Michael V. O'Brien
City Manager

CITY OF WORCESTER

Corrected Copy

cm2010apr07110428 Attachment for Item # 8.6 A

April 13, 2010

TO THE WORCESTER CITY COUNCIL

COUNCILORS:

I respectfully request City Council's review, deliberation and adoption of Appendix 102.AA of the Massachusetts State Building Code ("Stretch" Energy Code).

As part of our ongoing climate action initiatives and in accordance with the State's Green Community Act, the City has been actively pursuing designation as a "Green Community." This designation will set us apart as a leader in energy conservation and efficiency, and green public policy, and make us more competitive for new State and Federal grants. If designated a "Green Community" by the Commonwealth, the City will also be eligible to apply for up to $1 million in grants annually, made available from the Regional Greenhouse Gas Initiative. These grants can be used to fund energy-efficiency initiatives, renewable energy projects, and innovative development.

Communities must meet five requirements to qualify for this designation:

- Allow for "as-of-right" zoning for renewable or alternative energy generating facilities, renewable or alternative energy research and development facilities, or renewable or alternative energy manufacturing facilities in designated locations;
- Establish an expedited application and permitting process for these qualified renewable-energy facilities/projects;
- Conduct an energy use audit for municipal buildings, vehicles and street and traffic lighting, and implement a program designed to reduce energy use by 20% within five years;
- Commit to purchase fuel-efficient municipal vehicles when procuring non-emergency vehicles; and
- Adopt energy-efficient building code requirements.

The City has satisfied four of the five requirements through the efforts of the Division of Planning and Regulatory Services and in coordination with other municipal departments. The final requirement for designation as a "Green Community" is the local adoption of energy-efficient building code requirements (known as "stretch code"). This amended energy-efficient building code was signed into law by Governor Deval Patrick in July 2008 as part of the Green Communities Act and later adopted by the Massachusetts Board of Building Regulations and Standards in May 2009 as a local option appendix to the Massachusetts Building Code 780 CMR. Adoption of the "stretch code" is a local option for cities and towns; however, it is expected that it will become part of State Building Code within the next two to three years. It is referred to as "stretch code" for the State legislation made it a local option for communities to adopt in advance of the code's full implementation date in three years, hence the "stretch."

This local option amends existing Massachusetts building and energy regulations by requiring new construction (both commercial and residential) to adhere to higher energy-efficient practices. The new regulations would apply to all new residential construction; commercial construction (over 5,000 square feet floor area); residential additions and renovations; and affordable housing projects.

Adoption of this energy-efficient building code will yield long-term environmental benefits and reduce energy usage, resulting in significant cost-savings over the life cycle of a building/home. If a building was constructed in accordance with the enhanced regulations, new residential and commercial buildings would see between a 20%-35% increase in energy efficiency. In almost all cases, expected annual energy savings from complying with the new regulations will exceed the initial upfront cost. Anticipated payback period for commercial projects is two to four years while residential is estimated at five to nine years. The energy-efficient building code are roughly equivalent to meeting the Energy Star for Homes standard. In 2008, 15% of all new residential construction in Massachusetts satisfied the criterion of the "stretch code." When and if we receive designation as a "Green Community" and the resultant grants, it is our intention to use these funds to provide mini-grants to help applicants off-set the upfront costs of the required energy efficiency measures during this "stretch" period.

Among the cities that have recently adopted the energy-efficient building code are Newton, Cambridge, Springfield, Greenfield, and Lowell in addition to a number of

towns. Additional cities and towns are expected to adopt the code over the next few months, increasing the number of municipalities that will be eligible for application for "Green Community" designation and enhancing the competition for grant funds. It is important to note that all communities will ultimately be required to adhere to the amended code once the State Building Code is revised.

In order to provide for a sufficient transition period, I sought and secured the support from the State to carry a compliance date of July 1, 2011 if adopted by the City Council in May 2010 as recommended. If adopted in May 2010, we will have a little over a year to transition to the new regulations; this will provide sufficient time to educate homeowners, businesses, developers, and contractors to ensure that the community is well-prepared for full implementation of the new energy-efficient building code by July 1, 2011. There will be a six-month concurrency period from January 1, 2011 until July 1, 2011, in which any new project that requires a building permit would be subject to either the energy-efficient building code or the current building code, at the discretion of the applicant. The outreach program will not only inform stakeholders of the change in building code but will also market the proposed mini-grant program aimed at defraying some of the costs for those choosing to upgrade their homes.

The deadline for our "Green Communities" application is May 14, 2010. The City must achieve all five requirements of the Green Community Grant Program including adopting the code by the beginning of May 2010 to be eligible for the first round of grants.

I respectfully recommend that this item be referred to the City Council's Standing Committee on Economic Development for further review and consideration. With and upon City Council's deliberation and concurrence, I would respectfully request the adoption of the attached order.

Respectfully submitted,

Michael V. O'Brien
City Manager

CITY OF WORCESTER, MASSACHUSETTS

Executive Office of Economic, Neighborhood & Workforce Development
Planning and Regulatory Services Division

Julie A. Jacobson
Assistant City Manager

Joel J. Fontane, Jr
Director of Planning and
Regulatory Services

To: Michael V. O'Brien, City Manager

From: Julie A. Jacobson, Assistant City Manager

Date: April 8, 2010

Re: Stretch Code Consideration

The City of Worcester, through its Energy Efficiency and Conservation Program, has been actively pursuing the State's designation as a "Green Community" as part of its Climate Action Plan initiatives and in accordance with the State's 2008 Green Community Act. This prestigious designation benefits the City on multiple levels. It provides recognition for our community-wide efforts to conserve energy, identify and utilize renewable energy sources, implement recycling programs, and promote the reduction of energy and fuel use both as a municipality and as a community. It also would enable the City to promote itself on a regional, national and global basis as a City that is attractive to companies in the green energy sector, thus boosting our economic development business attraction and expansion activities. Most importantly, Green Community designation signifies the City of Worcester's commitment to cost reduction and energy saving measures for homeowners, businesses and municipal fleet and facilities. Rising energy costs will continue to be a challenge that residents, businesses and cities across the country will face, thus we must continually seek to reduce those costs through energy efficiency and conservation measures, especially those which have favorable economics over the life cycle of the products and buildings and generates value to property owners.

To be designated as a "Green Community", a municipality must meet the following five criteria under the Massachusetts Department of Energy Resources (DOER) Green Communities Grant Program:

1. Provide as-of-right siting of renewable or alternative energy generating facilities, renewable or alternative energy research and development facilities, or renewable or alternative energy manufacturing facilities in designated locations **(Status: Completed)**;
2. Establish an expedited application and permitting process under which these energy facilities may be sited within the municipality and which shall not exceed

one year from the date of initial application to the date of final approval **(Status: Completed)**;

3. Establish an energy use baseline inventory for municipal buildings, vehicles and street and traffic lighting, and put in place a comprehensive program designed to reduce this baseline by 20% within five years of initial participation in the program **(Status: Meets criteria as it is under development w/ ESCo)**;

4. Commit to a fleet replacement program under which the city agrees to purchase fuel-efficient vehicles for municipal use whenever such vehicles are commercially available and practicable. *Emergency vehicles are exempt.* **(Status: Meets criteria as it is under development)**; and

5. Adopt energy-efficient building code requirements to minimize the life-cycle cost of the facility by utilizing energy efficiency, water conservation and other renewable or alternative energy technologies. **(Satisfied by adoption of Stretch Code)**.

The legislation package adopted by the City Council on January 5, 2010 satisfies criteria one and two by allowing as-of-right siting of research and development facilities and manufacturing facilities related to renewable or alternative energy in appropriate zones throughout the city. This legislation also provides for an expedited permitting process as required. The third and fourth criteria have been satisfied by ongoing ESCo activities and the administration's commitment to a fleet replacement program. The remaining criterion to be met is the adoption of the stretch or energy efficiency code.

The following provides a summary policy analysis of the stretch code and recommends its adoption.

Overview – The "Stretch Code"

In July 2008, Governor Patrick signed into law a Green Communities Act which, in part, created the Green Communities Program within the State's Department of Energy Resources and required the state to adopt each new IECC (International Energy Conservation Code of the International Codes Council) as part of the state Building Code within one year of its release. IECC 2009 is based on real-life testing of residential and commercial energy efficiency measures in Massachusetts climate, specifically Boston. The act also included a local option "Stretch Code" that, if adopted, requires more efficient building design and construction.

According to the State, "Appendix 120.AA, known as the 'Stretch Code,' was adopted by the Massachusetts Board of Building Regulations and Standards (BBRS) in May 2009, as a local option appendix to the Massachusetts Building Code 780 CMR. This code was developed in response to the call for improved building energy efficiency in Massachusetts. The intent of the stretch code is to require approximately 20% more energy efficiency than the base code alternative (IECC 2009)[1], and focuses on actual performance in the field to ensure energy savings are realized." Similar to the IECC, the State expects that the stretch code will be updated every three years and that it will maintain the roughly 20% high efficiency "stretch" over the base code. Upon update,

[1] Currently, Massachusetts uses IECC 2006 Energy Code with 2007 amendments. In accordance with the requirements of the Green Communities Act in Jan 2010 the Board of Building Regulations and Standards (BBRS) amended the Building Code, requiring the use of the 2009 International Energy Conservation Code (IECC) with MA Amendments, instead of IECC 2006. IECC, or energy code, is a part of the 2009 "I" Codes.

both the BBRS and, subsequently, the Municipalities that adopt it have the option to discontinue the stretch code if desired.[2]

The Stretch Code applies to new construction, additions, and renovations with some exceptions. **Attachment A** provides summary matrices that present the Stretch Code and its applicability, requirements and estimated energy use reduction by type of construction.

Commercial Construction. For new construction the Stretch Code's requirements are expected to yield approximately 20% greater building efficiency over either code path: IECC 2009 or ASHRAE 90.1-2007. **Attachment B** summarizes Stretch Code requirements for new construction and large additions to commercial buildings including exemptions based on size and use. Building renovations are exempt, and would use the base energy code.

Residential Construction. For new construction the Stretch Code appendix codifies the requirements of the current federal Energy Star Homes program approximately at the "Tier 2 level". This means that buildings constructed to this standard will be approximately 20% more efficient than those built to IECC 2009 standards. Another important aspect of the stretch code for new construction is that it requires third party testing and a certified (HERS)[3] rating of a building's energy performance. Residential buildings constructed to the Stretch Code standards would qualify for subsidies through the Energy Star Homes program and may also qualify for a $2000 federal tax rebate. According to the State DOER, over 15% of the new residential construction in MA is already constructed to Energy Star standards; adoption of the Stretch Code would effectively require all to be. **Attachment C** summarizes Stretch Code requirements for new construction, additions, and renovations to residential buildings.

Policy Discussion. The overarching reason for considering this local option has to do with our policy goals related to reducing greenhouse gases – a central theme of the City's Climate Action Plan and its Energy Efficiency and Conservation Program. The adoption of the building stretch code is an effective way to make a significant community-wide change that should yield considerable environmental benefits in the long-term and provide an important hedge against energy price increases for buildings constructed to this standard. It also would set the City of Worcester apart as a leader in this area of public policy, and enable the City to apply for State grants[4] before the applicant pool is large and make the City more competitive for other grants from the State and Federal government and foundations.

> **Grant Opportunities.** Adopting the Stretch Code satisfies *one of five* key requirements (mentioned above) that together will enable the City to achieve "Green Community Status" and, through that designation, make the City eligible to apply for *up to* $1M from the Green Community Grant Program. This

[2] Source: DOER Website.

[3] "This index scores a home on a scale where 0 is a zero-net-energy home, and 100 is a code-compliant new home (based on the IECC 2006 code). The stretch code requires a HERS index of 65 or less for new homes of 3,000 square feet or more and 70 or less for new homes below 3,000 square feet (including multi-family units in buildings of three stories or fewer). A HERS index of 65 means that the home is estimated to use 65 percent as much energy as the same home built to the 2006 energy code, or a 35 percent annual energy savings." – Source: DOER Website, accessed Mar. 10, 2010.

[4] From the Green Communities Grant Program provided all five requirements mentioned previously are met.

competitive grant program has $7M remaining to allocate this year, but is required to allocate a total of $10M annually thereafter to designated "Green Communities". Given the State's difficult fiscal situation, it is unclear whether the total pool of funds will rise over time but we do expect that it will be maintained, although competition will likely increase as more communities apply for Green Community designation.

One of the key benefits of early adoption of the Stretch Code is that applicants for the first round of grants will face the least competition and have the largest pool of funds from which to be awarded because few (15-30 out of 351)[5] municipalities are expected to achieve "Green Communities" status this spring. This bodes well for the City of Worcester to obtain a grant since the City has just completed a city wide energy audit that identified multiple eligible projects, particularly renewable energy projects. We also expect that our vehicle fleet efficiency improvement plan, currently under development, will be looked upon favorably by the Green Communities Grant Program.

Upon being designated a Green Community, I recommend that the City's first grant proposal to the DOER - Green Communities Grant Program be to fund an outreach and sub-grant program administered by the City of Worcester. The outreach portion of the program will inform developers, businesses groups and residents about the energy efficient stretch code prior to it coming into effect in Worcester, which I recommend occur July 1, 2011. This nearly 14 month transition period will commence with City Council's adoption of the stretch code recommended to be May 2010, to enable the City to apply for Green Community designation by the May 14th deadline. This transition period will provide the administration with sufficient time to apply to the Green Communities Program and set up the City's outreach program in advance of the stretch code coming into effect in Worcester. The outreach program will not only inform stakeholders of the change in building code, but it will also market a residential sub-grant program administered by the City aimed at providing grants funds to those upgrading their homes to meet the stretch code. The specific details of this program are currently under development and will be subject to approval by DOER's Green Communities Grant Program prior to commencement.

Costs and Benefits of the Stretch Code. The fact that the adoption of the stretch code is a local option could lead to differential community adoption and possible competitive disadvantage for those that do. The level of this disadvantage, if any, is difficult to assess since although the upfront costs to construct a building to this standard are 1% to 4% higher[6], the energy efficient investments required by the Stretch Code pay for themselves in the near term and serve as a hedge against rising energy prices. The importance of the up front costs and this hedge depends on the relative contribution of energy costs to the operation of a business or household.

[5] Note: Acton, Cambridge, Greenfield, Kingston, Lexington, Lincoln, Lowell, Montague, Newton, Springfield, Sudbury and Tyngsboro have all recently adopted the Stretch Code.

[6] 2% to 4% for residential new construction and 1% to 3% for new commercial development: See Q&A for MA Stretch Energy Code Appendix 120.AA 09-15-2009 Page 3 of 10 included in attachments

Based on our research, we do not believe that adoption of the stretch code will have a negative effect on commercial development over its anticipated three year effective period. Moreover, upon update of the building code, municipalities can reassess whether to maintain the 20% energy performance "stretch" and choose to adopt the standard base code instead. Last, given that the 2009 "Stretch Code" requirements are highly likely to be incorporated in the 2012/13 base building code, the adoption of the "stretch" code would only accelerate by three years what is likely to become the standard anyway. Our preliminary outreach to developers and construction firms has indicated general support for adoption of the stretch code at this time.

Impact on Commercial Development. The business case studies provided by the State indicate a quick return on investment, less than 2 year payback[7], but are heavily dependant on utility rebates. For example, in the Fidelity Bank case **(see Attachment D)**, the return on investment was 3.7 years without incentives but 1.2 years with incentives[8]. We expect that utility rebate programs will continue to be able to provide mitigation as they are expected to be augmented over the time horizon of this Stretch Code adoption (about three years).

In addition, the Stretch Code has incorporated the following important *exemptions* for commercial buildings that provide relief for small businesses among others:

- Commercial buildings smaller than 5,000 SF
- Commercial renovations and existing interior fit-outs
- Special cases – buildings with unusual energy demands (supermarkets, labs, warehouses) – ***smaller*** than 40,000 SF

Impact on Residential Development (2006/7 Base Code vs. Stretch Code). As compared with commercial development, the financial returns on investment are slightly longer for residential new construction, additions and renovations. It is important to note that the following analysis provides a comparison of the 2006/7 base building code vs. the Stretch Code. Approximately *half* of the costs presented here are attributable to the recently adopted (January 2010) State base building code (IECC 2009) *not* the stretch code. Put another way, half of the incremental costs noted will occur regardless of whether or not the City Council adopts the stretch code as proposed.

For new construction, compliance with the stretch code could increase construction costs by ~$8K for a "typical" new home cited by DOER **(see Attachment E)[9].** These costs, however, are mitigated by avoided energy costs.

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[7] Payback periods greater than 2 years are less attractive to private sector investors who typically have short time horizons and alternative investment options. Exceptions include building headquarter locations and buildings that will be held in a company's portfolio long-term.

[8] It is important to note that the Fidelity Bank case is based on meeting the earlier voluntary 'Core Performance' program rather than the 'Core Energy Code' which forms the prescriptive stretch commercial code. According to DOER's Ian Finlayson, "[…] the bank case study is indicative but not the same as a true case study of a building meeting the stretch code" (e-mail Mar. 18, 2010). DOER does not have any examples of buildings meeting the actual 'stretch' code yet because it has only recently been developed.

[9] "New residential buildings three stories or fewer will be required to meet an energy performance standard using the Home Energy Rating System3 (HERS). This index scores a home on a scale where 0 is a zero-net-energy home, and 100 is a code-compliant new home (based on the IECC 2006 code). The stretch code requires a HERS index of 65 or

As shown in the example provided in the attachment, the value of the energy savings exceeds the cost to finance throughout the entire term of the mortgage. This greatly reduces the upfront costs[10] of making these efficiency investments. In addition, utility programs and various federal tax incentives can also reduce these costs should they continue as expected. Based on contemporary fuel prices and interest rates, these costs are recovered[11] in about 14 years without incentives and about 8 years with incentives before taxes, and approximately 5 to 9 years after taxes[12]. Moreover, despite having a payback period that exceeds the average time a person lives in a home, it is likely that much of the value of these efficiency investments will be recaptured upon resale, particularly if energy prices increase. Other benefits include greater comfort through the reduction of drafts caused by leaks and poor insulation and, of course, the environmental benefits of a high performance building, all of which are realized immediately.

Although residential additions are held to a similar standard as new construction, residential renovations are held to a lower standard (**see Attachment C**). As mentioned above, the incremental costs associated with the stretch code are only a portion of the total costs represented in this analysis, which includes the costs associated with the new IECC 2009 base code (adopted by the State already) and the local option to adopt the Stretch Code. As shown in the example provided in the attachment, the value of the energy savings exceeds the cost to finance throughout the entire term of the mortgage.

From a return on investment point of view, our analysis of the DOER Three-Family renovation example, finds that the costs incurred for renovations less than 2,000SF take about 14 years to recover[13] without incentives and renovations greater than 2,000SF do not have a positive financial return on investment. Note the assumption in the example provided by the State DOER is that three independent gas heating systems are installed **(see Attachment E)** and does not include the benefit of depreciation and other tax deductions. Returns on investment would improve if, instead of installing separate heating system for each unit, only one system was installed for the entire building. This has the operational drawback of having to include heating costs in monthly rent. Of course, the comfort and environmental benefits mentioned above also pertain to high performance residential renovations required under the stretch code.

Impact on Development in the Pipeline. The adoption of the stretch code has environmental benefits and may have some cost implications for commercial and residential projects in the future, although larger projects may already be under design to incorporate energy efficient measures that comply with the stretch code. After assessing our development pipeline, we believe that the grace period after adoption until full implementation in July 2011, more than 12

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less for new homes of 3,000 square feet or more and 70 or less for new homes below 3,000 square feet (including multi-family units in buildings of three stories or fewer). A HERS index of 65 means that the home is estimated to use 65 percent as much energy as the same home built to the 2006 energy code, or a 35 percent annual energy savings." DOER.

[10] Typically mortgage a down payment is 5% to 20% of the value of the loan. Thus the upfront costs of the $8,103 energy efficiency investment are significantly lower - $400 to $1,600.

[11] Defined as the length of time the investment achieves a positive net present value.

[12] Assuming 25% marginal income tax bracket and net incentives of $3,000 to achieve positive NPV in 5th year.

[13] Defined as the length of time the investment achieves a positive net present value.

months[14], will provide sufficient opportunity for several major projects to apply for building permits and, therefore, be exempt from this change should they be prepared and desire to do so. Moreover, our housing affordability programs currently recognize federal policies related to energy efficiency and already fund energy star compliance. Therefore, adopting the Stretch Code will not adversely affect the City's housing affordability programs.

Impact on City Operations. The adoption of the Stretch Code will require an additional four credit hours of training for all building officials before they can enforce the requirements of the Stretch Energy Code. According to Official Interpretation[15], "[...] the Building Official Certification Committee – an arm of the BBRS – has assigned 4 hours of continuing education credit to each of the two (2) training modules (Residential and Commercial). [...] The Stretch Energy Code training currently provided in the complete Massachusetts Building Energy Codes Trainings for 2010, (Residential + Commercial modules) presently satisfy BBRS policy requirements." This training is provided by the State at no cost to municipalities. According to the Acting Commissioner of Inspectional Services, all building officials will complete this training prior to July 2010. Inspectional Services is currently assessing the incremental workload the Stretch Code enforcement will cause. Since the Stretch Code requires third party HERS raters to certify performance in accordance with the Stretch Code this may be less than would otherwise be required.

Conclusion. Adoption of the building Stretch Code will yield not only significant long-term environmental benefits that in most cases pay for themselves, but it will also make the City of Worcester a leader in environmental policy and highly competitive for grant monies. With the creation of a mini-grant program to assist homeowners undertaking renovations that comply with the stretch code, we will be able to mitigate some of the associated costs that homeowners will face in two to three years when the state likely makes the stretch code its base building code.

Please note that to be eligible for the first round of Green Community grants ($7M) the City Council must adopt the stretch code by the beginning of May 2010. The Division of Planning and Regulatory Services will coordinate with the State to make a presentation on the details of the stretch code and cover frequently asked questions **(see Attachment F for both)** at the City Council's public hearing on the matter.

