Design and Building Community Disciplines

There seemed to be a uniform sentiment among design professionals that members of their own field could, and would, do a good job with code compliance. However, members of each discipline, felt that code compliance would be a significant problem for members of other design disciplines. In short, architects and engineers did not express confidence in each other, and neither group had confidence in a contractor’s ability to install or build systems to the designer’s code-compliant designs. In turn, contractors generally believe that they are being required to install systems that might not be properly conceived.

Discussion of Technical Assistance Administrative Process Tasks

This section provides a discussion of the process used for providing energy code technical assistance to architects, engineers, contractors, and other interested parties, as described in the following tasks.

Qualify Contact and Determine Needs

Upon initial contact, we verified the caller's eligibility for the program. Once an interested party was preliminarily qualified for a site visit, the project team worked with the main contact for the session to determine more specifically the nature of their interest or technical issues. The objective was to better understand their concerns, to encourage the customer's progress toward thinking through their problem(s) or issue(s), and to provide adequate information for the session presenters to aid in pre-session preparation.

Request Additional Information

We followed this task with a standard email to the key contact requesting a more detailed articulation of their specific questions. Most, though not all, firms provided a reasonably detailed response. In fact, many sent copies of applicable drawings and technical specification sections that effectively outline or indicate their unique issues. Although, we did not require each customer to respond in detail to our email request, our experience did show that the better sessions were for participants who did respond to such guiding requests.

Prepare for Session

From information gathered, the session presenters endeavored to effectively prepare for the technical assistance sessions. Preparation largely centered on technical review of the issues in question. Administrative tasks included ensuring session effectiveness by assigning the most appropriate project team member to each session. Additional information directed to us from the client company (drawings, technical specifications, etc.) was provided to the team expert.

At this point, the team experts performed a brief technical review of all provided questions, issues, and additional technical documents. In most cases, our experts were immediately familiar with these technical topics, but there were also some concerns of a unique nature that did arise. Our team undertook efforts to better understand such unique problems through review of the code or study of building and design practices that address the particular technical issue. We also had regular discussions with the BBRS or other organizations to help resolve more problematic concerns.

We also organized related ancillary materials to be brought to the session, including the following items: code section summaries; architectural drawing details; narrative report samples; and reference sources of information that was previously compiled.

Our objective has been to be as effectively prepared as possible so that each session was successful, and the benefits to client companies or organizations were optimal. In most cases, even with preliminary screening, it was during the session that we first truly understood the characteristics of a client's technical concerns. In such cases, we generally resolved issues during the session. Where ultimate resolution was not possible at the session, we invested the necessary time to develop resolution of key issues afterward.

Throughout the NEEP pilot program, we progressively experienced fewer and fewer issues for which we had to conduct post-session research to clarify code interpretation or technical approaches for problem resolution. Although some new issues did continue to arise, we quickly saw a common thread in the key issues pertaining to envelope, HVAC, or lighting that arose during the technical

sessions. Thus, more preparatory and post-session investigation of significant issues was required during the early stages of the project.

Discussion of Conducting Technical Assistance Program Sessions

The actual technical assistance sessions were the primary task of the TAP project, but preliminary efforts were also instrumental in ensuring the success of the sessions. Our fundamental objective for the sessions was to help participating design professionals understand whether their designs were code compliant and to improve their overall practice regarding design and construction of energy efficient buildings.

In addition to the technical role that session experts played, they also needed to be effective in the important function of session facilitator. In this role, the advisors had to be animated and dynamic. In effect, they had to be prepared and capable to motivate the group to ask questions, maintain focus, and limit potentially disruptive digressions. Our experience leads us to conclude that these interpersonal abilities, as much as technical expertise, were necessary to ensure support sessions were of high value and impact. Session facilitators were prepared to perform several functions and address several topic areas as listed below.

Code Clarification and Interpretation

While specific plans provided a basis for discussing some of the attendees' concerns, there were frequently other questions that did not strictly relate to a specific project. The project team's expert advisors were prepared to discuss any area of the energy code. In this regard, we supported participant efforts to clarify or best interpret particular sections or paragraphs of the code. When questions arose on the code for which we did not have an immediate response or clarification, we made attendees aware that we would discuss these details with other team experts or the BBRS, and then provided a follow-up response shortly thereafter.

