Dressing the Priestess:
Preparation for and Results of a Delphi Study for
a Residential New Construction Program

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ABSTRACT

To meet regulatory needs, the Massachusetts utilities sponsoring the ENERGY STAR® homes program required a ten-year forecast of the market penetration of qualifying units. A Delphi analysis was conducted, with a panel comprising nine experts, including a representative of the state's building community, an economist who deals with the housing market, a state codes expert, and national experts on the ENERGY STAR program, as well as a program implementation contractor, and members of the program management committee. The panel considered three scenarios—a no-program base case, continuity of the current program design, and an expansion of the current program involving potential federally sponsored financial incentives—applied to the single-family market rate sector, the multifamily market rate sector, and the multifamily low-income sector. The results provided input to the benefit-cost models of the utilities and indicated which program designs experts envisioned as most likely to lead to sustainable increases in the market penetration of qualifying homes.

Introduction

This paper reviews the need of Massachusetts utilities for projections of ENERGY STAR®-qualified homes under different scenarios of program support as well as the issues and procedures involved in conducting a Delphi panel to provide those data. In this introductory section, we first describe the history and current design of the Massachusetts ENERGY STAR Homes Program. We then summarize the information needs of the sponsoring utilities for regulatory and planning purposes, and finally turn to several important requirements of the Delphi method that was used to address those information needs.

Program Background and History

Residential new construction programs in Massachusetts began in 1991 with The Energy-Crafted Homes (ECH) program which promoted state-of-the-art construction for electrically heated single-family homes. In April of 1998, the ECH program was retired and the ENERGY STAR Homes Program was introduced, to take advantage of and coordinate with the national program sponsored by the Department of Energy and the Environmental Protection Agency.

As part of the national effort, the focus of the Massachusetts program was broadened to include multifamily building projects and fuel-neutral incentives. Opening the program in these ways greatly increased the number of new construction projects eligible to participate in the program. Furthermore, use of the ENERGY STAR name and logo leveraged its brand name recognition. In addition, basing ENERGY STAR certification criteria on Home Energy Rating System (HERS) performance made the

program accessible to all builders. Finally, this change allowed for expanding the sponsorship of the program, administered by the Joint Management Committee (JMC).[1]

The proportion of new housing units participating in the Massachusetts program and committed to be built to ENERGY STAR standards has grown from six percent in 1999 to 15 percent in 2000, 21 percent in 2001, and 19 percent in 2002. Meanwhile, the number of ENERGY STAR-qualified homes completed through the program as a percent of total home completions has grown from three percent in 1999 to ten percent in 2002.

Current Program Design

To date, the Massachusetts ENERGY STAR Homes program has focused on maximizing the number of qualified housing units in the market place and has therefore aimed at attracting large builders and developers of both single and multifamily units. As the program moves forward, maintaining the involvement of currently participating builders is considered important for sustaining the momentum of the program. At the same time, recruiting is being expanded to attract greater participation from the full spectrum of builders, particularly those who complete only a small number of homes each year. Over 150 builders actively participated in the 2002 ENERGY STAR Homes program, and the JMC would like to double the number of participating builders over the next three to five years. In addition, marketing to consumers is being expanded in ways that will help generate demand for the ENERGY STAR–qualified homes being built, and thus support the increase in builder program participation. Other objectives include continuing trade education and trade ally development, increasing industry investments and co-sponsorships, strengthening energy code compliance, expanding multifamily outreach and capabilities, and investigating the incorporation of green building elements into the program, while at the same time reducing the per-unit financial incentives.

Information Needs

As part of the regulatory environment in the state of Massachusetts, electric utilities are required to consider post-program effects for market transformation activities such as the ENERGY STAR Homes effort. Utilities must show the net energy and demand savings as well as the associated dollar benefits, for each program year and the following ten post-program years. This regulatory requirement drives the need for understanding the markets that are targeted and the factors influencing their development. With this understanding and the appropriate additional information, program planners can determine appropriate goals; needed program design or implementation modifications; and the likely effects of the program intervention on the target market.

To accomplish these tasks, most utilities have chosen to use a benefit-cost screening tool based on anticipated market effects. Input requirements for this tool include projections of the eligible market, as well as penetration rates for the program years and the out-years following program termination. With this information, including a reasonable range of penetration rates, program planners can explore the potential effects of changes in program budgets, other resources, and flexibility in market targets. Projecting the eligible market for a residential new construction market is relatively straightforward, given the availability of various industry and macroeconomic models. However, the projection of penetration rates for qualifying homes under different program scenarios requires custom-designed models or research.

