

Development and Implementation of a Multi-Utility Residential New Construction Program: The Energy Crafted Home Program

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The Energy Crafted Home (ECH) Program is a residential new construction program developed jointly by several electric utilities in Massachusetts, Rhode Island and New Hampshire. It has been endorsed by such diverse organizations the Home Builders Association of Massachusetts and the Northeast Sustainable Energy Association. Introduced in some areas in July, 1990, the ECH Program opened throughout the region in January, 1991.

Utilities promote and pay for conservation measures because it is often less costly to obtain power by saving it than it is to build a new plant to generate it. The utilities were interested in developing a residential new construction program as part of a complete portfolio of demand-side management resources. The ECH program promotes efficient construction practice so that utilities do not have to go back to inefficient homes later and procure savings through higher cost retrofits.

The ECH program encourages energy efficient construction in single-family and multi-family homes. Similar to the Canadian R2000 and the Bonneville Power Authority Super Good Cents programs, it is performance-based and builders are provided with training and technical assistance in getting their homes to meet the program specifications. Field inspections of each home are also part of the program. Financial incentives are paid to the builder for each qualifying home, but even more important to the builders is the marketing support for ECH homes.

In other respects, the ECH program is unique. It is open to all homes regardless of fuel type. (The financial incentives are significantly larger for electric heat homes.) Other end-uses are targeted, including lighting and cooling, in addition to heating. There is an air-tightness standard which is verified by a blower-door test. Mechanical ventilation is required.

Program Description

The Energy Crafted Home Program encourages the construction of homes which are substantially more energy efficient than those required by state building codes in Massachusetts, Rhode Island and New Hampshire. In addition, Energy Crafted Homes are healthier and more comfortable--significant advantages to both the home-builder and the homebuyer.

The ECH program includes training and technical assistance for builders, an energy analysis, quality assurance inspections during the construction phase, financial incentives for each house completed and certified, marketing of Energy Crafted Homes to homebuyers, and promotion to realtors and lending institutions. The goal is to make the program one in which builders want to participate both because the training is valuable and because Energy Crafted Homes will be easier to sell due to their superior quality and the general marketing appeal.

Program Specifications

The Energy Crafted Home program standards are listed in Table 1. There are standards for thermal efficiency for both heating and cooling, infiltration, moisture control, indoor air quality, fossil fuel appliances and lighting.

Thermal Efficiency. The Energy Crafted Home Program achieves energy savings in new construction by increasing thermal efficiency. Houses must meet an air-tightness requirement and building shell energy performance budgets for both heating and cooling. (In general, builders report that they have more trouble meeting the cooling budget; design modifications may include reorienting the building, selecting windows with different transmission characteristics, moving windows or adding overhangs.) Since the program is performance-based, the builder may meet the targets in any number of

Table 1. Energy Crafted Home Program Specifications

Heating	≤ 1.4 Btu/ft ² of shell area/heating degree day
Cooling	≤ 2.7 - 3.7 Btu/ft ² of shell area/cooling degree day (dependent on cooling load of utility region)
Infiltration	≤ 1 in ² of opening /100 ft ² of shell equivalent leakage area
Moisture Control	Continuous vapor barrier (on walls, ceiling and floors, around insulated ducts and under slabs)
Indoor Air Quality	Pollutant source reduction Continuous ventilation (60 - 100 cfm, based on size) Sub-slab gravel (radon pre-mitigation)
Fossil-Fuel Appliances	Sealed or closed combustion required Fireplaces/stoves: airtight doors, fresh air supply
Lighting	Bare bulb fixtures must have compact fluorescents Additional incentive for hard-wired compact fluorescent fixtures.

ways. There is no prescriptive set of standards which must be followed in order to participate. The use of a performance target allows builders flexibility in the design of their buildings, while simultaneously assuring savings. Participation in the ECH program need not constrain either the size of the home or the creativity of the architect or builder in the design process.

Moisture Control. Energy Crafted Homes must also meet moisture control specifications. A continuous vapor barrier (such as continuous polyethylene or the Airtight Drywall Approach) must be installed on exterior walls, ceilings, and floors and around insulated air ducts. Moisture barriers must be installed under slab floors and on crawl space ground surface. Although technically required by Massachusetts building code, vapor barriers have often been no more than craft paper, and are not always installed properly. Vapor barriers reduce the potential for condensation of water vapor in the walls and roof of homes, which can lead to dry rot and structural damage. Properly installed vapor barriers often also serve as air barriers, significantly reducing infiltration.

