Home Energy Ratings And Energy Codes -- A Marriage That Should Work

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ABSTRACT

This paper examines how voluntary home energy ratings systems (HERS) can be married to mandatory energy codes to increase code compliance while providing added benefits to consumers, builders, and code officials. Effective code enforcement and compliance is a common problem for state and local jurisdictions attempting to reduce energy consumption and increase housing affordability. Reasons frequently cited for energy code noncompliance are: 1) builder resistance to government regulations and change in building practices, 2) the perceived complexity of the code, 3) a lack of familiarity of energy impacts by code officials and the housing industry, and 4) inadequate government resources for enforcement. By combing ratings and codes, one can create a win-win approach for code officials and energy rating organizations, the housing industry, as well as consumers who wish to reduce air pollution and energy waste. Additionally, state and local government experiences where the marriage between codes and ratings has begun are highlighted and the barriers and benefits assessed.

BACKGROUND

Building code compliance is very important. Shortfalls in building code compliance surfaced after Hurricane Andrew in South Florida and the Northridge, California earthquake where structures were needlessly destroyed due to noncompliance with codes (May, Hansen & Donovan 1995). A State of Florida report on the economic devastation of back-to-back hurricanes in the mid-1990s and the resulting near-collapse of their property insurance industry found "it was not the weakness of the codes themselves that contributed to the extensive storm damage, but the failure to comply with and enforce today's complex and confusing system of multiple codes...." (Florida Building Codes Study 1997).

Energy Code Compliance Found Lacking

Building energy codes are no exception when it comes to compliance problems. A study at the University of Washington of state building energy code administrators, funded by the National Science Foundation, surveyed 33 states with broad-based code authority. The respondents indicated that "energy codes are too complex and design professionals do not pay sufficient attention." (May, et al. 1995). Another study of building energy codes in California, Washington, and Oregon conducted by Lawrence Berkeley National Laboratory found "that many homes do not meet energy codes...." (Vine 1996).

Lastly, a 1995 statewide study by Minnesota of their energy code found that "The full energy-saving benefits of the code changes are not being realized because in many cases they are not being implemented." (Noble 1995). This report also stated there was a growing concern that increasingly complex and stringent energy codes were outstripping the abilities of designers, builders, and code officials to meet and enforce their provisions. Additionally in 1995, the State had only 50 percent of one person's time allocated to upgrade their code and provide education to the housing industry and code officials. According to a Building Codes Assistance Project official in Washington, DC, the State has now added resources and has one of the better code compliance records nationally.

HERS Have Seen Limited Use Nationally

HERS systems have had problems going mainstream. Fewer than two percent of new homes receive an energy rating according to industry sources and most are utility programs with rate payer subsidies. Lenders are often unaware of energy-efficient mortgage programs available through Fannie Mae, Freddie Mac, Federal Housing Administration, and Department of Veterans Affairs. Also, builders are reticent to engage in any program that can delay their construction schedules, add costs for ratings, or that require significant changes in building practices.

Code Adoption And Compliance Save Consumer Dollars

The importance of building energy codes and their potential impact on energy savings are well documented. A recent study by the Alliance to Save Energy revealed potential utility savings of $81 million (see Figure 1 below) annually to home owners in states not currently adopting the 1993 Model Energy Code (Jones, Norland & Prindle 1998).

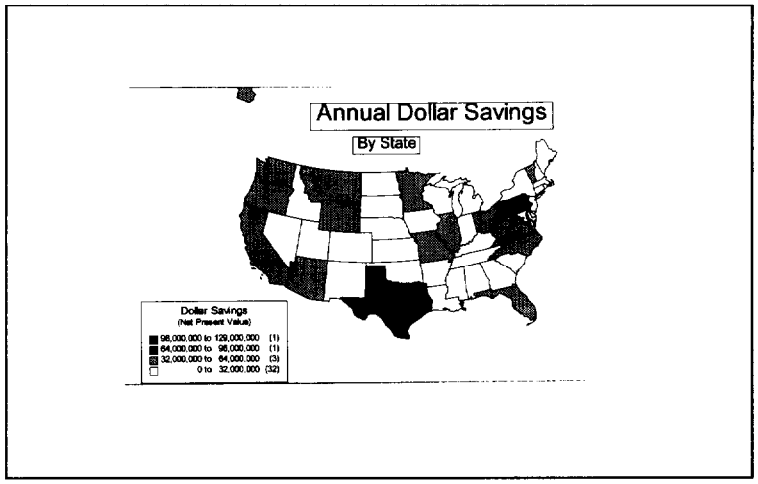

Figure 1. Potential cost savings from adopting MEC (Source: Jones, Norland and Prindle 1998)