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[1] The members of the Massachusetts Joint Management Committee include Bay State Gas, Berkshire Gas, Cape Light Compact, KeySpan Energy Delivery, Massachusetts Electric, Nantucket Electric, New England Gas, NSTAR Gas and Electric, Unitil/Fitchburg Gas and Electric, and Western Massachusetts Electric.

The Delphi Method and Its Requirements

To develop the required penetration projections, the sponsors[2] decided to apply the Delphi method. In brief, this approach involves the following key steps: (a) obtaining independent projections of future states of the market from a purposive sample of experts in one or more aspects of that market, under clearly specified scenarios; (b) compiling these projections and any relevant additional assumptions described by the experts and providing the summarized results to all members of the sample; and (c) obtaining additional projections from the panel of experts, based on their initial responses and the feedback they have received. Unlike a focus group, a Delphi panel typically interacts through correspondence and the members normally do not interact directly.

Although it would be difficult to argue that the Delphi method is an ideal method for projecting future states of a market, it does have advantages over other approaches that might be applied. Efforts to develop such projections from analogies to other historical situations suffer from the difficulties of identifying relevant situations that are closely enough aligned with the current situation; for example, here, a sustained statewide effort to expand energy-efficiency practices in the residential new construction market, building on a multi-year preparatory effort. Analogies with results in other states or regions are limited by the fact that those efforts are either at about the same stage of development as the Massachusetts program or several years behind. Even if the markets were similar enough for comparisons, given differences in the mix of climate, builders, and macroeconomic factors limit the ability to compare programs. The use of a broadly representative expert panel provides internal checks on the potential biases of a single expert or core group of experts invested in the program. Finally, direct face-to-face meetings—even among experts—often permit undue influence from individuals with particularly strong views.

As indicated, a potential strength of the Delphi method is the opportunity to obtain several independent projections of the state of the future market, representing the perspectives of different experts and balancing the biases involved. To reap these advantages, it is important to consider and address several methodological issues quite carefully. First, the areas of relevant market expertise should be made explicit and recruiting efforts conducted accordingly. Second, to avoid the possibility that the results reflect the weights accorded to different components of a heterogeneous market, the market considered should be relatively homogeneous. Third, to reduce the variability in background information from which the experts are projecting, relevant aspects of the current market situation should be described in as much detail as possible in the materials given the experts. Finally, relevant aspects of the scenario to which they are projecting should also be made as explicit as possible, again to minimize any variability in their understanding of the situation. In most cases, these steps will not eliminate the variation in expert opinions that will emerge (after all, if the answers about future states were obvious, there would be little need for this research), but they will help to reduce the proportion of the variance that results from unintended differences in interpreting the basic situation of interest.

Methods

This section describes the selection and recruitment of panel members, the development of the market description and scenarios, and the data collection procedures. Key aspects of each topic are discussed below; more detailed information may be found in the appendices to the report (Nexus Market Research et al. 2003).

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[2] The sponsors of this study are evaluators for the utilities represented on the JMC.

Selection and Recruitment of Panel Members

No set number of panel members is required for a Delphi study. Common practice suggests a minimum of five experts, to ensure diversity of experience and perspectives, and a maximum of one dozen, for practicality.

For this study, nine panelists were recruited. We sought (a) a diverse group of participants, representing a variety of perspectives, (b) each member of which is a recognized expert in his or her particular field. To this end, we sought a mixture of people who were directly involved with the program and those who were not affiliated with it. Among the former group, we included utility and non-utility party representatives to the JMC and an implementation contractor. Among the latter group, we sought economists familiar with the Massachusetts housing market, housing code officials, officials of Massachusetts builders' associations, and officials of major lending agencies familiar with the Massachusetts housing market. Specific candidates were identified through recommendations of advisory team members, web searches, and word-of-mouth recommendations from those unable to participate because of scheduling conflicts or other issues.

Two members of the research team called or E-mailed each of the potential panelists to invite participation, outlining the project purpose, the overall design, and the responsibilities involved. In the recruiting effort, they also noted that compensation would be provided for those who were not directly involved with the program, in the form of a $300 donation to the participant's favorite charity. (In general, this compensation makes no difference in securing agreement to participate, but qualitatively it appears to increase satisfaction with participation effectively. A summary of key points regarding participation was E-mailed to nominees/recruits as a follow-up to the initial contact and agreement to participate. The background expertise/experience of the panel members is summarized in Table 1. As will be noted, we were able to secure experts in all areas targeted except for the mortgage banking community.