Air Quality Control. It is essential to maintain good indoor air quality in a home. In an Energy Crafted Home, with its very low natural infiltration rate, special precautions are required to assure clean air and protect the health, safety and comfort for homebuyers. There are two

straightforward ways to do this: first, to minimize the pollutants in the home from the outset; and second, to exhaust indoor air which may contain pollutants and/or excess moisture and to bring in fresh air.

The best way to maintain indoor air quality is to begin with a house as free as possible of pollutants. To this end, in training builders are discouraged from using materials with high urea-formaldehyde content. Radon is another potential indoor air pollutant. All new ECH homes have a sub-slab layer of stone, which would provide adequate air flow for a sub-slab ventilation system, should radon mitigation become necessary.

Mechanical ventilation is required in all Energy Crafted Homes. Systems must be capable of operating continuously, but may operate intermittently. In many cases, builders have opted to install heat recovery ventilators to reduce the amount of energy required to heat the fresh outside air. An ECH certified mechanical ventilation installer must do the system installation.

Heating, Cooling, and Domestic Hot Water. All fossil-fueled heating appliances must be of the sealed or closed combustion variety. That is, the combustion air is provided directly to the combustion chamber from outside the house and the flue exhaust gases are vented directly to the outdoors. No interior house air is used for

combustion, so there is no risk of backdrafting. Fireplaces and woodstoves must have airtight doors and be provided with fresh outside air for combustion.

There are currently no standards for HVAC or water heating equipment, but they may be added in the future. Some of the participating utilities already run programs for high efficiency heat pumps, air conditioners or water heaters. Builders may participate in these programs when installing such equipment in Energy Crafted Homes.

Lighting. Compact fluorescent bulbs must be used in all bare bulb, non-decorative sockets inside an Energy Crafted Home. Each hard-wired compact fluorescent fixture installed will receive an additional incentive of \$25 (up to eight fixtures per home).

Training Workshops

Builders begin by taking a two-day Energy Crafted Home workshop. The program specifications and energy efficient construction techniques are covered. A Builder's Manual and computer software to simulate a home's thermal performance are distributed.

Plans Evaluation and Inspections

After attending a workshop, a builder is eligible to build an ECH home. The home, though, is not automatically an Energy Crafted Home. First, the plans are submitted to the utility for evaluation of thermal performance (generally done by an outside contractor) and then the home must pass a series of construction inspections. Only after the successful completion of the final inspection is the home certified as an Energy Crafted Home and the builder registered as an Energy Crafted Home Builder. A builder is registered once, after his/her first home is completed successfully, but each home is independently evaluated, inspected and certified.

Incentives

Financial incentives are paid for each home. For electric heat homes, the incentives are \$1,650 for single-family homes and \$900 for each multi-family unit. For fossil fuel heat homes, the incentives are \$150 for single-family homes and \$75 for each multi-family unit. The incentives were set to cover the average incremental cost to the builder for going from a (Massachusetts or Rhode Island) Code-built home to an Energy Crafted Home in the electric heat case.¹ Incremental cost was determined by asking builders to estimate costs for standard and ECH homes. Bonneville Power Authority's database was also

consulted and yielded similar incremental costs. Incentives are paid for fossil fuel homes based on the electrical savings for lighting and cooling.

Marketing

Feedback from builders during program design indicated that the primary incentive for the builders is not the money, but the program marketing. The marketing campaign shows that Energy Crafted Homes are desirable--that they cost less to operate and are also more comfortable and healthier homes. These features can provide a key edge in a difficult market. (A full discussion of the marketing component is found in the next section.)

Program Development

Multi-Utility Approach

The Energy Crafted Home program was developed jointly by several electric utilities in Massachusetts, Rhode Island and New Hampshire. The participating utilities are Blackstone Valley Electric, Boston Edison Company, Eastern Edison Company, Granite State Electric, Massachusetts Electric, Narragansett Electric, Newport Electric, and the Western Massachusetts Electric Company. There were challenges to having all the utilities work together, but the resulting program has many strengths which several individual utility programs would not have had.

The ECH program began in 1988, when electric utilities started filing conservation plans with the Massachusetts Department of Public Utilities. In early 1989, the utilities established the Joint Management Committee (JMC) to oversee the program development, builder training, and marketing, and to provide a forum to discuss other issues such as implementation problems and successes. Members represent each of the participating utilities and an outside consultant, which was hired to coordinate the program design. The JMC has been augmented, as necessary, to include builders and technical consultants. The JMC met bi-weekly for most of 1989 and 1990 and continues to meet monthly.