Inadequate code compliance has major implications for taxpayers, ratepayers, and home owners. Nationally, the U. S. Department of Energy (DOE) expends a large annual budget cost-justified by the benefits to be derived through energy codes. Without proper code compliance,

taxpayer dollars have a reduced effect. At the state level, public utility commissions use energy codes as the baseline for calculating the "value" of utility demand-side management incentives available for homes built beyond code. Lastly, home owners are ill-equipped to uncover code items such as missing insulation, poorly installed windows, or leaky air ducts and are faced with high utilities due to noncompliance.

Reasons For Code Noncompliance

The reasons for energy code noncompliance are not too different than the reasons associated with structural codes (McQueen 1998):

- builder resistance to regulations and change in building practices;
- lack of familiarity by code officials, design professionals, builders, and others; and
- lack of state or local government resources for adequate enforcement.

Home Builder Resistance.

Home builders and some code officials frequently complain about the complexity of the MEC. Mr. Terry Cobb, a code official, former builder, and Chairman of the International Residential Code (IRC) Committee, recently stated "....that the MEC is unnecessarily complicated...." and asked IRC committee staff to develop a simplified, "user friendly" approach (Energy Design Update 1998). The average, small home builder builds less than 15 homes per year according the National Association of Home Builders (Burton 1998) and has little schooling in the disciplines covered by the energy code. Also, a typical code inspector has a high school degree and no technical training in the MEC.

MEC Perceived as Too Complex.

Energy code complexity may be more perception than reality and is partly driven by the code length and terminology. The code contains terms such as thermal transmittance (U-value), thermal resistance (R-value), and Seasonal Energy Efficiency Ratio (SEER) which are foreign to many small builders. However, most equipment and materials must now be clearly labeled by the manufacturer and many states have reduced to a few pages the requirements to meet the energy code.

Given the significant public benefits from enhanced compliance, government officials and policy makers would benefit by examining alternative enforcement mechanisms to increase compliance. The remainder of this paper examines the use of home energy ratings for determining energy code compliance and examines the early experiences of selected states.

Traditional Approaches To Code Compliance

Energy codes establish minimum, acceptable design criteria for new construction and renovations to insure:

- adequate thermal resistance in the building shell and windows,
- minimum air leakage through the building envelope and air ducts, and

- minimum equipment efficiencies of mechanical and electrical, service water-heating and lighting systems of the planned structure.

Effective code compliance depends on good building practices, adequate training, and sufficient resources for code enforcement. Compliance with the national Model Energy Code (MEC 93) can be determined in one of three ways:

- on a prescriptive basis or accepted practice basis, where the minimum values or criteria for building components are specified,
- on a whole-house performance or systems analysis basis, where total building use for the proposed building may be no greater than the energy budget of a "standard" building that meets code, and
- on a component performance basis where the thermal performance of the building envelope and other criteria are specified.

Code officials must determine through site inspection, plan review, builder self-certification, or a combination of these, whether a building is designed and constructed in accordance with minimum code requirements. The MEC requires that building materials, components, and equipment must be clearly marked to facilitate compliance. Also, buildings are subject to a final site inspection.

Using Home Energy Rating Systems For Determining Code Compliance

A home energy rating system (HERS) analysis is the same approach as the performance analysis referenced in the MEC. The energy calculations necessary to assign a rating provide a means for comparing a house's energy performance with a base case or reference house. HERS procedures, such as those adopted by the Home Energy Ratings Systems Council (HERSC) are based on a comparative analysis of a rated (or proposed) home with an equivalent standard reference home (HERSC Guidelines 1996). Energy ratings may also provide an estimate of the cost to heat, cool, and provide domestic hot water for the proposed home plans or for modifications to an existing house.