I respectfully recommend that the City Council refer this item to the Economic Development Subcommittee for a public hearing, consideration and adoption.

Sincerely,

Julie A. Jacobson

Julie A. Jacobson
Assistant City Manager

[14] If adopted by City Council this spring, the Stretch Code would not go into effect until January 2011 with a mandatory compliance date of July 1, 2011 for the City of Worcester.

[15] 780 CMR 1-2010-03-09-10

Attachment A

- **New Construction: Summary of Estimated Energy Use Reduction for Existing and Upcoming Building Codes and the Stretch Code in Massachusetts**

- **Summary of "Stretch" Appendix to Mass. Energy Code, Adopted by BBRS May 2009 - .** Source: Massachusetts Executive Office of Energy and Environmental Affairs. Green Communities Grant Program. "Summary Table of Stretch Code." http://www.mass.gov/Eoeea/docs/doer/green_communities/grant_program/stretch_code_table.pdf. Accessed March 11, 2010.

- **780 CMR Appendix 120AA The "Stretch" Energy Code**

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Attachment A

New Construction: Summary of Estimated Energy Use Reduction for Existing and Upcoming Building Codes and the Stretch Code in Massachusetts[1]

Residential (New) Construction			
MA Building Codes	**Equivalent IECC[1]**	**Energy Use Reduction as compared to 2006 Base Code (IECC 2006/07)**	**Zone 5[2] or National Average**
2009 Building Base Code[3]	**IECC 2009**	10%	Zone 5
2009 Building Stretch Code	**IECC 2012**	30%	Zone 5
2012 Building Base Code[4]	**IECC 2012**	25%	Nationally
Commercial (New) Construction			
MA Building Codes	**Equivalent of IECC**	**Energy Efficiency Increase as compared to 2006 Base Code (IECC 2006/07 and ASHRAE 90.1-2007)**	**Zone 5[2] or National Average**
2009 Building Base Code	**IECC 2009**	10%	Zone 5
2009 Building Stretch Code	**IECC 2012**	30%	Zone 5
2012 Building Code[3]	**IECC 2012**	30%	Zone 5

1 - IECC = International Energy Conservation Code

2 - Due to lower than average cooling energy demand in climate Zone 5 (Massachusetts), the energy efficiency gains are somewhat less than the national average

3 - The prescriptive and performance paths under IECC 2009 are a little different – arguably the prescriptive path is more stringent than the performance path.

4 - Anticipated, currently being developed. U.S. Department of Energy' Building Energy Codes Program (BECP) stated its commitment to increase the level of efficiency of residential energy codes by 30% by 2012 and of commercial energy codes by 30% by 2010
(Building Energy Codes. FY 2008 Annual Report. Enhancing Energy Efficiency Nationwide.
http://www.energycodes.gov/whatwedo/pdfs/BECP_FY08_Accomplishments.pdf. Accessed January 5, 2010.)

NOTE: Just as the IECC is on a three-year update cycle, it is anticipated that the Stretch Code will be updated every three years also to maintain the roughly 20% stretch over the base code. At the point that it is updated, both the BBRS and subsequently the Municipalities that adopt it have the option to discontinue the Stretch Code. (Source: Ian Finlayson, Manager, Buildings and Climate Programs, MA Department of Energy Resources, e-mail communication November 25, 2009)

NOTE: All buildings are different so it should be recognized that these are all ballpark numbers accurate across a diverse portfolio of buildings but not necessarily accurate on a building-by-building basis.

Sources: Compiled by the City of Worcester Division of Planning and Regulatory Services. December 2009. Based on phone interviews and e-mail correspondence with Massachusetts Executive Office of Energy and Environmental Affairs' Ian Finlayson, Manager, Buildings and Climate Programs, Nov/Dec 2009.

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[1] **Exceptions**

1. Storm windows installed over existing fenestration.
2. Repairs to an existing sash and frame.
3. Existing ceiling, wall or floor cavities, of the building envelope, exposed or accessible during construction provided that any empty cavities are filled with insulation that meets or exceeds an R value of R - 3.5/inch.
4. Reroofing or residing over uninsulated roofs or walls where the sheathing is not exposed.
5. Replacement of existing doors that separate conditioned space from the exterior shall not require the installation of a vestibule or revolving door, provided, however, that an existing vestibule that separates a conditioned space from the exterior shall not be removed,
6. Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.
7. Alterations that replace only the bulb and ballast within the existing luminaires in a space provided that the alteration does not increase the installed interior lighting power.

Summary of "Stretch" Appendix to Mass. Energy Code, Adopted by BBRS May 2009

Building category	Definition	Requirements based on energy performance (can do prescriptive instead where shown)	Alternative "prescriptive" requirement – specific efficiency measures	Source, comments	Benefit-cost modeling results
New residential	Single-family, multi-family of 3 stories or less	HERS index 65 above 3,000 ft^2, 70 below 3,000 ft^2, certified by HERS rater; follow Energy Star thermal bypass checklist	None	HERS rating = energy use as % of use under IECC code. Current Mass. code ~ HERS 99; soon-to-be-adopted IECC 2009 ~ HERS 92	Sample 3 bedroom home, estimate $837/year savings ($8,103 extra construction cost = $527/year higher mortgage, but save $1,364/year energy costs)
Residential additions	Expansions of existing living space	HERS 65 over 3,000 ft^2, HERS 70 below 3,000 ft^2; certified by HERS rater (or can choose prescriptive option at right)	Prescriptive option of Energy Star Homes program - same as residential rehab below		3-bed home, estimate $40/year savings ($10,168 extra construction cost = $661/year, but energy costs $701/year lower)
Major residential rehab/ alterations	Major alterations as in existing code – excludes storm windows, reroofing, doors, etc.	HERS 80 over 2,000 ft^2, HERS 85 under 2,000 ft^2; certified by HERS rater (or prescriptive option)	Prescriptive option of Energy Star Homes program; insulation equal to IECC 2009	Quality air-sealing and insulation, EnergyStar windows	
Large commercial and large residential multi-family	Commercial above 100,000 ft^2; residential 4 stories or more and 100,000 ft^2	Energy use 20% below ASHRAE 90.1 2007, determined by modeling	None	DOE, NGRID modeling show energy savings greater than 20%	
Medium commercial and residential multi-family	Commercial 5,000 to 100,000 ft^2, residential 4 stories or more and below 100,000 ft^2	Energy use 20% below ASHRAE 90.1 2007, determined by modeling	IECC 2009 with NBI Core performance: improved air sealing, insulation, lighting, etc.	Prescriptive based on New Buildings Institute program; used by utilities now for incentive programs	NGRID, NSTAR case studies. Example – 60,000 ft^2 office bldg., $91,000 extra cost, $29,500 annual energy savings; and $63,100 NGRID rebate
Medium & large specialty commercial	Supermarkets, labs, warehouses above 40,000 ft^2	Energy use 20% below ASHRAE 90.1 2007, determined by modeling	None		
Small commercial & small specialty	Below 5,000 ft^2 or specialty commercial below 40,000 ft^2	Exempt	Exempt	Other specialty buildings can apply for waiver	
Commercial alterations		Exempt	Exempt		

* IECC is the International Energy Conservation Code. The Green Communities Act passed in June, 2008 requires that Massachusetts adopt the latest version of this Code within one year of its publication. IECC 2009 was published in January, 2009.
* ASHRAE is the American Society of Heating, Refrigeration and Air Conditioning Engineers.

Summary of the Massachusetts Building Code Appendix 120.AA, 'Stretch' Energy Code

Appendix 120.AA known as the 'Stretch code', was adopted by the Massachusetts Board of Building Regulations and Standards in May 2009, as an optional appendix to the Massachusetts Building Code 780 CMR.

This optional 'stretch code' was developed in response to the call for improved building energy efficiency in Massachusetts. Towns and cities in the Commonwealth may adopt Appendix 120.AA in place of the energy efficiency requirements of the 'base' building code. In addition, the 'base' building energy code in Massachusetts will be updated in 2010 to the recently published IECC (International Energy Conservation Code) 2009 energy code[1]. The 'stretch code' is similarly based on the IECC 2009 energy code, but with approximately 20% greater building efficiency requirements, and a move towards 3rd party testing and rating of building energy performance.

The stretch code may be adopted by any town or city in the commonwealth, by decision of its governing body following a public hearing. In a city the governing body is the city manager and the city council, or the mayor and city council[2]. In towns the governing body is the board of selectmen. In order to be adopted, the appendix must be first considered at an appropriate municipal public hearing, subject to the municipality's existing public notice provisions.

Stretch code provisions

Residential - New Construction

New residential buildings 3 stories or less will be required to meet an energy performance standard using the Home Energy Rating System[3] (HERS). The HERS index scores a home on a scale where 0 is a zero-net-energy home, and 100 is a code compliant new home (currently based on the IECC 2006 code). The HERS index has been in use for many years by beyond code programs such as Energy Star Homes, and LEED for Homes, and by the Federal IRS for tax credits and energy efficient mortgages. HERS ratings are performed by an independent HERS rater, working with the home builder, and then submitted to the local building code official.

The MA stretch code requires a HERS index of 65 or less for new homes of 3,000 square feet or above, and 70 or less for new homes below 3,000 square feet (this includes multi-family units in buildings of 3 stories or less).
A HERS index of 65 means that the home is estimated to use 65% as much energy as the same home built to the 2006 energy code, or a 35% annual energy savings.

Residential – Home renovations

Home additions and renovations have two options to meet the stretch code:

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[1] The Green Communities Act of 2008 requires that Massachusetts adopt each new IECC within one year of its release, the IECC is updated on a 3 year cycle so the next version will be IECC 2012.
[2] Cities having a Plan D or Plan E charter have the City manager and city council as the governing body, other cities have a Mayor and city council.
[3] For a summary of the HERS index see: http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_HERS

i) The same "performance" approach as new construction but requiring a HERS index of 80 or less for significant changes to homes over 2,000 square feet, or 85 or less for homes below 2,000 square feet.

ii) A "prescriptive" approach, where specific efficiency measures are required rather than a HERS index number. This utilizes the Energy Star for Homes program prescriptive requirements, and insulation at least equal to IECC 2009.

Commercial –New Construction

The stretch code also applies a performance-based code to commercial buildings, with the option of a prescriptive code for small and medium-sized commercial buildings. Buildings smaller than 5,000 square feet are exempt, as are building renovations, and "specialty" buildings – supermarkets, laboratories, and warehouses – below 40,000 square feet in size, due to their widely differing energy needs. These exempt buildings remain subject to the 'base' Massachusetts energy code (IECC 2009 and ASHRAE 90.1-2007).

Large buildings of any type over 100,000 square feet, and 'specialty' buildings over 40,000 square feet are required to meet a performance standard set at 20% below the energy usage of the commonly used ASHRAE 90.1-2007 code[4], demonstrated through modeling by methods and software approved by the BBRS.

Medium-sized commercial buildings, which include residential buildings of 4 stories or more, but that are less than 100,000 square feet, have the option of meeting the same 20% better than ASHRAE 90.1-2007 performance standard, or using a simplified, prescriptive energy code.

The prescriptive code is based on Chapter 5 of the IECC 2009 energy code, and adds incremental efficiency improvements primarily through:

a. Building envelope elements (walls, roofs, windows, insulation, etc.)
b. Commissioning requirements to ensure that buildings' energy systems operate as designed.
c. More efficient lighting power densities and improved lighting controls.
d. A choice of one of three compliance paths: high efficiency HVAC equipment, further lighting energy reductions, or on-site renewable energy.

This prescriptive option for commercial buildings between 5,000 and 100,000 sq. ft. was developed from the Core Performance program of the New Buildings Institute. This program has been developed and used for utility incentive programs in Massachusetts for the past couple of years. The Core Performance program used over 30,000 energy modeling runs to evaluate and rank the most cost effective modifications to the ASHRAE 90.1 code, and has been run specifically with Boston climate data to represent Massachusetts. Certain areas of this prescriptive option were also updated to reflect recent energy code development for future iterations of ASHRAE and IECC codes and refined for specific application in Massachusetts where they are cost-effective.

[4] Energy modeling must show a 20% improvement relative to ASHRAE 90.1-2007 Appendix G.

780 CMR Appendix 120 AA
Stretch Energy Code

The Stretch Energy Code is the *International Energy Conservation Code (IECC) 2009* with amendments contained herein.

CHAPTER 1 - ADMINISTRATION

SECTION 101 - SCOPE AND GENERAL REQUIREMENTS

Remove sections 101.1, 101.2, and 101.3 and replace with:

101.1 Title. This code shall be known as the Massachusetts Stretch Energy Code and shall be cited as such. It is referred to herein as "this code."

101.2 Scope. This code applies to residential and commercial buildings. Buildings not included in this scope shall comply with 780 CMR 13, 34, 61, or 93, as applicable.

101.3 Purpose and Intent.

The purpose of 780 CMR 120.AA is to provide a more energy efficient alternative to the base energy code applicable to the relevant sections of the building code for both new construction and existing buildings. A municipality seeking to ensure that construction within its boundaries is designed and built above the energy efficiency requirements of 780 CMR may mandate adherence to this appendix.

This appendix may be adopted by any municipality in the commonwealth, by decision of its governing body. In a city having a Plan D or Plan E charter the governing body shall be the city manager and the city council, and in any other city the mayor and city council. In towns the governing body shall be the board of selectmen. In order to be adopted, the appendix must be considered at an appropriate municipal public hearing, subject to the municipality's existing public notice provisions. If adopted by a municipality this appendix rather than 780 CMR 13, 34, 61, or 93, as applicable, shall govern.

This appendix shall regulate the design and construction of buildings for the effective use of energy. This appendix is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve the effective use of energy. This appendix is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Remove section 101.4.3 Exceptions and replace with:

Exceptions

1. Storm windows installed over existing fenestration.
2. Repairs to an existing sash and frame.
3. Existing ceiling, wall or floor cavities, of the building envelope, exposed or accessible during construction provided that any empty cavities are filled with insulation that meets or exceeds an *R* value of R - 3.5/inch.
4. Reroofing or residing over uninsulated roofs or walls where the sheathing is not exposed.
5. Replacement of existing doors that separate conditioned space from the exterior shall not require the installation of a vestibule or revolving door, provided, however, that an existing vestibule that separates a conditioned space from the exterior shall not be removed,
6. Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.
7. Alterations that replace only the bulb and ballast within the existing luminaires in a space provided that the alteration does not increase the installed interior lighting power.

Remove section 104.1 and replace with:
104.1 General. Construction or work for which a permit is required shall be subject to inspection by the code official or approved inspection agencies.

Remove section 104.5 and replace with:
104.5 Approved inspection agencies. The code official is authorized to require or accept reports of approved inspection agencies, provided such agencies satisfy the requirements as to qualifications and reliability.

Delete sections 107, 108 and 109

CHAPTER 2 – DEFINITIONS

Insert in section 202:
FENESTRATION PRODUCT, FIELD-FABRICATED is a fenestration product including an exterior glass door whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door. Field fabricated does not include site-built fenestration with a label certificate or products required to have temporary or permanent labels.
FENESTRATION PRODUCT, SITE-BUILT is fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing units. Examples of site-built fenestration include storefront systems, curtain walls, and atrium roof systems.
FURNACE ELECTRICITY RATIO. The ratio of furnace electricity use to total furnace energy computed as ratio = (3.412*EAE)/(1000*EF + 3.412*EAE), where EAE (average annual auxiliary electrical consumption) and EF (average annual fuel energy consumption) are defined in Appendix N to subpart B of part 430 of title 10 of the Code of Federal Regulations and EF is expressed in millions of Btu's per year.
ON-SITE RENEWABLE ENERGY. Includes solar photovoltaic; active solar thermal that employs collection panels, heat transfer mechanical components and a defined heat storage system; wind; small hydro; tidal; wave energy; geothermal (core earth); biomass energy systems; landfill gas and bio-fuel based electrical production. Onsite energy shall be generated on or adjacent to the project site and shall not be delivered to the project through the utility service.

CHAPTER 3 – CLIMATE ZONES

Delete section 301 and replace with:
Climate Zone 5 and moisture regime A (Moist) shall be used in determining the applicable requirements from Chapters 4 and 5 for locations in Massachusetts.

Delete Chapter 4 and replace with:
CHAPTER 4 – ADVANCED RESIDENTIAL ENERGY EFFICIENCY
401.1 Scope. This chapter applies to residential buildings.
401.2 New construction. New low-rise (three stories or less) residential buildings including townhouses shall require a HERS (Home Energy Rating System) index rating as verified by a RESNET (Residential Energy Services Network) certified HERS rater.

- For units equal to or greater than 3,000 sq ft in conditioned floor space, a HERS rating of 65 or less is required.
- For units less than 3,000 sq ft, a HERS rating of 70 or less is required.
- In addition, all new construction shall demonstrate compliance with the Energy Star Qualified Homes Thermal Bypass Inspection Checklist[1].

401.3 Prescriptive option for residential additions. Additions to an existing building, building system or portion thereof shall conform to the most recent Energy Star for Homes Prescriptive Builders Option Package (BOP), except for heating and cooling equipment and appliances, and shall demonstrate compliance with:

- The Energy Star Qualified Homes Thermal Bypass Inspection Checklist.
- Envelope insulation requirements that meet or exceed IECC 2009 requirements (Chapter 4, Section 402) for climate zone 5.

401.4 Performance option for residential additions. The performance approach and HERS ratings of 401.2 may be followed in lieu of the prescriptive requirements of 401.3

401.5 Prescriptive option for alterations, renovations or repairs. Alterations, renovations or repairs that involve accessing the building envelope shall require the affected portion of the envelope to comply with 401.3. Envelope insulation shall meet or exceed IECC 2009 requirements (Chapter 4, Section 402) for climate zone 5, or fully fill existing cavities with insulating material which meets or exceeds an R value of R 3.5/inch.

401.6 Performance option for alternations, renovations or repairs. In all cases of alternations, renovations or repairs the performance approach of 401.2 may be followed in lieu of the prescriptive requirements of 401.5 with the following HERS rating requirements:

- For units equal to or greater than 2,000 sq ft in conditioned floor space, a HERS rating of 80 or less is required.
- For units less than 2,000 sq ft, a HERS rating of 85 or less is required.
- Compliance with the Energy Star Qualified Homes Thermal Bypass Inspection Checklist.

Change Chapter 5 title to:

CHAPTER 5 – ADVANCED COMMERCIAL ENERGY EFFICIENCY

Remove section 501.1 and 501.2 and replace with:

501.1 Scope. The requirements contained in this chapter are applicable to new construction of commercial buildings, or portions of commercial buildings.

Exceptions:

1. Commercial buildings less than 5,000 sq. ft.
2. Commercial buildings from 5,000 to 40,000 sq. ft. in area with these uses:
    - Supermarkets
    - Warehouses
    - Laboratories

[1] http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Thermal_Bypass_Inspection_Checklist.pdf

- A building of specialized use by variance to this appendix through appeal to the BBRS.

501.1.1 Buildings greater that 100,000 sq. ft. Buildings greater than 100,000 sq. ft., and additions to such buildings greater than or equal to 30% of the existing conditioned floor area, shall be designed to achieve energy use per square foot equal to at least 20% below the energy requirements of *ASHRAE/IESNA Standard 90.1-2007, Energy Standard for Buildings Except for Low-Rise Residential Buildings*, Appendix G, measured by industry-accepted energy modeling.

501.1.2 Special energy use buildings. Buildings greater than 40,000 sq. ft. in area, and additions to such buildings greater than or equal to 30% of the existing conditioned floor area with these uses:

- Supermarkets
- Warehouses
- Laboratories

shall be designed to comply with the performance requirements of 501.1.1.

501.1.3 Performance option for buildings from 5,000 to 100,000 sq. ft. Buildings between 5,000 sq. ft. and 100,000 sq. ft. shall comply with the performance requirements of 501.1.1, or the prescriptive option 501.1.4.

501.1.4 Prescriptive option for Buildings from 5,000 to 100,000 sq. ft. The requirements contained in section 501.1.4.1 and beyond of this chapter are applicable to buildings from 5,000 to 100,000 sq. ft. and additions to such buildings greater than or equal to 30% of the existing conditioned floor area where the addition has its own heating system.

501.1.4.1 Application. The *commercial building* project shall comply with the requirements in Sections 502 (Building envelope requirements), 503 (Building mechanical systems), 504 (Service water heating), 505 (Electrical power and lighting systems), and 507 (Advanced Prescriptive Options) in its entirety.

Compliance with section 507 requires complying with any ONE of the following prescriptive options:

a. 507.2.1 Efficient Mechanical Equipment
b. 507.2.2 Reduced Lighting Power Density
c. 507.2.3 On-Site Supply of Renewable Energy

Compliance with section 507 does not remove the requirement to comply with any other mandatory requirements in this code.

SECTION 502 - BUILDING ENVELOPE REQUIREMENTS

Delete from section 502.1.1, the last sentence:

Buildings with a vertical fenestration area or skylight area that exceeds that allowed in Table 502.3 shall comply with the building envelope provisions of ASHRAE/IESNA90.1.

Remove Table 502.1.2, Table 502.2(1) and Table 502.2(2) and replace with:

TABLE 502.1.2 - BUILDING ENVELOPE REQUIREMENTS OPAQUE ELEMENT, MAXIMUM U-FACTORS

Roofs	All Other	Group R
Insulation entirely above deck	U - 0.039	U - 0.039

Metal buildings (with R-5 thermal blocks)	U - 0.049	U - 0.049
Attic and other	U - 0.027	U - 0.027
Walls, Above Grade		
Mass, exterior insulation	U- 0.080	U- 0.071
Mass, interior insulation	U- 0.085	U- 0.085
Metal building	U- 0.061	U- 0.061
Metal framed	U- 0.064	U- 0.057
Wood framed and other	U- 0.051	U- 0.051
Walls, Below Grade[a]		
Mass, exterior insulation	C- 0.119	C- 0.119
Mass, interior insulation	C- 0.063	C- 0.063
Floors		
Mass	U- 0.074	U- 0.064
Metal Joist	U- 0.033	U- 0.033
Wood Joist/Framing	U- 0.033	U- 0.033
Slab-on-Grade Floors		
Unheated slabs	F- 0.540	F- 0.520
Heated slabs	F- 0.580	F- 0.580
Opaque Doors		
Swinging	U- 0.37	U- 0.37
Roll-up or sliding	U- 0.50	U- 0.50

For SI: 1 inch = 25.4 mm.
ci – Continuous Insulation
a. When heated slabs are placed below grade, below grade walls must meet the F-factor requirements for perimeter insulation according to the heated slab-on-grade construction.