A major advantage of having a single regional program seems obvious: it is easier for the builders to participate. Since builders work across utility jurisdictions, having one program means they need to learn only one set of program requirements and attend one training session. It is also less confusing and more cost-effective to have one well recognized program and one marketing plan to reach customers throughout the region.

Building Community Involvement

Another advantage of a regional multi-utility program is apparent from the planning process. Together, the utilities worked closely with other involved trades and were able to pool resources and retain the services of regional builders, architects, and engineers to lend their expertise to the program design. Over a dozen task teams were assembled to work on specific issues such as building shell, cooling, lighting, appliance, construction details, ventilation, passive solar, etc. Each team was responsible for providing input on program specifications for that area. The inclusion of so many regional professionals in the design led to a very complete and workable program. Builders were able to tell the utilities when standards were impractical, for example, or to suggest specific energy efficient techniques that have worked for them.

A Builders' Advisory Board (BAB) was established to provide a forum for communication between the JMC and builders. Membership on the BAB was open to any interested builder. The Home Builder Association of Massachusetts (HBAM) were represented at meetings, as was the Northeast Sustainable Energy Association (NESEA). Through the BAB's regular meetings, builders were kept apprised of program status. They reviewed documents like the Builder's and Homeowner's Manuals and provided useful feedback on training sessions. They also let the JMC know what else they needed from the program--for example, more marketing. Several marketing pieces, such as a video to show prospective clients and a booth for display at home shows, were developed based on requests from the Builders' Advisory Board.

The involvement of so many "gate-keepers" in the building industry has been both challenging and also critical to the program's acceptance by the building community. Opinions often varied on what was required for good construction. For example, requiring mechanical ventilation was originally opposed by many builders who felt it was an unnecessary expense. After discussion and study, the builders agreed that mechanical ventilation was indeed mandatory for healthy indoor air in a tight house. These local professionals all feel some program ownership and hence are likely to build ECH homes themselves and encourage their colleagues to do likewise. A measure of the program's success is its endorsement by the Massachusetts Association of Home Builders. The Northeast Sustainable Energy Association (NESEA) has also endorsed and helped to market the ECH program, and its members have played key roles as program designers, workshop instructors and inspectors.

Performance Standard

The Energy Crafted Home Program thermal standards are performance based. Every major new construction program in North America and the building codes themselves have performance-based compliance paths. A performance-based program also allows builders more design flexibility since they are not constrained by prescriptive construction requirements. All homes will be built to the ECH standard or higher, so energy savings are likely to exceed that of a prescriptive-based program where homes will be built just to the qualifying standard. For example, if a prescriptive program requires R38 roof insulation, builders will put in R38 and collect the incentive, but there would be little reason for a builder to install any additional insulation. An ECH builder may build an R44 attic for one home and learn the technique. In a subsequent home, while only R38 may be required to meet the performance standard, the builder may decide to be consistent and install R44 again.

Another advantage of a performance-based program is that, as building technologies and/or building Codes improve, it is simple to update the program by changing the performance target. The training and program implementation remain the same, so the change is nearly transparent to builders, except for the distribution of revised compliance standards.

Lastly, prescriptive approaches which are limited to a few measures (such as windows and walls) cannot assure savings. It is possible for a home to comply with building code requirements by exceeding some prescriptive standards and relaxing others. This has the potential of allowing a builder to receive rebates and still not exceed the code overall or achieve net savings. A performance approach, by definition, does not permit off-setting tradeoffs but instead requires net energy savings.

Program Implementation

The implementation of the Energy Crafted Home Program is designed to be very builder-friendly. Throughout the training, plans evaluation and inspection, trained staff are available to help the builder to meet program specifications. Especially in the start-up phase, emphasis has been placed on hand-holding and working closely with builders.

Training

All builders interested in participating in the ECH program begin by attending a two-day training workshop. These workshops are offered frequently and at very low cost (\$100) throughout the participating utilities' service territories in Massachusetts, New Hampshire and Rhode Island. They are presented by a team of experienced building professionals (typically an architect/engineer and a builder) who use slides, schematic drawings, product samples, and interactive discussions to address program guidelines, recommended construction and mechanical details, and builders' questions. Builders are trained to treat a house as a system, with special attention to moisture, indoor air quality, thermal integrity, isolation of combustion equipment, and controlled ventilation (instead of uncontrolled infiltration). They are also given a reference manual and computer software which allows them to simulate a home's thermal performance.

A number of small builders in New England already use many of the state-of-the-art construction details recommended at the workshops. Most notable are the members of the Northeast Sustainable Energy Association (NESEA), who share ideas and techniques at their annual Quality Building Conference. But most builders are seeing this integrated package of construction techniques for the first time.

