Developing ASHRAE's First Standard for Commercial Energy Audits (Or; How I Spent My Summer Vacations)

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ABSTRACT

The business of performing energy audits has long lacked any regulation or standardization of approaches. What makes an energy audit acceptable, good, or great has been the subject of much discussion and debate. And what are considered best practices in the field has been akin to an oral tradition, where practitioners in the field pass knowledge and approaches from person to person.

In June 2018, ASHRAE released its first standard for energy audits in commercial and multifamily buildings. The author will share the results of the development of this first true industry standard, describe some of the contentious issues encountered, and summarize what the energy auditing community agreed upon for the requirements of Level 1, 2 and 3 audits.

There are several additions to ASHRAE's prior guidance (from a publication, not a standard) that are significant improvements over common energy audit approaches. The committee included means to submit recommendations, savings estimates and historical billing data electronically using the BuildingSync Schema. The standard also requires summary data validation to ensure that estimated savings are reasonable.

The author will also discuss the standard-setting process and what happens when you try to bring engineers, policy-makers and contractors to consensus in an ANSI governed setting.

Background

The energy audit industry has been a largely unregulated one, and the work products that are labeled "energy audits" vary greatly in scope, rigor, and quality. Our hope with ASHRAE Standard 211 is to establish minimum performance levels for energy audits and bring some order to the chaos. Prior work on the first and second editions of ASHRAE's Special Publication "Procedures for Commercial Building Energy Audits (PCBEA)" (aka "the green book") (ASHRAE 2011) has helped to define terms, and Levels 1, 2, and 3 are now commonly used in the U.S. and abroad as a shorthand for audit scoping. However, the prior work was not written in code enforceable language, and the "green book" left much room for interpretation.

Our intent in preparing this standard is to bring additional definition to the level descriptions within the "green book." With an increasing number of mandatory energy audits required by cities around the U.S., and a critical need to reduce the energy footprint of our building stock, there is a need for more closely ensuring audits are held to the appropriate level of quality, rigor, and depth. Greater consistency in approach also holds the promise for lowering costs if energy auditors can establish consistent reporting rather than custom approaches that are often required by different clients.

Prior Guidance

ASHRAE first published guidance on energy audits in 2004 when it released the first edition of Procedures for Commercial Building Energy Audits (ASHRAE 2004). It was short but made a big impact mainly due to the popularity of the terminology. It categorized energy audits as Level I, Level II and Level III – an idea that matched a need for a shorthand description of audit depth. That idea stuck, and although we've since changed the nomenclature to Levels 1, 2 and 3, that concept has been very popular.

The main problem with the "ASHRAE Audit Levels" shorthand is that the document that defined them (later updated in the second edition, released in 2011) provided a lot of leeway for interpretation, which has led to a lot of confusion. Adding to the confusion is that referring to Levels 1, 2, and 3 was such an easy concept to grasp and communicate, that a lot of people seemed to decide that they didn't really need to read the publication, and misinterpretations of the guidance document were many.

Need for a Standard

In 2012, New York City published what's known as Local Law 87 – the first mandatory energy audit program for commercial buildings in the U.S. Other cities followed New York's path. The laws were clear in describing which buildings required audits, and many referred to the "green book" audit levels as a de facto standard for the depth and rigor of those audits.

The principal problem was that the Procedures book was written more as a guidance document (officially it was actually a special publication), with less "teeth" than even an official guideline, much less rigorous than an actual ANSI Standard. So, the "green book" wasn't written in code-enforceable language (e.g. "the qualified energy auditor shall tour the building" vs. "the auditor will/might/may/can tour the building").

Furthermore, the "green book" left a lot of leeway for interpretation of many key points. For example, the requirements for a Level 1 "Walk-through Analysis" stated that it would include "the potential capital improvements, with an initial rough estimate of potential costs and savings." (It's important to note that this requirement has been removed from the standard's Level 1 requirements.) The problem with this wording is that it's unclear what is meant by "a rough estimate of potential costs and savings". Does this mean a range of typical costs for implementation, or a typical payback period, a percentage reduction, or a qualitative "low, medium, or high"?

