# Energy Efficiency Television Programming

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**ABSTRACT**

Many utilities are looking for ways to diversify their energy efficiency portfolios as stand-by measures like CFLs become standard practice. New behavior programs like home energy reports are increasingly popular because they can cost-effectively target a large portion of the population and result in significant program savings even though the savings per household may be small. One Midwestern utility has been running a related kind of education program on television for over 15 years. Originally meant for brand identification and outreach, the authors recently conducted an evaluation of the program and identified energy savings equivalent to the portfolio's home energy audit program and demand savings equivalent to half of the portfolio's goal.

This paper discusses the structure and format of the utility-offered television program. It also outlines the evaluation methodology used to determine the impacts resulting from the program. The paper reports the impact results and identifies the uncertainties associated with those results.

On the whole, the paper:

- Describes a unique channel to reach and educate a large number of utility customers.
- Describes an evaluation method that can be used to determine the impacts of such a program, and presents its results.
- Reports on the potential energy savings available based on the results seen in this evaluation.

## Introduction

The energy efficiency portfolio landscape is changing as stand-by measures like compact fluorescent lamps (CFLs) become standard practice. Traditionally, CFL measures have been the cornerstone of most residential energy efficiency programs because they are inexpensive, easy to install, and very cost-effective. The resulting market transformation has made legislative changes possible, such as the Energy Independence and Security Act of 2007 (EISA), which mandates the minimum efficiency of manufactured bulbs and greatly reduces the energy savings available from CFL installations. As a result, utilities are searching for the next measure that will produce large energy savings and be as cost effective as CFLs have historically been (Badger and Reed, 2010).

New behavior programs like home energy reports are increasingly popular because they can cost-effectively target a large portion of the population and result in significant program savings even though the savings per household may be small (Agnew et al. 2012). Such programs often rely on education and neighbor-to-neighbor comparisons provided through mailings to influence homeowner behavior. They often achieve success by encouraging small, easy-to-accomplish energy savings through measures such as turning off lights more frequently, increasing weatherization, and adjusting the thermostat for greater energy savings. Such

measures have long been part of traditional energy efficiency education, but the energy savings resulting from those measures has been difficult to quantify because:

- Traditional pre-post billing analyses cannot be done on such small measures because the energy savings are lost in the noise associated with typical usage. The natural ups-and-downs that occur because of weather and usage patterns can mask energy savings up to 10% of the household energy use.
- It is difficult to determine the influence of the program on the decision to install, which leads to net savings.
    - Opt-in programs attract people already interested in energy efficiency, called free riders, at a higher rate than they are found in the population.
    - Evaluators have found many ways to eliminate the effect of free riders, including self-report surveys. However, for such small measures spread across a wide population, these methods are difficult to implement effectively.

Some home energy report programs are able to avoid these problems and produce viable net energy savings through billing analysis by designing their programs as random control trials rather than traditional opt-in programs. In random control trials, the participant population is assigned randomly and another portion of the population is maintained as a control. The random assignment ensures that the portion of free riders in the participant and control groups is the same, eliminating the need to correct for them in the analysis.

A Midwestern utility has been running an education show on television that acts as a behavior energy efficiency program for over 15 years, reaching almost all of their 1 million residential customers on a weekly basis. The program relies on participants to act on the information provided on the show (opt-in) to produce energy savings. In order to determine the net savings from the program, the utility must prove that the customers installed the measures because they were influenced by the show. However, without the benefit of the random control trial program design, eliminating the effect of free-ridership is difficult.

The authors recently conducted an evaluation of the television program. The following sections describe the show, outline the evaluation methodology, and present the evaluation results along with associated uncertainties.

## Structure and Format of the Show

The PowerHouse (PH) television show was first aired in September 1996 in a single broadcast television market in Iowa. It began as customer outreach for the utility, and the primary objective was to educate customers on energy efficiency, encourage implementation of energy efficiency measures, and direct people to the utility's energy efficiency programs. Eventually it became a strong source of brand identification and grew to include a website and a YouTube channel. Its hosts also participate in local community events.

### Overview of Television Show

The PowerHouse television show is a ½-hour long program. It currently airs weekly in six broadcast television markets in Iowa, Wisconsin, and Minnesota and reaches more than 1 million residential utility customers. There are four to six new shows produced per year at a local television station.

