State of Wisconsin Public Service Commission of Wisconsin

Focus on Energy Evaluation

Business Programs: Acceleration Treatment and Life Cycle Net Savings

Final: March 10, 2010

Evaluation Contractor: PA Consulting Group, Inc.

Prepared by: Miriam L. Goldberg, J. Ryan Barry, Tammy Kuiken, Ben Jones, Paulo Tanimoto, Nicole Buccitelli, Colin Rickert, and Darcy DeAngelo-Woolsey; KEMA, Inc.

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The power is within you.

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TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

1.1 OVERVIEW OF OBJECTIVES

This report expands upon the results of the impact evaluation of the statewide Focus on Energy Business Programs measures implemented during the first five quarters (July 1, 2007, through September 30, 2008) of the 18-month contract period[1] (18MCP).[2]

The principal objective of the impact evaluation was to determine the energy and demand savings attributable to the program. The analysis calculates a set of adjustment factors that are used to determine evaluation verified gross and net energy savings for the statewide Focus on Energy Business Program. The Focus Business Program impact evaluation calculates net savings on a first-year net savings (Y1NS)[3] basis. During the 18MCP, the evaluation, under the direction of the PSCW, developed the life cycle net savings (LCNS) method as an exploratory exercise at producing lifetime net savings rather than first-year net savings.

This report has two primary objectives. First, the Focus evaluation has always included acceleration as a component of overall attribution. However, not all jurisdictions include acceleration and those that do employ a variety of approaches. We researched the current methods utilized by other jurisdictions and investigated the effect of acceleration on Focus attribution results by employing other methods. In this report, we refer to this research as the Effects of Acceleration Treatment.

For the second objective, we investigated the effects of using life cycle net savings (LCNS) assumptions (e.g., measure life, verified gross savings during the acceleration period for accelerated custom measures in the CATI) on the 18MCP attribution results. This analysis is an update on Focus evaluation team's December 2, 2008, memo *Business Programs Life Cycle Attribution Analysis Results.* The results presented here incorporate updated measure life values from the Focus measure life study[4] and additional data collected from the second round of the 18MCP data collection (April 1 through September 30, 2008). In this report, we refer to this research as the Life Cycle Net Savings Analysis.

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[1] The "18-month contract period" refers to program implementation between July 1, 2007, and December 31, 2008.

[2] Miriam L. Goldberg, J. Ryan Barry, Ben Jones, Paulo Tanimoto, Jeremiah Robinson, and Tammy Kuiken; KEMA Inc. *Focus on Energy Evaluation, Business Programs Impact Evaluation Report: First Five Quarters of the 18-month Contract Period, Final.* April 2, 2009.

[3] Throughout the report the Focus evaluation team's first-year net savings method (Y1NS) is referred to as the "current Focus evaluation method." We abbreviate this term as "Focus Y1NS" in selected tables and charts.

[4] Miriam L. Goldberg, J. Ryan Barry, Brian Dunn, Mary Ackley, Darcy Deangelo-Woolsey, KEMA Inc. *Focus on Energy Evaluation Business Programs: Measure Life Study.* August 25, 2009.

1.2 EFFECTS OF ACCELERATION TREATMENT

1.2.1 Overview of objectives

The Focus evaluation has always included acceleration as a component of overall attribution. Program attribution is determined based on the program's effect on the timing, efficiency, and quantity of equipment installed. For non-CFLs, these three parameters are based on responses to the direct attribution questions in the impact evaluation survey. A few jurisdictions are beginning to require consideration of the life cycle net savings stream similar to that produced by our new LCNS method. However, this is far from the norm.

Not all jurisdictions include acceleration and those that do employ a variety of approaches. The LCNS method and even the current Focus evaluation Y1NS method are complete and appropriate representations of the program's effect and provide a sound basis for program decision-making. However, the differences in analytic approach between Focus and other jurisdictions may confound comparisons between Focus and other energy efficiency programs.

For these reasons, we have prepared a comparison of attribution results using different treatments of acceleration based on the data collected for the 18MCP impact evaluation. In addition, we investigated the relative effects of acceleration and efficiency on the attribution ratios to better gauge its influence of the current first-year methods (Y1NS).

1.2.2 Overview of approach

KEMA reviewed the attribution methodologies of well-established, large-scale, nonresidential programs in California, Massachusetts, New York, Oregon, and Vermont. Though we focused primarily on the treatment of acceleration, we also reviewed and summarized the general attribution methods used by these jurisdictions.

Based on the findings of our literature review, we created alternative attribution factors based on the different treatments of acceleration used in other jurisdictions. For a wider comparison, we also tested the effect on attribution of entirely removing the acceleration factor. Similarly, we separately tested the effect efficiency on attribution by removing the efficiency factor.

The intent of this analysis is to clarify how much of the difference between Focus and other programs' NTG ratios may be due to differences in the treatment of acceleration when determining program attribution.

1.2.3 Literature review

For the purposes of this report, KEMA reviewed documents, reports, and manuals detailing the attribution methodologies used in the nonresidential energy efficiency program evaluations of the following five states[5]:

1. California
2. Massachusetts
3. New York
4. Oregon
5. Vermont.

All of the states that assess net savings use self-report participant survey data as all or part of their program attribution calculations for their evaluations of large-scale commercial and industrial programs.[6] Most of these states used acceleration either implicitly or explicitly in their attribution methodology. Table 1-1 below shows the states researched, their primary methodologies for acceleration, and the primary data collection method used for determining attribution.

[5] The methodologies included in the literature review have been widely used in each jurisdiction, but are not necessarily uniformly required in all cases.

[6] Vermont does not evaluate free-ridership or spillover, but does apply an attribution assumption to estimate net impacts.

Table 1-1. Comparison of Acceleration Methods

State	Primary Treatment of Acceleration	Primary Data Collection Technique
Focus Y1NS	Acceleration less than 48 months receives partial credit towards attribution. Acceleration 48 months or more receives full attribution.	Self report participant surveys
California[7]	Acceleration less than 6 months receives no acceleration credit. Acceleration more than 6 months, but less than 48 months receives partial credit towards attribution. Acceleration 48 months or more receives full attribution.	Self report participant surveys
Massachusetts[8]	Acceleration more than 12 months receives full attribution. No partial acceleration credit given for less than 12 months.	Self report participant surveys
New York[9]	Acceleration less than 60 months receives partial credit toward attribution. Acceleration 60 months or more receives full attribution.	Self report participant surveys
Oregon[10,11]	The evaluation uses the program's effect on timing (yes/no) in developing the scores used to determine attribution. The length of the acceleration period is not considered.	Self report participant surveys
Vermont[12]	The most recent Efficiency Vermont Program C&I impact evaluation did not attempt to assess attribution.	N/A

1.2.4 Comparison of acceleration methods

Acceleration is only one component of a broader methodological framework. There are likely interactions between each state's specific acceleration approach and the approach the state

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[7] Nonresidential Net-to-Gross Working Group. *Methodological Framework for Using the Self-report Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers.* February 9, 2009.

[8] Sponsor utilities included National Grid, NSTAR Electric, Northeast Utilities, Unitil, and Cape Light Compact.

[9] NYSERDA. *Annual Report for 2008 – Program Evaluation and Status Report – Issued March 2009*, Section 2.3 Largest Savers Impact Evaluation. December 31, 2008. http://www.nyserda.org/publications/default.asp.

[10] Energy Trust of Oregon, Inc. *Evaluation Committee Report.* May 11, 2007. http://www.energytrust.org/meetings/board/2007/070808/04a_EvalMay.pdf.

[11] ADM Associates, Inc. *Impact Evaluation of New Building Efficiency Program for 2004 and 2005, Final Report.* February 2008.

[12] KEMA, Inc. and RLW Analytics. *Final Report: Phase 2 Evaluation of the Efficiency Vermont Business Program.* February 2006. http://publicservice.vermont.gov/pub/other/evaluationoftheefficiencyvtbusprogfinalreportphase2.pdf.

takes to other issues. However, it is not possible to adapt the entire methodological frameworks of the other states to the data collected for the Focus evaluation. This limits our ability to fully compare Focus attribution results to those of other states and it is beyond the scope of this research to assess the magnitude of this limitation.

Our approach to comparing acceleration methods focuses exclusively on acceleration methods employed by the other states. We adapted the basic logic of other jurisdictions' approach to acceleration to the Focus evaluation framework and compared those results.

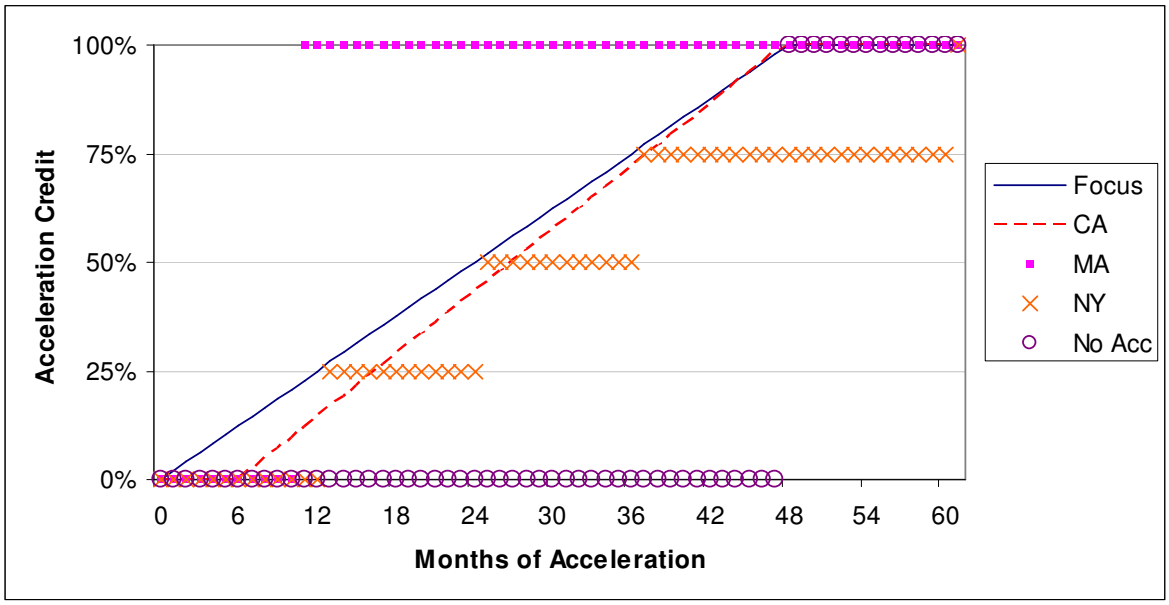
Table 1-2 through Table 1-4 provide comparisons of the current Focus evaluation method with five other methods using the impact evaluation data collection and basic attribution framework for the 18MCP. The five other attribution methods are:

1. California method: The California treatment of acceleration.
2. Massachusetts method: The Massachusetts treatment of acceleration.
3. New York method: The New York treatment of acceleration.
4. No acceleration: No partial acceleration credit is given. Acceleration of 48 months or more receives full attribution, otherwise, acceleration credit is zero.
5. No efficiency: No partial efficiency credit is given. Responses of "would have installed standard efficiency" receive full attribution, otherwise, efficiency credit is zero.

As discussed in Table 1-1, Oregon does not incorporate acceleration into its attribution calculation in a way that is compatible with the Focus data, and Vermont does not currently determine attribution in its evaluations, so neither state was included in the comparisons of acceleration methods.

Figure 1-1 shows the amount of acceleration credit by month for each acceleration method. Massachusetts gives zero acceleration credit for the first year and then jumps directly to 100 percent attribution after one year. The current Focus evaluation methodology gives more credit than both California and New York for any acceleration period less than 46 months. After 46 months, the difference between the current Focus evaluation method and California is less than one percent or equal, and the current Focus evaluation method continues to give more credit than New York's treatment through 60 months. After 60 months each state method gives full attribution credit.

Figure 1-1. Acceleration Credit by Month



The results produced with the acceleration treatments used by the Focus evaluation and other jurisdictions indicate that the current Focus evaluation treatment of acceleration provides attribution results comparable to those in other jurisdictions. Final attribution scores are not highly dependent on the acceleration calculation methodology.

The Massachusetts method's treatment of acceleration provides slightly higher attribution estimates, however not as high as might have been expected given that Massachusetts gives full attribution credit after one year. California and New York result in lower attributions than the current Focus evaluation method. This is consistent with the information provided in Figure 1-1. The effects of efficiency and acceleration on attribution are relatively equal: removing partial credit for either causes attribution to decline by roughly ten percent versus the current Focus evaluation method.

Table 1-2. Comparison of Acceleration Methods
kWh Attribution Factors by Sector

Sector	Focus Y1NS Method	CA Method	MA Method	NY Method	No Acc.	No Eff.
Agriculture	60%	59%	61%	58%	57%	46%
Commercial	70%	68%	71%	65%	65%	61%
Industrial	57%	55%	64%	50%	46%	50%
Schools and Government	43%	40%	43%	36%	33%	37%
Business Programs Overall	60%	57%	64%	54%	51%	51%

Table 1-3. Comparison of Acceleration Methods
kW Attribution Factors by Sector

Sector	Focus Y1NS Method	CA Method	MA Method	NY Method	No Acc.	No Eff.
Agriculture	57%	56%	58%	56%	55%	45%
Commercial	69%	68%	70%	66%	66%	61%
Industrial	54%	52%	61%	46%	43%	45%
Schools and Government	46%	44%	47%	41%	37%	39%
Business Programs Overall	58%	57%	62%	53%	51%	50%

Table 1-4. Comparison of Acceleration Methods
Therm Attribution Factors by Sector

Sector	Focus Y1NS Method	CA Method	MA Method	NY Method	No Acc.	No Eff.
Agriculture	17%	16%	18%	15%	14%	12%
Commercial	33%	29%	33%	24%	21%	25%
Industrial	63%	60%	71%	57%	44%	49%
Schools and Government	38%	36%	37%	34%	33%	27%
Business Programs Overall	52%	49%	57%	46%	38%	40%

1.2.5 Explaining the limited effects of acceleration treatment

To clarify why varying the acceleration treatment had such a limited effect upon attribution, KEMA first looked into the proportion of savings in the 18MCP sample that received different levels attribution. We grouped the attribution scores into the following categories:

- None: an attribution score of zero
- Partial: an attribution score between zero and one
- Full: an attribution score of one
- Market-based: an attribution score determined by a market study. In the 18MCP, CFLs less than 30 watts were the only measures with market-based attribution.

Changing the acceleration treatment only affects the net savings of measures that received partial attribution scores under the current Focus evaluation method. Those with no attribution and market-based attribution are unaffected by acceleration treatment. The majority of measures with full attribution under the current Focus evaluation method would be unaffected by the treatment of acceleration. The only exception is the few measures that received full attribution under the current Focus evaluation method due to an acceleration period between 48 and 60 months. These would have lower attribution scores under the NY treatment of acceleration, but would have full attribution with any of the other acceleration treatments.

As Table 1-5 shows, roughly half of each savings type receives partial attribution in BP overall though there is great variation among the sectors. The savings with partial attribution are greater for therms than kWh or kW in the two largest sectors, Commercial and Industrial, and BP overall. One reason the Commercial sector's large difference in partial attribution for

electric and therm savings is because the market-based attribution for CFLs does not affect therms. The difference for Industrial is not great.

Table 1-5. Percentage of Savings by Attribution Category

Sector	Amount of Attribution	kWh	KW	Therm
Agriculture	No attribution	22%	29%	76%
	Partial attribution	26%	19%	15%
	Full attribution	22%	25%	10%
	Market-based attribution	30%	28%	0%
Commercial	No attribution	15%	18%	30%
	Partial Attribution	36%	29%	62%
	Full attribution	18%	17%	8%
	Market-based attribution	28%	33%	0%
Industrial	No attribution	12%	15%	6%
	Partial attribution	58%	59%	65%
	Full attribution	28%	25%	30%
	Market-based attribution	0%	0%	0%
Schools & Government	No attribution	31%	29%	42%
	Partial attribution	47%	45%	32%
	Full attribution	13%	19%	24%
	Market-based attribution	9%	6%	0%
Business Programs Overall	No attribution	16%	19%	19%
	Partial attribution	49%	43%	56%
	Full attribution	23%	21%	25%
	Market-based attribution	11%	15%	0%

Next, we took a closer look at the measures with partial attribution. These are the only measures that are eligible for acceleration credit. As reported in Table 1-5 these measures account for 49 percent, 43 percent, and 56 percent of BP overall kWh, kW, and therms savings, respectively. Table 1-6 shows that 19 percent of overall kWh savings and 24 percent of overall therms received both partial attribution and had an acceleration period of greater than one year in the current Focus evaluation method. In these cases, the Massachusetts treatment granted full attribution where the current Focus evaluation method granted partial credit that is greater than both California and New York. On the other hand, 29 percent of kWh and 34 percent of therms received partial attribution and had less than one year of acceleration. For these measures, Massachusetts granted no additional attribution for acceleration effects, while California and New York both granted slightly less acceleration credit than the current Focus evaluation method.

Another interesting finding was that no acceleration credit was given for the “Three to Four Years” acceleration period category. That is, no respondents indicated they would have installed the measure on their own between three and four years. For data collected for the 18MCP, a change in the current Focus evaluation method’s acceleration period threshold from 48 months to 36 months would have a limited effect on attribution results. Roughly half of savings do not have partial attribution and would be unaffected by this change. This change has a maximum potential effect of a 25 percent difference in attribution for a measure with no other attribution credit and a 36-month acceleration period. The majority of accelerated measures have less than 36 months of acceleration and have partial attribution

from efficiency and quantity. Therefore, a 36-month threshold would increase the attribution by far less than the 25 percent. To take this one-step further, we could assert that we found little variation in acceleration effects on attribution results by varying the full attribution threshold from 36 to 60 months.

Table 1-6. Acceleration Periods of Measures with Partial Attribution

Sector	Length of Acceleration Period	kWh	kW	Therm
Agriculture	No acceleration	11%	10%	6%
	Less than one year	6%	4%	5%
	One to two years	5%	1%	3%
	Two to three years	3%	4%	1%
	Three to four years	0%	0%	0%
Commercial	No acceleration	8%	10%	13%
	Less than one year	16%	13%	36%
	One to two years	9%	5%	12%
	Two to three years	2%	1%	0%
	Three to four years	0%	0%	0%
Industrial	No Acceleration	19%	25%	10%
	Less than one year	14%	11%	22%
	One to two years	16%	17%	4%
	Two to three years	9%	6%	29%
	Three to four years	0%	0%	0%
Schools & Government	No acceleration	7%	12%	4%
	Less than one year	25%	18%	20%
	One to two years	6%	4%	7%
	Two to three years	9%	11%	1%
	Three to four years	0%	0%	0%
Business Programs Overall	No acceleration	14%	17%	9%
	Less than one year	15%	12%	22%
	One to two years	13%	9%	5%
	Two to three years	6%	5%	19%
	Three to four years	0%	0%	0%

Changing the treatment of acceleration only affects measures with partial attribution, which limits the maximum amount of effect it has on the ratio to roughly 50 percent. The amount of measures that receive partial attribution, but are not accelerated by the program further reduces this effect. In addition, because the acceleration grants credit for a percent of the savings that was otherwise not attributable to the program, the effects of acceleration on the attribution ratio are further reduced by the positive effects of quantity and efficiency attribution credit. In sum, the treatment of acceleration plays a small role in the overall assessment of attribution.

1.2.6 Conclusions

Our literature review shows that the current Focus evaluation framework is in the mainstream with its attribution methodology. Though each of the states in our study group that evaluate attribution has a different methodology, all use self-report participant surveys as the primary

data source for determining program attribution. Most of these states include acceleration in their attribution methodology either explicitly or implicitly. The Massachusetts method differs greatly from the Focus method and gives full attribution credit for measures accelerated by more than one year and no acceleration credit for measures accelerated by less than one year. The Massachusetts acceleration treatment results in a slightly higher attribution compared with the Focus method. The Focus evaluation's acceleration treatment is similar to that used in both California and New York. Of the three, the Focus methodology gives the most attribution credit for acceleration.

Though differences exist in each jurisdiction's exact treatment of acceleration, when we applied these different treatments to the Focus 18MCP data within the Focus evaluation's attribution framework, the resulting attributions did not change significantly. Only about half of the gross savings in Focus receive any partial attribution. The remainder is either fully attributable, not attributable, or receives a market-based attribution. For the portion that does have partial attribution, some of this is determined by partial efficiency or quantity adjustments, not acceleration. Thus, there is a limit to the effect that any changes to the Focus acceleration methodology will have on the results.

1.3 LIFE CYCLE NET SAVINGS (LCNS) ASSUMPTION ANALYSIS

1.3.1 Introduction

Most energy efficiency programs across the country, including Focus, have evaluated energy savings impacts based on first–year savings, rather than a full lifetime savings stream. The lifetime savings stream is the annual energy savings of an installed measure for each year of the measure's life. The annual energy savings may vary across years in the stream of savings. A primary contributor to this variation is acceleration; defined in this context as advancing the time when an energy efficiency measure is installed, compared to when it would have been installed in the absence of the program. For the Focus evaluation, it is appropriate to use a lower efficiency baseline (i.e., the efficiency of the existing equipment) during the acceleration period compared with the higher "standard" baseline for natural replacement measures and during the post-acceleration period. Accounting for the effects of acceleration within a stream of lifetime savings is a more accurate and complete representation of program accomplishments than more traditional first-year savings methods.

The Focus evaluation team's framework paper, *Treatment of Accelerated Savings,*[13] discusses the acceleration effect on the lifetime savings stream approach and the key considerations for a lifetime approaches with regards to:

1. Assessing program goal achievement
2. Periodic reporting of program accomplishments
3. Resource planning

[13] Miriam Goldberg, Rick Winch, Tom Talerico, Ralph Prahl, Bryan Ward. *Focus on Energy Evaluation: Treatment of Accelerated Savings.* July 2, 2008.