These uncertainties have led to a wide variety in the costs and quality of energy audits, and some segmentation of the market, especially in cities with mandatory audit programs. There are many building owners who are not interested in making investments in energy efficiency, and they are simply meeting the city's requirement. These customers will choose the cheapest bid that they receive, which has driven down energy audit prices for this part of the market so low that one wonders if the audits they receive could possibly afford the time and experienced staff to produce energy and cost savings estimates with any real validity. I've spoken with six experienced energy auditors from New York City, and all of them report that this pressure is real, and has adjusted cost expectations, even among sophisticated customers who expect to implement energy efficiency measures.

Energy Audits Aren't "Half Right"

The author posits that the value vs. cost relationship is not a linear one, and, in fact, it has a cliff on the low-cost side. In other words, if the client pays half as much for an energy audit, he or she doesn't get half the value, they might not get any value at all. That's due to the fact that audit recommendations are often evaluated on economic and feasibility criteria first. The industry is moving away from that kind of thinking but it's still quite pervasive. If your energy auditor can't spend the time needed to properly assess the costs and benefits, the recommendations may be on very shaky ground. If the auditor spends half the time on the audit, their recommendations are not half correct, their wrong. The new energy efficient chiller won't halfway fit through the door to the mechanical room, it simply won't fit. The measure that the client would do if the simple payback was two years, has a simple payback of eight years if the actual savings are half as much as expected and the estimated costs were half the actual ones. Most of our clients wouldn't pursue a measure with those economics.

What's the Same? The Intent of Levels 1, 2, And 3

The core of the new Standard is the definition of the energy audit levels themselves. The committee began with a common understanding for the purpose of those audit levels. While this summary is the author's own interpretation of how audits are used, it's informed by hours of discussion among committee members. The standard simply defines what it required, not how it is to be used.

- Level 1: To assess the potential at a given site with a brief, low-cost, qualitative study
- Level 2: The real "energy audit" with site-specific recommendations of energy efficiency measures, including low-cost and those requiring significant investment, informed with site-specific energy cost savings, estimated implementation costs, and simple economic metrics (e.g. simple payback and simple return on investment).
- Level 3: Reducing risk through project development using measurement, modeling, draft specifications, drawings and life-cycle cost analysis (LCCA) to reduce uncertainties.

In the "green book" each audit level had a title that set the tone for the level of depth. In the standard, we chose to drop those titles for simplicity and clarity. The prior titles were; (1) Walk-through Analysis, (2) Energy Survey and Engineering Analysis, and (3) Detailed Analysis of Capital Intensive Modifications. Had the titles remained, they had the potential to confuse the more-specific requirements of the procedures and reporting requirements.

Objectives: Title, Purpose and Scope

Every ASHRAE standard begins by defining the title, purpose and scope (TPS) of the standard. It's worth reviewing these important sections in detail as they form the foundation of the standard itself. I've directly quoted all three below.

Title

The document will be cited as the "ANSI/ASHRAE/ACCA Standard 211-2018."

Purpose

Directly quoting the standard, which is self-explanatory (yet every word chosen carefully) (ASHRAE 2018):

The purpose of this standard is to establish consistent practices for conducting and reporting energy audits for commercial buildings. This standard

a. defines the procedures required to perform Energy Audit Levels 1, 2, and 3;

b. provides a common scope of work for these audit levels for use by building owners and others;

c. establishes consistent methodology and minimum rigor of analysis required; and

d. establishes minimum reporting requirements for the results of energy audits.

The authoring committee wrote the standard while considering two primary uses:

1. For building owners as a means of specifying a defined scope for an energy audit of their facility(ies) while ensuring a common scope and level of rigor under contract or through a competitive bid.
2. For government agencies who require energy audits within their jurisdiction.

The committee attempted to serve the needs of each of those use cases at a minimum, though expected a broader application in the industry.

The SPC also attempted to maintain the standard as a minimum performance standard and not as a guideline for best practice. In many cases, best practice goes far beyond the minimums required within the standard.

Scope

As implied in the title, the scope was intended to be "commercial buildings" although, to be consistent with other standards we relied on the more verbose, yet technically-precise language:

This standard applies to all buildings except single-family houses, multifamily structures of three stories or fewer above grade, manufactured houses (mobile homes), and manufactured houses (modular).