TABLE 502.2
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

Roofs	All Other	Group R	Note: IECC 2009 equivalent
Insulation entirely above deck	R-25 ci	R-25 ci	Zone 7
Metal buildings (with R-5 thermal blocks [a,b])	R-13 + R-19	R-19 + R-10	Zone 7
Attic and other	R-38	R-38	Zone 2-7
Walls, Above Grade			
Mass, exterior insulation	R-11.4 ci	R-13.3 ci	Zone 5
Mass, interior insulation	R-13	R-13	N/A
Metal building [c]	R-13 + R-5.6 ci	R-13 + R-5.6 ci	Zone 5-6
Metal framed	R-13 + R-7.5 ci	R-13 + R-7.5 ci	Zone 5-6
Wood framed and other	R-13 + R-7.5	R-13 + R-7.5	Zone 6
Walls, Below Grade[d]			
Mass, exterior insulation	R-7.5 ci	R-7.5 ci	Zone 5-6
Mass, interior insulation	R-19	R-19	N/A
Floors			
Mass	R-10 ci	R-12.5 ci	Zone 5
Metal Joist	R-30	R-30	Zone 4-8
Wood Joist/Framing	R-30	R-30	Zone 4-8
Slab-on-Grade Floors			

Unheated slabs	R-10 for 24 in. below	R-15 for 24 in. below	Zone 6
Heated slabs	R-15 for 36 in. + R-5 ci below	R-15 for 36 in. + R-5 ci below	NBI Core Performance Values
Opaque Doors			
Swinging	U – 0.37	U – 0.37	
Roll-up or sliding	R – 4.75	R – 4.75	

For SI: 1 inch = 25.4 mm.
ci – Continuous Insulation
NR – No Requirement

a. Thermal blocks are a minimum R-5 of rigid insulation, which extends 1-inch beyond the width of the purlin on each side, perpendicular to the purlin.
b. The first R-value is for faced fiberglass insulation batts draped over purlins. The second R-value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins. Reference: ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
c. The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. the second *rated R-value of insulation* is for insulation installed from the inside, covering the girts. Reference: ASHRAE/IESNA 90.1 Table A3.2 Appendix "G"
d. When heated slabs are placed below grade, below grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

Remove section 502.3.2 (including Table 502.3) and replace with:

502.3.2 Maximum *U*-factor and SHGC. For vertical fenestration, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3, which is uniformly set at 0.40. For skylights, the limit is set at 3% of roof area, but can be expanded to 5% of roof area in conjunction with automatic daylighting controls. In all cases, the maximum *U*-factor and solar heat gain coefficient (SHGC) shall be as specified in Table 502.3.

TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

	All
Framing materials other than metal with or without metal reinforcement or cladding	
U-Factor	0.35
Metal framing with or without thermal break	
Curtain Wall/Storefront *U*-Factor	0.42
Entrance Door *U*-Factor	0.80
All Other *U*-Factor [a]	0.45
SHGC-All Frame Types	
SHGC	0.40

Skylights (3% maximum, or 5% maximum with automatic daylighting controls [b])	
U-Factor	0.45
SHGC	0.40

a. All other includes operable windows, fixed windows and doors other than entrance doors.
b. Automatic daylighting controls shall meet the requirements of Section 505.2.2.1.3

502.4 Air leakage (Mandatory).

Remove section 502.4.1 and 502.4.2 and replace with:

502.4.0 Air Barriers. The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier system shall also be provided for interior separations between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions.

The air barrier shall have the following characteristics:
1. It must be continuous, with all joints made airtight.
2. Materials used for the air barrier system shall have an air permeability not to exceed 0.004 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (75 Pa) when tested in accordance with ASTM E 2178. Air barrier materials shall be taped or sealed in accordance with the manufacturer's instructions.
3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
4. Air barrier materials shall be maintainable, or, if inaccessible, shall meet the durability requirements for the service life of the envelope assembly.
5. The air barrier material of an envelope assembly shall be joined and sealed in a flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep. Connections shall be made between:

a. joints around *fenestration* and *door* frames
b. junctions between *walls* and foundations, between *walls* at building corners, between *walls* and structural *floors* or *roofs*, and between *walls* and *roof* or *wall* panels
c. openings at penetrations of utility services through *roofs, walls*, and *floors*
d. site-built *fenestration* and *doors*
e. building assemblies used as ducts or plenums
f. joints, seams, and penetrations of vapor retarders
g. all other openings in the *building envelope*

502.4.0.1 Air Barrier Penetrations. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air tight.

502.4.1 Window and door assemblies. The air leakage of window, skylight and door assemblies that are part of the building envelope shall be determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, or NFRC 400 by an accredited, independent laboratory, and *labeled* and certified by the manufacturer. Window and skylight air leakage shall not exceed 0.2 cfm/ft² at 1.57 pounds per square foot (psf) (75Pa), or 0.3 cfm/ft² at 6.24 psf (300 Pa). Door assembly air leakage shall not exceed 0.3 cfm/ft² for all other products at 1.57 psf (75Pa).

Exceptions:
a. Site-constructed windows and doors that are sealed in accordance with Section 502.4.8.
b. Commercial entrance doors covered by section 502.4
c. Garage doors shall be permitted to use air leakage determined by test at standard test conditions in accordance with ANSI/DASMA 105.
d. Doors and Access Openings to Shafts, Chutes, Stairwells, and Elevator Lobbies. These doors and access openings shall either meet the requirements of 502.4.3 or shall be equipped with weather seals, except weatherseals on elevator lobby doors are not required when a smoke control system is installed.

502.4.2 Curtain wall, storefront glazing and commercial entrance doors. Curtain wall, *storefront* glazing and commercial-glazed swinging entrance doors and revolving doors shall be tested for air leakage at a pressure of at least 1.57 pounds per square foot (psf) (75 Pa) in accordance with ASTM E 283. For curtain walls and *storefront* glazing, the maximum air leakage rate shall be 0.06 cubic foot per minute per square foot (cfm/ft²) (1.1 m³/h × m²) of fenestration area. For commercial glazed swinging entrance doors and revolving doors, the maximum air leakage rate shall be 1.00 cfm/ft² (18.3 m³/h × m²) of door area when tested in accordance with ASTM E 283.

Remove section 502.4.5 and replace with:
502.4.5 Outdoor air intakes and exhaust openings. Stair and elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be equipped with not less than a Class I motorized, leakage-rated damper with a maximum leakage rate of 4 cfm per square foot (6.8 L/s · C m²) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D. These air tight, operable dampers shall be installed when the air barrier is penetrated by:

1. Fixed open louvers such as in elevator shafts and machine rooms.
2. Mechanical system components which allow infiltration or exfiltration of air when the systems are inactive, such as atrium smoke exhaust systems, elevator shaft smoke relief openings, and other similar elements.

Such dampers shall be set in the closed position and automatically open upon:

1. the activation of any fire alarm initiating device of the building's fire alarm system;
2. the interruption of power to the damper.

Exception: Gravity (nonmotorized) dampers are permitted to be used in buildings less than three stories in height above grade.

Remove section 502.4.7 and replace with:

502.4.7 Vestibules. Building entrances that separate *conditioned space* from the exterior shall be protected with an enclosed vestibule, with all *doors* opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior *doors* to open at the same time. Interior and exterior *doors* shall have a minimum distance between them of not less than 7 ft when in the closed position. The exterior envelope of conditioned vestibules shall comply with the requirements for a conditioned space. The interior and exterior envelope of unconditioned vestibules shall comply with the requirements for a semi-heated space.

Exceptions:

a. *Building entrances* with revolving *doors*.
b. *Doors* not intended to be used as a *building entrance*.
c. *Doors* opening directly from a *dwelling unit*.
d. *Doors* that open directly from a *space* that is less than 3000 ft^2 in area and is separate from the *building entrance*.
e. *Doors* used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.

Add section 502.5 Vapor retarders.

502.5 Vapor retarders. Class I or II vapor retarders are required on the interior side of walls.

Exceptions:

1. Basement walls.
2. Below grade portion of any wall.
3. Construction where moisture or its freezing will not damage the materials.

502.5.1 Class III Vapor retarders. Class III vapor retarders shall be permitted where any one of the conditions in Table 502.5.1 are met.

TABLE 502.5.1 - CLASS III VAPOR RETARDERS

Climate Zone	Class III vapor retarders permitted for:
5	Vented cladding over OSB Vented cladding over Plywood Vented cladding over Fiberboard Vented cladding over Gypsum Insulated sheathing with R-value >= R5 over 2x4 wall Insulated sheathing with R-value >= R7.5 over 2x6 wall

502.5.2 Material vapor retarder class. The vapor retarder class shall be based on the manufacturer's certified testing or a tested assembly. The following shall be deemed to meet the class specified:

Class I: Sheet polyethylene, non-perforated aluminum foil
Class II: Kraft faced fiberglass batts or low perm paint

(paint with 0.1 < perm <= 1.0)
Class III: Latex or enamel paint

SECTION 503 - BUILDING MECHANICAL SYSTEMS

Insert at end of section 503.1:

NOTE: Compliance path a. (Efficient Mechanical Equipment) in section 507 is not available for equipment installed according to the minimum performance values outlined in section 503.2.3. In this case, compliance can be met with one of the following paths:

b. 507.2.2 Reduced Lighting Power Density
c. 507.2.3 On-Site Supply of Renewable Energy

Replace section 503.2.1 with:

503.2.1 Calculation of heating and cooling loads. Design loads shall be determined in accordance with the procedures described in the ASHRAE/ACCA Standard 183. The design loads shall include an accurate representation of the building envelope, lighting, ventilation and occupancy loads based on the specific design characteristics of the project. Heating and cooling loads shall be adjusted to account for load reductions that are achieved when energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook*. Alternatively, design loads shall be determined by an *approved* equivalent computation procedure, using the design parameters specified in IECC 2009 Chapter 3.

Insert at end of section 503.2.5.1, Exceptions:

5. Building spaces where CO_2 Sensors are inappropriate measures for ventilation needs because of ventilation needs other than occupant requirements.
6. Building spaces where the primary ventilation needs are for process loads.

Replace sections 503.2.9 – 503.2.9.3 with:

503.2.9 Mechanical systems commissioning and completion requirements.

503.2.9.1 System commissioning. Commissioning is a process that verifies and documents that the selected building systems have been designed, installed, and function according to the owner's project requirements and construction documents. Drawing notes shall require commissioning and completion requirements in accordance with this section. Drawing notes may refer to specifications for further requirements. Copies of all documentation shall be given to the owner. The building official may request commissioning documentation for review purposes. At the time of plan submittal, the building jurisdiction shall be provided, by the submittal authority, a letter of intent to commission the building in accordance with this code.

503.2.9.1.1 Commissioning plan. A commissioning plan shall include as a minimum the following items:

1. A detailed explanation of the original owner's project requirements,

2. A narrative describing the activities that will be accomplished during each phase of commissioning, including guidance on who accomplishes the activities and how they are completed,
3. Equipment and systems to be tested, including the extent of tests,
4. Functions to be tested (for example calibration, economizer control, etc.),
5. Conditions under which the test shall be performed (for example winter and summer design conditions, full outside air, etc.), and
6. Measurable criteria for acceptable performance.

503.2.9.1.2 Systems adjusting and balancing. All HVAC systems shall be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within 10% of design rates. Test and balance activities shall include as a minimum the following items:

1. Air systems balancing. Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the International Mechanical Code. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp (18.6 kW) and larger. Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp, fan speed shall be adjusted to meet design flow conditions.

Exception: Fans with fan motors of 1 hp or less.

2. Hydronic systems balancing: Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the ability to measure pressure across the pump, or test ports at each side of each pump.

Exceptions:
1. Pumps with pump motors of 5 hp or less.
2. When throttling results in no greater than 5% of the nameplate horsepower draw above that required if the impeller were trimmed.

503.2.9.1.3 Functional performance testing

503.2.9.1.3.1 Equipment functional performance testing. Equipment functional performance testing shall demonstrate the correct installation and operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications. This demonstration is to prove the operation, function, and maintenance serviceability for each of the Commissioned systems. Testing shall include all modes of operation, including:
1. All modes as described in the Sequence of Operation,
2. Redundant or automatic back-up mode,

3. Performance of alarms, and
4. Mode of operation upon a loss of power and restored power.

Exception: Unitary or packaged HVAC equipment listed in Tables 503.2.3 (1) through (3) that do not require supply air economizers.

503.2.9.1.3.2 Controls functional performance testing. HVAC control systems shall be tested to document that control devices, components, equipment, and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to document they operate in accordance with approved plans and specifications.

503.2.9.1.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and provided to the Owner. The report shall be identified as "Preliminary Commissioning Report" and shall identify:

1. Itemization of deficiencies found during testing required by this section which have not been corrected at the time of report preparation and the anticipated date of correction.
2. Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.
3. Climatic conditions required for performance of the deferred tests, and the anticipated date of each deferred test.

503.2.9.2 Acceptance. Buildings, or portions thereof, required by this code to comply with this section shall not be issued a certificate of occupancy until such time that the building official has received a letter of transmittal from the building owner that states they have received the Preliminary Commissioning Report as required by Section 503.2.9.1.4. At the request of the building official, a copy of the Preliminary Commissioning Report shall be made available for review.

503.2.9.3 Completion requirements. The construction documents shall require that within 90 days after the date of certificate of occupancy, the documents described in this section be provided to the building owner.

503.2.9.3.1 Drawings. Construction documents shall include as a minimum the location and performance data on each piece of equipment.

503.2.9.3.2 Manuals. An operating manual and a maintenance manual shall be in accordance with industry-accepted standards and shall include, at a minimum, the following:

1. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
2. Manufacturer's operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
3. Names and addresses of at least one service agency.

4. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings at control devices or, for digital control systems, in programming comments.
5. A complete narrative of how each system is intended to operate, including suggested setpoints.

503.2.9.3.3 System balancing report. A written report describing the activities and measurements completed in accordance with Section 503.2.9.1.2

503.2.9.3.4 Final Commissioning Report. A complete report of test procedures and results identified as "Final Commissioning Report" shall include:

1. Results of all Functional Performance Tests.
2. Disposition of all deficiencies found during testing, including details of corrective measures used or proposed.
3. All Functional Performance Test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

Exception: Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.

SECTION 505 - ELECTRICAL POWER AND LIGHTING SYSTEMS (Mandatory)

Replace sections 505.2.2.1 and 505.2.2.2 with:

505.2.2.1 Automatic lighting controls. All commercial buildings shall be equipped with automatic control devices to shut off lighting in compliance with one of the following automatic control technologies:

1. Section 505.2.2.1.1 Occupancy Sensors
2. Section 505.2.2.1.2 Time Clock Controls
3. Section 505.2.2.1.3 Automatic Daylighting Controls

505.2.2.1.1 Occupancy sensors Occupancy sensors must be installed in all classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, storage rooms and janitorial closets, and other spaces 300 sf. or less enclosed by ceiling height partitions. These automatic control devices shall be installed to automatically turn off lights within 30 minutes of all occupants leaving the space, except spaces with multi-scene control.

505.2.2.1.2 Time Clock Controls In areas not controlled by occupancy sensors, automatic time switch control devices shall be used. It shall incorporate an override switching device that:

1. Is readily accessible.
2. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated.
3. Is manually operated.

4. Allows the lighting to remain on for no more than 4 hours when an override is initiated.
5. Controls an area not exceeding 5,000 square feet (465 m²).

Exceptions:
1. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, where captive-key override is utilized, override time may exceed 2 hours.
2. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, the area controlled may not exceed 20,000 square feet (1860 m²).

505.2.2.1.3 Automatic daylighting controls. Automatic controls installed in day lit zones must control lights in the day lit areas separately from the non-day lit areas. Controls for calibration adjustments to the lighting control device shall be readily accessible to authorized personnel. Each daylight control zone shall not exceed 2,500 square feet. Automatic daylighting controls must incorporate an automatic shut-off ability based on time or occupancy in addition to lighting power reduction controls.

Controls will automatically reduce lighting power in response to available daylight by either one of the following methods:

1. Continuous dimming using dimming ballasts and daylight-sensing automatic controls that are capable of reducing the power of general lighting in the day lit zone continuously to less than 35% of rated power at maximum light output.

2. Stepped Dimming using multi-level switching and daylight-sensing controls that are capable of reducing lighting power automatically. The system should provide at least two control channels per zone and be installed in a manner such that at least one control step shall reduce power of general lighting in the daylit zone by 30% to 50% of rated power and another control step that reduces lighting power by 65% to 100%. Stepped dimming control is not appropriate in continuously occupied areas with ceiling heights of 14 feet or lower

Exception: Daylight spaces enclosed by walls or ceiling height partitions and containing 2 or fewer luminaire are not required to have a separate switch for general area lighting.

*Retain section **505.2.2.3 Daylight zone control.***

Replace section 505.2.3 with:

505.2.3 Additional Controls for specific uses

a. Display/Accent Lighting—display or accent lighting shall have a separate control device.
b. Case Lighting—lighting in cases used for display purposes shall have a separate control device.

c. Hotel and Motel Guest Room Lighting—hotel and motel guest rooms and guest suites shall have a master control device at the main room entry that controls all permanently installed luminaires and switched receptacles.
d. Task Lighting—supplemental task lighting, including permanently installed undershelf or undercabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided the control device is readily accessible and located so that the occupant can see the controlled lighting.
e. Nonvisual Lighting—lighting for nonvisual applications, such as plant growth and food warming, shall have a separate control device.
f. Demonstration Lighting—lighting equipment that is for sale or for demonstrations in lighting education shall have a separate control device.

Exceptions: a., b. and d. Where LED lighting is used no additional control is required.

Insert at end of section 505.5.2:
NOTE: Compliance path b. (Reduced Lighting Power Density) in section 507 is not available for lighting installed according to the values in table 505.5.2. In this case, compliance can be met with one of the following paths:
a. 507.2.1 Efficient Mechanical Equipment
c. 507.2.3 On-Site Supply of Renewable Energy

Replace, but retain notes and exception, Table 505.5.2 with:
TABLE 505.5.2 - INTERIOR LIGHTING POWER ALLOWANCES

LIGHTING POWER DENSITY		
	Whole Building	**Space by Space**
Building Area Type[a]	**(W/ft²)**	
Active Storage		0.8
Atrium – First Three Floors		0.6
Atrium – Each Additional Floor		0.2
Classroom/lecture/training		1.3
Conference/Meeting/Multipurpose		1.3
Corridor/Transition		0.5
Dressing/Locker/Fitting Room		0.6
Electrical/Mechanical		1.5
Food Preparation		1.2
Inactive Storage		0.3
Laboratory		1.4
Lobby		1.1
Restroom		0.8
Stairway		0.6
Automotive Facility	0.9	
Automotive – Service Repair		0.7
Convention Center	1.2	
Exhibit Space		1.3
Audience/Seating Area		0.9

Courthouse	1.2	
Audience/Seating Area		0.9
Courtroom		1.9
Confinement Cells		0.9
Judges Chambers		1.3
Dining: Bar Lounge/Leisure	1.3	
Lounge/Leisure Dining		1.4
Dining: Cafeteria/Fast Food	1.4	
Dining: Family	1.6	
Dining		1.4
Kitchen		1.2
Dormitory	1.0	
Living Quarters		1.1
Bedroom		0.5
Study Hall		1.4
Exercise Center	1.0	
Dressing/Locker/Fitting Room		0.6
Audience/Seating Area		0.3
Exercise Area		0.9
Exercise Area/Gymnasium		1.4
Gymnasium	1.1	
Dressing/Locker/Fitting Room		0.6
Audience/Seating Area		0.4
Playing Area		1.4
Exercise Area		0.9
Healthcare Clinic	1.0	
Corridors w/patient waiting, exam		1.0
Exam/Treatment		1.5
Emergency		2.7
Public & Staff Lounge		0.8
Hospital/Medical supplies		1.4
Hospital - Nursery		0.6
Nurse station		1.0
Physical therapy		0.9
Patient Room		0.7
Pharmacy		1.2
Hospital/Radiology		0.4
Operating Room		2.2
Recovery		0.8
Active storage		0.9
Laundry-Washing		0.6
Hospital	1.2	
Hotel	1.0	
Dining Area		1.3
Guest quarters		1.1
Reception/Waiting		2.5
Lobby		1.1
Library	1.3	
Library-Audio Visual		0.7

Stacks		1.7
Card File & Cataloguing		1.1
Reading Area		1.2
Manufacturing Facility	1.3	
Low bay (< 25 ft Floor to Ceiling Height)		1.2
High bay (>25 ft Floor to Ceiling Height)		1.7
Detailed Manufacturing		2.1
Equipment Room		1.2
Control Room		0.5
Motel	1.0	
Dining Area		1.2
Guest quarters		1.1
Reception/Waiting		2.1
Motion Picture Theater	1.2	
Audience/Seating Area		1.2
Lobby		1.0
Multi-Family	0.7	
Museum	1.1	
Active Storage		0.8
General exhibition		1.0
Restoration		1.7
Bank/Office – banking activity area		1.5
Office	0.9	
Enclosed		1.0
Open Plan		1.0
Parking Garage	0.3	
Penitentiary	1.0	
Performing Arts Theater	1.6	
Audience/Seating Area		2.6
Lobby		3.3
Dressing/Locker/Fitting Room		1.1
Police Stations	1.0	
Fire Stations	0.8	
Fire Station Engine Room		0.8
Sleeping Quarters		0.3
Audience/Seating Area		0.8
Police Station Laboratory		1.4
Post Office	1.1	
Sorting Area		1.2
Lobby		1.0
Religious Buildings	1.3	
Lobby		1.7
Worship/Pulpit/Choir		2.4
Retail[b]	1.3	
Department Store Sales Area		1.3
Specialty Store Sales Area		1.8
Fine Merchandise Sales Area		2.9
Supermarket Sales Area		1.3
Personal Services Sales Area		1.3

Mass Merchandising Sales Area		1.3
Mall Concourse		1.7
School/University	1.2	
Classroom		1.3
Audience		0.7
Dining		1.1
Office		1.1
Corridor		0.5
Storage		0.5
Laboratory		1.1
Sports Arena	1.1	
Ring Sports Arena		2.7
Court Sports Arena		2.3
Indoor Playing Field Arena		1.4
Town Hall	1.1	
Transportation	1.0	
Dining Area		2.1
Baggage Area		1.0
Airport - Concourse		0.6
Terminal - Ticket Counter		1.5
Reception/Waiting		0.5
Warehouse	0.8	
Fine Material		1.4
Medium/Bulky Material		0.9
Workshop	1.4	

Replace section 506 with:

SECTION 506 – TOTAL BUILDING PERFORMANCE

As referenced in section 501.1, buildings establishing compliance with this appendix through total building performance shall be designed to achieve energy use per square foot equal to at least 20% below the energy requirements of *ASHRAE/IESNA Standard 90.1-2007, Energy Standard for Buildings Except for Low-Rise Residential Buildings*, Appendix G, measured by industry-accepted energy modeling.

