Tremendous Potential Benefits from Improving Energy Savings Estimates Across the Country

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ABSTRACT

Energy efficiency programs in various jurisdictions across the U.S. often promote similar measures. However, these programs often use different estimates of energy savings, even for climate-independent measures. We review and compare the evaluation parameters that have been adopted across programs in various jurisdictions across the U.S. with the estimates used in California, for four common measures. The results show that California has adopted estimates of energy savings for these measures that are generally substantially lower than those used in other jurisdictions.

Our analysis covers four measures whose energy savings should be largely independent of climate: residential compact fluorescent lamp (CFL) purchases, T12 to high performance T8 replacement in offices, residential refrigerator recycling, and efficient residential clothes washers. Where available, we compiled deemed savings parameters for each measure, for programs in ten states, two regions, and for the Energy Star program. For each measure, we exclusively reviewed parameters that affect unit energy savings such as watts used by the efficient versus base measure, effective useful life, and hours of use. However, we intentionally excluded comparisons of parameters whose differences could be influenced by regional location, such as net-to-gross ratios or climate-dependent variables.

Our analysis found differences in annual electric savings estimates that are often twice as high in one program compared with another. Differences in gas savings estimates based on interactive effects were even greater. Savings assumptions used in California were generally at the lower end of the range. We recommend that greater consistency and transparency of assumptions be used across programs to facilitate interstate and regional coordination, and to provide a more accurate assessment of progress.

Introduction

As the Success of Energy Efficiency Continues to Increase, so Does the Need for Clearer and More Coordinated EM&V

The need for transparent and accurate assessments of energy efficiency progress is more important than ever. As efficiency investments across the country increase at impressive rates (exceeding $9B in 2012 and more than doubling in the last five years) (CEE 2012), the need for a clearer barometer to measure the accomplishments of those investments has become more pronounced. Additionally, as the possibility arises of incorporating energy efficiency into a national clean energy standard, more consistent measurement across states becomes essential. In order to be relied on as a national energy resource, energy efficiency needs the improved consistency, transparency, and coordination recommended in this paper. We do not view the significant size of this problem as an indication that this obstacle is insurmountable, but rather, as an indication of the enormous value that will be realized by ameliorating these discrepancies.

Scope

Differences Among Energy Savings Estimates for Common and Comparable Measures

Our investigation began with a survey of four commonplace measures that were weather-independent in order to ascertain whether there are differences among energy saving estimates in different states and regions around the country, and if so, by what margins. Our goal was to identify savings estimates that could be readily compared across the country.

There already exists significant documentation that energy saving estimates differ greatly for various measures across various jurisdictions. (Jayaweera 2011, Schiller 2011, Messenger 2010) The 2011 State and Local Energy Efficiency Action Network (SEEAction) report conducted a detailed review of 20 measures across 17 technical reference manuals (TRMs). This report is the most comprehensive review in recent literature of savings estimates that we discovered. The report confirmed the legitimacy of many experts' concerns, concluding that "the TRMs had a wide variation in saving methodologies, technical assumptions, and input variables for estimating savings. Even where algorithms are similar, the input units and baseline assumptions are typically different." (Jayaweera 2011).

Our paper is distinct because we restrict our investigation to only a few measures that are climate-independent. By controlling for weather sensitivities, we can more pointedly show whether serious discrepancies reside in the algorithms and input values to determine energy savings, not just the climate-dependent variables. Additionally, we pay particular attention to California's estimates, because it has historically been a leader in many respects for energy efficiency (ACEEE 2011), is the nation's largest investor in energy efficiency, and its EM&V has been subject to significant controversy recently (CPUC 2010). In order to do so, we need to remove any bias that would be due to California's climate. Therefore, we narrowed our consideration to a select few measures that are climate-independent.