4. Cost-effectiveness testing

5. Program planning.

Under the direction of the PSCW, the evaluation team developed an alternative attribution analysis method called the life cycle net savings (LCNS) method. The life cycle method provides for a different treatment of accelerated projects and produces lifetime net savings instead of the first-year net savings produced by the current Focus evaluation method (Y1NS).

1.3.2 Overview of objectives

The purpose of this analysis is to explore the viability of the life cycle method as an alternative net savings methodology that takes a more nuanced approach to program attribution. This effort is part of the evaluation team's continued effort to adapt, adjust, and refine the life cycle method analysis assumptions. To that end, we:

1. Update the life cycle method results reported in the December 2008 LCNS memo with:
   a. Additional data collected in the second round of the 18MCP impact evaluation data collection (projects implemented between April 1 and September 30, 2008)
   b. The new measure lives developed for the Business Programs' measure life study[14]
2. Compare the life cycle method and results with those of the first-year method
3. Investigate the effects of assumptions used in the life cycle method, including the effects of the updated measure lives.

1.3.3 Overview of approach

The December 2008 LCNS memo used data from the first nine months of the 18MCP. This analysis was able to take advantage of data from an additional six months of the 18MCP. In addition, the release of the Focus Business Programs measure life study offered us the opportunity to update the measure lives used in the life cycle method.

The primary goal of the new methodology, LCNS, is to produce life cycle net savings as opposed to the first-year net savings. Because savings in the life cycle method are based in part on length of time that the equipment operates, measure lives are a key input to the life cycle method analysis. All else being equal, in the life cycle method a measure with a lifetime of 10 years will be twice as important in the final analysis as a measure with a 5-year lifetime. (Like a simple payback analysis, the life cycle method does not incorporate a discount rate such as would be included in a full-scale benefit/cost analysis.) The updated measure lives for Focus rebated equipment and services range from 2 to 19 years depending on the equipment and application. Some of the new measure lives varied significantly from those used in the December 2008 LCNS analysis as shown in Table 1-7. KEMA ran results using

[14] Miriam L. Goldberg, J. Ryan Barry, Brian Dunn, Mary Ackley, Darcy Deangelo-Woolsey, KEMA Inc. *Focus on Energy Evaluation Business Programs: Measure Life Study.* August 25, 2009.

both the new and the old measure lives to investigate the effect of changing the measure lives.

Table 1-7. Measure Life in Years

End-use Category	Measure Type	Sector							
		Agriculture		Commercial		Industrial		Schools and Government	
		New	Old	New	Old	New	Old	New	Old
Building Shell	Equip or Tech	19	10	19	10	19	10	19	10
HVAC	Equip or Tech	15	15	15	15	15	15	15	15
	Service	5	15	5	15	5	15	5	15
Lighting	Equip or Tech	12	15	12	15	12	15	12	15
Manufacturing Process	Equip or Tech	11	12	11	12	11	12	11	12
	Service	2	12	2	12	2	12	2	12
Other	Equip or Tech	12	17	12	19	12	28	12	10
CFL	Equip or Tech	7	6	5	6	4	6	5	6
Motors	Equip or Tech	16	16	16	16	16	16	16	16

Like the first-year method, the life cycle method calculates attribution as a ratio of net savings to a ratio of verified gross savings and the realization rate as a ratio of net savings to tracked savings; however, the life cycle approach has two significant differences in its estimation of verified gross savings and net savings for the measure. First, the life cycle method looks at the total lifetime savings of the equipment. Second, it increases the annual verified gross savings in the acceleration period for custom measures where the existing equipment had lower than standard efficiency. In the post-acceleration period and for non-accelerated measures the annual verified gross savings are the same as those used in the first-year method.

The annual gross savings in the acceleration period was estimated for some measures because the input data needed to calculate annual gross savings for these measures is not currently available. The 18MCP impact evaluation used two surveys, one conducted by KEMA engineers, referred to as “the engineering survey” and one CATI survey. The CATI survey did not result in verified gross savings estimations. For all measures in the CATI, the ratio of verified gross savings to installed savings was assumed to be one for the purposes of the first-year method. This assumption is continued in the life cycle method analysis for the annual verified gross savings of non-accelerated measures and post-acceleration periods of accelerated measures. As described above, accelerated custom measures often have annual verified savings in the acceleration period that are greater than the annual verified savings in the post-acceleration period. The ratio of these two savings is referred to throughout this report as the A/P ratio.[15] The life cycle method assumes an A/P ratio of two for custom measure in the CATI. That is, the energy savings in the acceleration period is twice that of the post-acceleration period.

[15] The A/P ratio is the ratio of Acceleration Period to Post-Acceleration Period savings (VGI). For more details on the LCNS method, please review the *Business Programs Life Cycle Attribution Analysis Results* memo released on December 2, 2008.

To investigate the uncertainty introduced by our assumed A/P ratio and confirm the robustness of our results, KEMA ran life cycle method results with the aforementioned assumptions and an alternative set of assumptions. LCNS Method A is official life cycle method result which uses an assumed an A/P ratio of two for custom measures in the CATI; and LCNS Method B used the observed sector level A/P ratios from the engineering survey for the custom CATI measures. Table 1-8 shows the differences in methodology among the first-year method and the two life cycle methods.

Table 1-8. Methodological Differences between Y1NS Method and LCNS Methods

Assumption	Y1NS	LCNS Method A	LCNS Method B
Type of savings	First year savings	Lifetime savings	
Annual acceleration period verified gross savings	The difference between the energy use of the rebated equipment and the energy use of its standard efficiency replacement.	The difference between the energy use of the rebated equipment and the energy use of the equipment replaced.	
Annual post-acceleration period verified gross savings		The difference between the energy use of the rebated equipment and the energy use of its standard efficiency replacement.	
Acceleration period net savings	n/a	Acceleration period verified gross savings multiplied by the acceleration period.	
Post-acceleration period net savings	n/a	Post-acceleration period verified gross savings times the simple program attribution (SPA).	
A/P ratio assumed for custom CATI	n/a (implied 1)	2	Based on sector level A/P ratios observed in the engineering survey
Net savings calculation	Verified gross savings times [SPA + (Acc/48)(1-SPA)]	Acceleration period net savings plus post-acceleration period net savings	

1.3.4 Summary of results

As can be seen in Table 1-9 and Table 1-10, both life cycle methods result in attribution factors and realization rates that are lower than those found using the current, first-year method. To a large extent, this difference is less about acceleration treatment per se than it is the difference between weighting measure attribution by first-year versus lifetime savings. The lower attribution for life cycle method indicates that the program is receiving higher attribution under the current, first-year method on shorter-lived measures than on measures with longer lifetimes. While each sector has lower attribution using the life cycle method, we see the greatest difference in the Agriculture and Commercial sectors. Each of these sectors has a significant amount of savings from CFLs, which receive high market-based attribution scores. CFL attribution brings the sector level attributions up, but the short measure lives of CFLs mutes this effect in the life cycle method. A shorter measure life results in less lifetime savings than measures of similar annual savings with a longer lifetime.

Table 1-9. Attribution Factors by Method

Sector	kWh			kW			Therms		
	Y1NS	LCNS A	LCNS B	Y1NS	LCNS A	LCNS B	Y1NS	LCNS A	LCNS B
Agriculture	60%	51%	51%	57%	48%	48%	17%	13%	13%
Commercial	70%	57%	57%	69%	55%	55%	33%	24%	24%
Industrial	57%	51%	51%	54%	47%	47%	63%	50%	49%
Schools & Government	43%	39%	39%	46%	47%	47%	38%	30%	29%
Business Programs Overall	60%	52%	52%	58%	50%	50%	52%	40%	40%

Table 1-10. Realization Rates by Method

Sector	kWh			kW			Therms		
	Y1NS	LCNS A	LCNS B	Y1NS	LCNS A	LCNS B	Y1NS	LCNS A	LCNS B
Agriculture	56%	47%	47%	55%	47%	47%	13%	11%	11%
Commercial	63%	54%	54%	66%	55%	55%	34%	25%	25%
Industrial	53%	47%	47%	49%	42%	42%	60%	42%	42%
Schools & Government	43%	35%	35%	43%	43%	43%	30%	22%	22%
Business Programs Overall	55%	48%	48%	54%	46%	46%	48%	34%	34%

The difference in the life cycle attributions from Method A to Method B is very slight; when rounded to the nearest percent, none of the overall attributions appears to be different. Life cycle Method A and B differ only in the assumed A/P ratio that was applied to custom measures from the CATI survey. Because the majority of CATI measures were deemed measures, custom CATI measures only make up a small portion of savings in each sector, so the A/P ratio has a limited ability to affect the results. Table 1-11 shows the percent of savings in each sector that use an assumed A/P ratio. Table 1-12 displays the A/P ratios used in Method B, which are all less than Method A's assumption of 2.

Table 1-11. Proportion of Gross Savings Affected by the Acceleration-to-Post-Acceleration Savings A/P Ratio Assumption

Sector	kWh	kW	Therms
Agriculture	20%	16%	3%
Commercial	10%	5%	1%
Industrial	3%	3%	5%
Schools & Government	6%	5%	5%
Business Programs Overall	7%	5%	5%

Table 1-12. Average Acceleration-to-Post-Acceleration Savings A/P Ratio for Custom Measures in the Engineering Review

Sector	kWh	kW	Therms
Agriculture	1.6	1.1	0.8*
Commercial	1.0	1.0	1.0
Industrial	1.1	1.1	1.3
Schools & Government	1.5	1.1	1.5

*Agriculture therms had an A/P ratio of less than one due to a large fuel switching measure with negative therm savings.

KEMA also investigated the effect of the new measure lives on the ratios. The new measure lives are generally shorter than the old measure lives. However, the expected effect on the ratios is ambiguous because the ratios depend of the mix of measures and attributions. For example, if the measure life for a measure with low attribution were shorter, this would tend to increase the ratio, as would having a longer measure life for a measure with high attribution.

When we compared the life cycle method realization rates using the updated measure lives to the life cycle method realization rates with the old measure lives, we found that the overall electric ratios had not changed, while the overall therm ratios decreased. The realization rates for schools and government improved, while they fell in other sectors. Whether a ratio increased or declined depended on the mix of measures and attributions in the sector for each particular savings types.

Table 1-13. Effect of New Measure Lives on LCNS Method A Realization Rates

Sector	KWh			kW			Therms		
	New Measure Life	Old Measure Life	Diff.	New Measure Life	Old Measure Life	Diff.	New Measure Life	Old Measure Life	Diff.
Agriculture	47%	49%	-2%	47%	49%	-2%	11%	13%	-2%
Commercial	54%	54%	0%	55%	55%	0%	25%	27%	-2%
Industrial	47%	48%	-1%	42%	43%	-1%	42%	45%	-3%
Schools & Government	35%	34%	2%	43%	37%	6%	22%	21%	1%
Business Programs Overall	48%	48%	0%	46%	46%	0%	34%	36%	-3%

1.3.5 Conclusions

The life cycle method provides a more realistic estimate of the lifetime savings attributable to the program than simply projecting the first-year results forward. We recommend the PSCW consider continued development and refinement of this method in addition to the current Focus (first-year) methods in future evaluations.

Conceptually, there are two key differences between the approaches:

1. The first-year approach treats the reported acceleration period more as an indicator of the likelihood the measure would have been installed without the program rather than as a literal indicator of the time until the measure would have been installed.

2. The first-year approach determines aggregate attribution for a program, sector, or portfolio weighting measures only by first-year savings. The life cycle approach weights measures according to lifetime savings. The first-year approach gives more weight to shorter-lived measures.

Further work remains to be done on understanding how best to obtain meaningful information on timing of installations absent the program, or conversely on how to interpret self-reported acceleration. However, taking measure life into account in assessing aggregate attribution is important in its own right.

The most current input data, such as measure lives, should be incorporated into the life cycle analysis as they become available. This research indicates the acceleration-to-post-acceleration savings A/P ratio assumption of two for custom measures in the CATI is slightly more generous compared to an A/P assumption based on custom projects in the engineering sample. However, KEMA recommends continued use of this assumption for the following reasons:

- The results of this analysis exhibited no meaningful differences in sector-level attribution estimates using the A/P ratio from reviewed custom projects rather than assuming a ratio of two.
- A small fraction of overall energy savings is affected by this assumption.
- The PSCW has directed the evaluation team to transition impact evaluation reporting from sector-level analysis to technology based analysis. This change merits further investigation into A/P ratios by the technology groupings to be used for impact reporting.
- This assumption may become moot in further evaluations if custom measures are excluded from the CATI, as was the case with the CY09 impact evaluation sample design.

2. INTRODUCTION

2.1 OVERVIEW OF OBJECTIVES

This report expands upon the results of the impact evaluation of the statewide Focus on Energy Business Programs measures implemented during the first five quarters (July 1, 2007, through September 30, 2008) of the 18-month contract period[16] (18MCP).[17]

The principal objective of the impact evaluation was to determine the energy and demand savings attributable to the program. The analysis calculates a set of adjustment factors that are used to determine evaluation verified gross and net energy savings for the statewide Focus on Energy Business Program. The Focus Business Program impact evaluation calculates net savings on a first-year net savings (Y1NS)[18] basis. During the 18MCP, the evaluation, under the direction of the PSCW, developed the life cycle net savings (LCNS) method as an exploratory exercise at producing lifetime net savings rather than first-year net savings.

This report has two primary objectives. First, the Focus evaluation has always included acceleration as a component of overall attribution. However, not all jurisdictions include acceleration and those that do employ a variety of approaches. We researched the current methods utilized by other jurisdictions and investigated the effect of acceleration on Focus attribution results by employing other methods. In this report, we refer to this research as the Effects of Acceleration Treatment.

For the second objective, we investigated the effects of using life cycle net savings (LCNS) assumptions (e.g., measure life, verified gross savings during the acceleration period for accelerated custom measures in the CATI) on the 18MCP attribution results. This analysis is an update on Focus evaluation team's December 2, 2008, memo *Business Programs Life Cycle Attribution Analysis Results.* The results presented here incorporate updated measure life values from the Focus measure life study[19] and additional data collected from the second round of 18MCP data collection (April 1 through September 30, 2008). In this report, we refer to this research as the Life Cycle Net Savings Analysis.

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[16] The "18-month contract period" refers to program implementation between July 1, 2007, and December 31, 2008.

[17] Miriam L. Goldberg, J. Ryan Barry, Ben Jones, Paulo Tanimoto, Jeremiah Robinson, and Tammy Kuiken; KEMA Inc. *Focus on Energy Evaluation, Business Programs Impact Evaluation Report: First Five Quarters of the 18-month Contract Period, Final.* April 2, 2009.

[18] Throughout the report the Focus evaluation team's first-year net savings method (Y1NS) is referred to as the "current Focus evaluation method." We abbreviate this term as "Focus Y1NS" in selected tables and charts.

[19] Miriam L. Goldberg, J. Ryan Barry, Brian Dunn, Mary Ackley, Darcy Deangelo-Woolsey, KEMA Inc. *Focus on Energy Evaluation Business Programs: Measure Life Study.* August 25, 2009.

2.2 OVERVIEW OF APPROACH

This report contains the results of two different sets of analyses, the Effects of Acceleration Treatment and the Life Cycle Net Savings Assumption Analysis. The approach used for each of these analyses is described below.

2.2.1 Effects of acceleration treatment

KEMA reviewed the attribution methodologies of well-established, large-scale, nonresidential programs in California, Massachusetts, New York, Oregon, and Vermont. Though we focused primarily on the treatment of acceleration, we also reviewed and summarized the general attribution methods used by these jurisdictions.

Based on the findings of our literature review, we created alternative attribution factors based on the different treatments of acceleration used in other jurisdictions. For a wider comparison, we also tested the effect on attribution of entirely removing the acceleration factor. Similarly, we separately tested the effect efficiency on attribution by removing the efficiency factor.

The intent of this analysis is to clarify how much of the difference between Focus and other programs' NTG ratios may be due to differences in the treatment of acceleration when determining program attribution.

2.2.2 Life cycle net savings assumption analysis

The December 2008 LCNS memo used data from the first nine months of the 18MCP. This analysis was able to take advantage of data from an additional six months of the 18MCP. In addition, the release of the Focus Business Programs measure life study offered us the opportunity to update the measure lives used in the life cycle analysis.

The primary goal of the new methodology, LCNS, is to produce life cycle net savings as opposed to the first-year net savings. Because savings in the life cycle method are based in part on length of time that the equipment operates, measure lives are a key input to the life cycle method analysis. All else being equal, in the life cycle method a measure with a lifetime of 10 years will be twice as important in the final analysis as a measure with a 5-year lifetime. (Like a simple payback analysis, the life cycle method does not incorporate a discount rate such as would be included in a full-scale benefit/cost analysis.) The updated measure lives for Focus rebated equipment and services range from two to 19 years depending on the equipment and application. Some of the new measure lives varied significantly from those used in the December 2008 LCNS analysis as shown in Table 2-1. KEMA ran results using both the new and the old measure lives to investigate the effect of changing the measure lives.

Table 2-1. Measure Life in Years

End-use Category	Measure Type	Sector							
		Agriculture		Commercial		Industrial		Schools and Government	
		New	Old	New	Old	New	Old	New	Old
Building Shell	Equip or Tech	19	10	19	10	19	10	19	10
HVAC	Equip or Tech	15	15	15	15	15	15	15	15
	Service	5	15	5	15	5	15	5	15
Lighting	Equip or Tech	12	15	12	15	12	15	12	15
Manufacturing Process	Equip or Tech	11	12	11	12	11	12	11	12
	Service	2	12	2	12	2	12	2	12
Other	Equip or Tech	12	17	12	19	12	28	12	10
CFL	Equip or Tech	7	6	5	6	4	6	5	6
Motors	Equip or Tech	16	16	16	16	16	16	16	16

Like the first-year method, the life cycle method calculates attribution as a ratio of net savings to a ratio of verified gross savings and the realization rate as a ratio of net savings to tracked savings; however, the life cycle approach has two significant differences in its estimation of verified gross savings and net savings for the measure. First, the life cycle method looks at the total lifetime savings of the equipment. Second, it increases the annual verified gross savings in the acceleration period for custom measures where the existing equipment had lower than standard efficiency. In the post-acceleration period and for non-accelerated measures the annual verified gross savings are the same as those used in the first-year method.

The annual gross savings in the acceleration period was estimated for some measures because the input data needed to calculate annual gross savings for theses measures is not currently available. The 18MCP impact evaluation used two surveys, one conducted by KEMA engineers, referred to as "the engineering survey" and one CATI survey. The CATI survey did not result in verified gross savings estimations. For all measures in the CATI, the ratio of verified gross savings to installed savings was assumed to be one for the purposes of the first-year method. This assumption is continued in the life cycle analysis for the annual verified gross savings of non-accelerated measures and post-acceleration periods of accelerated measures. As described above, accelerated custom measures often have annual verified savings in the acceleration period that are greater than the annual verified savings in the post-acceleration period. The ratio of these two savings is referred to throughout this report as the A/P ratio.[20] The life cycle method assumes an A/P ratio of two for custom measure in the CATI. That is, the energy savings in the acceleration period is twice that of the post-acceleration period.

To investigate the uncertainty introduced by our assumed A/P ratio and confirm the robustness of our results, KEMA ran life cycle method results with the aforementioned assumptions and an alternative set of assumptions. LCNS Method A is official life cycle

[20] The A/P ratio is the ratio of Acceleration Period to Post-Acceleration Period savings (VGI). For more details on the LCNS method, please review the *Business Programs Life Cycle Attribution Analysis Results* memo released on December 2, 2008.

method result which uses an assumed an A/P ratio of two for custom measures in the CATI; and LCNS Method B used the observed sector level A/P ratios from the engineering survey for the custom CATI measures. Table 2-2 shows the differences in methodology among the first-year method and the two life cycle methods.

Table 2-2. Methodological Differences between Y1NS Method and LCNS Methods

<table>
<tr><th>Assumption</th><th>Y1NS</th><th>LCNS Method A</th><th>LCNS Method B</th></tr>
<tr><td>Type of savings</td><td>First year savings</td><td colspan="2">Lifetime savings</td></tr>
<tr><td>Annual acceleration period verified gross savings</td><td rowspan="2">The difference between the energy use of the rebated equipment and the energy use of its standard efficiency replacement.</td><td colspan="2">The difference between the energy use of the rebated equipment and the energy use of the equipment replaced.</td></tr>
<tr><td>Annual post-acceleration period verified gross savings</td><td colspan="2">The difference between the energy use of the rebated equipment and the energy use of its standard efficiency replacement.</td></tr>
<tr><td>Acceleration period net savings</td><td>n/a</td><td colspan="2">Acceleration period verified gross savings multiplied by the acceleration period.</td></tr>
<tr><td>Post-acceleration period net savings</td><td>n/a</td><td colspan="2">Post-acceleration period verified gross savings times the simple program attribution (SPA).</td></tr>
<tr><td>A/P ratio assumed for custom CATI</td><td>n/a (implied 1)</td><td>2</td><td>Based on sector level A/P ratios observed in the engineering survey</td></tr>
<tr><td>Net savings calculation</td><td>Verified gross savings times [SPA + (Acc/48)(1-SPA)]</td><td colspan="2">Acceleration period net savings plus post-acceleration period net savings</td></tr>
</table>

2.3 ORGANIZATION OF REPORT

Section 3 of this report begins with a summary of attribution methodologies used in recent business program evaluations in other jurisdictions. We pay particular attention to how the acceleration of measures is used in determining the program attribution of a given measure. After describing the methodologies used elsewhere, we then apply the methodologies used to Focus evaluation data collected for the 18MCP impact evaluation and compare these results to the findings reported in *Business Programs Impact Evaluation Report: First Five Quarters of the 18-month Contract Period*.

Section 4 provides a detailed description of the life cycle methodology, results using the life cycle method, a comparison of the life cycle method and first-year method results, and an examination of the key assumptions of the life cycle methodology.