During development, the scope of the standard was expanded to include multi-family buildings in response to requests from a number of stakeholders.

Avoiding Negative Effects on Resource Costs

The business of doing energy audits is a constant balance between opposing pressures between the level of effort that is required to reliably find energy savings and the costs inherent in hiring qualified and experience people to conduct an energy audit. One can think of energy audits in parallel with a supply-side option where energy auditors are essentially "mining" a resource of potential energy and demand savings in existing buildings. In fact, this is exactly the way costs for energy efficiency (EE) programs have been justified (at least in advance), through resource potential studies that focus on the theoretical availability of savings in building stock, and the cost per kWh (or less frequently per kW for demand). Studies of this potential in the US typically value the levelized cost of these savings between $0.02/kWh and $0.04/kWh and $0.35/therm (Molina 2014).

It's important to realize that cost is, like all costs in a free market, a response to pressures of the market. It reflects both the actual cost of "mining" the resource through energy efficiency program delivery and what the buyers are willing to pay. In this, that cost includes a lot of program activity beyond the energy audit itself, such as customer acquisition, administration, reporting and incentives. Therefore, the cost of what the market will bear for energy audits (at least as an EE program) is significantly less.

Using a simple "rule of thumb", one can conclude that energy audits are however, much more valuable than that to customers. One such rule is that the cost of an energy audit should, at most, add one year to the simple payback of the measures identified at the site. I like this rule because it scales based on the economic criteria of the client – the longer the payback that the client is willing to invest in (akin to a low discount rate), the "deeper" the auditor can afford to "dig" in the building to get to the resource. This is true even if you use a lower cost threshold – say for instance that the energy audit should uncover enough savings to pay for the audit activity itself in the first year. In other words, the cost of the audit should at least be as much as the annual savings of the projects identified. This price model effectively puts the value of the resource ($ saved) at the cost of supplied energy for the site, or about $0.10/kWh in the US, significantly more that the value provided to the energy efficiency program, or the cost that market is willing to bear.

This leads to the conclusion that most programs have come to – that energy audits aren't a good EE program strategy, except for larger buildings with high levels of savings that are easily (i.e. cost effectively) identified. Retro-commissioning and monitored-based commissioning programs come to mind, where the paybacks are very short, and the level of effort and investment is scaled back to the most cost-effective of measures.

In developing the standard, the committee members were inherently aware of the balance between the energy audit level of effort and its impact on the time spent on the audit, and ultimately the cost of that audit. The members were keen to not add undue (i.e. unproductive) effort to the audits that would increase the cost of the resource (savings) to the client, without added value to them. This was probably the major work of the committee, developing a compromise between the needs of various stakeholders. In particular, cities and counties who require energy audits would prefer those audits to provide consistent data on their building stock and report those results in a standardized way. Energy auditors and other audit customers were, however, wary of any "extra" activities that would add cost without an associated benefit to the end user client. In the end, the standard probably went farther than many auditors would have liked in this regard, and not as far as cities and counties would have liked in terms of standardization—the essence of compromise.

Another pressure on costs is simply the level of effort that is needed to do a "quality" energy audit. The resource has to be dependable and real. Too little effort, or too little knowledge and experience on the part of the energy auditor, and it's possible (and unfortunately common) for energy audits to fail in a variety of ways. Some of the most common audit failures are overestimating the potential savings of measures and underestimating the costs of retrofits.

Associated with the competing pressures above, there is an inherent pressure on auditors to "deliver", thus justifying their cost to the client and/or EE Program. It's natural that when the market is set up as it is, this is somewhat bound to happen due to the economic pressures of the situation – some auditors are bound to succumb to those pressures. Although I think there are few outright abuses, there are incentives for people to identify measures that either won't work, can't be constructed or will cost much more than they expect. In some jurisdictions, there are also rules that may push auditors the other direction. For example, if a city requires implementation of measures that meet specific economic criteria (e.g. a two-year simple payback), the owner may specifically seek an auditor who will make sure that they don't "find" any such measures. It's exactly these kinds of pressures of the market that we hoped to minimize through the development of the standard.