We also distinguish our report by highlighting California's relationship to regional averages, whereas the SEEAction study focused on all interregional relationships. While the general variation in savings estimates across regions is a major point of this paper as well, we highlight the unique relationship between California's estimates and that of the rest of the nation.

Methodology

Selection of Measures, Evaluation Parameters, and Values

We comprehensively reviewed four measures that are climate-independent, that were common among multiple jurisdictions, and that composed a significant portion of efficiency portfolios at the time of our research. As detailed in this paper, we developed a comparison of savings estimates for these four key measures that were included in the California IOUs' 2006-08 energy efficiency portfolio. The measures included in this comparison are: 1) compact fluorescent lamps (CFLs); 2) refrigerator recycling /early retirement; 3) commercial fluorescent light replacements; and 4) high-efficiency residential clothes washers. To present the results clearly, we have compiled tables that show each program's deemed parameter, as compared to other jurisdiction's parameters, including the minimum, maximum, and median values.

For each measure included in the analysis, we conducted a literature review of energy efficiency programs around the country to find programs that promote the same or a similar measure. For purposes of comparison, the measures were based on the definitions in the California Public Utilities Commission (CPUC) staff's 2006-08 Energy Efficiency Evaluation Report (Energy Division 2010).

Evaluation Parameters

We compared the following key parameters for all measures: measure name and base measure; base watt, efficient watt, and delta watt; annual deemed electric savings; measure life; effective useful life (EUL); and coincidence factor and demand savings. Because of the specifics for each measure, we also compared a few additional parameters for each (e.g., heating penalty for CFLs and T8s, loads per year for clothes washers). The full list of parameters compared is shown in each table below.

Values and Regional Selection

To collect California values, we used the most recent DEER database at the time of our research, which was DEER 2008,[1] which was used for the 2010-2012 programs. DEER presents savings parameters under various scenarios (e.g., for each climate zone in California, for different building types). We used data for each utility, across the relevant building types (e.g., Residential – single family). For the comparison tables, we presented the median value among the four utilities.

For other regions around the country, we found the assumptions underlying the savings estimates for each measure wherever available, including internet searches and by contacting program administrators. We used values from regions that had the most readily available information. This resulted in information from the following states and regions: Energy Trust of Oregon (ETO), Maine, Michigan, MidAtlantic (which includes Delaware, Maryland, and DC), Minnesota, New Mexico, New York, Regional Technical Forum (RTF) (which includes Washington, Idaho, Oregon, and Montana), Texas, U.S. DOE Energy Star, Vermont, and Wisconsin.

Results & Analysis

Residential CFLs

We selected residential CFLs because they are one of the most common measures promoted by energy efficiency programs. Consequently, the comparison for this measure includes many states and regions. There were various types of CFLs promoted through California's 2006-08 programs. When possible, we chose the replacement of a 60W incandescent bulb with a 15 W CFL in residential applications, purchased in a single pack, for an optimal

[1] Formally known as DEER 208 v.2.05.

comparison. This particular measure was common to other programs (only a few of the programs did not have this specific CFL). The results of the analysis are summarized in Figure 1, below.

A comparison of the various evaluation parameters reveal that across the board, California ranks either lowest, or at least well below the median, for values used. Electric savings for CFLs in California are estimated to be 32 kWhs; whereas the median is 42 kWhs and the highest is 49 kWhs. California uses estimates of daily hours of use and delta watts that are the lowest of all the regional estimates. California's delta watts are the lowest, at 38 watts; whereas the median is 46 and the highest is 53. California uses estimates of annual deemed electric savings and effective useful lives that are noticeably below the median of all the jurisdictions. California's hours of operation are the lowest, at 1.7;[2] whereas the median is 2.3 and the highest is 3.0. Low hours of operation could be accounted for in an above-average EUL, since the two factors are related. However, this is not the case: California's EUL is 6.6 years; whereas the median is 8 and the highest is 12. Combined, these evaluation parameters create a low estimate of electricity savings for residential CFLs in California.

