

# **Comparing Approaches to Reducing Efficiency Market Barriers through Interactive Energy Audit Software**

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## **ABSTRACT**

Since the 1970's energy audits have been an important tool for assisting energy consumers in understanding and implementing strategies to reduce energy costs. Energy audits were once a professional engineering and economic study, out of reach for all but the largest energy intensive businesses. However, for those who paid for and received such information, the result was a clearer understanding of energy use, and how their choices could benefit themselves with lower costs while aiding the economy and the environment.

The author's company, and other energy software firms, has developed and released several types of interactive audits to support consumer interest in energy efficiency including interactive web-based energy audits. In addition, the company has developed CD-based audits, mail-back audits, and most recently e-mail monthly audits. In total, more than 1.5 million consumers have used at least one of these tools, through more than 35 utility or government-sponsored implementations. Most have paid nothing for the information; the utilities sponsoring the audits are spending much less than previously, and receiving greater benefits for themselves and their consumers.

This paper will present and compare characteristics of web, CD, e-mail and mail-based consumer communications systems for energy efficiency understanding and implementation. The approaches are described, and compared based on relative cost, benefits, customer participation rates, as well as lessons learned about consumer response.

## **The Energy Audit: A Tool for Market Transformation.**

### **Background: the Birth of the Energy Audit**

Energy audits developed in the 1970's as a solution to a market failure in the energy sector. Until that time, consumers had inadequate information to properly consider the life-cycle energy cost in buying decisions. Consumer decision-making for all forms of appliances, automobiles, and home structural components tended towards low cost options, excluding consideration of energy costs. The result was in fact higher total costs, and much higher energy use. Commercial and industrial sector decision-making regarding facilities and industrial processes was little better.

It is interesting to note that, when Thomas Edison invented the light bulb, and then soon thereafter the electric utility in 1878, his business model was one of providing light as an end use service: customers would be offered light bulbs and electricity as a package, which they could compare in value and total cost to other ways of lighting their home or business. Edison couldn't imagine that he could ever sell electrons.

As we know, it didn't work out that way. Energy utilities sell therms or kilowatt-hours, which to most consumers are but an abstraction. Consumers want light, comfort, or

hot water, but no one sells that directly. Instead they need to separately purchase equipment, energy, and maintenance.

By divorcing end use equipment from energy in buying decisions, we created a massive market chasm due to faulty information: consumers chose to build inefficient homes, buy cheaper inefficient appliances and heating systems, and build inefficient offices and factories, which drove up the total cost of satisfying their needs. As a result, our economy became a bastion of energy waste, a national security time bomb, and in 1973 it went off in the first Arab oil embargo, which quadrupled energy costs within a 2 year period. Meanwhile our overuse of energy was creating unnecessary air and water pollution, rapidly depleting our natural resources, and driving up costs that accelerated inflation as well as creating stagnant economic growth.

While the price jump of the 1970's taught us that efficiency considerations are necessary, only a small fraction of consumers had any real understanding of how to control their bill. By 1975, out of necessity *the energy audit* was born. An energy audit was a structured consulting study of energy use, providing a better understanding of how buying decisions affected the energy bill. While on occasion engineers and accountants would examine energy costs for clients prior to that period, the economic necessity of the mid-1970's price jump created a market for this well-defined study. Early practitioners, such as XENERGY in Massachusetts, and Fuel and Energy Consultants, of the UK and New Jersey, developed an approach to the energy audit business that rapidly became a worldwide industry. Within a few years, the Association of Energy Engineers was developing standards and certifications for auditors.

### **What Is an Energy Audit?**

While the formula for an energy audit varies, in most cases it covers the topics proven to have interest to energy users, and value to managing their use. Typically, an audit provides its sponsor with answers to the following ubiquitous questions:

**Is my bill too high?** Energy bills provide no basis to gauge their reasonableness. Particularly when rising, energy consumers wonder how they compare with neighbors or competitors. Most energy audits therefore produce a benchmark comparison by examining the energy bills on a normalized basis, taking into account demographic factors, such as home size or commercial sector. In addition, local weather severity (often measured in degree-days) is considered. In many cases, the appliances used and the fuel choices are considered.