The New Standard – What's Changed

The Good, the Bad and Ugly on Energy Use Intensities (EUI's)

One of the basic requirements of the standard (and prior guidance from the "green book") is the requirement to compare the EUI of a building to a sample of "peer" buildings. The EUIs described here are simply the historical energy consumption of the building (in Btus or MJ) divided by the gross floor area of the building (in square feet or square meters).

The purpose of this "benchmarking" is to provide a simple comparison to the performance of other buildings. In the Standard, we gave the energy auditor the ability to choose from a number of sources, including ENERGY STAR (EPA 2018), ASHRAE Standard 100 (ASHRAE 2015), Building EQ (ASHRAE 2018-2), their own data for other buildings, as long as the method and sample size that was used is documented in the energy audit report.

We gave a lot of latitude for interpretation on this topic because one needs to be increasingly careful about how much to use that benchmarking for the real evaluation of a building. Finding building "peers" may actually be harder than it sounds and factors like occupancy schedule, weather, vacancy rates and sales (retail) may have a big impact on the EUI.

Furthermore, comparing EUIs inherently assumes that a low EUI building is "better" than a high EUI. However, promoting low EUI's favors, for example, underutilized buildings. A high-rise office building in a congested city might look bad because it had twice as many workers using the space than a more sparsely populated one. The efficiency of that building, if measure for example in economic terms like revenue generated per BTU (or ton of CO_2 equivalent), may be much higher that a sparsely populated, low-intensity building. We need to think about what behaviors to incentivize and make sure that our metrics encourage the right outcomes.

The discussion is further muddied by the current metering practices in the U.S. and the inconsistent treatment of onsite-site distributed energy resources such as renewables, cogeneration (or tri-generation of heat, cooling and power), as well as fuel cells. For example, photovoltaics (PV) in some areas of the country are required to be metered as a separate system at the grid intertie, whereas in other areas the PV is net-metered "downstream" of the utility meter.

These inconsistencies left us with little choice but to allow the energy auditor to report the EUI that was available to them, along with an indication of whether the EUI was at the "site" or "building" level. This designation was borrowed from ASHRAE Standard 105, that previously addressed the topic (ASHRAE-2014). The relationship is best summarized in the Figure 1 below, from the standard.

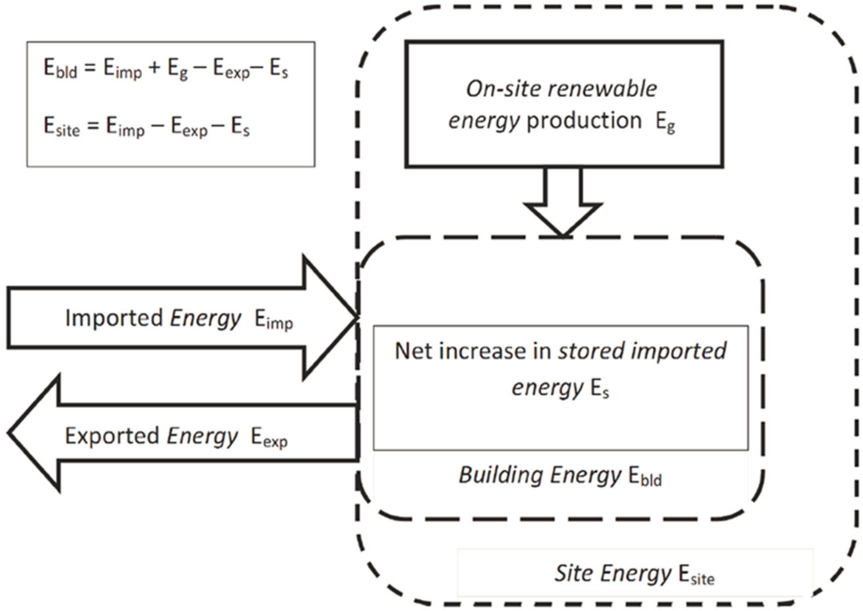

Figure 1 Relationship of site energy (Esite) and building energy (Ebld)

As you can see from the diagram, Ebld includes the metered production of on-site renewable energy sources (i.e. sub-metered PV is added to the total energy consumed in the numerator of the EUI) whereas Esite only looks at the net imports or exports of energy (i.e. the net-metered building). In two buildings with identical net building energy consumption where one building has renewable generation installed, the buildings will have the same EUIbld, but the one with PV will have a low EUIsite .