Figure 1. Residential CFL Savings Estimates

Source Description	Minnesota	Texas	RTF	Mid-Atlantic	Michigan	Wisconsin	New York	Maine	ENERGY STAR pgm	Vermont	New Mexico	California - DEER: Median	Median	Value for Highest Deemed Savings	Value for Lowest Deemed Savings
Program Description or name	CFL program	CFL Market Transformation Pgm	Res Lighting	Res CFL	CFL program	Buy down CFLs	CFL program	CFL program	CFL program	Residential CFL program	CFL program	Res lighting program			
Measure name	15W CFL		CFL - Ave. Interior	CFL Screw base	CFL Screw in < 50W			15W CFL	15W, screw in CFL	CFL Screw base	13W CFL	15W CFL			
Daily Hours of use	2		2.21	2.8	2.30	2.77	3	2.70	3.0	1.81	2.1	1.7	2.3	3.0	1.7
Delta Watt (EE Measure - Base Measure)	43		47	46		53	46		45	45.7	47	38	46	53	38
Annual Deemed Electric Savings (kWh)	43	38.5	44	41	44.1	43.7	36	44	49	22	35	32	42	49	22
EUL - effective useful life	9	5.3	5.3	8	9	6.8	7	7.6	9	12		6.6	8	12	5.3

Comparing the various parameters across regions also reveals that there is great divergence in the values used. We show the median values used for each parameter in the right hand portion of the figure, along with the highest and lowest values used among them all. For daily hours of use, the highest value used was nearly double that of the lowest value used. Delta watts had a spread of 40% between the highest and lowest values. Interestingly with delta watts,

[2] In fact, in the more recent 2011 DEER, the estimate for interior CFLs hours of use has dropped to 1.48.

there is a noticeable cluster around 46W, as confirmed by the very low coefficient of variation for this parameter, of 0.06. EULs showed a spread of greater than two-fold, between the lowest and highest values. Most important is the difference in annual deemed electric savings. The final deemed value for savings showed a difference that was greater than two-fold between the highest and lowest values. In sum, the savings estimates and their composite evaluation parameters show significant discrepancies.

These differences in CFL savings estimates are particularly relevant because at the time of our research, they composed a significant portion of portfolio savings. In California, the 2006-2008 portfolio's single largest technology to provide savings was indoor lighting, achieving about 58% of total savings. (Energy Division 2010). If indoor lighting can compose half of the portfolio-wide savings, and the savings estimates for CFLs can vary two-fold, the difference between using the highest and lowest saving estimates is incredibly significant. If California were to use the median estimates for indoor lighting, it could increase total portfolio savings by roughly 50%. Conversely, if another state, which had a comparable composition of measures, were to change from median values to California values, it would be the equivalent of erasing all the savings from every other technology besides indoor lighting. These differences are staggering and highlight the importance of working towards better coordinated regional approaches to M&V.

CFLs are also highlighted first here because they have been one of the most common energy efficiency measures. If there were any measure that would be a good candidate to show that M&V can overcome these differences, screw-in bulbs for residential fixtures would be an excellent candidate. In DOE's search for good candidate measures on which to coordinate EM&V, it found that "Residential lighting on a single fixture level is a relatively straightforward measure that can be included in a national database." (Jayaweera 2011). The commonality and straightforwardness of this measure warrants prioritization in any assessment of national estimates.

Commercial Lighting T8 Replacement

We also selected commercial lighting programs because they were common across jurisdictions and largely climate-independent. (We note that lighting is unlikely to be affected by temperature, but hours of operation could be affected by daylength, which is correlated with climate.) These lighting programs incented the early retirement of T12 light fixtures with high performance T8 fixtures in commercial (primarily office) applications. Where possible, we compared savings for 4' 3-lamp T8 lamps meeting the high performance standard, as set by the Consortium for Energy Efficiency, replacing 4' 3-lamp magnetic ballast T12s. The only jurisdiction whose program differed was Wisconsin's, which used a 4-lamp instead of a 3-lamp fixture; so, we only display Wisconsin's parameters but do not include them in the median, low, and high calculations, as they are not common. The specific base and efficient measure is shown below in Figure 2.