Each show consists of three or four segments that discuss energy, energy safety, or energy efficiency behaviors and equipment. A typical segment may consist of:

- An interview with a local home service professional contractor or dealer who is recognized nationally or regionally as an expert in his field. In most cases, these contractors and retailers are part of the energy efficiency portfolio trade ally network.
- A demonstration or overview of products or equipment that can help to save energy. The selected brands are usually produced or distributed by Midwestern companies, such as Pella, Eagle, Kohler, Whirlpool, Sub-Zero, and Lennox.
- A discussion of the non-energy benefits of energy efficiency measures, such as cost savings, maintenance reductions, and increased comfort or air quality.
- Tips and tricks for purchasing new equipment or appliances, general home maintenance, or identifying high energy users.

### Overview of Website and YouTube Channel

The PH YouTube channel (AEP) houses 248 segments, 18 of which are only available on the web. The PH website (AE) links to the YouTube segments and organizes them into 16 categories: air quality, appliances, building and remodeling, DIY projects, energy basics, heating and cooling, insulating and weatherizing, lighting, outdoor living, power quality, renewable energy, safety, water heating and plumbing, whole house, windows and doors, and energy-saving tips. There are also a number of articles that reinforce the information found in the videos.

The PH website identifies the segments that will appear in the upcoming shows and the stations and times it will air. The website also provides links to the current energy efficiency programs offered by the utility for residential, business, and agriculture customers.

### Other Outreach

DVDs of the show are available at many Iowa, Minnesota, and Wisconsin libraries for check out. The hosts of the show also provide outreach at events such as farmers markets and community festivals.

## Evaluation Methodology

The objective of the evaluation of the PH program, including the television show, website, and YouTube channel, was to determine the energy savings attributable to PowerHouse. The evaluators aimed to divide the savings into two categories: those that were tracked by the utility and reported in existing rebate programs but influenced by PH, and those that were untracked and did not receive a rebate but were influenced by PH.

The evaluation was conducted in two phases, both of which addressed only customers in the state of Iowa. At a high level, the objective of the first phase was to find evidence of savings, while the objective of the second phase was to quantify those savings. The following sections provide a more detailed overview of the two evaluation phases and provide a summary of the data collection and analysis methodology for the evaluation.

## Overview of Phase I

The first phase of the evaluation was conducted as part of the overall portfolio evaluation and had a limited budget. The objectives were:

- Identify specific behaviors and actions taken by the customer that resulted from exposure to PH
- Assess the impacts of the PH-induced energy savings actions
- Assess whether the utility could claim savings from PH

In Phase I, the authors conducted a web survey with approximately 1000 utility customers who pay their bill online. Respondents were asked to identify whether they had watched the PH television show in the past two years, and what energy efficiency measures they had installed in the past two years. To complete the analysis within the available budget, the authors assumed that non-observers (those that do not watch PH or visit the website or YouTube channel) represent the actions of observers in the absence of PH. Although the authors felt this assumption would over-state the energy savings, the analysis would be much less expensive than the alternative and the result would adequately indicate whether viable energy savings were present.

The results of Phase I suggested that energy savings were evident at a magnitude that would justify a more rigorous study. Because of the assumption made, however, the authors could not recommend that the utility report those savings. As a result, Phase II of the evaluation was designed and implemented.

## Changes from Phase I to Phase II

The authors instituted five changes from Phase I to Phase II, shown in Table 1 and discussed in greater detail below.

Table 1. Overview of changes from Phase I to Phase II

| Phase I methodological compromise | Phase II correction |
|---|---|
| Non-observers represent the actions of observers in the absence of PH | Created Energy Efficiency Attitude factor and conducted a regression analysis to determine program influence |
| Online bill payers are representative of the general population | Sampled from all residential utility customers in Iowa |
| The education provided by the show can be captured in a small number of measure descriptions | Increased the number of measures to represent most of those encouraged by PH |
| The customers who could get a rebate for installing their equipment did get a rebate for it | Used the energy efficiency program tracking database to identify those who received a rebate in the previous two years |
| The per-unit energy savings estimates can be determined in a limited amount of time. | Conducted a more rigorous engineering analysis to determine energy savings. |

**Non-observers represent actions of observers.** As described in the introduction, the PH program relies on self-selection to produce energy savings. Customers must self-select to watch the television show or go to the website, and viewers must self-select to install energy efficiency measures that produce energy savings. The authors hypothesized that there was an underlying conservation ethic that caused some people to be more likely to watch the show and also more likely to install energy efficiency measures. In other words, the hypothesis was that people who were interested in energy efficiency were overrepresented in the PH viewing audience.