This issue begs the question as to whether we really care about Ebld anyway, or Esite—which one is the best target? Is it okay to "put lipstick on a pig" and compensate with poor building performance by installing renewables to compensate? Or do we want to incentivize building owners to improve efficiency first as a means of maximizing the cost-effective resources of both efficiency and renewables? As a committee, we left that for better policy minds than our group of (mostly) engineers to decide and, in any case, the decision was essentially made clear for us by the above-mentioned metering infrastructure. If we chose one method over the other we would essentially be condemning some building owners to installing added metering, just to report the EUI. As a committee, we didn't think that the value provided would justify that cost.

Level 1 Clarity

Level 1, as defined in prior guidance, was beginning to become an impossible task – identifying, and quantifying rough savings and costs for measures, with very limited time and at a low cost. The "green book" suggested "a listing of low-cost/no-cost changes with estimate saving for these improvements" and "an initial rough estimate of potential costs and savings" for capital measures. With all that information, why ever do a Level 2?

The committee felt that quantifying measure costs and savings, even for low-cost measures, was too heavy a lift for Level 1. Since it was supposed to be low-cost, auditors had to be very careful to set realistic owner expectations based on very little work. This is the nightmare scenario of high risk for very little reward. Since the effort is supposed to be low cost, this forced the auditor into a difficult choice; either underestimate the potential for savings, and the owner may choose to quick looking; or put in extra time to be sure the savings are there, blowing the budget and any chance for profit, and/or risk setting customer expectations that he has no way that he can, with certainty, meet.

The SPC chose to change the Level 1 effort to a purely qualitative assessment of measures, reporting only measures that might have potential and rough, simple economics of those measures. Auditors will report whether each of the following is "high", "medium" or "low".

- Cost
- Savings Impact
- Typical ROI
- Priority

As part of a Level 1, auditors are still required to review historical billing data, briefly assess rates, survey the facility, and benchmark the energy use intensity of the site.

Level 2 Specificity

The changes to Level 2 requirements were primarily with respect to specificity and enforceable direction to the energy auditor. The Level 2 is the most-commonly requested energy audit and what most people expect from an audit – detailed, site specific recommendations with reasonable estimates of economic return and feasibility. The main changes to Level 2 are in the areas of quality assurance and quality control (QA/QC), Reporting Forms, facilitating electronic reporting, and new requirements to assess Distributed Energy Resources (DERs).

Quality Assurance / Quality Control

One of the aspects of energy audits that is the hardest to control and regulate is that of quality. Everyone on the committee agreed that the training and experience of the auditor was one of the key attributes (more on that topic later). But beyond identifying that person, how to your control quality?

Consistency is not necessarily quality. I've heard a number of people complain that if you invite three energy auditors into a building to do energy audits, you'll get three very different reports, measures and savings. I find that approach to be misplaced attention. Would anyone expect that if you hired three different mechanical engineers to design the HVAC for a building, or three illuminating engineers to design the lighting, that you'd get the same lighting design? Engineers and energy auditors naturally gravitate to what they know will work because risks can be high and, like all of us, they prefer success to failure.

It's my opinion, however, that as an industry, energy auditors haven't really done much to improve the consistency of audits. I attribute this a little to the culture of the industry – energy auditors generally want the freedom to "follow their nose" or seek out energy savings where they typically find them. For us engineers in California, that's usually HVAC controls, lighting, and lighting controls. With our mild climate, those are the measures where we know we can find cost effective savings. In New York, that might be boilers, boiler controls, and lighting instead, simply due to the abundance of boilers and the heavy winters that necessitate them. This isn't wrong – it's necessary to know the local weather, and the systems that most often produce savings. It's important to spend time where the savings are. To follow our "mining the resource" analogy, you have to mine where the rich veins are, not mine everywhere and hope you get lucky. Standardization can be a threat to this approach if it requires California energy auditors to do boiler combustion tests and New York energy auditors to measure economizer effectiveness. Both of them are going to potentially be wasting half their time.