3. EFFECTS OF ACCELERATION TREATMENT

This section provides a summary of attribution methodologies used with large-scale nonresidential energy efficiency programs in five other jurisdictions. The review of these methods focuses on the treatment of acceleration effects. After describing these methodologies, we compare the treatment of acceleration effects with that of the current Focus evaluation method. As part of this comparison, we calculated attribution factors for the 18MCP using the alternative treatments of acceleration effects employed by the other jurisdictions.

3.1 LITERATURE REVIEW

Currently there is no national standard methodology for determining the attribution for energy efficiency programs. To improve our understanding of Focus attribution results and the effect of acceleration on the attribution results KEMA reviewed the standardized and established attribution methodologies of large-scale nonresidential energy efficiency programs within:[21]

1. California
2. Massachusetts
3. New York
4. Oregon
5. Vermont.

We focused our research on the treatment of acceleration effects but also include a synopsis of the general attribution methodologies. Most of the states we looked at used acceleration either implicitly or explicitly in their attribution methodology. With the exception of Vermont, which uses a deemed value for program attribution, each of the jurisdictions included in the review employ participant self-report survey techniques to determine program attribution.

The attribution methodology summaries for each of the aforementioned states include:

- A succinct description of the attribution methodology (A. Attribution Calculation)
- A deeper look at the methodology's treatment of acceleration effects in the calculation (B. Treatment of Acceleration)
- A brief look at the state's approach to incorporating spillover into the attribution computation (C. Spillover).

3.1.1 California

In February 2009, the California Public Utilities Commission's (CPUC) Nonresidential Net-To-Gross Working Group prepared the *Methodological Framework for Using the Self-report*

[21] The methodologies included in the literature review have been widely used in each jurisdiction, but are not necessarily uniformly required in all cases.

Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers.[22] This framework is the most recent attribution standards set by the CPUC. It is the basis for all future net-to-gross analysis of California's commercial and industrial incentive programs.

The framework includes as a part of its attribution analysis a scoring system that allows the customer to express levels of agreement to the questions posed; and asks the customer about outside factors that may have influenced their decision-making.

The program attribution estimate is determined using data collected from surveys with customers. The following three "scores" are calculated.

1. **Timing and Selection.** Survey questions require the decision maker to rate the importance of each factor in the decision to implement the program-sponsored measure. If the vendor is considered a factor in the decision-making process, then the vendor is asked about the importance of each factor in the vendor's decision to make the recommendation.
2. **Program Influence.** Survey questions ask the decision maker to rate the importance of the program's efforts in the decision to implement the specific measure versus those other factors discussed in the Timing and Selection questions.
3. "**No-program.**" Survey questions investigate the likelihood of various actions the customer might have taken at the same time of the program-supported measure installation and in the future, if the program had not been available. Acceleration is included in the calculation of this score. In California, acceleration is considered as a factor if the customer planned to purchase the measure at least six months later than the actual implementation.

These scores are combined to determine the net-to-gross ratio.

A. ATTRIBUTION CALCULATION

The California net-to-gross approach encompasses a majority of the elements used in previous approaches; however, it also incorporates several enhancements designed to improve upon that approach. The California framework identified the following two key enhancements.

- The method introduces a 0 to 10 scoring system for key questions used to estimate the net-to-gross ratio (NTGR), rather than using fixed categories that were assigned weights (as was done previously). This scoring system allows the customer to attribute a number from 0 to 10 that indicates their agreement with the question. We provide more details below regarding the use of this scale and its effect on program attribution.

- The method asks respondents to jointly consider and rate the importance of many likely events or factors that may have influenced their energy efficiency decision making, rather than focusing narrowly the program's influence.

[22] Nonresidential Net-to-Gross Working Group. *Methodological Framework for Using the Self-report Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers.* February 9, 2009.

The California net-to-gross approach is a general framework designed to address all large nonresidential programs. This net-to-gross approach allows customization to reflect the nature of the individual programs and offers three levels of free-ridership rigor (Basic NTG, Standard NTG, and Standard-Very Large Project NTG).

The most detailed level of analysis, the **Standard-Very Large Project** NTG, is applied to the largest and most complex projects with the greatest expected levels of gross savings. The **Standard** NTG, involving a somewhat less detailed level of analysis, is applied to projects with moderately high levels of gross savings. The least detailed analysis, the **Basic** NTG, is applied to all remaining projects. Evaluators are expected to exercise their own discretion as to what the appropriate thresholds should be for each of these three levels.

The California net-to-gross approach utilizes information gathered from at least one of five sources of information based on the level of rigor needed to determine program attribution applicable to the type of program. Table 3-1 shows the levels of rigor and the sources of information that each uses.

Table 3-1. California NTG Levels of Rigor and Sources of Information

Source Utilized	Definition of Source of Information	Levels of Rigor Needed to Determine Program Attribution		
		Basic Net-to-Gross	Standard Net-to-Gross	Standard Very Large Project Net-to-Gross
Program File	Information such as letters written by the utility's customer representatives that document what the customer had planned to do in the absence of the rebate and the customer's motivation for implementation.	X	X	X
Decision Maker Survey	Responses by decision maker indicate the probability that the customer would have implemented the same measure in the absence of the program.	X	X	X
Vendor Survey	Responses by vendor determine the program influence on recommendations of the measure	X	X	X
Utility and Program Staff Interview	Responses by program and utility staff flesh out the historical background of decision making, and the role of others in the decision making.		X	X
Other Research Findings	Other research such as standards and best practices and interviews with other offices and vendors to get a broader picture of the customer's standard practices versus the programs influence.			X

The majority of the information needed to determine attribution of the program is derived during the self-report Decision Maker Survey and, if prompted, the Vendor Survey. These sources of information are used to determine program attribution at all levels of rigor. The Program File, Utility and Program Staff Interviews, and Other Research Findings may be utilized to flesh out the answers already given during the Decision Maker Survey and Vendor

Survey, but for all levels of rigor, attribution is calculated as an average of three scores from responses that are gathered from the Decision Maker Survey, and at times the Vendor Survey. These scores are:

1. The **Timing and Selection** score reflects the influence of the ***most important***[23] of various program and program-related elements in the customer's decision to select the specific program measure *at this time*. Program influence through vendor recommendations is also incorporated in this score.

2. The **Program Influence** score captures the perceived importance of the program (whether rebate, recommendation, training, or other program intervention) relative to non-program factors in the decision to implement the specific measure that was adopted or installed.

3. The **No-Program** score captures the likelihood of various actions the customer might have taken at this time and in the future if the program had not been available (the counterfactual).

The net-to-gross ratio is calculated as the average of the three 11-point scale scores divided by 10.

NTGR = (AVERAGE (Timing and Selection, Program Influence, No Program)) / 10

Next, we take a closer look at the sources of information and how they inform the three scores.

i. Decision Maker Survey

The Decision Maker Survey is a self-report program participant survey. All three levels of rigor utilize the decision maker survey. The survey contains structured questions concerning previous decision making to incorporate energy efficient measures and plans to do so in the future, the importance of the program in deciding to incorporate energy efficient measures, and the probability that the customer would have implemented the same measure in the absence of the program in varying degrees.

California's Decision Maker Surveys ask a series of questions designed to measure the influence of the program on the participant's decision to implement program-eligible energy efficiency measure(s). These questions are categorized as "core questions" and "background questions". The former are utilized to calculate net-to-gross at all rigor levels and the latter may be utilized for reference or to better understand the decision to install. If the background questions are inconsistent with the core questions in the case of Standard – Very Large NTG sites, adjustments may be made to the net-to-gross ratio.

California's framework provides some detail in how to deal with inconsistencies between responses to the core and background questions. In all cases where qualitative information from either the background questions or other information sources may suggest an alteration of a core response for the NTGR, judgments must be made as to how compelling the

[23] Identification of the most important factors is explained in "Section iv. Scoring."

contradicting information is. At least two analysts must independently review the supplemental data, determine whether and by how much a score should be changed, and make a case for it. The analysts then review their cases together and come to an agreement on how to proceed.

ii. The Vendor Survey

The vendor survey is a survey utilized by all Standard and Standard-Very Large NTG customers that used vendors and by Basic NTG customers that indicate the vendor was influential in decision-making. Vendors are queried about the program's significance to their decisions. The vendor is asked five questions regarding the influence of the program on the vendor's recommendation:

1. Using this 0 to 10 scale where 0 is 'Not at all important" and 10 is "Very Important," how important was [PROGRAM], including incentives as well as program services and information, in influencing your decision to recommend that [CUSTOMER] install the energy efficiency [MEASURE] at this time?
2. And using a 0 to 10 likelihood scale, where 0 denotes "not at all likely" and 10 denotes "very likely," if the [PROGRAM], including incentives as well as program services and information, had not been available, what is the likelihood that you would have recommended this specific energy efficiency [MEASURE] to [CUSTOMER]?
3. Now, using a 0 to 100 percent scale, in what percent of sales situations did you recommend [MEASURE] before you learned about the [PROGRAM]?
4. And using the same 0 to 100 percent scale, in what percent of sales situations do you recommend [MEASURE] now that you have worked with the [PROGRAM]?
5. And, using the same 0 to 10 scale where 0 is "Not at all important" and 10 is "Very important", how important in your recommendation were:
   a. Training seminars provided by [UTILITY]?
   b. Information provided by the [UTILITY] website?
   c. Your firm's past participation in a rebate or audit program sponsored by [UTILITY]?

A vendor score (VMAX) is calculated to capture the "highest degree of program influence on the vendor's recommendation." This vendor score is the maximum value of the following:

1. The response to question 1
2. 10 minus the response to question 2
3. The response to question 4 minus the response to question 3, divided by 10
4. The response to question 5a
5. The response to question 5b
6. The response to question 5c.

iii. Remaining Information Gathered

The following remaining information is gathered to construct the evaluation story, and adjustments may be made for Standard – Very Large NTG sites if the additional information that is collected is inconsistent with information provided throughout the Decision Maker Survey.

- **Program File.** Files from the program, such as letters written by the utility's customer representatives and information on the measure payback with and without the rebate may be utilized by all three levels of rigor.
- **Utility and Program Staff Interviews.** Interviews with utility staff and program staff may be conducted to gather the following information:
  - Background information on the customer's decision to install the efficient equipment
  - The role of the utility and program staff in this decision
  - Contact information of vendors involved in the specification and installation of the equipment in the case of the Standard and Standard-Very Large NTG analyses.
- **Other Information.** Secondary resource information may be gathered for the Standard Very Large NTG projects rigor level projects (e.g., a review of standard and best practices through industry associations, interviews with other employees at the participating firm).

iv. Scoring

This section briefly outlines the scoring process.

Timing and Selection

These questions require the decision maker to rate the importance of each factor in the decision to implement the program sponsored measure(s) using a rating based on a 0 to 10 scale, with 0 being "Not at all Important" and 10 being "Very Important." The factors specified by the framework are:

- Availability of the [PROGRAM] rebate
- Information provided through a recent feasibility study, energy audit or other types of technical assistance provided through [PROGRAM]
- Information from [PROGRAM] training course
- Information from [PROGRAM] or [UTILITY] marketing materials
- Endorsement or recommendation by [UTILITY] representative
- Recommendation from a vendor/supplier.

The Timing and Selection Score is calculated as the highest of the responses to the first four decision maker questions. However, if the vendor score is higher, the timing and selection

score becomes the vendor score (VMAX) multiplied by the score the decision makers assigned to the vendor recommendation.

Program Influence

The decision maker is asked a battery of questions regarding the degree of influence a number of factors had on their decision to implement the measure. The Program Influence questions ask the decision maker to rate on a scale of 0 to 10, with 10 being "most important", the importance of the program influence versus those other factors in the decision to implement the specific measure. The answer to this question is the Program Influence Score; however, it is reduced by half if respondents say they had already made their decision to install the specific measure before they learned about the program.

"No-program"

"No-program" questions deal with the likelihood of various actions the customer might have taken at the same time the program supported measure was installed and in the future if the program had not been available. While there are many no-program questions, only two are included in the no-program score. First, participants are asked:

> Regarding the installation of this equipment, if the [PROGRAM] had not been available, using a likelihood scale from 0 to 10, where 0 is "Not at all likely" and 10 is "Extremely likely" how likely is it that you would have installed exactly the same item/equipment?

If the answer to the above question is answered with a 1 or more, than the respondent is asked to answer within a set of time ranges given. The corresponding value derived from this answer is the acceleration value. The acceleration value is discussed further in the next section.

The algorithm to determine the No-program score is:

> 10 - (likelihood of installing same equipment × (1-acceleration value)).

B. TREATMENT OF ACCELERATION

As described in the previous section, acceleration is considered within the No-Program scoring element of the NTGR. It refers to the No-Program question in which the respondent rates the likelihood of installing the same equipment if the program had not been available. If the participant answers with 1 or greater, then the following question is asked to determine the acceleration value.

> You indicated in your previous responses that there was an "X" in 10 likelihood that you would have installed the same equipment if the [PROGRAM] had not been available. When do you think you would have installed this equipment? Please express your answer in months.

The response to this question is used to create the acceleration value used in the No-Program Score algorithm provided above. Table 3-2 describes the net-to-gross equation related to the number of months from the installation the respondent was originally intending to adopt the measure without the program.

Table 3-2. Acceleration Value

Number of Months from Installation Respondent Would Have Installed Measure without Program	Deferred NTG Value
Within six months	0
Six to 47 months later	(Months-6)×.024[24]
Forty-eight or more months	1
Never	1

C. SPILLOVER

California does not currently include spillover in its net-to-gross calculation.

3.1.2 Massachusetts

In 2003, PA Government Services evaluated the methodologies utilized by a consortium of Massachusetts utilities[25] to calculate attribution for commercial and industrial incentive programs. The final report, *Standardized Methods for Free-Ridership and Spillover Evaluation*, provided a review of the previous methods used by the Massachusetts utilities, and recommended standard methods for calculating net-to-gross[26].The sponsoring utilities adopted the recommended methods.

Massachusetts has an outlined method for calculating program attribution that includes free-ridership—how likely the customer would have installed the same or similar product without the program—and spillover—how the program affects future purchases of the same or similar product without additional program support. The general framework of this methodology utilizes self-report participant surveys with questions aimed at determining how effective program efforts have been in producing energy savings.

The participant survey includes four sequences of questions. Table 3-3 provides a high-level summary of the data collected via the surveys.

[24] The value 0.024 is 1 divided by 41 (41 is calculated as 47-6). This assumes that the deferred NTG value is a linear function beginning in month 7 though month 47, increasing 0.024 for each month of deferred installation.

[25] Sponsor utilities included National Grid, NSTAR Electric, Northeast Utilities, Unitil, and Cape Light Compact

[26] Pamela Rathbun, Carol Sabo, Bryan Zent, PA Government Services Inc. *National Gird, NSTAR Electric, Northeast Utilities, Unitil, Cape Light Compact Standardized Methods for Free-Ridership and Spillover Evaluation – Task 5 Final Report (Revised).* June 16, 2003.

Table 3-3. Massachusetts Participant Survey Question Sequences

Survey Question Sequence	Purpose of Question Sequence
General Free-ridership	Determine if the customer would have purchased the same or smaller quantity of the product within a year.
Quantity, Efficiency, and Cost	Determine percentage of the quantity and efficiency purchased through the program that would have been purchased within the year without the incentive, and at what cost.
Technical Assessment and Audit Impact	Determine if the participants would have paid the full cost of the technical assessment study if the program had not provided an incentive.
Past Program Participation Impact	Determine if past program participation in one of the Sponsor's energy efficiency programs may have had a positive impact on a customer's behavior as well as their decision to install equipment through the program again.

Each sequence of questions is used to determine a customer's level of free-ridership. The methodology includes the likelihood of the customer purchasing similar products without the program within a year. Customers that indicate they would have installed the measure more than one year later receive full attribution credit and customers that would have installed within one year receive no acceleration credit.

The attribution methodology includes participant and non-participant spillover. The spillover method includes self-reported savings from participating customers and participating vendors, and at times on-site analyses. The collected data are used to determine if additional savings can be attributed to the program for influencing customers to implement energy saving measures without the program's financial incentive but because of the program's previous efforts.

A. ATTRIBUTION CALCULATION

Massachusetts utilizes self-report participant surveys to estimate attribution for commercial and industrial efficiency projects. Evaluators administer surveys by telephone, although large custom or industrial projects may require on-site surveys. The exact survey questions utilized for the net-to-gross calculation specified by the PA Report are provided in this section.

The Massachusetts net-to-gross ratio is calculated using the following algorithm.

> Net Savings = (Gross Savings) × (Gross Savings Adjustment[27]) × (1-Free-ridership + Participant Spillover + Non-participant Spillover)

[27] In Massachusetts terminology, the Gross Savings Adjustment is referred to as the "Realization Rate." To avoid confusion, terms used in Focus on Energy Evaluations are applied to their counterparts in other state's methodologies where appropriate.

The Massachusetts protocols define a free rider as a customer who received an incentive through an energy efficiency program who would have installed the same (pure free rider) or smaller (partial free rider) quantity of the same high-efficiency measure on their own within one year in the absence of the program. The participant surveys are organized into the following four sequences.

1. General Free-ridership
2. Quantity, Efficiency, and Cost
3. Technical Assessment and Audit Impact
4. Past Program Participation.

Next, we take a closer look at each of the survey sequences and their input into the free-ridership calculation.

i. General Free-ridership

The General Free-ridership sequence determines whether the customer would have purchased the same or smaller quantity of the product within a year. If the customer would have purchased that same or smaller quantity within a year then an initial free-ridership estimate is set to 100 percent and the customer is then asked the "Quantity, Efficiency, and Cost" sequence.

However, if the customer would not have purchased the measure without the program, the initial free-ridership is set to 0 percent and the customer is then asked a series of consistency questions to confirm the response. At the end of the consistency questions, the customer is asked:

> I'd like to better understand your purchase decision. Maybe you could just describe in your own words what impact, if any, the program had on your decision to install the energy efficient [measure # description] at the time you did?

If the consistency questions reveal that the consumer did not plan to purchase the products within a year, their final free-ridership is set to 0 percent and the net-to-gross portion of the customer survey concludes.

If the initial free-ridership of 0 percent is clearly contradicted by the customer's response to the last consistency question, which is open ended, (i.e., the response indicates that the consumer would have purchased at least some of the product within the year) then the initial free-ridership is set to 50 percent. The customer then skips the Quantity, Efficiency, and Cost questions and moves directly to the Technical Assessment and Audit Impact sequence.

ii. Quantity, Efficiency, and Cost

The Quantity, Efficiency, and Cost sequence determines the percentage of the quantity and efficiency purchased through the program that would have been purchased within the year without the incentive, and at what cost. Only those consumers who have an initial free-ridership of 100 percent are asked this sequence of questions. The questions utilized in the survey are as follows:

1. If [sponsor] had not paid a portion of the equipment cost or provided any technical assistance or education through the [program], would your company have purchased any [measure # description] within one year of when it was installed?
2. Without the program [contribution/incentive/rebate], technical assistance, or education, would your company have purchased the exact same quantity of [measure # description] within one year?
3. What percent of this [measure # description] do you think your company would have purchased on its own within one year? (PROBE: Would you have purchased about one-fourth (25%), one-half (50%), three-fourths (75%) of what you installed through the program?)
4. You said your company would have installed at least some [measure # description] on its own if the program had not been available. What percent of this equipment would have been of the same efficiency or higher efficiency as what was installed through the program? (PROBE: Would about one-fourth (25%), one-half (50%), three-fourths (75%) been of equal efficiency?)
5. Do you think your company would have paid the additional [measure # sponsor contribution], on top of the amount you already paid, to install the same quantity and efficiency of [measure # description] within one year?
6. How would you have adjusted your purchase to accommodate the fact that you wouldn't have paid all of the costs? Would you have purchased less equipment, lower efficiency equipment, or done something else?
7. What percent of the [measure # description] do you think your company would have purchased on its own at that same time? (PROBE: Would you have purchased about one-fourth (25%), one-half (50%), three-fourths (75%) of what you installed through the program?)
8. What percent of the [measure # description] that your company would have purchased on its own would have been of a lower efficiency than what was installed through the program? (PROBE: Would about one-fourth (25%), one-half (50%), three-fourths (75%) been of lower efficiency?).

If the consumer answers zero or less for each of these questions, the interviewer will ask the consistency questions to confirm the score. If their responses are consistent (i.e., indicating no free-ridership), the final free-ridership is zero percent and the net-to-gross portion of the customer survey concludes. If responses to the consistency questions reveal inconsistencies, then the initial free-ridership is changed to 50 percent and the customer continues on to the Technical Assessment and Audit Impact sequence.

If the customer answers 100 percent on all eight of the above factors, then the initial free-ridership remains equal to 100 percent pending the outcome of a series of consistency questions. If inconsistencies are revealed the initial free-ridership is changed to 50 percent; consistent answers result in the initial free-ridership remaining equal to 100 percent. The customer then continues on to the Technical Assessment and Audit Impact sequence.

If any of the responses to the above Quantity, Efficiency, and Cost questions indicate a percentage between 1 and 99 percent, then this percentage is applied in the following partial free-ridership algorithm:

Initial FR =% QUANTITY × {% PROGRAM EFFICIENCY}

where:

% QUANTITY = the percent of the equipment the customer would have purchased on their own without the program; and

% PROGRAM EFFICIENCY = the percent of the equipment the customer would have purchased that would have been of an efficiency level similar to (or higher than) the program equipment.

The amount a customer would have paid (cost) does not factor directly into this equation. However, if a customer claims they planned to install the same quantity and efficiency level of the measure within a year, but not at the full cost, the above formula is applied to the quantity and/or efficiency percentages that the customer reports they would have made to lower the total cost. These respondents continue on to the "Technical Assessment and Audit Impact" sequence.

iii. Technical Assessment and Audit Impact

The Technical Assessment and Audit Impact sequence determines if the participants would have paid the full cost of the technical assessment study if the program had not provided an incentive. The interviewer only asks these questions of those participants who were offered and utilized an incentive for a technical assessment study. Other participants skip to the "Past Program Participation Impact" sequence.

