

October 2011 ■ RFF DP 11-42

Assessing the Energy-Efficiency Information Gap: Results from a Survey of Home Energy Auditors

Karen Palmer, Margaret Walls, Hal Gordon, and
Todd Gerarden

1616 P St. NW
Washington, DC 20036
202-328-5000 www.rff.org



Assessing the Energy-Efficiency Information Gap: Results from a Survey of Home Energy Auditors

Karen Palmer, Margaret Walls, Hal Gordon, and Todd Gerarden

Abstract:

Commercial and residential buildings are responsible for 42 percent of all U.S. energy consumption and 41 percent of U.S. CO₂ emissions. Engineering studies identify several investments in new energy-efficiency equipment or building retrofits that would more than pay for themselves in terms of lower future energy costs, but homeowners and businesses generally do not have good information about how to take advantage of these opportunities. Energy auditors make up a growing industry of professionals who evaluate building energy use and provide this information to building owners. This paper reports the results of a survey of nearly 500 home energy auditors and contractors that Resources for the Future conducted in summer 2011. The survey asked about the characteristics of these businesses and the services they provide, the degree to which homeowners follow up on their recommendations, and the respondents' opinions on barriers to home energy retrofits and the role for government. Findings from the survey suggest that the audit industry only partially is filling the information gap. Not enough homeowners know about or understand audits, and the follow-through on recommendations once they do have audits is incomplete. But the survey findings suggest that low energy prices and the high cost of retrofits may be more responsible for these outcomes than failures of information.

Key Words: energy efficiency, climate change

JEL Classification Numbers: L94, L95, Q40

© 2011 Resources for the Future. All rights reserved. No portion of this paper may be reproduced without permission of the authors.

Discussion papers are research materials circulated by their authors for purposes of information and discussion. They have not necessarily undergone formal peer review.

Contents

Introduction.....	1
The RFF Home Energy Audit and Retrofit Survey.....	4
Characteristics of Survey Respondents and Audit Practices.....	5
Homeowner Follow-up on Audit Recommendations.....	12
Do Energy Audits Fill the Information Gap?	18
Conclusions.....	25
References	29
Appendix A: Survey Questions.....	32
Appendix B: American Council for an Energy-Efficient Economy State Energy Efficiency Scorecard	41

Assessing the Energy-Efficiency Information Gap: Results from a Survey of Home Energy Auditors

Karen Palmer, Margaret Walls, Hal Gordon, and Todd Gerarden*

Introduction

As the United States searches for ways to reduce emissions of carbon dioxide (CO₂) to address concerns about global warming, policymakers and others are focusing their attention on reducing energy consumption in buildings. Commercial and residential buildings are responsible for 42 percent of U.S. energy consumption and 41 percent of total CO₂ emissions.¹ As a result of building codes, appliance standards, and general technological improvements, new buildings tend to be much more efficient than existing buildings. A home built in the 1940s consumes, on average, 50.8 thousand British thermal units (mBtu) per square foot, even with improvements that have been made over the decades since it was built. In comparison, an average home built in the 1990s consumes only 37.7 mBtu per square foot (U.S. Department of Energy 2008). The Joint Center for Housing Studies (2009) estimates that 40 percent of residential energy consumption is attributable to homes built before 1970 and 72 percent attributable to homes built before 1990. Significant reductions in CO₂ emissions associated with energy use will not be achieved without retrofitting these existing buildings.

Many experts have posited the existence of low-hanging fruit for improving energy efficiency, especially in existing buildings (Chandler and Brown 2009; EPRI 2009; McKinsey & Company 2009; NRC 2009). In one of the most often-cited studies of energy-efficiency potential, McKinsey & Company (2009) finds that by 2020 building owners could save 12.4 quadrillion Btus of energy—or roughly 29 percent of predicted baseline energy use in residential and commercial buildings—through investments for which the present discounted value of the stream of future energy savings is greater than the upfront equipment costs. For a

* Karen Palmer is a senior fellow, Margaret Walls is the Thomas Klutznick Senior Fellow, Hal Gordon a research intern, and Todd Gerarden a research assistant at Resources for the Future (RFF). The authors wish to thank Ian Shapiro of Taitem Engineering in Ithaca, New York, Richard Burbank of Evergreen Home Performance in Rockland, Maine, Troy Tanner of The Home Energy Detective in Manassas, Virginia, and Elizabeth Crabtree of Efficiency Maine Trust for comments and suggestions on draft versions of the RFF Survey and Joe Loper of Itron, Inc. and Chandler von Schrader of EPA for comments and suggestions on draft versions of this discussion paper. All remaining errors are our own. Funding for the survey comes from RFF's Center for Climate and Electricity Policy.

¹ Energy consumption and CO₂ emissions shares from EIA (2009).

variety of reasons, many building owners choose not to take advantage of these seemingly cost-effective investments. The untapped market may be large, however. It has been estimated that between 13 and 20 percent of the approximately \$181 billion spent annually on home renovations relates in some way to energy (State and Local Energy Efficiency Action Network 2011; Joint Center for Housing Studies 2009). One study (von Schrader 2010) finds that \$54 billion was spent on energy related home improvements in 2007.

One of several reasons offered for this efficiency gap, or what Jaffe and Stavins (1994) term the energy paradox, is lack of information about the cost-effective investments that can be made to improve energy efficiency.² The lack of information may be particularly important for owners of older existing buildings who do not have the expertise to assess energy retrofit options and may not know how to improve energy efficiency. For example, it is difficult for homeowners to know how much insulation is in their walls, what the options are for adding additional insulation, and what the resulting energy savings would be. Homeowners are also unlikely to know the payoffs from sealing heating and cooling ducts or upgrading their heating and air conditioning systems. In addition, comparing alternative options and combinations of options can be overwhelming.

Energy audits of homes and commercial buildings can provide important information about current energy use and opportunities for improving energy efficiency. An energy audit is an inspection and evaluation of energy use in a building coupled with recommendations for reducing energy use while maintaining the same or better level of energy services. Although some home energy professionals prefer “home performance” and other terms that represent more holistic approaches to assessing and improving building energy performance, we use the “audit” as a general term to encompass all related home energy assessment activity.

Energy audits encompass a wide range of test procedures and evaluations, and the quality of the information varies across this industry. Potential tests include commonly used blower door tests to detect air leaks and thermographic imaging to locate heat loss (or gain) by detecting surface temperature variation over interior or exterior walls. Auditors often use software tools to predict the effect of retrofits and upgrades on building energy use, but the industry has no single standard. Quality control systems, such as auditor certification, are not

² See Gillingham et al. (2009) for a list of the many explanations for the efficiency gap that have been discussed in the economics literature.

universal, and not all auditors follow up to assess actual savings after retrofits have taken place. There is also a great deal of variability in the cost of audits.

While sources of energy inefficiency in American homes have long been recognized and residential energy assessments have been performed for more than 30 years, the industry has grown substantially in the United States in recent years, in part due to the federal stimulus funding provided by the American Recovery and Reinvestment Act of 2009. Many states and utilities require energy audits before providing incentives for efficiency upgrades, including access to low-interest loans. For example, in New York State, NYSERDA requires an energy audit to take advantage of the loans available through its Green Jobs Green New York low-interest loan program. In Maryland, the Home Energy Loan Program finances appliance upgrades and building-shell upgrades, such as insulation and duct sealing, but lower rates are available for building-shell improvements that have been recommended by an energy audit.

Yet by most accounts, only a small fraction of U.S. homes have had audits and energy retrofits. Neme et al. (2011) estimate that state- and utility-sponsored programs currently reach less than two percent of homes each year. According to the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, less than one percent of homes have had energy retrofits specifically to save energy (Lee 2010). Fuller et al. (2010) report on findings from a 1980–1992 Bonneville Power Administration program that provided free audits and highly subsidized retrofits. Widely considered one of the more successful residential energy-efficiency efforts, the program nonetheless only motivated 5 percent of eligible customers to have an audit. Evidence from the Residential Conservation Service, a subsidized audit program established in the late 1970s, suggests that of customers offered audits at \$50 or less by their utilities, only 3–5 percent usually responded (Tonn and Berry 1986).³ Similarly, a review of 85 programs offering audits based on Electric Power Research Institute data found that the average annual participation rate was 3.2 percent (Berry 1993).

The Home Performance Resource Center (2010a) cites four common barriers to audits and retrofits: (1) “consumer inertia” attributed to time costs, hassles, and general difficulties gathering information; (2) limited access to capital for financing improvements; (3) lack of public awareness; and (4) unavailability of home performance services in many locations. Fuller et al. (2010) also emphasize the difficulty in reaching consumers, saying that energy retrofits are

³ Maximum audit cost was inflated to 2010 dollars (U.S. Bureau of Labor Statistics, 2011).

a “tough sell.” These authors argue that providing information to homeowners about their home’s energy performance is not enough. With low energy prices, energy expenditures are not a pressing enough issue for homeowners; instead, other attributes and services that come with retrofits need to be emphasized.⁴

In this study, we conducted a survey of businesses that provide energy auditing and retrofit services. The survey gathered basic information about these businesses, the services they provide, and the actions that homeowners take after having an audit. It also asked the survey respondents’ opinions on customer rationale for undertaking particular improvements and a range of challenges facing the industry. Our objectives were twofold: to understand first, the extent to which these home energy professionals are providing information that closes the energy-efficiency gap; and second, how and why homeowners act, or do not act, on this information.

The RFF Home Energy Audit and Retrofit Survey

In the summer of 2011, we conducted a survey of home energy performance professionals to learn more about the energy audit and retrofit businesses. Electronic invitations to fill out the online survey were sent via e-mail to 576 members of Efficiency First, a trade association that represents and advocates for the home performance industry, and to 1,942 contractors who have been accredited or certified by the Building Performance Institute (BPI), a national standards development and credentialing organization for residential energy-efficiency retrofit work. To encourage participation in the survey, we offered a chance to be entered into a drawing for a \$500 donation to the charity of the respondent’s choice. We received 479 responses that met a minimum level of completeness, for a 19.0 percent response rate. Appendix A presents the survey in its entirety.

Of the 479 respondents, 459 (95.8 percent) reported that they perform some type of energy audit or assessment, while 20 (4.2 percent) reported only performing retrofits or installations. Nearly 64 percent, or 305 respondents, reported that they performed both energy audits/assessments and retrofits/installations.

⁴ The effect of energy price on homeowner uptake of audits and retrofits is not well understood. Regions with high energy prices also tend to be regions with more financial incentives for retrofits so sorting out the effect of prices alone requires substantial amounts of time series data.

The geographic breakdown of responses by Census Division is shown in Table 1. The majority of respondents were from the Eastern Seaboard and Pacific Coast. Approximately 28 percent of the responses were concentrated in two states, New York (17 percent) and California (11 percent). But the response rate—the number returned relative to the number sent out—was relatively stable across regions. With the exception of the East South Central region, which had a high percentage returned but of only a small number sent out, the response rate by region varied only between 16.1 and 23.8 percent.