To account for this predisposition toward energy efficiency, the authors developed an Energy Efficiency Attitude (EEA) factor and conducted a regression analysis to control for that factor and determine the actual program influence on the energy savings reported by viewers. Further information on the EEA factor can be found in the analysis section.

**Online bill payers represent the general population.** Phase I used a web survey to limit costs. Web surveys require email addresses to contact potential respondents. Therefore, the authors limited the sample to those customers who paid their bills online. In general, however, those who pay their bills online tend to be younger, more educated, and more affluent than the general population. In Phase II, the authors selected a sample from all of the residential customers in Iowa using the utility billing database. Surveys were conducted by telephone.

**Show's effects can be captured in a small number of measures.** The PH show encompasses a wide array of energy efficiency education. To limit the time (and the cost) of the Phase I survey, the authors limited the number of measures addressed. In Phase II, the number of measures in the survey was increased to include almost everything delivered by the program.

**Customers who could get rebate did.** In Phase I, the authors assumed that people received rebates for high efficiency equipment where possible, which assigned those savings to the "already reported through rebate programs" bin instead of the "influenced by PH but never counted" bin. In Phase II, the authors used the rebate program tracking data to match respondents to the data and confirm whether they participated in the rebate program.

**Less rigor on savings estimates.** In Phase I, the per-unit energy savings estimates determined by the authors were also limited by the evaluation budget. In Phase II, the authors used more rigorous calculations and data that represented actual utility customers to estimate the per-unit energy savings.

### Overview of Phase II

The objective of Phase II was very similar to that of Phase I: to determine the energy savings attributable to the PH show, both those that were already tracked in the utility's energy efficiency portfolio and those that were not. The main analysis aimed to quantify the effects of a customer's viewing PH on the probability that the customer undertook energy efficiency measures. In other words, did PH cause the energy efficiency actions? If yes, how much savings resulted? Some specific evaluation objectives included:

- Measure residential customer awareness and viewership of PH
- Identify specific energy efficiency actions implemented by PH viewers
- Estimate the energy savings resulting from the specific actions implemented by viewers
- Determine the influence of PH on the specific energy efficiency actions implemented by viewers
- Quantify the tracked and untracked energy savings influenced by PH viewership.

### Summary of Data Collection

The authors conducted a computer-aided telephone survey (CATI) with 600 viewers and 605 non-viewers. The sample was pulled from the utility billing data and loosely stratified based on geographic area, rebate program participation, service type (electric, gas, or both), and usage in Btu as proxy for income.

The major complication in data collection was that the most important analysis variable, whether or not the respondent was a viewer, was not known until the call was initiated. As a

result, the sample design quotas could not be precisely controlled. The authors directed the CATI house to concentrate on rebate program participation and viewership distribution while actually completing the surveys. Respondents were considered a viewer if they reported that they had watched at least one segment of the show in the past 24 months. An analysis was conducted after the survey was completed and the final sample of respondents was determined to be representative.

The survey instrument focused on the following topics:

- Whether and how often the respondent watched PH in the last 24 months
- Whether and how often the respondent visited the website or watched YouTube segments
- Energy efficiency awareness (EEA) or conservation ethic
- Energy efficiency actions promoted by PH and taken in the last 24 months
- Self-reported influence of PH on identified actions
- Demographics and housing characteristics

**Analysis**

There were four steps to the analysis: per-unit energy savings, modeling, bundling, and expansion. The following sections describe each step in greater detail. There is also a section dedicated to the EEA factor, which played an important role in the analysis methodology.

**Per-unit energy savings.** The authors used engineering analyses to determine the per-unit energy savings for each of the 63 measures that were installed by viewers. To determine energy savings for measures rebated by the utility, the analysis used existing prescriptive savings estimates and assumptions where possible. The rebate tracking database was used to determine "average" savings, which provided two benefits: the method produced household-level savings estimates rather than unit-level, and it produced estimates that inherently included things like the average HVAC capacity, average square footage of insulation installed, etc. To determine energy savings for measures not rebated by the utility, the analysis used secondary source review and engineering best practices.

