Combining Deemed and Measured: The Modified Lighting Approach Blends Deemed and Measured Methodologies to Create an Alternative Model for Determining Energy Savings

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ABSTRACT

From 2009 through 2011, US ratepayer-funded utility energy efficiency programs achieved first-year energy savings of 32,749 GWh. Lighting retrofits were responsible for 44% of this savings or 14,409 GWh (LBNL 2014). But times are changing. New building codes mandate increasingly efficient and expensive equipment, raising the baseline for savings calculations. Simultaneously, regulators are increasingly focused on improving the accuracy of saving claims and increasing the rigor of project reviews. Within these new constraints, utilities are struggling to maintain portfolio cost effectiveness while also continuing to offer customers a viable value proposition. An alternative approach to calculating energy savings offers utilities a way to continue to realize a significant portion of portfolio energy savings from lighting retrofits.

The Modified Lighting Approach (Modified) combines elements of both Deemed and Measured savings estimation models into a hybrid system that delivers many of the advantages of traditional approaches while avoiding some of their drawbacks. Energy savings projections using the Modified approach are calculated for each project, yielding significantly more accurate values than Deemed, while allowing a much broader choice of replacement equipment. At the same time, the inputs and calculations used by the Modified approach are sufficiently simple so as to avoid much of the delay and cost typically required for Measured calculations. Because of this accuracy, broad equipment specification, and reduced review requirements, the Modified approach offers a compelling alternative for calculating energy savings as the country moves into a code-driven world of more efficient equipment and increased regulation on savings claims.

Introduction

The energy savings projections for lighting retrofits are typically calculated using one of two approaches: “Deemed” or “Measured” (US EPA). These two methods have been successfully utilized for many years to determine the first-year energy savings that will accrue if lighting retrofits are installed. The purpose of this paper is to describe the Modified Lighting Approach, an alternative method for determining energy savings projections. The Modified approach offers a middle path that fills some of the gaps of existing techniques, while offering a solution for continued lighting savings in an increasingly code-driven world.

Deemed: Average Savings Values For Simple Measures

Deemed savings is a method of estimating energy and demand savings that is typically used for programs that target simpler efficiency measures with established performance characteristics. This method involves multiplying the number of installed measures by an estimated savings per measure, which is normally derived from historical evaluations (Schiller

2007). These savings values are pre-determined average values based on savings across a range of buildings and equipment. Deemed savings values are an easy way to determine the energy savings projections for retrofits. Simply select eligible replacement equipment and building type, look up energy savings per retrofit, and multiply by the number of installed units to establish energy savings. The simplicity of the Deemed approach makes program delivery fast and simple, and has enabled utilities, program implementers, and contractors to save tremendous amounts of energy with reduced administrative costs.

Measured: Sophisticated Analysis, Accurate Calculations

Measured savings is an approach for calculating energy and demand savings that is typically used for larger or more complex projects, especially retrofits with significant impact to multiple systems within a building (HVAC, lighting, etc.). Estimates of energy and/or demand savings are calculated using different techniques, including metering and monitoring, statistical analyses, and computer simulation (US EPA). Measured savings are just that – individual custom calculations for each retrofit project. As opposed to Deemed programs, Measured calculations require trained staff and engineers to collect information and perform analyses to determine savings. Utility and regulatory groups then review these calculations to ensure accuracy, often before projects can be installed. Below is a generalized comparison of the current energy savings models:

Table 1. Comparison of energy savings estimation methods

	Deemed	**Measured**
Site-specific accuracy	Low	High
Breadth of measures	Low	High
Project review requirements	Minimal	Extensive
Utility cost per kWh or kW	High	Medium to Low
Time to complete projects	Weeks to few months	Several months to years
Typical customer size	0-500 kW demand	200+ kW demand
New measure addition	Slow	Rapid
Auditor expertise required	Low	High

Reviewing these two models it becomes clear that they represent opposite ends of a trade-off between simplicity and accuracy. Deemed programs are fast and easy, but they are also costly, frequently inaccurate at the project level, support a limited measure set, and are slow to adapt to rapid changes in equipment and regulation. On the other hand, Measured approaches are methodical, sophisticated, and accurate. But these calculations are costly to prepare, and project reviews can significantly delay project installation, which can derail many projects in the Small to Medium Business (SMB) market segment. These limitations of traditional savings estimation approaches have regulators, utilities, and implementers searching for ways to address the following issues:

Increased Accuracy in Energy Savings Estimates Over Deemed

The acceptability of the Deemed approach fundamentally rests upon a willingness to accept accurate savings at the program or portfolio level but frequently inaccurate energy savings

for individual retrofits. Deemed savings estimates are average values assembled from multiple individual projects, which have a range of actual energy savings. In this way, savings projections for individual projects are often inaccurate, but portfolio-level total savings should be very close to the Deemed value.