Instead the committee focused the standard on a couple of important, yet often overlooked quality control steps:

1. Compare your savings to that of your building and its end uses
2. Use the same approach for modeling pre- and post-installation savings

The first requirement is a simple one, that all experienced energy auditors do, but is effective a weeding out big mistakes and ridiculous savings claims. I think this is the single most important requirement of the new standard. It simply requires that you compare the savings of the measures that you recommend to the base-case energy consumption of the building, according to its historical bills. More specifically it requires you to compare the savings to the end use that is most directly affected. A related requirement requires that the energy auditor estimate the primary end use categories of the consumption (e.g. heating, domestic hot water for gas). So, if you say that the new insulation on the domestic hot water lines is going to save more energy than you estimated for the domestic hot water consumption, you'll get a red flag on the required QA/QC form.

The second requirement means that the same model or calculation must be used for pre- and post-installation calculations. In other words, if you model the building in EnergyPlus to determine your breakdown of end uses, you need to find savings for a window retrofit with that same model. Or if you're using spreadsheet calculations, you need to follow the same approach for base-case and proposed scenarios and calculate savings as the difference between the two. This rules out over-simplified methods such as "using a rule-of-thumb windows reduce your heating bills by 30%."

The second requirement isn't perfect – there are many measures that affect multiple end uses, sometimes adding load to one while reducing it elsewhere. However, the committee chose not to "make perfect the enemy of the good", which is appropriate for an industry that, until now has been completely unregulated.

Distributed Energy Resource Evaluation

One new aspect of the standard is that it requires a brief, qualitative assessment of the potential for distributed energy resources (DERs) and renewable energy resources (RERs). A qualitative assessment was deemed suitable to not overly-burden the audit cost. The evaluation of at least one DER and one RER is required.

Reporting Form Standardization

The Standard includes normative (i.e., required) reporting forms. These forms were a compromise in a sense, as many people and organizations have very different viewpoints as to what should be reported in an energy audit. We expect that the end user of the standard, be they building owners or local jurisdictions, may choose to implement the standard using these forms, by modifying them, or by explicitly not requiring their use, as they see fit. However, we included these forms in the standard for three principal reasons:

- They provide a minimum standardized reporting path to follow for local jurisdictions who do not have the resources to develop their own.
- They are designed to facilitate the use of electronic data transfer
- They require important quality control checks on energy savings estimates.

To be clear, the standard requires standardized "reporting forms", not standardized forms for collecting data on site.

Having standardized forms holds the promise of some cost savings in the audit process (although very modest). If auditors consistently use the same approach, they will become accustomed to them, and will develop efficient processes around them. This is in contrast to clients and jurisdictions that have differing requirements that require customized approaches every time one practices somewhere new.

BuildingSync Reporting

BuildingSync® (Alliance for Sustainable Energy 2018) is a common schema for energy audit data that can be utilized by different software and databases. It was developed, collaboratively through the efforts of three national labs under the Department of Energy (DOE) – Lawrence Berkeley National Laboratory, National Renewable Energy Laboratory and Pacific Northwest National Laboratory. The schema allows data to be more easily aggregated, compared, and exchanged between different databases and software tools. BuildingSync has the potential for streamlining the energy audit process, improving the value of the data, minimizing duplication of effort for subsequent audits, and facilitating achievement of greater energy efficiency(Alliance for Sustainable Energy 2018).

The focus of BuildingSync is on developing a language, rather than developing a tool. Those of us who've been doing energy audits for their whole careers have seen a lot of attempts to make the energy audit process more streamlined or automated. And most of those efforts have resulted in making things more cumbersome, rather than easier. I've seen several audit tools (usually created by software developers rather than energy auditors) that required way more baseline data than we normally collect. For example, a tool that we developed (prior employer) to do lighting audits, needed, not only a list of lamps, but a list of fixtures, ballasts, and lamp-ballast combinations, a rate library, etc. in order to accurately estimate energy and cost savings. Once you start building up all the possible combinations, the freedom of a clipboard and a blank sheet of graph paper is pretty hard to give up.

BuildingSync was developed to address the lack of an industry-standard collection format for energy audit data. Standardizing energy audit data can help energy auditors, software providers, building owners, utilities, and other entities by maximizing the value that can be obtained from each set of data - value obtained through collaboration, comparison, and reuse (Alliance for Sustainable Energy 2018).