Table 1. Composition of the Delphi Panel

Number of Panel Members	Background Expertise/Experience
2	Involved with or monitor national ENERGY STAR homes program
1	Involved with Massachusetts builder association
1	Member of regulatory commission dealing with building codes
1	Assists with program implementation
1	Economist dealing with housing market
3	Participates in program design and oversight as utility representative or non-utility party

Markets and the Market Description

The research team worked closely with the sponsors and the implementation contractor to develop descriptions of the current Massachusetts residential new construction markets, the ENERGY STAR home qualification criterion, and the HERS process, as well as possible scenarios for the near future.

The team first determined that residential new construction comprised relatively distinct submarkets for single family dwellings[3] and for multifamily dwellings,[4] and that the differences among these were more critical (and easier to address) than differences among the housing markets in different areas of the Commonwealth. Moreover, factors affecting units produced for low-income buyers and renters differed considerably from those affecting market-rate buyers and renters, because of tax policies, subsidies, and zoning issues, aside from affordability. Together with the sponsors, they chose to address three of these subsectors,[5]

- Single-family, market-rate homes,
- Multifamily market-rate homes, and
- Multifamily low-income homes.

Information about the rating system and ENERGY STAR certification were obtained from the federal website. Descriptions of the current markets were drawn from reports of annual single-family and multifamily housing permits from the U.S. Census Bureau, as well as various official sources of information on low-income housing programs. (The Census data do not distinguish between low income units and others.) Reports on the number of housing units committed to the program and completed each year were provided by the program implementation contractor.[6]

Scenarios

To meet the regulatory and planning needs of the sponsors, the research team presented the panel members with three different scenarios differing in the presence and extent of market intervention. (To simplify the exercise and limit response variability, the scenario descriptions asked respondents to assume that various other factors, such as interest rates and building codes would remain stable.) These may be designated as:

- Base case (no intervention)
- Continuity (the current program, with minor modifications)
- Continuity plus federal support (the current program supplemented with a federally funded bonus for builders, based on level of energy efficiency, as considered by Congress in 2002)

Each of these is described in more detail below.

Base Case. In the base case scenario, all publicly funded market intervention specific to the Commonwealth would cease at the end of 2002. The federal ENERGY STAR program which allows builders who enroll and agree to be tested to use the name and the logo would continue and provide some marketing support. However, this national program does not include the additional assistance that is part of the intervention in the Commonwealth program.

Continuity. The continuity scenario described the current program, and projected its continuation through 2007. As presented to panel members, this scenario described the current budget projections and program strategies, such as efforts to reach builders with information about energy-efficient practices and equipment, provide training, offer support for co-op advertising to home buyers, etc., and to provide

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[3] Including both single-family detached and single-family attached (e.g., garden apartments, row houses) units.

[4] The focus is on housing units, not buildings or complexes.

[5] We did not work with the fourth possible subsector, single-family, low-income homes, in order to limit the burden on panel members and in recognition of the relatively low level of activity in that subsector.

[6] Some adjustments were required because, for historical reasons, the program database used a different definition of single-family homes than does the U.S. Census. The program implementer, Conservation Services Group, helped the authors adjust the program tracking data to be more consistent with the Census information.

incentives to participating builders (those who sign agreements to complete ENERGY STAR-qualifying homes), including:

- A per-unit incentive to builders for meeting ENERGY STAR standards
- Free plan review, technical assistance, and on-site quality assurance inspections
- Free HERS rating and certification
- Free HVAC design and installation verification service
- Rebates for the purchase and installation of energy-efficient equipment
- Additional incentives for particularly high HERS ratings (of 87 or above)

Continuity plus federal support. The continuity plus federal support scenario also assumed that the program would continue through 2007, and further assumed that federal legislation that encourages the construction of ENERGY STAR-qualified homes would pass Congress and be signed into law by the President, and that the necessary implementation rules and regulations will be developed and promulgated during 2003. Hence, the regulations would take effect as of January 2004 and run through December 2007. As described, this would provide up to $1,250 credit to the builder for construction of a new home that reduces energy use by 30 percent compared to the 2000 International Energy Conservation Code, and up to $2,000 for homes that save 50 percent more relative to that code, using either component-based or performance-based measures.[7] Although this scenario focuses on the proposed federal program, it can also be understood as reflecting possible additional investments in the Massachusetts program from other sources.