Add Section 507:

SECTION 507 - ALTERNATIVE PRESCRIPTIVE COMPLIANCE PACKAGES

507.1 Requirements. Buildings complying with the prescriptive option of section 501.4.1 shall meet the requirements of any one of the following sections:

a. 507.2.1 Efficient Mechanical Equipment

b. 507.2.2 Reduced Lighting Power Density

c. 507.2.3 On-Site Supply of Renewable Energy

507.2.1 Efficient Mechanical Equipment

This mechanical alternative compliance option is intended to allow the builder to meet the requirements of section 507 by choosing to install efficient mechanical equipment.

This section does not replace the requirements in section 503, but is one of several optional compliance packages.

Mechanical equipment choices that fulfill requirements for section 507.2.1 shall comply with the following:

a. Package unitary equipment shall meet the minimum efficiency requirements in Tables 507.2.1(1) and 507.2.1(2)

b. Package Terminal Air Conditioners and Heat Pumps shall meet the minimum efficiency requirements in Table 507.2.1(3)

c. Warm air furnaces and combination warm air furnaces / air conditioning units shall meet the minimum efficiency requirements in Table 507.2.1(4)

d. Boilers shall meet the minimum efficiency requirements in Table 507.2.1(5)

e. Electric chillers shall meet the energy efficiency requirements in Table 507.2.1(6)

f. Absorption chillers shall meet the minimum efficiency requirements in Table 507.2.1(7)

TABLE 507.2.1(1)
UNITARY AIR CONDITIONERS AND CONDENSING UNITS, ELECTRICALLY OPERATED, EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Subcategory Or Rating Condition	Minimum Efficiency[a]
Air conditioners, Air cooled	< 65,000 Btu/h	Split system	15.0 SEER 12.5 EER
		Single package	15.0 SEER 12.0 EER
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split system and single package	11.5 EER[b] 11.9 IPLV[b]
	≥ 135,000 Btu/h and < 240,000 Btu/h	Split system and single package	11.5 EER[b] 11.9 IPLV[b]
	≥ 240,000 Btu/h and < 760,000 Btu/h	Split system and single package	10.5 EER[b] 10.9 IPLV[b]
	≥ 760,000 Btu/h		9.7 EER[b] 11.0 IPLV[b]
Air conditioners, Water and evaporatively cooled		Split system and single package	14.0 EER

For SI: 1 British thermal unit per hour = 0.2931 W.

a. IPLVs are only applicable to equipment with capacity modulation.

b. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.

TABLE 507.2.1(2)
UNITARY AND APPLIED HEAT PUMPS, ELECTRICALLY OPERATED, EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Subcategory Or Rating Condition	Minimum Efficiency[a]
Air cooled (Cooling mode)	< 65,000 Btu/h	Split system	15.0 SEER 12.5 EER
		Single package	15.0 SEER 12.0 EER
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split system and single package	11.5 EER[b] 11.9 IPLV[b]
	≥135,000 Btu/h and < 240,000 Btu/h	Split system and single package	11.5 EER[b] 11.9 IPLV[b]
	≥ 240,000 Btu/h	Split system and single package	10.5 EER[b] 10.9 IPLV[b]
Water source (Cooling mode)	< 135,000 Btu/h	85°F entering water	14.0 EER
Air cooled (Heating mode)	< 65,000 Btu/h (Cooling capacity)	Split system	8.5 HSPF
		Single package	8.0 HSPF
	≥ 65,000 Btu/h and < 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb outdoor air	3.4 COP
		77°F db/15°F wb outdoor air	2.4 COP
	≥ 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb outdoor air	3.1 COP
		77°F db/15°F wb outdoor air	2.1 COP
Water source (Heating mode)	< 135,000 Btu/h (Cooling capacity)	70°F entering water	4.6 COP

For SI: °C = [(°F) - 32] / 1.8, 1 British thermal unit per hour = 0.2931 W.
db = dry-bulb temperature, °F; wb = wet-bulb temperature, °F
a. IPLVs and Part load rating conditions are only applicable to equipment with capacity modulation.
b. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.

TABLE 507.2.1(3)
PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINALHEAT PUMPS

Equipment Type	Size Category	Minimum Efficiency
Air conditioners	< 7,000 Btu / h	11.9 EER
& Heat Pumps (Cooling Mode)	7,000 Btu / h and < 10,000 Btu / h	11.3 EER
	10,000 Btu / h and < 13,000 Btu / h	10.7 EER
	≥ 13,000 Btu / h	9.5 EER

a. Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY: NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches (406 mm) high and less than 42 inches (1067 mm) wide.

TABLE 507.2.1(4)
WARM AIR FURNACES AND COMBINATION WARM AIR FURNACES/AIR-CONDITIONING UNITS, WARM AIR DUCT FURNACES AND UNIT HEATERS, EFFICIENCY REQUIREMENTS

Equipment Type	Size Category (Input)	Subcategory Or Rating Condition	Minimum Efficiency	Test Procedure
Warm air furnaces, gas fired	< 225,000 Btu/h	-	90% AFUE or 90% *Et*	DOE 10 CFR Part 430 or ANSI Z21.47
	≥ 225,000 Btu/h	Maximum capacity	90% *Ec*, note 1.	ANSI Z21.47
Warm air furnaces, oil fired	< 225,000 Btu/h	-	85% AFUE or 85% *Et*	DOE 10 CFR Part 430 or UL727
	≥ 225,000 Btu/h	Maximum capacity	85 % *Et*, note 1.	UL 727
Warm air duct furnaces, gas fired	All capacities	Maximum capacity	90% *Ec*	ANSI Z83.8
Warm air unit heaters, gas fired	All capacities	Maximum capacity	90% *Ec*	ANSI Z83.8
Warm air unit heaters, oil fired	All capacities	Maximum capacity	90% *Ec*	UL 731

For SI: 1 British thermal unit per hour = 0.2931 W.
1. Units must also include an IID (intermittent ignition device), have jackets not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space. Where there are two ratings, units not covered by the National Appliance Energy Conservation Act of 1987 (NAECA) (3-phase power or cooling capacity greater than or equal to 65,000 Btu/h [19 kW] shall comply with either rating.
Et = Thermal efficiency
Ec = Combustion efficiency (100% less flue losses)
Efficient furnace fan: All fossil fuel furnaces in zones 3 to 8 shall have a furnace electricity ratio not greater than 2% and shall include a manufacturer's designation of the furnace electricity ratio.

TABLE 507.2.1(5)
BOILER, EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Minimum Efficiency
Gas Hot Water	< 300,000 Btu/h	90% *Et*
	> 300,000 Btu/h and < 2.5 mBtu/h	89% *Et*
Gas Steam	< 300,000 Btu/h	89% *Et*
	≥ 300,000 Btu/h	89% *Et*
Oil	< 300,000 Btu/h	90% *Et*
	≥ 300,000 Btu/h	89% *Et*
***Et* = thermal efficiency**		

TABLE 507.2.1(5)
CHILLERS - EFFICIENCY REQUIREMENTS

		Required Efficiency-Chillers		Optional Compliance Path - Required Efficiency - Chillers With VSD	
Equipment Type	**Size Category**	Full Load (KW/ Ton)	IPLV (KW/ Ton)	Full Load (KW/Ton)	IPLV (KW/ Ton)
Air Cooled w/ Condenser	All	1.2	1.0	N/A	N/A
Air Cooled w/o Condenser	All	1.08	1.08	N/A	N/A
Water Cooled, Reciprocating	All	0.840	0.630	N/A	N/A
Water Cooled, Rotary Screw and Scroll	< 90 tons	0.780	0.600	N/A	N/A
	90 tons and < 150 tons	0.730	0.550	N/A	N/A
	150 tons and < 300 tons	0.610	0.510	N/A	N/A
	≥ 300 tons	0.600	0.490	N/A	N/A
Water Cooled, Centrifugal	< 150 tons	0.610	0.620	0.630	0.400
	150 tons and < 300 tons	0.590	0.560	0.600	0.400
	300 tons and < 600 tons	0.570	0.510	0.580	0.400
	≥ 600 tons	0.550	0.510	0.550	0.400

a. Compliance with full load efficiency numbers and IPLV numbers are both required.
b. Only Chillers with Variable Speed Drives(VSD) may use the optional compliance path here for chiller efficiency.

TABLE 507.2.1(6)
ABSORPTION CHILLERS - EFFICIENCY REQUIREMENTS

Equipment Type	Required Efficiency Full Load COP (IPLV)
Air Cooled, Single Effect	0.60, but only allowed in heat recovery applications
Water Cooled, Single Effect	0.70, but only allowed in heat recovery applications
Double Effect - Direct Fired	1.0 (1.05)
Double Effect - Indirect Fired	1.20

507.2.2 Reduced Lighting Power Density.
Whole Building Lighting Power Density (Watts/ft^2) must be reduced by at least 10% from the values in table 505.5.2, or as shown in table 507.2.2.

507.2.2.1 Automatic Daylighting Controls.

Automatic daylighting controls shall be installed in the daylight zone and shall meet the requirements of 505.2.2.1.3.

TABLE 507.2.2
REDUCED INTERIOR LIGHTING POWER ALLOWANCES

LIGHTING POWER DENSITY	
Building Area Type[a]	**Reduced whole building (W/ft²)**
Automotive Facility	0.8
Convention Center	1.1
Court House	1.1
Dining: Bar Lounge/Leisure	1.2
Dining: Cafeteria/Fast Food	1.3
Dining: Family	1.4
Dormitory	0.9
Exercise Center	0.9
Fire Station	0.7
Gymnasium	1.0
Healthcare-Clinic	0.9
Hospital	1.1
Hotel	0.9
Library	1.2
Manufacturing Facility	1.2
Motel	0.9
Motion Picture Theater	1.1
Multi-Family	0.6
Museum	1.0
Office	0.8
Parking Garage	0.3
Penitentiary	0.9
Performing Arts Theater	1.4
Police	0.9
Post Office	1.0
Religious Building	1.2
Retail[b]	1.2
School/University	1.1
Sports Arena	1.0
Town Hall	1.0
Transportation	0.9
Warehouse	0.7
Workshop	1.3

See IECC 2009 Table 505.2 for notes and exception.

507.2.3 On-site Supply of Renewable Energy

The building or surrounding property shall incorporate an on-site renewable energy system that supplies 3% or more of total building electrical loads. On-site power generation using nonrenewable resources does not meet this requirement.

The jurisdiction shall be provided with an energy analysis that documents the renewable energy contribution to the building or a calculation demonstrating that the on-site supply of renewable energy:

a) Is capable of providing at least 3 percent of the total energy load of the building, or
b) Has an installed maximum generating capacity equal to or greater than 0.50 watts per square foot of usable floor space.

Insert IECC 2009 Chapter 6 – Referenced Standards

Attachment B

Stretch Code – Energy Efficiency Requirements for Commercial Buildings

Construction Type	Performance – 20% better than the Base Code	Prescriptive
5,000 - 100,000 SF	Energy model showing 20% below ASHRAE 90.1-2007[2]	Stretch code amendments to IECC Chapter 5 (about 18 pages in the Stretch Code with a goal of reducing energy consumption by 20% from base code) *Prescriptive option includes 3 choices:* – Heating and cooling equipment improvements, – Improved Lighting efficiency (LPD) – 3% + of electric needs from on-site renewables
Over 100,000 SF	Energy model showing 20% below ASHRAE 90.1-2007	N/A
Special cases – buildings with unusual energy demands (supermarkets, labs, warehouses) – ***larger*** than 40,000 SF	Energy model showing 20% below ASHRAE 90.1-2007	N/A
EXEMPTIONS		
▪ Commercial buildings smaller than 5,000 SF	Base Energy Code (IECC 2009)	
▪ Commercial renovations and existing interior fit-outs	Base Energy Code (IECC 2009)	
▪ Special cases – buildings with unusual energy demands (supermarkets, labs, warehouses) – ***smaller*** than 40,000 SF	Base Energy Code (IECC 2009)	

Source: Compiled by the City of Worcester Division of Planning and Regulatory Services. December 2009. Based on:

- Massachusetts Building Code Appendix 120.AA, 'Stretch' Energy Code
- Massachusetts Executive Office of Energy and Environmental Affairs, Green Communities Grant Program, Power Point Presentation entitled "MA Stretch Appendix and Building Energy Codes" by Ian Finlayson, Senior Climate Policy Analyst and Marc Breslow, Director of Buildings and Transportation Policy. http://www.mass.gov/Eoeea/docs/doer/green_communities/grant_program/stretch_code_webinar.pdf. Accessed March 11, 2010.

[2] ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) develops codes for commercial buildings. Using ASHRAE Code is an option for complying with the IECC 2009 Code.

Attachment C

Stretch Code – Energy Efficiency Requirements for Residential Buildings

Base Energy Code - IECC 2009			
Performance	*Performance with HERs rating*	*Prescriptive with trade-offs*	*Prescriptive*
IECC Chapter 4 section 405	HERS rating 100 or lower	REScheck (based on IECC Ch. 4)	IECC Chapter 4
Stretch Energy Code – Appendix 120.AA			
Construction Type	*Performance*	*Prescriptive*	
New Homes	HERS (65 or 70)	N/A	
Additions	HERS (65 or 70)	Energy Star Homes Builders Option Package (BOP)	
Renovations	HERS (80 or 85)	Energy Star Homes Builders Option Package (BOP)	

Source: EOEEA Green Community Grant Program

New Homes or Additions:

– HERS* 70 or less < 3,000 sq ft.
– HERS* 65 or less > 3,000 sq ft.

Residential Renovations:

– HERS* 85 or less < 2,000 sq ft.
– HERS* 80 or less > 2,000 sq ft.

Source: Massachusetts Executive Office of Energy and Environmental Affairs. Green Communities Grant Program. Power Point Presentation "MA Stretch Appendix and Building Energy Codes" by Ian Finlayson, Senior Climate Policy Analyst and Marc Breslow, Director of Buildings and Transportation Policy. *Slide: "Many Ways to Meet Code."* http://www.mass.gov/Eoeea/docs/doer/green_communities/grant_program/stretch_code_webinar.pdf. Accessed March 11, 2010.

* "New residential buildings three stories or fewer will be required to meet an energy performance standard using the Home Energy Rating System3 (HERS). This index scores a home on a scale where 0 is a zero-net-energy home, and 100 is a code-compliant new home (based on the IECC 2006 code). The stretch code requires a HERS index of 65 or less for new homes of 3,000 square feet or more and 70 or less for new homes below 3,000 square feet (including multi-family units in buildings of three stories or fewer). A HERS index of 65 means that the home is estimated to use 65 percent as much energy as the same home built to the 2006 energy code, or a 35 percent annual energy savings." - DOER

Attachment D

Stretch Code – Fidelity Bank Case

Source: Massachusetts Executive Office of Energy and Environmental Affairs. Green Communities Grant Program. "Fidelity Bank Corporate Office and Branch Case Study." http://www.mass.gov/Eoeea/docs/doer/green_communities/grant_program/fidelity_case_study.pdf accessed March 11, 2010.

Fidelity Bank
Corporate Office and Branch Case Study
Leominster, MA

Advanced Building Features

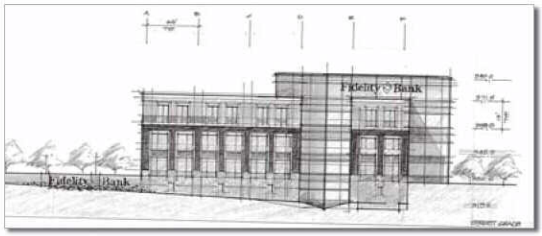
- High Efficiency T-5 Pendant Lighting
- Lighting Control Efficiency
- Reduced Lighting Power Density
- Efficient Site Lighting
- Additional Wall Insulation
- High Performance Glazing
- Efficient VAV RTU's, with ECM Motors
- Demand Control Ventilation
- Part Load HVAC Efficiency Enhancements

Funded Utility Services Support

- Early Life Cycle Cost Analysis
- Integrated Design Team Approach
- Commissioning

Project Description

The 47,000 SF Fidelity Bank Corporate Office and Branch was constructed as a design-build project in Leominster, MA. The four story building will provide office space plus a ground floor branch bank office. This project is acclaimed for its highly successful implementation of the national Advanced Buildings program. The project demonstrates the validity of the Advanced Buildings program assertions. The guideline cost effectively delivered even more than the expected 20% to 30% reduction in annual energy costs compared to a code based design.



Envelope Improvements

- Walls: Added 3-1/2" batt insulation to planned 2" rigid.
- Glazing:
  - Upgrade U value from 0.42 to 0.31
  - Upgrade SHGC from 0.50 to 0.30
- Projected envelope savings: $1,500

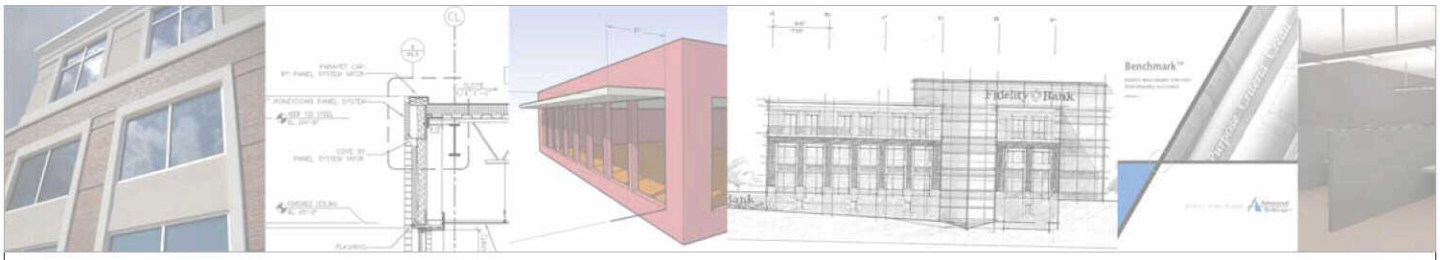
Project Team

Owner:
Fidelity Bank
Project Management:
Habitat Advisory Group
Architect:
Maugel Architects
General Contractor:
Construction Dynamics
Energy Efficiency Incentives and Support:
National Grid and Keyspan Energy Delivery

Advanced Buildings

nationalgrid

KEYSPAN

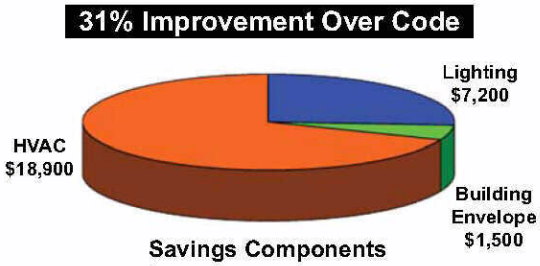


High Performance Building Design Uses 31% Less Energy

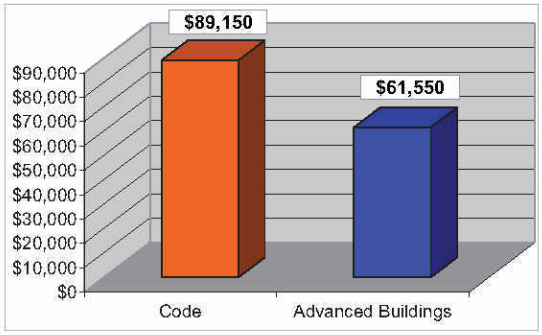
Savings Projection

Annual Energy Savings:	$ 27,600
Additional Cost for Upgrades:	$100,622
Utility Incentives:	- $ 66,587
Net Owner Costs:	$ 34,035

Payback with Incentives: **1.2 years ROI: 83%**
Payback without Incentives: 3.7 years ROI: 27%



Savings Components
($27,600 annual savings)



Annual Energy Costs

Lighting Savings Summary

The lighting layout consisted mainly of T-5 pendants in open office areas, and the latest generation of recessed T-5 fixtures in the remaining areas.

Projected Lighting Savings: $7,200

	Mass Energy Code	Advanced Buildings Criteria	Final Design	% Reduction
Lighting Power Density	1.34 w/SF	0.96 w/SF	0.86 w/SF	36%

Improved lighting quality while using <u>less</u> energy!

HVAC Savings Summary

HVAC moves that deliver!

Advanced Buildings emphasizes an integrated approach to the HVAC Design with particular focus on efficiency under part load conditions. Savings are credited to Advanced Buildings' focus on the specifics of the application instead of just the full load equipment efficiency.