The overwhelming majority of the builders leave the workshops with praise for both the workshop and the ECH program. Many are almost converted--prepared to experiment with new technologies but not sure if they can find the right customers. They tend to need both marketing tools and additional technical assistance. That is where the utility representatives and plans evaluators come in.

Role of Utility Representatives

The utility representatives are responsible for marketing the Energy Crafted Home Program to builders and to the home-buying public. To date, much of the focus has been on encouraging builders to attend the training and submit plans for review. In the case of small custom builders, the utility representative generally forwards the plans directly to the plans evaluator. Most homes don't comply with program guidelines when first evaluated; it is then the role of the plans evaluator to work with the builder to explore and evaluate options.

Larger developers are handled differently since they both pose more challenges and also represent more energy savings potential for the utility. Since large-production developers often build "to code," upgrading to ECH

standards means different construction techniques, new products, extra attention to detail, and greater risks. The utility presence is very valuable when trying to overcome the "Why fix it if it's not broken?" attitude. In some cases, the utility representative, plans evaluator, and a developer have met on site to tour a model house, review necessary improvements, and demonstrate infiltration with a blower door. In some cases, this extra attention and commitment from the utility to assist with marketing has convinced developers to experiment with Energy Crafted Home techniques.

Plans Evaluation and Technical Support

Once a builder is ready to build an Energy Crafted Home, s/he submits the proposed plans to the appropriate utility for evaluation. Each builder is assigned to a plans evaluator who reviews the blueprints and system details to see if the proposed house will comply with the ECH energy efficiency, mechanical, and air quality standards. A computer simulations program is used by the plans evaluator to determine whether the design meets ECH thermal standards. It can also be used by the builder and plans evaluator to test the energy benefits of various building envelope and orientation changes, and to help design for maximum thermal performance. Modifications are generally required, so the plans evaluator discusses possible thermal upgrades and mechanical system designs with the builder, who ultimately decides on the changes. Once a modified plan meets all ECH requirements and gets approved by the plans evaluator and utility, the builder can begin construction.

A detailed Builder's Manual, developed by the JMC and its technical task teams, is distributed and referred to at the workshops. It is a valuable reference manual which includes program requirements, many example construction details, and the explanations behind the recommendations. Even so, most builders need additional technical assistance on such issues as how to improve thermal integrity, how to install a truly continuous air/vapor barrier, and how to incorporate state-of-the-art heating and ventilation equipment. The plans evaluators and inspectors provide technical resources and work with the builders to identify difficult construction details and resolve potential problems before they happen.

Inspections and Quality Control

During construction the utility provides for at least three on-site inspections. The inspector's role is to ensure that a home is constructed as it was specified and approved. The inspector focuses on the insulation, vapor barrier, air sealing, heating, air conditioning, and ventilation systems,

and other combustion equipment. The cost of the three inspections is paid by the utilities.

The first inspection is to verify that the insulation and air/vapor barrier are properly installed. On a builder's first ECH project, this visit is often done in two stages, so any insulation inconsistencies can be spotted and properly corrected before the insulation is covered by the vapor barrier and less accessible.

The second inspection takes place after the drywall is in place, but before any trim is installed. The primary purpose of this inspection is to confirm that the building meets the air-tightness standards set by the ECH program. The inspector uses a blower door test procedure to estimate infiltration and to identify any air sealing still required to meet program guidelines. If the house does not comply with program standards after the first test, the inspector will use the blower door and a smoke bottle to help the builder locate areas which still need to be sealed. If only minor air sealing is required, the inspector stays on-site and re-tests. If substantial work is required, a follow-up test is scheduled. This test may be repeated until the home meets the air-tightness requirements. For a builder's first ECH home, the utility will pay for a second blower door test, if one is required. If repeat blower door tests are needed for subsequent homes, they are paid for by the builder.

The third inspection is a final walk-through when the home is complete. While the heating, domestic hot water and ventilation equipment and distribution systems are generally examined at each stage, the final inspection is to confirm that these systems and their controls are functioning properly. Sealed combustion is critical in ECH homes, as is proper air flow and balancing of ventilation systems. Fluorescent lights, duct and pipe insulation, fireplaces, wood stoves, and exhaust hoods are also checked during a final inspection.

By having inspectors oversee each project at several stages, the Energy Crafted Home Program can be assured of consistent high quality construction and anticipated energy savings. It is very important that the quality of construction be high since the reputation of the entire program could be tarnished by a home with high energy bills, excess moisture, or air quality problems.