The running[28] free-ridership rate is reduced by 50 percent for customers that would not have paid the costs to have a similar technical assessment study done on their own. If the incentive did not have an impact on the customer's decision to conduct the study then the running free-ridership rate does not change.

In all cases, the customer continues on to the "Past Program Participation Impact" sequence.

[28] The term "running" refers to the changing free-ridership rates pending the responses to each sequence of questions until a final free-ridership rate is determined.

iv. Past Program Participation

The Past Program Participation sequence determines if past program participation in one of the Sponsor's energy efficiency programs may have had a positive impact on the customer's behavior as well as their decision to install equipment through the program again. This sequence consists of the following three "yes" or "no agreement" questions:

1. The energy savings performance of equipment installed through the program in earlier years was a primary reason why we decided to install energy efficient [measure] through the program.
2. Because of our previous experience, we asked our contractor to look into energy efficient option for [measure] when developing project plans.
3. Because of our previous experience, we took into account the cost-effectiveness of energy efficient [measure] when evaluating different options.

If the customer agrees with all three Past Program Participation questions, the final free-ridership rate equals the running free-ridership rate multiplied by 0.25. This adjustment reduces free-ridership by 75 percent to award the program for the effects of past program participation.

If the consumer agrees with two of the program influence questions, the final free-ridership rate equals the running free-ridership rate multiplied by 0.6625. This adjustment reduces free-ridership by 33.75 percent to award the program for the effects of past program participation.

If the respondent indicates influence on one or none of the questions, the final free-ridership rate equals the running free-ridership rate.

B. TREATMENT OF ACCELERATION

The standardized methods do not directly define or calculate a timing attribution or acceleration period. Instead, they define pure free riders as someone who would have installed the same quantity and type of equipment within one year in the absence of the program services. Free-ridership is reduced to partial free-ridership by the effects on quantity and efficiency purchased within the first year based on the Quantity, Efficiency, and Cost questions, however timing attribution is not explicitly incorporated in to the calculation of attribution.

C. SPILLOVER

Spillover in Massachusetts refers to additional energy-efficient equipment installed by a utility customer due to program influences but without any financial or technical assistance from the program. Participant like-measure spillover is derived from customers who participated in the program being evaluated and who, influenced by the program, installed additional equipment without assistance. Non-participant like-measure spillover is derived from utility customers who did not participate in the program being evaluated, but may have been impacted by the program in another way, for instance word of mouth from a participating vendor, and in turn installed the same (or similar) equipment without assistance.

The Massachusetts attribution methodology includes questions throughout the customer survey to determine participant like-measure spillover. Participants can answer spillover

questions during a telephone survey. This approach asks the participants about measures installed outside the program that are of exactly the same type and efficiency as the ones installed through the program. Another option is to conduct a follow-up inspection and measurements at facilities where customers report spillover. A combined telephone survey/site visit approach may also be used if desired by the utility sponsor.

To determine non-participant like-measure spillover, analysts conduct separate surveys with participating design professionals and vendors. The non-participant like-measure spillover survey asks ***participating*** design professional and equipment vendors what percent of their sales in Massachusetts to customers of the utility sponsor met or exceeded the program standards for each program measure category and what percent of these sales did not receive an incentive through the program.

Depending on the nature of the program being evaluated, participant spillover may or may not have an effect on the net savings. This also applies to determining non-participant spillover. If the evaluated program is not conducive to generating non-participant spillover, or if the utility chooses not to consider non-participant spillover, the additional survey work will not be executed.

Total spillover is the sum of the Participant "Like" Spillover fraction and the Non-participant "Like" Spillover fraction.

Spillover = Participant Spillover + Non-participant Spillover

When spillover research is conducted, the net savings is calculated as:

Net Savings =

(Gross Savings) × (Gross Savings Adjustment[29]) × (1-Free-ridership + Participant Spillover + Non-participant Spillover)

Next, we take a closer look at participant and non-participant spillover.

i. Participant "Like" Spillover

For participant "like" spillover to be present, the customer reports similar equipment purchased outside the program after the customer's previous participation in a program and deems the outside purchase to be program influenced. After indicating spillover, the total Participant "Like" Spillover rate is weighted by quantity installed through the program and by measure category kilowatt-hour (kWh) savings. To determine this, the evaluator must know three points:

1. Program savings for the specified measure in terms of kWh (initial kWh)

[29] In Massachusetts terminology, the Gross Savings Adjustment is referred to as the "Realization Rate." To avoid confusion, terms used in Focus on Energy Evaluations are applied to their counterparts in other state's methodologies where appropriate.

2. Additional measure savings installed outside of the program, expressed as a percentage in comparison to the original installation done through the program (additional kWh percentage)
3. How much past participation in a program effected the decision making verses a recommendation by a program contractor or designer, expressed as a percentage (initial spillover).

The algorithm for participant spillover that utilizes information gathered from these three points is as follows:

kWh participant "like" spillover = Initial kWh × additional kWh percentage × Initial Spillover

Participant "like" spillover rate = kWh participant "like" spillover / Initial kWh

The participant "like" spillover rate is expressed as a percentage.

ii. Non-participant "Like" Spillover

Non-participant spillover refers to energy efficient measures installed by program non-participants due to the program's influence. The program can have an influence on design professionals and vendors as well as an influence on product availability, product acceptance, customer expectations, and other market effects, all of which may induce non-participants to buy high-efficiency products. To estimate non-participant spillover from non-participating customers, a separate telephone survey is required. Because of the limitations involved, Massachusetts utilities' instead interview participating design professionals and equipment vendors in order to estimate non-participant spillover.

3.1.3 New York

The summary of New York's NTG methodologies is based largely on the standardized methodologies outlined in *"Advancing the "Science" of Free-ridership Estimation: An Evolution of the Self-report Method for New York Energy $martSM Programs*"[30]; and the most recent large commercial and industrial incentive program impact evaluation. (Largest Savers Study)[31]

The New York method makes use of self-report techniques and associated analysis methods for the estimation of free-ridership. The free-ridership estimation method relies on experienced interviewers who are knowledgeable enough to probe respondents for details of

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[30] Stuart Schare, Summit Blue Consulting, Jennifer Ellefsen, NYSERDA. *Advancing the "Science" of Free-ridership Estimation: An Evolution of the Self-report Method for New York Energy $martSM Programs.* http://www.summitblue.com/dyn_downloads/advancingthescience.pdf.

Large portions of this summary were taken directly from the Summit Blue paper.

[31] NYSERDA. *Annual Report for 2008 – Program Evaluation and Status Report – Issued March 2009*, Section 2.3 Largest Savers Impact Evaluation. December 31, 2008. http://www.nyserda.org/publications/default.asp.

program influence and who can characterize the responses in quantitative terms that can be used in the analysis. Free-ridership is determined based on scores in the following two categories:

- Direct free-ridership questions estimate the likelihood of installations and/or the percentage of efficient measures that would have been installed without the assistance of the program.
- Free-ridership "Influence." questions are both quantitative and open-ended. The main goal of these questions is to clarify the role that program incentives played in the decision-making.

Additionally, if any inconsistency seems apparent, the New York methodology also includes a formula for adjusting free-ridership.

The responses to the above category questions are used as the initial free-ridership value, however the free-ridership is reduced if the respondent indicated that the program influenced them to install the equipment more than one year earlier than they otherwise would have. In New York, acceleration is considered a factor if the customer planned to purchase the measure within five years of the implementation. Anything longer than 5 years is considered fully attributable to the program.

A. ATTRIBUTION CALCULATION

New York's guidelines allow program evaluators to select and modify methodologies based on the complexity and needs of that program. Furthermore, the exact survey questions and scoring for these individual questions are not explicit. According to the Largest Savers Study, historically the free-ridership and spillover effects have been assessed through self-report telephone surveys of decision makers at the participating companies.

Estimates of savings attributable to the program are based on the responses of program participants to carefully designed questions that seek to understand prior intentions, the importance of program factors such as financial incentives, and the likelihood that the same actions would have been taken even without the program. Free-ridership is determined based on scores derived from the Direct Free-ridership and Free-ridership Influence survey questions. We discuss each in the following two sections.

i. Direct Free-ridership

These questions estimate from respondents the likelihood of installations and/or the percentage of efficient measures that would have been installed without the assistance of the program. The direct free-ridership questions separately address the following aspects of the projects:

1. Each major measure category[32] that was reported to the program
2. The project as a whole across all measures categories.

[32] Synonymous to the term "end-use" in Focus BP evaluation work.

For the measure-specific questions, customers are first asked when, if at all, they would have replaced existing equipment or installed new equipment and the likelihood that they would have installed measures of the same high level of efficiency without the program. In cases where respondents indicate that they may have installed some, but not all, of the measures, they are asked to estimate the percentage of measures installed that would have been high-efficiency measures. The responses to the questions regarding the likelihood and percentage of high-efficiency measures are used as the initial free-ridership value. For example, if the customer says that they would have installed 100 percent of the high-efficiency measure, then initial free-ridership equals 100 percent. However, this is only true in the case that the customer would have installed the product within the year.

The free-ridership value is reduced if the respondent indicated that the program influenced them to install the equipment more than one year earlier than they otherwise would have. Below in the Treatment of Acceleration section, we provide a detailed synopsis of New York's approach to quantifying the effects of acceleration.

Each measure is also assigned an energy savings value from the savings recorded for that respondent in the program database, expressed as a percentage. For instance, a project may have included both lighting and HVAC measures. Lighting may account for 80 percent of the savings, and HVAC for 20 percent of the savings for that program. The direct free-ridership estimate, after being adjusted for acceleration for each measure, is weighted according to the relative savings to determine a weighted average free-ridership estimate for the participant across all measure categories (measure-based estimate). This estimate is expressed as:

Measure Based Estimate =

∑(free-ridership measure category 1 x measure category energy savings value) /

∑(measure category energy savings value)

This estimate forms one-half of the customer's direct free-ridership estimate. The second half is based on as assessment of free-ridership for the project as a whole.

Additional questions are then asked to obtain a lower bound, an upper bound, and a best estimate of the overall energy savings attributable to the program across all measures the participant installed. These questions focus on the incremental savings from installing high-efficiency equipment instead of standard efficiency equipment. If sufficient information is available for the determination of a "best estimate," it is used as a second direct free-ridership estimate. The final direct free-ridership estimate, which would potentially be adjusted according to responses to the program influence questions, is the average of the measure-based estimate and the "best estimate."

Final direct free-ridership estimate = (Measure-based estimate×"Best Estimate")/2

If sufficient information is available for only one of these values, then the final direct free-ridership estimate equals this value.

ii. Free-ridership "Influence"

These questions are both quantitative and open-ended. The main goal of these questions is to clarify the role that program incentives played in the decision-making. Questions address the following three topics:

1. Plans to incorporate high efficiency
2. Program influence on project
3. Importance of program in project decision-making.

To asses plans to incorporate high efficiency, each respondent that indicates any degree of planning for high-efficiency installation prior to participating in the program is asked to describe these plans in detail. Follow-up probing questions are designed to investigate equipment type, timing, quantity, and efficiency, as well as for any prior budgeting for the high-efficiency equipment. Based on the response to this inquiry, the interviewer then assigns a "project planning" score using a 5-point scale. This methodology has established guidelines for the number of points given based upon the participant's response; however, they are not prescriptive. Table 3-4 provides the project planning scoring guidelines.

Table 3-4. Project Planning Scoring Guidelines[33]

Scoring	Extent of Planning
1	No plans for high-efficiency equipment; respondent may have considered alternative technology options, but did not explicitly consider high efficiency.
2	Initial steps toward consideration of high efficiency such as requesting information on or discussing, in general, high-efficiency options with vendors or contractors.
3	In-depth discussion or consideration of specific types of high-efficiency equipment (e.g., lighting controls, high-efficiency chillers), including their positive and negative attributes and costs.
4	Identification of specific equipment manufacturers and models, including assessment of their relative costs and performance characteristics.
5	High-efficiency equipment and designs fully specified and explicitly approved or incorporated into project budget.

To assess program influence on project, customers are asked whether their participation in the program in any way influenced the type or efficiency level of the equipment, or the amount of high-efficiency equipment installed in the project. Each respondent indicating some degree of program influence is asked to describe how the program influenced the decision to install high-efficiency equipment in the project. The interviewer then uses this response to assign a "program influence" score using a 5-point scale. Similar to the plans to incorporate high efficiency, this methodology has established guidelines for the number of points given based upon the participant's response. Table 3-5 provides these guidelines.

[33] Stuart Schare, Summit Blue Consulting, Jennifer Ellefsen, NYSERDA. *Advancing the "Science" of Free-ridership Estimation: An Evolution of the Self-report Method for New York Energy $mart[SM] Programs*. Page 4. January 2007.

Table 3-5. Program Influence Scoring Guidelines[34]

Scoring	Characteristics of Program Influence
1	No influence on the decision to install high-efficiency equipment. All equipment would have been installed at the same efficiencies even without the program.
2	Program helped in making final decision on equipment that had already been thoroughly considered.
3	Program lent credibility to the decision to invest in high efficiency and/or it provided information that helped expand the quantity, scope, or efficiency of the equipment.
4	Program identified a significant number of specific high-efficiency options that were installed and had not previously been considered and/or the program was a major driver behind a significant increase in the quantity, scope, or efficiency of installed equipment.
5	Program was the primary reason that the high-efficiency equipment was installed.

To assess importance of program in project decision-making, evaluators ask the customer to provide their own assessment of the program's importance in the decision to install the high-efficiency equipment. A 5-point scale is used, with 5 indicating the program was "very important" and 1 indicating the program was "not at all important."

iii. Making Adjustments

Analysts review and potentially adjust the free-ridership estimates if one or both of the following conditions are true:

- The respondent's average score for the Free-ridership Influence questions was a 4.0 or greater
- The respondent's initial free-ridership score was beyond the bounds that could reasonably be expected based on responses to the influence questions.

The process for whether and by how much to adjust a respondent's direct free-ridership estimate is as follows:

Step 1. Calculate an average program influence score (on a 5-point scale) from the scores assigned to the program influence questions. A higher score for program influence and importance suggests greater program impact, but a higher score for planning indicates lower impact. Therefore, prior to calculating an average score across questions, the planning score is inverted so that 1=5, 2=4, etc.

Step 2. In the Direct Free-ridership question sequence, customers are asked to provide an upper and lower bounds range for free-ridership estimates for the whole project. This can be used in conjunction with the program influence questions to adjust the direct free-ridership. If a customer's average influence score is toward the extremes (4.0 or higher, or 2.0 or lower), then the direct free-ridership estimate is adjusted to reflect the lower or upper bound values provided by the customer. For example, if a customer's score is the maximum possible value of 5.0 then the lower bound free-ridership estimate will be used. For lower scores, a free-ridership value between the initial value and the lower bound would be assigned.

[34] Ibid, page 5.

For example, for a score of 4.5, the initial estimate would be averaged with the lower bound; in other words, the adjusted value would be 50 percent of the way between the initial estimate and the lower bound value (Table 3-6).

Table 3-6. Free-ridership Adjustment Within Respondent's Lower and Upper Bounds[35]

Average Program Influence Score	1.00	1.33	1.67	2.00	2.33 to 3.67	4.00	4.33	4.67	5.00
Adjust FR value…	100%	75%	50%	25%	No adjustment made	25%	50%	75%	100%
…of the way toward the _____ bound.	Upper				No adjustment made	Lower			

Step 3. Further adjust the free-ridership estimate within reasonable bounds based on the average program influence score. These bounds are intended to reflect the range of free-ridership values that the evaluation team believe could reasonably characterize a program's project based on a customer's answers to the program influence questions. If a customer's score is the maximum possible value of 5.0, then a reasonable free-ridership value would be as low as zero percent, and it is assumed that a direct free-ridership estimate higher than 25 percent would be inconsistent with responses to the program influence questions. For successively lower scores, the range of reasonable free-ridership values increases to successively higher values (Table 3-7).

Table 3-7. Range of Reasonable Free-ridership Values Based on Program Influence Responses[36]

Average Program Influence Score	1.0	1.33	1.67	2.0	2.33	2.67	3.0	3.33	3.67	4.0	4.33	4.67	5.0
Lower Bound Free-ridership	75%	70%	60%	50%	40%	30%	25%	20%	10%	0%	0%	0%	0%
Upper Bound Free-ridership	100%	100%	100%	100%	90%	80%	75%	70%	60%	50%	40%	30%	25%

After any necessary adjustment for the customer's lower and upper bound estimates in Step 2 is applied, the free-ridership estimate is compared to the appropriate range of values, according to the average program influence score from Step 3. If the free-ridership value falls outside of the bounds, then it is adjusted to a final free-ridership estimate equal to the closest lower or upper bound value.

[35] Ibid, page 7.

[36] Ibid, page 8.

B. TREATMENT OF ACCELERATION

Similar to Wisconsin and California, New York awards the program partial attribution credit for accelerating the installation of the energy efficiency measures. California and Wisconsin cap the acceleration period at four years, while New York's methods does not grant full attribution until one year later, capping its acceleration period at five years. Beyond the high-end thresholds (four years for California's and Wisconsin's Y1NS Method), free-ridership is equal to zero. The three states vary slightly in their handling of the start of the acceleration period. As shown in Table 3-8, New York does not award partial credit for measures accelerated less than one year. California has a low-end threshold of six months while Wisconsin's Y1NS Method does not have a low-end threshold.

Table 3-8. Net-to-Gross Multipliers[37]

Number of Years from Installation Respondent Would Have Installed Measure without Program	Net-to-Gross Multipliers
Within one year	100%
One to two years	75%
Two to three years	50%
Three to five years	25%
More than five years	0%

C. SPILLOVER

Spillover includes the energy saving actions an organization takes as a result of the program, but for which it does not receive any program incentives. The Largest Saver's method for participant spillover was a direct query, self-report approach. Both participant and non-participant spillover is incorporated. but KEMA was not able to locate a source that provides New York's definition of participant and non-participant spillover; or a detailed description of the state's process used to calculated spillover.

3.1.4 Oregon

KEMA was not able to obtain formal net-to-gross guidelines for Oregon. In the absence of formal guidelines for Oregon, KEMA based our summary of Oregon's attribution methodology on the *Impact Evaluation of Building Efficiency Program* prepared by ADM Associates[38]. This is the most current commercial and industrial impact evaluation we were able obtain.

[37] Ibid, page 6.

[38] ADM Associates, Inc. *Impact Evaluation of New Building Efficiency Program for 2004 and 2005, Final Report.* February 2008.

Oregon defines free riders as those participants that would have installed the same energy efficiency measure without the program. ADM's methodology for net-to-gross analysis utilizes a self-report survey of a sample of program participants. Free-ridership is immediately set to zero for all customers that indicate an inability to install the measure without the financial incentive of the program. For the remaining customers, three categories of questions determine the rate of free-ridership.

1. **Category one** questions consider whether a participant in the program indicated prior installation of an energy efficiency measure similar to one installed under the program.
2. **Category two** questions consider whether a participant intended to install an energy efficiency measure even without the program.
3. **Category three** questions consider whether a customer indicated that a recommendation from a program representative was influential in the decision.

The survey included a question regarding the program's ability to accelerate the purchase of the measures, however there is no attempt to determine the length of the acceleration period.

ADM's spillover analysis focuses primarily on additional energy efficiency actions that participants might have undertaken at the same time or after their participation in the program that were caused primarily by the program, but for which they received no additional financial incentive. Non-participant spillover was not included in the analysis.

A. ATTRIBUTION CALCULATION

ADM utilized information collected from a telephone survey of a sample of participants for the net-to-gross analysis. Oregon defines free riders as those participants that would have installed the same energy efficiency measures without the program.

ADM's first method of determining free-ridership was to assign all customers indicating an inability to install the equipment or measure without the financial incentive of the program full attribution. The evaluators then utilized three categories of questions to determine the rate of free-ridership to be applied to the remaining customers. For each of these categories, rules were applied that provided a binary indicator of whether or not a participant's behavior showed free-ridership.

Category one. These questions consider whether a participant in the program indicated that he/she had previously installed an energy efficiency measure similar to one that they installed under the program.

Category two. Category two questions consider whether a participant stated that his/her intention was to install an energy efficiency measure even without the program.

Category three. Category three questions consider whether a customer indicated that a recommendation from a program representative was influential in the decision.

Operationally, responses to the questions in each category are reduced to binary Yes/No indicator variables for the determination of final attribution: Yes, program did influence/No,

program did not have influence in this category. A single response that indicates program influence in the category makes the binary variable for that category equal yes.

Once each of the categories has been assigned either a yes or a no, the free-ridership score can be determined as shown in Table 3-9.

Table 3-9. Free-ridership Scores for Combinations of Indicator Variable Responses[39]

Indicator Variables			Free-ridership Score
Category 1	Category 2	Category 3	
Participant had Previous Experience with Measure	Participant had Plans and Intentions to Install Measure without Program	Program had Influence on Decision to Install Measure	
No	No	Yes	0.00
No	No	No	0.33
No	Yes	Yes	0.33
Yes	No	Yes	0.33
No	Yes	No	0.67
Yes	Yes	Yes	0.67
Yes	No	No	0.67
Yes	Yes	No	1.00

B. TREATMENT OF ACCELERATION

The category three program influence questions incorporate acceleration effects. The following question was posed to determine the program influence on the timing of the purchase and installation:

- How did the availability of information and financial incentives through the program affect the timing of your purchase and installation of the measure?

While a question regarding the program's ability to accelerate the purchase of the measures is posed, there is no attempt to determine the length of the acceleration period. Furthermore, it has the same effect as any other question used to determine the category three indicator variable; any of the category three questions answered in the affirmative will make the indicator variable "Yes."

C. SPILLOVER

ADM's spillover analysis "focuses primarily on participant spillover. Non-participant spillover was not included in the analysis. The evaluators used answers to two questions in the participant survey to determine the existence of participant spillover:

- Before you knew about the Energy Trust's energy efficiency incentive programs, had you purchased and installed any energy efficient equipment at this facility?

[39] ADM Associates, Inc. *Impact Evaluation of New Building Efficiency Program for 2004 and 2005, Final Report.* Table 3-2.February 2008.