Some assumptions were necessary to complete the savings estimates.

- If a customer reported installing "high efficiency" equipment, the analysis assumed the equipment was of sufficient efficiency to qualify for a utility rebate. This assumption would tend to bias the result toward higher energy savings.
- The analysis needed to assume a frequency for behavior change measures such as turning off lights. The frequency assumptions were tested with self-report responses from the survey instrument and judged to be reasonable.

**Modeling.** There were two models used in the regression analysis. The first determined a customer's propensity for viewing PH based on several demographic variables and the EEA factor, which is discussed in greater detail in the following section. It produced a viewer correction factor that was used in the second set of models, which determined the effect of PH viewing on the energy savings resulting from a customer's energy-related actions, controlling for their propensity to view PH. The second set of models estimated the amount of energy savings

attributable to PH viewing while controlling for the other variables in the equation. Combined, the models predicted the influence of PH on energy action while controlling for inherent EEA with the PH viewing audience.

**Energy Efficiency Attitude factor.** The Energy Efficiency Attitude (EEA) is the analysis proxy for conservation ethic, or a pre-existing propensity for energy efficiency that might cause someone to both view PH and be more likely to install energy efficiency measures. The EEA is a score from 1 to 10 that combines respondent attitude and knowledge. On the attitude side, the respondents were asked to respond to three statements on a scale of one to five, where one is strongly agree and five is strongly disagree. The average of the scores was used for the attitude portion of the EEA. The three statements were:

- Conserving energy is important to me.
- I want to reduce my household energy use to protect the environment.
- I want to reduce my household energy use to lower my energy bill.

On the knowledge side, the respondents were asked three questions, each of which was assigned a certain number of points.

- Respondents received one point if they were aware of ENERGY STAR.
- Respondents received two points if they correctly identified "Insulation" as the measure (of three choices) that saves the most energy.
- Respondents received two points if they correctly identified "Turn off lights" as the measure (of three choices) that saves the least energy.

The final EEA score was the sum of the knowledge questions added to the average of the attitude questions.

**Bundling.** Ideally, the analysis would have been done individually on each of the 63 measures installed by PH viewers. However, the incidence rate of each variable was not sufficient to produce viable results; therefore, the measures needed to be bundled into larger groups. It was important to do the bundling in a way that would enhance the utility's ability to interpret the results and allow them to report energy savings. Therefore, at minimum, the analysis needed to separate in-rebate program measures from uncounted savings and electricity savings (kWh and kW) from natural gas savings (therms). The authors also needed to group measures in such a way as to reduce the variance in the group, which would increase the likelihood of getting statistically significant results. Ultimately, the measures were divided into 7 end-use categories: appliances, building shell, electronics, HVAC, lighting, water heating, and other. The "other" category included measures such as PV or planting a tree to save energy.

**Expansion.** For each analysis group, the regressions produced an estimate of the per-viewer energy savings attributable to PH. If the regression result was statistically significant, it was multiplied by the estimated number of viewers to produce the energy savings estimate for that analysis group. If the regression result was not statistically significant, the savings for that analysis group were judged to be zero. For example, the regression model produced a statistically significant per-viewer energy savings estimate for non-rebated kWh savings in the appliances

end-use category, which was multiplied by the number of viewers to produce the total attributable non-rebated kWh savings attributable to PH for appliances. The results were summed across end-used categories to produce the total kWh, kW, and therm savings for in-program and non-rebated measures.

## Evaluation Results

There were three major inputs into the regression models: viewership, measure adoption rate, and EEA, described in the following sections. The models produced the final savings results, presented in the fourth section below. The last section describes the key uncertainties associated with the analysis.

### Viewership

The authors considered a respondent a "viewer" if they watched at least one segment of the show on television or online in the previous 24 months. Figure 1 shows the results. Nearly 30 percent of all respondents watched PH on television, the internet, or both. The vast majority of viewers watch the show on television. Program participants were slightly less likely to watch than non-participants, though the difference was not statistically significant.