Data Collection Procedures

This application of the Delphi technique required two rounds of market penetration projections by the panel members. First, the market description and the scenarios were sent to each expert with a request that he or she complete a matrix showing the expected level of market penetration for each submarket for each calendar year, from 2003 through 2012, under the scenarios described. The experts were also instructed to list the assumptions they made as they developed their estimates. Of major importance, the panel members were instructed to project the penetration of all homes that would qualify for the ENERGY STAR designation, whether built within the program and tested through HERS or not.

The panel members returned their projections and the descriptions of their assumptions to the research team. The team then compiled a summary of the initial projections by each of the panelists as well as their comments and assumptions regarding the scenarios and the submarkets. These summaries were then sent back to the panelists, along with a request that they review the materials and provide a second set of projections, based on their initial responses and that review. The instructions also indicated that, while we were interested in their considered opinions, we were not striving for homogeneity; hence, they were under no obligation to change their initial responses. The findings described below are based on the second set of projections from the panelists.

Results

This section describes the results of the Delphi exercise regarding the penetration of ENERGY STAR-qualified homes in Massachusetts over the 2003-2012 period, under each of the three intervention

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[7] Such legislation was before Congress as part of a comprehensive energy bill in 2002, when this study was conducted, and was carried over into the post-election session, but did not come to a final vote.

scenarios. We will first summarize the results for each submarket and then explore several analytic issues.

Summary Findings

We first present three figures, summarizing the penetration projections under each scenario, for each of the submarkets, and then discuss these results. The three figures are presented first, because each submarket is distinct and the range of projections is peculiar to that market. The discussion is organized by scenario, however, to emphasize the commonalities that emerge in projecting their effects.[8] This choice of statistics will be discussed more fully in the later portion of the Results section.
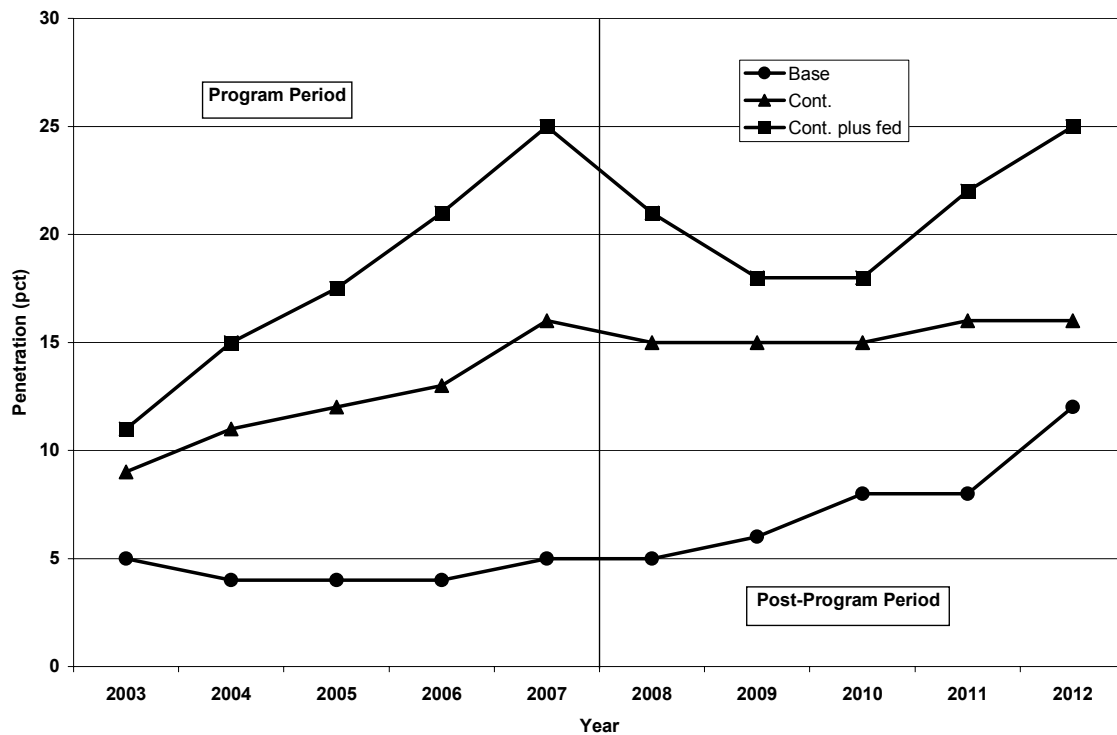
Figure 1. Median Projections, Single Family Homes

As would be expected, in each submarket panel members expect the lowest penetration rates to be found under the no-program scenario and the highest penetration rates under the scenario in which the current Massachusetts program is supplemented by a federal program through 2007. However, the projected penetration rates and their time course differ from one submarket to the next.

