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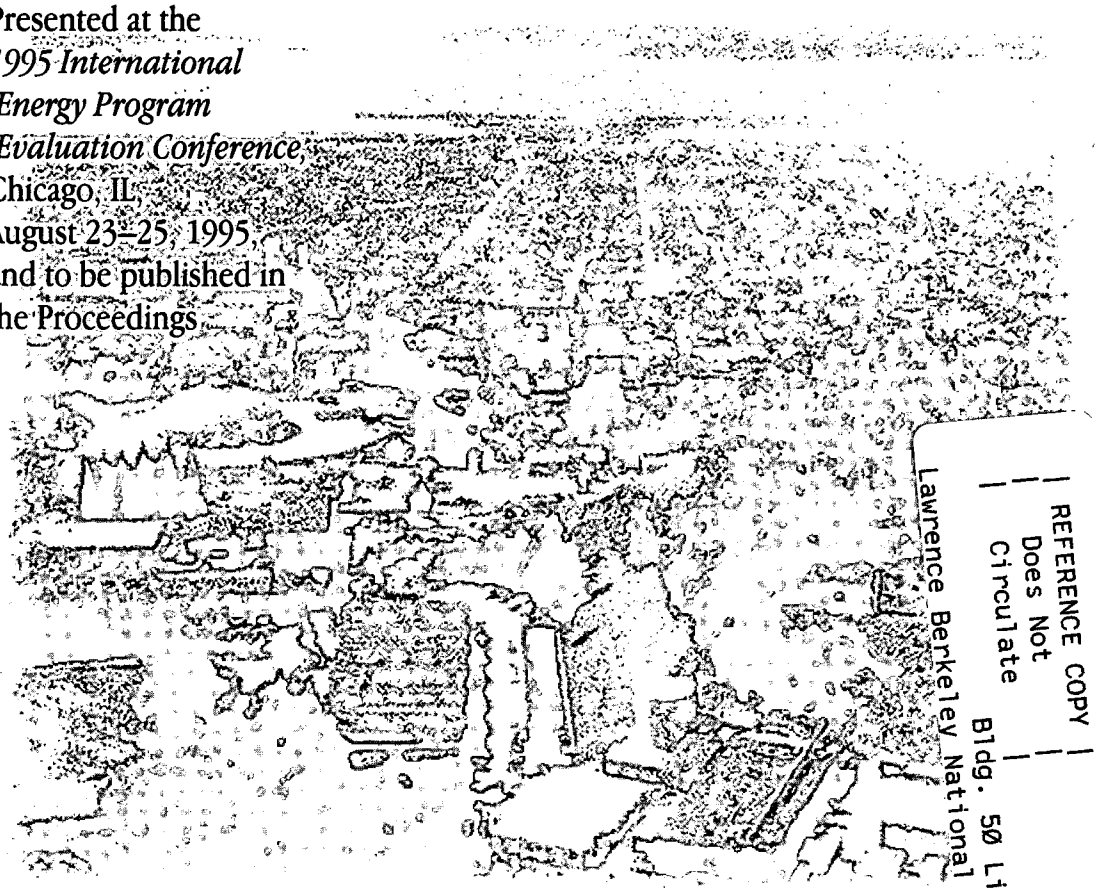
# The Demise of Residential New Construction Programs: Is There Life After Death?

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**Environmental Energy Technologies Division**

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# The Demise of Residential New Construction Programs: Is There Life After Death?

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# THE DEMISE OF RESIDENTIAL NEW CONSTRUCTION PROGRAMS: IS THERE LIFE AFTER DEATH?

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## Abstract

Based on an evaluation of 10 residential new construction programs sponsored by investor-owned utilities in the United States, we find that many of these programs are in dire straits and are in danger of being discontinued because they are not cost-effective. We believe that the cost-effectiveness of residential new construction programs can be improved by: (1) reducing program marketing costs and developing more effective marketing strategies; (2) promoting technologies and advanced building design practices significantly exceeding state and federal standards; (3) recognizing these programs' role in increasing compliance by participants with existing state building codes; and (4) obtaining an "energy-savings credit" for program spillover (market transformation) impacts. The issues involved in evaluating residential new construction programs will be challenging as evaluators attempt to quantify the savings from program spillover.