Commercial lighting replacements offered comprehensive results for a robust comparison. The results show that for nearly every evaluation parameter, California's value is either the lowest, or significantly below the median. The following parameter estimates for California were the lowest among all the regional estimates: delta watts, annual electric savings, annual gas savings (negative), heating penalty, and demand savings. The effective useful life estimate for California can be considered either the lowest or the median, as there were two varying estimates available. (The E-3 calculator, which California requires IOUs to use to compute program savings, is more recent and uses the lowest estimate in the country.) One parameter had the highest estimate in California: electric cooling savings due to interactive effects. The estimate for daily hours of use was characteristically below the median estimate, and near the bottom of all estimates. Ultimately, the combination of these evaluation parameters creates significantly lower estimates of energy and demand savings for commercial lighting in California.

As mentioned above in the sub-section on residential CFL programs, the implications of divergent estimates for lighting savings can have enormous impacts on the total portfolio savings. Consistent with our previous comparison of residential CFLs in indoor lighting, we note here that the commercial sector displays similarly divergent estimates, with annual electric savings varying by a factor of two, described below.

Figure 2. Commercial Lighting Savings Estimates

Source Description	Minnesota	MidAtlantic	Michigan	Wisconsin	Vermont	ETO	California - E3	California - DEER: Median (Min to Max)	Median	Value for Highest Deemed Savings	Value for Lowest Deemed Savings
Pgm Description	Office - retrofit	High perf T8 retrofit			High perf T8 retrofit			Office - retrofit			
Measure Name	(3) T8 48" 32W with high effic, electronic, low BF ballast	(3) T8 48" CEE high performance	(3) T8 48" 32W with high effic, electronic, low BF ballast	(4) T8 48" CEE high performance	(3) T8 high performance	(3) T8 high performance, with low BF ballast		(3) T8 48" 32W with high effic, electronic, low BF ballast			
Base Measure	(3) T12 40W, magnetic ballast	(3) T12 F34, magnetic ballast	(3) T12	(2) 96" T12	T12 first 3 yrs, std T8 remaining yrs	(3) T12 F34		(3) T12 48", magnetic ballast			
Daily Hours of use	9.4	9.4	10.1	10.08	9.41	7.5		9.0 (8.9-9.2)	9.4	10.1	7.5
Delta Watt (EE Measure - Base Measure)		64		26	38	67		37	51	67	37
Annual Deemed Electric Savings (kWh)	263	220	173	96	131	133		123	173	263	123
Annual Deemed Gas Savings (therms)	-0.23	-0.75			-1.06			-1.9	-0.9	-0.23	-1.9
heating penalty (kWh heating / kWh saved)	-0.03	-0.10			-0.24			-0.51	-0.17	-0.03	-0.51
Cooling savings (kWh cooling / kWh saved)	0.11	0.11			0.03			0.15	0.11	0.15	0.03
EUL - effective useful life	18	15	12		15	13	11	15	15	18	11
Demand savings (kW)	0.09		0.04					0.03	0.04	0.09	0.03

In addition to California being at the low end of the spectrum, the fact that there is a wide spread in estimates around the country is an equally important observation here. Daily hours of use and effective useful lives have the narrowest spread among all the parameters, with a discrepancy of 34% and 63%, respectively. Delta watts and annual electric savings are the next closest, with a divergence of about a factor of two. Demand savings and cooling savings show three- and four-fold differences in estimates. The most variable estimates are the (negative) annual gas savings, in other words the heating penalty per kWh saved. Here, estimates around the country vary by an incredible amount: factors of eight and nineteen, respectively.