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[8] The summary data are presented in the form of median projections of market penetration in each year. (In each case, this is the median of all projections for the given year, for the submarket under consideration, for the selected scenario. Accordingly the data do not represent any one panel member.) The choice of the median is discussed in the full report.
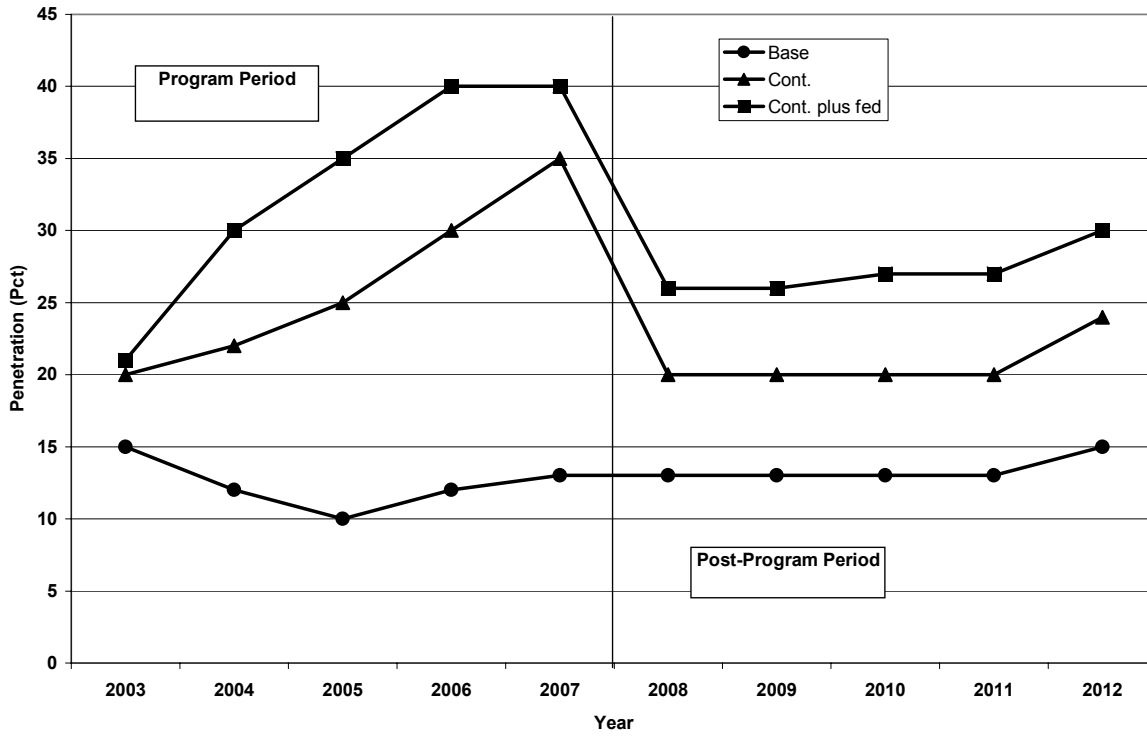
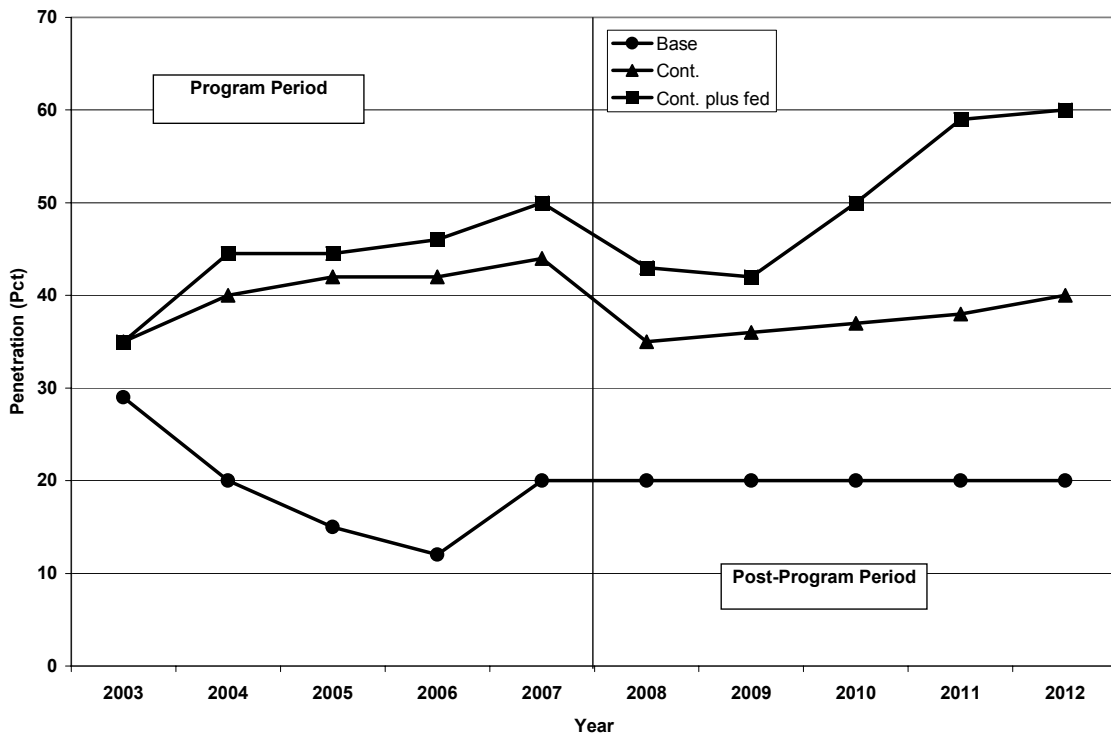**Figure 2. Median Projections, Market-Rate Multifamily Homes**