In keeping with the 1992 U. S. Energy Policy Act (EPAct), the reference house in the HERS Council guidelines was designed to be compliant or equivalent with the 1993 MEC. By comparing the rated energy use of a proposed home with the energy use of the corresponding standard HERSC reference house one can readily determine if the home is MEC compliant – it's that simple!

HERS Council Rating Bench Marked To The MEC

Through a consensus process conducted by the national HERS Council between 1992 and 1996, a HERS rating "scale" from 0-100 points (with 100 representing the best possible energy-efficiency) was developed. The MEC-compliant reference house earns a score of 80 on this HERSC scale. If the HERS Council score for a rated home is 80 or greater, then it complies with MEC 93, by definition. For state codes more stringent than MEC 93 or later versions of the MEC, the minimum rated score is easily changed to reflect the more stringent standard and can be moved up or down the scale.

Information Contained In A Uniform Home Energy Rating

Home energy ratings give an objective analysis of a home's energy efficiency based upon consistent inspection procedures, operating assumptions, climate data, and calculation methods (HERS Council Guidelines 1996). The information typically is provided so consumers can readily compare a house's relative efficiency. Points earned from an energy rating are often translated into efficiency levels such as one-to-five stars, with a five-star house being more efficient and less costly to operate than a four-star house. The rating analysis is often reported in a paper document which can be displayed in a new or existing house and also shared with lenders, code officials, Realtors, appraisers, and others (See Figure 2 below for an example of an energy rating form).

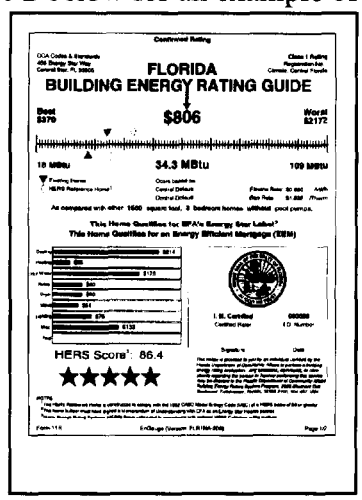

Figure 2. Example of a home energy rating from Florida

The national HERS Council guidelines require that a minimum set of features be analyzed and accounted for when establishing an home energy rating. These minimum-rated features are consistent with the minimum equipment and thermal performance requirements of the MEC. Also, most home energy rating methodologies contain some type of graduated scale showing the relative efficiency of a new or existing house to a reference house with standardized assumptions for equipment, operating conditions, solar orientation, and climate.

Benefits Of Marrying Energy Ratings With Energy Codes

Energy ratings provide several potential advantages over traditional methods for determining code compliance. These benefits include:

1) Market incentives --

- Ratings can be linked to market-based incentives by providing documentation for increasing a home's appraised value.
- Ratings help increase competition among rated homes by providing a basis for comparison.
- Ratings provide the economic data necessary to make tradeoffs among competing housing components, i.e, more efficient windows versus increased wall insulation.

- Energy ratings are more easily understood by buyers and can be prominently displayed by the seller.
- Ratings provide a comparative economic analysis useful to consumers, lenders, and appraisers.

2) Increased innovation and accuracy --
   - Performance analysis encourages innovation and provides more flexibility in home design versus the rigidity of prescriptive approaches.
   - Energy ratings give an overall assessment of the whole house versus individual components.
   - Most ratings are computer-based, allowing raters to perform complex analysis with relative ease.
   - Performance analysis encourages design beyond prescriptive code requirements, which often become the minimum as well as the maximum level of installed energy efficiency.
3) Enhanced enforcement --
   - Energy raters are schooled in energy inspections through rater certification/training requirements in many states and are therefore familiar with the technical specifications contained in the MEC.
   - Energy raters can reduce the workload and the number of public code inspection personnel required.
4) Benefits for HERS programs --
   - Integrating HERS and codes can the shift cost of code compliance from the public to the private sector.
   - Using HERS for code compliance can move HERS programs into the mainstream builder market by providing builders with a valuable marketing/differentiation tool.
5) Other benefits to energy code jurisdictions --
   - Building performance professionals, working with code officials, can help introduce building science concepts to the housing industry.
   - Code changes can be more easily upgraded if performance concepts are accepted in the field.
   - More effective code compliance is assured due to added documentation and site inspections.

