Virtual Audits: The Promise and The Reality

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Abstract

In recent years a new service offering, virtual audits, has appeared in the market, which claims to provide energy audits on buildings at a faster rate, and a lower cost by completing the audit virtually. Several vendors offer this service, and have directed their marketing efforts at the utility and Federal sector. This paper examines claims made by purveyors of virtual audits against the reality. Positive aspects of virtual audits include: lower cost, less time required of building employees, faster audits, and better aggregation of results. Negative aspects of virtual audits include small number of energy efficiency measures found, lack of specificity on measures that are found, and inability to properly cost the measures. This paper presents the inherent shortcomings of virtual audits, and suggests the net effect of deficient audit reports on the building owner.

Introduction

A good energy audit can be a valuable guide to making the best building energy efficiency investment decisions. When the most cost-effective energy efficiency measures (EEMs) are identified and implemented, the facility owner will have made the smartest choices, and will receive the greatest return on investment. When the best EEMs have not been identified and implemented, then the opportunity for reducing utility costs will have been squandered, and the facility owner will suffer financially as a result. Generally, the more seasoned and skilled the energy auditor, the better the energy audit.

With the advent of advanced databases and the availability of electricity interval data, new software and services are now available that provide some impressive analysis of building energy usage. One of these new services, virtual audits, offers inexpensive energy audits, an attractive online presentation, and may be capable of providing fast analysis of individual buildings as well as building portfolios, all without an energy auditor having to set foot on site.

The question addressed in this paper is whether companies that provide virtual audits are making claims that are unsupported. The main claim is that a virtual audit can produce a valuable and actionable energy audit, at low cost, without having an energy auditor set foot on site. This paper endeavors to evaluate these potentially overreaching claims.

The Promise of Virtual Audits

Virtual audits may potentially fill a market need, as traditional energy audits that require on-site inspection can be perceived to be too expensive. The high price of an energy audit often serves as a bar, preventing many facility owners from having them done. The auditor might spend one or many days on site, and often requires hours of the facility staff's time, which also costs money.

Virtual audits require only electric interval data, gas bills (which are optional), and the address of the building. Virtual audits sell for a fraction of the cost of traditional audits. In addition, virtual audits do not tie up busy facility staff for hours. The virtual audits may be presented on a web portal with attractive graphics, utility usage analysis, benchmarking, and the virtual auditing company might even offer measurement and verification on the same platform.

How the Analytics Model Works

Although their marketing material may stress new technology (namely powerful analytics, new developments in computer power and the successful utilization of interval data analysis), the actual methods employed by these companies rely heavily on an off-site survey that is similar to a telephone audit. Using a question and answer format, they seek to uncover energy efficiency opportunities. The survey may be conducted online or on the telephone and asks many questions about the facility, such as: construction type, age of facility, occupancy hours, BAS type, and what control strategies are in place. These types of phone calls or surveys can be useful and can identify energy savings opportunities.

Virtual audits also employ software to analyze 15-minute electric interval data. The software uses algorithms to break out utility usage into end uses, such as lighting, pumping, and HVAC fans. The software can also identify potential EEMs and some potential areas of waste, such as lighting and HVAC schedule problems.

An energy engineer will then interpret the results and may dig deeper into the data to find more potential measures, and disqualify any that the software inappropriately recommended. During this stage, the energy engineer may also contact the facility manager or engineer to talk through questions that present themselves.

Once an analysis has been completed, and a list of measures has been created, the virtual auditors may meet with the client (usually in a web conference) to discuss the measures found and the next steps the client should take.

After the measures are presented, it is suggested that the client call an appropriate contractor to implement the measures. The contractor will then determine counts of equipment to be replaced, or in some cases, the exact issue(s) causing the excessive energy usage, and will then put together a proposal and price to remedy the situation.

Strengths of Virtual Audits

EEMs are identified quickly. Virtual audits are able to identify EEMs quickly. While audits sometimes take 30 to 60 days to produce, a virtual audit can be done in just a fraction of the time.

Audits are provided at a fraction of the cost. There is no dispute that virtual audits are less expensive than traditional audits. For entities with a large portfolio of buildings, the cost savings associated with virtual audits can be substantial.[1]

Reduced staff time needed. Most facility personnel are very busy and have very limited time available to spend with energy auditors. Rather than spending hours walking auditors around the

[1] This claim is true only if it is assumed that the virtual audit will be able to deliver actionable recommendations. If further study is required before EEMs can be installed, then this claim may not be valid.

building, an online survey or telephone survey with the virtual auditors provides a quick and easy method to convey information about the building.

Presentation of data from multiple buildings. Many customers of the virtual audit companies are responsible for a large portfolio of buildings. Trying to review and track energy efficiency projects from a stack of separate reports is difficult and time consuming, if not outright impossible. The analytical engines are able to compile hundreds of virtual audit reports into one powerful interface that provides managers with an easier method to review and track EEM opportunities and energy usage characteristics of their buildings. Imagine having one thousand buildings to track, and being able to see an aggregate energy balance, which breaks out energy usage into lighting, cooling, etc. These web interfaces can also report the frequency of EEM types, which types of buildings or regions are associated with different EEMs, etc. The information presented on these tools helps managers prioritize sites, track projects and evaluate the results.