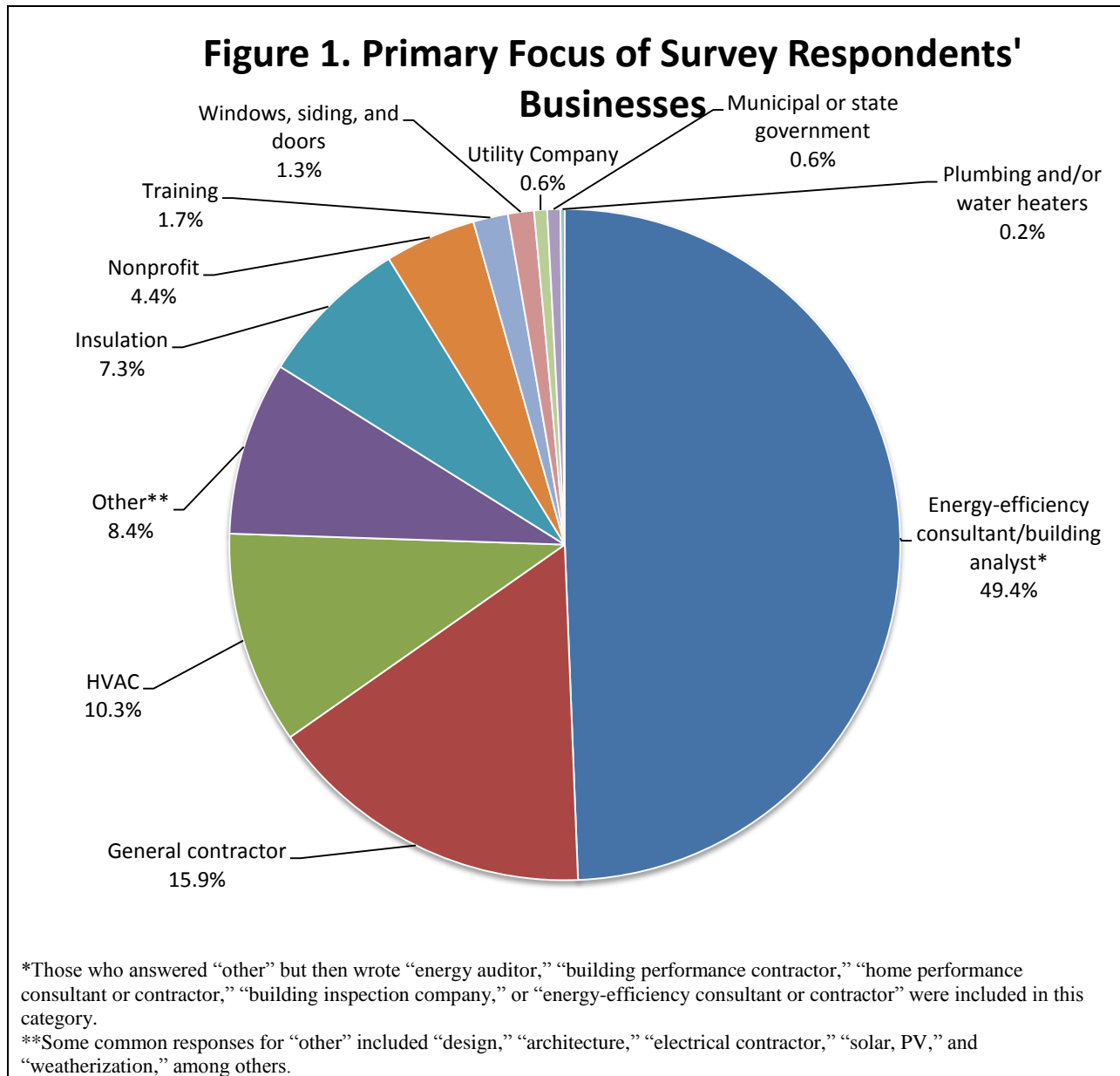
Table 1. Survey Distribution and Completion

Region*	# Sent	% of Sent	# Returned	% of Returned	Response rate (%)
New England	292	11.6	60	12.5	20.5
Middle Atlantic	806	31.9	130	27.1	16.1
South Atlantic	367	14.5	73	15.2	19.9
East South Central	21	0.8	11	2.3	52.4
West South Central	111	4.4	13	2.7	11.7
East North Central	235	9.3	56	11.7	23.8
West North Central	93	3.7	18	3.8	19.4
Mountain	179	7.1	38	7.9	21.2
Pacific	421	16.7	80	16.7	19.0
Total	2525	100.0	479	100.0	19.0

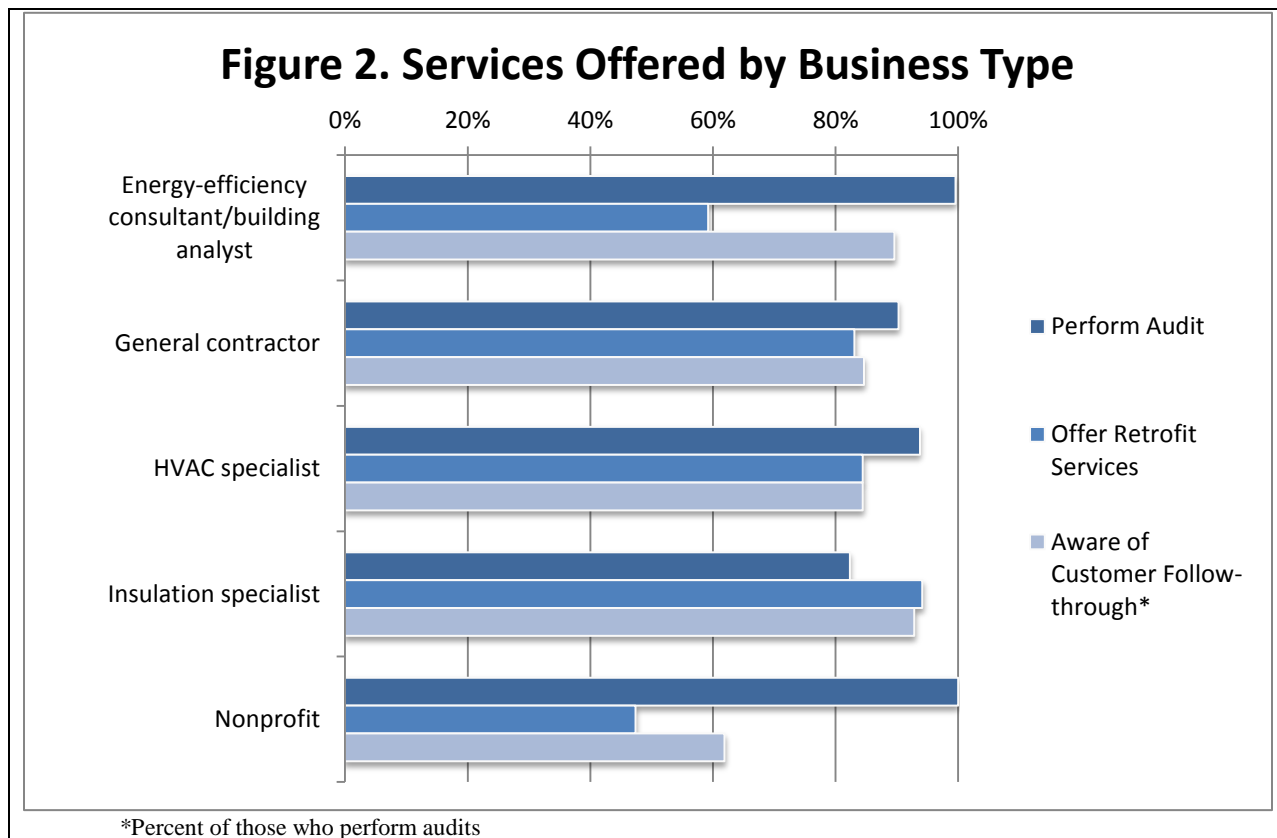
* Regions are defined based on Census Divisions. See www.census.gov for more information.

Characteristics of Survey Respondents and Audit Practices

We asked the home performance professionals who took our survey to categorize the primary focus of the work their companies do. Figure 1 shows the answers to this question.



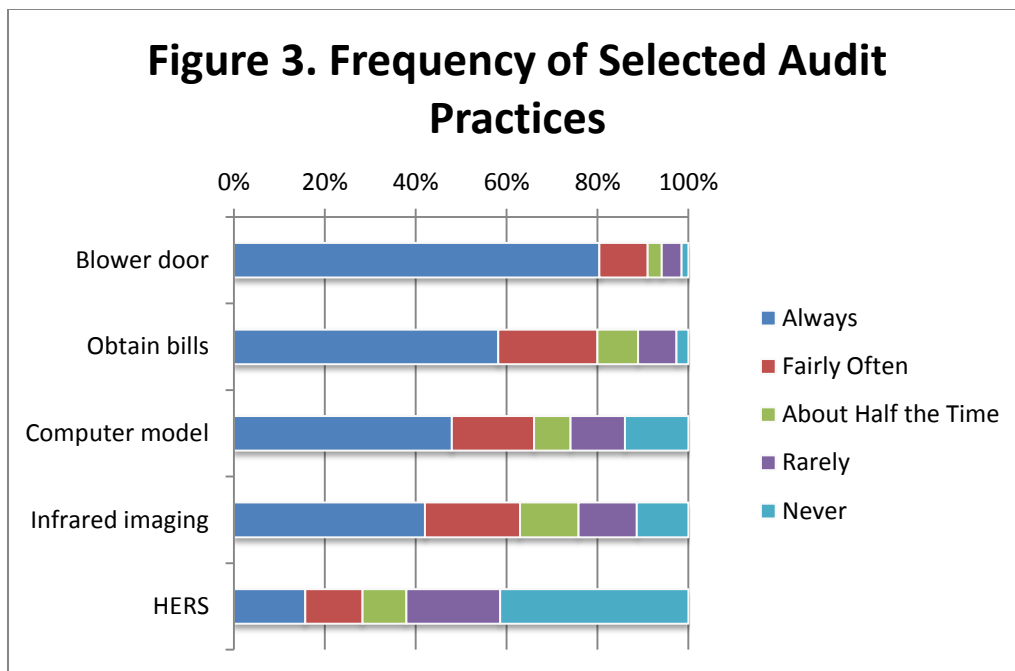
As previously mentioned, we asked each respondent if they administer some type of energy audit or assessment; if they responded affirmatively, we then asked if they “have some knowledge about the actions homeowners take after you perform an audit.” Of the 459 respondents who do audits, 400 (87 percent) reported to have some idea about how homeowners follow up with the information provided in the audit. We also asked if respondents offer retrofit or installation services themselves, of which 325 (68 percent) did. The breakdown of these responses by business type is summarized in Figure 2.



As Figure 2 shows, those who view themselves primarily as general contractors, HVAC specialists, or insulation specialists are much more likely to offer retrofit services than those who classify themselves as energy-efficiency consultants or those in the nonprofit field. All respondents seem to have a roughly similar level of knowledge about homeowner follow-through on recommendations except those in the nonprofit field.