- Has your experience with the program led you to buy any energy efficient equipment for which you did not apply for a rebate?

A participant response of "no" to the first question, and "yes" to the second question, indicated the existence of participant spillover, but the quantification method is not specified in the ADM report.

3.1.5 Vermont

The Vermont Department of Public Service (DPS) explicitly chose not to quantitatively assess free-ridership and spillover in its most recent evaluation of the Efficiency Vermont Business Programs, *Final Report: Phase 2 Evaluation of the Efficiency Vermont Business Programs*.[40] Efficiency Vermont (EVT) annually reports its net savings based on measure specific free-ridership and spillover factors found in the EVT Technical Reference User Manual (TRM). According to the EVT TRM, free-rider and spillover factors in the EVT TRM are the result of agreements between the Vermont DPS and EVT.[41] Further explanation is not provided in the TRM.

3.2 COMPARISON OF ACCELERATION METHODS

Based on the findings of our research into other states methods, we changed our current Focus evaluation method treatment of acceleration in our estimation of attribution for the 18MCP to see if other methodologies made a significant difference.[42] In addition to applying methods found in the states detailed above we also present results of the attribution analysis if no acceleration was considered. Finally, to test the sensitivity of the findings to another key component of attribution, we ran the results where no efficiency credit was considered.[43]

Acceleration is only one component of a broader methodological framework. There are likely interactions between each state's specific acceleration approach and the approach the state takes to other issues. However, it is not possible to adapt the entire methodological frameworks of the other states to the data collected for the Focus evaluation. This limits our ability to fully compare Focus attribution results to those of other states and it is beyond the scope of this research to assess the magnitude of this limitation.

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[40] KEMA, Inc. and RLW Analytics. *Final Report: Phase 2 Evaluation of the Efficiency Vermont Business Program*. February 2006. http://publicservice.vermont.gov/pub/other/evaluationoftheefficiencyvtbusprogfinalreportphase2.pdf.

[41] Efficiency Vermont, Vermont's Energy Efficiency Utility. *Technical Reference User Manual: Measure Savings Algorithms and Cost Assumptions*. December 30, 2008.

[42] Attribution for CFL measures is determined by market research rather than the self-report surveys. As such, their attribution was left unchanged by the alternative methodologies described below. The estimation and inclusion of supplier attributions also when unchanged from the methodology described in the *Business Programs Impact Evaluation Report: First Five Quarters of the 18-month Contract Period.*

[43] The other key component in the Focus on Energy calculation, quantity was not subject to a sensitivity test as it is conceptually the base of all attribution analyses.

Our approach to comparing acceleration methods focuses exclusively on acceleration methods employed by the other states. We adapted the basic logic of other jurisdictions' approach to acceleration to the Focus evaluation framework and compared those results.

The intent of this analysis is to clarify how much of the difference between Focus and other programs' NTG ratios may be due to differences in the treatment of acceleration used in determining program attribution.

3.2.1 Acceleration methods

The acceleration methods included in our comparative analysis include:

1. Current Focus evaluation method
2. California method
3. Massachusetts method
4. New York method
5. No acceleration
6. No efficiency.

Oregon and Vermont were not included in the acceleration method comparison. The Oregon method acknowledges acceleration and asks customers how program affected the timing of purchase and installation. It does not collect any data on the length of the acceleration period; therefore it cannot be used in the comparative analysis. Vermont did not estimate net impacts in its most recent impact evaluation.

As control scenarios, we added two additional looks at the results. In the "no acceleration" scenario, all measures that received less than full attribution due to the timing of their installations were given no acceleration credit in the attribution calculation. This provides an idea of how much counting acceleration improved the program attribution ratio.

To look at the relative impact of efficiency on the attribution ratio, we also looked at what the attribution would be without efficiency credit. This look allows us to better understand the relative effect of acceleration verses efficiency on the attribution ratio.

Below we detail the operational definitions for each of the above acceleration approaches. In the following scenarios, the current Focus evaluation method simple program attribution (i.e., free-ridership adjustments for quantity and efficiency) estimation for each measure was unchanged (with the exception of the "no efficiency credit" method). We varied the calculation of timing free-ridership, per the alternative approaches, to test the hypothesis that the final attribution ratio is highly dependent on the methodology used in determining how much acceleration credit the program receives for a given reported acceleration time frame.

A. CURRENT FOCUS EVALUATION METHOD

The overall attribution factor is a function of the simple program attribution (SPA) and the timing free-ridership. The SPA is the fraction of verified savings that are attributable to the program and is a function of the efficiency free-ridership and the quantity free-ridership.

The fraction of verified savings that would have occurred *without* the program is the product of the fraction of units that would have been installed without the program, f_Q, and the fractional unit savings that these units would have had without the program, f_E.

$$f_{QE} = f_Q f_E$$

For example, if two-thirds as many units would have been installed without the program (f_Q = 2/3), and the savings per unit would have been only half as much (f_E = 1/2), the portion of the savings that would have occurred without the program would be

$$f_{QE} = (2/3) \times (1/2) = 1/3.$$

The SPA is the complement of this free rider portion.

$$SPA = 1\text{-}f_{QE} = 1\text{-}\ f_Q\ f_E$$

The timing free-ridership is calculated from the acceleration period using

$$f_T = 1 - m_a/48.$$

The overall attribution factor is

$$A = 1 - f_Q f_E f_T$$

Thus, if the measure was accelerated by more than 48 months, the no-program timing factor f_T is 0 and the attribution is 1, regardless of f_Q and f_E. If the measure was not accelerated at all, f_T = 1, and the simple attribution is the final attribution, A = SPA.

The net savings can be calculated

$$\text{First-year net savings} = \text{Verified Savings} \times A_{historic}$$

B. CALIFORNIA METHOD

The methods described above in section 3.1.1 were applied to the data collected for the Focus on Energy 18MCP Business Programs impact evaluation in the following manner:

We calculated the timing free-ridership from the acceleration period using the following algorithm:

When $m_a \leq 6$ then $f_{T\text{-}CA} = 1$.

When $6 < m_a \leq 47$ then $f_{T\text{-}CA} = 1 - (m_a - 6) \times 0.24$.

When $48 \leq m_a$ then $f_{T\text{-}CA} = 0$.

The timing free-ridership ($f_{T\text{-}CA}$) was then included in the estimation of attribution according to the standard focus methodology:

$$A_{CA} = 1 - f_Q f_E f_{T\text{-}CA}$$

This method is very similar to that of the current Focus evaluation method. We expect attribution result to be quite similar.

C. MASSACHUSETTS METHOD

Timing, while not explicitly included in the Massachusetts attribution methodology is implicit in the questions regarding quantity and attribution. We incorporated the Massachusetts treatment of timing by setting timing free-ridership to zero for any measure accelerated one year or more.

When $m_a \leq 1$ then $f_{T\text{-}MA} = 1$.

When $1 < m_a$ then $f_{T\text{-}MA} = 0$.

The Massachusetts timing free-ridership ($f_{T\text{-}MA}$) was then included in the estimation of attribution according to the standard focus methodology:

$$A_{MA} = 1 - f_Q f_E f_{T\text{-}MA}$$

The net result is that for acceleration periods of one year or greater, attribution in this scenario (A_{MA}) is equal to one, while for periods less than one year, A_{MA} = SPA. This makes Massachusetts a noteworthy outlier: the current Focus evaluation method, California and New York methods all allow for four or five years, respectively, prior to setting free-ridership to zero.

D. NEW YORK METHOD

The New York methodology was applied in the following manner:

When $m_a \leq 12$ then $f_{T\text{-}NY} = 1$.

When $12 < m_a \leq 24$ then $f_{T\text{-}NY} = 0.75$.

When $24 < m_a \leq 36$ then $f_{T\text{-}NY} = 0.50$.

When $36 < m_a \leq 60$ then $f_{T\text{-}NY} = 0.25$.

When $60 < m_a$ then $f_{T\text{-}NY} = 0$.

The New York timing free-ridership ($f_{T\text{-}NY}$) was then included in the estimation of attribution according to the standard focus methodology:

$$A_{MA} = 1 - f_Q f_E f_{T\text{-}NY}$$

We expect that attribution in this scenario (A_{NY}) will be slightly lower than that in the current Focus evaluation method due to NY using a five-year acceleration period instead of the four-year period used in the current Focus evaluation method.

E. NO ACCELERATION CREDIT

To see how much effect on overall attribution that including acceleration in the Focus evaluation attribution methodology has, we first performed the analysis with every measure's acceleration credit set to zero. In this scenario, Attribution is the simple program attribution:

$$A_{NO\ ACC} = SPA$$

Measures that were accelerated 48 months or more continued to receive 100% attribution because this response was considered equivalent to a respondent indicating that they would never have installed the measure without the program's assistance.

F. NO EFFICIENCY CREDIT

In the no efficiency credit scenario, we kept the acceleration treatment used in the current Focus evaluation methodology, but gave no credit for reported increases in efficiency due to the program. Our intent was to test the sensitivity of overall attribution to efficiency credit in order to compare it to the differences seen from our varying the calculation of acceleration credit. Granting no efficiency credit makes

$$SPA_{NO\ EFF} = 1 - f_Q$$

And

$$A_{NO\ EFF} = 1 - f_Q\, f_T$$

Consistent with how we handled cases with acceleration periods of 48 months or more in the "No Acceleration Credit" scenario, measures that received 100% credit based on their responses to the efficiency questions were considered equivalent to a respondent indicating that they would never have installed the measure without the program's assistance. They continue to receive 100% attribution ($A_{NO\ EFF} = 1$) in this scenario.

G. SUMMARY OF ACCELERATION TREATMENTS

Table 3-10 highlights the primary methodological differences in each state's treatment of acceleration.

Table 3-10. Primary Treatment of Acceleration

State	Primary Treatment of Acceleration	Primary Data Collection Technique
Focus Y1NS	Acceleration less than 48 months receives partial credit towards attribution. Acceleration 48 months or more receives full attribution.	Self report participant surveys
California[44]	Acceleration less than 6 months receives no acceleration credit. Acceleration more than 6 months, but less than 48 months receives partial credit towards attribution. Acceleration 48 months or more receives full attribution.	Self report participant surveys
Massachusetts[45]	Acceleration more than 12 months receives full attribution. No partial acceleration credit given for less than 12 months.	Self report participant surveys
New York[46]	Acceleration less than 60 months receives partial credit toward attribution. Acceleration 60 months or more receives full attribution.	Self report participant surveys
Oregon[47,48]	The evaluation uses the program's effect on timing (yes/no) in developing the scores used to determine attribution. The length of the acceleration period is not considered.	Self report participant surveys
Vermont[49]	The most recent Efficiency Vermont Program C&I impact evaluation did not attempt to assess attribution.	N/A

[44] Nonresidential Net-to-Gross Working Group. *Methodological Framework for Using the Self-report Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers.* February 9, 2009.

[45] Sponsor utilities included National Grid, NSTAR Electric, Northeast Utilities, Unitil, and Cape Light Compact.

[46] NYSERDA. *Annual Report for 2008 – Program Evaluation and Status Report – Issued March 2009*, Section 2.3 Largest Savers Impact Evaluation. December 31, 2008. http://www.nyserda.org/publications/default.asp.

[47] Energy Trust of Oregon, Inc. *Evaluation Committee Report.* May 11, 2007. http://www.energytrust.org/meetings/board/2007/070808/04a_EvalMay.pdf.

[48] ADM Associates, Inc. *Impact Evaluation of New Building Efficiency Program for 2004 and 2005, Final Report.* February 2008.

[49] KEMA, Inc. and RLW Analytics. *Final Report: Phase 2 Evaluation of the Efficiency Vermont Business Program.* February 2006. http://publicservice.vermont.gov/pub/other/evaluationoftheefficiencyvtbusprogfinalreportphase2.pdf.

3.3 SCENARIO RESULTS

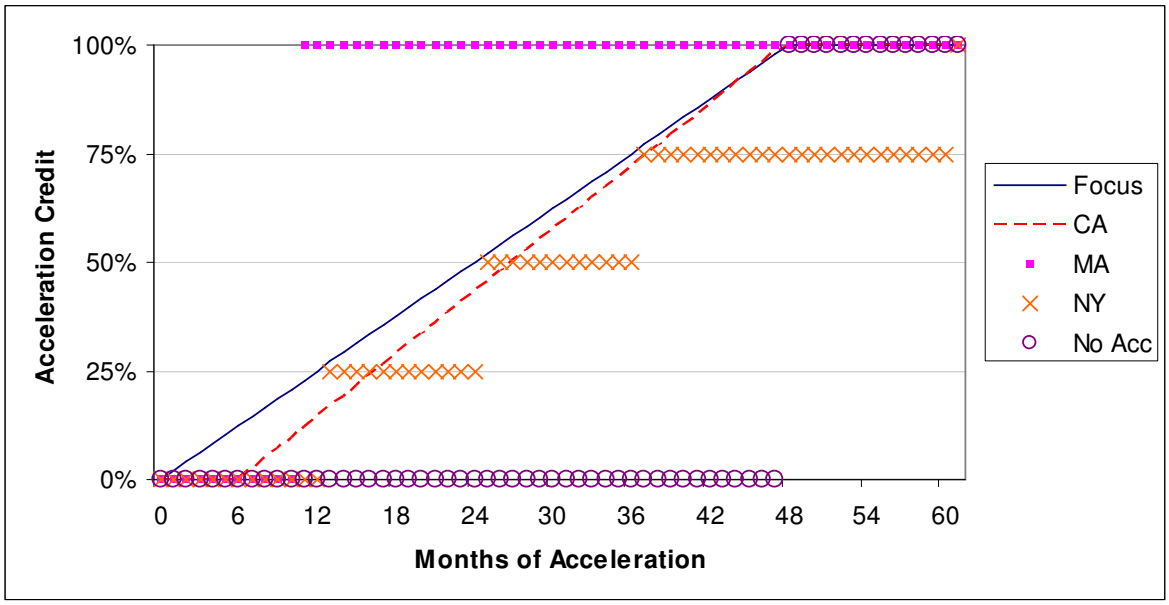
Table 3-11 through Table 3-13 provides comparisons of the current Focus evaluation method with five other attribution methods using the impact evaluation data collection for the 18MCP. The five other attribution methods are:

1. California method: The California treatment of acceleration.
2. Massachusetts method: The Massachusetts treatment of acceleration.
3. New York method: The New York treatment of acceleration.
4. No acceleration: No partial acceleration credit is given. Acceleration of 48 months or more receives full attribution, otherwise, acceleration credit is zero.
5. No efficiency: No partial efficiency credit is given. Responses of "would have installed standard efficiency" receive full attribution, otherwise, efficiency credit is zero.

As discussed in Table 3-10, Oregon does not incorporate acceleration into its attribution calculation in a way that is compatible with the Focus data, and Vermont does not currently determine attribution in its evaluations, so neither state was included in the comparisons of acceleration methods.

Figure 3-1 shows the amount of acceleration credit by month for each acceleration method. Massachusetts give zero acceleration credit for the first year and then jumps directly to 100 percent attribution after one year. The current Focus evaluation methodology gives more credit than both California and New York for any acceleration period less than 46 months. After 46 months, the difference between the current Focus evaluation method and California is less than one percent or equal, and the current Focus evaluation method continues to give more credit than New York's treatment through 60 months. After 60 months, each state method gives full attribution credit.

Figure 3-1. Acceleration Credit by Month



The results produced with the acceleration treatments used by the Focus evaluation and other jurisdictions indicate that the current Focus evaluation treatment of acceleration provides attribution results comparable to those in other jurisdictions. Final attribution scores are not highly dependent on the acceleration calculation methodology.

Massachusetts method's treatment of acceleration provides slightly higher attribution estimates, however not as high as might have been expected given that Massachusetts gives full attribution credit after one year. California and New York result in lower attributions than the current Focus evaluation method. This is consistent with the information provided in Figure 1-1. The effects of efficiency and acceleration on attribution are relatively equal: removing partial credit for either causes attribution to decline by roughly ten percent versus the current Focus evaluation method.

Table 3-11. Comparison of Acceleration Methods
kWh Attribution Factors by Sector

Sector	Focus Y1NS Method	CA Method	MA Method	NY Method	No Acc.	No Eff.
Agriculture	60%	59%	61%	58%	57%	46%
Commercial	70%	68%	71%	65%	65%	61%
Industrial	57%	55%	64%	50%	46%	50%
Schools and Government	43%	40%	43%	36%	33%	37%
Business Programs Overall	60%	57%	64%	54%	51%	51%

Table 3-12. Comparison of Acceleration Methods
kW Attribution Factors by Sector

Sector	Focus Y1NS Method	CA Method	MA Method	NY Method	No Acc.	No Eff.
Agriculture	57%	56%	58%	56%	55%	45%
Commercial	69%	68%	70%	66%	66%	61%
Industrial	54%	52%	61%	46%	43%	45%
Schools and Government	46%	44%	47%	41%	37%	39%
Business Programs Overall	58%	57%	62%	53%	51%	50%

Table 3-13. Comparison of Acceleration Methods
Therm Attribution Factors by Sector

Sector	Focus Y1NS Method	CA Method	MA Method	NY Method	No Acc.	No Eff.
Agriculture	17%	16%	18%	15%	14%	12%
Commercial	33%	29%	33%	24%	21%	25%
Industrial	63%	60%	71%	57%	44%	49%
Schools and Government	38%	36%	37%	34%	33%	27%
Business Programs Overall	52%	49%	57%	46%	38%	40%

3.3.1 Explaining the limited effects of acceleration treatment

To determine why varying the acceleration treatment had such a limited effect upon attribution, KEMA first looked into the proportion of savings in the 18MCP sample that received different levels attribution. We grouped the attribution scores into the following categories:

- None: an attribution score of zero
- Partial: an attribution score between zero and one
- Full: an attribution score of one
- Market-based: an attribution score determined by a market study. In the 18MCP, CFLs less than 30 watts were the only measures with market-based attribution.

Changing the acceleration treatment only affects the net savings of measures who received partial attribution scores under the current Focus evaluation method. Those with no attribution and market-based attribution are unaffected by acceleration treatment. The majority of measures with full attribution under the current Focus evaluation method would be unaffected by the treatment of acceleration. The only exception being the few measures who received full attribution under the current Focus evaluation method due to an acceleration period between 48 and 60 months. These would have lower attribution scores under the NY treatment of acceleration, but would have full attribution with any of the other acceleration treatments.

As Table 3-14 shows, roughly half of each savings type receives partial attribution in BP overall though there is great variation among the sectors. The savings with partial attribution are greater for therms than kWh or kW in the two largest sectors, Commercial and Industrial, and BP overall. One reason the Commercial sector has such a wide disparity is because the market-based attribution for CFLs does not affect therms. The difference for Industrial is not great.

Table 3-14. Percentage of Savings by Attribution Category

Sector	Amount of Attribution	kWh	KW	Therm
Agriculture	No attribution	22%	29%	76%
	Partial attribution	26%	19%	15%
	Full attribution	22%	25%	10%
	Market-based attribution	30%	28%	0%
Commercial	No attribution	15%	18%	30%
	Partial Attribution	36%	29%	62%
	Full attribution	18%	17%	8%
	Market-based attribution	28%	33%	0%
Industrial	No attribution	12%	15%	6%
	Partial attribution	58%	59%	65%
	Full attribution	28%	25%	30%
	Market-based attribution	0%	0%	0%
Schools & Government	No attribution	31%	29%	42%
	Partial attribution	47%	45%	32%
	Full attribution	13%	19%	24%
	Market-based attribution	9%	6%	0%
Business Programs Overall	No attribution	16%	19%	19%
	Partial attribution	49%	43%	56%
	Full attribution	23%	21%	25%
	Market-based attribution	11%	15%	0%

Next, we took a closer look at the measures with partial attribution. These are the only measures that are eligible for acceleration credit. As reported in Table 3-14 these measures account for 49 percent, 43 percent, and 56 percent of BP overall kWh, kW, and therms savings, respectively. Table 3-15 shows that 19 percent of overall kWh savings and 24 percent of overall therms received both partial attribution and had an acceleration period of greater than one year in the current Focus evaluation method. In these cases, the Massachusetts treatment granted full attribution where the current Focus evaluation method granted partial credit that is greater than both California and New York. On the other hand, 29

percent of kWh and 34 percent of therms received partial attribution and had less than one year of acceleration. For these measures, Massachusetts granted no additional attribution for acceleration effects, while California and New York both granted slightly less acceleration credit than the current Focus evaluation method.

Another interesting finding was that no acceleration credit was given for the "Three to Four Years" acceleration period category. That is, no respondents indicated they would have installed the measure on their own between three and four years. For data collected for the 18MCP, a change in the current Focus evaluation method's acceleration period threshold from 48 months to 36 months would have a limited effect on attribution results. Roughly half of savings do not have partial attribution and would be unaffected by this change.This change has a maximum potential effect of a 25 percent difference in attribution for a measure with no other attribution credit and a 36 month acceleration period. The majority of accelerated measures have less than 36 months of acceleration and have partial attribution from efficiency and quantity. Therefore, a 36 month threshold would increase the attribution by far less than the 25 percent. To take this one-step further, we could assert that we found little variation in acceleration effects on attribution results by varying the full attribution threshold from 36 to 60 months.