Upon successful completion, the house is certified as an Energy Crafted Home and the builder is registered as an Energy Crafted Home builder. An owner's manual, which details the advantages of owning an ECH home and how to care for it, is then presented to the buyer.

Marketing

The program will only succeed if large numbers of ECH homes are built. Without widespread acceptance by both builders and homebuyers, a technically sound and comprehensive program will not save much energy.

The core message of the ECH marketing strategy is that energy efficiency is not only an economic feature of a new home but part of a package of features as important as kitchen design or location. These features include comfort, durability, environmental safety and quality control. Customer and builder education is designed to create the understanding that these features are not standard in new homes. For example, many new homes have inadequate ventilation in all or part of the home. With the extensive use of toxic materials in construction and home decoration, there is significant danger of unsafe indoor air quality. The ECH features of mechanical ventilation, sealed combustion appliances, reduced formaldehyde, and radon pre-mitigation lead to a significantly reduced risk of unsafe homes.

Energy Crafted Homes have fewer drafts and temperature swings than do new homes which have traditional features. Moisture damage is prevented with extensive use of vapor barriers and proper exhaust systems. Taken as a package, ECH homes are economical, safe, durable and comfortable. It is this interrelated package of building techniques and consumer features that comprise the ECH marketing message.

Marketing to Builders

The initial marketing audience has been the builder and related trade allies such as developers and architects. These were the gatekeepers of industry opinion who could validate the ECH message and the program could not begin without their awareness and support. The program could not begin without their support and awareness. The early participants provided the initial base for a long-term campaign to both attract builders to the program and provide them with visible benefits.

The message to builders has focused on two themes. First is the marketing advantage--"looking for a hard edge in a soft market"--something to set the ECH builder apart. Second is the fear of being left behind in a market trend--"the market for inefficient homes is disappearing". In both cases, the message was that the ECH package of features will help sell homes more easily than others that lack these features.

Marketing to Potential Homeowners

The homebuyer message is sent through direct customer marketing by utilities and one-on-one discussions with enthusiastic ECH builders. A buyer interested in building a home is educated about the advantages of building an Energy Crafted Home and provided with a list of participating builders. This is an initial strategy while the ECH home is still new to the market. Conversely, developers of "spec" housing or developments are encouraged to participate and receive assistance with marketing to homebuyers. The goal is to market the ECH message directly to the buyer to stimulate market acceptance and desirability of these high quality homes.

Utilities and builders are using creative strategies to enhance the marketing of ECH homes. Feature articles in newspapers, lawn signs, homeowner users manuals, cooperative advertising in real estate journals, home show booths staffed by ECH builders, videos, TV advertising and promotional items such as hats, pens and brochures are just a few of the marketing ideas being implemented. The advantages of one program logo and name is beginning to bring results as the message is reinforced across utility service territories.

The newest marketing piece is a video, created by the utilities as a result of builders' requests through the Builder's Advisory Board. The video, which is provided to builders for distribution to prospective clients, features many Energy Crafted Homes of various layouts and architectural styles. Builders explain the quality construction of Energy Crafted Homes and satisfied customers talk about lower fuel bills, increased comfort, and knowing that they are acting in environmentally responsible ways. Recently, cable television advertising has begun.

The slow start-up of this or any new construction marketing strategy is frustrating, but should be expected. Housing starts in the region are down by 40-60% from "boom" times of only four years ago and there is typically a 12-18 month gestation period for any new construction project. Patience from program managers, regulators and builders will pay off in the long term.

Status

Builder Interest and Participation in Training

In the first full year of program implementation, over 400 builders were trained and nearly 150 Energy Crafted Home units were completed. There are 10 workshops scheduled for 1992, many of which are booked to capacity

several months in advance, a sign of great interest by the building community. The program-wide goal for 1992 is to begin construction of between 400 and 600 ECH single- and multi-family units. Admittedly, this is an ambitious goal in a slow market. The smooth coordination of the many program elements, including trade allies (manufacturers, architects, realtors, suppliers and bankers), utility administrators, builders, plans examiners, inspectors and others is necessary for success.

Typical Construction Detail

The performance-based approach of the ECH program results in a great deal of flexibility on the part of the builder. However, several basic construction details are being used in many ECH homes. Figure 1 shows typical code and ECH constructions.

Walls - Some house plans pass the thermal analysis with R-21 in the walls (2x6 wall with cellulose or high density fiberglass) but most are 2x6 construction with an inch of rigid foam on either the inside or outside (R-24 to R-28 total). The foam, typically extruded polystyrene or foil-faced isocyanurate, helps reduce thermal bypasses through the studs, and in some cases can function as the air/vapor barrier. Current Massachusetts code requires R-19 walls in houses with electric resistance heat, and just R-11 wall insulation in fossil fuel and heat pump homes.