Unfortunately, portfolio-level accuracy may not translate well into customer-facing product offerings in the emerging world in which retrofits are increasingly expensive. Efficiency retrofits are specified and sold to customers on a project-by-project level. Providing customers with Deemed energy savings and bill impact projections can be successful and low risk when projects are no cost for customers (as is typical of many Deemed programs to date). But retrofits costs are going up, and customers are increasingly being asked to pay for a portion of the retrofit. In these cases, providing customers with inaccurate energy savings and payback estimates as the foundation for putting their own money down reduces customer participation and is a significant public satisfaction risk. Raising the accuracy of energy savings projections for individual projects is important if lighting retrofits are to continue in the face of rising project costs and diminishing savings and incentives.

As identified above, Deemed savings are average values determined by combining a range of actual energy savings. By extension, many individual projects will yield actual energy savings that are above the Deemed average, while many others will produce actual savings below the average. This structure does not provide implementers with an incentive to seek projects with high actual savings potential. Instead, all projects within the range of the Deemed value receive the same energy savings and rebate. In extreme cases, Deemed savings estimates can exceed a facility's actual total energy use – clearly an inefficient expenditure of ratepayer funds. However, if implementers are rewarded for finding high energy savings opportunities, these projects will be pursued and projects with lower savings will not. Failing to incentivize implementers to seek higher energy savings opportunities within a measure range is one of the fundamental drawbacks of a Deemed approach.

Reduced Project Review Burden and Delay Compared to Measured

Savings calculations resulting from a Measured approach typically include several interactive variables, unique to each project, combined in a complex set of calculations. Collecting and calculating this information is expensive and time-consuming. Measured project calculations are reviewed by the utility and often the Regulator to verify accuracy. In some jurisdictions this "parallel" review occurs both before and after project installation. This careful review process is necessary to accurately vet savings claims for large, complex projects. However, applying the full suite of complex project review requirements to lighting retrofits with only a few variables is unnecessary. Simplifying the review process for straightforward lighting projects significantly reduces workload for reviewers and implementers, while also improving participation rates for smaller customers, who often cannot wait for the extended delay typical of Measured reviews.

Flexibility to Accommodate Changing Equipment and Code

As Measured savings projections are individually calculated for each project, it is straightforward to add new measures and code baseline changes as they emerge in the market. Deemed savings, however, are based on studies of average savings. As Deemed values are determined by looking backward, a period of time must necessarily pass for the new measure to

be installed, studied, and finally averaged across a range of installations. This results in a time lag of many months to a few years for new equipment to be available for installation through Deemed programs. Historically, this was not a significant hurdle, as lighting innovations were less common and typically incremental. This is not the reality today, with new technologies and equipment emerging and evolving on the order of months, especially LEDs. Often, by the time utilities have studied and approved a product and included it in their Deemed catalogue, a new and improved version is available in the market, rendering the old technology obsolete. Reducing the time and effort necessary to add new technologies into utility programs is a significant issue that needs to be addressed.

Opportunity for a New Approach

An opportunity clearly exists for an alternative approach to determining energy savings from lighting retrofits that strikes a middle path between the existing approaches. This new approach should offer increased accuracy over Deemed, be flexible to quickly incorporate both new equipment and regulatory changes, and require a low level of review while producing relatively accurate projections. The Modified Lighting Approach blends elements of both Deemed and Measured approaches to create a model that fulfills these needs.