Among those who perform audits, nearly 96 percent of survey respondents reported having BPI qualifications. This is partially explained by the fact that we obtained contact information for many survey recipients from a list of companies on the BPI Web site. A third (33.5 percent) of the auditors reported having Residential Energy Services Network (RESNET) certification, an alternative certification regime that focuses on providing homeowners with Home Energy Rating Score (HERS). And 65.8 percent of auditors reported participation in Home Performance with Energy Star, a joint program of the U.S. Department of Energy and Environmental Protection Agency that emphasizes comprehensive, whole-house assessments and retrofits.

We asked auditors to report whether they “never,” “rarely,” “about half the time,” “fairly often,” or “always” performed five recognized audit practices: a blower door test, infrared (or thermographic) screening, obtainment of past energy bills, HERS score determination, and computer modeling designed to project energy costs before and after improvements. Responses are shown in Figure 3.



Blower door tests determine the air infiltration rate of a building and assist auditors in targeting air leaks. They have become almost standard practice in the auditing industry and often can differentiate a professional audit from a more simple energy assessment. Our survey responses bear this out: 91 percent of respondents reported conducting this test fairly often or always. Blower door tests are required by BPI standards before and after any building envelope improvement is performed in order to verify a safe amount of ventilation; again, our use of information from the BPI website to contact businesses could explain these relatively high percentages. Nonetheless, it is generally viewed that the blower door test is becoming quite common.

Infrared imaging (thermography) is a procedure in which a camera shows surface heat variation to help the auditor detect heat losses and air leakage in a building envelope. Auditors often use this imaging in conjunction with blower door tests, but because the necessary

equipment is costly, this test is not practiced as commonly as the blower door test. In our survey, 63 percent of respondents reported using infrared imaging fairly often or always.

Of the remaining practices, obtaining past energy bills is very common, with 80 percent of auditors reporting that they do this fairly often or always.⁵ Computer modeling of energy savings showed more variability across auditors: 66 percent of respondents reported using such models fairly often or always, but 26 percent reported rarely or never using them.⁶ Finally, providing a HERS rating is less common, an unsurprising finding given that only 33 percent of the auditors responding to the survey were RESNET certified.

We asked auditors about the prices they charge for their services, and results are shown below in Table 2. On average, auditors reported a fee of \$349, excluding any government or utility incentives and discounts.⁷ Reported fees varied greatly, however (see Table 2). Nearly 24 percent of respondents charge less than \$250, but 4.6 percent charge more than \$700. These prices are roughly consistent with numbers from other sources; the Home Performance Resource Center (2010a), for example, reports that a whole-house energy audit costs between \$300 and \$600 depending on the region of the country and the activities performed in the audit.

⁵ Comparing pre- and post-retrofit bills was asked in a later question and we discuss those findings below.

⁶ The most common computer software packages listed by survey respondents were REM/Rate, REM/Design, TREAT, EnergyPro, and Real Home Analyzer. Most have been developed by the private sector. However, the market share of some software may be partially attributable to requirements from government and utility programs. For example, respondents reported that EnergyPro is required by Energy Upgrade California and Real Home Analyzer is required by New Jersey's Home Performance with Energy Star program.

⁷ Information on auditor fees was selected through use of categorical ranges. The mean fee was calculated by assuming that the value for each range was the mid-point of that range and the value assigned to the top range, \$700 and above, was \$750.

Table 2. Home Energy Audit Fees

<u>Fee range</u>	<u>Respondents (%)</u>
No fee	9.6
<\$100	3.5
\$100-249	10.7
\$250-399	38.3
\$400-549	26.1
\$550-699	7.2
≥\$700	4.6
Average fee	\$348.90
Standard deviation	\$189.40

We found that government or utility incentives for audits are widespread, with 66 percent of auditors reporting that subsidies, incentives, or rebates were offered to their customers. In addition to these government and utility discounts, 22.7 percent of auditors offered a partial discount and 18.1 percent offered a free audit if homeowners hired them to make some or all of the recommended installations or retrofits. Several respondents also reported that their fees vary with house size.

To better understand the size of these businesses, we asked about companies' numbers of employees and sales revenues. Of the 343 respondents who reported that they perform audits and provided employee information, 69 percent had 5 or fewer full-time employees, 21 percent had more than 10, and only 12 percent had more than 20 full-time employees. While 189 firms (55 percent) also employed part-time workers, only 10 reported employing more than 5 part-time workers. The businesses in our sample were, on average, slightly smaller than the businesses in a recent workforce survey of Efficiency First members. Only 52 percent of firms responding to that survey had five or fewer employees (Redman 2010). Similarly, Hendricks and Golden (2010) report detailed employee numbers by business type and show that 80 percent of insulation companies, window companies, and HVAC specialists employ fewer than 20 people.⁸ Our results suggest that the audit business, like much of the home improvement industry, is dominated by small companies.

⁸ A recent policy brief based on a survey conducted in California, the Pacific Northwest, Massachusetts, and Connecticut by the Lawrence Berkeley National Laboratory (2011) reports that small firms are typical of the broader energy-efficiency services sector.

Indeed, among the 268 companies that provided their firm’s most recent total annual sales revenue (including revenue from products and services unrelated to energy efficiency), the median annual revenue was \$237,500. The middle 50 percent of reported revenues ranged from \$57,000 to \$950,000. A handful of large companies include 74 (26 percent) that reported revenues of \$1 million or more and 6 that reported revenue of \$10 million or more. Firms with more than \$1 million in revenues looked markedly different than other firms. For instance, only 15 percent of firms reporting at least \$1 million in revenues listed their primary business as energy-efficiency consulting or building analysis (compared to 52 percent of firms reporting less than \$1 million), and 36 percent reported their primary focus either as HVAC or insulation (compared to 12 percent of those reporting less than \$1 million). Of the six firms reporting more than \$10 million in revenues, two focused on HVAC, while one each was a general contractor, insulation specialist, nonprofit, and “other.”

To understand the types of information revealed in a typical audit, we asked auditors to estimate how often they recommended homeowners make an improvement or retrofit related to 15 commonly cited sources of potential inefficiency in building energy use (see Figure 4). Auditors could choose from “rarely,” “sometimes,” “about half the time,” “fairly often,” “always,” or indicate that a particular improvement was not covered by their audit.

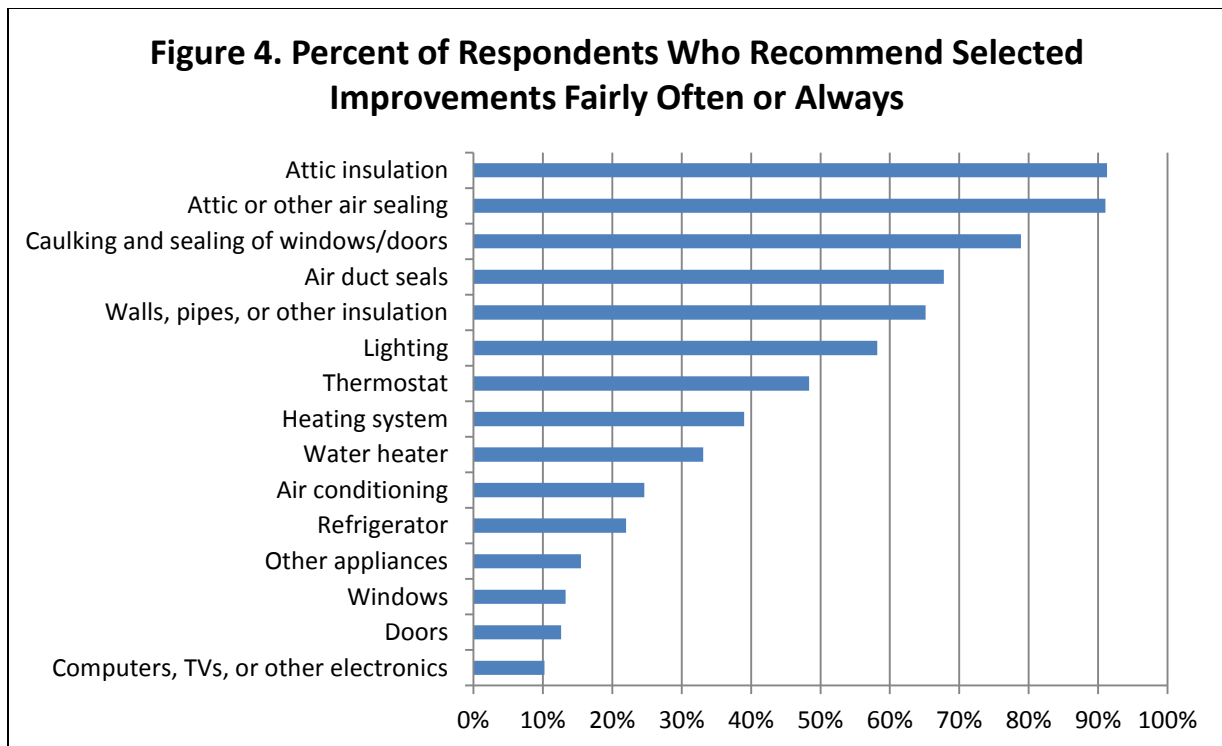
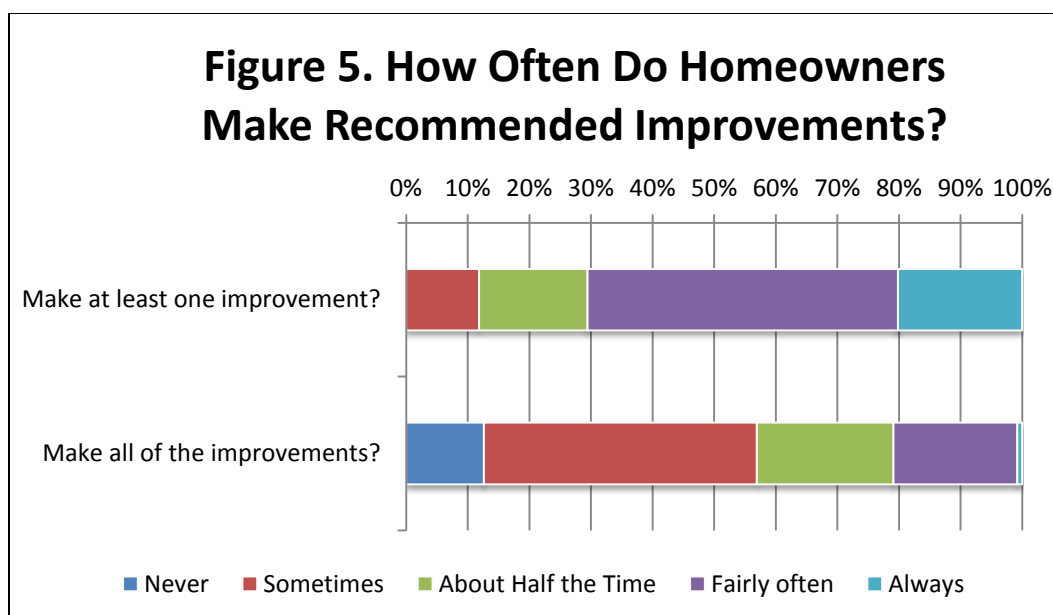


Figure 4 indicates that attic insulation and attic air sealing are almost universally recommended: 91 percent of respondents report that they recommend these measures either fairly often or always. Sealing of windows and doors is a relatively close second, with 79 percent of respondents recommending this improvement fairly often or always. In fact, all the top five recommendations concern changes to the building envelope. This focus on envelope improvements may be a result of the training and tools used by residential auditors (Shapiro 2011). After these building envelope items, lighting improvements are most recommended, with 58 percent of auditors doing so fairly often or always. The next four most common recommendations—changes to thermostats (48 percent), heating systems (39 percent), water heaters (33 percent), and air conditioning (25 percent)—relate to heating and cooling systems. The least common improvements recommended by auditors are replacement of appliances, windows, doors, and assorted electronics.