**What am I getting for my money?** Most energy audits then proceeded to disaggregate the energy bill into the costs of individual end use services, such as the cost of heat, air conditioning, light, and hot water. The end use service components of cost provide the consumer with understanding of the value of energy in relation to cost, and a starting point for considering changes to purchase decisions or behavior.

**What can I do to improve end use services and lower costs?** All energy audits evaluate the costs and benefits of bill-reducing options, which continue to grow in variety and complexity. Options evaluated can include behavioral or maintenance improvement,

equipment replacements, facility improvements, rate options, or fuel options. In addition, audits are often used to propose bundled solutions with financing (the Energy Service Company or *ESCO* market), or with deregulated energy (retail supplier market). Finally, audits often identify program opportunities such utility efficiency and demand response programs, government incentives and tax credits.

**How do I get my choices implemented?** Often, the energy audit provides a path to implementation, and the audit provider may serve as a referrer or supplier of design, implementation or financing services.

In combination, the answers to the consumer's questions provide both the consumer and the economy with a valuable outcome. The knowledgeable consumer makes educated decisions, and the market failure of energy decisions is remedied, at least as far as the participating consumer is concerned. The informed consumer is more likely to substitute technology for energy, resulting in lower total costs as well as improved end use services, with less energy used. And the economy draws benefit from this substitution by reducing energy demands resulting in lower prices, mitigated environmental damage, and improved security.

## **Progress in the Technology and Cost of Energy Auditing**

Energy audits vary in completeness, depth, and cost. If provided by a vendor of equipment or services, it may serve as a subsidized sales instrument. However, the anecdotes below are instructive on how energy audits have progressed since the 1970's. The author draws these observations of cost and performance from first-hand his experiences with each of these approaches at XENERGY and now at Nexus Energyguide. At Nexus alone more than 1.5 million consumers have used at least one of these tools, through more than 35 utility or government-sponsored implementations. In summary each successive step has lowered the cost of providing energy audit information to the consumer by an order of magnitude: *here is the progression from \$5000 to \$.50:*

**The manual audit.** In the early years of energy audits in the 1970's, pricing of commercial energy audits were based on matching the costs of professional consultants with the value of the audit to the customer. A very typical pricing was "one month energy bill" - \$5,000k to \$10,000 for a 100,000 square foot facility. Home audits weren't economically feasible.

**The computer audit.** Software-assisted audits became available in the early 1980's. Technicians could be trained to complete forms, which were returned to the software firm for batch entry, resulting in an energy audit report covering routine measures. The total cost for a basic commercial facility audit (software and auditor) dropped by an order of magnitude to \$500 to \$1000 for a commercial facility. And, residential energy audits became feasible: the total cost was about \$250. Utilities most frequently purchased the software, provided by energy audit and software companies such as XENERGY and Enercom, and trained personnel in conducting the audits. By 1985, government requirements and standards for these audits were in place. Typically, they were heavily subsidized or free to the consumer. In DSM-active states, up to 5% of homes or businesses could receive energy audits in a year.

**The self-service audit.** By the early 1990's there was experimentation with mail-based self-service energy audits. The consumer completed a survey, which was returned to the utility for processing. In 2 to 3 weeks a report was produced and mailed back with summary audit contents. While limited, these audits were able to provide at least initial answers to many of the questions answered by on-site audits. Costs again dropped by an order of magnitude. A mail-based self-service commercial audit program cost \$50 to \$100 per participant; residential about \$25. Nexus Energyguide and XENERGY are providers of such services.

**The web and CD-ROM audit.** The late 1990's brought energy audits to utility CD-ROM's and websites, providing interactive tools and content to answer these key questions for energy consumers. Several companies, including those mentioned above, provide web audits, and Nexus Energyguide provides CD-ROMs. While the cost per participant varies substantially, based on the amortization of website costs by amount of web traffic, the CD-based program represented another order of magnitude cost reduction, to \$5 to \$10 per participant.

**E-mail audit.** Since the web-based audit cost is driven by traffic, a key parameter is its promotion, and the popularity of the utility's website. In 2001, Nexus Energyguide released an e-mail based audit (Energygram) to address the issue of low utility web traffic. In essence, the Energygram is promoted by utility e-mail related to billing, and encourages the consumer to click from the e-mail to a web audit registration. Then, a portion of the audit is sent to the consumer seasonally or monthly, with click-back for more detailed analysis. Per analysis sent to the consumer, this process creates an additional order of magnitude cost reduction, to \$.50 to \$1. Over an annual cycle, the process delivers a complete energy audit to the customer in installments.