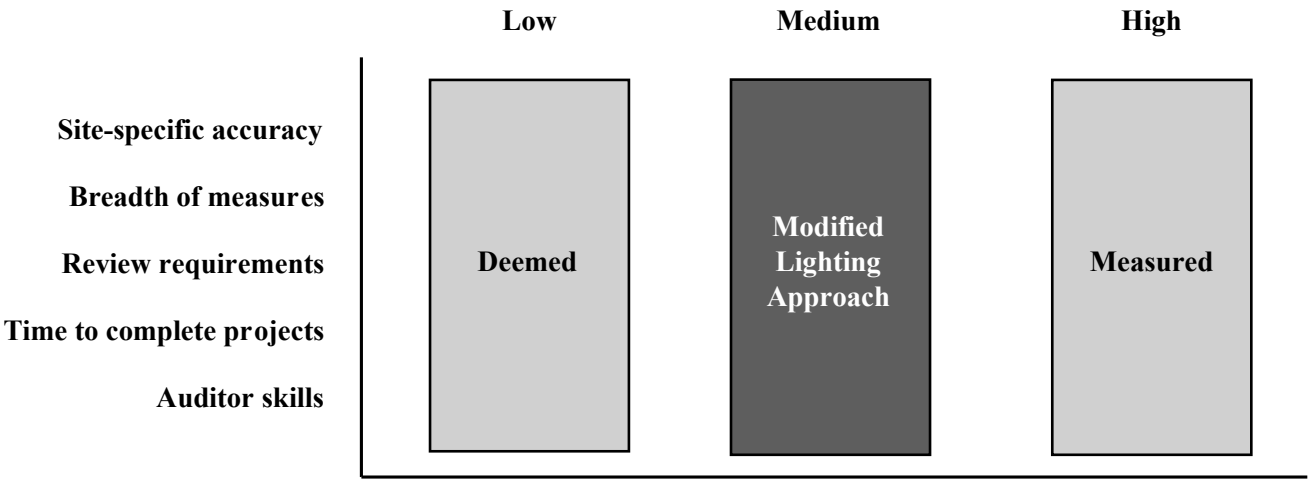

Figure 1.

Logic and Mechanics of Modified Lighting Approach

This section explains the logic and mechanics of the Modified approach to estimating energy savings from lighting retrofits. Reviewing the basic energy savings calculation formulae provides a framework to understand how the Modified approach brings together elements of both Deemed and Measured methodologies.

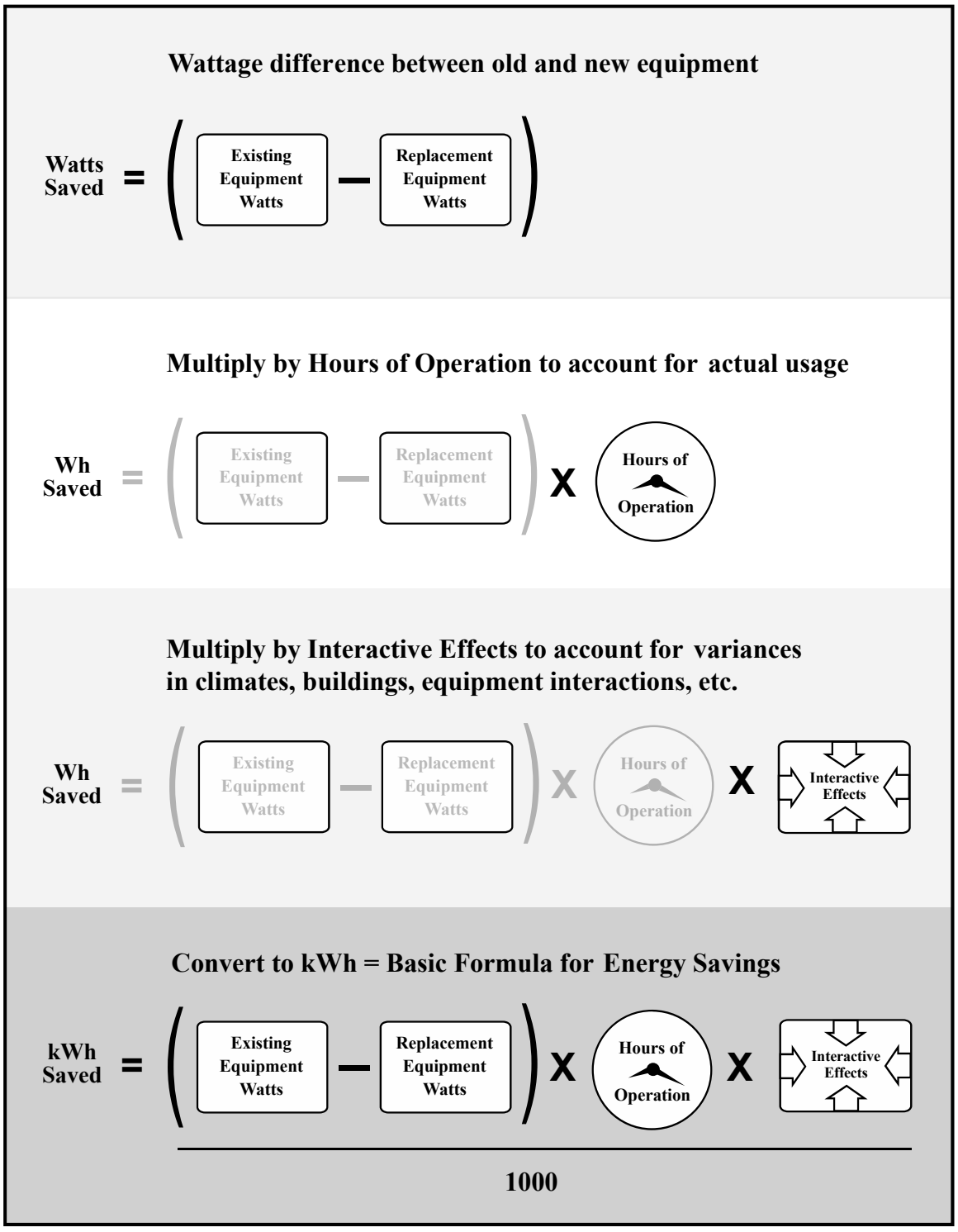
Wattage difference between old and new equipment
Watts Saved
Existing Equipment Watts
Replacement Equipment Watts
Multiply by Hours of Operation to account for actual usage
Wh Saved
Existing Equipment Watts
Replacement Equipment Watts
Hours of Operation
Multiply by Interactive Effects to account for variances in climates, buildings, equipment interactions, etc.
Wh Saved
Existing Equipment Watts
Replacement Equipment Watts
Hours of Operation
Interactive Effects
Convert to kWh = Basic Formula for Energy Savings
kWh Saved
Existing Equipment Watts
Replacement Equipment Watts
Hours of Operation
Interactive Effects
1000