Consistent with our data, Goldman et al. (2010) find that the majority of window sales to existing buildings are brought on by end-of-life replacement or remodeling for aesthetic reasons rather than energy-efficiency concerns. According to that study, very high-efficiency windows (above Energy Star-rated, which are commonplace for replacement windows) have a low market share. Appliances and electronics are not often assessed by home energy auditors, which could explain the low percentage for those items.

Homeowner Follow-up on Audit Recommendations

Audits generally are purely informational, so homeowner follow-up is critical to realizing energy-efficiency gains. To understand how often follow-up occurs, we asked auditors “In general, how often does a homeowner make at least one of the improvements you recommend?” and “In general, how often does a homeowner make all of the improvements you recommend?” The results are shown in Figure 5.



Seventy-one percent of auditors report that homeowners make at least one of the recommended improvements fairly often or always. However, 29 percent report that homeowners make at least one of the recommended improvements only about half the time or less. In addition, our survey suggests that homeowners rarely follow *all* recommendations—less than 1 percent reported that homeowners always make all the recommended improvements. Only 20 percent reported that homeowners fairly often make all improvements.

These responses accord with previous research findings. For example, Neme et al. (2011) assert that government and utility programs offering audit subsidies without requiring some minimum level of retrofit work result in large numbers of audits with little follow-through. Fuller et al. (2010) also emphasize the difficulties associated with spurring homeowners to follow up on audit recommendations. They cite the best results obtained to date, from the Bonneville Power Administration program that operated between 1980 and 1992, which succeeded in getting approximately half the 5 percent of eligible homeowners who opted to be audited to follow up on audit recommendations. That program was very generous, fully covering the costs of audits for homeowners and 85 percent of the costs of the recommended energy improvements.

Because such incentives seem to play an important role in residential retrofits, we asked if respondents were aware of any state, municipal, or utility incentives, rebates, or retail buy-downs (excluding energy-efficiency financing) for energy improvements. Seventy-one percent of the auditors responded that such programs were available, 16 percent said they were aware of no such programs, and 13 percent said they did not know. The goal of these incentives is to increase

the adoption rate, so we analyzed if auditors' awareness of incentives influenced their answers regarding how often their clients make recommended changes. Surprisingly, there was no discernable difference in reported outcomes between those who operate in areas where incentives are available, those who operate where there are no incentives, and those who do not know.

In addition to subsidies and rebates, many utilities and state and local governments offer financing programs as a means to lower the cost of energy-efficiency investments. These programs offer loans to homeowners that are usually unsecured and have favorable terms compared with credit cards and other relevant options. Some of these programs operate through contractors, and most work with contractors in one way or another.⁹ In addition, some private lenders offer loans for energy-efficiency improvements. These, too, often operate through contractors. *GEOSmart* Sustainable Financing, a GE Money product, is one example; *GreenStreet* Lending, an Umpqua Bank program in the Pacific Northwest, is another.¹⁰ In some communities, credit unions and community banks make energy-efficiency loans. Larger contractors may do their own financing. To find out how widespread these programs are, we included some questions about financing in our survey. Forty-one percent of the survey respondents who do retrofits reported that they act as a gateway to financing, 9 percent offered financing themselves, and 7 percent did both. Forty-two percent of respondents did not participate in any way in financing. We also asked if the interest rate on the financing, when it was available, was below market due to a government or utility program, and 68 percent involved in financing responded affirmatively.

Finally, to sort out how important financing options are to homeowners doing energy retrofits, we asked respondents to estimate approximately what share of customers pay for their improvements using five common methods: cash or check; credit card; energy-efficiency financing; home equity loan; and other. The results are reported in Table 3. Most homeowners pay for these investments with cash: on average across all survey respondents, 57.6 percent of

⁹ The Keystone HELP program in Pennsylvania is one example of a program that works through contractors. The program has a list of approved contractors; those contractors handle the paperwork for the loans with homeowners. See <http://www.keystonehelp.com/> for more information. Several other programs emphasize their contractor relationships. See Palmer et al. (forthcoming) for descriptions of several programs and a general discussion of energy-efficiency financing.

¹⁰ *GEOSmart* is offered by GE Money through the Electric & Gas Industries Association. For more information, see <http://www.egia.org/geosmart>. See <http://www.umpquabank.com/GreenStreet/> for information on *GreenStreet* Lending.

homeowners use cash (or check). Cash and credit cards combined account for more than 70 percent. This finding parallels broader industry trends: Guerrero (2003) estimates almost 72 percent of general remodeling expenditures are covered by homeowner savings (including tax returns and gifts) or credit cards.

Energy-efficiency finance programs, on the other hand, account for about 17 percent of homeowner payments for retrofits according to survey respondents; this contrasts with the general remodeling market, in which unsecured loans comprise 4.1 percent of expenditures and are only employed by 2.3 percent of homeowners (Guerrero 2003). Customers of businesses that offer financing or act as a gateway to financing use these energy-efficiency finance programs more often than the average homeowner, as one would expect: the average rises to 24.3 percent for this group.¹¹ On average, though, more than half these customers still pay with cash.¹² Survey respondents also reported that 6.5 percent of their customers use home equity loans, and 4.5 percent employ some other mechanism.

Table 3. How Homeowners Pay for Retrofits (Unweighted Average Across Respondents)

Method of payment	All respondents (%) (N=261)	Respondents who don't provide financing or act as gateway (%) (N=102)	Respondents who provide financing or act as a gateway to financing (%) (N=159)
Cash or check	57.6	68.3	50.7
Credit card	14.1	13.6	14.2
Energy-efficiency finance	17.3	6.1	24.4
Home equity loan	6.5	5.9	6.8
Other	4.5	6.1	3.6
Total	100.0	100.0	100.0

To assess whether offering financing or acting as a gateway affected adoption of auditors' recommendations, we looked at answers to follow-up questions for the different subsamples. Interestingly, auditors who are involved with financing report that their clients make at least one improvement *less* often but all of their improvements *more* often than auditors not

¹¹ Each respondent provided an estimate of the percentage of customers who use each method of payment. Over the entire sample of respondents, 56 percent reported that at least some customers (i.e., a percentage greater than zero) use energy-efficiency financing; for the group who offer financing or act as a gateway to a program, this percentage rises to 76 percent.

¹² One of the three public policy initiatives Efficiency First lobbied for is improved access to financing for home energy retrofits. The other two are industry standards and federal incentives, such as rebates. See <http://www.encyfirst.org/about/>.

involved in financing. While we can only speculate about these differences, some financing programs require homeowners to make all recommended improvements in order to secure the most favorable loan terms. Another possibility is that access to financing enables homeowners to undertake deeper, more costly, retrofits than they might otherwise do.

Since most incentive and financing programs are administered on a state, local, or utility level, we expect differences in the prevalence and possibly the effects of policies across auditors from different states. To explore how these differences affected our survey results, we used the American Council for an Energy-Efficient Economy's 2010 State Energy Efficiency Scorecard, which ranks states from most to least policy-friendly toward energy efficiency and categorizes states into five groups (ACEEE 2010).¹³ Since building audit and retrofit policy affects the rankings, we expected auditors from states that rank high on the Scorecard to report more government support. Indeed, we observed a small but steady rise in the percentage of auditors aware of incentives (other than financing) as we moved from lower-ranked to higher-ranked categories of states. The rise in percentage of auditors involved with financing was also steady but more pronounced.

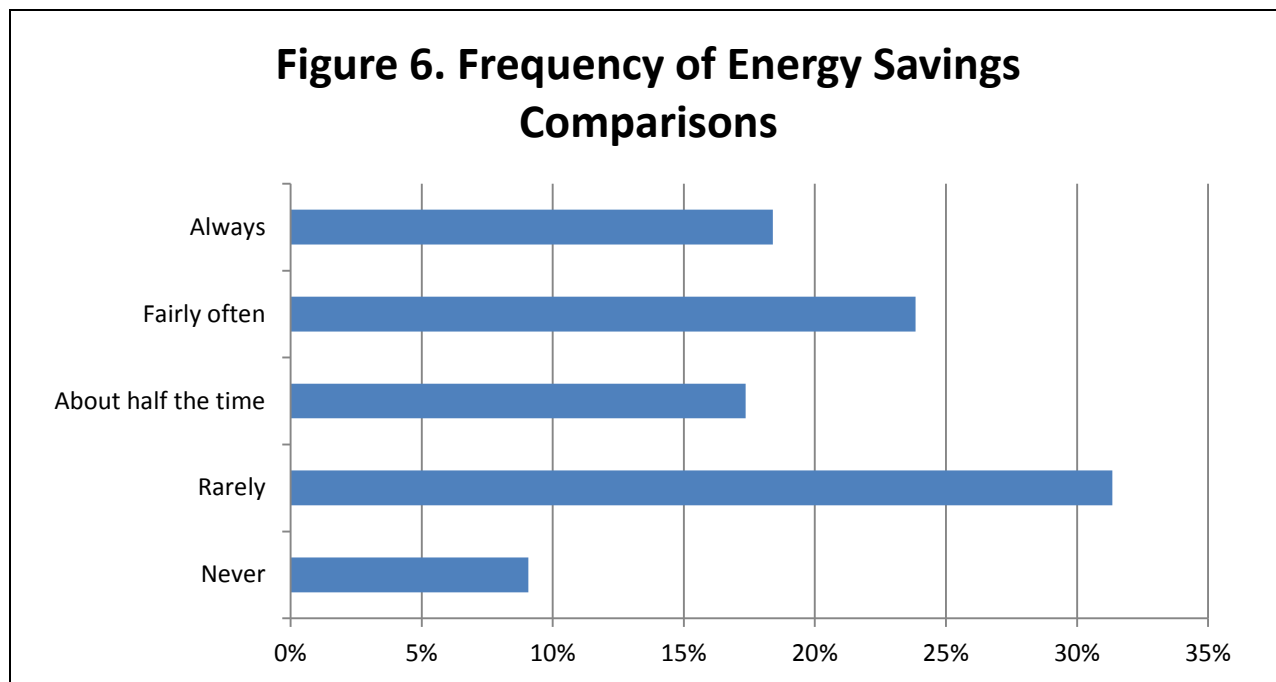
We then compared the adoption rate responses across the state groupings. We found no discernable differences in the reported rates of homeowner adoption of energy improvements between auditors operating in higher- and lower-ranked states. This suggests that auditors in states with better scorecard rankings on the West Coast and in the Northeast do not feel that homeowners are any more likely to listen to their recommendations than auditors in less green states.