Building energy codes can provide a critical function by establishing an energy efficiency "floor" below which homes can not be constructed. Also by using energy ratings for code compliance, code officials, builders, and consumers can realize the multiple benefits of a better designed, better built, and more cost-effective homes through the application of building performance analysis.

Experiences of Selected States With Ratings And Code Compliance

Although home energy ratings were conceived to better access energy efficiency financing, initial experience in some states have shown they can also be used effectively to determine energy code compliance. With the passage of the Energy Policy Act of 1992, all states now are required to review and either adopt the MEC, or justify its reasons for noncompliance to the Secretary of Energy. As a result, an increasing number of states have adopted the MEC or other energy codes and are devising enforcement mechanisms. A recent Alliance to Save Energy survey determined that 31 states have now adopted the MEC 1993 version or its equivalent (Jones, Norland, and Prindle 1998).

A number of states and local jurisdictions are beginning to use energy ratings for determining code compliance. These include, but are not limited to, California, the City of Chicago, Delaware, Florida, New York, and Vermont.

California

California enforces their energy code (Title 24 which exceeds the '95 MEC) statewide. The State has proposed rules which allow HERS raters who have demonstrated competence to the Code official to provide certain code compliance documentation and field verification and diagnostic testing of building components such as credit for minimal duct air leakage. The state is also one of two in the United States that provide energy rater certification.

City of Chicago

In 1995, the City of Chicago undertook a new housing affordability project. The Chicago task force charged with overseeing environmental and energy-related issues did not think that adopting an energy code would yield optimum efficiency and adopted a HERS system instead for determining code/program compliance. Chicago used the state's existing home energy rating program, Energy Rated Homes of Illinois. Their HERS/code integration worked well initially for determining compliance with MEC 93. However, DOE, while reviewing their Building America Program project uncovered significant building deficiencies indicating that both HERS and codes can have quality control problems.

Delaware

Another example of the marriage between codes and ratings occurred in Delaware when the state decided to upgrade its energy code to the MEC 93 equivalent. A building performance contractor recognized the business potential of linking code compliance with financial institutions willing to lend additional dollars for more efficient houses. Energy Services Group (ESG), of Wilmington, DE, contacted several large Delaware builders in advance of the code implementation with a proposal to determine code compliance and provide access to energy-efficient mortgages (EEM) with easier qualifying loan to debt ratios in exchange for their air sealing, insulation, HVAC duct sealing and heating system sizing business. The marriage worked great initially. This effort has since run awry of local code jurisdictions who will not accept the local HERS software analysis as being equivalent to actual code compliance.

Florida

Florida's energy code and rating system are effectively "joined at the hip." In 1993, Florida was required by statute to develop, adopt, and implement a statewide, uniform rating system standard for buildings that was responsive to both Florida's energy code and to a national rating system standards under development by DOE by the HERS Council. Florida's builders prefer using the performance-based (Florida Method A) compliance pathway (about 90% of the time) as compared with prescriptive-based pathways (Florida Methods B and C). Florida's Method A

compliance pathway provides the computational basis of Florida's rating system. Therefore, Florida's code compliance system and its rating system are virtually identical in terms of home energy use prediction, and code officials could easily use their rating to determine compliance.

Florida's rating tool (EnergyGauge™) has been successfully subjected to the BESTEST procedure developed by the National Renewable Energy Laboratory for the DOE (Fairey, 1998). Results clearly show that Florida's rating system and its code compliance system are consistently capable of predicting building energy loads near the midpoint of the BESTEST predictive accuracy range. The State of Florida, however, has not yet allowed ratings to be used for energy code compliance, possibly because Florida's energy code is typically 5-10% more restrictive than the MEC.