Figure 2.

The first step in determining energy savings is obtaining the variables to input into the formula.

- **Deemed** energy savings values are determined by using average values for each variable to estimate average savings per measure[1] that is applied across a range of equipment, building, and use types.
- **Measured** approaches typically use site-specific values for each of the variables to calculate unique, retrofit-specific energy savings projections.
- **Modified** calculations employ a combination of average and site-specific values to determine retrofit-specific projections of energy savings.

To calculate energy savings, the Modified approach uses the site-specific wattage values typical of the Measured approach. These wattage values are combined with the average interactive effects of the Deemed approach. The final variable – hours of operation – comes from either Deemed or site-specific sources. Bringing together values from both the Deemed and Measured methods allows the Modified approach to estimate energy savings that are specific to each retrofit and more accurate than Deemed methods, while reducing complexity by using Deemed values for energy interactive effects. Combining values in this way creates a simple approach that calculates site-specific energy savings, while requiring significantly reduced regulatory review compared to the Measured approach.

Wattage Values

The difference between wattage values for the new and old equipment provides a starting point for calculating energy consumption during operation. The Modified approach uses the actual wattage specifications of the existing and replacement equipment to determine the wattage delta between old and new equipment. This is the same as a Measured approach and different than Deemed, which would instead use average values. For most types of lighting equipment, the wattage values can be easily obtained from standard wattage tables, cut sheets, equipment nameplates, or other sources. Available wattage tables can provide pre-approved values for multiple technologies such as CFLs, linear fluorescent, LED lamps and fixtures, induction, incandescent, and HID. Additionally, the Modified approach allows for moving between technologies, such as removing linear fluorescents and installing LED fixtures, which can be difficult to account for in a Deemed approach. Finally, code baselines can be used in place of the existing equipment when required.

Hours of Operation

The Modified approach can employ either Deemed or site-specific hours of operation depending on regulatory requirements or utility preference. Deemed hours typically come from approved tables of average building operating hours based on building type, such as DEER. Alternatively, site-specific values can come from a variety of sources such as customer-stated, field-measured, or data-derived hours. In some situations, operating hours for the replacement equipment need to be reduced to account for occupancy controls. The Modified approach adjusts

[1] An individual "measure" is a combination of old and new equipment, average use, and interactive affects into a single energy savings value. These single savings values are typically applied to include a range of equipment, use, and building type.

operating hours to account for the impact of lighting controls by referencing a table of approved reduction factors for various space types. Again, the Measured approach would require the post-retrofit operating hours to be determined through additional data loggers or other procedures during a performance period to determine how the lighting controls affected energy consumption.

Interactive Effects

With an installation of energy conservation measures in one technology, there is an interaction with another technology. For example, an energy efficient lighting retrofit will decrease cooling loads in the summer and increase heating loads in the winter. With the Measured approach, site-specific measurements can be taken of the HVAC system to establish the changes in HVAC loads. Rather than performing individual engineering calculations, the Modified approach uses Deemed interactive factors that include the impact of building characteristics, climate, and time of use. Using pre-established values for these variables significantly reduces the effort and time necessary to produce and review energy savings calculations. The incremental accuracy established through calculating interactive effects for each project may not justify the effort to assemble and review these calculations, particularly for relatively small retrofit projects. This explicit tradeoff between accuracy and expediency is at the heart of the Modified approach.