While these last two parameters are climate dependent, we note that normalizing for climate would only exacerbate the difference. Currently, California is at the high end of the estimate for the heating penalty and negative gas savings, while Wisconsin is at the low end. However, Wisconsin's climate imposes a higher heating load than does California's. The same follows for many other regions in the country: California has lower heating load in winter. This milder winter should result in a lower heating penalty, since fewer therms are being used to provide heat in the first place. Because of California's relatively mild winter, normalizing for weather would lower the heating penalty from lighting measures in California and increase the spread in estimates.

Residential Refrigerator Recycling / Early Retirement

We selected residential refrigerator programs because they, too, were common across jurisdictions. These refrigerator programs incented the early retirement of residential refrigerators. The base measure was categorized as either a secondary or primary refrigerator. We also tracked whether the measurement assumed that the refrigerator was in a conditioned or unconditioned space. We note however, that some jurisdictions did not provide information on some of these assumptions, only highlighting the need for better transparency and coordination. Other programs, such as new refrigerator programs, or retirement & replacement of refrigerators are shown further below.

While data points for lighting programs were more robust than for refrigerator early retirement programs, a similar trend occurs here. The final determination of electricity and demand savings vary by factors of nearly 3x and about 2.5x, respectively. This variation is comparable to that of electricity and demand savings from lighting measures. There was however, large agreement on one parameter evaluated, delta watts, showing a low coefficient of variation of 0.03. The detailed results for early retirement programs are shown in Figure 3.

Figure 3. Residential Refrigerator Early Retirement Savings Estimates

Source Description	MidAtlantic	Michigan	Wisconsin	Vermont	California - DEER		Value for Highest Deemed Savings	Value for Lowest Deemed Savings	Median
Measure Name / Pgm Description	Refrigerator Retirement	Refrigerator Retirement	Refrigerator and Freezer Retirement	Refrigerator Retirement	Refrigerator Retirement	Refrigerator Retirement			
Base Measure	inefficient refrigerator	inefficient refrigerator	inefficient refrigerator	inefficient refrigerator	Customer Ave inefficient refrigerator	Customer Ave inefficient refrigerator			
Primary (P) or Secondary (S) unit	mixed	NA	mixed	S	S	S			
Conditioned (C) or Unconditioned (UC) Space	NA	NA		C	C	UC			
Delta kWh/yr	1728		1656	1775	1655	1655	1,775	1,655	1,656
Annual Deemed Electric Savings (kWh)	950	1672	591	1238	1276	964	1,672	591	1,101
EUL - effective useful life (yrs)	8	8		8	5	5	8	5	8
Demand savings (kW)	0.118	0.191	0.100	0.248	0.239	0.214	0.248	0.100	0.203

Figure 4: Residential Refrigerator Retirement & Replacement Savings Estimates

Source Description	RTF	New Mexico PNM only	CA-DEER 2011 proposed	California - DEER		Value for Highest Deemed Savings	Value for Lowest Deemed Savings	Median
Measure Name / Pgm Description	Refrigerator Retirement	Refrigerator Retirement	Refrigerator Retirement	Refrigerator Retirement	Refrigerator Retirement			
Base Measure	AHAM-based inefficient refrigerator	DOE-based inefficient refrigerator	DOE-based inefficient refrigerator	Customer Ave inefficient refrigerator	Customer Ave inefficient refrigerator			
Primary (P) or Secondary (S) unit	mixed	mixed	mixed	P	S			
Conditioned (C) or Unconditioned (UC) Space	N/A	mixed		C	UC			
Delta kWh/yr	1196		774	986	986	1,196	774	986
Annual Deemed Electric Savings (kWh)	482	912		760	574	912	482	667
EUL - effective useful life (yrs)	9	5	NA	5	5	9	5	5
Demand savings (kW)	0.030	0.140		0.142	0.127	0.142	0.030	0.13