Figure 3. Median Projections, Low Income Multifamily Homes

Base Case. Overall, panelists see little change in the market penetration of ENERGY STAR-qualified homes in Massachusetts without the support and stimulation of a dedicated statewide program. They foresee some growth in the single-family market, but only after a five or six year period of stasis. However, they expect considerable declines from current levels of penetration in both of the multifamily markets under consideration.

Panel members believe that the penetration rate for qualified *single-family, market-rate homes* will grow, albeit after some time, even in the absence of a Massachusetts program. In their view, the penetration rate will remain essentially stable through 2008, but will ramp up from 5 percent that year to 12 percent in 2012.

With no program in place, panel members expect penetration of qualified *market-rate multifamily homes* to drop by one-third from current levels over the next two years. They project that this would be followed by a slight increase, but to a level that does not recover to 15 percent until 2012.

Expected penetrations for qualified *low-income multifamily units* in the no-program scenario drop from 30 percent to just over 10 percent over the next four years. They recover to a "resting" level of 20 percent thereafter—sustainable, but clearly lower than the current level of penetration.

Continuity. Panel members expect continuous growth in the market penetration of qualifying homes in each of the markets considered, with continuation of the current program. From 2003 to 2007, this growth would be particularly strong in both the single-family sector and the multifamily, market rate sector (7 percentage points and 78 percent higher at the end of the period; 15 percentage points and 75 percent higher at the end of the period, respectively). But growth would also be considerable in the multifamily, low-income sector, despite the market share starting from a higher base (9 percentage points and 25 percent higher at the end of the period). However, panel members foresee the penetration rate dropping after the end of the program: only slightly and temporarily in the single-family sector, but considerably in both multifamily sectors, suggesting that the program-induced growth will have been sustainable only for the single-family home sector.

According to panel members, continuation of the current program through 2007 will cause slow but steady growth in the *single-family, market-rate sector* over the next five years. Moreover, when the program comes to an end, the penetration rate will remain relatively stable, at about 15-16 percent. Although the penetration rate under the base case may approach this level toward the end of the period considered, the lack of a continuing program would result in considerable lost opportunities, as may be seen in the gap between the projections in Figure 1.

Panel members foresee a rapid growth in the penetration of qualifying *market-rate multifamily homes*, from 20 percent to 35 percent, with the current program continuing through 2007. Here, however, they anticipate a considerable drop (back to 20 percent at the end of the program period), followed by a delayed and relatively weak recovery. Nonetheless, the projected levels of penetration would be higher than those under the base case scenario.

Expectations are similar, but somewhat less dramatic for the *low-income multifamily sector*. Here, panel members foresee an increase in penetration, from 35 percent to 44 percent, during the life of the program. When the program ends in 2007, however, they believe there will be a noticeable drop, back to 35 percent, followed by a slow recovery, to 40 percent penetration.