Shortcomings with Virtual Audits

On the other hand, using virtual audits exclusively to in place of traditional audits has significant weaknesses.

Limitations of the survey/interview. A critical component of the virtual energy audit is the survey. In a typical virtual audit a facility manager answers a questionnaire, either online or by phone, about the building energy using systems. There are some shortcomings with this approach:

Most facility personnel are very busy and this can hinder the effectiveness of a remote survey. When the audit involves an online survey, there will be many facility managers who will answer the survey as quickly as possible, and in their hurry may either misinterpret questions, or skip the questions that require more time. If the survey is too long, the facility manager will be less likely to complete it. If the survey is too short, less building information can be collected. In our own experience, we have sent out pre-site visit questionnaires, only to have them returned nearly blank, with very little effort taken. Some are not even returned. When the energy auditor is there in person, it is easier to get the attention of facility operators, and get the needed information.

The other problem with remote surveys is that the facility manager's answers are not verified by actual observations. As every seasoned auditor knows, facility operators' understanding of their buildings varies greatly. Some are very knowledgeable, but many are not intimately familiar with their buildings because they are new to their jobs, at too high a level to know the actual workings of the building, or too busy to stay on top of all the changes.

In traditional audits, after the in-person interview, we then inspect the BAS and the HVAC equipment, and that is where we find out how accurate the facility manager has been. We have encountered facility managers trying to conceal their lack of knowledge. We have run across facility operators giving answers that they think we want to hear, and in rare cases, operators outright lying to us. How is a virtual audit going to determine the accuracy of the remote interview?

A virtual energy audit is highly dependent on the assumption that the answers given in the remote interview accurately represent the building. We believe that in a large percentage of buildings, this is just not so.

One common problem with military bases is that the facility operators and technicians rotate every 2 or 3 years. These facility operators may never get the time to actually learn how the buildings work. We have also run across many buildings where the person who knew the systems had just retired. There were no drawings of the buildings, sparse records of all the renovations, and nobody knew anything about the HVAC. In either of these cases, who is going to answer the remote survey? What value will they be able to provide? How valuable will the virtual audit be for these buildings?

To summarize, when the majority of the data collection associated with the virtual audit is associated with an online survey or telephone interview, there is a great likelihood that the collected information is neither accurate nor complete. If the virtual auditor's knowledge of the building is based on inaccurate and/or incomplete information, how is the virtual auditor to develop a list of EEMs appropriate for the building?

Limited list of measures. There are some EEMs that are nearly impossible to identify with only interval data and a remote survey. An auditor really needs to see the problem with his or her own eyes. The list of these possible measures is actually quite long and only a few are listed here.

- Temperature sensors out of calibration or poorly placed
- Questionable control strategies, overridden set points
- Stuck chilled water or hot water valves
- Daylighting
- Water loops with partially closed throttling valves

We have seen three virtual audits, and they had three, three, and six EEMs identified in the reports. In contrast, when we perform energy audits, we typically have a difficult time keeping the number of EEMs under 15, and have turned in reports with over 30. Providing a comprehensive list of measures is a critical component of any audit. Because an energy auditor is not onsite, virtual audits cannot produce a comprehensive list of EEMs.

Identifying which items are problematic. Another issue with a virtual audit is that it is unable to determine the exact actions that need to be taken. Suppose that a virtual audit identifies that there is not enough free cooling being utilized in the building. Although this is a useful insight, there are still many questions that need to be answered concerning the root cause of the problem. Could it be that:

- The ducting is too small to allow in sufficient outside air for free cooling?
- The economizer dampers are rusted in place?
- The damper linkages are faulty?
- The actuators are broken?
- The pneumatic lines have been disconnected from the actuators?
- The economizer programming is faulty?
- The economizer setpoints in the BAS have been overridden?
- The outside air temperature sensor is not reporting?
- The BAS is not communicating with the AHU controllers?

Each of these different issues would lead to the AHUs not providing free cooling. The answer could be any one or a combination of these root causes. A remote audit could not make that

determination, and instead can only provide vague guidance, such as, economizer control should be implemented. This is where the added expense of a traditional audit provides real value. The audit should identify exactly what needs to be addressed.[2]

Furthermore, it is not unusual for a large building to have 50 or more AHUs. Suppose a large number of these AHUs have economizer issues, and that the virtual audit is able to identify that there is insufficient free cooling. Not only will the remote auditor not know what types of economizer issues need to be addressed, the remote auditor will not even know which, or how many, of the 50 AHUs have economizer issues. A real energy audit will recommend specific remedies calling out specific AHUs that need attention, while a virtual audit can only generally identify a problem that needs to be addressed. This becomes very important when it comes to costing the EEMs, as will be addressed later.