SPC decided early in the process that we wanted to establish compatibility between BuildingSync and the reporting forms required by the standard. Both were under development at the same time, and we had members of our committee that fortunately were involved in both efforts.

We're only now getting around to using an XML schema for energy audit data and it's difficult to determine the optimum amount of definition and standardization. You want to go "deep" enough to provide value and bring some consistency to the chaos. But you also don't want to over-specify the language – you could end up unwittingly limiting what the conversation is about.

One example of this conflict is the issue of Energy Efficiency Measures. It might be tempting to define a set list of standardized energy efficiency measures, based, for example, on the type of equipment you see in the building. There could be a lot of power in doing so – it would allow you to compare energy savings for the same measures across various building types, occupancies, weather, etc. However, creating such an "enumeration" (in XML schema jargon) could also create problems. What happens when technology evolves faster than our language? We wouldn't want to limit the energy efficiency measures reported for a site simply to those measures that have been done in the past.

Another tricky part is the fact that the success of BuildingSync depends on the number of tools that adopt it and support data exchange through BuildingSync. gbXML (Green Building XML 2018) (not green button but green building XML) has reached the stage where many building design software tools support data exchange through its schema. But BuildingSync still has long way to go.

Level 3 – Minimizing Risks

The Level 3 energy audit is where the audit begins to turn the corner from identifying and evaluating opportunities, to minimizing risks by beginning the development of measure implementation. The Level 3 procedures in the new standard are summarized in less than a page, reflecting that this audit level still has the greatest opportunity for interpretation.

In my experience, it's rare for an owner to request a Level 3 audit as a first step, before a Level 1 or 2 can be completed. More often than not, we've simply increased the depth of the Level 2, while providing additional information requested by the owner to more carefully evaluate the move forward.

If a Level 2 has not been completed before starting a Level 3, the standard requires the steps of the Level 2 to be followed, in addition to following the required elements of a Level 3. These steps need only be completed according to the owner's criteria for implementation, whatever that may be.

- Develop a schematic diagram for the EEMs (except for like-for-like replacements)
- Measures must be analyzed using either measured data, building energy modeling or engineering calculations. Envelope measures must use building energy modeling – this is the only real way to analyze the important transient effects and complicated interactions among measures. If engineering calculations are used, they must rely on measure data for key baseline data.
- Costs of measure must be quotes from vendors willing to do the work for the price quoted or based on actual previous project costs for similar projects. There is an exception if other methods are approved by the building owner's representative.

- Life-cycle cost analysis is required for all measures and must include accounting for important factors such as escalation (or de-escalation) of expected energy costs, the time-value of money, utility and tax incentives, periodic replacements, other non-energy related costs or savings.
- A simplified risk assessment approach based on the impact of "key assumptions" on project economic criteria. For example, for a chiller replacement, the operating efficiency of the chiller will depend, in part, on the capacity of the cooling tower. If the tower is not being replaced, there may be uncertainty in how much capacity the old tower has, or will have over the lifetime of the new chiller. If a modest performance decrease in the tower results in a big impact on cost effectiveness, this could impact the choice of chiller among different alternatives.

The Level 3 analysis may not be necessary for some energy efficiency measures, such as those that have low risk or where the measure is compelling to the building owner for reasons beyond cost effectiveness. For example, tried and true cost effect measures like LED retrofits, don't really need this level of development, unless one wants to be absolutely sure of the retrofit costs before proceeding. Similarly, if a chiller has reached the end of its useful lifetime, and the owner prefers to maintain reliability at the site, you might choose to replace it, even if the cost is so high that the simple payback doesn't meet their typical criteria for investments.

Who is Qualified to do Energy Audits?

This question was the most contentious issue that arose in creating the standard. While the committee largely agreed that the knowledge and experience of the energy auditor is probably the single best determinant of the value of the audit, it became very hard to define those qualifications in a way that was acceptable in an ANSI-approved development process.

There are quite a few Energy Auditor "Certifying" bodies, each with emphasis on different criteria for experience and different tests for certification. It wasn't an acceptable ANSI practice for our committee to decide which of these programs are credible or not, so we had to find a means of "generically" approving certifications, rather than naming individual organizations themselves.