While only a limited amount of analysis can be performed as compared with the more thorough processes above, the Energygram approach has two benefits: it is sent periodically which reawakens the consumers' attention, and it allows the consumer to click-back to appropriate content, detailed analyses, or worksheets, which create the opportunity for greater focus and depth at the point of highest consumer interest than any fixed set of audit content can provide.

Therefore, we've seen steady and dramatic progress at bringing the market-transforming information of energy audits to consumers for a lower and lower price. But considering measures of effectiveness, are we making progress towards transforming the energy market?

## **Customer Response to Alternate Audit Technologies**

On-site audits done by professionals, or with software assisted technicians, are not compared or evaluated in this paper, having been the topic of many evaluation studies over the last 15 years. In general, these studies find substantial benefits of on-site audits, both as a source of efficiency improvements, and as an enabler of cross-marketing of other utility DSM programs. However, their cost-effectiveness is challenged by the relatively high cost. Depending on local economics and politics, on-site audits have often been discontinued or are less promoted. Comparatively, the use of web, mail, and e-mail based audits has grown

rapidly; the vast majority of utility-sponsored audits are now of one of these forms. On-site professional audits, however, continue to thrive as an approach to marketing ESCO services, providing the basis for a detailed proposal of facility improvements to be provided and often financed by the auditing company.

1. *The mail-based self-service audit* has now been used by over 3 million US households and businesses, and continues in use by at least 20 utilities. It has proven to have strong consumer demand; the response rates to these mailed audits have no equal in any other mail-based campaign. Typically, a workbook is mailed to a household, with the offer to provide a detailed analysis of their electric and/or gas bill. The workbook, which takes 30 minutes to an hour to complete, is returned with an expectation of a report in 2 to 4 weeks. The typical response rate to blind mailings is 30%; variation of 20% to 40%. This response level shows that at least a third, and probably 50% of consumers have questions that energy audits can answer. Surveys show that consumers find the information provided to be useful, and have a better understanding of how to manage their energy costs. Further, it is clear that the process puts the utility in a positive light by the consumer, and that the high response rate is partially a result of the consumer's trust of the utility as a valid source of such information. If not under utility brand, the response rate is likely to be much lower.
2. *CD-ROM energy audits* are typically offered by a mailer; a response card or telephone call is required to receive one. Nexus' Energysmart audit was developed under contract to Massachusetts Electric in 1998. The initial mailers generated approximately a 10% response rate for the free CD.

Compared with the mail-based audit, the CD-ROM software supports interactivity, allowing the consumer to address areas of interest after a summary analysis, and return to the software during other periods of interest. For most utility implementations, billing data can be downloaded. Because consumers choose the depth of information and analysis interactively, it can be a shorter or longer experience than the mail-based audit. It also supports web links to utility customer service, DSM programs, and in some cases direct e-commerce of energy-saving products and competitive energy supplies. Because the audit is run on the consumer's computer, the data is private which consumers appreciate. However some utilities have seen this as a drawback, and have encouraged customers to upload their data with a contest offer. Utilities however see the CD as a vehicle to benefit them by delivering marketing and branding messages; the CD format supports video clips which have included EnergyStar public service announcements, a message on efficiency from the President of Consumer's Power, and from Governor George Pataki of New York on a CD produced for NYSERDA. The commercial CD, recently released by Pacific Gas and Electric, has a series of professional instruction clips to help implement measures.

3. *Web-based energy audits* for homes and commercial facilities are now widely available on utility websites. There are several providers and the audits vary substantially; relative features are not compared in this paper.

Ease of use however is a clear determinant of the benefit consumers draw from web audits. On the web, consumers often have a particular question and seek a quick and clear answer. Interactivity and choice in the interface design is key to use

and satisfaction. When properly implemented, web audits allow the user to have real time access to information with detail and accuracy dictated by their immediate needs. This creates a substantial advantage of these tools as compared with mail-based systems, which generally have a fixed question set, and fixed detail on the content. A survey conducted of 5000 users of Nexus' home audit showed that consumers found the information extremely valuable, and claimed that they planned to implement measures that were computed to lower their bill by an average of 20% to 30%. Again, no actual impact evaluations have been performed.