Advanced Buildings additional investments:

- 10.2 EER HVAC Units
- Demand Controlled Ventilations (CO2 Controls)
- ECM Fan Box Motors
- Dedicated Data Room Cooling Unit

Projected HVAC Savings: $18,900
Payback Before Incentives: **1.8 Years**
Efficient HVAC Cost: $ 34,100

Attachment E

Incremental Cost vs. Benefit Associated with Compliance IECC 2009 and Stretch Code By Housing Type (Typical Home, Small Home and Triple Decker)

Source: Massachusetts Executive Office of Energy and Environmental Affairs. Green Communities Grant Program Ian Finlayson, Senior Climate Policy Analyst with additional title changes, annotations and formatting by the Division of Planning & Regulatory Services

Incremental Costs Associated w/Compliance with IECC 2009 and Stretch Code

Single- Family Home (2,672SF Home)

	IECC 2009 Code vs. IECC 2006	Stretch Code vs. IECC 2009	Stretch Code - with ENERGY STAR[4,5] - vs. IECC 2009
HERS Index Modeled in REM/Rate	86	70	70
Improvement Measures (changes relative to Basecase)	- Unconditioned basement - Floor, R30 - Walls, R21 - Ceiling, R38 G2 - Heating, 80 AFUE - Cooling, 13 SEER - Water Heating, .59 EF - Duct leakage, 8% - Infiltration, 7 ACH50 - Efficient lighting, 50%	- Ceiling, R38 G1 - Heating, 94 AFUE - Water heating, .62 EF - Infiltration, 4 ACH50 - Efficient lighting, 75% - Exhaust Only Ventilation	- Ceiling, R38 G1 - Heating, 94 AFUE - Water heating, .62 EF - Duct leakage, 6% - Infiltration, 5 ACH50 - Efficient lighting, 80% - Exhaust Only Ventilation
Improvement Costs		$2,049	$2,155
HERS Rater Fee[1]		$700	$700
HERS Rater reimbursement[2]		-	-$700
ENERGY STAR Incentive[3]		-	-$750
Total Improvement Costs		$2,749	$1,405
Mortgage Interest Rate		$0	$0
Loan Term (Years)		$30	$30
Annual Incremental Mortgage Payment		$200	$102
Annual Energy Costs[6]	$3,970	$3,463	$3,454
Annual Energy Savings from Baseline		$507	$516
Annual Cash Flow	**$0**	**$307**	**$414**

Notes

[1]Massachusetts ENERGY STAR Homes Program Tier 1 HERS Rater Fee. Includes cost for conducting Thermal Bypass Inspection.

[2]HERS Rater Fees are reimbursed by the Massachusetts ENERGY STAR Homes program.

[3]Massachusetts ENERGY STAR Homes Program incentive for Tier 1 (single-family new construction).

[4]ENERGY STAR Tier 1 requirements have been added to the Stretch Code package.

[5]Stretch code homes may qualify for Tier 2 incentives ($1250).

[6]Annual energy costs are based on current average fuel costs.

Incremental Costs Associated w/Compliance with IECC 2009 and Stretch Code

Single-Family Home (1,708SF)

	IECC 2009 Code vs. IECC 2006	Stretch Code vs. IECC 2009	Stretch Code - with ENERGY STAR[4,5] - vs. IECC 2009
HERS Index Modeled in REM/Rate	**86**	**70**	**70**
Improvement Measures (changes relative to Basecase)	- Unconditioned basement - Floor, R30 - Walls, R21 - Ceiling, R38 G2 - Heating, 80 AFUE - Cooling, 13 SEER - Water Heating, .59 EF - Duct leakage, 8% - Infiltration, 7 ACH50 - Efficient lighting, 50%	- Ceiling, R60 G1 - Heating, 94 AFUE - Water Heating, .62 EF - Infiltration, 5 ACH50 - Efficient lighting, 75% - Exhaust Only Ventilation	- Ceiling, R60 G1 - Heating, 94 AFUE - Water Heating, .62 EF - Infiltration, 5 ACH50 - Duct leakage, 6% - Efficient lighting, 80% - Exhaust Only Ventilation
Improvement Costs		$3,262	$3,643
HERS Rater Fee[1]		$700	$700
HERS Rater reimbursement[2]		-	-$700
ENERGY STAR Incentive[3]		-	-$750
Total Improvement Costs		$3,962	$2,893
Mortgage Interest Rate		$0	$0
Loan Term (Years)		$30	$30
Annual Incremental Mortgage Payment		$288	$210
Annual Energy Costs[6]	$3,754	$3,171	$3,159
Annual Energy Savings from Baseline		$583	$595
Annual Cash Flow	**$0**	**$295**	**$385**

Notes

[1]Massachusetts ENERGY STAR Homes Program Tier 1 HERS Rater Fee. Includes cost for conducting Thermal Bypass Inspection.

[2]HERS Rater Fees are reimbursed by the Massachusetts ENERGY STAR Homes program.

[3]Massachusetts ENERGY STAR Homes Program incentive for Tier 1 (single-family new construction).

[4]ENERGY STAR Tier 1 requirements have been added to the Stretch Code package.

[5]Stretch code homes may qualify for Tier 2 incentives ($1250).

[6]Annual energy costs are based on current average fuel costs.

Incremental Costs Associated w/Compliance with IECC 2009 and Stretch Code Renovation Cambridge Triple Decker Condo (6,848 GFA) < 2,000SF per unit[7]				
		IECC 2009 Code vs. IECC 2006	**Stretch Code vs. IECC 2009**	**Stretch Code - with ENERGY STAR[4,5] - vs. IECC 2009**
HERS Index Modeled in REM/Rate		**86**	**85**	**86**
Improvement Measures (changes relative to Basecase)	- Conditioned basement - Foundation Walls, R13 - Walls, R13 - Ceiling, R38 G2 - Heating, 80 AFUE - Water Heating, .59 EF - Infiltration, 7 ACH50 - Efficient lighting, 50%		- Infiltration, 6.75 ACH50 - Efficient Lighting, 75% - Exhaust Only Ventilation	- Infiltration, 6.75 ACH50 - Efficient Lighting, 75% - Energy Recovery Ventilation
Improvement Costs			$655	$6,976
HERS Rater Fee[1]			$700	$700
Total Improvement Costs			$1,355	$7,676
Mortgage Interest Rate			$0	$0
Loan Term (Years)			$30	$30
Annual Incremental Mortgage Payment			$98	$558
Annual Energy Costs[6]		$8,091	$7,956	$8,107
Annual Energy Savings from Baseline			$135	-$16
Annual Cash Flow		**$0**	**$37**	**-$574**

Notes

[1]Massachusetts ENERGY STAR Homes Program Tier 1 HERS Rater Fee. Includes cost for conducting Thermal Bypass Inspection.

[2]HERS Rater Fees are reimbursed by the Massachusetts ENERGY STAR Homes program.

[3]Massachusetts ENERGY STAR Homes Program incentive for Tier 1 (single-family new construction).

[4]ENERGY STAR Tier 1 requirements have been added to the Stretch Code package.

[5]Stretch code homes may qualify for Tier 2 incentives ($1250).

[6]Annual energy costs are based on current average fuel costs.

[7] Greater than 2,000SF must achieve HERS of 80

Attachment F

Stretch Code Presentation
&
Frequently Asked Questions

Source: Massachusetts Executive Office of Energy and Environmental Affairs. Green Communities Grant Program. Power Point Presentation "MA Stretch Appendix and Building Energy Codes" by Ian Finlayson, Senior Climate Policy Analyst and Marc Breslow, Director of Buildings and Transportation Policy.
http://www.mass.gov/Eoeea/docs/doer/green_communities/grant_program/stretch_code_webinar.pdf.
Accessed March 11, 2010.

STRETCH CODE OVERVIEW

Build Boston November 18th, 2009

Ian Finlayson – Executive Office of Energy and Environmental Affairs

Green Communities Act (GCA)

- GCA - 2008 Energy legislation in MA
- Adopts latest IECC building energy code
  - Plus other energy measures
  - Building commisioning
  - Building code training

- Creates Green Communities Program

IECC = International Energy Conservation Code – of International Codes Council (ICC)

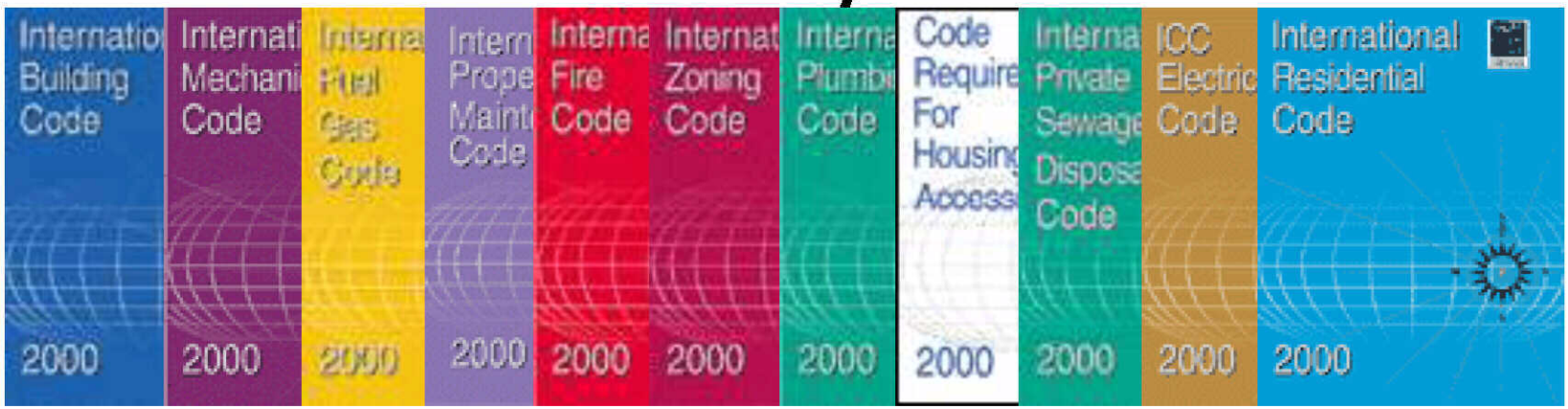
IECC and ASHRAE Codes

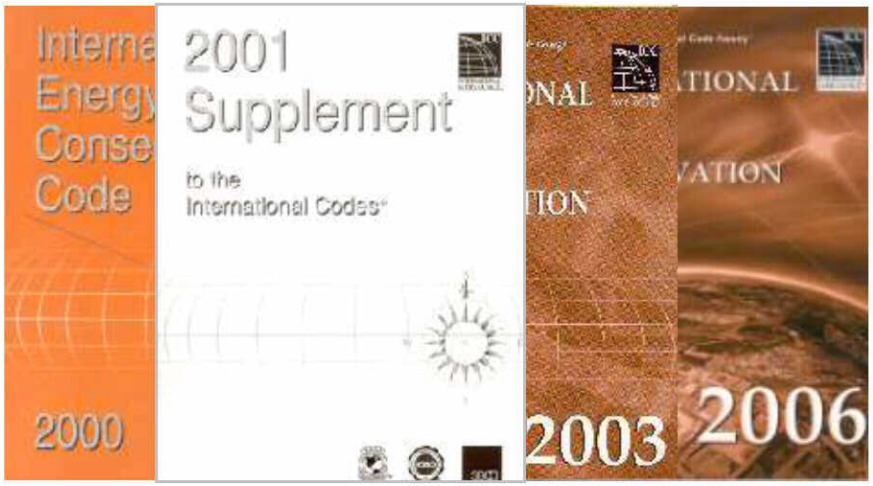
- ICC & ASHRAE develop model building codes and standards for the US.
- ICC: publishes IECC energy code
  - 3 year cycle IECC 2006, IECC 2009
- ASHRAE: publishes 90.1 standard
  - 3 year cycle 90.1-2007, 90.1-2010

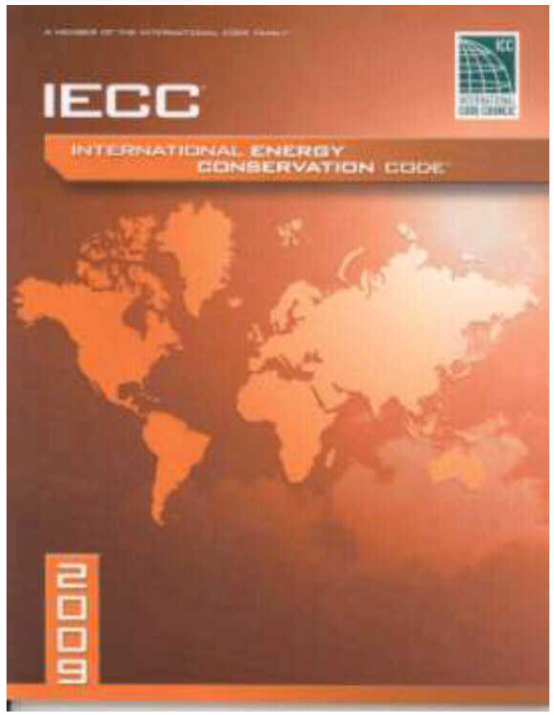
IECC = International Energy Conservation Code – of International Codes Council (ICC)

ASHRAE = American Society of Heating, Refrigerating and Air-Conditioning Engineers

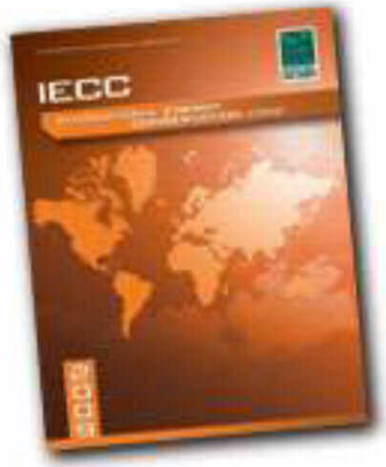
The ICC Family of I-Codes







MA 8th Edition: IECC 2009 and other 'I' codes



- MA required to adopt IECC 2009 energy code in Jan 2010
- Becomes sole code in July 2010
- MA BBRS adopting other ICC 'I' codes
  - International Building Code (IBC)
  - International Mechanical Code (IMC)
  - International Existing Bldg. Code (IEBC)
- BBRS public hearings Dec, Jan and early 2010

BBRS = Board of Building Regulations and Standards – independent MA code authority

MA code IECC Improvements

- MA 7th edition to 8th edition
  - IECC 2006 to IECC 2009 – 10% more EE
- IECC 2006 to IECC 2012 - ~25% more EE
  - Based on Baltimore Code Hearings 2009
- MA 8th edition to 9th edition
  - IECC 2009 to 2012 = 25% - 10% = approx 15%

2009 IECC energy savings over 2006/07 IECC

Homeowner Energy Cost Savings Average $235/Year

If the 2009 IECC were adopted and enforced for new homes constructed throughout the US, ICF's analysis estimates national energy cost savings of 12.2% and average weighted energy cost savings to the new homeowner of $235 per year (using 2007/2008 EIA cost data by state). It should be noted that these costs likely substantially understate actual cost savings because they do not incorporate expected increases in energy prices over the life of the home. By Climate Zone, the estimated energy savings range from 9.5% -14.1% and the energy cost savings range from $163-$437 per home, as follows (ICF used energy cost savings as the metric to be consistent with how the IECC measures energy savings):

Nationally Weighted	By Climate Zone								
	1	2	3	4	4 Marine	5	6	7	8
12.2%	14.1%	13.2%	13.4%	11.6%	9.5%	10.0%	11.6%	13.1%	13.3%
$ 235	$ 437	$ 223	$ 242	$ 238	$ 163	$ 221	$ 276	$ 337	$ 419

RESIDENTIAL STRETCH CODE

Residential based on 'Energy Star'

- Proven cost-effective program
  - 15% of new construction in MA
- Builder incentives/rebates
  - $1250/home for HERS 65
  - Rebates on appliances, heating and cooling, lighting, etc.
- Builder training and materials
- Subsidized HERS raters

New Homes – Energy Rating (HERS)

- Energy 'Performance' rating (like car MPG)
  - Uses Home Energy Rating System (HERS)
  - 70 or less < 3,000 sq ft.
  - 65 or less > 3,000 sq ft.
- Requires a certified HERS rater
  - Review building plans
  - Check insulation installation
  - Blower-door and duct testing
  - Thermal bypass Checklist

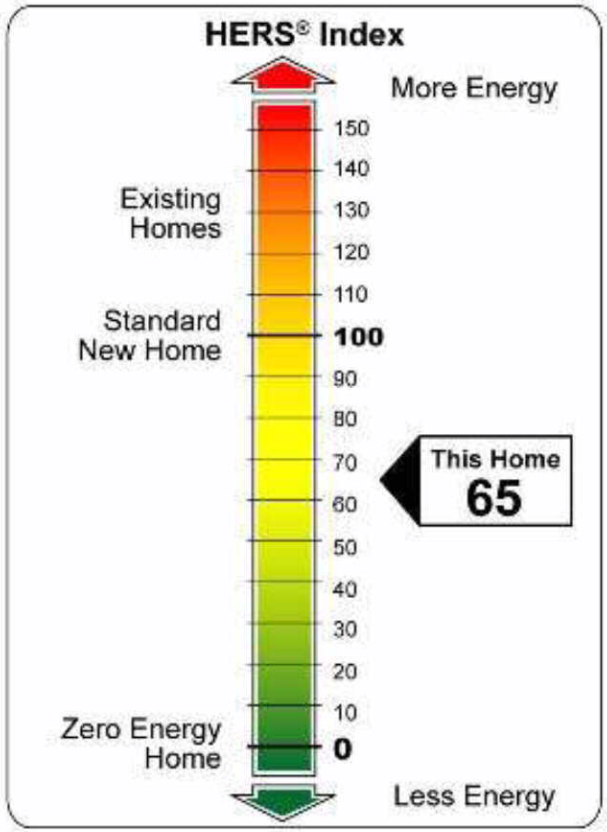


Image source: www.lexingtoninfrared.com/hers-ratings.php

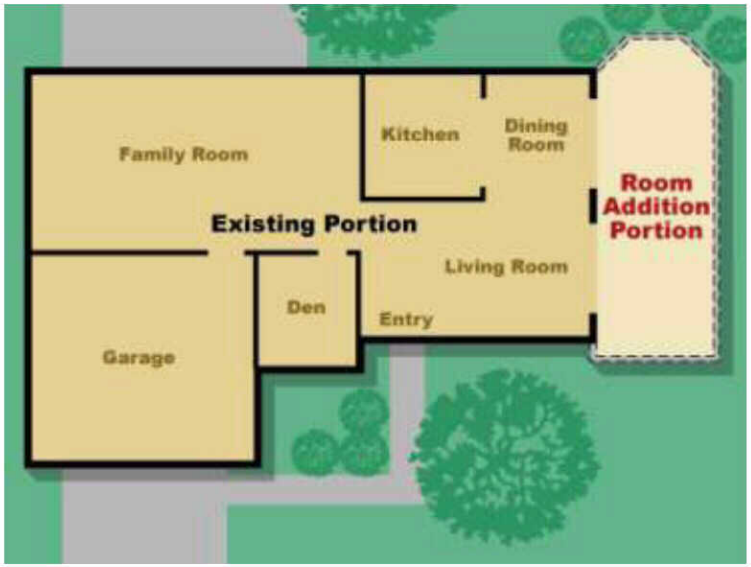
ENERGY STAR Qualified Homes
Thermal Bypass Inspection Checklist

Home Address:_____ City:_____ State:_____

Thermal Bypass	Inspection Guidelines	Corrections Needed	Builder Verified	Rater Verified	N/A
1. Overall Air Barrier and Thermal Barrier Alignment	**Requirements:** Insulation shall be installed in full contact with sealed interior and exterior air barrier except for alternate to interior air barrier under item no. 2 *(Walls Adjoining Exterior Walls or Unconditioned Spaces)*				
	All Climate Zones:				
	1.1 Overall Alignment Throughout Home	☐	☐	☐	☐
	1.2 Garage Band Joist Air Barrier (at bays adjoining conditioned space)	☐	☐	☐	☐
	1.3 Attic Eave Baffles Where Vents/Leakage Exist	☐	☐	☐	☐
	Only at Climate Zones 4 and Higher:				
	1.4 Slab-edge Insulation (A maximum of 25% of the slab edge may be uninsulated in Climate Zones 4 and 5.)	☐	☐	☐	☐
	Best Practices Encouraged, Not Req'd.:				
	1.5 Air Barrier At All Band Joists (Climate Zones 4 and higher)	☐	☐	☐	☐
	1.6 Minimize Thermal Bridging (e.g., OVE framing, SIPs, ICFs)	☐	☐	☐	☐
2. Walls Adjoining Exterior Walls or Unconditioned Spaces	**Requirements:** • Fully insulated wall aligned with air barrier at both interior and exterior, **OR** • Alternate for **Climate Zones 1 thru 3**, sealed exterior air barrier aligned with RESNET Grade 1 insulation fully supported • Continuous top and bottom plates or sealed blocking				
	2.1 Wall Behind Shower/Tub	☐	☐	☐	☐
	2.2 Wall Behind Fireplace	☐	☐	☐	☐
	2.3 Insulated Attic Slopes/Walls	☐	☐	☐	☐
	2.4 Attic Knee Walls	☐	☐	☐	☐
	2.5 Skylight Shaft Walls	☐	☐	☐	☐
	2.6 Wall Adjoining Porch Roof	☐	☐	☐	☐
	2.7 Staircase Walls	☐	☐	☐	☐
	2.8 Double Walls	☐	☐	☐	☐

Home Additions – 2 options

- HERS index on just addition or whole house
  - 70 or less < 3,000 sq ft.
  - 65 or less > 3,000 sq ft.



- Prescriptive Path
  - Energy Star

    Builders Option Package (BOP)
  - Energy star windows and Thermal Bypass Checklist

Existing Home Renovations

- Two options similar to additions
  - Easier HERS option (mostly gut-renovations)
  - 85 or less < 2,000 sq ft.
  - 80 or less > 2,000 sq ft.
- Prescriptive Energy Star
  - Same as for additions

Image source: http://www.wilkinsonbuild.co.uk/Portals/5/Renovation/renovation2.jpg

ENERGY STAR Qualified Homes
National Builder Option Package

The requirements for the ENERGY STAR Builder Option Package (BOP) are specified in the table below.
To qualify as ENERGY STAR using this BOP, a home must meet the requirements specified, be verified and field-tested in accordance with the HERS Standards by a RESNET-accredited Provider, and meet all applicable codes.