## Introduction

Residential new construction programs are of special interest because new homes determine the trends of the future housing stock and the penetration of innovations into the marketplace, thereby affecting both present and future energy use. While the actual number of homes built per year is small relative to the housing stock (e.g., homes built in 1988 or later represent only 3 percent of the total 1990 U.S. housing stock (EIA 1992)), residential new construction programs do affect the future housing stock both directly (by what is actually built) and indirectly (by creating a demand for

materials that may as a result become available locally to others, and by training builders, contractors, architects, and engineers who will use this knowledge in future construction). Thus, if cost-effective energy efficiency opportunities are not fully captured by existing codes and standards, they may become "lost opportunities" for society unless they are included in new construction programs (i.e., retrofitting may not be a cost-effective way to install the same level of energy efficiency investments that can be built at the time of construction).

We present two perspectives in this paper: a resource acquisition perspective and a market transformation (program spillover) perspective. The former perspective is the primary goal of most utility energy efficiency programs. We focus on the resource value that residential new construction programs contribute to utilities' DSM portfolios, since from a resource planning perspective, energy efficiency programs are desirable only to the extent that they cost less than the alternatives available for meeting customer energy service needs. However, because these programs may have significant spillover benefits, we also examine residential new construction programs as part of a larger effort to transform markets for energy efficient products and services. Under this concept of market transformation, residential new construction programs influence the attitudes and behavior of key members of the residential construction community (e.g., builders, architects, engineers, retailers, manufacturers, and homebuyers) so that investments in energy efficiency persist even after the program is changed or eliminated (Prahl and Schlegel 1993 and 1994). The impact of these programs may not be visible until many years after a program has been implemented. As a result, most current estimates of resource value do not capture spillover benefits and, therefore, overstate costs.

In this paper, we first discuss how the programs were selected and then assess the total resource cost of these programs. We then recommend opportunities for improving the cost-effectiveness of these programs and conclude by offering a research agenda for evaluating program spillover impacts of residential new construction programs.

## Program Selection

Four objectives guided the process of selecting programs to study.[a] First, we focused on residential new construction programs that promoted the design and construction of energy-efficient buildings, with a particular emphasis on the building shell or envelope. Although lost opportunities occur if energy-efficient appliances are not installed at the time of construction, programs that simply promote the purchase of energy-efficient appliances, without addressing the building envelope, were not included in this study.

Second, we selected full-scale programs and excluded pilot programs. The latter were excluded because we were interested in the implementation and evaluation experience of "mature" residential new construction programs.

Third, and most important, in order to estimate the total resource cost of energy efficiency, we considered only those residential new construction programs for which we could obtain information on the total costs and performance of the program. For each program, we needed information on: (1) post-program evaluation of energy savings, (2) total cost of the program to the utility, (3) total cost of the program to participating customers, and (4) economic lifetimes of measures installed through the program (see Eto et al. 1994). These requirements proved decisive in choosing the final set of programs analyzed in this paper.

And fourth, we selected residential new construction programs that offered rebates to builders, homebuyers, or manufacturers. We did not examine other nonmandatory programs, such as technology demonstrations, consumer information and marketing programs, and technical information programs, because, while important (see Vine and Harris 1990), these kinds of programs have seldom been evaluated.

Based on a review of the literature, consultations with DSM program experts knowledgeable about residential new construction programs, and a

[a] For a more detailed discussion of the research methodology and other issues discussed in this paper, see Vine (1995).

preliminary telephone screening of candidate programs, we were able to complete as fully as possible a standardized DEEP data collection form for 10 programs.[b] We established contact with one or more utility staff members familiar with the program and asked them to verify the information we had collected on their programs and to supply missing information.

While the number of programs examined in this report is small (10), the sample is homogeneous (e.g., the delivery mechanisms and technologies offered are quite similar) and likely reflects the current activity in residential new construction in most parts of the United States. However, they may not be representative of programs offered in the Southeast where high summer temperatures and humidity generally dictate different types of measures (e.g., cooling alternatives) than those needed, for example, in the Pacific Northwest or in New England.