Education on Technical Approaches (Envelope, HVAC, and Electrical/Lighting)

Frequently, session attendees understood the basic requirements outlined in some section of the code, but did not understand the technical approaches necessary to best comply. In these circumstances, the project team's expert advisors provided relevant detailed discussions of design approaches, technical equipment and systems, or construction techniques. Our team members brought documents with sample drawings or prototypical example materials to help educate attendees. We also presented information on additional technical resources that would be helpful to session attendees in improving their overall design approach as it pertains to energy efficiency.

Pilot Program Indicators of Success

Project team members viewed our role in the technical assistance sessions as consultant on energy codes and energy efficient design practice, explainer of code administrative requirements, and liaison between session participants and the State of Massachusetts.

We also had an additional major role—calming session attendees and motivating them to be more effective with code compliance and energy efficient design. Since participants did not see us as state officials who were judging their practice, they tended to be very open. In turn, they were highly

receptive to hearing our perspectives and seemed willing to consider a transition to more efficient design practices.

Session attendees were verbally positive about the value of the technical assistance sessions. Many individuals inquired about the possibility of receiving additional consulting, either for other company staff members or as an opportunity to review code compliance for additional projects. Other attendees claimed the sessions were valuable since there was the opportunity to reach more of their staff because the sessions occurred in their office.

The NEEP pilot project was successful beyond all expectations as determined through a number of key indicators, as follows.

Interest in Code Sessions

For the pilot project, energy code technical assistance sessions were largely promoted through announcements at formal code training sessions and through emails to groups of past training attendees. The level of interest in the technical assistance sessions was huge. Despite the limited number of email solicitations, there was never any difficulty in attracting participants to the sessions.

Number of Session Attendees

For each technical assistance session, there was a desire to get at least 10 attendees. In general, sessions had far greater attendance than this. In fact, at 35% of the sessions more than half of the firm's professional staff came to the sessions. The largest session had more than 35 attendees.

Verbal Comments During Sessions

At all sessions, attendees openly complemented the program, claiming that this customized approach was highly valuable and uniquely adapted to the cause of motivating higher levels of code compliance.

Request for Additional Sessions

Many participating firms and attendees asked if additional sessions could be arranged, either for others in their firm who could not attend or to discuss other specific projects and problems.

Evaluation Form Responses

Formal session evaluations were uniformly positive, with respondents claiming the sessions were valuable and would result in improved compliance and implementation of buildings systems that exceed code requirements.

Backlog of Firms Desiring Sessions

There has been continued interest in technical assistance sessions, even after completion of the pilot project. There was a backlog of interested firms after all available sessions were completed.

Immediate Implementation of Design Ideas

At several sessions, design firms made on-the-spot revisions to plans that were “in progress.” These changes involved building envelope details, HVAC control specifications, lighting fixture and design choices, and lighting control details.

Recommendations for Next Steps

Based on our efforts through the pilot project and the associated success, **ERS** has developed a series of recommendations to improve the overall objective of enhancing code compliance. This section discusses our program or process recommendations for offering similar or related services.

Expand and Continue the Technical Assistance Program

As previously stated, there was considerable interest and a favorable reception to the pilot project. Further, for most sessions, a significant percentage of a firm’s professional staff attended each session. We believe the technical assistance sessions should be continued, marketed to a wider variety of firms, and there should be opportunities for firms to receive multiple sessions. The sessions have a primary objective of improving code compliance. Availability and persistence of such assistance programs have a considerable likelihood of progressively educating design professionals and creating a firm that is more capable of effectively complying with codes.

It is important to understand the limitations of formal training relative to on-site, customized technical assistance oriented to a firm’s specific projects. Most firms send a relatively small percentage of their staff to out-of-office seminars or training, even when there is no fee involved. In contrast, as the pilot project demonstrated, in-office, project focused sessions are often attended by a large percentage of staff, including both senior and junior staff. Thus, code technical assistance sessions can impact both management who have the prime decision making authority on a project, and junior staff who work on the project details and can then implement better practices for subsequent projects.

As we stated previously, the BBRS is now sponsoring a much larger scale technical assistance effort for Massachusetts. While the NEEP Pilot Project consisted of 28 sessions, the goal of the BBRS effort is to provide more than 100 sessions.

Expand General Training Opportunities

It was immediately apparent through the code sessions that many professional designers repeat aspects of designs from previous projects, whether those represent good or bad practice. Many designers, both architects and engineers, seemed to have lost their edge in developing energy efficient designs or incorporating energy efficient systems. We believe the objective of improved compliance would be well served through offering a series of specific technical courses, centered on technical approaches for compliance with sections of new energy codes.