Table 3-15. Acceleration Periods of Measures with Partial Attribution

Sector	Length of Acceleration Period	kWh	kW	Therm
Agriculture	No acceleration	11%	10%	6%
	Less than one year	6%	4%	5%
	One to two years	5%	1%	3%
	Two to three years	3%	4%	1%
	Three to four years	0%	0%	0%
Commercial	No acceleration	8%	10%	13%
	Less than one year	16%	13%	36%
	One to two years	9%	5%	12%
	Two to three years	2%	1%	0%
	Three to four years	0%	0%	0%
Industrial	No Acceleration	19%	25%	10%
	Less than one year	14%	11%	22%
	One to two years	16%	17%	4%
	Two to three years	9%	6%	29%
	Three to four years	0%	0%	0%
Schools & Government	No acceleration	7%	12%	4%
	Less than one year	25%	18%	20%
	One to two years	6%	4%	7%
	Two to three years	9%	11%	1%
	Three to four years	0%	0%	0%
Business Programs Overall	No acceleration	14%	17%	9%
	Less than one year	15%	12%	22%
	One to two years	13%	9%	5%
	Two to three years	6%	5%	19%
	Three to four years	0%	0%	0%

Changing the treatment of acceleration only affects measures with partial attribution, which limits the maximum amount of effect it has on the ratio to roughly 50 percent. The amount of measures that receive partial attribution, but are not accelerated by the program further reduces this effect. In addition, because the acceleration grants credit for a percent of the savings that was otherwise not attributable to the program, the effects of acceleration on the attribution ratio are further reduced by the positive effects of quantity and efficiency attribution credit. In sum, the treatment of acceleration plays a small role in the overall assessment of attribution.

3.3.2 Conclusions

Our literature review shows that the current Focus evaluation framework is in the mainstream with its attribution methodology. Though each of the states in our study group that evaluate attribution has a different methodology, all use self-report participant surveys as the primary data source for determining program attribution. Most of these states include acceleration in their attribution methodology either explicitly or implicitly. The Massachusetts method differs greatly from the Focus method and gives full attribution credit for measures accelerated by more than one year and no acceleration credit for measures accelerated by less than one year. The Massachusetts acceleration treatment results in a slightly higher attribution compared with the Focus method. The Focus evaluation's acceleration treatment is similar to that used in both California and New York. Of the three, the Focus methodology gives the most attribution credit for acceleration.

Though differences exist in each jurisdiction's exact treatment of acceleration, when we applied these different treatments to the Focus 18MCP data within the Focus evaluation's attribution framework, the resulting attributions did not change significantly. Only about half of the gross savings in Focus receive any partial attribution. The remainder is either fully attributable, not attributable, or receives a market-based attribution. For the portion that does have partial attribution, some of this is determined by partial efficiency or quantity adjustments, not acceleration. Thus, there is a limit to the effect that any changes to the Focus acceleration methodology will have on the results.

4. LIFE CYCLE NET SAVINGS ESTIMATION

4.1 INTRODUCTION

Most energy efficiency programs across the country, including Focus, have evaluated energy savings impacts based on first–year savings rather than a full lifetime savings stream. The lifetime savings stream is the annual energy savings of an installed measure for each year of the measure's life. The annual energy savings may vary across years in the stream of savings. A primary contributor to this variation is acceleration; defined in this context as advancing the time when an energy efficiency measure is installed, compared to when it would have been installed in the absence of the program. For the Focus evaluation, it is appropriate to use a lower efficiency baseline (i.e., the efficiency of the existing equipment) during the acceleration period compared with the higher "standard" baseline for natural replacement measures and during the post-acceleration period. Accounting for the effects of acceleration within a stream of lifetime savings is a more accurate and complete representation of program accomplishments than more traditional first-year savings methods.

The Focus evaluation team's framework paper, *Treatment of Accelerated Savings,*[50] discusses the acceleration effect on the lifetime savings stream approach and the key considerations for a lifetime approaches with regards to:

1. Assessing program goal achievement
2. Periodic reporting of program accomplishments
3. Resource planning
4. Cost-effectiveness testing
5. Program planning.

Under the direction of the PSCW, the evaluation team developed an alternative attribution analysis method called the life cycle net savings (LCNS) method. The life cycle method provides for a different treatment of accelerated projects and produces lifetime net savings instead of the first-year net savings produced by the current Focus evaluation method (Y1NS).

4.2 OVERVIEW OF OBJECTIVES

Under the direction of the PSCW, the evaluation team developed an alternative attribution analysis method called the life cycle net savings (LCNS) method. The life cycle method provides for a different treatment of accelerated projects and produces lifetime net savings instead of the first-year net savings produced by the current Focus evaluation method (Y1NS). The purpose of this analysis is to explore the viability of the life cycle method as an alternative net savings methodology that takes a more nuanced approach to program

[50] Miriam Goldberg, Rick Winch, Tom Talerico, Ralph Prahl, Bryan Ward. *Focus on Energy Evaluation: Treatment of Accelerated Savings.* July 2, 2008.

attribution. This effort is part of the evaluation team's continued effort to adapt, adjust, and refine the life cycle method analysis assumptions. To that end, we:

1. Update the life cycle method results reported in the December 2008 LCNS memo with:
   a. Additional data collected in the second round of 18MCP impact evaluation data collection (projects implemented between April 1 and September 30, 2008)
   b. The new measure lives developed for the Business Programs' measure life study[51]
2. Compare the life cycle method and results with those of the first-year method
3. Investigate the effects of assumptions used in the life cycle method, including the effects of the updated measure lives.

The December 2008 LCNS memo used data from the first nine months of the 18MCP. This analysis was able to take advantage of data from an additional six months of the 18MCP. In addition, the release of the Focus Business Programs measure life study offered us the opportunity to update the measure lives used in the life cycle method analysis.

We begin with a complete description of the life cycle methodology and the factors used to calculate program realization rates, largely taken from the December 2, 2008, memo *Business Programs Life Cycle Attribution Analysis Results*. In the next section, we report the results using the life cycle method, and in the third section we compare the results determined using the life cycle method with the results determined using the first-year method. In the final section, we examine how one of the key assumptions of the life cycle methodology might affect the results as well as assess the impact of the new measure life estimates on the life cycle method results.

4.3 FOCUS ATTRIBUTION METHODOLOGY

This section introduces the data used for determining measure attribution and outlines the methods used to calculate attribution using that data.

4.3.1 Defining attribution analysis parameters

The attribution analysis is based on a number of parameters that are determined from the engineering review and participant survey.

- **Installation rate.** This factor corresponds to the fraction of measures that were installed. Each measure is assigned a binary factor that identifies whether it was installed or not installed. Adjustments to the number of units installed for a particular measure are included in the engineering verification factor, not in the installation rate.
- **Engineering verification factor.** This is the ratio of the verified gross savings to the tracking estimate of gross savings for installed measures. The engineering

[51] Miriam L. Goldberg, J. Ryan Barry, Brian Dunn, Mary Ackley, Darcy Deangelo-Woolsey, KEMA Inc. *Focus on Energy Evaluation Business Programs: Measure Life Study.* August 25, 2009.

verification factor includes corrections to the numbers of units installed, changes in operating hours, changes in operating levels, etc. This correction is applied only for measures installed by participants that were part of the engineering sample. Participants in the CATI sample do not receive an engineering verification adjustment (they are assumed to have a factor of 100 percent in the analysis).

- **Attribution factors.** These factors are used to determine the proportion of the verified gross savings attributable to the Focus on Energy Business Programs. For non-CFL measures[52], the attribution factors are determined from the participant's responses to a battery of survey questions designed to determine how influential Focus on Energy Business Programs was in the decision to install a particular measure. For CFL measures, the final attribution is determined based on market research done to measure the balance between attribution and spillover in the entire state and across sectors.

There are two attribution factors and two time periods that affect the final lifetime net savings in the life cycle method.

- **Acceleration Period, m_a.** This is a measure of the effect the program had on when the equipment was installed. The Acceleration Period corresponds to the number of months between the time the equipment was actually installed and the time it would have been installed in the absence of the program. For respondents who say they would have installed at the same time or earlier without the program, $m_a = 0$. For those who say they would have installed later, m_a is the number of months later the equipment would have been installed, up to a maximum of 48.
- **Measure Life, m_L.** This represents the amount of time a piece of equipment will remain installed and operating before being replaced by a new piece of equipment.
- **Efficiency Attribution, A_E.**. This measures the effect the program had on the efficiency of the equipment installed. The efficiency attribution measures the proportion of savings attributable to the program for increasing the efficiency of the equipment above what would have been installed otherwise.
- **Quantity Attribution, A_Q:** This measures the effect the program had on the quantity of the equipment installed. The quantity attribution measures the proportion of savings attributable to the program for increasing the quantity of equipment above what would have been installed otherwise.

The acceleration period, efficiency attribution, and quantity attribution are based on responses to the attribution questions in the impact evaluation survey.

The compliment of attribution is free-ridership. Attribution measures the portion of the savings that result because of the actions of the program. Free-ridership measures the portion of the savings that would have happened in the absence of the program. The free-ridership equivalents of the two attribution factors are used to determine the overall program net savings. They are:

[52] For purposes of this discussion, "CFLs" includes small CFLs only; for example, measures with the description "CFL <= 30W". Larger CFL installations follow the standard FOE evaluation attribution approach.

- **Efficiency Free-ridership, f_E:** This is the fraction of verified gross (VGI) savings per unit that would have occurred without the program (free rider efficiency increment). This value is also equivalent to the factor E used in previous attribution analysis reports.
- **Quantity Free-ridership, f_Q:** This is the fraction of installed units that would have been installed without the program (free rider quantity factor). This value is also equivalent to the factor Q used in previous attribution analysis reports.

The free-ridership values are easily calculated from the attribution factors.

- $f_E = 1 - A_E$
- $f_Q = 1 - A_Q$

4.3.2 First-year attribution analysis

A detailed description of the current Focus evaluation attribution methodology is available in the final Focus Business Programs impact evaluation report[53] as "Appendix E: Attribution Analysis Methodology."

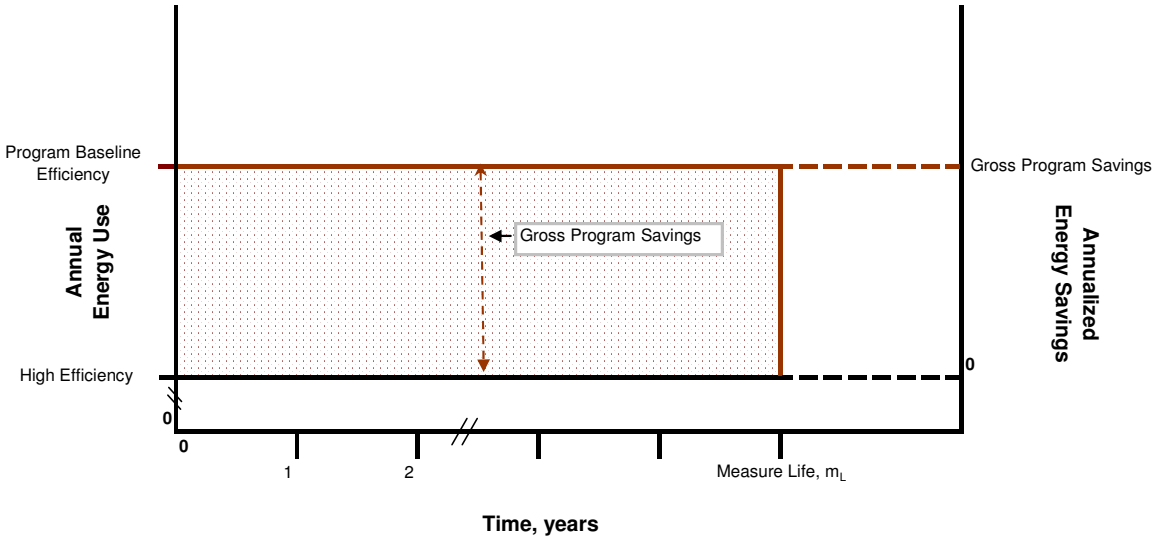
4.3.3 Life cycle attribution analysis

This section outlines the calculation methods necessary to determine net program savings using the attribution analysis parameters defined above.

The impact evaluation starts with the program-reported gross savings for a measure. The goal of the new methodology is to produce lifetime net savings as opposed to the first-year net savings produced with the current Focus evaluation methodology. If the program-reported annual gross savings are combined with the measure life, m_L, then the simple lifetime gross savings can be plotted as shown in Figure 4-1.

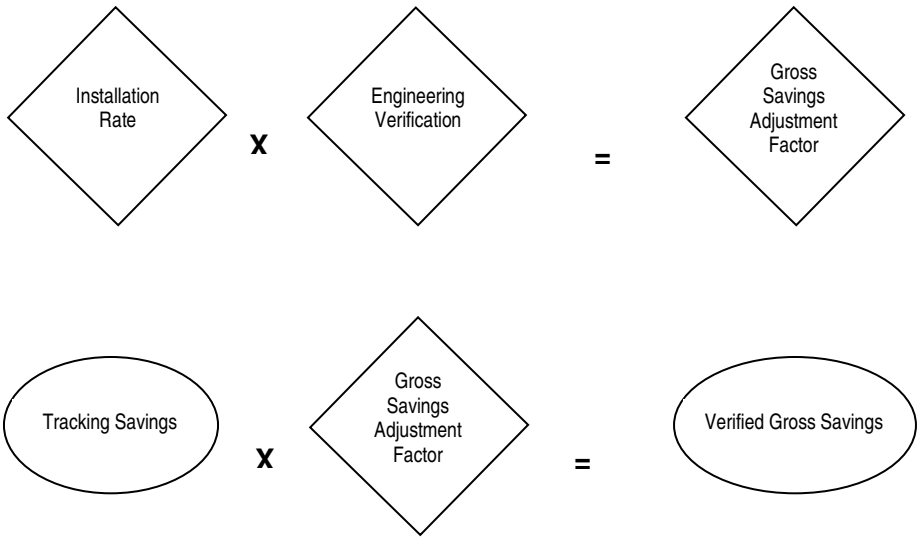
[53] Miriam L. Goldberg, J. Ryan Barry, Ben Jones, Paulo Tanimoto, Jeremiah Robinson, and Tammy Kuiken; KEMA Inc. *Focus on Energy Evaluation, Business Programs Impact Evaluation Report: First Five Quarters of the 18-month Contract Period, Final.* April 2, 2009.

Figure 4-1. Simple Lifetime Savings of a Focus on Energy Measure



The simple lifetime savings are simply the first year savings multiplied by the measure life.

The annualized verified gross (VGI) savings are determined by multiplying the annualized tracking savings (from the tracking database) by the installation rate and the engineering verification factor. The combined installation rate and engineering verification factor has also been called the gross savings adjustment factor.



The final net savings are a function of the simple program attribution (SPA) and the acceleration period. The SPA is the fraction of VGI savings that are attributable to the program and is a function of the efficiency free-ridership and the quantity free-ridership.

The fraction of VGI savings that would have occurred *without* the program is the product of the fraction of units that would have been installed without the program, f_Q, and the fractional unit savings that these units would have had without the program, f_E.

$$f_{QE} = f_Q f_E$$

For example, if two-thirds as many units would have been installed without the program (f_Q = 2/3), and the savings per unit would have been only half as much (f_E = 1/2), the portion of the savings that would have occurred without the program would be

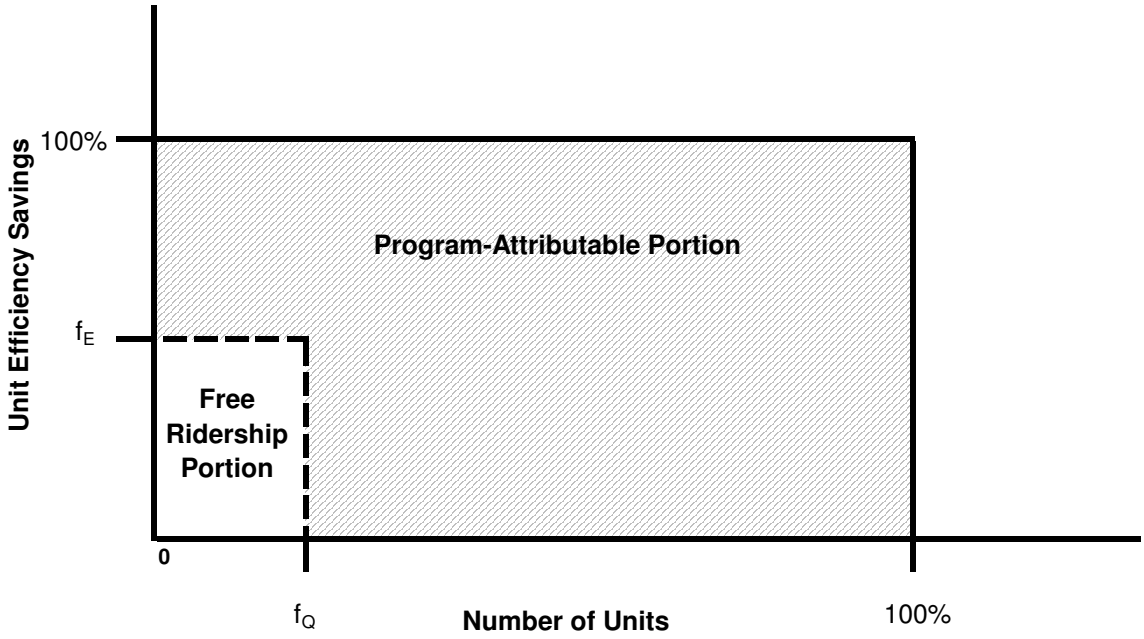
$$f_{QE} = (2/3) \times (1/2) = 1/3.$$

The SPA is the complement of this free rider portion.

$$SPA = 1\text{-}f_{QE} = 1\text{-} f_Q f_E$$

The relationship is illustrated in Figure 4-2.

Figure 4-2. Graphical Derivation of the SPA Equation



For a replacement measure with acceleration, the program caused the participant to install an energy efficiency measure before they originally intended to install it. During the acceleration period, the energy savings caused by the program are the difference between the energy use of the high-efficiency equipment that was installed and the energy use of the equipment that was replaced. We call this value the Acceleration Period Savings.

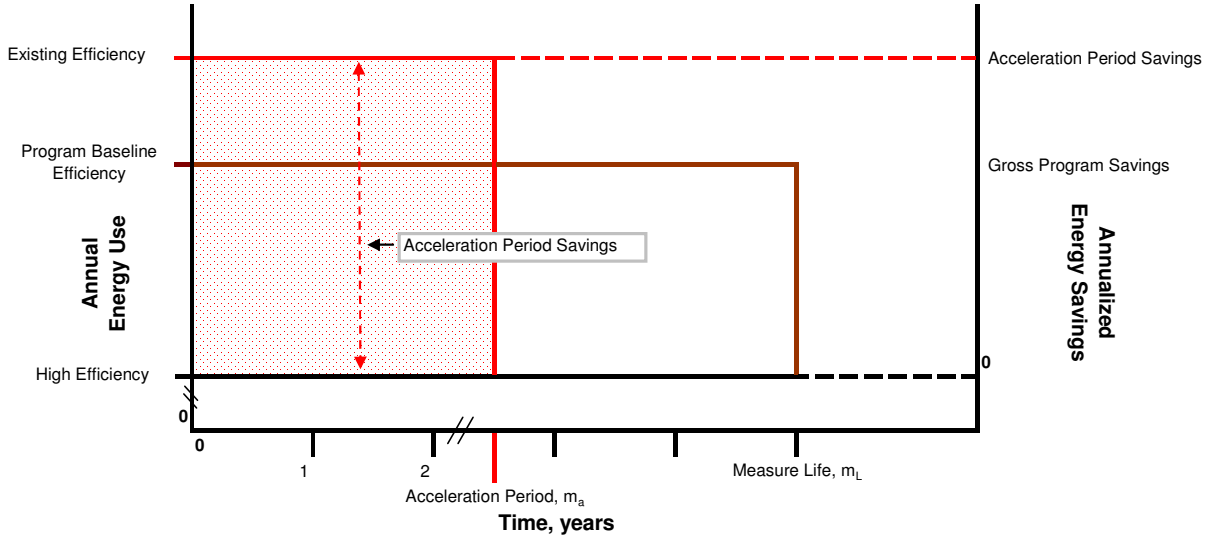
For non-deemed measures in the engineering review, the Acceleration Period Savings are determined in the same way as the VGI Savings but by using the existing equipment efficiency as the measure baseline instead of the standard or program-defined efficiency. The evaluating engineer is able to determine the existing equipment efficiency from the project

contact at the participating site. The engineer then uses a number of sources including the documentation provided by the program, other information from the participant contact, and secondary sources to estimate the Acceleration Period Savings for a particular measure.

The Acceleration Period Savings are not based on an adjustment to program-reported savings because the program has not traditionally addressed variations in energy savings over the life of accelerated measures. If the program were to estimate and produce acceleration period savings in the future then we expect that our methodology would adjust to verify both the program-reported Acceleration Period Savings and the program-reported Acceleration Period in the same manner that we now verify installation or gross savings.

Figure 4-3 shows the Acceleration Period Savings superimposed over the gross program savings. The lifetime acceleration period savings are the acceleration period savings multiplied by the acceleration period, m_a.

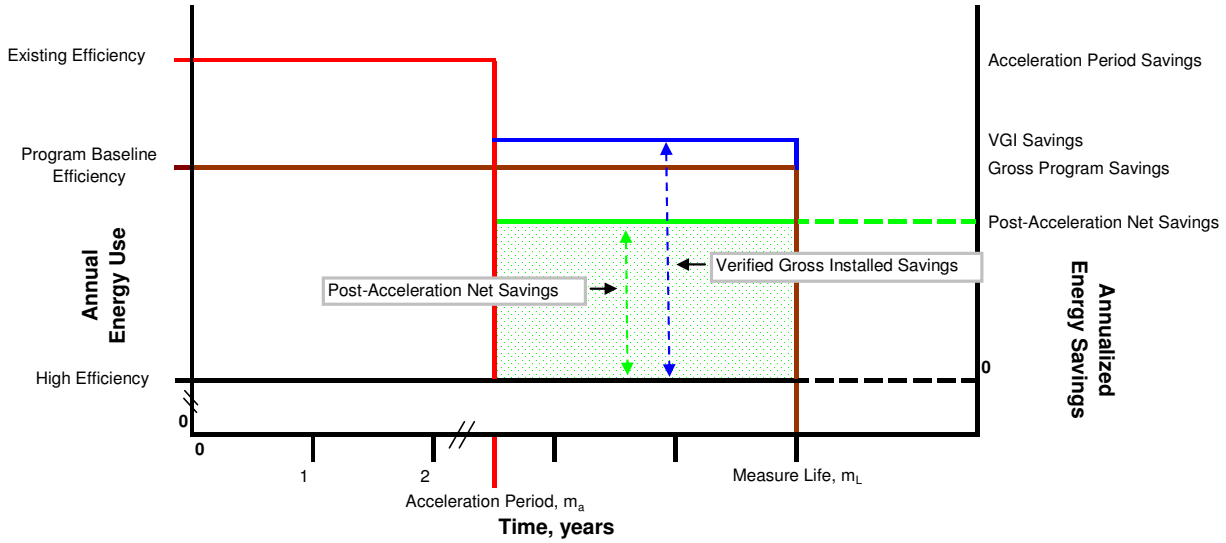
Figure 4-3. Acceleration Period Savings



There is no “net” or “gross” associated with the Acceleration Period Savings. The concept of acceleration already incorporates elements of net savings so no further adjustments to acceleration period savings are necessary (essentially Acceleration Period Savings are by definition 100 percent attributable).