## The Total Resource Cost of Residential New Construction Programs

When weighted by energy savings, we found the average total resource cost of the 10 residential new construction programs in our sample to be $0.07/kWh; the median was $0.25/kWh. All costs are expressed in 1994 dollars. The standard deviation of the total resource cost was large, reflecting the diverse performance of these programs. Table 1 reports the total resource costs for our sample of 10 residential new construction programs as well as the elements used to calculate them. We also provide the levelized utility resource costs for those interested in a utility perspective rather than a societal perspective.

[b] The DEEP data collection form was prepared for the Database on Energy Efficiency Programs (DEEP) project, managed by Lawrence Berkeley Laboratory (Vine et al. 1993). The goal of the DEEP project is to compile and analyze the measured results of energy efficiency programs in a consistent and comprehensive fashion.

**Table 1. Cost-Effectiveness of Residential New Construction Programs (in $1994)**

| Utility (1) | Year | Gross Annual Electricity Savings (MWh) | Economic Lifetime of Measures (Years) | Admin. Costs of Utility ($1,000) | Incentives Paid by Utility ($1,000) | Annual Participant Costs ($1,000) | Levelized Total Resource Costs ($/kWh) (2) | Levelized Utility Costs ($/kWh) (2) |
|---|---|---|---|---|---|---|---|---|
| BPA- MAP | 1994 | 45,900 | 45 | 1,329 | 25,254 | 2,434 | 0.04 | 0.002 |
| BPA - SGC (3) | 1993 | 2,348 | 20 | 936 | 1,404 | 0 | 0.08 | 0.08 |
| BECo | 1992 | 8 | 20 | 611 | 73 | 28 | 7.14 | 6.86 |
| CMP (4) | 1992 | 88 | 20 | 79 | 0 | 193 | 0.25 | 0.07 |
| NEES (5) | 1993 | 123 | 35 | 524 | 164 | 0 | 0.34 | 0.34 |
| NYSEG | 1992 | 230 | 20 | 516 | 194 | 0 | 0.25 | 0.25 |
| O&R | 1992 | 804 | 30 | 309 | 310 | 0 | 0.05 | 0.05 |
| PG&E (4) | 1993 | 5,872 | 20 | 6,589 | 9,565 | 3,395 | 0.33 | 0.28 |
| PECO (4) | 1992 | 705 | 20 | 300 | 765 | 0.5 | 0.13 | 0.13 |
| SCE (6) | 1993 | 2,074 | 20 | 919 | 2,282 | 5,549 | 0.17 | 0.06 |
| | | | | | | | | |
| Weighted Average (7) | | | | | | | 0.07 | 0.06 |
| Average | | | | | | | 0.97 | 0.90 |
| Standard Deviation | | | | | | | 2.32 | 2.24 |
| Median | | | | | | | 0.25 | 0.13 |

(1) BPA = Bonneville Power Administration (MAP = Manufactureed Housing Acquisition Program; SGC = Super Good Cents Program); BECo = Boston Edison Company; CMP = Central Maine Power Company; NEES = New England Electric System; NYSEG = New York State Electric and Gas Company; O&R = Orange and Rockland Company; PG&E = Pacific Gas and Electric Company; PECO = PECO Energy Company; SCE = Southern California Edison Company.

(2) For calculating the levelized total resource cost, we calculate the total resource cost for each program (utility and participant costs) by using the discount rate (5% real) to levelize total costs over the average economic lifetime of installed measures for each program. The levelized costs are then divided by annual energy savings. The levelized utility resource cost was calculated in the same manner, except participant costs were excluded from the calculation.

(3) BPA's figures include BPA and utility costs. Incentive costs were estimated to be approximately 60% of the program costs, based on an outside review of the program (The Results Center 1992).

(4) The new construction programs of these utilities also resulted in gas and/or fuel oil savings that are not reported in this table. Since program costs cover all savings, the total resource cost and the levelized utility cost are actually lower than shown. At this time, we were unable to separate out the costs for the non-electricity savings.

