PUGET SOUND ENERGY

Program:

- Resource Conservation Manager

Program Year:

- 2015-2016

Contents:

- Evaluation Report
- PSE Evaluation Report Response

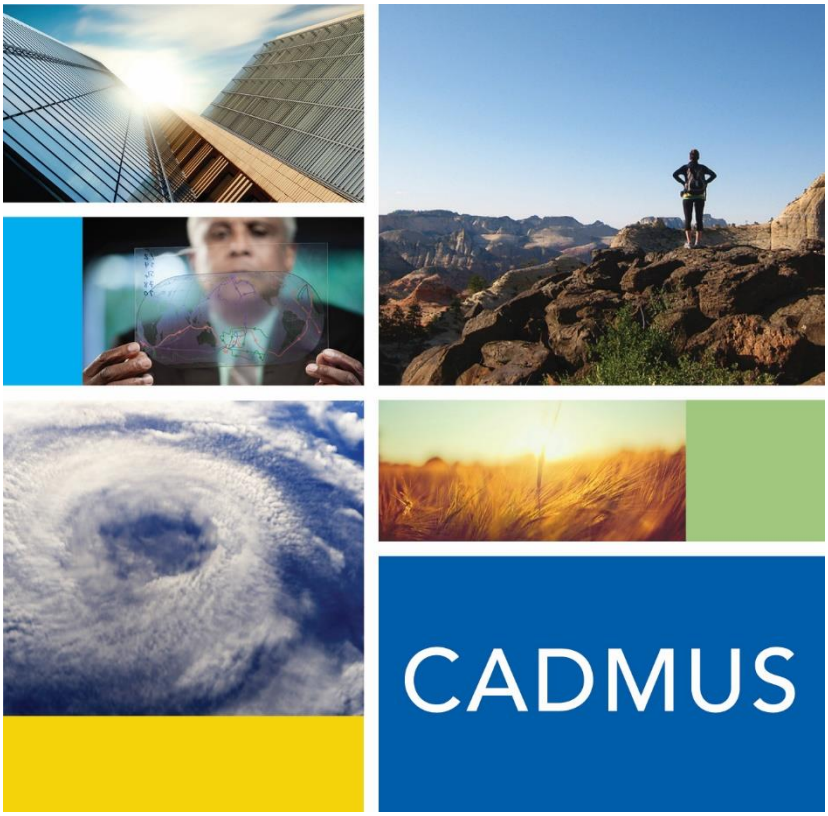
This document contains Cadmus' Resource Conservation Manager Program Evaluation Final Report. In accordance with WUTC conditions, all PSE energy efficiency programs are evaluated by an independent, third party evaluator.[1] Evaluations are planned, conducted and reported in a transparent manner, affording opportunities for Commission and stakeholder review through the Conservation Resource Advisory Group (CRAG) and reported to the UTC.[2] Evaluations are conducted using best-practice approaches and techniques.[3]

PSE program managers and evaluation staff prepare an ERR upon completion of an evaluation of their program. The ERR addresses and documents pertinent adjustments in program metrics or processes subsequent to the evaluation.

Please note that this is an evaluation of the program as it operated during the 2015-2016 program years.

This and all PSE evaluations are posted to Conduit Northwest. To view an electronic copy and to leave comments, visit https://conduitnw.org/Pages/File.aspx?rid=4525, or search words 'PSE Resource Conservation Manager Program Evaluation Final Report.'

1 (6)(c.) Approved Strategies for Selecting and Evaluating Energy Conservation Savings, Proposed Conditions for 2016-2017 PSE Electric Conservation.
2 PSE 2016-2017 Biennial Plan, Exhibit 8: Evaluation, Measurement & Verification (EM&V) Framework, revised August 6, 2015.
3 Ibid.



Resource Conservation Manager Program Evaluation Final Report

June 4, 2018

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Acronyms and Definitions

Acronym	Definition
AIC	Akaike information criterion
BB	Behavior-based
CDD	Cooling degree day
DOE	U.S. Department of Energy
HDD	Heating degree day
KPI	Key performance indicator
M&V	Measurement and Verification
NOAA	National Oceanic and Atmospheric Administration
O&M	Operations and maintenance
OLS	Ordinary least squares
PPS	Probability proportional to size
PSE	Puget Sound Energy
QA/QC	Quality assurance/quality control
RCM	Resource Conservation Manager
SEM	Strategic Energy Management
SQC	Site Quarterly Checklist
UMP	Uniform Methods Project