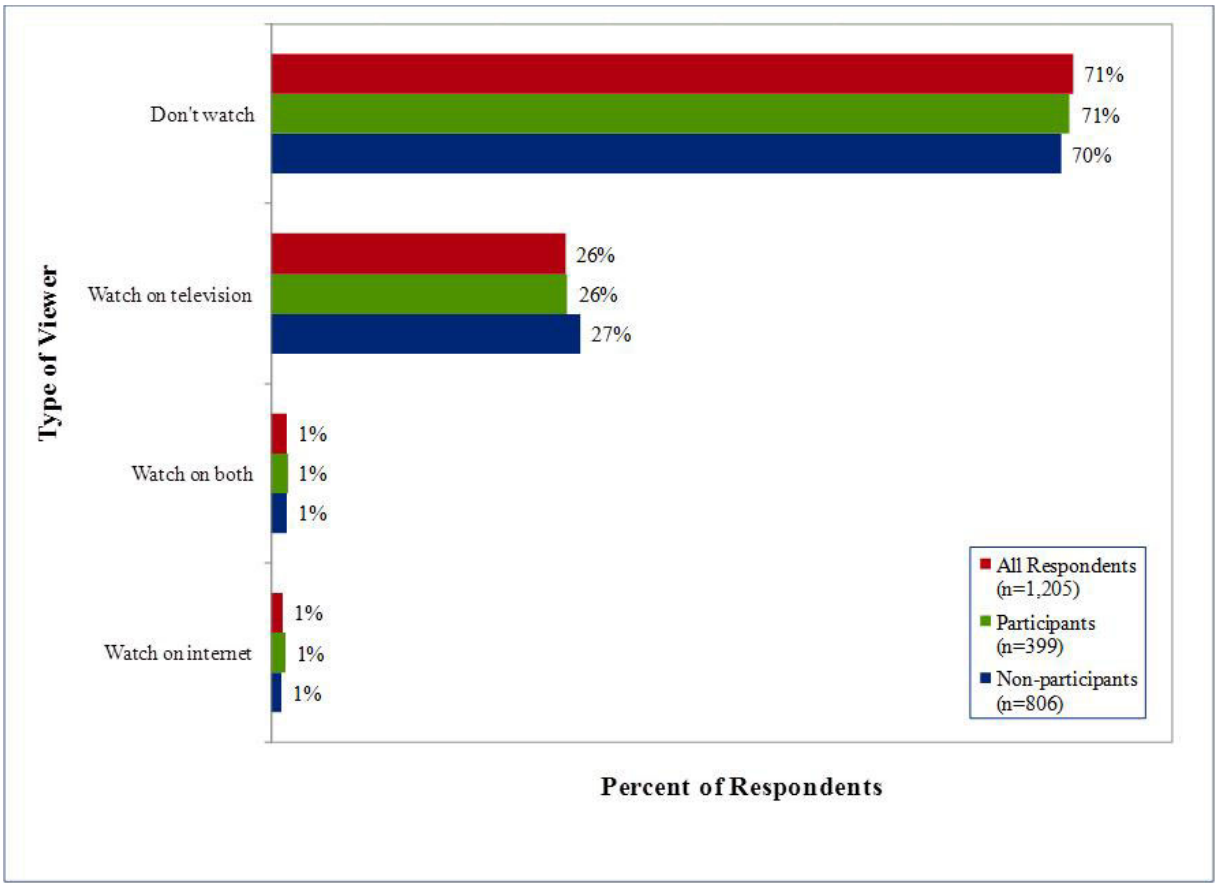


Figure 1. Percent of respondents who viewed PowerHouse. *Source:* KEMA 2013.

**Measure Adoption Rate**

Respondents were asked to identify the energy efficiency measures they had installed in the past two years. The two most popular measures installed for viewers were Replace Furnace Filters (58%) and Install CFLs (57%). Those were also the two most popular measures installed for non-viewers, at 50% and 38%, respectively. Viewers were more likely to install energy efficiency measures in all cases except those measures shown in Table 2, though the differences were not statistically significant at the 90% confidence interval.

Table 2. Measures with non-viewer adoption rates greater than viewer adoption rates

| | |
|---|---|
| High efficiency furnaces | Tankless water heaters |
| Pipe wrap | Solar hot water |
| Maintain dryer vents | Requisition an energy audit |
| Unplug appliances | |

Differences were not statistically significant at the 90% confidence interval

Measures that did show a statistically significant difference in adoption between viewers and non-viewers are shown in Table 3.