The lack of availability of transparent values used in all the jurisdictions limited our results to three jurisdictions. The data show a common trend for the overall spread but an uncommon result for California. With delta kWh, the highest estimate is 54% above the lowest, and annual deemed electric savings nearly 90% higher. This variation in electric savings is slightly less than that of electricity savings from lighting measures and refrigerator early retirements, however it is nonetheless a significant difference that needs to be addressed. Similar to lighting measures, we see agreement surrounding the delta watt parameter, with a coefficient of variance of 0.17, though this is higher than that of retirement programs. But contrary to other measures, California uses the median value for both delta kWh and annual electric savings.

Residential Clothes Washer

We selected residential clothes washer programs because they showed commonalities across states as well. These programs incentivized the sale of a new clothes washer that is more efficient than the federal standard. Because domestic hot water and dryers may be electric or gas, we categorize the measures according to each of the three permutations. The programs also incentivize different categories of efficient washer, CEE Tier 2 and CEE Tier 3. For clarity, we create two separate tables to account for this distinction. The results are provided in Figures 5 and 6, respectively. Because these measures are divided so narrowly, the number of jurisdictions that populate each division is small. Therefore we do not provide the median column typical of the graphs above, but rather just indicate the highest and lowest values (where sufficient data exist) using green and red text accordingly.

Figure 5. Residential Clothes Washer CEE Tier 2 Savings Estimates

Source Description	RTF	Michigan	ENERGY STAR pgm	California - DEER	RTF	Michigan	ENERGY STAR pgm	California - DEER	Michigan		California - DEER
Measure Name / Pgm Description	New Washer	New Washer	New Washer	New Washer	New Washer	New Washer	New Washer	New Washer	New Washer	New Washer	New Washer
Base Measure	DOE ave	Fed minimum	ave of non-qualified model	Fed minimum	DOE ave	Fed minimum	ave of non-qualified model	Fed minimum	Fed minimum	ave of non-qualified model	Fed minimum
Efficient Measure: Energy Star/CEE Tier	CEE Tier 2	CEE Tier 2	Energy Star	CEE Tier 2	CEE Tier 2	CEE Tier 2	Energy Star	CEE Tier 2	CEE tier 2	Energy Star	CEE tier 2
DHW	gas				gas				electric		
type of dryer	electric				gas				electric		
Loads per year	352	293	392		352	293	392		293	392	
Annual Deemed Electric Savings (kWh)	46	123	97	99	15	8	24	6	322	224	136
Annual Deemed Gas Savings (therms)	2.1	9.0	6.0	1.2	3.3	13.7	9.0	4.9	0.0	0.0	-0.4
EUL - effective useful life	14	14	11	11	14	14	11	11	14	11	11

Figure 6. Residential Clothes Washer CEE Tier 3 Savings Estimates

Source Description	RTF	Michigan	California - DEER	RTF	Michigan	California - DEER	Vermont	Michigan	California - DEER	MidAtlantic
Measure Name / Pgm Description	New Washer	New Washer	New Washer	New Washer	New Washer	New Washer	New Washer	New Washer	New Washer	New Washer
Base Measure	DOE ave	Fed minimum	Fed minimum	DOE ave	Fed minimum	Fed minimum	inefficient mode	Fed minimum	Fed minimum	Fed minimum
Efficient Measure: Energy Star/CEE Tier	CEE tier 3	CEE tier 3	CEE tier 3	CEE tier 3	CEE tier 3	CEE tier 3	CEE tier 3	CEE tier 3	CEE tier 3	CEE tier 3
DHW	gas			gas			electric			aggregated
type of dryer	electric			gas			electric			aggregated
Loads per year	352	$293		352	$293		290	$293		282
Annual Deemed Electric Savings (kWh)	81	154	106	16	8	6	899	372	152	180
Annual Deemed Gas Savings (therms)	3.1	9.8	1.6	5.6	15.7	5.7	3.3	0.0	-0.4	4.9
EUL - effective useful life	14	14	11	14	14	11	14	14	11	14