(5) NEES data is for Massachusetts Electric Company only.

(6) The energy savings filed with the California Public Utilities Commission were reduced by 50%, based on a measurement and evaluation study.

(7) The weighted average is the average of the programs weighted by energy savings.

As shown in Table 1, the performance of residential new construction programs is generally poor from a total resource cost perspective. Only one program was below $0.05/kWh (focusing on manufactured housing and contributing a large percentage of our sample's total energy savings), and 70% of the programs were above $0.15/kWh. Due to the small sample size, we did not conduct a statistical analysis of this sample to determine the key determinants of performance. A larger data set would enable us to learn more about the difference results.

The reasons for the poor cost-effectiveness of residential new construction programs are diverse, but, based on our interviews with program managers and evaluators and analysis of the data, the following appear to be significant: (1) increased tightening of state building standards and national appliance standards have improved the baseline; (2) inadequate (incomplete or misdirected) marketing strategies; and (3) savings calculations limited to only those savings achieved by program participants for measures covered under the program, excluding savings by nonparticipants and savings from non-program measures by participants as a result of the program (the "market transformation" perspective). In the next section, we address these shortcomings in more detail and suggest options for improving the cost-effectiveness of these programs.

## Improving the Cost-Effectiveness of Residential New Construction Programs

In recent years, some residential new construction programs have been terminated or significantly modified because of economics. For example, in our sample: Boston Edison, Orange and Rockland, and Southern California Edison have stopped their programs; Central Maine Power is contemplating the termination of their program; and Bonneville Power Administration (BPA), Pacific Gas and Electric (PG&E), and PECO Energy have significantly revised their programs. In response to the problems described in the previous section, four options for improving the cost-effectiveness of these programs are available, some of which have already been undertaken by the utilities in

our sample: (1) reduce program marketing costs and develop more effective marketing strategies, (2) promote technologies and advanced building design practices significantly exceeding state and federal standards, (3) recognize these programs' role in increasing compliance by participants with existing state building codes, and (4) obtain "energy-savings credit" for program spillover impacts. These approaches are not mutually exclusive and in some cases may be synergistic: e.g., targeted marketing may lead to reduced program costs. If utilities do not take advantage of these opportunities, then energy efficiency measures will most likely not be implemented in residential new construction by investor-owned utilities. In this section, we describe the first three options in greater detail and discuss program spillover later in the paper.

### *Reducing Program Marketing Costs and Developing More Effective Marketing Strategies*

*Reduce, modify, or eliminate financial incentives*

Financial incentives are one of the most visible components of program costs targeted for budget reductions. In our sample, incentives varied from $2,500/home (BPA's Manufactured Housing Acquisition Program (MAP)) to $500/home for cooperative advertising (Central Maine Power), and, in general, incentive costs accounted for most of the program costs (Table 1). In addition to the elimination of incentives (being replaced by information-only programs, that is, programs where customers pay the incremental costs of energy efficiency), other options are being explored: (a) reduction (or elimination) of incentives for custom builders (see below); and (b) targeting of incentives only to very high-efficiency appliances, including ones just entering the market.

*Use market segmentation techniques to target program to selected builders and home buyers*

The two types of builders participating in residential new construction programs (custom builders and production builders) incur program costs differentially. For example, on a per unit basis, the amount of time a staff person spends on custom builders is disproportionately larger than the

amount of time spent on production builders. While custom builders might be targeted at the beginning of a program (as "innovators"), programs could structure incentives to enlist production builders (as was done by PG&E) to impact more homes (e.g., by requiring a minimum number of energy-efficient homes to be built in order to be eligible for any incentives). By encouraging builders to build several homes in a residential new construction program, the money spent on training builders is immediately spread out over a larger number of homes, rather than potentially over time. Market segmentation could also be used for targeting specific segments of the home buyer population for new construction.