Ceilings - Virtually every house participating in ECH has more than the R-30 insulation in attics that is required by code. R-40 or more is typical, and builders are encouraged to avoid thermal bypasses by effective air sealing and by insulating over joists and out over the top of exterior walls.

Windows - Since windows are a major source of heat loss and solar gain, they are an obvious building component to improve. Massachusetts building code calls for standard thermal glazing in most new homes, and requires higher standards (low-e glazing) only in homes with electric resistance heat. Most ECH houses have either thermal low-e glazing or low-e argon filled glazing, and a few have "super windows" with two low-e coatings. The thermal analysis considers orientation, unit U-values, solar transmittance, and exterior shading in the analysis of the effect of windows on heating and cooling loads.

Heating Equipment - Heating systems and fuels in ECH homes vary, but in all cases, the systems are smaller than what would have been installed in non-ECH homes. Design loads are typically 25-50,000 BTUs per hour instead of 50-150,000 BTUs per hour. Many fossil fuel heat houses have integrated systems, where one heating

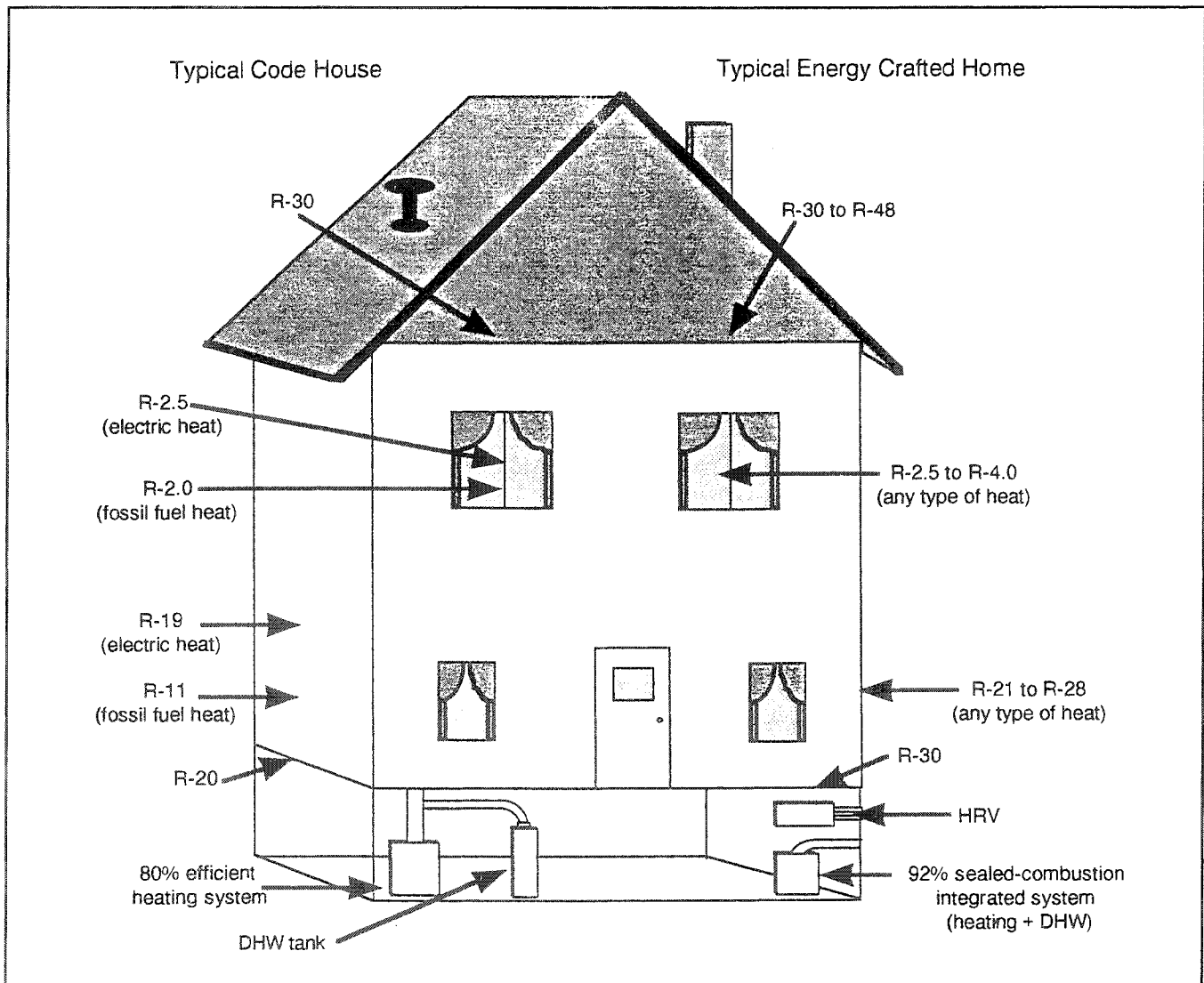


Figure 1. Comparison of Code and Energy Crafted Home Sample Characteristics

unit provides both space heat and domestic hot water. These are typically a high efficiency boiler that also supplies an indirect domestic hot water storage tank, or a high efficiency hot water heater that sends a hot water coil to an air handler.

Ventilation Equipment - Most ECH homes have heat recovery ventilators, sometimes fed directly into the forced air heating system to minimize ductwork. The rest have exhaust-only ventilation, which typically exhausts air continuously from bathrooms and kitchens directly outside, drawing in fresh air through inlets in living room and bedroom walls. Either method of controlled ventilation is acceptable, however less energy is required to heat air which has passed through an HRV.

Homes Built to Date and Projected

The number of homes built to date is not high. This is to be expected in the start-up phase of a program. Across the four participating utilities, 20 electric homes (11 single family and 9 multi-family) and 105 fossil fuel homes (9 single family and 96 multi-family) have been built. Another 29 electric homes (16 single family and 13 multi-family) and 65 fossil fuel homes (41 single family and 24 multi-family) are under contract. There are many more homes which are in the process of plans review, but not yet under contract. Table 2 shows the participation numbers.

Table 2. Energy Crafted Home Participation

<u>Completed as of 5/92</u>			
	<u>Electric</u>	<u>Fossil</u>	<u>Total</u>
SF	11	8	20
MF	9	96	105
Total	20	105	125
<u>In Process as of 5/92</u>			
	<u>Electric</u>	<u>Fossil</u>	<u>Total</u>
SF	16	41	57
MF	13	24	37
Total	29	65	94

Evaluation