Fortunately, while the standard was under development there was a parallel effort at the Department of Energy to do just such high-level certification of programs. The Better Buildings Workforce Guidelines (BBWG) was developed to recognize programs that are accredited and in compliance with ISO/IEC 17024:2012 – essentially those who agreed to a structure for developing and administering certifications, as well as meeting additional experience and training requirements from BBWG for specific roles such as energy auditors, commissioning professionals, and energy managers. The BBWG was developed to recognize certification schemes by "identifying eligibility criteria and prerequisites, exam structures, recertification requirements, and other elements."

With this "generic" reference to certifications in place, the resulting definition for a "qualified energy auditor" is:

"an energy solutions professional who assesses building systems and site conditions; analyzes and evaluates equipment and energy usage; and recommends strategies to optimize building resource utilization. Experience must include completion of five commercial (non-residential) building energy audits within the past three years or a cumulative completion of ten or more commercial building energy audits. The auditor must be one of the following:

a) A person who holds a certification from a credentialing program approved by the U.S. Department of Energy Better Buildings Workforce Guidelines for Building Energy Auditors or Energy Managers.

b) A licensed Professional Engineer or a Licensed Contractor specifically approved to conduct energy audits by the authority having jurisdiction (AHJ).

c) A person approved as qualified by the authority having jurisdiction (AHJ).

Informative Note: For a current listing of certifications that meet the requirements of the DOE's Better Building Workforce Guidelines see the DOE's website at www.betterbuildingssolutioncenter.energy.gov/workforce/participating-certifying-organizations."

The above qualifications were essentially a compromise solution. As one might expect, no stakeholders want to be excluded from performing audits under the standard. Criterion "b" above is predicated on the fact that these are "licensed" professions, with associated ethics provisions as part of those licenses that prevent people from practicing outside their level of competence. They both carry the potential loss of license, a presumably severe punishment, for ethical violations and malpractice. Provision "c" is perhaps, in retrospect, redundant as the adopting agency always has the freedom and ability to modify a standard as they chose to implement it.

"Virtual" Energy Audits

Beyond the three levels of audits defined in this standard, simple benchmarking of energy performance is sometimes referred to as a "Level 0" audit. In recent years, other types of preliminary energy analyses have become more common, sometimes referred to as "virtual" or "remote" energy audits. The committee recognized that there is a role for these types of analysis for initial screening of buildings among a portfolio for the greatest savings opportunities.

There are a number of companies that now offer these audits or assessments, based upon great resources of available data such as interval meter data, online imaging, and other sources. Committee members felt that, while virtual audits may make a great first step, they are not to be considered a replacement for an on-site energy audit by an experienced, qualified energy auditor. Furthermore, the field is a new one, and the need for regulation or standardization of the field is not yet apparent.

Frankly, members expressed a great deal of skepticism about the efficacy of these audits. Given the kinds of auditing errors that committee members have seen that were based on actual site visits by consultants, engineers, vendors, and others (who had at least visited the site), it's hard to imagine those audits being very specific in terms of potential savings or costs of measures. However, I'll identify this as an opinion, not a conclusion based on evidence or experiment. Based on my own experience, there's no doubt that its possible, at least qualitatively, to identify types of opportunities based only on external data.

Conclusions and Next Steps

There is still room for improvement in the industry and Standard 211 is only a first step to structuring procedures and expectations in the world of energy audits. The Standard was written to clarify the differences among Level 1, Level 2 and Level 3 energy audits. Ambiguities from prior publications were eliminated so that the standard could be enforced, with clear boundaries of what is required for minimum compliance. Our primary audiences for the standard, cities with mandatory energy audit requirements and building owners looking for a standard scope of work, now have a clear and enforceable means of obtaining audits that meet the minimum specification of the standard.

The audit standard itself, and its associated forms have not yet been widely tested. For these reasons the SPC 211 committee has committed itself to developing a review schedule to publish updates as needed. The reporting forms themselves will be distributed for free on ASHRAE's website so that they may be updated more frequently than the text version of the standard itself. Though the standard is only a first step and there's uncertainty ahead, defining this important step is important in improving building efficiency and is critical to reducing our carbon footprint effectively by ensuring building owner's receive informed value.

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