*Simplify certification process by offering only prescriptive compliance path, and eliminate performance compliance path*

In 1994, PG&E modified its program to be prescriptive rather than performance based, in order to reduce program costs. In a prescriptive program, qualifying measures for incentives are selected from a prescriptive list of measures prepared by the utility. In a performance-based program, customers select (groups of) measures that save a specified amount of energy. PG&E staff felt that the performance approach was too complex and time consuming for builders. PG&E expects to significantly reduce program costs with a more simplified approach, especially for production builders.

*Reduce mass-media marketing efforts*

A major percentage of the costs of residential new construction programs is administrative, primarily the marketing of the program. Most of the programs examined in this report relied on mass-media marketing to publicize their program to builders (and in some cases to homebuyers). As these programs develop over time, program advertising will become more targeted and focused, so that the use of mass media will be reduced in effort (e.g., as reflected by Southern California Edison's experience in promoting its Welcome Home Program), while direct contact with builders and homebuyers will increase.

*Collaborate with other utilities*

One of the principal reasons for having utilities work together in New England Electric System's (NEES) and Boston Edison's Energy Crafted Home (ECH) program and in BPA's MAP was the leveraging of limited funds: by pooling their funds together, utilities could share program development, training, and marketing costs. Other utilities might want to replicate this model; however, in a more competitive environment, the willingness of utilities to work cooperatively is unclear, especially if regulatory incentives for cooperation are absent. Another model of utility cooperation that will not only reduce program costs but will also help promote new technologies and transform markets are utility consortiums that seek to stimulate the introduction of specific technologies, such as those sponsored by the Consortium for Energy Efficiency (a non-profit organization comprised of utilities, environmental and public interest groups, and governmental agencies) (Goldstein 1994).

*Market the advantages of energy-efficient homes to builders*

In the evaluation of NEES's ECH Program, custom builders reported that the advantages of an ECH home (e.g., lower operating costs and increased comfort and safety) were more important to builders than financial incentives. The incentive, although necessary to offset the incremental cost to the builder, was not sufficient to convince builders to go through the additional work of designing and building to ECH standards.

*Expand the scope of marketing to include home buyers, not just builders*

PECO Energy has introduced an "800 number" for homebuyers to obtain information about the utility's new construction program. And NEES shifted its marketing toward the home buyer: while the builders still remained the center of attention for the program, program marketing was designed to create customer demand for ECH homes which would in turn drive builders' participation.

*Expand the scope of marketing to include bankers and realtors*

Two lending institutions in Pennsylvania link their energy efficient mortgages with PECO Energy's new construction program. This market segment could be very important in the future if energy-efficient mortgages and loans become more popular, as these interest groups can play an important role in educating potential home buyers about the advantages of an energy-efficient home.

*Target specific regions*

Certain areas within a service territory may be more attractive in getting new participants (e.g., high growth regions), compared to marketing the program across an entire service area. These areas would be ideal candidates for improving the cost-effectiveness of residential new construction programs.

***Promoting New Technologies and Advanced Building Design Practices***

Because of the tightening of state building codes and the increasing efficiency of federal appliance standards, residential new construction programs need to promote technologies and advanced building design practices not currently addressed in state building standards, or that significantly exceed state building codes and federal appliance standards. A few programs in our sample promoted energy-efficient technologies that were either not in existing state and federal standards, or significantly exceeded standards, such as: improved duct design and installation, infiltration reduction, energy-efficient lighting and windows, alternatives to compressor cooling, and tree planting. Additional energy-efficient technologies that might be commercialized in the near future for residential new construction include: high efficiency refrigerator, horizontal axis clothes washer, high spin speed clothes washer, heat pump clothes dryer, low energy/water dishwasher, indirect/evaporative cooling, internal access duct sealants, pilotless instantaneous hot water system, combined refrigerator/water heater, and new lighting measures (Nadel and Geller 1994).