While marginal costs of web audits are low, the fixed costs of web installations need to be amortized by use. Utilities have frequently created little traffic to their websites, and often make the web audits hard to find. As a result, some utilities have disappointingly high average costs per audit. Utilities who have promoted their site through mailers or bill inserts have achieved costs in the range of \$10 per completed audit, but on average costs are higher, and volumes lower, than CD's or mail-based programs to date. Web audits however provide customer data in all cases however.

4. *E-mail energy audits* for homes and businesses were developed by Nexus in 2001 to try to achieve the high participation rates of mail audits to web-based programs. Energygrams are a delivery of an energy audit in monthly installments via e-mail, designed to provide consumers with ongoing guidance regarding their energy bills and options to lower them. The technology consists of an extrapolation process to pre-run an audit simulation based on a brief demographic survey, typically 12 questions. The initial Energygram creates contact with bill history record. Based on an estimated audit, monthly Energygrams create a customer-specific web page, sent by e-mail, containing at least one instance of major elements of an energy audit: benchmark, end use analysis, measures, and program opportunities. The consumer can click on any item of interest, and return to the utility web audit and proceed to more in-depth analysis. Over the course of a year, the consumer receives the summary content of a comprehensive energy audit. If they clicked through on areas of interest, they will have a full detailed audit.

Energygram audits, in use for 9 months as of this writing, have shown several benefits as compared with other audit approaches:

- The click rate on e-mailed Energygrams to customers who have opted in exceeds 50%; that is, over half of all Energygrams are read and result in a web revisit the audit tools and other utility web content.
- The continuity of communication provides persistence of market-transforming messages beyond that of any other energy audit form. The connection to the energy billing cycle creates an analysis of energy and options at the time of greatest interest.
- The monthly messaging can include updates on programs and efficiency opportunities not released as of the initial contact, screened and offered only to the appropriate participants. This reduces the marketing costs of other programs, and allows sub selection of participants to maximize program impacts and minimize free-ridership.

Utilities using the Energygram system have tried several approaches to recruitment to receive the 12 questions, e-mail address, and opt-in permission. Each has resulted in substantially greater use of utility web audit tools, as compared with web presence alone:

- A mail offering of the Energygram requests the 12 questions, e-mail address, and opt-in via web, phone, or response card. The response card is the clear favorite: 10% to 15% return the card in several trials. This is an excellent direct mail response rate, and a low cost recruitment, but still not as high as the full mail-in audit which runs 20% to 40%.
- An e-mail offering to utility e-mail lists requests the 12 questions, and opt-in via a hot link to web enrollment. The response rate to this recruitment is near 40%; and since there is no mailing or handling costs, this is remarkably inexpensive per participant.
- Referrals from customer service is an additional method; customer service representatives fielding high bill inquiries can direct the customer to the web audit to answer their concerns (which it often does much better than the CSR is equipped to do), and/or enroll the customer in Energygrams. As of this writing, research as to the costs and benefits of using this process in customer service is underway; however a preliminary analysis indicates that fielding high bill inquiries in this manner *saves call centers time and money*, and therefore recruitment costs are negative. Notably, many utilities report that high bill inquiries are received from 3% to 8% of their customers each year, providing an extremely large source of referrals.

## Conclusion

The impact of the invention of the energy audit in the 1970's is a story that is still being written. The cost of providing consumers with clear, concise guidance to decisions that impact their energy bill has dropped by 4 orders of magnitude since then as the result of new audit processes: mail, on-line, on a home computer application, or in summary form in a monthly e-mail.

It has become clear that providing consumers with information on their energy use can benefit the utility, as well as its customers. A utility that gives its customers effective information on their bill increases their customer satisfaction, and reduces its costs. The knowledgeable consumer makes educated decisions, and is more likely to realize improved end use services, with less energy used. And the economy draws benefit from this substitution by mitigating environmental damage, and improving national security.

It can be clearly established, based on program results to date, that at least a large plurality of consumers are interested in this information, and they claim that they find it useful and are ready to act upon it. It remains to be proven that they do act. With further improvements made possible by consumer feedback and impact evaluations, energy audit systems will likely continue to improve, reduce in cost, and become increasingly ubiquitous, potentially a part of standard utility billing. When this is achieved, an end to the market barrier to an energy efficient economy may be in sight.