As the primary purpose of home energy audits and retrofits is reducing energy consumption, we asked our survey respondents how often they compare realized energy savings to the predicted savings from the audit (see Figure 6). Approximately 42 percent reported that they always or fairly often compare actual energy saved to predicted savings. But almost the same percentage report rarely or never conducting such comparisons.

According to a follow-up question, 24 percent of respondents reported that a government or utility incentive program in which they participate requires them to evaluate actual energy

¹³ The Scorecard looks at six policy areas: (1) utility and public benefits programs, (2) transportation policies, (3) building energy codes, (4) combined heat and power, (5) state government initiatives, and (6) appliance efficiency standards. States can earn points in each area, and points are based on potential energy-use impact (ACEEE 2010). See Appendix B for the quintile breakdown of states.

savings versus predicted energy savings. Unsurprisingly, these respondents were much more likely to report doing so: 61 percent reported comparing actual savings to predicted savings fairly often or always. In comparison, only 33 percent of respondents who were not part of programs that require evaluations responded that they do evaluations fairly often or always.¹⁴



Even when the auditors do make comparisons, their methods vary substantially. We asked auditors which of three methods they used: asking the homeowner directly; comparing pre- and post-improvement energy bills; and comparing post-improvement energy consumption to predictions from a computer model. Perhaps unsurprisingly, the simplest method is also most popular: 56 percent of survey respondents who compare savings say they fairly often or always directly ask customers, while 47 percent fairly often or always check bills and 36 percent compare actual savings to a computer prediction. Asking customers how much energy they save is also a flawed method that can be fraught with response bias as homeowners may be reluctant

¹⁴ Forty-two percent of respondents reported that their local utility or government conducted its own evaluations independent of the respondent.

to admit when costly investments don't yield savings. Evaluations of bills can take a lot of forms, but careful evaluations need to control for changes in weather and house occupancy pre and post retrofit. Overall, it seems that confirming that investments have paid off at the predicted rate is not widely practiced in any consistently verifiable way.

Do Energy Audits Fill the Information Gap?

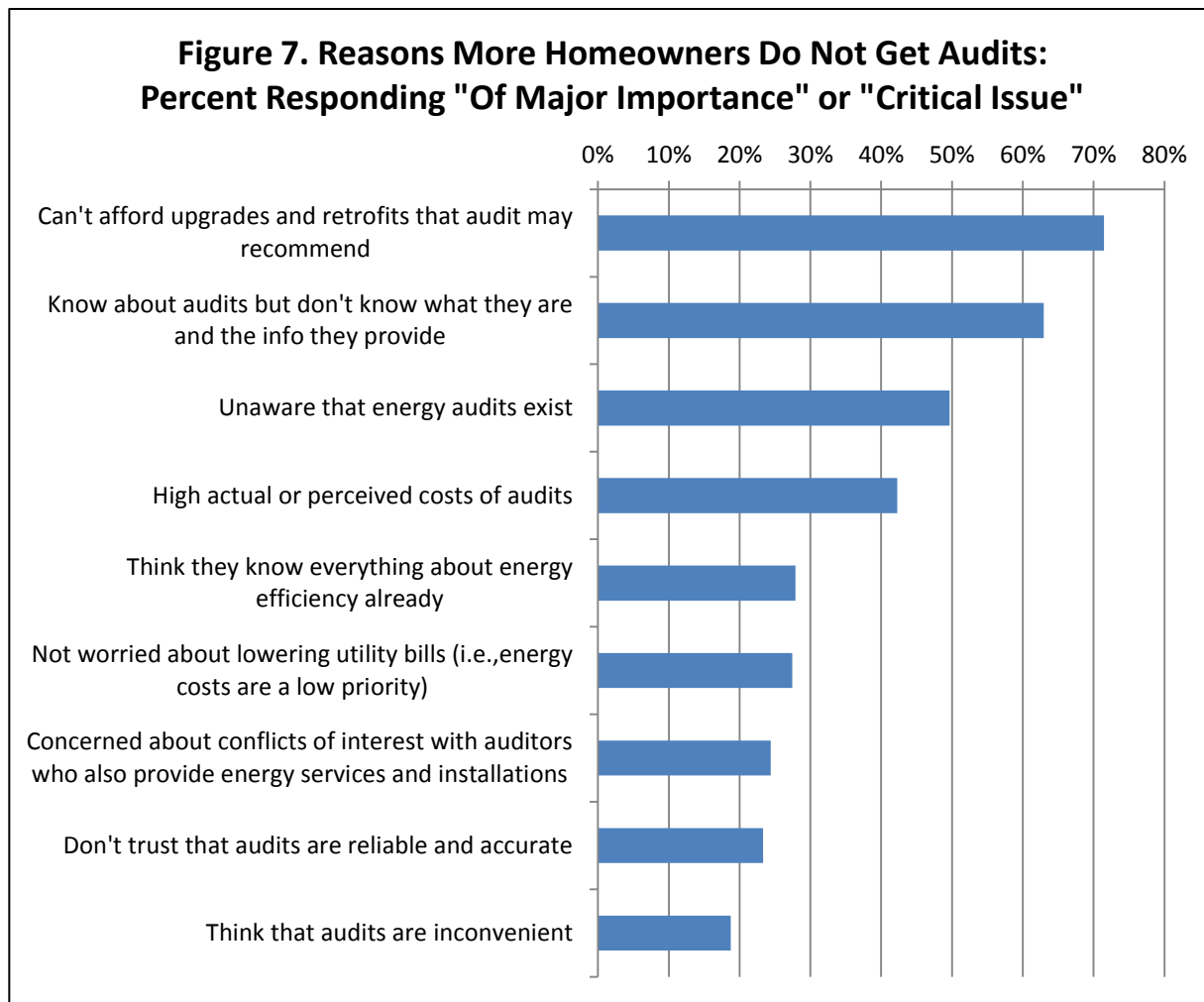
As discussed in the introduction, one explanation for why the low-hanging fruit of home energy efficiency remains on the tree is a lack of information. Homeowners may not be aware that their homes are inefficient and that retrofits and improvements are available that would provide a stream of future energy savings to offset the upfront costs of those retrofits. The energy audit industry exists for the express purpose of filling this information gap, and our survey was designed to gauge how well this process is working.

The first step toward a well-functioning process is getting homeowners to have audits. Although the industry has grown in recent years and audits themselves have become more sophisticated, it is still the case that very few homeowners have audits. In the Bonneville Power Administration program, which is considered a success in terms of the number of homes audited and retrofitted, only about 5 percent of the customers who were eligible chose to have an audit (Fuller et al. 2010).

This paucity of interest may have several causes. First, homeowners may generally lack information and understanding about audits. For example, they may not know the service is available, or they may know the service is available but not what it entails. Homeowners may think they know enough about their home already, or they may not trust the information that audits provide. Second, cost factors could be important. The cost of the audit itself could be prohibitive (or homeowners may perceive it to be so), or the cost of retrofits may be too high. Finally, it is possible that energy bills are simply not high enough as a share of monthly expenditures for homeowners to spend time and money retrofitting their homes. Therefore, they have little interest in paying for audits.

Ideally, one would ask homeowners these questions directly. Short of that, professionals in the home performance industry deal with homeowners every day and thus have some knowledge about homeowner concerns. We therefore asked our survey participants the following question: "In your opinion, which of the following are reasons why more homeowners do not have energy audits?" We presented nine possibilities and asked them to respond "not important," "of minor importance," "moderately important," "of major importance," and "critical issue" to

each. The percentage of respondents who reported “of major importance” or “critical issue” to each option is shown in Figure 7.



Auditors view cost concerns as very important. Seventy-two percent of respondents cited the fact that homeowners cannot afford the upgrades that would be recommended as a majorly important or critical barrier to getting audits. Even the cost of the audit, which is small relative to upfront retrofit costs, is listed as a top barrier by 42 percent of our respondents. One potential reason for this focus on cost might be that respondents are answering strategically and want to encourage more financial support for the audit and retrofit industry while minimizing mentions of internal industry problems. Information problems are also of key importance. Sixty-three percent and 50 percent of respondents, respectively, cited homeowners’ lack of understanding

about the information audits provide and awareness of audits in general as an issue that is critical or of major importance.

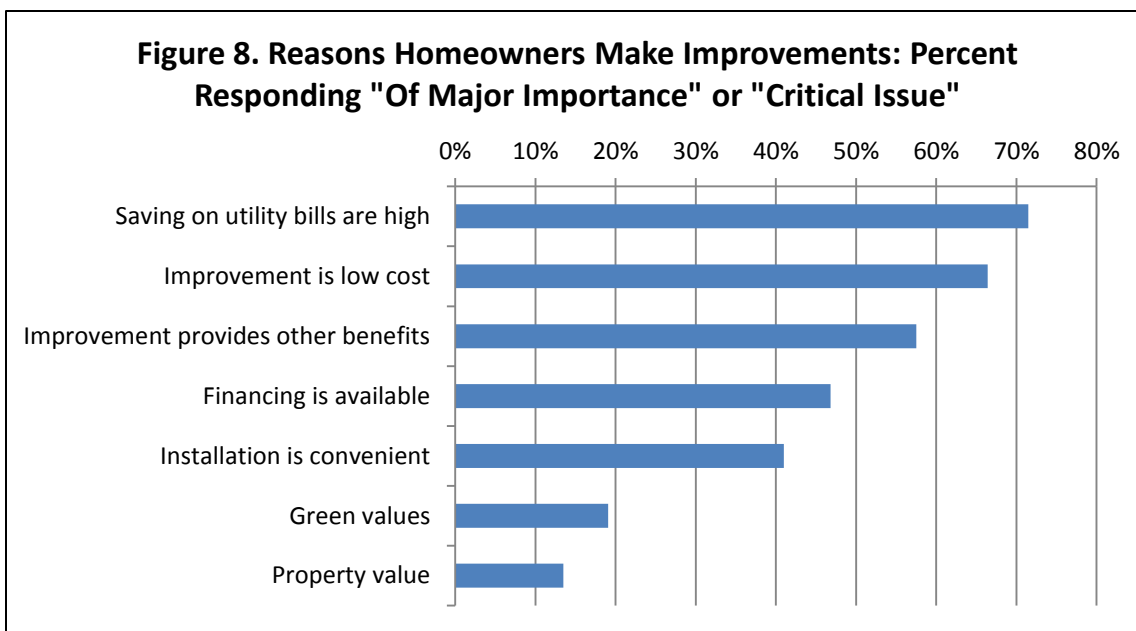
Perhaps unsurprisingly, auditors do not think that problems with their own industry are important reasons why audits are not more widespread. Forty-six percent of respondents said the inability to trust that audits are reliable and accurate was not important or of minor importance. In contrast, Shapiro (2011) identifies missed improvement opportunities and insufficient guidance for implementing recommendations as the top two problems with energy audits. Meanwhile, 47 percent and 49 percent, respectively, of survey respondents think audit inconvenience and conflicts of interest are not important or of minor importance. To determine whether auditors who do and do not provide installations view potential conflicts of interest differently, we disaggregated these responses. Thirty-seven percent of auditors who do not also complete retrofits or installations listed conflicts of interest as an issue that is critical or of major importance, compared to only 18 percent of auditors who do complete installation work. This suggests that some differences exist between the views of those businesses that are primarily in the audit and assessment business and those who do both audits and retrofits.