*Improving Building Code Compliance*

A few studies have shown that compliance with state building codes is higher for participants in utility residential new construction programs than for non-participants. PG&E found that, on average, non-participating homes in PG&E's service territory were being built that were 5.8% below Title 24 standards across all measures and equipment. PG&E's California Comfort Home (CCH) program forced builders through the program's "Plan Check" process to comply with the standards when they might not have otherwise done so. Accordingly, PG&E claimed additional energy savings from its CCH program through its role in enforcing compliance with the Title-24 standards. A similar finding was found in the analysis of compliance with Oregon's building code: all of the buildings reviewed and that participated in utility programs complied with the energy code and, on average, these homes' performance was 6% better than anticipated by the code (Frankel and Baylon 1994). The evidence suggests that residential utility programs have a very positive impact on compliance and result in noticeable improvements in energy performance.

## The Evaluation of Residential New Construction Programs

The goal of new construction program evaluation is to measure how much energy would have been consumed by program participants if the program had not encouraged efficient equipment and building shell to be incorporated into building plans. The key issue in the evaluation of residential new construction programs is the determination of the baseline. Without an appropriate baseline, it is impossible to accurately estimate program savings.[c]

Typically, program designers consider the current state building code as the baseline for participating buildings and as the basis for providing incentives to builders ("program baseline"). For those states without a

[c] New construction programs present a unique challenge to evaluators due to the lack of pre-program billing history. Most evaluations of these programs used building energy computer simulation models for estimating the change in energy consumption and demand for specific energy conservation actions. In addition to calibrated engineering models, a few utilities used post-program billing data for comparing energy use between participants and non-participants. In order to distinguish program effects from weather, price, and other exogenous factors, three utilities conducted multiple regression analysis in their comparison of participants and non-participants.

building code, standard building practices, usually obtained from builder surveys, were used as the program baseline. The problem with the first baseline (state standards) is that builders both exceed and fall below codes. The problem with the second baseline (builder practices) is that the surveys used to characterize building practices may be inaccurate because they are not conducted on a regular basis and rapidly become outdated.

Because actual builder practices may be different from the program baseline, utilities need to determine an "evaluation baseline" prior to calculating the energy savings from these programs (and, where applicable, for receiving incentive payments), as shown in Table 2. For example, in PG&E's CCH program, the existing state building code (Title 24) was used as the program baseline. Builders applying for participation in the program submitted two energy-efficiency plans: one "baseline" plan that met the Title-24 standards, and one "enhanced" plan that met the program standards (e.g., 10% more efficient than Title 24).[d] However, in the evaluation of the program, the evaluation baseline was determined by examining the nonparticipant population through on-site surveys and end use metering. A computer model was used to create a nonparticipant model based on the characteristics of the metered sample of buildings, along with the actual weather for a particular climate zone. The nonparticipant model was calibrated using load data collected for that climate zone. This model was then adapted to create the participant baseline, by adjusting the non-programmatic building characteristics (e.g., square feet and number of stories) and by adjusting the model to those of the participant meter buildings. This model then represented the baseline for the participant population.

[d] PG&E's baseline plan was more stringent than the Title-24 requirements: e.g., PG&E required all measures to be permanently installed, which eliminated consideration of measures such as temporary window shading that is allowed in the code. PG&E also required the "worst-case" orientation of the home in a development to meet the Title-24 standards in the baseline plan, in contrast to the Title-24 requirement that the average home orientation in the development meet the standards.

**Table 2. Program and Evaluation Baselines in Residential New Construction Programs**

| Utility (1) | Program Baseline | Program Requirements | Evaluation Baseline Data (2) |
|---|---|---|---|
| **BPA - MAP** | Federal building regulations | Exceed Federal regulations | Not measured |
| **BPA - SGC** | Current practice | Exceed current practice by 30-50% space heating energy use | BP, E, IB, IBI, IT, OS |
| **BECo** | State building code | Exceed state code | Not measured |
| **CMP** | Current practice | Exceed current practice by 40% space heating energy use | OS |
| **NEES** | State building code | Exceed state code | Not measured (3) |
| **NYSEG** | State building code | Exceed state code by 25% | B, OS |
| **O&R** | State building code | Exceed state code | BP, IB, IBI, IT |
| **PG&E** | State building code | Exceed state code by 10% cooling energy use | BP, OS, E |
| **PECo** | State building code | Exceed state code | Not measured |
| **SCE** | State building code | Exceed state code by 10% cooling energy use | Not measured |

(1) See Table 1 for identification of utilities and programs.