The post-acceleration period net savings are shown in Figure 4-4. The post-acceleration net savings are equal to the VGI savings times the SPA defined above.

Figure 4-4. Post-Acceleration Period Net Savings

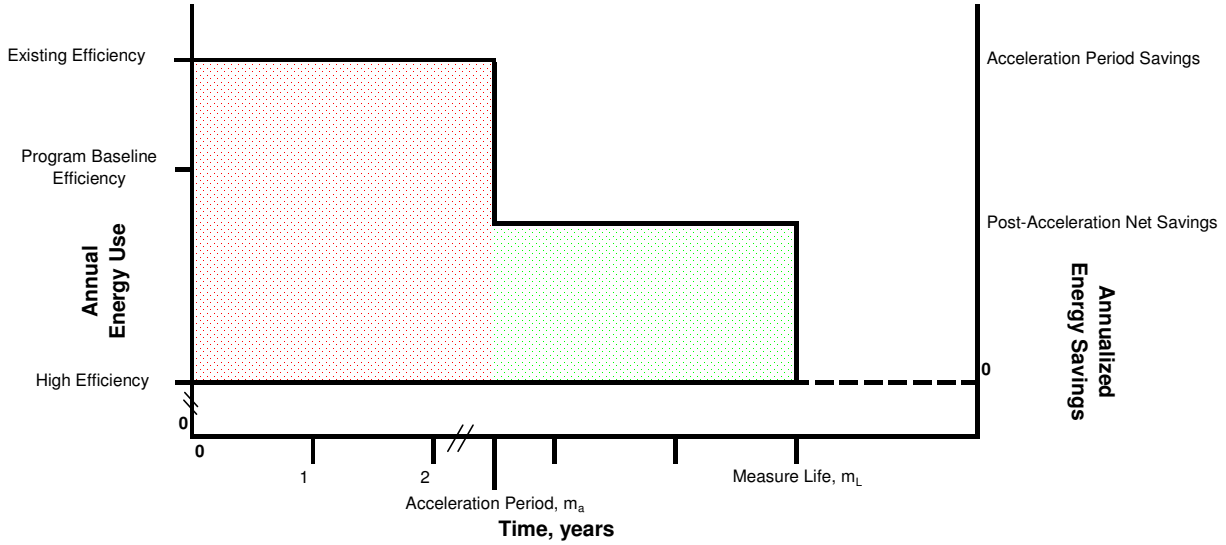


The lifetime net savings for an accelerated measure are the sum of the acceleration period savings and the post-acceleration net savings. This can also be written as

$$\text{Lifetime net savings (accelerated)} = \text{Acceleration Period Savings} + \text{VGI}_{\text{post-accel}} \times \text{SPA}$$

The lifetime net savings are shown graphically in Figure 4-5.

Figure 4-5. Simple Lifetime Net Savings



4.3.4 Determining attribution parameters

The attribution factors defined above are determined from the participant responses gathered during the survey. The survey questions and procedure for calculating the Acceleration Period, m_a , Efficiency Attribution, A_E , Quantity Attribution, A_Q, and incorporation of supplier effect is detailed in the final 18MCP impact evaluation.[54]

4.4 DIFFERENCES BETWEEN LIFE CYCLE AND FIRST-YEAR METHODS

In this section, we describe the important differences between the life cycle and first-year methods.

4.4.1 Summary of differences

Like the first-year method, the life cycle method calculates attribution as a ratio of net savings to a ratio of verified gross savings and the realization rate as a ratio of net savings to tracked savings; however, the life cycle approach has two significant differences in its estimation of verified gross savings and net savings for the measure. First, the life cycle method looks at the total lifetime savings of the equipment. Second, it increases the annual verified gross savings in the acceleration period for custom measures where the existing equipment had lower than standard efficiency. In the post-acceleration period and for non-accelerated measures the annual verified gross savings are the same as those used in the first-year method.

For the life cycle method, the annual gross savings in the acceleration period had to be estimated for some measures because the input data needed to calculate annual gross savings for these measures is not currently available. The 18MCP impact evaluation used two surveys, one conducted by KEMA engineers, referred to as “the engineering survey” and one CATI survey. The CATI survey did not result in verified gross savings estimations. For all measures in the CATI, the ratio of verified gross savings to installed savings was assumed to be one for the purposes of the first-year method. This assumption is continued in the life cycle analysis for the annual verified gross savings of non-accelerated measures and post-acceleration periods of accelerated measures. However, as described above (and shown in Figure 4-3), accelerated custom measures often have annual verified savings in the acceleration period that are greater than the annual verified savings in the post-acceleration period. The ratio of these two savings is referred to throughout this report as the A/P ratio.[55] The life cycle method assumes an A/P ratio of two for custom measure in the CATI. That is, the energy savings in the acceleration period is twice that of the post-acceleration period.

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[54] Miriam L. Goldberg, J. Ryan Barry, Ben Jones, Paulo Tanimoto, Jeremiah Robinson, and Tammy Kuiken; KEMA Inc. *Focus on Energy Evaluation, Business Programs Impact Evaluation Report: First Five Quarters of the 18-month Contract Period, Final.* April 2, 2009.

[55] The A/P ratio is the ratio of Acceleration Period to Post-Acceleration Period savings (VGI). For more details on the LCNS method, please review the *Business Programs Life Cycle Attribution Analysis Results* memo released on December 2, 2008.

To investigate the uncertainty introduced by our assumed A/P ratio and confirm the robustness of our results, KEMA ran life cycle method results with the aforementioned assumptions and an alternative set of assumptions. LCNS Method A is official life cycle method result which uses an assumed an A/P ratio of two for custom measures in the CATI; and LCNS Method B used the observed sector level A/P ratios from the engineering survey for the custom CATI measures. Table 4-1 shows the differences in methodology among the first-year method and the two life cycle methods.

Table 4-1. Methodological Differences between Y1NS Method and LCNS Methods

Assumption	Y1NS	LCNS Method A	LCNS Method B
Type of savings	First year savings	Lifetime savings	
Annual acceleration period verified gross savings	The difference between the energy use of the rebated equipment and the energy use of its standard efficiency replacement.	The difference between the energy use of the rebated equipment and the energy use of the equipment replaced.	
Annual post-acceleration period verified gross savings		The difference between the energy use of the rebated equipment and the energy use of its standard efficiency replacement.	
Acceleration period net savings	n/a	Acceleration period verified gross savings multiplied by the acceleration period.	
Post-acceleration period net savings	n/a	Post-acceleration period verified gross savings times the simple program attribution (SPA).	
A/P ratio assumed for custom CATI	n/a (implied 1)	2	Based on sector level A/P ratios observed in the engineering survey
Net savings calculation	Verified gross savings times [SPA + (Acc/48)(1-SPA)]	Acceleration period net savings plus post-acceleration period net savings	

4.4.2 Detailed review of expected effects

As part of the December 2 memo, KEMA put together a brief explanation of how we expected the life cycle method attribution results to differ from the first-year method results based on some relevant factors. The previous memo also explained, in detail, the first-year attribution analysis method and the calculations used to determine analysis.

There are two primary differences between the first-year and the life cycle attribution methods. First, the first-year method deals only with first-year savings, not lifetime savings. This means that the first-year method weights savings from long-lived measures the same as savings from short-lived measures.

Second, the first-year method used a simple relationship to determine timing attribution instead of assigning an acceleration period with a potentially different magnitude of savings. In the first-year method, the overall attribution is calculated as a function of timing free-ridership as well as efficiency and quantity free-riderships as shown below.

$$A_{Y1NS} = 1 - f_Q f_E f_T$$

The timing free-ridership is a function of the acceleration period

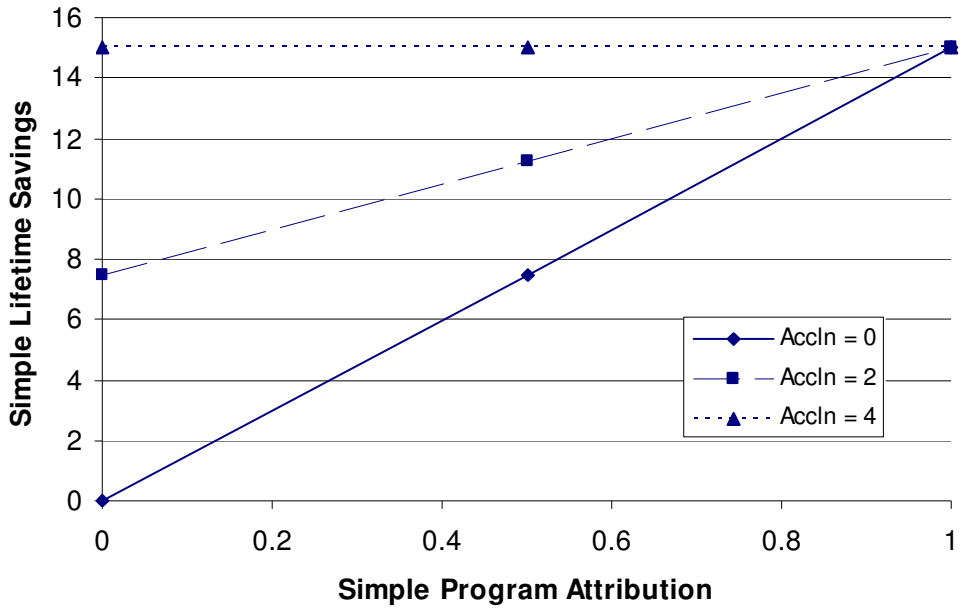
$$f_T = 1 - m_a/48.$$

for all acceleration periods less than or equal to 48 months.

A. CHANGING ACCELERATION

Figure 4-6 shows a plot of the simple lifetime savings using the first-year method. The values in the plot assume a measure life of 15 years and an A/P ratio[56] of 1. Savings are shown for acceleration periods of zero, two, and four years. Since the SPA is only a function of the efficiency and quantity free-riderships, this plot isolates the effect of acceleration when efficiency and quantity attribution are changing.

Figure 4-6. Simple Lifetime Savings, Y1NS Method; A/P Ratio = 1



The plot shows that the first-year method produces full savings for all SPA when the acceleration period is four years. Mathematically, an acceleration period of four years

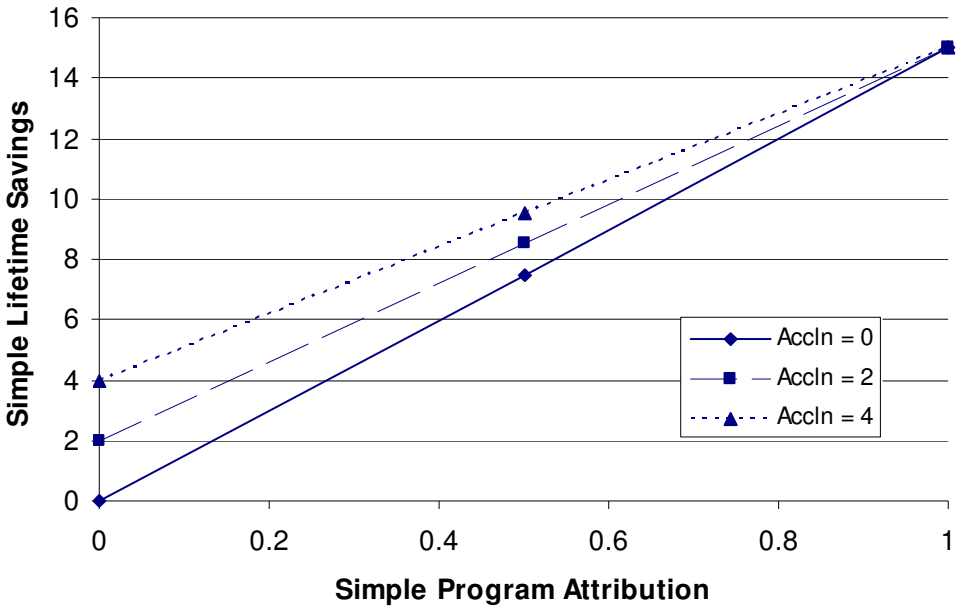
[56] The A/P ratio is the ratio of the Acceleration Period to the Post-Acceleration Period savings (VGI).

produces a timing free-ridership of zero ($f_T = 1 - 48/48 = 0$). A timing free-ridership of zero produces an overall attribution of 100% ($A_{Y1NS} = 1 - f_Q f_E(0) = 1$) regardless of the values of the quantity or efficiency free-riderships. When the attribution is 100 percent, the lifetime savings are equal to the VGI savings.

On the other extreme, the plot shows that the simple lifetime savings are solely a function of the SPA when the acceleration period is zero. This is because a zero acceleration period produces 100 percent acceleration free-ridership and the effect of acceleration is no longer felt in the overall attribution equation (($A_{Y1NS} = 1 - f_Q f_E(1) = 1 - f_Q f_E$). In that case, the overall attribution is equal to SPA.

Figure 4-7 shows the same plot with the values produced using the life cycle method.

Figure 4-7. Simple Lifetime Savings, LCNS Method; A/P Ratio = 1

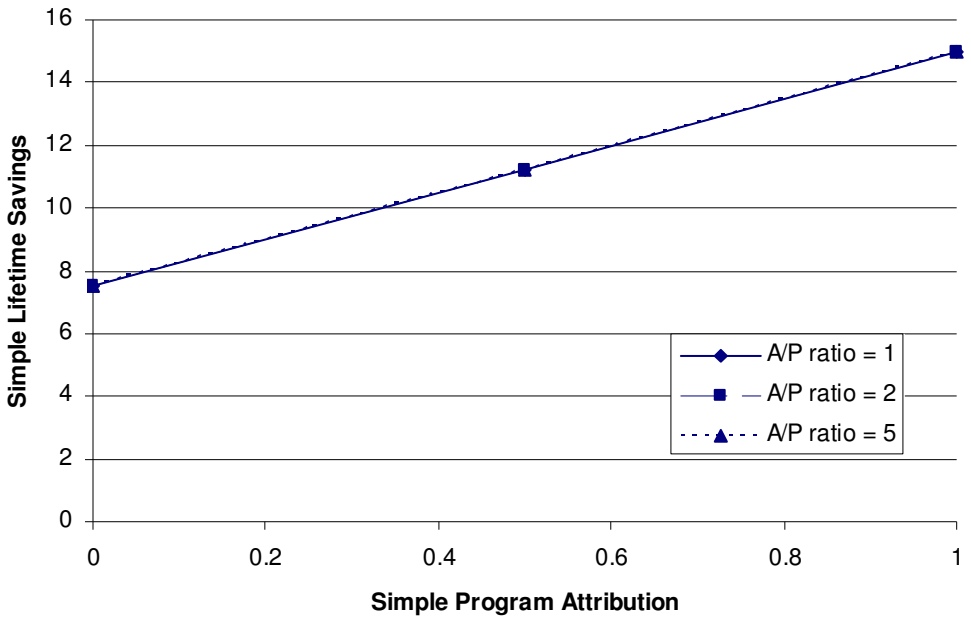


The plot of the life cycle method shows that the final lifetime savings are always dependent on the efficiency and quantity attributions, for any acceleration period that gives less than full attribution. On the other hand, the difference in lifetime savings between no acceleration and an acceleration period of four years is much smaller than it is when using the first-year method.

B. CHANGING A/P RATIO

Figure 4-8 shows a plot of the simple lifetime savings using the first-year method. The values in the plot assume a measure life of 15 years and an acceleration period of two years. Savings are shown for A/P ratios of 1, 2, and 5. Since the SPA is only a function of the efficiency and quantity free-riderships, this plot isolates the effect of A/P ratio when a measure is accelerated and efficiency and quantity attribution are changing.

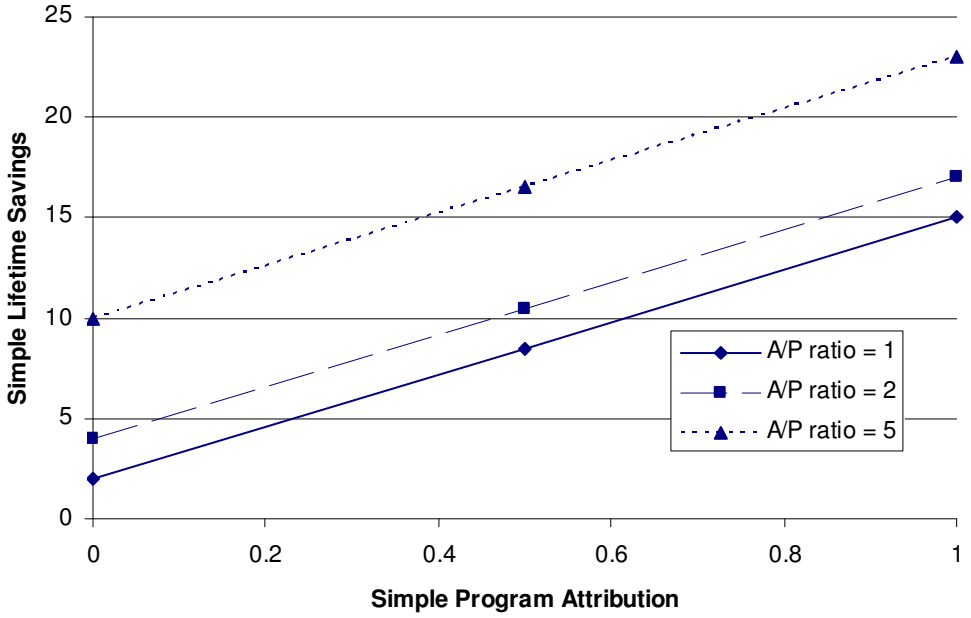
Figure 4-8. Simple Lifetime Savings, Y1NS Method; Acceleration Period = 2



The figure shows that the A/P ratio has no effect on the lifetime savings using the first-year method. This is because the first-year method does not incorporate changing savings values that may result from early replacement over the life of a piece of equipment.

Figure 4-9 shows the same plot with the values produced using the life cycle method.

Figure 4-9. Simple Lifetime Savings, LCNS Method; Acceleration Period = 2



The figure shows that simple lifetime savings increase with increasing A/P ratio, reflecting how the relative energy use between the standard piece of equipment and the existing piece of equipment affect the overall lifetime savings.

4.5 ANALYSIS RESULTS

KEMA performed the life cycle analysis outlined above using the data collected during the first fifteen months of the 18MCP. This section reports the results of the analysis.

4.5.1 Measure life

To complete the analysis, we assigned measure lives to each measure in our analysis sample. We assigned each measure to one of nine end-use measure type combinations and assigned a measure life based on the sector and end-use group.

The (old) measure lives used in the December 2008 life cycle analysis are consistent with those used in the 2007 evaluation benefit cost analysis.[57] Between the completion of the December 2008 life cycle memo and this report, the evaluation team completed the Focus Business Programs measure life study.[58] Table 4-2 shows the measure lives assigned in our analysis (new) and those used in the December 2008 life cycle memo (old).

Table 4-2. Measure Life in Years

End-use Category	Measure Type	Sector							
		Agriculture		Commercial		Industrial		Schools and Government	
		New	Old	New	Old	New	Old	New	Old
Building Shell	Equip or Tech	19	10	19	10	19	10	19	10
HVAC	Equip or Tech	15	15	15	15	15	15	15	15
	Service	5	15	5	15	5	15	5	15
Lighting	Equip or Tech	12	15	12	15	12	15	12	15
Manufacturing Process	Equip or Tech	11	12	11	12	11	12	11	12
	Service	2	12	2	12	2	12	2	12
Other	Equip or Tech	12	17	12	19	12	28	12	10
CFL	Equip or Tech	7	6	5	6	4	6	5	6
Motors	Equip or Tech	16	16	16	16	16	16	16	16

4.5.2 Analysis results

Table 4-3 shows the attribution ratio results using the life cycle method by sector and for the program overall. These results incorporate the updated measure lives and use an assumed A/P ratio of two for custom CATI measures.

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[57] Miriam L. Goldberg, Chris Clark, and Sander Cohan, KEMA, Inc. *State of Wisconsin Department of Administration Division of Energy, Focus on Energy Statewide Evaluation, Interim Benefit-Cost Analysis: FY07 Evaluation Report*, *Final Report.* February 26, 2007.

[58] Miriam L. Goldberg, J. Ryan Barry, Brian Dunn, Mary Ackley, Darcy Deangelo-Woolsey, KEMA Inc. *Focus on Energy Evaluation Business Programs: Measure Life Study.* August 25, 2009.