Limited measure descriptions. EEM descriptions in virtual audits are brief. A typical EEM description will have one or two sentences. These descriptions are likely short because there is not enough detail known to provide fuller EEM descriptions. Many types of information are missing: what equipment is to be installed, a description of the proposed control sequences, and which pieces of equipment need to be addressed (i.e. which fixtures, which AHUs).

A simple example may be "Install occupancy sensors in office spaces and restrooms." On the surface, this measure is a good EEM. But in most cases, occupancy sensors are only cost effective when there are several fixtures on one occupancy sensor. Many smaller private offices would not be cost-effective choices for occupancy sensors. But not having seen the spaces, the virtual auditor would not be able to identify which spaces should have sensors installed.

It is best when EEM descriptions are detailed. This way contractors will know exactly what needs to be done. Short EEM descriptions can lead to improper implementation of the measures by the contractor, which can severely limit energy savings.

Construction contractors are not energy experts. One virtual audit company explained to us that after a problem is found, then the client would pay a contractor to identify the underlying issues, provide a quote, and then implement the remedy. For this reason, there is no need to provide specific EEM descriptions, as the contractor, an expert in their field, will determine what needs to be done.

Ask any energy engineer with a decade or more of experience, and they will tell you that most contractors are not trained to identify and implement energy conservation measures. They do know how to install a specific piece of equipment and how to make it work, however they need instruction on how to make it work in an energy efficient manner. In a case where a virtual audit identifies excessive cooling usage but is unable to identify the problem, a chiller contractor might recommend a new chiller, a controls contractor might recommend new controls, etc. Contractors are typically not the right people to identify energy efficiency strategies. They are very knowledgeable about their field, often knowing more in their specialty than the energy auditor, but their area of expertise is narrow. Someone is needed with a building-wide, systematic approach who takes into account all of the systems. Only then can the problems be identified and remedied. This is a job for someone with experience in energy efficiency and auditing, which is not a typical contractor.

[2] In fact, if the lack of free cooling is due to poor HVAC design, with outdoor air ducts being too small to allow in sufficient outdoor air, then there may not be any feasible EEMs to implement, as re-ducting the building could be prohibitively expensive.

Inaccurate measure pricing. Building owners will typically use a financial metric, such as simple payback or life cycle cost, when determining which EEMs to implement. These financial metrics are calculated using both energy savings and implementation costs as inputs. For accurate financial metrics, you need accurate energy savings and accurate costing. They are equally important.

To determine accurate costing, the auditor must know what exactly needs to be repaired, replaced or installed, and how many units need to be addressed, not to mention deal with problems of access or whether new controllers are needed. As we have already stated, a virtual audit cannot provide this information. Instead of providing a good estimate of costing, virtual audits may provide a cost range. In our previous example about economizers, the cost range would be between releasing BAS overrides of outside air percentage (perhaps $25 per incident) to replacing rusted dampers (up to several thousand dollars each). Still worse, in this building of 50 AHUs, how many of them need to be addressed? The cost range for this example can range from a few hundred dollars to tens of thousands of dollars. Wide cost ranges like this render the financial metrics of little value to the facility owner. In this example, the simple payback might range from 0.1 to 20 years. So how is the client to assess the viability of this EEM, or better, select the best EEMs to implement if they cannot get an accurate financial metric?

Conclusions

Though virtual audits can be a powerful tool, there are a number of reasons why traditional auditing methods are still necessary. One of the biggest weaknesses of virtual audits (and poorly done traditional energy audits) is that the best EEMs are often missed. This has two negative impacts. First, the facility owner will devote limited resources on measures that are not going to provide the best results. When the best EEMs are overlooked, the facility owner will end up investing in second-tier solutions and receive less return on investment. Second, when the virtual audit reveals few EEMs, the facility owner may be left with a sense that their building is actually quite efficient with limited opportunities to save energy. The owner will be, in essence, leaving money on the table by not implementing EEMs that the virtual audit did not identify.

Virtual audits can identify some EEMs, but cannot accurately estimate the energy savings or costs, because the specifics of the problem at hand are not known, so savings and cost estimates are given as a range of values instead. This inaccuracy makes it difficult for the facility owner to determine which EEMs would be most cost-effective to implement, again with the result that, the facility owner, heeding the advice of the virtual audit may end up implementing EEMs that in reality have higher simple paybacks, while those with lower simple paybacks are overlooked.

An energy audit, by definition, provides expert guidance so that the facility owner makes the best energy efficiency investments. If the energy audit provides poor guidance, and the owner is misled into making second-tier investments, then the audit proved to be, if anything, a detriment to the owners' sound financial decision making. When relying solely on a virtual audit, an owner is very likely to be led into making poor investment decisions. In this case, the audit provides the opposite of its intended function, to the point that the owner might have been better off with no audit at all.

Authors

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