(2) Evaluation baseline data: B = Billing data of nonparticipants; BP = Building permits; E = End-use metering; IB = Interviews with builders; IBI = Interviews with building inspectors; IT = Interviews with trade allies; OS = Onsite surveys of nonparticipants.

(3) Baseline study underway - report is expected to be completed by Summer 1995.

*Program Baseline Versus Evaluation Baseline*

Only one study examined in detail the differences between program and evaluation baselines. PG&E found significant differences in building practices between builders that built developments (production builders) and builders who built a few, custom-built homes (custom builders). For example, PG&E found that: 5% of production builders exceeded Title-24 shell standards by at least 10% and installed the same HVAC appliances as program participants, in contrast to 25% of custom builders. These data suggest that the existing state building code is an inappropriate baseline for residential new construction programs (see below where enforcement of state codes is discussed).

*Participants Versus Non-Participants*

Based on the auditing of participants and non-participants, New York State Electric and Gas found NYSE-Star homes to be significantly different than nonparticipants in terms of natural air infiltration (0.22 ACH versus 0.44 ACH), wall insulation (R-24 versus R-19), floor insulation (R-28 versus R-14), attic insulation (R-44 versus R-38), and windows (R-3.12 versus R-2.76). In contrast, Orange and Rockland found that baseline construction practices in the single-family home market were very close to Good Cents building energy efficiency practices. This was especially true for air infiltration rates (similar air-infiltration barriers) and windows (similar high performance windows). Thus, both the baseline and Good Cents homes had design heat loss characteristics well below state code, so that the net savings for participants were lower than expected.

*Compliance With State Codes*

Only two utilities compared building code compliance for program participants and non-participants. PECO Energy found 72% of its EEE homes complied with the state standard for attic insulation (R-30) while 65% of non-EEE homes complied with this standard. Since this study, the utility revised its EEE program (now called the Smart Choice program), so that all homes in its program exceed the state standard for attic insulation by 20% (all homes are inspected prior to being certified). In another study, PG&E's CCH program found its program not only caused homes to be built that exceeded state

energy efficiency standards but also forced builders through the program "Plan Check" process (see above) to comply with the standards when they might not have otherwise done so. Thus, PG&E found that, on average, non-participating homes in PG&E's service territory were built that were 5-6% below Title-24 standards across all measures and equipment.

## Transforming Markets

Residential new construction programs represent the kinds of programs that best fit the model of market transformation: introducing measures that are relatively new or that have, for one reason or another, failed to establish thriving markets for themselves due to market barriers (see Vine and Harris 1990). If one effect of residential new construction programs is to transform the construction industry, then the energy savings from this transformation should be included in cost-effectiveness calculations under the resource acquisition perspective. However, estimating the savings from program spillover represents a significant challenge.

### *The Evaluation of Residential New Construction Programs as Market Transformation Programs*

The evaluation of residential new construction programs from a market transformation perspective is a challenging task, both conceptually and practically. While proponents assert that market transformation programs have the potential to generate greater savings, more cost-effectively, than traditional resource acquisition programs, such benefits are harder to evaluate (e.g., through simple, pre-post studies) due to the complex, iterative, and potentially slow moving nature of market transformation. Under the market transformation perspective, evaluators will need to collect data on market changes from a variety of sources and assemble this evidence into a "mosaic" to help policy makers interpret the results of market transformation programs (Prahl and Schlegel 1994).

With market transformation as the goal of a program, a new issue arises related to the life cycle of a program and the relative roles of free riders and free drivers. In the early stages of market transformation, free riders may be unavoidable to achieve economies of scale to dramatically reduce costs or change standard practice. However, when calculating net savings, a program is penalized for having a large percentage of free riders. Similarly, if nonparticipants achieve energy savings because of the program, they should be added to program savings rather than subtracted from the savings of participants - otherwise, there would be a systematic bias - underestimation of program savings (Goldstein 1994; Kitchin 1993; Prahl and Schlegel 1993). In the later stages of a program, the utility may be achieving savings from free drivers, but savings from free drivers are not normally accounted for in the calculation of net savings. Unless utilities are explicitly credited for such results in the calculation of their incentive payments (decreasing the emphasis on net savings and increasing the emphasis on gross savings), these actions will tend to reduce the apparent net impacts of their program.