For both tiers of efficiency, the various parameters across these jurisdictions reveal that there is great divergence in values used. The results also show that California is often at the low end of estimates, and never on the high end. Electric annual savings range in estimates by a factor of 2.5x for CEE Tier 2 washers. For Tier 3, they vary two-fold to six-fold, depending on fuel source. Annual gas savings are even more varied, ranging from factors of 4x to 8x, across both levels of efficiency. More pronounced than previous measures, these final savings values for clothes washers show significant discrepancies.

Summary of Results

After investigating four common measures that are largely climate-independent, the results show that there are large differences among energy savings estimates. The findings demonstrate that electricity savings across all measures often vary by a factor of more than two. The most common measure, residential CFLs, show electricity savings that vary by a factor of more than two, which is in line with the problem identified in other literature on energy savings from CFLs (Jayaweera). Electricity savings from commercial lighting measures and residential clothes washers follow a similar trend, with ultimate estimates usually varying by a factor of more than two. Residential refrigerators show about the same variation in electric savings estimates, varying by factors of two to three. Data is sufficient to determine variation in estimates of demand for two measures: refrigerators and commercial lighting, which show 2.5x to 5x differences. Natural gas savings reveal the most severe discrepancies, such as 3x to 7x differences for washers and 8x differences in commercial lighting.

Generally, California is on the low end of estimates for all four measures. For commercial lighting and for two-thirds of the washer types, California had the lowest estimates of electricity and natural gas savings. For CFLs, California was below the median estimate for both electricity and natural gas savings. Refrigerators are interesting because California was closer to the median, and were one of the measures that had some agreement surrounding an important parameter: Estimates surrounding delta watts for refrigerator measures (as well as for CFLs) had close agreement, with low coefficients of variance. These findings demonstrate that consistency across regions is possible.

We do not attempt to explain the causes of these differences here, but rather present the evidence that plain energy savings estimates are divergent for similar measures that are climate-independent. There are many possible reasons for the differences, which could include measurement uncertainty, errors, or bias. Some markets are different across various regions; however, this should not affect plain energy savings of common measures that are climate-independent. While we could speculate as to the potential reasons as to why the values are so divergent, the limited scope of this paper and research do not support such conclusions. Therefore, we merely supply the evidence that savings estimates are divergent and provide recommendations to resolve the differences.

The variations in savings estimates reveal the need for increased regional and/or national coordination and transparency in M&V. They also shine a light on the need to increase transparency of the estimate calculations in order to ensure that accurate comparisons can be made. On the other hand, these same severe discrepancies demonstrate the tremendous benefits that could be delivered to efficiency by improved M&V. Increased coordination and transparency among evaluation parameters could reduce the costs and resources of conducting comprehensive M&V. Improving transparency, consistency, and coordination of EM&V across regions and states, is essential to elevate energy efficiency to the top priority resource that it should be.

Implications and Issues

Improvements through Increased Transparency and Coordination Could Yield Vast Benefits Quickly

The implications for such stark differences in estimates of energy savings are profound. The differences identified in this study create problems for states and regions across the country. A recent ACEEE study surveyed all the jurisdictions in the country that run efficiency programs and found that 70% of them establish deemed values by taking them from sources or databases in other states. (Kushler, 2012). Our research corroborated this conclusion through numerous occurrences of technical reference manuals citing values from other database sources. For example, a recent report evaluating commercial lighting programs found that TRMs often cite other TRMs, and that the source of the reference is often ultimately found to be California. (Joe Loper 2011). We also found several instances of TRMs or other evaluation reports citing California studies for reference. For example, the Vermont TRM cites a California study, Residential Appliance Recycling Program, for its refrigerator early retirement for baseline efficiencies. (ADM 2008). Furthermore, the CFL Modeling Report from NYSERDA cites a market effects study done in California. (Cadmus 2009). Our research supports the finding that many jurisdictions are establishing deemed values by taking them from sources in other states.