"Modified Lighting Calculator"

California IOUs implement the Modified Lighting Approach in the form of an extensive Excel spreadsheet called the Modified Lighting Calculator (MLC). To clarify, the MLC is a "calculator" built to put into practice the Modified Lighting Approach or "methodology" described throughout this paper. The Modified Lighting Calculator was developed by a joint effort of PG&E, program implementers, and the Energy Division of the California Public Utilities Commission, and is approved for use by all California IOUs. All projects using a Modified approach are required to use the Modified Lighting Calculator to verify and report savings. Currently, the MLC is in use by seven program implementers on behalf of PG&E. Some implementers specify projects and calculate energy savings within their own software, and then port the project information into a copy of the MLC for reporting to PG&E. Other implementers build and specify projects directly within the MLC, using the spreadsheet itself to calculate energy savings.

The Modified Lighting Calculator contains the data tables and formulas necessary to perform energy savings calculations to account for connected load savings, hours of operation, and Interactive Effects. The MLC uses data from the Database for Energy Efficient Resources (DEER), derived in part from data provided by the Consortium for Energy Efficiency High Performance Ballast list and the Design Light Consortium Qualified Products List of LED luminaires. DEER is a CPUC-sponsored database designed to provide documented estimates of energy and peak demand savings values and measure costs. Using the third party-approved DEER data allows for simplified technical review as the values have already been vetted.

Sources Of Values

Wattage. To use the MLC, existing and replacement equipment are selected from a pre-approved wattage table containing almost 4,000 fixture line items, consisting of either a lamp, or a lamp and ballast system. Each fixture line item in the wattage table contains an identification number, the source of the data, a description, and the system wattage. Based on a user selection of existing and retrofit equipment, the Calculator computes the wattage delta between existing and replacement equipment. For measures which Federal and State regulations have established minimum performance requirements, the baseline from which energy savings can be measured is not the wattage of the existing equipment but is instead the wattage of the code minimum equipment. In these situations, the MLC uses the code minimum wattage not existing equipment to calculate the watts saved by the retrofit. For situations in which the total measure lifetime savings is important, the MLC can track the wattage of the existing equipment for it's remaining useful life as well as the code baseline for the rest of the life of the measure.

Hours of operation and interactive effects. For the next two values needed to calculate energy savings – hours of operation and interactive effects – the MLC uses values from DEER, which are associated with building type and climate zone. DEER has developed these factors as common values accepted by all California IOUs to be applied to measures installed across the state. Operating hour estimates are assigned according to defined building use types built into the DEER database. The interactive factors are based on climate zone, and account for wattage demand reduction in the summer and increased heating demand in the winter. Additionally, to accurately claim peak load reduction, a coincident demand factor is used. The coincident demand factor—the ratio of demand reduction during the peak coincident period to the entire connected load reduction—estimates electric load reduction that occurs during peak periods. Through using these DEER values for operating hours and interactive effects, the Modified approach can provide accurate, climate-specific savings calculations across the state of California, while eliminating the need for extensive project review as the data is already approved. DEER also provides adjustment factors to account for the presence of lighting controls.

Review Process

Projects using the MLC are reviewed in several ways. First, program implementers conduct 100% pre and post field inspection on all projects to verify installation accuracy and suitability. A subset of projects receives a technical desk-based review by PG&E to verify inputs, outputs, and baseline justification. The intent of the utility review is to ensure that the correct lamp or fixture inputs were used, appropriate building types were selected, and program influence is justified. Additionally, all projects are available for random regulatory review.

Modified Lighting Approach in a Publicly Owned Utility

An example of how the Modified approach functions in a different regulatory environment is found in the Sacramento Municipal Utility District's (SMUD) use of the Modified Lighting Approach. Publicly Owned Utilities (POUs) in California are regulated by the California Energy Commission rather than the CPUC, and as such have a slightly different set of guidelines for determining energy savings. SMUD calculates energy savings using a variant of the Modified Lighting Calculator that uses all the same DEER values and calculation methods as

PG&E's version, with one difference: Instead of using DEER (Deemed) average hours of operation, SMUD uses site-specific hours of operation unique to each project. Because hours of operation is such a key variable, using site-specific values rather than Deemed average hours can considerably sharpen the accuracy of savings estimates. These operating hours are estimated based on the customer's reported building use, which is less accurate than typical Measured methods but quick and sufficiently accurate to satisfy regulatory reviews.

History of the Modified Lighting Approach

Over the past few years, California IOUs have been directed to clearly delineate between the Deemed and Measured approaches to calculating energy savings. Local government partners and direct install implementers were concerned that requiring most smaller energy efficiency lighting projects to follow either a Deemed or Measured path would slow innovation and result in a decrease in program participation, while making it difficult for local governments to quantify their GHG reductions. These entities worked together with PG&E to develop a standardized "hybrid" approach that combined elements of Deemed and Measured to give customers a more an accurate understanding of energy savings and payback, while avoiding the costly review of Measured projects. In order to monitor the savings being claimed using this approach, both the utility and the regulator required a standardized "tool" in which the methodology for calculating savings would be consistently applied. PG&E, the Energy Division of the CPUC, and implementers together created the Modified Lighting Calculator.