	Hot Climates [1] (2004 IRC Climate Zones 1,2,3)	**Mixed and Cold Climates** [1] (2004 IRC Climate Zones 4,5,6,7,8)
Cooling Equipment (Where Provided)	Right-Sized [2]: • ENERGY STAR qualified A/C *(14.5 SEER / 12 EER)*; OR • ENERGY STAR qualified heat pump [3] *(14.5 SEER / 12 EER / 8.2 HSPF)*	Right-Sized [2]: • 13 SEER A/C; OR • ENERGY STAR qualified heat pump [3] *(14.5 SEER / 12 EER / 8.5 HSPF)*
Heating Equipment	• 80 AFUE gas furnace; OR • ENERGY STAR qualified heat pump [2, 3] *(14.5 SEER / 12 EER / 8.2 HSPF)*; OR • 80 AFUE boiler; OR • 80 AFUE oil furnace	• ENERGY STAR qualified gas furnace *(90 AFUE)*; OR • ENERGY STAR qualified heat pump [2, 3] *(See Note 3 for specifications)*; OR • ENERGY STAR qualified boiler *(85 AFUE)*; OR • ENERGY STAR qualified oil furnace *(85 AFUE)*
Thermostat [3]	ENERGY STAR qualified thermostat (except for zones with radiant heat)	
Ductwork	Leakage [4]: ≤ 4 cfm to outdoors / 100 sq. ft.; AND R-6 min. insulation on ducts in unconditioned spaces [5]	
Envelope	• Infiltration [6,7] (ACH50): 7 in CZ's 1-2 | 6 in CZ's 3-4 | 5 in CZ's 5-7 | 4 in CZ 8; AND • Insulation levels that meet or exceed the 2004 IRC [8]; AND	

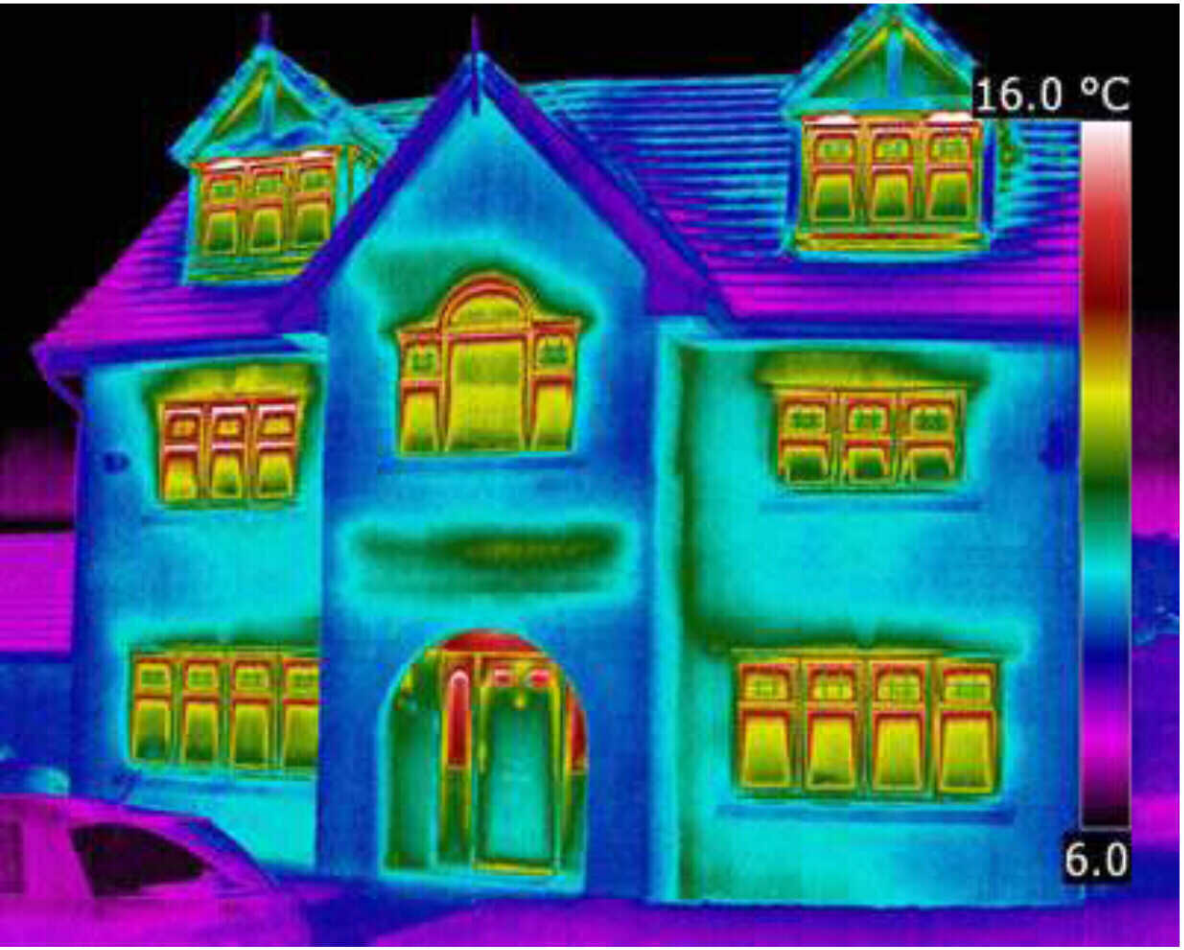
Why test Performance?

Image source: Environmental Protection Agency

Prescriptive codes don't guarantee good installation, air and water tightness, or that thermal insulation is effective.

(small air gaps can reduce insulation R-values by 50% or more)

Why test Performance?



Design, Installation & Equipment all important.

- Blower-door test for air leakage
- Infra-red camera tests thermal barrier install.
- Duct test for heating & AC

Image source: http://www.pixelthermographics.co.uk/images/FrontJoinedIR.jpg

Cost of Stretch code

- Cost effective and already proven in the voluntary market
  - Energy star 15% of all MA new residential in 2008

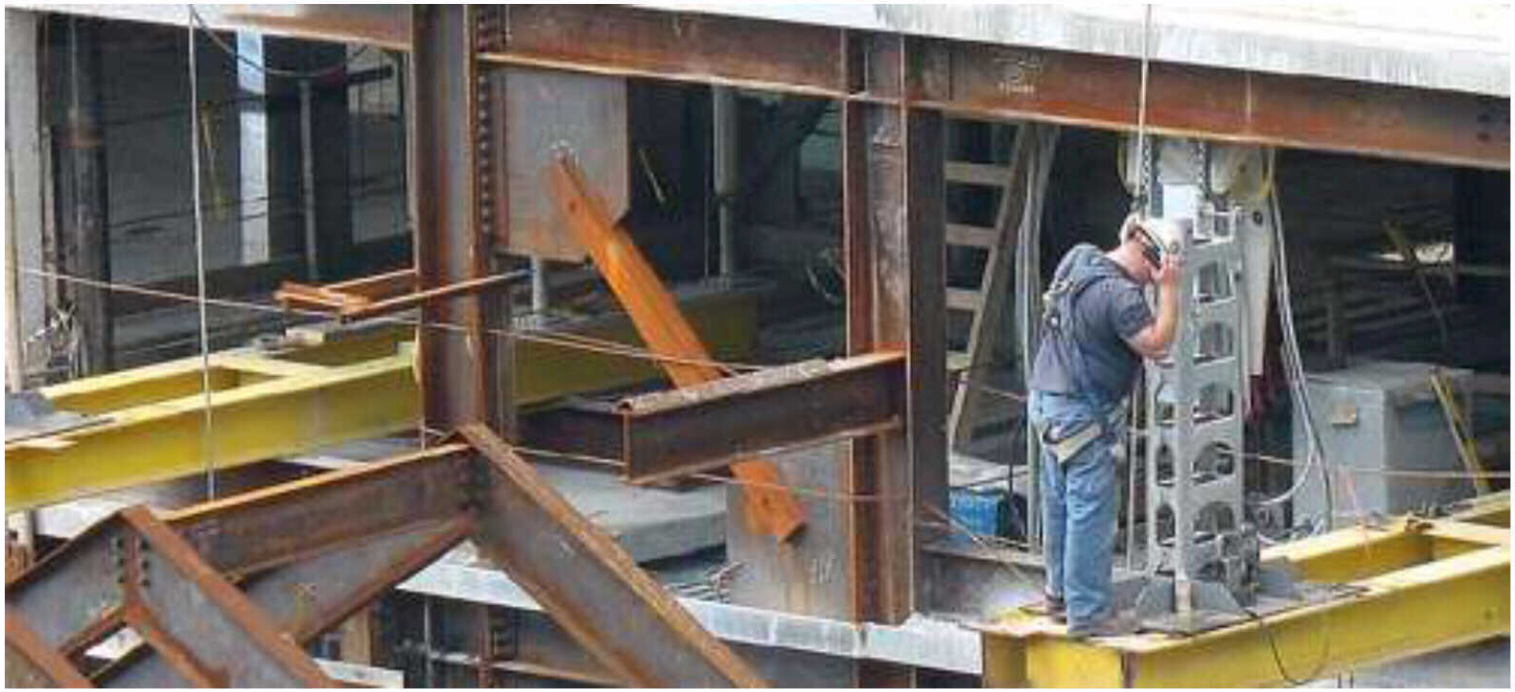
- Example homes show clear $$ savings
  - New 3-bed 2,700 ft^2 ranch
  - Rehab. urban triple-decker – 3x 1,400 ft^2 units

Example of Benefit-Cost Modeling:
2,672 square foot, 3-bedroom home

Task A – New Home	
HERS Index Modeled in REM/Rate	**60** (energy use 40% below 2006 IECC code)
Improvement Measures (changes relative to base case)	- Conditioned basement - Foundation Walls R10 insulation - Above grade walls R22 insulation - Window U-factor .33 - Attic ceiling R38 cellulose insulation - Slope ceiling R32 cellulose insulation - Infiltration 4 ACH50 - Natural Gas Furnace 94 AFUE, 65kBtuh - Central Air Conditioner 3 ton 15 SEER - Domestic Hot Water .62 natural gas tank - Programmable thermostat - 75% Fluorescent lighting
Improvement Costs	$ 8,103
Mortgage Interest Rate	5%
Loan Term (Years)	30
Annual Incremental Mortgage Payment	$527
Annual Energy Costs	$ 3,103
Annual Energy Savings from Baseline	$1,364
Annual Cash Flow Gain	**$ 837**

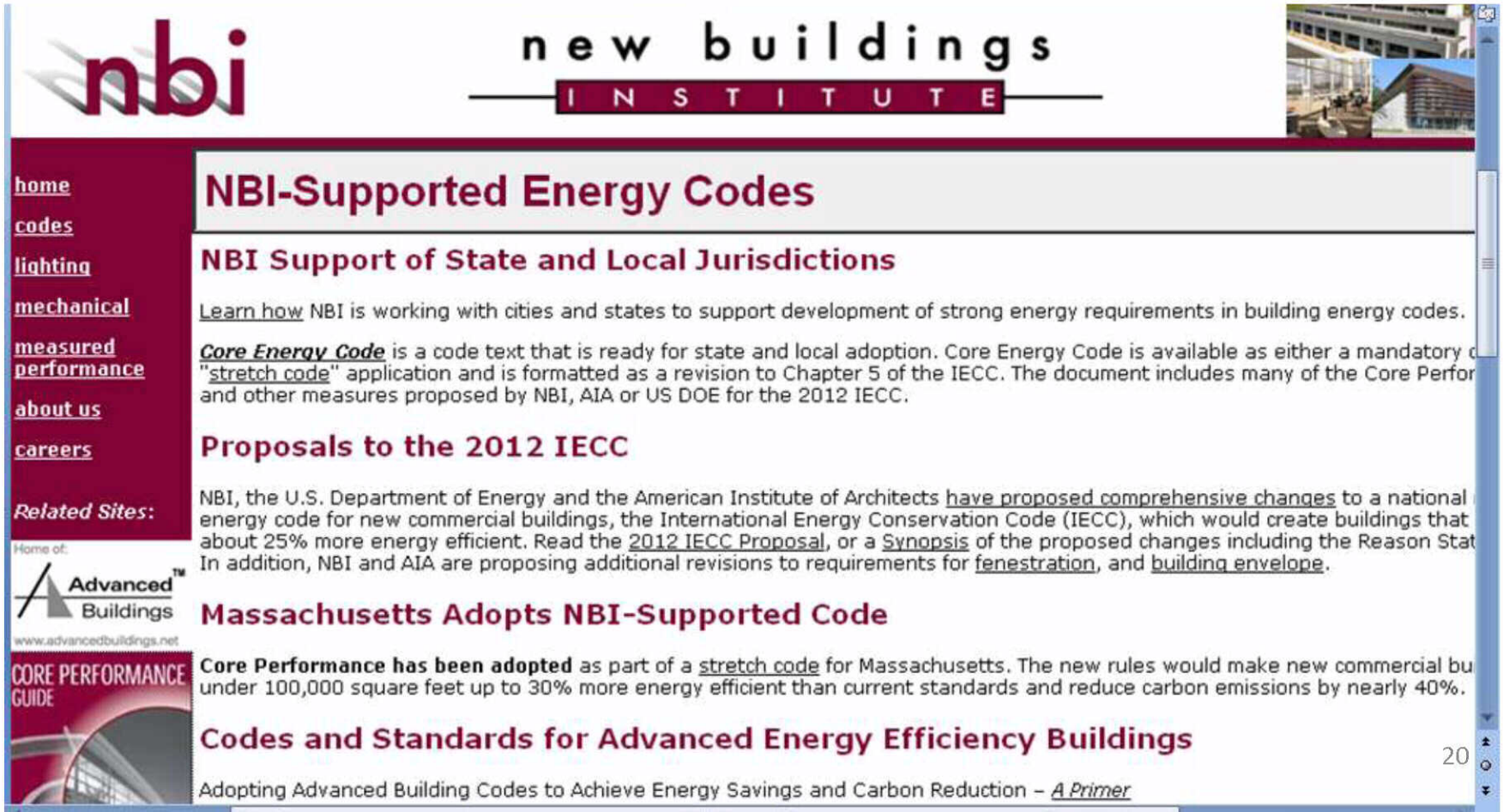
Note: This does not include the cost of a HERS rater (est. $500-1200) or the savings from utility rebates and Federal Tax Credits (up to $4000).

COMMERCIAL STRETCH CODE



Commercial ‘Stretch’ Appendix

- Based on New Buildings Institute – ‘Core Performance’ Energy Code

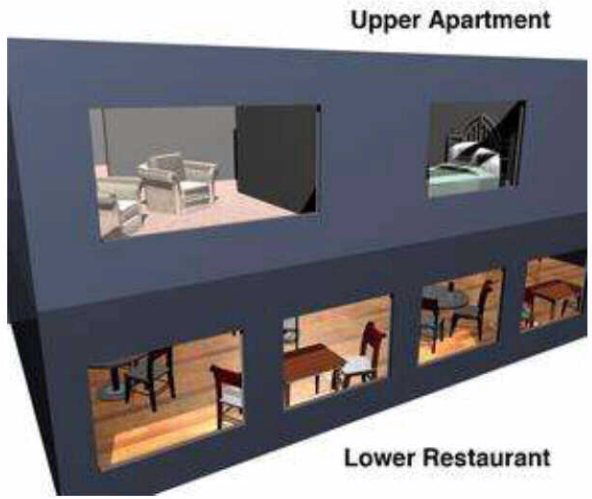


Commercial 'Stretch' Appendix

- Only New Buildings over 5,000 ft^2
  - or large Building additions
- Performance option
  - 20% below Code (ASHRAE 90.1-2007)
  - all buildings over 100,000 ft^2
  - Labs, Supermarkets, over 40,000 ft^2
- Prescriptive option for most building types
  - 5,000 - 100,000 ft2
  - Likely to be next base energy code (IECC 2012)
- Exemptions (comply with base code)
  - Commercial buildings smaller than 5,000 ft^2
  - Special cases smaller than 40,000 ft^2
  - Commercial renovations and existing interior fit-outs

Mixed Use Buildings

- **Mixed occupancies**
  - Treat the residential occupancy under the applicable residential code
  - Treat the commercial occupancy under the commercial code



Key Aspects of the Commercial Prescriptive option

120 AA goes slightly beyond the 2009 IECC in:

- More stringent opaque envelope
- More stringent window efficiency & sealing
- Addition of commissioning requirements.
- More stringent lighting control requirements.
- Option of more stringent HVAC requirements.
- Option of including renewable energy.

Likely to be in the IECC 2012 Commercial code

Commissioning Section 503.2.9

DURING CONSTRUCTION PROCESS

- Commissioning Plan
- Systems Balancing/Adjustment
- Equipment Performance Tests
- Controls Performance Tests
- Preliminary Report
- Acceptance of Reports

POST-CERTIFICATE OF OCCUPANCY

- As-Built Drawings
- Equipment Service Manuals
- Final Balance Report
- Final Commissioning Report
- Deferred Testing Report

Compliance Options – 120aa

1 of 3 OPTIONS for PRESCRIPTIVE COMPLIANCE

507.1 Requirements. Buildings* are required to comply with any one of the following sections:

- a. 507.2.1 Efficient Mechanical Equipment (%)
- b. 507.2.2 Reduce Lighting Power Density a further 10%
- c. 507.2.3 On-Site Renewable Energy at least 3%

*Includes Additions > 30% of 5Ksf – 100Ksf (101.4.6)

Builders may select more than one

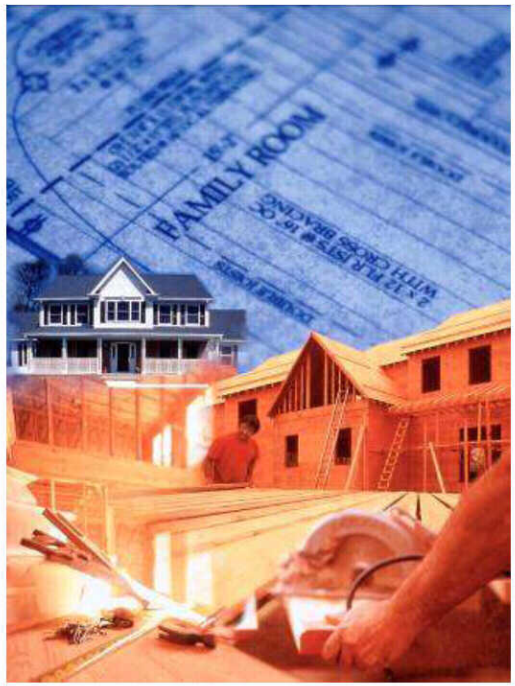
Commercial 'Stretch' & LEED(v.3)

- LEED and Commercial 'Stretch' code are fully compatible
  - Both use ASHRAE 90.1-2007 as the energy modeling baseline.
- LEED energy model = Stretch code model

  20% better than ASHRAE 90.1-2007= 5 LEED energy modeling points
- LEED also has non-energy requirements

Code Compliance & Inspections

- Essentially the same as base code
- Code Official has the same authority
  - Same building inspections
  - Approves building documents, Energy Star and HERS rating or ASHRAE modeling as documentation of energy
- Certificate is required



Training on new energy codes

- Covering both the IECC 2009 & Stretch code
- Provided free to all Code Officials
  - Includes IECC code book and Stretch appendix
- Provided at cost to building professionals
- Begins in the new year
  - Separate Commercial and Residential sessions
- Energy star homes training available for free: www.energystarhomes.com/
- Utilities offer commercial 'Core Performance' energy training

Incentives available

- Towns/Cities – Green Communities Program
  - Technical assistance available now
  - Larger grant round out soon
- Builders – Energy Star & Utility Programs
  - ICF – Residential
  - Utility - Commercial
  - Federal $2k/unit residential tax credit

Image source: http://www.transformations-inc.us/zero-energy-homes.html

www.mass.gov/Eeops/docs/dps/inf/appendix_120_aa_jul09_09_final.pdf

Energy Conservation 'Appendix 120 AA' Approved

A code change proposal relating to energy conservation was approved by the BBRS at the May 12, 2009 meeting and will become an appendix to the MA State Building Code (780 CMR) on or about August 1, 2009. It is based on the *International Energy Conservation Code (IECC) 2009* and can be viewed by following the 1st link below. The 2nd link will take you to a two-page overview of this new appendix.

This appendix may be adopted by any municipality in the commonwealth, by decision of its governing body. In a city having a Plan D or Plan E charter the governing body shall be the city manager and the city council, and in any other city the mayor and city council. In towns the governing body shall be the board of selectmen. In order to be adopted, the appendix must be considered at an appropriate municipal public hearing, subject to the municipality's existing public notice provisions. If adopted by a municipality this appendix rather than 780 CMR 13, 34, 61, or 93, as applicable, shall govern.

Also at the May 12 meeting a concurrency period and a training policy were approved. Concurrency period is a period when *either* the new code *or* the existing code can be used but *not comingled*. The BBRS approved a concurrency period of 6 months to a maximum of 12 months, with such period to begin on either January 1 or July 1 of any year. In addition a town or city which adopts the appendix must provide training to the building official prior to the start of the concurrency period. If you have comment or questions on this subject please forward them to mike.guigli@state.ma.us

Appendix 120 AA July 9, 2009 Final PDF (270kb)

Stretch Code Overview June 5, 2009 PDF (66kb)

Questions ?