Table 4-3. Attribution Factor Results by Sector and Overall

Sector	kWh						kW						Therms					
			90% Confidence Interval						90% Confidence Interval						90% Confidence Interval			
	n	Attribution Adjustment Factor	Relative Error (%)	±	Lower Bound	Upper Bound	n	Attribution Adjustment Factor	Relative Error (%)	±	Lower Bound	Upper Bound	n	Attribution Adjustment Factor	Relative Error (%)	±	Lower Bound	Upper Bound
Agriculture	127	51%	20.5%	10.4%	40.5%	61.3%	108	48%	25.3%	12.2%	36.0%	60.4%	22	13%	58.6%	7.8%	5.5%	21.1%
Commercial	133	57%	19.5%	11.2%	46.1%	68.4%	128	55%	22.6%	12.5%	42.7%	67.8%	26	24%	53.8%	12.9%	11.1%	36.8%
Industrial	131	51%	16.5%	8.4%	42.5%	59.3%	125	47%	17.5%	8.2%	38.8%	55.3%	39	50%	26.0%	12.9%	36.6%	62.4%
S&G	77	39%	24.9%	9.6%	29.1%	48.4%	68	47%	37.4%	17.6%	29.4%	64.6%	59	30%	34.3%	10.1%	19.4%	39.6%
Business Programs Overall	468	52%	11.5%	5.9%	45.7%	57.6%	429	50%	12.2%	6.1%	43.7%	55.9%	146	40%	18.2%	7.3%	32.6%	47.1%

The table shows that the Commercial kWh and kW attribution adjustment factors were higher than the other sectors, at 57 and 55 percent, respectively. The Industrial sector had the highest therm attribution at 50 percent.

Table 4-4 shows the realization rate results using the life cycle method by sector and for the program overall.

Table 4-4. Realization Rate Results by Sector and Overall

Sector	kWh						kW						Therms					
			90% Confidence Interval						90% Confidence Interval						90% Confidence Interval			
	n	Realization Rate	Relative Error (%)	±	Lower Bound	Upper Bound	n	Realization Rate	Relative Error (%)	±	Lower Bound	Upper Bound	n	Realization Rate	Relative Error (%)	±	Lower Bound	Upper Bound
Agriculture	130	47%	22.2%	10.5%	36.7%	57.6%	110	47%	25.5%	12.0%	34.9%	58.8%	25	11%	58.5%	6.4%	4.5%	17.3%
Commercial	136	54%	18.4%	9.9%	43.8%	63.5%	132	55%	21.8%	11.9%	42.8%	66.6%	26	25%	53.1%	13.2%	11.7%	38.1%
Industrial	131	47%	18.1%	8.6%	38.8%	56.0%	125	42%	20.9%	8.8%	33.4%	51.0%	39	42%	24.9%	10.5%	31.8%	52.8%
S&G	78	35%	24.6%	8.7%	26.7%	44.1%	69	43%	38.2%	16.3%	26.5%	59.1%	61	22%	33.8%	7.3%	14.3%	29.0%
Business Programs Overall	475	48%	12.2%	5.9%	42.2%	54.0%	436	46%	13.2%	6.1%	40.3%	52.6%	151	34%	18.3%	6.1%	27.5%	39.8%

Again, the Commercial sector had the highest realization rate for kWh and kW at 54 and 55 percent, respectively. The Agriculture sector had the lowest therm realization rate at 11 percent.

4.6 COMPARISON TO FIRST-YEAR RESULTS

The results in this memo were produced to allow a comparison between adjustment factors determined using the first-year method and adjustment factors determined using the life cycle method using the same data.

4.6.1 Attribution factors

Table 4-5 shows the kWh attribution rates by sector and overall using the first-year and life cycle methodologies.

Table 4-5. LCNS and Y1NS kWh Attribution Factors

Sector	LCNS Method						Y1NS Method					
			90% Confidence Interval						90% Confidence Interval			
	n	Attribution Adjustment Factor	Relative Error (%)	±	Lower Bound	Upper Bound	n	Attribution Adjustment Factor	Relative Error (%)	±	Lower Bound	Upper Bound
Agriculture	127	51%	20.5%	10.4%	40.5%	61.3%	126	60%	14.2%	8.4%	51.1%	68.0%
Commercial	133	57%	19.5%	11.2%	46.1%	68.4%	131	70%	12.1%	8.4%	61.1%	77.9%
Industrial	131	51%	16.5%	8.4%	42.5%	59.3%	130	57%	12.9%	7.4%	49.8%	64.6%
S&G	77	39%	24.9%	9.6%	29.1%	48.4%	77	43%	26.6%	11.4%	31.5%	54.4%
Business Programs Overall	468	52%	11.5%	5.9%	45.7%	57.6%	464	60%	8.4%	5.0%	54.6%	64.5%

Table 4-6 shows the kW attribution rates by sector and overall using the first-year and life cycle methodologies.

Table 4-6. LCNS and Y1NS kW Attribution Factors

Sector	LCNS Method						Y1NS Method					
			90% Confidence Interval						90% Confidence Interval			
	n	Attribution Adjustment Factor	Relative Error (%)	±	Lower Bound	Upper Bound	n	Attribution Adjustment Factor	Relative Error (%)	±	Lower Bound	Upper Bound
Agriculture	108	48%	25.3%	12.2%	36.0%	60.4%	107	57%	18.7%	10.6%	46.1%	67.4%
Commercial	128	55%	22.6%	12.5%	42.7%	67.8%	126	69%	13.9%	9.6%	59.6%	78.9%
Industrial	125	47%	17.5%	8.2%	38.8%	55.3%	124	54%	14.0%	7.5%	46.2%	61.3%
S&G	68	47%	37.4%	17.6%	29.4%	64.6%	68	46%	14.1%	14.1%	31.8%	59.9%
Business Programs Overall	429	50%	12.2%	6.1%	43.7%	55.9%	425	58%	9.0%	5.2%	53.0%	63.4%

Table 4-7 shows the therm attribution rates by sector and overall using the first-year and life cycle methodologies.

Table 4-7. LCNS and Y1NS Therm Attribution Factors

Sector	LCNS Method						Y1NS Method					
			90% Confidence Interval						90% Confidence Interval			
	n	Attribution Adjustment Factor	Relative Error (%)	±	Lower Bound	Upper Bound	n	Attribution Adjustment Factor	Relative Error (%)	±	Lower Bound	Upper Bound
Agriculture	22	13%	58.6%	7.8%	5.5%	21.1%	22	17%	8.5%	8.5%	8.1%	25.2%
Commercial	26	24%	53.8%	12.9%	11.1%	36.8%	26	33%	12.7%	12.7%	20.5%	45.8%
Industrial	39	50%	26.0%	12.9%	36.6%	62.4%	38	63%	11.6%	7.3%	56.0%	70.7%
S&G	59	30%	34.3%	10.1%	19.4%	39.6%	62	38%	30.2%	11.5%	26.7%	49.7%
Business Programs Overall	146	40%	18.2%	7.3%	32.6%	47.1%	148	52%	11.9%	6.2%	46.2%	58.6%

Table 4-5, Table 4-6, and Table 4-7 show that the attribution factor for all savings types and all sectors and overall is lower when using the life cycle method than when using the first-year method. The statistical errors are comparable for both methods.

Table 4-8 shows the difference in the values using the two methods by sector and overall.

Table 4-8. Difference between LCNS and Y1NS Attribution Factors

Sector	kWh			kW			Therms		
	LCNS Method	Y1NS Method	Diff.	LCNS Method	Y1NS Method	Diff.	LCNS Method	Y1NS Method	Diff.
Agriculture	51%	60%	-9%	48%	57%	-9%	13%	17%	-3%
Commercial	57%	70%	-12%	55%	69%	-14%	24%	33%	-9%
Industrial	51%	57%	-6%	47%	54%	-7%	50%	63%	-14%
S&G	39%	43%	-4%	47%	46%	1%	30%	38%	-9%
Business Programs Overall	52%	60%	-8%	50%	58%	-8%	40%	52%	-13%

Table 4-8 shows that the greatest difference between the two methods is in the commercial sector for electrical savings and in the industrial sector for therms. The schools and government sector had the lowest difference in kW and kWh ratios, while the agriculture sector had the lowest difference in therms. Agriculture has only a small difference in its therm attributions. The fact that the biggest differences in the electrical ratios were found in the commercial and agriculture sectors is unsurprising as a large portion of net savings in each sector come from CFLs, which have a shorter measure life than most other measures.

4.6.2 Realization rates

Table 4-9 shows the kWh realization rates by sector and overall using the first-year and life cycle methodologies.

Table 4-9. LCNS and Y1NS kWh Realization Rates

Sector	LCNS Method						Y1NS Method					
			90% Confidence Interval						90% Confidence Interval			
	n	Realization Rate	Relative Error (%)	±	Lower Bound	Upper Bound	min n	Realization Rate	Relative Error (%)	±	Lower Bound	Upper Bound
Agriculture	130	47%	22.2%	10.5%	36.7%	57.6%	126	56%	14.8%	8.3%	48.0%	64.6%
Commercial	136	54%	18.4%	9.9%	43.8%	63.5%	131	63%	12.9%	8.1%	54.9%	71.1%
Industrial	131	47%	18.1%	8.6%	38.8%	56.0%	130	53%	14.8%	7.9%	45.4%	61.1%
S&G	78	35%	24.6%	8.7%	26.7%	44.1%	77	43%	26.7%	11.4%	31.2%	54.0%
Business Programs Overall	475	48%	12.2%	5.9%	42.2%	54.0%	464	55%	9.3%	5.2%	50.2%	60.5%

Table 4-10 shows the kW realization rates by sector and overall using the first-year and life cycle methodologies.

Table 4-10. LCNS and Y1NS kW Realization Rates

Sector	LCNS Method						Y1NS Method					
			90% Confidence Interval						90% Confidence Interval			
	n	Realization Rate	Relative Error (%)	±	Lower Bound	Upper Bound	min n	Realization Rate	Relative Error (%)	±	Lower Bound	Upper Bound
Agriculture	110	47%	25.5%	12.0%	34.9%	58.8%	107	55%	18.9%	10.4%	44.6%	65.4%
Commercial	132	55%	21.8%	11.9%	42.8%	66.6%	126	66%	14.6%	9.6%	56.2%	75.4%
Industrial	125	42%	20.9%	8.8%	33.4%	51.0%	121	49%	17.2%	8.4%	40.3%	57.1%
S&G	69	43%	38.2%	16.3%	26.5%	59.1%	68	43%	13.5%	13.5%	30.0%	57.0%
Business Programs Overall	436	46%	13.2%	6.1%	40.3%	52.6%	425	54%	10.0%	5.4%	48.9%	59.8%

Table 4-11 shows the therm realization rates by sector and overall using the first-year and life cycle methodologies.

Table 4-11. LCNS and Y1NS Therm Realization Rates

Sector	LCNS Method						Y1NS Method					
			90% Confidence Interval						90% Confidence Interval			
	n	Realization Rate	Relative Error (%)	±	Lower Bound	Upper Bound	min n	Realization Rate	Relative Error (%)	±	Lower Bound	Upper Bound
Agriculture	25	11%	58.5%	6.4%	4.5%	17.3%	22	13%	6.7%	6.7%	6.2%	19.6%
Commercial	26	25%	53.1%	13.2%	11.7%	38.1%	26	34%	13.2%	13.2%	21.1%	47.5%
Industrial	39	42%	24.9%	10.5%	31.8%	52.8%	38	60%	13.1%	7.8%	52.1%	67.8%
S&G	61	22%	33.8%	7.3%	14.3%	29.0%	62	30%	32.9%	9.9%	20.2%	39.9%
Business Programs Overall	151	34%	18.3%	6.1%	27.5%	39.8%	148	48%	12.8%	6.1%	41.5%	53.7%

Table 4-9, Table 4-10 and Table 4-11 show that, again, the realization rate for all savings types and sectors and overall is lower when using the life cycle method than when using the first-year method. The same is true for all of the therm realization rates except that for the Agriculture sector.

Table 4-12 shows the difference in the values using the two methods by sector and overall.

Table 4-12. Difference between LCNS and Y1NS Realization Rates

Sector	kWh			kW			Therms		
	LCNS Method	Y1NS Method	Diff.	LCNS Method	Y1NS Method	Diff.	LCNS Method	Y1NS Method	Diff.
Agriculture	47%	56%	-9%	47%	55%	-8%	11%	13%	-2%
Commercial	54%	63%	-9%	55%	66%	-11%	25%	34%	-9%
Industrial	47%	53%	-6%	42%	49%	-6%	42%	60%	-18%
S&G	35%	43%	-7%	43%	43%	-1%	22%	30%	-8%
Business Programs Overall	48%	55%	-7%	46%	54%	-8%	34%	48%	-14%

Table 4-12 illustrates that nearly all realization rates are more than five percent lower using the life cycle versus the first-year methods. The overall therm realization rates show a greater difference in realization rates than the kWh and kW values, which is a change from the attribution results caused by a few negative engineering adjustments for large, long lasting therm projects.

4.7 SENSITIVITY OF LIFE CYCLE RESULTS TO ASSUMED A/P RATIOS

Figure 4-6 and Figure 4-7 illustrated the difference between the first-year and life cycle method results for accelerated measures. In general, the life cycle method tends to produce lower attribution savings for an accelerated project if all other variables (i.e., A/P ratio) are equal. The difference in results between the two methods decreases as the acceleration period approaches zero. Table 4-13 shows the percentage of 18MCP installed savings that were accelerated. That is, the percentage of installed energy savings that would have been installed within one to 48 months without the influence of the program.

Table 4-13. Percentage of Installed Savings that are Accelerated

Sector	kWh	kW	Therms
Agriculture	24%	23%	12%
Commercial	32%	38%	55%
Industrial	44%	51%	69%
Schools and Government	45%	42%	28%
Business Programs Overall	39%	45%	57%

Overall, around 40 percent of installed kWh and more than half of the installed therm savings were installed earlier due to program influence. The highest proportion of accelerated projects was in the Industrial sector, where almost 50 percent of the kWh and 70% of the therm savings were accelerated. The lowest proportion of accelerated projects was in the Agricultural sector with less than 30 percent of savings accelerated across the board.

As shown in Figure 4-6 and Figure 4-7, the difference in results between the life cycle and first-year methods decreases as the acceleration period approaches zero. Table 4-14 shows the average acceleration period for the accelerated measures in 18MCP.

Table 4-14. Average Acceleration Period in Years

Sector	kWh	kW	Therms
Agriculture	1.4	1.5	1.6
Commercial	1.3	1.4	1.2
Industrial	1.1	1.3	1.1
Schools and Government	1.5	1.5	1.7
Business Programs Overall	1.4	1.4	1.4

Table 4-14 shows that the average acceleration period overall is approximately 1.4 years for all savings types. Figure 4-8 and Figure 4-9 illustrated the difference between the first-year and life cycle method results for measures with similar acceleration periods but varying A/P ratios. The A/P ratio had no effect on the first-year method because the first-year method does not attempt to estimate lifetime savings. In general, the life cycle method tends to produce lower lifetime savings for lower A/P ratios and higher lifetime savings for higher A/P Ratios and longer acceleration periods.

As previously noted, the life cycle results we have reported incorporate assumptions about the A/P ratios for measures from the CATI sample. Specifically, we assumed an A/P ratio of 2.0 for custom measures in the CATI sample. A rough test of the reasonableness of these assumptions can be had by examining the A/P ratios for custom measures in the engineering

review, where we were able to capture the efficiency of the equipment being replaced. These values are shown in Table 4-15.

Table 4-15. Average Acceleration-to-Post-Acceleration Savings A/P Ratio for Custom Measures in the Engineering Review

Sector	kWh	kW	Therms
Agriculture	1.6	1.1	0.8*
Commercial	1.0	1.0	1.0
Industrial	1.1	1.1	1.3
Schools & Government	1.5	1.1	1.5

*Agriculture therms had an A/P ratio of less than one due to a large fuel switching measure with negative therm savings.

With the exception of the ratio for therms in the agricultural sector, which was based on a unique situation,[59] all of the A/P ratios in Table 4-15 fall in a range between the values of deemed measures (1.0) and those we assumed for custom CATI measures (2.0). We created life cycle Method B to show what the results would look like if we assumed that the A/P ratios calculated for each sector from the engineering sample (Table 4-15) applied to the custom measures from the CATI sample (rather than defaulting to ratios of 2.0 for the custom measures in the CATI sample).

The results using life cycle Method B are very close to the results obtained when we assumed the value of 2.0 for the custom CATI A/P ratio (life cycle Method A). This fact can be seen clearly in Table 4-16 and Table 4-17, which summarize the attribution factor and realization rate results for all three methods (first-year, life cycle Method A, and life cycle Method B).

Table 4-16. Attribution Factors by Method

Sector	kWh			kW			Therms		
	Y1NS	LCNS A	LCNS B	Y1NS	LCNS A	LCNS B	Y1NS	LCNS A	LCNS B
Agriculture	60%	51%	51%	57%	48%	48%	17%	13%	13%
Commercial	70%	57%	57%	69%	55%	55%	33%	24%	24%
Industrial	57%	51%	51%	54%	47%	47%	63%	50%	49%
Schools & Government	43%	39%	39%	46%	47%	47%	38%	30%	29%
Business Programs Overall	60%	52%	52%	58%	50%	50%	52%	40%	40%

[59] The agriculture sector therm A/P ratio was based on two sample points, one of which included a fuel-switching measure with negative therm savings.

Table 4-17. Realization Rates by Method

Sector	kWh			kW			Therms		
	Y1NS	LCNS A	LCNS B	Y1NS	LCNS A	LCNS B	Y1NS	LCNS A	LCNS B
Agriculture	56%	47%	47%	55%	47%	47%	13%	11%	11%
Commercial	63%	54%	54%	66%	55%	55%	34%	25%	25%
Industrial	53%	47%	47%	49%	42%	42%	60%	42%	42%
Schools & Government	43%	35%	35%	43%	43%	43%	30%	22%	22%
Business Programs Overall	55%	48%	48%	54%	46%	46%	48%	34%	34%

As seen in Table 4-16 and Table 4-17, the difference in the life cycle attributions and realization rates from Method A to Method B is very slight: when rounded to the nearest percent, none of the overall attributions appears to be different. Life cycle Method A and B differ only in the assumed A/P ratio that was applied to custom measures from the CATI survey. Because the majority of CATI measures were deemed measures, custom CATI measures only make up a small portion of savings in each sector, so the A/P ratio has a limited ability to affect the results. Table 4-18 shows the percent of savings in each sector that use an assumed A/P ratio.

Table 4-18. Proportion of Gross Savings Affected by the Acceleration-to-Post-Acceleration Savings A/P Ratio Assumption

Sector	kWh	kW	Therms
Agriculture	20%	16%	3%
Commercial	10%	5%	1%
Industrial	3%	3%	5%
Schools & Government	6%	5%	5%
Business Programs Overall	7%	5%	5%

4.8 SENSITIVITY OF LIFE CYCLE RESULTS TO MEASURE LIFE

KEMA also investigated the effect of the new measure lives on the ratios. The new measure lives are generally shorter than the old measure lives. However, the expected effect on the ratios is ambiguous because the ratios depend of the mix of measures and attributions. For example, if the measure life for a measure with low attribution were shorter, this would tend to increase the ratio, as would having a longer measure life for a measure with high attribution.

When we compared the life cycle attributions and realization rates using the updated measure lives to the life cycle realization rates with the old measure lives we found that the overall electric ratios had changed only slightly, while the overall therm ratios decreased. The realization rates for schools and government improved, while they fell in other sectors. Whether a ratio increased or declined depended on the mix of measures and attributions in the sector for each particular savings types.

Table 4-19. Effect of New Measure Lives on LCNS Method A Attributions

Sector	KWh			kW			Therms		
	New Measure Life	Old Measure Life	Diff.	New Measure Life	Old Measure Life	Diff.	New Measure Life	Old Measure Life	Diff.
Agriculture	51%	52%	-1%	48%	49%	-1%	13%	17%	-3%
Commercial	57%	57%	0%	55%	56%	-1%	24%	26%	-2%
Industrial	51%	51%	0%	47%	48%	-1%	50%	53%	-4%
Schools & Government	39%	36%	3%	47%	39%	8%	30%	30%	-1%
Business Programs Overall	52%	51%	0%	50%	49%	1%	40%	43%	-4%

Table 4-20. Effect of New Measure Lives on LCNS Method A Realization Rates

Sector	KWh			kW			Therms		
	New Measure Life	Old Measure Life	Diff.	New Measure Life	Old Measure Life	Diff.	New Measure Life	Old Measure Life	Diff.
Agriculture	47%	49%	-2%	47%	49%	-2%	11%	13%	-2%
Commercial	54%	54%	0%	55%	55%	0%	25%	27%	-2%
Industrial	47%	48%	-1%	42%	43%	-1%	42%	45%	-3%
Schools & Government	35%	34%	2%	43%	37%	6%	22%	21%	1%
Business Programs Overall	48%	48%	0%	46%	46%	0%	34%	36%	-3%

4.9 CONCLUSIONS

The life cycle method provides a more realistic estimate of the lifetime savings attributable to the program than simply projecting the first-year results forward. We recommend the PSCW consider continued development and refinement of this method in addition to the current Focus (first-year) methods in future evaluations.

Conceptually, there are two key differences between the approaches:

1. The first-year approach treats the reported acceleration period more as an indicator of the likelihood the measure would have been installed without the program rather than as a literal indicator of the time until the measure would have been installed.
2. The first-year approach determines aggregate attribution for a program, sector, or portfolio weighting measures only by first-year savings. The life cycle approach weights measures according to lifetime savings. The first-year approach gives more weight to shorter-lived measures.

Further work remains to be done on understanding how best to obtain meaningful information on timing of installations absent the program, or conversely on how to interpret self-reported acceleration. However, taking measure life into account in assessing aggregate attribution is important in its own right.

The most current input data, such as measure lives, should be incorporated into the life cycle analysis as they become available. This research indicates the acceleration-to-post-acceleration savings A/P ratio assumption of two for custom measures in the CATI is slightly more generous compared to an A/P assumption based on custom projects in the engineering sample. However, KEMA recommends continued use of this assumption for the following reasons:

- The results of this analysis exhibited no meaningful differences in sector-level attribution estimates using the A/P ratio from reviewed custom projects rather than assuming a ratio of two.
- A small fraction of overall energy savings is affected by this assumption.
- The PSCW has directed the evaluation team to transition impact evaluation reporting from sector-level analysis to technology based analysis. This change merits further investigation into A/P ratios by the technology groupings to be used for impact reporting.

This assumption may become moot in further evaluations if custom measures are excluded from the CATI, as was the case with the CY09 impact evaluation sample design.