PG&E supported the development of the Modified approach for several reasons. First, gaining regulatory approval of the methodology would allow reduced review requirements administrative costs for projects, which are typically high volume, low cost, and low savings. Second, the turnkey model of providing a more facilitated and structured project experience for the contractor and customer would eliminate upfront delays and uncertainty around energy savings and related incentive payments. Finally, it would demonstrate a true collaborative approach by incorporating implementer input, customer experience, and regulatory direction to standardize and streamline a process for calculating energy savings.

PG&E's Perspective on the Modified Approach

Following the national model, California calculates energy savings projections using both Deemed and Measured (called "Custom") approaches. These traditional approaches to estimating energy savings have certain advantages and disadvantages. The Deemed approach results in savings that are less accurate but require fewer immediate resources from the utility and regulator to approve and claim. The Measured approach allows a custom, calculated model, but requires review of the calculations by the utility both before and after project installation. Measured projects are also subject to the possibility of a parallel regulatory review. The review process for Measured projects increases costs for the utility and adds weeks to months to the project implementation timeline.

The resource-intensive review of Measured lighting projects makes sense for complicated projects with unique circumstances. The complexity and/or size of these projects results in long lead times and require a fair amount of upfront work related to procurement of funding, project design, equipment specifications, and required permitting and installation activities. Fitting calculation and savings reviews into this process does not add significantly to the timeline, while ensuring accurate savings projections. This accuracy generates solid project payback values,

giving customers the data necessary to make an informed decision about whether or not to proceed with a project.

Benefits to Using the Modified Approach

The Modified approach is typically used to determine savings in projects having less than a three-month lifecycle from project proposal to installation. These projects require a relatively limited project design and are implemented through a direct install model. These projects are frequently small in both scale and cost since these programs target customers with annual energy usage less than 200 kW. Project payback is often less than two years.

As the Modified approach uses a "pre-approved" methodology, it reduces the need for pre-installation review, which significantly reduces the project timeline and required administrative resources to manage what are normally lower cost, lower incentive projects. This, in combination with a pre-defined approach to proposing savings and incentive estimates to a customer, increases the number of projects that can be implemented in a given program cycle, helping the utility claim savings faster.

By partnering and contracting with trained implementers familiar with both savings claims requirements and the tool, the utility reduces the risk of over estimating energy savings. The Modified approach is not limited to the fixed options of lamps or fixtures in the Deemed catalog, making it easier to add measures and adapt quickly to code changes. The ability to define wattages and baselines at the individual project level allows for innovative and cost-effective projects that can result in deeper savings. The Modified approach also allows more accurate savings estimates resulting in more realistic project specification and payback estimates. The benefits of the Modified approach allow the utility to be more adaptive to the ever-changing lighting market without risking savings due to overestimation, while also reducing costs to administrate programs. Responsible administration ensures that the utility is using ratepayer dollars as effectively and efficiently as possible and at the same time provides a better overall experience for the customer.

Complications Related to a New Savings Calculation Approach

Adopting a third approach to calculating energy savings brings both opportunities and challenges. Although the tool utilizes deemed averages, which are updated on a regular basis based on regulatory guidance, it also requires maintenance, relies on user-entry, and must comply with utility policies that dictate custom calculated energy savings.

Maintenance. Whereas the regulatory environment follows a schedule of semi-regular updates to policies and work paper specifications, the flexibility of the Modified approach requires more constant maintenance in order to remain "innovative." New lighting products, as well as any changes to deemed operating hours, interactive effects, and savings values, must be incorporated into the tool quickly and implementers regularly adjust their systems and sales techniques to reflect these changes. Technology updates must be built into the Modified approach, which requires review by the utility and regulator prior to approval.

Limited review necessary. The Modified approach depends on correct user input of equipment baseline and operating hours or building type. These inputs must be spot-checked by the utility to ensure accurate savings projections. The Modified approach relies on the implementer to conduct

a pre-installation site inspection to verify existing equipment and a post-installation site inspection, to ensure that the equipment was installed correctly. PG&E requires an internal post-installation, desk-based review to verify inputs and outputs are in accordance with utility and regulatory policies, which adds some additional administrative burden.

Unique policies. The Modified approach is dynamic and can quickly adapt to new lighting policies related to regulatory changes, code updates, and other drivers. However, the rulebook for the Modified approach is still being written. As such, some policy discrepancies exist between guidelines that were originally designed to apply to traditional Deemed and Measured methodologies that may not make sense when applied to the Modified approach. Presently, a need for "truing up" the two sets of policies occurs often, and requires regulatory input, which can take time and lead to some implementer and project confusion.