To further investigate the nature of the information and audit awareness problem, we asked our survey participants what percentage of homeowners who could benefit from an audit are not aware of the existence of audits. The average across all respondents was 57 percent. If the surveyed auditors are correct, approximately 43 percent of homeowners who could benefit from an audit know they are available. Since there is a consensus that a low percentage of homes have had audits (much lower than 43 percent), either awareness is more of a problem than auditors believe or many informed homeowners simply choose not to obtain information about their home's energy performance.

This measure of audit awareness varied just slightly across regions. The Census Region reported by respondents as most lacking awareness was the South, where on average auditors reported that 63 percent of homeowners who could benefit from their services did not know about audits. At the other end of the spectrum, respondents from the New England region reported that 49 percent of homeowners who could benefit were unaware of audits. The other regions varied around the 57 percent average.

As Figure 5 showed, even when homeowners have audits—at least partially filling the information gap—a significant percentage of these homeowners do not make all the

recommended improvements.¹⁵ We asked auditors about the relative importance of several possible explanations. First, we questioned whether cost factors loom large—how important is it that the cost of the improvement the homeowner chooses to make is relatively low or the projected energy savings are high (or both)? We also asked whether having financing available, another factor related to costs, might be important. Second, we asked respondents to indicate the importance of benefits beyond cost savings, such as a more comfortable home, more attractive or better working windows and doors (when those are replaced), a safer home (if carbon monoxide issues are addressed), and so forth. Third, we asked if convenience is an important consideration. Fourth, we asked respondents whether energy retrofits appeal mostly to “green” consumers. Finally, some energy-efficiency advocates argue that green investments can improve property values, so we included this potential reason. Respondents were asked to rate each explanation as “not important,” “of minor importance,” “moderately important,” “of major importance,” or “critical issue.” Figure 8 shows the percentage of respondents who reported each option was “of major importance” or a “critical issue.”



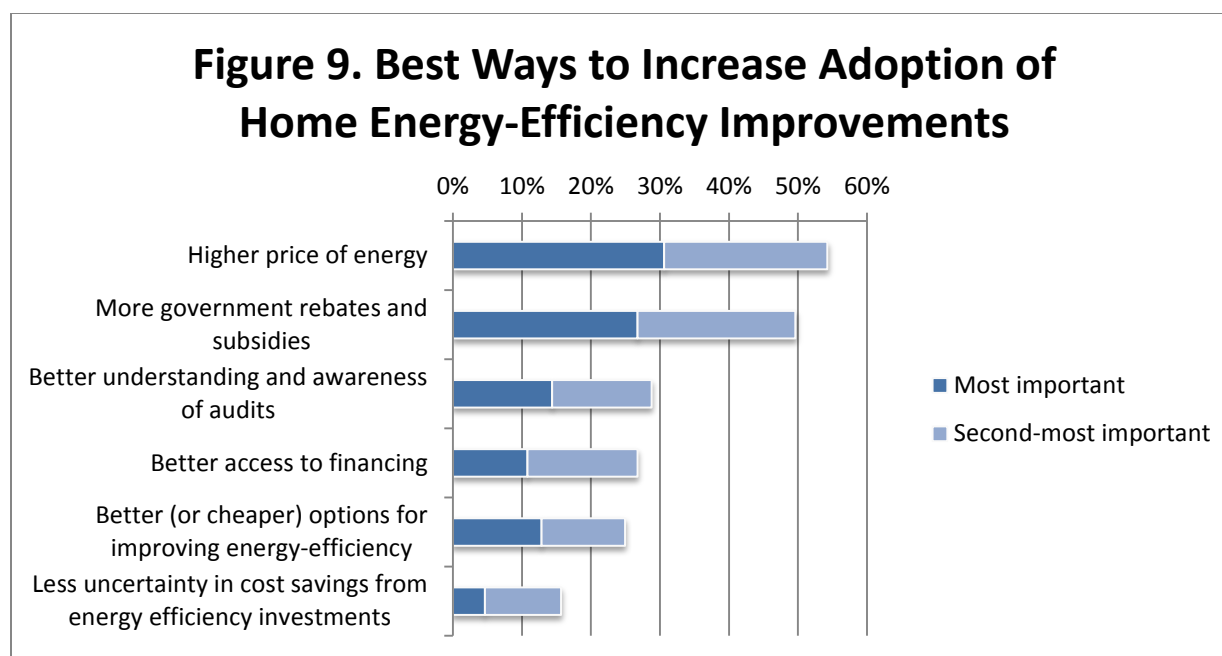
¹⁵ Note that there may be substantial variability across the respondents in the threshold comparison of savings to up front cost that causes the auditor to recommend a particular measure and this would affect the likelihood that households will undertake all recommended measures.

Auditors see the most important motivator to be saving money on utility bills (72 percent) closely followed by low costs of improvements (66 percent), which suggests that the financial aspects of energy efficiency are of chief concern to homeowners. The third most cited reason improvements are undertaken is that they provide ancillary benefits beyond cost savings: 58 percent of respondents report this factor is of major or critical importance. “Green” preferences and improvement of property values do not appear to be important factors in retrofit decisions as reported by the contractors in our survey.¹⁶

As a follow-up question, we asked those who responded that the low cost of an improvement was “of major importance” or “critical issue” if the low cost was often a result of a government or utility subsidy or financing program. More than 70 percent responded affirmatively, suggesting that these programs play an important role in motivating investments in energy efficiency.

Perhaps the most important insights auditors provided were their views on how best to increase home energy efficiency. We asked our survey participants to rank six potential policies or actions from the most important to the least important ways to induce more homeowners to adopt energy-efficient retrofits and improvements. Each auditor had to assign each policy a unique rank. Figure 9 shows the six policies or actions and the percentage of respondents who ranked each as most or second-most important.

¹⁶ Some evidence exists that high-efficiency commercial buildings can charge higher rental rates than those with low efficiency (Eichholtz et al. 2010). Whether high-efficiency residential properties are also more valuable is unclear. Nevin and Watson (1998) find that real estate markets do capitalize efficiency into sales prices. In other words, the present discounted value of the stream of future energy savings is included in the sale price of homes. However, some experts argue that mortgages cannot be differentiated for properties with different energy characteristics because loan-origination requirements do explicitly account for energy expenditures; some of these experts have argued for legislation to rectify this problem (Institute for Market Transformation 2011).



Fifty-four percent of respondents listed a higher price for energy as the most or second-most important way to increase energy efficiency retrofits, making it the highest-ranked option. After that, the highest-ranked option was “more government rebates and subsidies,” with 49 percent of respondents listing this as the most important or second-most important option. Thus cost factors figure prominently in the rankings.

Although information problems were listed as important reasons more homeowners do not obtain audits in response to an earlier question (Figure 7), only 28 percent of respondents chose “better understanding and awareness of audits” as the most or second-most important way to spur retrofits. This suggests awareness of audits is an important factor in determining whether homeowners obtain audits but that awareness of audits is only one of many factors influencing the decision to implement energy-efficiency measures. Better access to financing was not reported as the most important way to increase retrofits by many respondents. This seems consistent with our earlier findings that few customers use financing when paying for retrofits (Table 3), even in the case where specific programs are available. Historic participation in financing programs is also low. According to Fuller (2008), energy-efficiency finance programs reached less than 0.1 percent of eligible recipients in 2007. The survey findings are interesting in

light of the fact that access to financing is often listed by others as a barrier to energy efficiency and many organizations advocate for improvements in that area.¹⁷

Finally, similar to the responses reported in Figure 7, the survey respondents do not view the performance of their industry as a major problem: neither improving the certainty or predictability of cost savings nor “better (or cheaper) options for improving energy efficiency” are expected to have a big effect on retrofit adoption.

At the end of the survey, we invited respondents to share their thoughts on the industry. We first asked, “what, if any, changes or improvements in the audit industry could increase homeowner adoption of energy efficient improvements?” Responses are diverse, but most comments fit broadly into three categories. First, approximately 47 percent of comments concern consumers’ lack of information, knowledge, understanding, or confidence in audits and the savings from audits. Commenters variously stated that very few people have ever heard of the industry, that customers cannot grasp how investing in retrofits will save them money in the long run, and that homeowners do not understand that their homes are inefficient in the first place.

Another 36 percent of comments relate in some way to problems within the industry. A common thread among these diverse comments is the fact that the industry is poorly defined, and a wide variety of firms and organizations are offering very different products of different quality. Some respondents, for example, cited free and low-quality audits by utility companies as hurtful to the industry. Others are frustrated that there is no way to restrict unqualified auditors with little to no experience from entering the market and giving poor advice. Still others are frustrated by the bureaucracy and requirements of certification regimes and government programs. Some want a clear and consistent way of conducting an audit to be defined, better techniques for predicting energy savings, or both. Finally, some respondents pointed out problems with a conflict of interest when auditors also perform retrofits. Underscoring these kinds of problems, Fuller et al. (2010) highlight communication problems between contractors and homeowners, as well as issues with contractor training and certifications.

Finally, 25 percent of respondents commented that the high costs of audits, retrofits, or both, or the low costs of energy prevent homeowners from getting audits and making improvements. To address this barrier, respondents suggested incentives of all types, from subsidies to financing to tax breaks. Many expressed frustration that the price of energy is so low

¹⁷ See, for example, Home Performance Resource Center (2010b)

that it may take many years for homeowners to realize a return on investments in energy efficiency. We find it interesting that so many of the free-response comments returned to this issue even though the topic had been covered in the other questions. Making energy savings matter more to consumers and making retrofits cheaper seem to be important points of emphasis.

To elicit any other thoughts on how the government could help, we asked respondents to “provide additional comments you may have on the government's role in increasing homeowner adoption of energy efficiency through audit and implementation incentives.” Fifty-four percent of the 149 responses are similarly worded comments on incentive and cost factors. Many respondents specifically mentioned that without subsidies, their businesses would dry up all together. Although a few respondents said that subsidies should be curtailed either because people do not take a free audit seriously or for more personal political reasons (“the country can't afford to keep spending money”), they are a small minority compared to those wanting more support.

Another 26 percent of comments could be categorized as pertaining to information barriers. Some specifically mention that government programs too often allocate large sums for incentives but relatively meager ones for communicating that incentives exist. Some commenters expressed a desire for the government to use its bully pulpit to unite people in support of the goal of enhancing energy efficiency. We find it interesting, however, that while information problems figured prominently as a barrier to audits and an area that needs improvement in the industry, they did not show up as significantly in comments about the government's role.

Finally, 18 percent of the suggestions for government related to problems with the industry, its rules, and its organization. Along with many of the same comments from the question before, a handful of auditors want the government to require audits to be performed or efficiency scores to be calculated either when a house sale occurs or when a mortgage is secured.