A process evaluation of the ECH program was conducted by the utilities. End-use metering is being done on six home by New England Electric.

Process Evaluation

The Energy Crafted Home Program process evaluation was undertaken jointly by the participating utilities (NEES, BECo, EUA and NU). It was completed in April, 1992. The objective of the process evaluation was to understand the current status of the ECH Program and to determine the future direction of the program. The first phase of the process evaluation consisted of qualitative semi-structured interviews with 18 utility staff and contractors, 14 participating builders 12 ECH home owners, 13 mortgage lenders and 13 real estate agents. Approximately 25% of these interviews were conducted in person, the remainder by telephone. The second phase of the process evaluation consisted of quantitative structured telephone interviews of 200 builders who have not yet built ECH homes (half aware and half unaware of the program) and 200 recent or potential home buyers (half aware and half unaware of the program).

Over 90% of the builders surveyed build single-family homes. Most of these are custom (75%) and 1500-2500 square feet. They reported building 9-10 homes per year prior to 1990, but expect to build only 5-6 in 1992. Of the

builders who were aware of the ECH program, 58% completed the ECH training. Most of these (44%) intend to submit plans, but so far relatively few (9%) have.

Builders who have participated in ECH training and built ECH homes have been uniformly positive about their experience. They like the training, technical assistance, and third-party endorsement and third-party certification. They cite as program weaknesses that the incentives are too low to cover additional costs, the marketing should be more buyer focused and that two days is insufficient to train a new ECH builder.

Builders who were unaware of the program until called for an interview had initial positive responses to the program. Seventy percent of the unaware builders requested more information.

The current ECH builders are the early participants. They were pre-disposed to participate due to their interest in energy efficiency, environmental issues and high quality construction. The same is true for the early buyers. The next crop of builders will be more difficult to recruit.

Home buyer awareness of the program is still quite low. All parties agree that buyers must be educated about the ECH program and the advantages of ECH homes to increase the demand. Even the most enthusiastic ECH builders assert that their role is to build, not to educate.

Another common barrier to participation given by the builders is the slow economy. The utilities cannot influence this, but marketing can, within the housing slump, shift demand towards a certain type of construction.

Other barriers to participation include the fear of doing something new for the builders or buying something experimental for the buyers. Finally, the increased first cost is a barrier, especially for first-time buyers.