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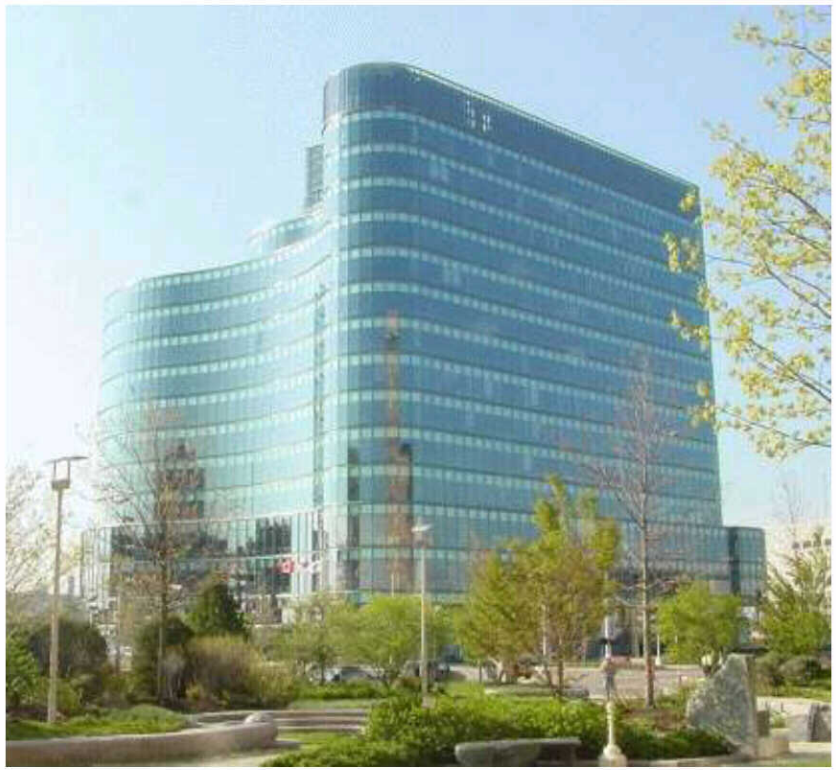
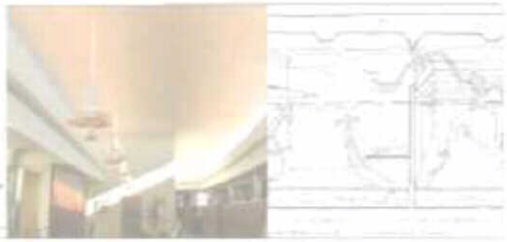


Image source: Manulife building, Fort Point Associates, Inc.
http://www.fpa-inc.com/HTML%20Files/Projects_Com.htm

Fidelity Bank
Corporate Office and Branch Case Study
Leominster, MA



Advanced Building Features
- High Efficiency T-5 Pendant Lighting
- Lighting Control Efficiency
- Reduced Lighting Power Density
- Efficient Site Lighting
- Additional Wall Insulation
- High Performance Glazing
- Efficient VAV RTU's, with ECM Motors
- Demand Control Ventilation
- Part Load HVAC Efficiency Enhancements

Funded Utility Services Support
- Early Life Cycle Cost Analysis
- Integrated Design Team Approach
- Commissioning

Project Description
The 47,000 SF Fidelity Bank Corporate Office and Branch was constructed as a design-build project in Leominster, MA. The four story building will provide office space plus a ground floor branch bank office. This project is acclaimed for its highly successful implementation of the national Advanced Buildings program. The project demonstrates the validity of the Advanced Buildings program assertions. The guideline cost effectively delivered even more than the expected 20% to 30% reduction in annual energy costs compared to a code based design.

Envelope Improvements
- Walls: Added 3-1/2" batt insulation to planned 2" rigid.
- Glazing:
  - Upgrade U value from 0.42 to 0.31
  - Upgrade SHGC from 0.50 to 0.30
- Projected envelope savings: $1,500

Project Team
Owner:
Fidelity Bank
Project Management:
Habitat Advisory Group

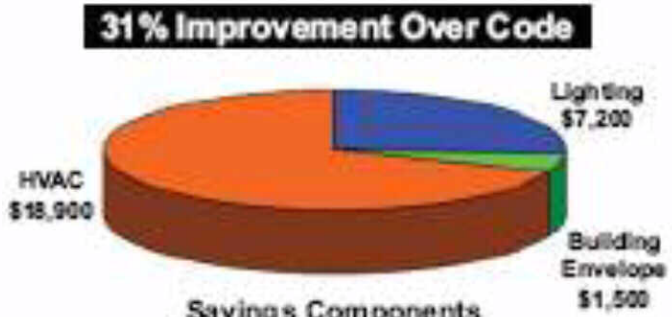
High Performance Building Design Uses 31% Less Energy

Savings Projection

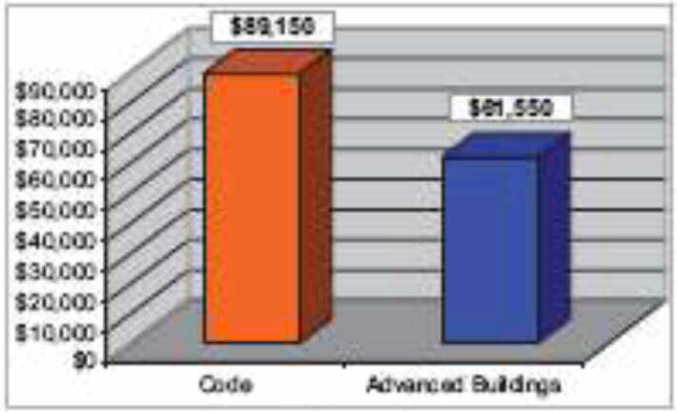
Annual Energy Savings:	$ 27,600
Additional Cost for Upgrades:	$100,622
Utility Incentives:	- $ 66,587
Net Owner Costs:	$ 34,035

Payback with Incentives: 1.2 years ROI: 83%

Payback without Incentives: 3.7 years ROI: 27%



Savings Components
($27,600 annual savings)



Annual Energy Costs

Lighting Savings Summary

The lighting layout consisted mainly of T-5 pendants in open office areas, and the latest generation of recessed T-5 fixtures in the remaining areas.

Projected Lighting Savings: $7,200

	Mass Energy Code	Advanced Buildings Criteria	Final Design	% Reduction
Lighting Power Density	1.34 w/SF	0.96 w/SF	0.86 w/SF	36%

Improved lighting quality while using less energy!

IECC 2012 – Code Committee endorses Stretch code

- Recent National Code hearings in Baltimore
  - EC-147 proposed by the New Buildings Institute (NBI) and the Dept. of Energy (DOE)
  - Endorsed by IECC 2012 committee
    - Now only requires a simple majority vote in final hearings
  - Requires 25% better than ASHRAE 90.1-2007

- Final Hearings in Charlotte, NC in Oct 2010

Proposed Massachusetts Stretch Energy Code

Question and Answer (Q&A)

General Questions:

What changes to the building code are being proposed?

It is proposed that in addition to the baseline energy code for Massachusetts, that there be a more energy-efficient code option that cities and town could elect to adopt. This 'stretch code' option would increase the energy efficiency code requirements in any municipality that adopts it, for all building types covered by the stretch code.

What is the motivation for this change?

There have been mounting calls for additional stringency in the building energy code, linked to concerns about energy costs, climate change and national security. The last legislative session in Massachusetts saw an unprecedented number of bills put forward on energy and green building and led to the passage of the Green Communities Act, the Green Jobs Act, and the Global Warming Solutions Act.

Moreover, several towns and cities continue to lobby for a stronger state building energy code, and/or legislative changes to allow municipalities to strengthen their own codes.

Finally, the Executive Office of Energy and Environmental Affairs, the Department of Public Safety and the Department of Energy Resources all believe that it would be more efficient to develop one alternative 'stretch' code that is consistent across the state, to meet the demand for a stricter code, rather than having a plethora of competing code standards developed and implemented at the local level.

What are some of the expected benefits to a municipality of a more stringent energy code?

In addition to allowing municipalities to take meaningful action on energy use and climate change, the adoption of a more stringent energy code is anticipated to result in significant medium- and long-term cost savings for local residents and businesses, as well as increased design and construction firm competitiveness in the growing green building marketplace.

What is the anticipated cost of implementing a more stringent energy code?

Initial adoption of a higher performance standard for buildings is likely to result in higher first costs for construction. For residential, on average perhaps $8,000 per home. However, the goal of the program is to select and adopt standards that are based on demonstrated cost-effective energy improvements that minimize these additional first costs while providing a stream of energy cost savings. The required improvements have been chosen based on modeling which shows that when the added construction costs are rolled into a 30-year mortgage, the monthly energy bill savings will exceed the increase in the monthly mortgage payment.

What is the process for adoption of the stretch energy code?

If approved by the BBRS, the stretch code would be incorporated into the Massachusetts building code as an optional appendix. Towns and cities in Massachusetts would then be able to choose between remaining on the base energy code or adopting the stretch energy code as their mandatory energy code requirement. Interested municipalities could adopt the stretch code as part of their town meeting, city council meeting, by vote of their board of alderman, or their equivalent public meeting process at the municipal level. Once adopted the stretch code would then become a code requirement in that municipality.

Scope:

What buildings would the stretch energy code apply to?

The proposed stretch code would apply to:

i) Residential buildings from single family homes up to and including buildings of three stories or less with any number of units.

ii) Commercial buildings over 5,000 sq ft, including multi-family residential buildings over three stories, but excluding specialized facilities such as supermarkets, laboratories, and warehouses. Other building types with unusual energy usage profiles can also apply for a waiver from the stretch code from the Board of Building Regulations and Standards (BBRS).

Does the stretch code apply to major renovation projects as well as new construction?

The stretch energy code would also apply to residential building additions and renovations, but would require a lower threshold of energy performance than new buildings, due to general design and cost constraints in renovating an existing building. At this time there is not an equivalent program available for renovating commercial buildings, but this building stock may be addressed in future with amendments.

Does the stretch code apply to minor additions to existing buildings?

Small additions that are both less than 30% of the floor area and less than 600 sq ft in size will have to meet the stretch code, but don't require 3rd party verified performance rating. Instead they are required to follow the IECC 2009 code for climate zone 6A or the Energy Star National Builders Option Package, whichever is more stringent. This results in modest increases in insulation requirements over the requirements of the Massachusetts base code for small building addition projects.

What happens to buildings not covered by the stretch energy code?

Building types that do not fall under the stretch energy code scope, such as very small commercial buildings or specialized use buildings like laboratories, will remain under the existing base code and are encouraged to meet voluntary green building program standards.

Standards:

What standards are the proposed code changes based on?

The residential stretch code proposal is based on the existing 'Energy Star for Homes' and Residential Energy Services Network (RESNET) HERS ratings approach.

The commercial stretch code proposal for buildings from 5,000 sq ft to 100,000 sq ft is based on The *International Energy Conservation Code, 2009*, and the New Buildings Institute (NBI) *Core Performance*

Guide for commercial buildings. Commercial buildings above 100,000 sq ft are required to show a percentage improvement below *ASHRAE 90.1-2007* standards; this is also an option for smaller commercial buildings.

Enforcement/Requirements:

How would the stretch code be implemented and enforced?

Once the stretch energy code is adopted by a town or city, it replaces and supplements the base energy code language and becomes the energy code language for relevant buildings in that municipality. Implementation and enforcement of the code is similar to existing code enforcement and implementation. However, the residential performance testing parts of the stretch code require independent 3rd party certification of building construction performance.

What is the role of building code officials in a code that requires 3rd party verification?

Any construction projects falling under the stretch energy code would still require sign-off from local code inspectors. However, the project oversight and verification of residential energy measures would in most cases be provided by a 3rd party. A 3rd party report would be submitted to the local building inspector for his/her review prior to the issuance of a certificate of occupancy. In this way the local inspectors retain their oversight role but the additional energy requirements would not place a significant additional burden on their time.

Residential Building Questions:

What is the rating system proposed for use by the residential stretch code?

The residential stretch code proposal is based on adoption of the nationally successful 'Energy Star for Homes' program requirements. The Energy Star for Homes program evaluates home energy efficiency based on the HERS Index, which is also a national standard developed by the non-profit RESNET for the mortgage industry, and utilized by the Federal Internal Revenue Service (IRS) and the Leadership in Energy and Environmental Design (LEED) for Homes residential program.

What is required to meet the residential stretch code?

The residential stretch code proposal would require all residential buildings up to and including three stories to meet the Energy Star requirements, including the Energy Star thermal bypass checklist, and in addition to be verified as meeting a HERS index rating of 60 or less by a certified 3rd party HERS rater. This certification would be a required submission to the local code inspector prior to a project being issued a certificate of occupancy.

How is the MA stretch code different from the existing Energy Star for Homes program?

The Energy Star for Homes program is a voluntary program for home builders with over 250 builders enrolled. The stretch code makes the Energy Star program requirements mandatory in any adopting municipality and requires a HERS index rating of 60 or less, which is slightly more stringent than the current Energy Star tier 2 requirement of a HERS Index of 65 or less.

Cost-Benefit Analysis:

What cost-benefit analysis is being done to assess the cost-effectiveness of a stretch code?

Extensive cost-benefit analysis has been undertaken to develop the energy star for homes program that the residential stretch code is based upon. In addition, to help select the appropriate initial target for the stretch code the state has commissioned additional detailed cost analysis. Findings show that this stretch code will likely provide significant economic benefits to homeowners and tenants of stretch code homes in Massachusetts, with net savings from the 1st year onwards due to lower utility bills offsetting incremental construction costs.

What assumptions have been used to project the initial costs and positive cash flow for a target HERS rating?

Data from homes that have received HERS ratings under the Energy Star for Homes program in MA in the past two years have been analyzed. The number of homes achieving ratings in the 50-60 range has grown significantly. In addition, homes using typical construction types were used to illustrate and model the measures likely to be used to meet these scores. So, builders and other stakeholders are able to judge for themselves the level of energy efficiency improvements typically required in residential construction. The modeled examples are limited to single family new construction, as this is the primary area of development, but there are also many examples of Energy Star-rated multi-family projects built recently in Massachusetts.

A 3rd party was contracted to assess the costs and benefits of energy improvements in a typical residential house, in order to determine which HERS ratings allow for net savings on an annual basis for a new homeowner when additional upfront construction costs are weighed against annual expected energy savings.

HERS Rating Questions:

Are there enough HERS raters in all areas of Massachusetts? Are there likely to be areas with either an abundance of HERS raters or not enough of them for the expected building permit activity?

Due to the existing Energy Star for Homes, and other programs, there are already a significant number of HERS raters in Massachusetts and other north east states, and plenty of surplus rating capacity relative to the current demand for HERS raters. The regional RESNET office is working to ensure that there is no potential shortage of HERS raters in any part of the State, as this code is implemented and adopted by municipalities.

What process and timeframe is needed to become a certified 'HERS rater' and who or what entity controls such certification process?

HERS raters are certified by RESNET, a national non-profit that was established in 1995. HERS raters are required to complete an intensive training course of 1 to 2 weeks, pass appropriate test s, and then participate in at least 5 ratings with an existing certified HERS rater before they are qualified to do ratings independently. Individual HERS raters are also affiliated with a RESNET affiliated company or cooperative that ensures that the raters are up-to-date on their energy-efficiency knowledge and training and to provide appropriate insurance coverage.

What are the "cradle-to-grave" costs to have a new building HERS rated? *(Building design, actual construction, as-built completion and blower door and duct blaster testing is involved in a comprehensive HERS rating process.)*

Estimated costs for HERS ratings currently range from $400 to $1000 per unit in Massachusetts. There are several companies providing this service and the price variation likely reflects differing levels of technical assistance to the builder, depending on their needs and preferences as well as the range of different construction project sizes and scopes.

Stretch Appendix to the Energy Code in Massachusetts

Question and Answer (Q&A)

General Questions:

1. What is the 'stretch' code?
2. How is the stretch code different from the existing 'base' energy code?
3. Why did the Board of Building Regulations and Standards (BBRS) create this option?
4. What are some of the expected benefits to a municipality of a more stringent energy code?
5. What is the anticipated cost of implementing a more stringent energy code?
6. Where can I find and read more about the stretch code appendix?

Scope:

7. What building types does the stretch energy code apply to?
8. Does the stretch code apply to major renovation projects as well as new construction?
9. Does the stretch code apply to minor additions to existing buildings?
10. What happens to buildings not covered by the 'stretch' energy code?
11. What categories do multi-family residential buildings fall into?
12. How does the stretch code apply to historic buildings?

Standards and Training:

13. What standards are the stretch code appendix based on?
14. What training and materials are available on these standards?

Process:

15. What is the process for adoption of the stretch energy code?
16. How would a town or city adopt the stretch energy code?
17. How soon after a town or city adopts it would the stretch code take effect?

Enforcement/Requirements:

18. How would the stretch code be implemented and enforced?
19. What is the role of Building Code Officials in a code that includes 3rd Party verification?

Residential Building Questions:

R1. How do I meet the residential stretch code for new homes?
R2. What is a HERS rating?
R3. Do I have to get a HERS rating?
R4. How do I meet the residential stretch code when making renovations to existing homes?
R5. If I'm doing a small remodeling project, like a kitchen or a bathroom renovation, will I have to meet the stretch energy code?
R6. How do I find a HERS rater?
R7. What training do HERS raters undergo?
R8. What testing equipment is required to meet the residential stretch code?
R9. Are there enough HERS raters and testing equipment available?
R10. How much more does it cost to build to the stretch code, and how does this compare to the energy savings?
R11. What financial savings/rebates are there from building to the stretch code?
R12. How is the MA stretch code different from the existing Energy star for Homes program?
R13. Do I have to use the Energy Star program?
R14. How does the building official in my town/city check whether I met the stretch energy code?
R15. How does the stretch code work with LEED for Homes?

Commercial Building Questions:

C1. What building types are covered by the commercial stretch code?
C2. What is required for large new commercial buildings above 100,000 square feet?

C3. What is required for new commercial buildings between 5,000 and 100,000 square feet?
C4. What is required of small new commercial buildings, below 5,000 square feet?
C5. How are commercial renovations handled by the stretch code?
C6. How are new commercial buildings with special energy needs handled?
C7. How do the benefits and costs of the Stretch Code standards compare to the baseline code?
C8. How does the stretch code work with LEED buildings?
C9. Does the stretch code require 3% renewable electricity or solar panels?

General Questions:

1. What is the 'stretch' code?
The 'stretch code' is an optional appendix to the Massachusetts building energy code that allows cities and towns to choose a more energy-efficient option. This 'stretch code' option increases the energy efficiency code requirements in any municipality that adopts it, for all new residential and many new commercial buildings, as well as for those residential additions and renovations that would normally trigger building code requirements.

2. How is the stretch code different from the existing 'base' energy code?
The stretch code appendix offers a streamlined and cost effective route to achieving approximately 20% to 35% better energy efficiency in new residential buildings, and 20% in new commercial buildings, than is required by the existing base energy code. This is largely achieved by moving to a performance-based code, where developers are required to design buildings so as to meet an energy target substantially better than code, and have flexibility in how they meet that target to allow for cost effective and appropriately designed solutions. New residential construction must use the performance-based approach, but residential renovations and most commercial buildings may instead follow a 'prescriptive' route that requires a set of specific energy efficiency improvements, which in the commercial case add up to approximately a 20% improvement over the current code. Many of these changes have been endorsed by the federal Department of Energy and are likely to be incorporated into the next International Energy Efficiency Code (IECC) in 2012, so to a large degree the stretch appendix is an early look at the potential 'next' code.

3. Why did the Board of Building Regulations and Standards (BBRS) create this option?
There have been mounting calls for additional stringency in the building energy code, linked to the desire to reduce energy costs, cut dependence on imported fuels, and address concerns about climate change and national security.

Several towns and cities asked for the ability to adopt their own stronger building energy code, and/or proposed legislative changes to allow municipalities to strengthen their building code options. The last legislative session in Massachusetts led to the creation of several new laws related to energy and the building sector, notably the Green Communities Act, the Green Jobs Act, and the Global Warming Solutions Act.

In response to this, the BBRS, along with the energy and environmental agencies, collaborated with regional and national code experts to develop one alternative 'stretch' code that is consistent across the state, in order to meet demands for a stricter code without having multiple competing code standards developed and implemented at the town or city level.

4. What are some of the expected benefits to a municipality of a more stringent energy code?
In addition to allowing municipalities to take meaningful action on energy use and climate change, the adoption of the more stringent and more performance based 'stretch' energy code is anticipated to result in significant cost savings for local residents and businesses, and increase design and construction firm competitiveness in the growing green building marketplace.

5. What is the anticipated cost of implementing a more stringent energy code?
Initial adoption of a higher performance standard for buildings is likely to result in slightly higher first costs for construction, estimated to be approximately $8,000 for a typical single family home, and in the 1% to 3% range for commercial buildings. However, after energy cost savings on heating and electricity are included these higher performance standards save money. In addition, the electric and gas utilities in the state provide financial incentives that further reduce the upfront costs of high performance buildings, and allow for faster returns on the investment in energy saving measures.

For example, a residential home purchased with a 30-year mortgage would typically result in net savings to the homeowner in the first year due to energy bill savings that are larger than the increase in mortgage payments from construction and financing costs. Case studies of commercial buildings following the energy efficiency recommendations on which the commercial code changes are based have shown paybacks of 1 to 2 years, when standard incentives from electric utilities are included on the benefits side.

6. Where can I find and read more about the stretch code appendix?
The stretch code appendix language is freely available on the Massachusetts BBRS website.[1] Also available on the BBRS website is a 2-page summary[2] of the code. In addition the stretch code appendix 120.aa can be found with the rest of the Massachusetts energy code in the state bookstore. Because the stretch code is an appendix to the base energy code, it is best read together with the new base energy code document published as the International Energy Conservation Code, 2009 edition (IECC2009) available from the ICC website[3] and other online bookstores.

Scope

7. What building types does the stretch energy code apply to?
The stretch code appendix applies to both residential and commercial buildings:
i) All Residential buildings from single family homes up to and including buildings 3 stories or less of any size. This includes both new and existing residential buildings that are renovated. Historic buildings and existing buildings not being renovated are exempt from both the stretch code and the base code.
ii) New Commercial buildings over 5,000 square feet in size, including multi-family residential buildings over 3 stories, but excluding specialized facilities with unusual energy usage requirements such as supermarkets, laboratories, and warehouses up to 40,000 square feet. Other building types with unusual energy usage profiles can also apply for a waiver from the stretch code from the BBRS.