Conclusions

Lack of information about specific ways to improve energy efficiency and reduce unnecessary energy use has long been identified as an important reason why all types of building owners, including homeowners, do not make apparently cost-effective improvements in their buildings or upgrade to more efficient appliances or equipment. Energy audits are a way to provide homeowners with information about current energy use, inefficient energy losses, and ways to improve the energy performance of their homes. Audits have been performed for several decades, but the question remains whether the industry is filling the energy-efficiency

information gap. This question has two components. First, is the industry reaching homeowners and providing them with useful information? And second, is the information making a difference? How often are homeowners following up on the recommendations of the audit and improving their homes' energy efficiency? Our survey sheds some light on these questions.

Reaching the Market. The results of our survey and the findings reported in past studies suggest that the industry has yet to make anything more than very small inroads into the residential market. As we reported above, utility and government programs that actively promote audits and retrofits have reached only small fractions of eligible households—between 1 and 5 percent by most accounts. Our survey asked auditors their views about homeowners' knowledge of the industry. Responses indicate that on average, auditors believe that 57 percent of the households who could benefit from an audit do not know about the existence of audits. We also asked our survey participants to speculate about why more homeowners do not obtain audits. Lack of information figured prominently in the responses – 63 percent said that a lack of understanding about what information an audit provides is of major importance or a critical issue. But a larger percentage blamed costs – 72 percent reported that homeowners' inability to afford the cost of upgrades was of major importance or a critical issue in explaining why people do not obtain audits.

Whether the information provided to households in an audit is useful to consumers remains an open question. Our survey found that the services provided in the audit itself vary. While the blower door test has become standard practice, the more costly infrared imaging is less common, and home energy ratings are less common still. The improvements most frequently recommended as a result of an audit relate to the building envelope: attic insulation, other kinds of insulation, attic air sealing, sealing of windows and doors, and air duct sealing. These specific opportunities for improving the energy efficiency of a building are typically more difficult for homeowners to evaluate on their own than, say, the potential energy savings from upgrading a refrigerator or other appliance. Thus, the information in the audit should be useful. On the other hand, we found it disappointing that energy use is very rarely measured. Most companies do not follow up and systematically measure post-retrofit energy use to compare to model predictions and/or to pre-retrofit energy use. This makes it difficult to assess how accurate and thus useful the information provided by the auditors ultimately is to households.

Using the Information to Retrofit Homes. One measure of the usefulness of the information in audits is how often homeowners who do have audits follow up on the recommendations. According to our survey findings, homeowners rarely adopt all the improvements recommended in an audit. While most respondents indicated that homeowners

usually follow up with at least one improvement, almost 30 percent reported that homeowners make at least one improvement only about half the time or less. This leaves a significant number of consumers paying for audit services but doing very little to improve the energy efficiency of their homes.

To figure out why consumers do or do not follow up, we asked our survey participants about the possible reasons why homeowners undertake the specific improvements they do make. Again, costs loomed large. Seventy-two percent of respondents said that large savings on utility bills were of major or critical importance in explaining why homeowners choose to undertake specific improvements. Sixty-six percent said that a specific improvement being low cost was of major or critical importance. The answers to this question are thus consistent with the answers to the question about why more people do not have audits. Costs matter.

The role of government incentives in the industry is complex. When asked if the low costs of some improvements were due to a government rebate, tax credit, or other incentive, more than 70 percent of respondents said yes. But our analysis of the survey data could discern no statistically significant correlation between the existence of government incentives and the reported extent of homeowner follow-up on energy improvements. When we asked these industry participants what would most help in getting homeowners to retrofit their homes, 49 percent said more government rebates and subsidies would be the most or second-most important thing. Interestingly, though, a higher price for energy was the top choice. Better information about audits ranked third among the options, supporting the responses to the earlier questions—that is, while auditors believe a significant fraction of consumers do not know a lot about audits, they view economic factors as an even more important barrier.

While many auditors cite government intervention as vital to the health of the audit business, our analysis could discern no statistically significant differences between homeowner follow-up and the level of energy-efficiency policy in the state the respondent was from. While there are many ways to look at the relationship between government support and efficiency gains, this contradiction calls into question the effectiveness of state and local government actions and the ultimate success of government intervention in producing more building upgrades.

The survey results do present clear evidence that the industry believes it is in a precarious position. The auditors who responded feel the public knows too little about them or does not trust their advice, while government incentives have not done enough to lower the costs of efficiency investments relative to the price of energy. At the same time, many auditors told us about threats

to their industry from within, citing a lack of professionalism from their competitors or endless amounts of red tape resulting from interaction with government programs or certification requirements slowing their growth.

More research is needed to sort out the successes and shortcomings of the energy audit business and identify how its performance could be improved. The lessons from our survey are somewhat limited due to methodological considerations. This survey was conducted using a readily available list of contact information for auditors from sources on the Web rather than a random sample of auditors and contractors, limiting our ability to draw conclusions about the industry more broadly. Future survey research focused on the audit industry would ideally investigate some of the responses to this survey more carefully. For example, more detailed questions about homeowner follow-up on recommendations would be useful. What actions do homeowners take most often? How much, on average, do homeowners typically spend on retrofits? What is the distribution in spending across customers? What explains the variability across homeowners in follow-through on recommendations? We were reluctant to make our survey too time consuming and information intensive, thus we avoided questions of this kind. But further information from the industry on their interactions with customers and the nature of follow-up would be instructive.

Ultimately, a survey of homeowners would provide interesting and complementary information about the audit and retrofit marketplace. It would shed light on consumer awareness and understanding as well as the extent to which homeowners who have received audits follow up on the recommendations. The 2009 Residential Energy Consumption Survey, a household-level survey on energy use conducted by the U.S. Energy Information Administration, includes questions about energy audits and the role of government assistance in paying for them. When the results of this survey become available, it will provide more information on national and regional use of audits and could be used to understand how the propensity to obtain audits varies with characteristics of houses, energy prices, and other factors.

As federal and state policymakers seek low-cost ways to reduce energy use and greenhouse gas emissions, interest in policies to promote greater energy efficiency in buildings is growing. Energy auditors have a potentially important role to play in the development and implementation of these policies. In particular, their role in filling the information gap that exists on building energy efficiency is critical. Without addressing economic factors, such as the price of energy and the costs of building retrofits, however, these endeavors may have only limited success.

References

- ACEEE (American Council for an Energy-Efficient Economy). 2010. *The 2010 State Energy Efficiency Scorecard*. <http://www.aceee.org/files/pdf/ACEEE-2010-Scorecard-Executive-Summary.pdf> (accessed September 22, 2011).
- Berry, Linda. 1993. A Review of the Market Penetration of U.S. Residential and Commercial Demand-Side Management Programmes. *Energy Policy* 21(1): 53–67.
- Chandler, S., and M. Brown. 2009. Meta-Review of Efficiency Potential Studies and Their Implications for the South. Working paper 51. Atlanta, GA: Georgia Institute of Technology, Ivan Allen College of Public Policy.
- Eichholtz, Piet, Nils Kok, and John M. Quigley. 2010. Doing Well by Doing Good? Green Office Buildings. *American Economic Review* 100(5): 2492–2509.
- EPRI (Electric Power Research Institute). 2009. *Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the US 2010—2030*. Palo Alto, CA.
- Fuller, Merrian, Cathy Kunkel, Mark Zimring, Ian Hoffman, Katie L. Soroye, and Charles Goldman. 2010. *Driving Demand for Home Energy Improvements: Motivating Residential Customers to Invest in Comprehensive Upgrades that Eliminate Energy Waste, Avoid High Bills, and Spur the Economy*. Report LBNL-3960E. Berkeley, CA: Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division.
- Gillingham, Kenneth, Richard Newell, and Karen Palmer. 2009. Energy Efficiency Economics and Policy. *Annual Review of Resource Economics* 1: 597–619.
- Goldman C., M. Fuller, E. Stuart, J. Peters, M. McRae, N. Albers, S. Lutzenhiser and M. Spahic., 2010. Energy Efficiency Services Sector: Workforce Size and Expectations for Growth Report LBNL-3987E Berkeley, CA: Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division.
- Guerrero, Alvaro Martin. 2003. Home Improvement Finance: Evidence from the 2001 Consumer Preferences Survey. N03-1. Cambridge, MA: Joint Center for Housing Studies, Harvard University.
- Hendricks, Bracken, and Matt Golden. 2010. *Taking on the Tool Belt Recession: Energy Efficiency Retrofits Can Provide a Real Help for Construction Unemployment*. Joint report of the Center for American Progress and Home Performance Resource Center. Washington, DC: Center for American Progress.

- Home Performance Resource Center. 2010a. *Best Practices for Energy Retrofit Design: Financing and Incentives Recommendations*. Washington, DC.
http://www.hprcenter.org/sites/default/files/ec_pro/hprcenter/best_practices_financing_and_incentives.pdf (accessed September 22, 2011).
- Home Performance Resource Center. 2010b. *Best Practices for Energy Retrofit Design: Best Practices White Paper*. Washington, DC.
http://www.hprcenter.org/sites/default/files/ec_pro/hprcenter/best_practices_white_paper.pdf (accessed September 22, 2011).
- Institute for Market Transformation. 2011. *The SAVE Act: Sensible Accounting to Value Energy*. Washington, DC. <http://www.imt.org/save-act> (accessed September 22, 2011).
- Jaffe, Adam, and Robert Stavins. 1994. The Energy Paradox and the Diffusion of Conservation Technology. *Resources and Energy Economics* 16: 91–122.
- Joint Center for Housing Studies. 2009. *The Remodeling Market in Transition: Improving America's Housing*. Cambridge, MA: Harvard University.
- McKinsey & Company. 2009. *Unlocking Energy Efficiency in the US Economy*. New York and London.
- Lawrence Berkeley National Laboratory. 2011. *Contractor Sales Training: Providing the Skills Necessary to Sell Comprehensive Home Energy Upgrades*. Clean Energy Program policy brief. Berkeley, CA: Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division.
- Lee, David. 2010. *Better Buildings 2.0*. Presentation at Building America Residential Energy Efficiency Meeting, Denver, CO, July 20, 2010.
http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/ns/plenary_3_betterbuildings.pdf (accessed September 15, 2011).
- NRC (National Research Council). 2010. *Real Prospects for Energy Efficiency in the United States*. Washington, DC: The National Academies Press.
- Neme, Chris, Meg Gottstein, and Blair Hamilton. 2011. *Residential Efficiency Retrofits: A Roadmap for the Future*. Montpelier, VT: Regulatory Assistance Program.
- Nevin, Rick, and Gregory Watson. 1998. Evidence of Rational Market Valuations for Home Energy Efficiency. *The Appraisal Journal* 66, no. 4: 401–09.