The process evaluation also assessed to what extent, if any, fuel switching was occurring as a result of the ECH program. There is no indication that the program is encouraging builders to switch to electric heat. When asked if the incentives would have an impact on fuel choice, 55% of builders aware of the program said no; 16% said they would be more likely to build electric; 20% said they would be more likely to build fossil; and 6% said the buyer always decides. Most builders either have a particular fuel which they always use or they leave the choice to the customer. Since the incentive is perceived not to cover incremental cost, there is no lure to switch to electric heat.

One recommendation is to increase marketing and education for home buyers, emphasizing the increased health and comfort and documented savings of Energy Crafted Homes. Another recommendation is to increase the incentive for electric heat homes and to eliminate the incentive for fossil heat homes. Other suggestions for improvement include more post-training follow-up with builders, development of a simplified, prescriptive path, and a special segment for multi-family construction.

Impact Evaluation

End-use metering of six homes, four ECH and two non-ECH is underway in Webster and Southbridge, Massachusetts. Five of the homes were built by the same builder and the ECH and non-ECH homes have similar floor plans and occupancy patterns. End-uses monitored, including heating, cooling, ventilation, water heating, oven/stove, microwave, dishwasher, refrigerator, washer, and dryer; in addition, the whole building load and indoor and outdoor temperatures are measured. Instantaneous measurements are made every second and averaged over fifteen-minute intervals. These average values are stored in an on-site data logger and downloaded to a central computer.

Monitoring equipment installations were completed in April, 1992. Monitoring will continue for two heating seasons.

Future Direction

The ECH program is not yet a mature program. In the next year, the program will be revised to increase participation and to address other issues from the process and impact evaluations.

Increasing Participation

The utilities provide financial incentive payments for meeting the program's thermal and quality construction guidelines. One of the issues addressed by the process evaluation was whether the financial incentive was sufficient to cover a builder's incremental costs. Most builders felt that the incentive was not sufficient to cover incremental costs for electric heat homes, especially for builders new to the program. One possible response would be to add an additional incentive for first-time ECH builders, to cover the increased cost of learning new construction techniques.

The utilities have developed a wide range of marketing tools to attract builders into the program and to help builders sell these healthier, more energy efficient homes.

Targeting both builders and the homebuying public are newspaper, magazine and television stories and ads, an information video and booklet, sign on ECH homes, and homeshow booths. From the builder's perspective, the biggest barriers are the slow market and the low priority most buyers place on energy efficiency relative to other amenities.

Benefits

Homeowners indicate that saving money is the most compelling reason for conserving energy. Increased comfort and positive environmental impact are also important reasons for investing in an Energy Crafted Home. Other benefits, cited less frequently, include better air quality, higher resale value and qualifying for an energy efficient mortgage.

Converting the Building Industry

One of the biggest challenges for the ECH builders and utilities is converting the rest of the industry. Builders routinely depend on subcontractors for insulation, vapor barriers, heating systems, plumbing and electrical work. In many cases, they have had trouble finding subcontractors who are familiar and comfortable with the equipment and installation details required by the program.

Until the ECH approach becomes common practice among tradespeople and subcontractors, it will be difficult for many builders to participate. One way to expand the number of qualified subcontractors may be to develop and present shortened training sessions which would review the ECH house-as-a-system approach and the discipline-specific installation details. Builders would have an easier time if they could select subcontractors who were "ECH Certified" installers. A ventilation workshop and certification program already exists.

Continuing Education and Technical Support for Builders

It has been a challenge to provide the right amount of training for builders. They enter the program with different levels of expertise, from those who need little more than positive reinforcement and marketing assistance, to the majority who need a significant amount of technical support. Two days seems to be enough time to cover the basics, but not enough to teach all the details.

NESEA's regional Quality Building Conference is one avenue for providing continuing education. Many of the conference planners are also Energy Crafted Home builders. This year builders who had participated in an

ECH workshop were encouraged to attend NESEA's conference and associated workshops. Builders would probably also benefit from other advanced technical workshops.

Other options discussed include an information hotline and/or a panel of experts who could be available over the telephone, or possibly even on-site to answer questions and provide advice. Currently, most of the technical support and hand-holding is still provided by the plans evaluators and inspectors.

Long Term Goals of Program

Ultimately, the utilities plan to have 30% of the new, electric heat homes be Energy Crafted Homes. While the program began with small, custom home builders, the economies of scale suggest that the utilities can attain the largest savings by targeting larger developers.

Endnotes

1. When surveyed in the process evaluation, builders indicated that their incremental costs were higher than

the incentives for electric heat homes, especially for first-time ECH builders. The utilities are examining the possibilities of increasing the incentives or having an additional incentive for first-time ECH builders.

References

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