8. Does the stretch code apply to major renovation projects as well as new construction?
For commercial buildings: no, for residential buildings: yes. The 'stretch' energy code does apply to residential building renovation and addition projects, but has less stringent energy performance requirements for renovations than for new buildings. In addition, renovators have the option of using a simple 'prescriptive' path to code compliance, installing specified efficiency measures, instead of performance testing. This greater flexibility is available for residential renovations due to the greater design constraints in working with an existing building. Due to the wide variety in types and conditions of commercial buildings, at this time there are no widely-accepted standards for renovating such buildings, so only new commercial buildings are covered by the stretch code requirements.

9. Does the stretch code apply to minor additions to existing buildings?

[1] Stretch code language: http://www.mass.gov/Eeops/docs/dps/inf/appendix_120_aa_jul09_09_final.pdf
[2] Stretch code 2-page summary: http://www.mass.gov/Eeops/docs/dps/inf/stretch_code_overview_jun05_09.pdf
[3] The IECC 2009 code book is available for purchase from the ICC website at:
http://www.iccsafe.org/e/prodshow.html?prodid=3800S09&stateInfo=fEadjxjbnWjcdbaj1729|5

Additions to existing buildings that are large enough to require code compliance are treated in the same way as new construction for commercial buildings, and in the same way as renovations in residential buildings. In both cases additions can elect to follow the performance approach to code compliance or a simplified prescriptive path. In the case of residential additions, this requires following the Energy Star Homes program National Builders Option Package, which results in modest, cost-effective, increases in energy savings over those already required by the new Massachusetts base code.

10. What happens to buildings not covered by the 'stretch' energy code?
Building types that do not fall under the 'stretch' energy code scope, such as small commercial buildings under 5,000 sq ft, or specialized use buildings like small laboratories, will follow the existing base code requirements, which are also changing to the 8th edition of the MA building code in 2010.

11. What categories do multi-family residential buildings fall into?
Residential multi-family buildings that are above 100,000 square feet and at least four stories tall have to follow the same performance path (20% better than the ASHRAE standard 90.1-2007) as other commercial buildings larger than 100,000 square feet. Residential buildings below 100,000 square feet and at least four stories tall would be classified with commercial buildings between 5,000 and 100,000 square feet. Multi-family buildings with one to three stories of any size fall under the residential stretch code standards. In the rare case of a multi-family building of three stories or less that is larger than 100,000 square feet, the developer may elect to be treated either as a residential or as a commercial building.

12. How does the stretch code apply to historic buildings?
The stretch code appendix, similar to the base energy code, allows an exemption for listed historic buildings. More specifically, historic buildings listed in state or national registers, or designated as a historic property under local or state designation law or survey, or with an opinion or certification that the property is eligible to be listed, are exempt from both the base energy code and the stretch appendix to the energy code.

Standards

13. What standards are the stretch code appendix based on?
The residential stretch code is based on the existing 'Energy Star for Homes'[4] program developed by the federal EPA and Department of Energy, and customized for Massachusetts. This Energy star program is in turn built upon the Home Energy Rating System (HERS) which is developed and administered by the national residential energy organization called RESNET.[5]

The Commercial stretch code for buildings from 5,000 square feet to 100,000 square feet is based on a comparison to the current edition of the International Energy Conservation Code (IECC 2009), developed by the International Code Council[6] (ICC), which will also be the new base energy code for Massachusetts. The energy saving improvements above the commercial IECC code are based on the New Buildings Institute (NBI) Core Performance program for commercial buildings, recently revised and published as the Core energy code.[7] Above 100,000 square feet commercial buildings are required to show a percentage improvement below ASHRAE 90.1-2007 energy standards.[8] This performance approach is also an option for smaller commercial buildings.

[4] The Massachusetts New Homes with Energy Star program website is: http://www.energystarhomes.com/
[5] The RESNET website is: http://www.natresnet.org/
[6] The ICC website is: http://www.iccsafe.org/
[7] The Core energy code is available online at: http://www.newbuildings.org/codes.htm
[8] The ASHRAE 90.1-2007 standard is readable online in a Java enabled browser at: http://openpub.realread.com/rrserver/browser?title=/ASHRAE_1/ashrae_90_1_2007_IP_1280

14. What training and materials are available on these standards?
In addition to the websites referenced in the answer to the prior question, training on the IECC 2009 base energy code and an introduction to the stretch code appendix is being provided to all municipal code officials (at no cost), as well as to interested building professionals (at a cost), beginning in November 2009. In addition, the existing Massachusetts Energy Star Homes program provides regular training covering HERS and other requirements of the residential stretch code, and the major Massachusetts electric and gas utilities offer training on NBI Core Performance for commercial buildings.

Process

15. What is the process for adoption of the stretch energy code?
Now that it has been approved and published by the Board of Building Regulations and Standards (BBRS), the stretch code has been incorporated into the Massachusetts building code as optional appendix 120.AA. Towns and cities in Massachusetts are able to choose to remain on the base energy code, or to adopt the stretch energy code as their mandatory energy code requirement. A municipality would remain on the base energy code unless and until they adopt the stretch code through their appropriate public process.

16. How would a town or city adopt the stretch energy code?
The stretch energy code appendix may be adopted by any municipality in the commonwealth, by decision of its governing body. In a city having a Plan D or Plan E charter the governing body shall be the city manager and the city council, and in any other city the mayor and city council. In towns the governing body shall be the board of selectmen. In order to be adopted, the appendix must be considered at an appropriate municipal public hearing, subject to the municipality's existing public notice provisions.

17. How soon after a town or city adopts it would the stretch code take effect?
In order to provide consistency among communities, once adopted the stretch code can only go into effect on January 1st or July 1st, and there must be at least six months between adoption and when the stretch code becomes mandatory. For example: if Town A voted to adopt in November 2009, then on July 1st 2010 the stretch code would replace the base energy code as the sole, mandatory energy code in Town A. During the interim period the stretch code would be available as an option for builders to use.

Enforcement/Requirements

18. How would the stretch code be implemented and enforced?
Once the stretch energy code is adopted by a town or city, it supplements the base energy code language and becomes the binding energy code language for building projects in that municipality. Implementation and enforcement of the code is similar to existing code, where the developer is responsible for submitting documentation of compliance to the building inspector for review, and the building inspector conducts a site review.

19. What is the role of a building code official and a HERS rater for residential projects?
Residential buildings meeting the stretch code through a HERS rating and thermal bypass checklist require independent certification by a HERS rater. Their work will produce a report detailing the energy systems in the building and will provide a HERS index score, together with proof of whether the home qualifies for the federal $2,000 tax credit. Submission of a copy of the HERS report, together with a completed Energy Star Thermal Bypass checklist, and posting the relevant energy data on the electrical panel in the home are the steps required to demonstrate compliance with the energy portions of the code, and must be submitted to the local building inspector prior to receiving a certificate of occupancy. In this way the local inspector retains their oversight role but the additional energy requirements are intended to not place a significant additional burden on their time.

Residential Building Questions:

R1. How do I meet the residential stretch code for new homes?
For new residential homes including multi-family homes of 3 stories or less, builders essentially follow the Energy Star for Homes program requirement in Massachusetts, and are required to show that each unit meets or is below a maximum HERS index score. For new homes greater than 3,000 square feet in size the maximum HERS score is 65 (Energy Star tier 2), for smaller homes less than 3,000 square feet in size the maximum HERS score is 70. In addition to the HERS score the homes must be inspected using the Energy Star 'thermal bypass checklist' and similar to the new base code may require duct testing. These inspections ensure that the home is well air sealed, while the HERS rating ensures that the home is designed to be well insulated with efficient heating and cooling and lighting – all measures that save energy and reduce utility bills.

R2. What is a HERS rating?
HERS stands for 'Home Energy Rating System,' and is a national standard that uses information on the design of the energy systems in a home to calculate, via computer modeling, the average energy needs of that home and give it a rating score. The HERS Index was developed by the non-profit Residential Energy Services Network (RESNET) for the mortgage industry, and is utilized by the Federal Internal Revenue Service (IRS) and the LEED for Homes program. On the HERS 2006 index scale smaller numbers are better, with 0 representing a net zero energy home, and 100 represents a home built according to meet the national model energy code in 2006 (the IECC 2004 with 2005 amendments) . A HERS rating of 65 means that the home uses about 35% less energy than the same size home built to the 2004/2005 IECC code requirements. The Residential Stretch code is based on the nationally successful 'Energy Star for Homes' program requirements, which utilize HERS ratings.

R3. Do I have to get a HERS rating?
New homes built under the stretch code will have to get a HERS rating. Renovations and additions to homes have the option of the HERS rating or a 'prescriptive' approach, whereby specific efficiency measures are required, but no computer modeling is done. The HERS performance-based approach provides a very good way to ensure that homes are not only well designed but also well built. As part of the HERS rating the home will be tested for air leakage, and under both the base and the stretch code homes with heating and cooling ducts may also have those tested for leakage. Combined with the thermal bypass checklist the HERS rater, builder and building inspector can have confidence that the completed homes really are energy efficient.

R4. How do I meet the residential stretch code when making renovations to existing homes?
Existing homes being renovated or expanded have two choices when it comes to stretch code compliance. The performance option is to use a HERS rating, and the prescriptive option is to use the Energy Star Builders Option Package and the base IECC 2009 code where it is more stringent (for example in wall insulation). If the prescriptive option is chosen, then you only need to meet code for the systems that are being replaced. This means that adding a new efficient boiler does not require changing the windows, and adding wall and attic insulation does not require modifying the basement – although it may often make sense to combine measures where that is cost-effective.

However, choosing to follow the HERS rating approach used by new construction often makes sense when doing a whole house renovation. While using the same HERS approach as new homes, existing homes have an easier standard to meet. For home renovations greater than 2,000 square feet the maximum HERS score is 80 and for renovated homes less than 2,000 square feet the maximum HERS score is 85. 85 is also the maximum score allowed to meet the Energy Star Homes program baseline.

R5. If I'm doing a small remodeling project, like a kitchen or a bathroom renovation, will I have to meet the stretch energy code?

If a small renovation involved replacing a couple of windows and opening part of a wall cavity, then those new windows and wall cavity would have to be brought up to the stretch energy code, just as the plumbing in the kitchen or bathroom being remodeled would have to comply with the plumbing code. However, improving a kitchen or bathroom would not trigger required changes to the rest of the home such as attic insulation or a new heating system. Only the systems being modified have to be brought up to code. Despite not being required, your contractor, utility company and code official may help advise on cost effective changes – often with tax and rebate incentives to reduce your energy bills that you may want to consider doing at the same time.

R6. How do I find a HERS rater?

HERS raters work with the residential builder/developer/design team, and should be included in the team from the outset. The easiest way to find and choose a HERS rater is to register for the free Energy Star for Homes program and work with the program staff to contact a HERS rater in your region.

R7. What training and certification do HERS raters undergo?

HERS raters are typically experienced building professionals, who in addition take a week or two week long intensive training course in residential energy efficiency. After completing the training, learning how to use HERS rating software, and passing a test,[9] new raters must also complete at least 5 ratings with an experienced HERS rater before being able to independently award ratings. In addition to this initial training and certification, HERS raters must be affiliated with a certified HERS provider which is responsible for ongoing code education and quality assurance oversight of the HERS rater's work. The HERS providers also carry liability insurance and allow builders to request a review from a second HERS rater in the rare case of disputes.

R8. What testing equipment is required to meet the residential stretch code?

HERS ratings require testing of the air leakage rate of residential units. In addition, for homes that have forced air heating and central air conditioning systems that have ductwork running outside of the heated portion of a house, a duct leakage test is needed. These tests help calculate how much energy is needed to heat and cool a home, and help builders to identify possible problems before a home is completed, when there is still time to fix them cost-effectively.

R9. Are there enough HERS raters and testing equipment available?

In 2008 over 15 percent of all new homes in Massachusetts were built through the Energy Star for Homes program, a percentage that is steadily increasing. The majority of these homes used HERS raters and testing equipment to achieve a HERS rating. Several states surrounding Massachusetts have higher percentages of new construction using HERS ratings on a voluntary basis. This means that there is already in place an active market for HERS raters and testing equipment and the gradual adoption of the stretch energy code is not likely to cause a dramatic increase in demand for these services. That said, the growing interest in HERS ratings has led to more building professionals going through HERS training and certification and expanded sales of blower door and duct testing equipment. This is a good sign of a market response to our growing green economy, and we don't anticipate demand for HERS raters exceeding supply in towns and cities adopting the stretch code.

R10. How much more does it cost to build to the stretch code, and how does this compare to the energy savings?

For new construction additional first costs are estimated at around $8,100 based on a 2,700 square foot single family home, which translates to $530 extra a year on a 30-year mortgage at 5% interest. These investments cut energy bills by about $1,360/year, resulting in net annual savings to the homeowner of

[9] The passing score is 80% or higher. More information on the HERS rater test is available here: http://www.resnet.us/rater/tests/rater.htm

$830. Initial costs will be slightly higher for larger homes, though the percentage of total costs will likely be lower. In addition, larger homes will have proportionally larger energy savings.

In the case of renovating a 3-unit urban triple-decker, the additional construction costs for all three units combined was around $15,000, while the annual energy savings were over $2,700/year, again yielding immediate net cash savings to the unit owners. Separate documents are available that summarize the detailed cost-benefit analysis that has been undertaken to help set the appropriate level of energy efficiency for the stretch code. These calculations do not include substantial financial incentives available both from utilities in Massachusetts and through federal tax credits (see next question). This economic benefit to the homeowner comes in addition to the broader societal benefits of more energy efficient buildings. Costs for HERS ratings currently range from $400 to $1,200 per unit in

Massachusetts, and they are also subsidized by the utility-sponsored Energy Star for Homes program. There are several companies providing this service and the price variation may reflect differing levels of technical assistance to the builder depending on their needs and preferences.

R11. What financial savings/rebates are there from building to the stretch code?
The stretch code is designed to allow builders to get the maximum benefits of the existing Energy Star Homes program with its full range of training, support and financial incentives. A new home with a HERS rating of 65 or less currently qualifies for $1,250 from the Energy Star utility sponsors, and additional rebates are available for installing high efficiency heating and cooling equipment, appliances and lighting. The utility companies also partially cover the cost of hiring a HERS rater to work with the builder. In addition to these Massachusetts-based incentives there is a federal $2,000 tax credit available for homes built with less than half of the heating and cooling load of a 2004 code home. The HERS rater and software can tell you whether a new home qualifies for this and the HERS report provides the core documentation needed.

For existing home renovations there are tax credits for the homeowner as well as the same utility incentives on efficient equipment, appliances, and windows. There are also major incentives available to add insulation to existing homes, through the MassSave program sponsored by the gas and electric utility companies.

R12. How is the MA stretch code different from the existing Energy Star for Homes program?
The Energy Star for Homes program is a voluntary program for home builders. In Massachusetts this program is currently administered by ICF International on behalf of the major energy utilities in the state, and has several hundred builders enrolled. This program accounted for 15% of all new homes in Massachusetts in 2008. There are 2 or 3 tiers to the Energy Star program. The stretch code essentially makes the current Energy Star program requirements mandatory in any adopting municipality, and sets a specific minimum HERS index rating of 65 or 70 based on size for new homes, and less strict requirements for renovations. This standard for new construction is more stringent that the base Energy Star for Homes requirement currently set at 85, but for large homes it is the same as the current Energy Star tier 2 set at a HERS index score of 65.

R13. Do I have to use the Energy Star program?
Residential builders in stretch code communities will be required to get a HERS rating for new homes. In the case of renovation or additions to existing buildings builders may instead meet the requirements of the Energy Star Builders Option package. In both cases builders must also complete the Energy Star thermal bypass checklist. In order to do this and also to simplify qualification for all the rebates and training and technical assistance that is offered we strongly recommend that builders participate in the Energy Star for Homes program. However, it is not mandatory, and in the future when the Energy Star Homes program or the stretch code is revised and updated they may take different approaches.

R14. How does the building official in my town/city check whether I met the stretch energy code?
Currently, under the 7th edition base energy code in Massachusetts it is already possible to meet the code requirements by achieving a HERS rating and/or Energy Star homes certification, and submitting a copy of the HERS report and Energy Star paperwork to the local building code official to demonstrate this. The stretch code expands the use of this existing code compliance option to all residential construction. Building officials will be receiving free training on the new base energy code and the stretch code. This training is scheduled to begin before the end of the year to ensure that they are fully aware of this option and the requirements. The same training is also available to interested building professionals for a small fee to cover costs.

R15. How does the stretch code work with LEED for Homes?
LEED for Homes is a voluntary residential green building program that encompasses a significant energy efficiency component. The mandatory energy and atmosphere requirements of the LEED for homes program are that a home at least meets the minimum Energy Star Home requirements of a HERS rating of 85 and a completed thermal bypass checklist. Homes can then gain additional points for achieving a lower HERS score. Because LEED for Homes and the stretch code share the same HERS and Energy Star underpinnings they are completely compatible.

Commercial Building Questions:

C1. What building types are covered by the commercial stretch code?
New buildings, and new additions to existing buildings covered by the commercial energy code, that are greater than 5,000 square feet in size are covered by the stretch code appendix. New commercial buildings smaller than 5,000 square feet, as well as all existing commercial buildings and renovation to existing commercial buildings are exempt from the stretch code and would remain on the base energy code.

C2. What is required for large new commercial buildings above 100,000 square feet?
The designed energy use in large commercial buildings is required to be at least 20% below the use expected based on the building code energy modeling standards contained in ASHRAE 90.1 2007,[10] which is the latest version of the national model code for commercial buildings. This would be determined by computer modeling of the building, taking into account factors such as air sealing, insulation, and efficiency of the cooling and heating systems, ventilation, and lighting design. Builders have the flexibility to choose the set of energy efficiency features they prefer, as long as modeling shows that overall they yield the 20% reduction relative to the base ASHRAE 90.1-2007 requirements for the same building.

C3. What is required for new commercial buildings between 5,000 and 100,000 square feet?
Builders of such buildings have two choices. First, they can use the same modeling as for buildings above 100,000 square feet, and meet the same standard of 20% below ASHRAE 90.1 2007. Alternatively, they can choose a set of "prescriptive" requirements for particular efficiency measures, based on the new base energy code for commercial buildings (International Energy Conservation Code 2009), supplemented by cost-effective energy saving enhancements taken from the Core Performance program developed by the New Buildings Institute.[11] The Core Performance program and the newly updated Core Energy Code are nationally-recognized standards already in use by Massachusetts gas and electric utility companies as the basis for providing financial incentives to commercial building developers.

[10] Specifically: ASHRAE Standard 90.1-2007 Energy Standard for Buildings Except Low-Rise Residential Buildings, Appendix G.
[11] For more information please see the New Buildings Institute press release available here: http://www.newbuildings.org/downloads/press/MAAdoptsStretchCode.pdf

C4. What would be required of small new commercial buildings, below 5,000 square feet?
Such buildings would be exempt from the Stretch Code requirements.

C5. How are commercial renovations handled by the stretch code?
Commercial renovations are exempt from the Stretch Code requirements.

C6. How are new commercial buildings with special energy needs handled?
Supermarkets, laboratories, and warehouses **above 40,000** square feet in size must meet the performance modeling requirements of the stretch code that apply to regular commercial buildings greater than 100,000 square feet. Because these buildings often have large and unusual energy loads they are likely to be energy modeled, so meeting the standard of 20% below ASHRAE 90.1-2007 via energy modeling should be a straightforward compliance approach.

Supermarkets, laboratories, and warehouses **below 40,000** square feet are exempt from the stretch code requirements, but must still meet the base energy code. Other specialty buildings could apply for waivers based on evidence that they have unusual energy loads, and that they are not typically built using energy modeling.

C7. How do the benefits and costs from the commercial Stretch Code standards compare to the baseline code?
Case studies of specific buildings by Massachusetts utility companies National Grid and NSTAR show that the savings in reduced energy costs far exceed the greater initial construction costs. If the costs are included in a mortgage, then owners would see immediate cash-flow savings. Moreover, the utilities offer generous incentives that make the efficiency improvements even more profitable. For example, on one mid-sized office building in Warwick, Rhode Island, the additional cost was $91,000, while the annual energy savings were $29,500, for a three year payback. But NGRID provided a rebate of $63,100, reducing the initial cost to $28,000, which is covered by the first year's energy savings. More generally, we anticipate that any additional upfront costs incurred in construction should be recovered from energy savings with a payback after rebates of less than three years.

C8. How does the stretch code work with LEED buildings?
The commercial stretch code has two code compliance pathways. Both of these qualify for LEED new construction points, and require no additional work because of the stretch code. If pursuing the performance approach, then achieving the stretch code standard of 20% below ASHRAE 90.1-2007 uses the same baseline and modeling as the 2009 LEED program and qualifies for 5 out of 19 LEED energy and atmosphere points. Many LEED buildings will go significantly beyond these energy efficiency requirements, in order to obtain additional LEED points. Similarly meeting the stretch code through the Core Performance-based prescriptive approach qualifies for LEED points.

C9. Does the stretch code require 3% renewable electricity or solar panels?
This question has come up because there is an option under the prescriptive path of the stretch code to meet the requirements of one section of the code with onsite renewable electricity generation. However, this is not a requirement, it is merely one of three options under this code approach, and there is also the alternative to meet the commercial stretch code requirements using the 20% better than ASHRAE 90.1-2007 modeling approach. The three options which appear in section 507 of the prescriptive code option for buildings between 5,000 and 100,000 square feet are:

a) More efficient heating and cooling equipment – widely available and with utility rebates available to offset much of the incremental cost.
b) More efficient lighting – also widely available and eligible for significant utility rebates.
c) Providing at least 3% of the onsite electric load from onsite renewable generation – which qualifies for both large federal tax incentives and significant state renewable energy incentives from the Massachusetts Renewable Energy Trust (MRET).

City of Worcester

BE IT ORDERED that the city of Worcester does hereby accept the provisions of 780 CMR Appendix 120.AA, the Massachusetts Stretch Energy Code, with such acceptance to be effective on January 1, 2011.