- Palmer, Karen, Margaret Walls, and Todd Gerarden. forthcoming. Energy Efficiency Financing: Assessing Market Barriers and Evaluating Government and Utility Programs. Discussion paper. Washington, DC: Resources for the Future.
- Redman, Elizabeth. 2010. *2010 Efficiency First Workforce Survey*. Washington, DC: Home Performance Resource Center.
http://www.hprcenter.org/sites/default/files/ec_pro/hprcenter/2010_efficiency_first_workforce_survey.pdf (accessed September 15, 2011).
- Shapiro, Ian. 2011. 10 Common Problems in Energy Audits. *ASHRAE Journal*, February 2011, p. 26-32.
- State and Local Energy Efficiency Action Network. 2011. *Residential Building Retrofits Working Group Blueprint*.
http://www1.eere.energy.gov/seeaction/pdfs/residentialretrofits_blueprint.pdf (accessed September 29, 2011).
- Tonn, Bruce, and Linda Berry. 1986. Determinants of Participation in Home Energy Audit/Loan Programs: Discrete Choice Model Results. *Energy* 11(8): 785–95.
- U.S. Bureau of Labor Statistics. 2011. *CPI Detailed Report: Data for July 2011*. Washington, DC. <http://www.bls.gov/cpi/cpid1107.pdf> (accessed September 14, 2011).
- U.S. Department of Energy. 2008. *2005 Residential Energy Consumption Survey (RECS): Housing Unit Characteristics and Energy Usage Indicators*. Washington, DC: Energy Information Administration.
- Von Schrader, Chandler. 2011. I Got Your Deep Energy Savings Right Here, presentation at the ACI San Francisco, Home Performance with Energy Star National Symposium, San Francisco, Ca, March 30.

Appendix A: Survey Questions

1. Tell us about you and your company:

Your Name:

Company:

Company Address:

Company Address 2:

City/Town:

State:

ZIP:

Email Address:

Phone Number:

2. Company Website:

3. Your Position or Title:

4. Please list the primary city, county, or metro area in which you work:

Your Company

5. What best describes you or your company's primary focus?

General contractor

Utility company

Windows, siding, and doors

Insulation

HVAC

Plumbing and/or water heaters

Energy efficiency consultant/building analyst

Municipal or State Government

Training

Non-Profit

Other (please specify)

6. Do you or does your company perform home energy "audits" or similar assessments on residential properties?

Yes

No

Note: Respondents who answer "No" are sent directly to Question #27.

7. What types of buildings do you perform energy audits on? Select all that comprise a significant portion of your business.

- Single family homes
- Multi-family homes
- Commercial buildings

From this point on, please limit your responses to only single family residential audits, installations and retrofits (do not consider commercial or multifamily energy efficiency projects).

Certification

8. Do you or does your company hold certifications or accreditations from the following organizations (check all that apply):

- BPI
- RESNET
- Other (please specify)

9. Does your company participate in the Home Performance with Energy Star program?

- Yes
- No

The Audit

10. Does your company, as a standard part of each home energy audit: (check all that apply)

Choices: Never, Rarely, About half the time, Fairly often, Always

- Perform a blower door test?
- Use infrared (thermographic) scanning?
- Obtain utility bills from the homeowner or their utility?
- Provide a HERS rating index or other energy index for the home?
- Use computer modeling software to project energy usage and/or energy costs before and after improvements are made?

11. If you use computer modeling, what software do you use?

Audit Fees

12. On average, how much do you charge for an Audit? Do not include any incentives, rebates, or subsidies you, the government, or the utility provides. If you have a variable fee, please attempt to calculate an approximate average.

- No fee (free)
- Less than \$100
- \$100-\$249
- \$250-\$399
- \$400-\$549
- \$550-\$699
- \$700 or more

13. If your fee varies by house size, geographical area, or other factors, please explain:

14. Are there incentives/rebates/subsidies for the audit provided by the government or the utility?

- Yes
- No

15. If yes, please provide a brief description:

16. Do you discount the cost of the audit if the customer enlists your company for energy equipment installation and retrofit services?

- Yes, partial refund
- Yes, full refund
- No

The Audit's Results

17. In the home energy audits you perform, how often do you recommend the following items for improvements or retrofits. If you do not cover a particular item in your audit, mark N/A.

Choices: Rarely, Sometimes, About half the time, Fairly often, Always, N/A

Windows

Doors

Attic Insulation

Walls, pipes, or other insulation

Heating system

Air Conditioning

Thermostat

Water heater

Refrigerator

Other appliances

Computers, TVs, or other electronics

Lighting

Air duct seals

Caulking, weatherstripping, and sealing of windows/doors

Attic or other air sealing

Other (please specify)

Reasons for the Audit

18. In your opinion, which of the following are reasons why more homeowners do not have energy audits?

Choices: Not important, Of minor importance, Moderately important, Of major importance, Critical issue

Unaware that energy audits exist

Know about audits but don't know what they are and the info they provide

Think they know everything about energy efficiency already

Think that audits are inconvenient

Don't trust that audits are reliable and accurate

Concerned about conflicts of interest with auditors who also provide energy services and installations

Not worried about lowering utility bills (i.e., energy costs are a low priority)

High actual or perceived costs of audits

Can't afford upgrades and retrofits that audit may recommend

Other (please specify)

19. In your experience, of the homeowners who could benefit from an audit, what percentage do not know about audits?

- <20%
- 20-40%
- 40-60%
- 60-80%
- >80%
- Don't Know

After the Audit

20. Do you have some knowledge about the actions homeowners take after you perform an audit?

- Yes
- No

Note: Respondents who answer "No" are sent directly to Question #35.

Follow through

21. How often does a homeowner follow through within six months on each recommendation? If you do not make recommendations for a particular item, mark N/A.

Choices: Rarely, Sometimes, About half the time, Fairly Often, Always, N/A

- Windows
- Doors
- Attic Insulation
- Walls, pipes, or other insulation
- Heating system
- Air Conditioning
- Thermostat
- Water heater
- Refrigerator
- Other appliances
- Computers, TVs, or other electronics
- Lighting
- Air duct seals
- Caulking, weatherstripping, and sealing of windows/doors
- Attic or other air sealing
- Other (please specify)

More Follow Through

22. In general, how often does a homeowner:

Choices: Never, Sometimes, About half the time, Fairly often, Always

Make at least one of the improvements you recommend?

Make all of the improvements you recommend?

More Follow Through

23. In your opinion, which of the following are important reasons why homeowners undertake specific improvements after getting an audit?

Choices: Not important, Of minor importance, Moderately important, Of major importance, Critical issue

The specific improvement/investment is low cost

Projected savings on utility bills are high

Installation is convenient and nondisruptive to the household

The improvement provides other benefits (attractive windows, home temperature comfort)

Financing is available for the improvement

Homeowner values "green" investments (strong environmental values)

Homeowner is interested in increasing property value

Other (please specify)

24. If you answered "of major importance" or "critical issue" to the "improvement/investment is low cost" option in the above question, was a government or utility subsidy or financing program a reason for the low cost?

Yes

No

25. If yes, can you supply specific examples?

Increasing the adaptation of energy efficient practices

26. Provide a ranking of what you believe the least important to most important factors are that would induce more homeowners to adopt energy efficient retrofits and improvements. Rank them from 1 (least) to 6 (most).

Better understanding and awareness of audits

Better access to financing

More government rebates and subsidies

Better (or cheaper) options for improving energy efficiency

Higher price of energy

Less uncertainty in cost savings from energy efficiency investments

Installation and Retrofits

27. What type of installations/retrofits does your company offer? (check all that apply)

- None/do not do retrofits or installations
- Heating and A/C
- Water heaters
- Insulation
- Air duct sealing/taping
- Air sealing
- Window Replacement
- Lighting
- Appliance installations
- Other (please specify)

Note: Respondents who answer “None/do not do retrofits or installations” are sent directly to Question #35.

Financing

28. Do you offer financing (or act as a gateway to financing) for energy efficient retrofits/investments? Check all that apply.

- Offer financing
- Act as gateway
- Neither

29. If you act as a gateway, what company or government agency provides the financing?

30. What is the interest rate and loan term?

31. Is the interest rate a below-market interest rate due to a government or utility incentive program in your area?

- Yes
- No
- N/A

32. In you experience, approximately what percentage of customers pay for their energy efficient retrofits/investments using the following methods? (put in whole number only...do not use % signs...try to make numbers add up to 100...skip only if you cannot make an educated guess)

- Cash/check
- Credit Card
- Home Energy Financing Program

Home Equity Loan

Other

Other Incentives

33. Are there other incentives/rebates/retail buydowns offered by the state or local government or utility incentive program in your area? Do not include manufacturers' rebates.

Yes

No

Don't know

34. If there are, please provide their names and a brief description:

Ex-post analysis

35. How often do you compare actual energy savings after retrofits and improvements to the energy savings predicted in the audit? If you do not perform audits, mark N/A.

Choices: Never, Rarely, About half the time, Fairly often, Always, N/A

36. If you do compare actual savings after retrofits and improvements have been made, how often do you use the following methods?

Choices: Never, Rarely, About Half the time, Fairly often, Always

Ask the homeowner directly about savings (phone or email)

Compare pre and post improvement energy bills

Compare post improvement energy used to predictions from computer model

Other (specify method and frequency)

37. Do any of your federal/state/utility programs require an evaluation that compares actual energy savings to predicted energy savings?

Yes

No

N/A

If so, which ones?

38. Do any of your federal/state/utility programs conduct their own evaluations of actual energy savings to predicted energy savings?

Yes

No

N/A

If so, which ones?

Final Comments

39. Please provide comments you may have on what, if any, changes or improvements in the audit industry could increase homeowner adoption of energy efficiency improvements:
40. Please provide additional comments you may have on the government's role in increasing homeowner adoption of energy efficiency through audit and implementation incentives.
41. Would you like a copy of our research results of this study when it is completed?
Yes
No
42. If you own or manage your own company: (please use only numbers and omit dollar signs and commas)
How many fulltime employees do you have?
How many part-time employees do you have?
What was your (estimated) revenue in the most recent year in US Dollars?
What was your total revenue from energy audits in the most recent year?
43. As a thank you for completing this survey, would you like to be entered into a drawing to win \$500 for the charity of your choice? (If you win, we will contact you by email)
Yes
No

Appendix B: American Council for an Energy-Efficient Economy State Energy Efficiency Scorecard

First Quintile:

- 1) California
- 2) Massachusetts
- 3) Oregon
- 4) New York
- 5) Vermont
- 6) Washington
- 7) Rhode Island
- 8) Connecticut
- 8) Minnesota
- 10) Maine

Second Quintile:

- 11) Wisconsin
- 12) Hawaii
- 12) Iowa
- 12) New Jersey
- 12) Utah
- 16) Maryland
- 16) Pennsylvania
- 18) Arizona
- 19) Colorado
- 19) District of Columbia
- 19) Nevada

Third Quintile:

- 22) New Hampshire
- 22) New Mexico
- 24) North Carolina
- 25) Illinois
- 26) Idaho
- 27) Delaware
- 27) Michigan
- 27) Ohio
- 30) Florida
- 31) Indiana

Fourth Quintile:

- 32) Texas
- 33) Montana
- 34) Virginia
- 35) Tennessee
- 36) Kentucky
- 37) Alaska
- 37) Georgia
- 39) South Dakota
- 40) South Carolina
- 41) Arkansas

Fifth Quintile:

- 42) Louisiana
- 43) Missouri
- 43) Oklahoma
- 43) West Virginia
- 46) Kansas
- 47) Nebraska
- 48) Wyoming
- 49) Alabama
- 50) Mississippi
- 51) North Dakota