New York

One of the first state HERS programs to be used for code compliance was the NYSTAR program in New York. The New York State Energy Office, which administered both codes and ratings, did several things to fully integrate codes and HERS. First, it bench marked their HERS program to the New York Energy Code, much as the HERSC guidelines are linked to the '93 MEC. Second, the NYSTAR HERS rating, which was a minimum of 25% better than their energy code, was acknowledged by state officials as a "deemed-to-comply" method under that code's whole-building performance approach. While numerous builders used the NYSTAR ratings and inspection regime as a code compliance assurance tool, NYSTAR HERS providers did not recognize the market for their product as a code compliance tool. When state resources dwindled, the energy rating program failed.

Vermont

Vermont recently adopted an enhanced version of MEC 95. Effective July 1, 1998, Vermont established the use of their state HERS program as a code compliance mechanism along with builder self-certification. Their new, mandatory energy code may lead to the first successful statewide integration of HERS and energy codes, since they have no traditional statewide code enforcement system but do have a very successful home energy rating program with energy raters in many communities. Meanwhile, local energy code program coordinators are packing the training sessions for their combined energy code/building performance training sessions.

Policy Implications of Using Ratings For Code Compliance

The policy implications of adding home energy ratings to the code compliance tool box are profound. Codes and energy ratings each have distinctive features which would benefit consumers, code officials, and the housing industry if the two were properly integrated. The synergistic effect of combing these tools are profound when you add the market-driven impacts (carrot) of home energy ratings with the regulatory controls of energy codes (stick).

Institutional Benefits

In many states, code organizations with small, untrained staffs can gain access to a wide network of certified energy raters who can supplement their in-house expertise and manpower. Likewise, rating organizations can "sell" their services and software expertise to code jurisdictions and builders who desire to utilize this approach.

The technical requirements of the code and energy rater training can be easily combined in the same training curriculum. Both organizations can benefit from the synergy of using energy rating to determine energy code compliance.

Builders who self-certify code compliance can order an energy rating and provide a copy of the energy rating as documentation of having met either the performance path of the code or the prescriptive provisions.

Institutional Obstacles

Institutional obstacles which hinder the rapid expansion of energy ratings as a code compliance tool include:

- lack of familiarity with HERS by code officials and the construction trade industries,
- perceived lack of impartiality of rating/code inspections when purchased by the builder,
- lack of a uniform HERS rating system in all states,
- lack of a national organization to certify the accuracy of HERS rating software using BESTEST,
- lack of integrated training for code, energy rating organizations, and the building industry,
- lack of a common MEC benchmark among state-based HERS rating systems, and a
- lack of federal, state and local funding to implement this new approach.

However, none of these obstacles are insurmountable and are worth addressing, given the potential benefits from utilizing this approach.

Policy Recommendations For Enhancing Code Compliance Using Ratings

The following actions by federal, state, and local governments would help facilitate the increased use of energy ratings by code organizations as a compliance tool:

- support for state activities by creation of pilot programs, regional HERS organizations and sources of technical assistance,
- issue national, uniform HERS guidelines pursuant to EPACT,
- adopt MEC code changes that specifically reference the use of HERS tools as a performance compliance path and procedures for determining software tool accuracy,
- create an official home for BESTEST for energy rating software certification, and
- develop model state implementation plans for enabling legislation, certification procedures of tools and raters, training, and awareness programs.

Summary

Integrating home energy ratings and energy codes hold significant promise for consumers, code officials, and the housing industry as a market-based approach to energy code compliance. The reasons frequently cited for energy code noncompliance -- builder resistance to government regulations and changes in building practices, the perceived complexity of the code, a lack of familiarity by code officials and the housing industry, and a lack of government resources for enforcement-- all can be overcome by using existing HERS software and trained energy raters for code compliance.

A limited number of states are now seriously investigating the use of raters and HERS software to validate energy code compliance. The State of Vermont, which has a very strong energy rating system and trained rater network, may become the first state to fully integrate ratings statewide for energy code compliance. With increased energy code compliance through the use of home energy ratings, states and local governments can decrease air pollution and reduce energy waste while consumers benefit from reduced utility bills.

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