The following sections represent our perspective on several training agendas that we believe would be helpful in achieving the overall objectives of improved energy code compliance and increased energy efficiency. In general, we believe that each discipline (architects, engineers, contractors,

vendors, etc.) will be best served through focused training topics for their particular group, rather than dilute the effectiveness of an agenda by catering to too wide an attendee background.

General Energy Efficiency Training for Architects

Architectural education and most design practices place very little emphasis on designing for energy efficiency. In addition, a general lack of understanding of building science details was also apparent in sessions we conducted with architecture firms. We recommend offering energy efficiency/building science training for architecture professionals. We believe this approach will have significant results since attendees would develop a much greater appreciation for the impact of their designs on building energy operating costs. Further, we believe architects will be highly receptive since they must meet specific continuing education requirements.

Load Estimating/Equipment Sizing Training for HVAC Engineers

During technical assistance sessions with engineering firms, we discovered a general lack of understanding about proper load determination approaches and associated equipment sizing. Similarly, while many HVAC design engineers are well versed in design with efficient technologies and systems, there are a considerable number of buildings where systems choices indicated poor judgment. For example, many buildings are designed with less efficient air-cooled systems in lieu of more cost-effective water-cooled technologies. We believe general training in load determination techniques, equipment sizing, and appropriate system selection would achieve considerable benefits, both in increased reception to code compliance and in overall improved efficiency.

Summary Energy Efficiency and Code Training for Contractors

Contractors generally do not focus on the energy efficiency aspects of their projects. Their primary objectives are to build buildings and install building systems cost effectively, and to ensure the projects operate properly. We believe general energy efficiency training that demonstrates the energy operating cost impacts of various systems would increase contractor sensitivity toward properly installing designed energy efficiency features. The focus of this type of training would be on installation and operation of energy efficient systems, not on design aspects.

Summary Energy Efficiency and Code Training for Vendors

Vendors are frequently intimately involved in the design, equipment selection, and installation of many building systems. They regularly work with architects, engineers, contractors, and building owners. Unfortunately, many vendors do not understand or appreciate the benefits of energy efficiency. We recommend training for vendors that educates them on the basics of energy efficiency, similar to that suggested for contractors. The hope is that such training would motivate them to promote products in their lines that support both code compliance and more appropriate energy use.

Energy Efficiency and Code Training for Architecture/Engineering Students

Both architecture and engineering students have limited exposure to the basics of energy codes and energy efficiency during their formal education. We believe that training in these subjects during a

designer's formative stages would ultimately result in a higher percentage of firms that are staffed by designers capable of producing more energy efficient and energy code-compliant buildings.

Improve Outreach for Non-Architectural Firms

For a variety of reasons, specifically since professional registration databases were used for program marketing, formal code training attendees tended to be dominated by architects and engineers, with the primary focus on the architectural community. This situation was also somewhat true of the technical assistance sessions provided through the pilot programs. We believe there should be enhanced outreach to a broader range of organizational types (contractors, vendors, building owners, property managers, etc.). This approach will expand the impact of these educational and support services, and result in improved compliance and energy efficiency.

Expand Process to Other States

Few states have had state-sponsored energy code technical assistance sessions other than Massachusetts. As other states adopt new energy codes, we believe this type of technical assistance should be offered in addition to formal code training. As we have stated, there has been a very enthusiastic reception to this service in Massachusetts, and we believe the impact of the service will be enhanced compliance with the new Massachusetts commercial energy code. Similar results could be anticipated in other states.

Distribute Simplified Listing of Compliant HVAC Equipment

Many HVAC design engineers with whom we have worked are poorly informed regarding the availability of efficient equipment of various types. Numerous engineers have claimed that equipment of certain code-mandated efficiencies are unavailable, while in fact, essentially all mandates are based on readily available stock. We recommend distribution of a simplified list of major manufacturers offering equipment lines or products that are compliant with the energy codes.

Develop Support Service for Code Administration and Documentation

Many firms that we visited demonstrated the technical ability to deal with code issues, but were seeking to avoid code compliance because they were unsure about their ability and/or responsibility in terms of compliance documentation. Architects and engineers, although highly trained in the technical aspects of their fields, are often ill equipped to deal with preparation of code compliance narrative reports and other administrative details. A well conceived effort to provide this type of assistance to design professionals would not only provide code officials with more effective documentation, but would enhance compliance through the lessening of what is viewed as a burdensome task.