Continuity plus federal support. As noted earlier, the expected increases in the market penetration of qualifying homes is greatest under this scenario (by 14 or more percentage points in each sector, doubling or nearly doubling in both the single-family sector and the multifamily, market-rate sector). Moreover, although the penetration rate is expected to fall at the end of the program period in each sector, it is also projected to rebound and equal or surpass the rate achieved during the program period in both the single-family and the multifamily, low-income sectors.

Under this scenario, the penetration of qualifying homes in the ***single-family market-rate sector*** increases rapidly through 2007, but falls markedly when both the Massachusetts program and the federal program lapse. Nonetheless, the penetration begins to recover again after three years, ending at 25 percent of the market, the same level as projected for 2007.

With both the Massachusetts program and the federal program in place, panel members believe that the penetration of qualified ***market rate multifamily homes*** would rise rapidly, to reach 40 percent by 2006 and remain at that level in 2007. However, they believe that the penetration of such homes would drop, to about 25 percent, as the programs end, and would not begin to trend upward again until 2012. Thus, they suggest that the maximum program effects for this sector would not be sustainable.

With both the Massachusetts and federal programs in place, panel members would expect the penetration of qualifying ***low-income multifamily homes*** to grow to from 35 percent to 50 percent. Once more, they see a drop, to 42-43 percent when the programs lapse. However, they also believe that the market penetration of qualifying homes will jump upward at the end of the period considered, to 60 percent, as a result of the kick-start imparted by the combined effect of the support programs.

Analytic Issues

This subsection addresses several analytic issues relating to the presentation of the summary findings. Additional information and analyses are available from the research team, on request.

Use of medians. We reported the results in terms of median responses of panelists to each scenario in each sector for each year to eliminate the effects of extreme projections by one or two panelists. However, despite the wide variance in the projections of different panel members, the use of medians rather than means had relatively little effect on the results.

Figure 4 illustrates differences in the results for one scenario, depending on whether the median or mean, or the maximum and minimum projections are reported. As will be noted, the maximum projection in each year is somewhat of an outlier,[9] which systematically inflates the mean. However, the summary curves are quite similar and the gap between them not as great as might be feared.
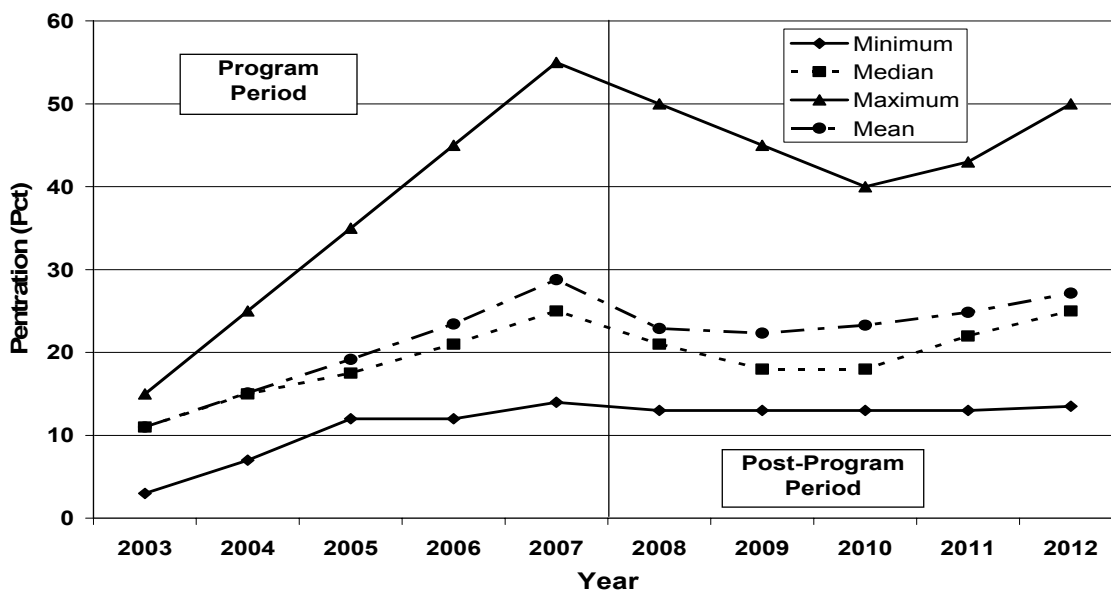

Figure 4. Single-Family Sector Projections, Continuity plus Federal Support, by Statistic

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[9] The maximum reflects contributions by two different panel members.