The evaluation of market transformation by residential new construction programs is challenging because some of the techniques traditionally used in the evaluation of DSM programs may not be appropriate for the evaluation of program spillover (Kitchin 1993; Prahl and Schlegel 1994). New techniques will need to be designed for addressing three key market transformation issues:

(1) **Market changes.** Although many techniques test and control for differences between participants and nonparticipants, they do not test or control for differences in markets resulting from the program. And these market changes (e.g., differences in prices of electricity and substitute fuels, costs, and availability of efficient equipment or other efficiency measures) that result from the program have an impact on the behavior and choices of participants and nonparticipants and, therefore, program savings.

(2) **Long-term changes.** Changes in the attitudes, motivations, knowledge and incentive structure of market actors may occur imperceptibly over a matter of years, so that long-term tracking studies are needed.

(3) **Comparison group.** Finding a comparison group will become increasingly difficult as more utilities implement DSM programs - especially, if a program is designed to achieve market transformation.

### *A Research Agenda for Evaluating Residential New Construction Programs*

A wide range of methodological innovations will be needed to adequately document the effects of program spillover effects. If a primary focus of the evaluation of residential new construction programs as market transformation programs is changes in the market as a whole, rather than analyzing changes undertaken solely by participants, then the following data collection and analytical activities need to be conducted for evaluating residential new construction programs.

*Data collection activities*

1. **Measure the market baseline.** Compared to previous efforts, these activities need to be expanded and systematized, and cover a wide range of indicators, such as: sales data, stocking practices, and distribution of appliances. Market surveys should target market actors for which change is expected to be the most important.

2. **Track attitudes and values.** Due to the gradual, incremental nature of market transformation, it is necessary to conduct longitudinal panel studies, or at least regular surveys of participants and nonparticipants, in order to track attitudinal change. These studies will also be needed for evaluating the persistence ("lasting changes") of attitudes, behaviors, and their impact on energy use.

3. **Track sales.** Sales of efficient equipment and services, including insulation, windows, and ducts (from dealers to customers, from manufacturers to distributors, and from distributors to trade allies) need to be tracked through regular tracking studies over time.

*Data analysis activities*

1. **Model market processes.** To see how changes in market components affect the diffusion curves of specific technologies, models of market transformation which integrate and synthesize disparate types of data need to be developed.

2. **Analyze the relationship between attitudes and behavior.** Research is needed to better document the long-term relationship between attitudes and behaviors considered conducive to energy efficiency, so that, for example the impacts of information strategies can be measured.

3. **Compare pre-program and post-program market survey and billing data.** The pre-program implementation conditions serve as the baseline for comparing energy savings.

4. **Perform multivariate regression with control groups from outside the service area.** This approach takes into account differences in the market between the service areas of the program and the service area of the control group.

5. **Simulate market transformation.** Engineering-econometric models can be used to simulate how energy use would have changed in the absence of a DSM program. By combining engineering information with data on DSM measures, equipment stock, building characteristics, fuel choices, and energy use, net savings can be estimated as the difference between post-program use and the simulation of what energy use would have been according to the model.

6. **Compare multiple methodologies.** Multiple analytical methodologies need to be used to obtain a more accurate estimate of savings and changes from these programs. Differences in estimates of market transformation savings need to be investigated and explained in terms of data accuracy, analytic bias, and methodological limitations.

## Conclusions

The future of residential new construction programs is in dire straits because many of them are not cost-effective. Several utilities in our sample have terminated their programs, significantly modified their programs (e.g., by eliminating incentives and focusing on information and design assistance), or reduced their program budgets. Accordingly, utilities must take advantage of opportunities for improving the economics of residential new construction programs, including the incorporation of energy savings from program spillover.

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