Distribute More Samples of Narrative Reports

Currently, the Massachusetts Energy Code requires a narrative report. This document is simply a concise outline of how the design form has complied with the various elements of the code. To date, a single sample narrative report has been made available as an example or template to demonstrate expectations. Such sample documents are extremely helpful for design firms. We recommend

development and publication of several additional templates, representing a wide array of building types and system complexities.

Distribute Code Compliant Architectural Detail Drawings

We believe it would be very helpful to the architectural and building community to have architectural detail sample drawings for all primary construction types. Such samples would indicate typical arrangements for air barriers, vapor barriers, and insulation in wall sections, roof sections, windows, and the connections between these and other building components.

Distribute Sample Lighting Layout and Control Drawings

Similar to the previous recommendation, we believe it would be extremely valuable for those involved in lighting system and control design to have the benefits of several sample drawings to use as the basis for code-compliant, energy efficient design. In numerous sessions, it became apparent that architects, engineers, or vendors developing lighting designs had limited knowledge of truly effective designs that did not sacrifice lighting performance for code compliance. Such samples could create a framework on which many designers would model their subsequent project designs.

Produce Checklists and Simplified Guides to Support Code Official Efforts

During many of our sessions, design firms asked if code officials were properly trained on code requirements, and whether they have all the tools necessary to effectively assess energy code compliance. While additional training geared towards officials may be helpful, it may also further tax this already busy group. We believe it would be most helpful to develop some support materials that assist code officials in assessing energy code compliance more effectively. Two items are suggested: a condensed guide to the energy code that would be a simplified overview illustrating the primary requirements and presenting key areas where compliance may be deficient; and a checklist (1-2 pages) that simplifies the review process of design documents and inspection of the facility in question.

Produce Simplified Guides of Available Utility Programs and Requirements

Although most utility companies expend considerable time and expense promoting their conservation programs, their target audience has primarily been end users. While conducting our sessions, we did not find a single architectural firm that had a good working knowledge of the utility efficiency programs in their clients' service territories. Engineering firms were only slightly better versed in these programs. Because additional cost is often cited as a deterrent to incorporating energy efficient construction techniques, it is imperative that the design community recognizes all of the financial resources available to assist in energy efficient design/construction. Energy codes and utility efficiency programs are interrelated and can work together toward a common goal of energy efficiency. The production and distribution of a simplified guide to utility programs would greatly enhance this synergy.

Integrate Code Technical Assistance Efforts with Utility Programs

Through recent discussions with utility program managers, it is increasingly apparent that utility staff members are also not well informed on code requirements and their impact on utility programs. We suggest the following.

Technical Assistance Sessions for Utilities

We suggest several code technical assistance sessions be conducted at each utility with new construction programs. Utility program managers and their staff would be encouraged to bring sample drawings from new construction projects so that these can be assessed for code compliance. During such sessions, it could also be determined whether customers are receiving incentives for projects that are either just meeting code or not even in compliance.

Utility Program Overview Sessions for Design Firms

We recommend that utilities or their designated consultants provide program information sessions at architecture and engineering firms. These sessions could address potential for incentives for active or future projects. Such sessions could also be piggybacked with upcoming code technical assistance sessions.

In general, we believe that the lack of awareness of code by the utilities, and utility programs by the design community, results in many lost opportunities for higher performance buildings. Many other ideas, in addition to those stated above, should be investigated for enhancing general cross-community awareness.

Concluding Remark

During more than two thirds of technical assistance sessions, firms indicated that they would be able to better comply with the new energy code as a result of the session. This attitude applies to design firms who claim they now have an enhanced understanding of the new requirements, and to contractors who claim they previously did not make compliance a priority. Such changed perspectives are indicators of the general value and success of the technical assistance effort.

References

1. Department of Energy (DOE). 2002. *Status of State Energy Codes*. Washington, DC.: U.S. Department of Energy, Office of Building Technology, State and Community Programs. www.energycodes.gov/implement/state_codes/index.stm.
2. ANSI/ASHRAE/IESNA. 1999. *Standard 90.1-1999*. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).
3. International Code Council. 1999. *International Energy Conservation Code 2000*. Falls Church, Va.: International Code Council.
4. Commonwealth of Massachusetts. 2001. *Massachusetts Energy Code, Chapter 13 (780 CMR Chapter 13)*. Boston, Mass.: Commonwealth of Massachusetts Executive Office of Public Safety-Board of Building Regulations and Standards.