The result of such inter-reliance on other states' deemed values is that the differences among regions get distorted as they move to other states or regions. Jurisdictions do not always take entire replicas of other states' values, but rather, can pick and choose various parameters to borrow. If the majority of jurisdictions are sampling here and there from other states' estimates, the ability to create consistent estimates, and to compare savings across jurisdictions, becomes increasingly complex and difficult. On the other hand, this inter-reliance also speaks to the significant benefits of interstate and interregional coordination of EM&V. If the minority of states that are developing new savings estimates could work together and use consistent estimates, then other states could borrow these consistent estimates accurately and easily.

Recommendations

Our report confirms that various states use different parameter estimates, interpret savings parameters differently, and have different reporting metrics. These differences lead to difficulty in comparing program impact estimates. Therefore, we call for increased communication across regions and increased transparency to facilitate that communication. We note that the Northeast Energy Efficiency Partnerships NEEP released "Common Statewide Energy Efficiency Reporting Guidelines" in December 2010, in an attempt to move programs towards more consistent and transparent reporting, and LBNL has researched preliminary steps towards a national EM&V standard. We join these and others in the evaluation community in urging states to provide savings analysis in a straightforward and consistent format. Whether this be a format already proposed by one region, or to be developed through a collaboration of regions, we support the advancement of such transparency.

We also recommend that states make their EM&V information publicly available. The DEER is easily accessible, and includes information about the scenario in which it applies (e.g., building type, vintage, climate zone, etc.). However, for other regions' estimates, information was not always publicly available and easily accessible. Additionally, we recommend that all sources of savings data should be clear about their assumptions and applications.

Conclusion

Treating Energy Efficiency as a Resource Necessitates Improved M&V Across the Country

We set out by acknowledging that energy efficiency programs in various parts of the country often promote similar measures. Consequently, we identified four measures that were common around the nation and whose energy savings should be largely independent of climate. They were: residential CFLs, commercial lighting improvements in offices, residential refrigerator recycling, and efficient residential clothes washers. We reviewed savings estimates wherever available, compiling deemed savings parameters for each measure, for programs in over a dozen jurisdictions.

We found that these programs often use different estimates of energy savings, even for common, climate-independent measures. Furthermore, the results show that for these measures California uses estimates of energy savings that are significantly lower than the median, and often the lowest of those jurisdictions in the survey. Annual electric savings for common measures in California were lower than other jurisdictions often by factors of two or more. California's estimates of interactive effects were particularly large, imposing large heating penalties (19x greater than that of other jurisdictions), leading to annual deemed gas savings estimates that were 8x lower. This discrepancy particularly affects California's recent assessment of efficiency achievements. From a national perspective, this range of difference is not unique: similar differences occur between other states as well.

Because deemed savings estimates are often borrowed from the minority of jurisdictions that are independently developing new savings estimates, these discrepancies are of broad concern. We recommend increasing the coordination among the states developing new M&V protocols and savings estimates. We also recommend greater consistency and transparency of assumptions across programs. This harmonization would facilitate interstate coordination and would allow for more accurate assessments of comparative, as well as absolute, progress.

Cost effective energy efficiency is being deployed as the best resource to meet customers' needs, and quickly rising in states across the country, so the need for improved coordination, consistency, and transparency will increase. As the efficiency budgets start to multiply, so must our effort to harmonize our measurements of this resource. Furthermore, the possibility of a national clean energy standard that could include efficiency as a resource, creates an additional reason to strive for improved M&V of energy efficiency. Efficiency has accomplished much over the last several decades, as indicated by its rising share in our national portfolio of energy resource. We hope the next great step is to provide improved measurement that allows the entire country to rely on efficiency as the best resource to meet customers' needs.

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