Implementer Perspective on Modified Lighting Approach

Third party direct install programs have served large portions of the SMB market segment in California for over a decade. During this time, many customers have upgraded their facilities and become more energy efficient. This leaves behind hard to reach customers with difficult and less financially viable projects. The Modified approach offers program implementers ways to improve the program offering to increase participation and continue to achieve energy savings in a difficult market. From a customer perspective, using the Modified approach instead of Deemed allows programs to provide customers site-specific energy savings and bill impacts, a wider selection of replacement equipment options to address previously stranded savings, and increased specification flexibility to save energy in situations that cannot be served with the Deemed approach. Because projects do not need to be reviewed prior to installation, these benefits can be provided quickly. Bringing all these advantages together enables implementers to achieve energy saving with customers that are less likely to participate in either traditional Deemed or Measured programs.

Advantages in the Market

Providing customers with site-specific energy savings calculations significantly improves customer participation in retrofit projects for several reasons. First, customers are often making buying decisions based on simple pay back – how quickly will an investment pay for itself. Because Deemed values are not project specific, they should not be used to estimate energy savings and bill impacts. Using the Modified approach yields relatively accurate savings and pay back values that can be used by customers to inform their decision to pursue an energy efficiency retrofit. This issue is becoming increasingly important as retrofits costs are increasing and customers are being asked to contribute more copay. Finally, reliable pay back values enable financing to be applied in the SMB market, which is widely recognized as an important tool to increase customer participation in efficiency retrofits.

Another key advantage of the Modified approach over Deemed is the greater breadth of replacement equipment that is available. Many customers are interested in emerging lighting technologies, including LEDs and new control options. However, adding a new measure to Deemed programs is often a protracted process, as measures must be installed and studied before an average savings value can be established. On the other hand, adding a measure to the Modified approach can be achieved very quickly.

In the Modified approach, savings are calculated for each project, which means that the wattage consumption of the new equipment is the only variable that needs to be added to the savings formula.[2] Because of the ease of adding measures, the Modified approach supports a wider equipment catalog from which auditors can build a retrofit. This avoids stranding savings and results in greater savings opportunities for customers and utilities in situations where the Deemed options do not meet the need. Finally, the swift inclusion of new technologies is particularly important for rapidly evolving products such as LEDs. During the time it takes for a new measure to be added to a Deemed catalog, an improved version of the equipment is often released, making the original equipment obsolete. This means that an implementer would have to install outdated equipment or simply not address the opportunity – both undesirable outcomes.

An additional benefit of the Modified approach is increased flexibility in specifying the appropriate lighting retrofit to fulfill customers' needs. Because savings projections are calculated for each project, auditors are able to design lighting solutions that are unavailable using normal Deemed measures. In practical terms, the use of building spaces in the SMB sector change relatively frequently, and the accompanying lighting needs often change as well. Deemed programs typically only support the replacement of certain types of equipment with a limited set of new equipment. Modified approach calculations allow any technology to be used, allowing auditors the opportunity to build retrofits that meet the unique requirements of building users.

Drawbacks of the Modified Approach

Modified projects do come with burdens for implementers, including the need for elevated lighting expertise and an ability to support the additional project documentation and review requirements. Because auditors need to accurately identify existing equipment and specify replacement equipment from a much wider measure set, using the Modified approach requires greater auditor knowledge than necessary for Deemed. This translates to more training and potentially higher salaries to develop and maintain an auditor team with the necessary expertise. However, the level of skill and knowledge necessary to use the Modified approach is significantly less than is required for Measured programs.

Simplified as it is, the Modified approach requires a greater level of regulatory and/or utility review than Deemed values to ensure accuracy. The additional staff time needed to prepare project documentation and respond to reviewers' inquiries increases costs and slows project delivery. Thus, it is critical for successful program delivery that review requirements strike an appropriate balance between accuracy and efficiency, and a streamlined review process is appropriate because only one or two variables are at play.

Reasons for the Success of the Modified Approach in California

In order to successfully develop, standardize, and begin to institutionalize the Modified approach, several factors were in place. The development of the Modified approach required involvement from many stakeholders representing agencies and organizations with differing roles in the energy efficiency space. The utility and regulator were willing to consider a hybrid methodology which combined aspects of both the Deemed and the Measured approach to calculating savings. Statewide efforts to collect and publish data on acceptable wattages, average

[2] New equipment must also be vetted for quality and suitability. This is typically done by confirming certification from UL, ENERGY STAR, Design Lights Consortium, etc.

hours of operation by building type, and interactive effects was integral to standardizing the approach. The collaborative approach of working with third party and government implementers was also important, as it ensured that the approach was tested and proven to be effective in the field, demonstrated through the successful turnkey model.