Table 2. Measures with statistically significant differences in adoption rate between viewers and non-viewers

| | |
|---|---|
| High efficiency window air conditioners | High efficiency boilers |
| Replace furnace filters | Set-back/up thermostat |
| Install CFLs | Install lighting controls |
| Turn off lights more frequently | High efficiency windows |
| High efficiency doors | Weatherization |
| High efficiency storage water heaters | Low flow showerheads |
| Faucet aerators | Wash clothes in cold water |
| High efficiency refrigerator/freezer | High efficiency clothes washer & dryer |
| High efficiency dishwasher | High efficiency television |
| Smart strip | High efficiency DVD player |
| Plant trees for energy efficiency | ENERGY STAR new home or high efficiency addition |
| PV solar panels | |

Significance tested at the 90% confidence interval

A statistically significant difference in adoption rates does not indicate a statistically significant result from the regression models. However, the end-use categories that DID produce statistically significant regression results are well represented in the list above (see below for further details).

### Energy Efficient Attitudes

The analysis produced an average EEA score for viewers of 6.84 and for non-viewers of 6.22, a difference that was statistically significant at the 90 percent confidence interval. The result proves the original hypothesis that PH viewers are subject to influences which both increase their likelihood to install energy efficiency AND increase their likelihood to watch PH. In other words, non-viewers do not represent what viewers would do in the absence of the program.

### Savings Results

The analysis produced statistically significant energy savings for non-rebate program electric measures only. This does not mean that PH is not influencing people to participate in the utility energy efficiency programs or install measures that affect gas usage; it simply means the analysis results were not statistically significant. Four end-use categories were affected; for kWh, the analysis produced statistically significant savings in Lighting and Electronics. For kW, the analysis produced statistically significant savings in Building Shell, Electronics, HVAC, and Lighting. Overall, the annual energy savings found through the analysis were approximately 1.2 million kWh, which is roughly equivalent to the utility's home energy audit goal, and 4.3 MW, which is roughly half of the residential portfolio goal.

### Key Uncertainties

There are five key uncertainties associated with the study results: CFL savings, self-identified energy efficiency, recall, self-responses, and model fit.

**CFL savings.** The analysis was unable to determine whether savings from CFL measures should be considered in-program or out-of-program. The state has an upstream lighting program that buys down the cost of CFLs for most CFL retailers in the state, but not all. The end-user participants of the CFL upstream program cannot be matched to the survey data, and in many cases the end-user participants are not aware that they are participating and so cannot self-identify as participants. If CFLs were considered in-program, the Lighting group would no longer be statistically significant and the energy savings would drop by approximately 80 percent.

**Self-identified energy efficiency.** The analysis chose to assume that respondents who self-identify as installing high efficiency equipment installed equipment that would qualify for a utility rebate. The assumption may not be true; for example, someone replacing a SEER 10 air conditioner with a SEER 13 air conditioner may consider it high efficiency because it is better than their previous equipment; however, it would not qualify for a utility rebate. The assumption would tend to bias savings upward.

**Recall.** The survey asked people to identify viewership and measures installed within the previous 24 months. Respondents may not be able to accurately report actions in such a long time frame.

**Self-responses.** Studies show that respondents may answer questions in a way that reflects perceived social norms rather than the truth (McRae 2002).

**Model fit.** The data available for the regression analysis was too variable to be fully explained by the model used in the analysis; however, a more appropriate model was out of project scope.

## Conclusions

Behavior programs have been touted as "the next big thing" in energy efficiency program portfolios, replacing CFL programs and producing large energy savings at low cost. Though the programs themselves are not new, the evaluation of such programs has often been difficult because the savings are small and it is difficult to separate the effect of free riders.

This paper describes a television show produced by a Midwestern utility that acts as an education-based behavior program. The television show encourages people to install energy efficiency through demonstrations, how-to segments, and introduction to new, efficient equipment. A recent evaluation study showed that the education and information provided by the television show and website influenced the installation of energy efficiency measures.

The study developed and used something called the Energy Efficiency Attitude factor to control for the underlying conservation ethic that both caused people to watch the television show and install energy efficiency measures, effectively eliminating the free riders through a regression and producing net energy savings.

Based on this study, a similar program may be able to achieve viewership greater than 25 percent and energy savings equivalent to a basic home energy audit program.

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