Results of Individual Scenarios vs. Differences between Scenarios. We also chose to report the results for each scenario independently of the results for each of the other scenarios in each sector. Additional information may be found in comparing the differences in projections for each panel member under different scenarios. Again, the variability is considerable, particularly in projections of what will occur when the program ends. Nonetheless, except for one obvious outlier, the differences are not as great as might be expected. In our opinion, therefore, this information is more useful in understanding the responses of the individual panel members, rather than the overall expectations for the different scenarios. The reports provided in Figures 1-3 can be readily parsed to determine expected differences in the effects of different scenarios.

Conclusions, Discussion, and Recommendations

Several conclusions can be drawn from these results. First, the current level of market penetration for ENERGY STAR-qualified homes appears to be unsustainable without a program that goes forward. In the no-program scenarios, penetration falls markedly for low-income multifamily homes; falls and recovers very slowly for market-rate multifamily homes, and remains flat for about six years in the single-family market-rate sector. Assuming that the benefits of homes that qualify for ENERGY STAR certification outweigh the costs of implementing the current program, it is clear that such support will reduce lost opportunities in residential new construction over the next five years.

Second, continuation of the current program is expected to have two effects: (a) It will cause a steady increase in the penetration of qualifying homes during the life of the program, particularly in the multifamily sectors—and most pronounced in the market-rate multifamily sector. (b) Although the penetration levels reached during that period will not be sustainable, the levels that do result over the years following the end of the program will be higher than would have come about under the base case scenario and will represent a considerable decrease in longer-term lost opportunities.

Third, the results of the continuity-plus scenario suggest that the infusion of additional resources may be expected to create a considerably larger effect—and one that may signal the start of actual market transformation (after a period of perhaps three years of adjustment)—in the single-family, market-rate sector and the low-income multifamily sector. The actual scenario attributed the additional investment to the federal government (based on the then-current version of the energy bill). Nonetheless, there is no reason to believe that the same effects would differ if the funds were to come from additional resources in the Commonwealth if it can be assumed that the force involved was the investment itself rather than the intangible effect of being part of a broader, but still short-term national effort.

Finally, the data from the continuity-plus scenario also suggest that transforming the market-rate multifamily sector may entail overcoming other barriers and require additional resources. Panel members believe that penetration rates in the other sectors will be sustainable or even grow after the end of the programs, but not in this sector.

The results of this Delphi study can be used to meet the immediate regulatory needs of the sponsoring utilities and stimulate discussion of various options for program modification. In addition, they provide grounds for suggesting various improvements in applying the research approach.

Program Effects and Application Issues

As indicated earlier, the screening tool used by most of the Massachusetts utilities requires projections of the eligible market size (here, the housing starts in each part of the market). Without Program results (the number of units built to ENERGY STAR-qualifying levels if there were no program in place), With Program results, and In-Program results (the units for which the program directly provided incentives or related assistance). The program effect is calculated as the difference

between the With Program and Without Program forecasted numbers, which is then used to determine the magnitude of the savings attributable to the program. Clearly, the base and continuation scenarios provide the Without Program and With Program inputs required by the screening model forecasts.

A practical complication arose in that the results had to be applied to individual utility service territories. The Delphi Analysis projected the penetration rates for single-family, market-rate homes and the two multifamily submarkets, on a statewide basis. (We believed that asking the panel members to provide projections for more limited geographic areas would create an extremely onerous task and would yield results of little reliability.) To meet their regulatory needs, the utilities took the overall state numbers and adjusted them to fit their individual service territories, using the U.S. Census Bureau permits data and program database information on the distribution of committed and completed units among the sponsoring utilities.

The application of the results was further complicated in that forecasters were required to deal with some irregularities between the projections of the Delphi analysis and the projections of the program managers. These inconsistencies were due to the fact that the program planners had access to more recent information than the Delphi panel regarding the penetration of ENERGY STAR homes in Massachusetts. In addition, they faced some regulatory incongruities dealing with market transformation programs in a market effects model.

Encouraging consideration of program design options

The Delphi panel members project sharp increases in the penetration of both market based and low income multifamily ENERGY STAR housing during the life of the program as currently designed. However, most do not believe these penetration rates are sustainable without continued program intervention. If correct, their views signal a challenge to program planners whose goal is to implement a program that will transform the residential construction market by getting builders to adopt ENERGY STAR building as standard practice. The Delphi results thus alert the program staff as to the need to explore and consider design options and resource allocations that may be more effective in producing lasting changes in building practices. They raise the question as to the appropriate balance between a design that focuses on stimulating the construction of as many ENERGY STAR housing units as possible during the life of the program and one that is more sustainable but may have a. lower penetration rate during program years.

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