In addition to its energy efficiency goals, California is a leader in developing and implementing climate action plans to reduce greenhouse gas emissions. Many of the government partnerships have goals to calculate and demonstrate their reductions to electricity-related emissions in the community sector. The Modified approach provides a more accurate picture of the impacts that these programs have on reaching these goals.

Increased accuracy also impacts customer satisfaction, through more realistic payback estimates and accurate incentive payments. California is also supporting financing mechanisms, allowing customers easy access to funding for energy efficiency retrofits from the utility that is paid back through savings on their bill. The Modified approach provides more accurate data to structure the loan upon, which results in the desired "bill neutral" financing option.

Accuracy is important, but it must be demonstrated through evaluation, measurement and verification activities. Projects using this approach are subject to both desk-based calculation reviews as well as random field inspections by both the utility and regulator. Random field inspections by PG&E have found a 99% pass rate, demonstrating that the equipment specified is actually installed and functioning properly. Additionally, independent, ex post M&V is also conducted on efficiency programs using the Modified approach. The two most recent M&V studies of one PG&E program found savings realization rates of 97% and 98%, providing confidence in the accuracy of the Modified approach.

Current Use of Modified Lighting Approach

Investor owned utilities. PG&E has been using different versions of the Modified approach for over a decade. In March of 2013, the Energy Division of the CPUC officially approved the current version of the Modified Lighting Calculator that is built upon the Modified approach described above. The CPUC has approved the "Calculator" for use by all California IOUs. In their disposition, the CPUC laid out the basic set of rules and project review requirements which projects must abide by in order to use the Modified approach. Importantly, the CPUC has also outlined a "Streamlined Review" process that exempts Modified projects from many of the documentation and review requirements that are normally applied to Measured projects.

PG&E continues to lead the way in vetting the Modified approach and improving the MLC. PG&E is currently supporting the use of the MLC by seven third party implementers who are using it to deliver over a dozen energy efficiency programs in the SMB market. From March 2013 to March 2014, these programs saved 3.3 MW and 1.6 GWh of energy using the Modified approach. SCE is currently reviewing the Modified approach with plans for a pilot in 2014.

Publicly owned utilities. Modified projects for publicly owned utilities (POU) are calculated the same way using the same DEER values as California IOUs. Two publicly owned utilities are now using the Modified approach for lighting. The City of Palo Alto Utilities (CPAU) has been using the method exclusively since 2005 for their SMB program. The Sacramento Municipal Utility District (SMUD) began using the Modified approach for their SMB customers in early 2013. Since beginning to use the MLA, both utilities have exceeded their energy savings goals for those programs each year.

The Future of the Modified Lighting Approach: Expanding Use

The dynamics of increasing project cost, tightening regulations, rapidly evolving equipment and an increased need for accurate savings projections are likely to continue, if not increase. To the degree that the Modified approach continues to address these concerns, its acceptance and use seems likely to expand. The US Department of Energy has indicated their interest in the model by recently funding Ecology Action, a Third Party Implementer and co-developer of the Modified approach that uses the MLA for it's California IOU and POU clients. For this study, Ecology Action is charged with refining their program delivery model – featuring the Modified approach at its center – and preparing it for national application. PG&E is also expecting expanding its use, with additional program implementers beginning to switch from Deemed estimates to Modified calculations.

As previously described, the Modified approach can use either Deemed or site-specific hours of operation to calculate energy savings. As both of these values are estimates rather than measurements, a certain degree of inaccuracy remains. Looking to the future however, meter data and sophisticated analytics may soon be able to accurately understand actual hours of use per individual meter or facility. Using actual hours of operation instead of estimated values in Modified calculations would dramatically increase the accuracy of savings estimates. This ability to incorporate site-specific operating hours is one of the fundamental advantages of the Modified approach compared to Deemed methods.

Conclusion

The Modified approach combines the best elements of Deemed and Measured methodologies into an alternative energy savings approach for lighting retrofits, which creates a balanced middle ground between accuracy and efficiency. The Modified approach generates more accurate savings estimates than Deemed while supporting flexible equipment specification to address non-standard applications. The Modified approach improves the product offerings for customers by making available the full range of current lighting technologies, while providing finance-ready energy savings and pay back projections. Additionally, because Modified projects need only limited review, the utility and regulatory workload is significantly reduced compared to Measured projects, while also minimizing project review delays for customers. In conclusion, the Modified approach has been vetted and approved for use in California's rigorous regulatory environment and is poised for widespread expansion to other markets.

References

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