Abstract

Puget Sound Energy's (PSE) Resource Conservation Manager (RCM) program seeks energy savings from operations and maintenance (O&M) and behavior-based (BB) measures in commercial buildings. The RCM program provides financial incentives, technical trainings, and other assistance to participating customers. Cadmus evaluated the electricity and natural gas savings from the program in 2015 and 2016 and conducted interviews with 16 RCMs. We estimated incremental annual RCM savings from O&M and BB measures assuming a three-year measure life for the program. Cadmus verified 107% of PSE's reported electricity savings and 92% of its natural gas savings in 2015 and 2016. Cadmus also found that RCM participants saved an average of 1.5% of electricity consumption and 1.2% of gas consumption from O&M and BB measures and 1.2% of electricity consumption and 0.8% of gas consumption from capital projects. In general, participants reported high levels of satisfaction with the program but also identified some opportunities for improving program delivery. The findings show that utilities can engage commercial utility customers in managing energy consumption through implementation of O&M and BB measures.

Executive Summary

Evaluation Background

Through changes in operations and maintenance (O&M) and implementation of behavior-based (BB) measures, commercial utility customers can obtain significant energy savings. Puget Sound Energy's (PSE) Resource Conservation Manager (RCM) program seeks energy savings from O&M and BB measures in primary and secondary schools, colleges and universities, government facilities, hospitals, and non-profit facilities. The RCM program provides financial incentives, technical trainings, and other assistance to support participating customers in implementing efficiency improvements. PSE reported that the RCM program achieved incremental annual savings of 21,975,882 kWh and 1,479,238 therms in the 2015 and 2016 reporting years.

In 2017, PSE contracted with Cadmus to evaluate the RCM program with the following main evaluation objectives:

- Estimate the electricity and natural gas savings from O&M and BB measures in the 2015 and 2016 reporting years
- Identify potential improvements to PSE's approach for measurement and verification (M&V) of savings
- Verify the program's measure life assumptions
- Assess customer satisfaction and experience with the program
- Identify potential improvements to program delivery and customer experience

To initiate the evaluation, Cadmus conducted background interviews with PSE program managers. Cadmus then randomly sampled 47 participant facilities for estimating savings. Using regression analysis of electricity and gas consumption, Cadmus estimated energy savings for individual sampled participant facilities in 2015 and 2016. For each facility, Cadmus identified a baseline year and adjusted the baseline consumption for differences in weather and facility closures between the baseline and reporting periods. We estimated each facility's O&M and BB electricity and natural gas annual savings by subtracting reported savings from capital projects not incentivized by the RCM program from the regression-based facility savings estimate. Cadmus then estimated incremental annual savings under the assumption of a three-year measure life and annual savings relative to the fixed baseline.[1] By comparing the evaluated incremental savings to PSE's initial incremental savings estimate, Cadmus calculated electricity and natural gas savings realization rates, which were used to calculate program annual incremental savings for 2015 and 2016.

[1] Incremental savings are the change in annual savings from the previous year. To illustrate, suppose a facility's annual savings are 100 kWh in 2015 and 150 kWh in 2016, and savings in both years are measured relative to baseline consumption in 2014. Then, under the assumption of a multiyear measure life, the incremental savings for 2015 are 100 kWh and the incremental savings for 2016 are 50 kWh.

In calculating the RCM program savings realization rate, Cadmus adopted a different convention than PSE for addressing negative estimates of incremental savings at RCM facilities.[2] Like PSE, Cadmus estimated each specific project's savings relative to a fixed annual baseline (e.g., energy consumption in a given year) and adjusted consumption for weather. Following guidance from the previous evaluation report and industry standard practice, PSE had reported negative savings estimates as zero savings when it estimated negative savings for a participant facility.[3] In contrast, Cadmus left any negative savings estimates unadjusted. As explained in the body of this report (see *Negative Savings Estimate Facilities* under the *A*ssessment of Reported Savings Calculation Methodologies section), leaving negative savings estimates unadjusted results in more accurate estimates of program savings and realization rate. However, to ensure an "apples-to-apples" comparison of savings, Cadmus reports two estimates of the RCM program savings and realization rates: one using industry standard practice for addressing negative savings estimates and another using Cadmus' recommended approach.

Cadmus developed an analytical framework for estimating RCM program measure life, but did not implement it because data required for the analysis were not available.

For the process evaluation, Cadmus interviewed 16 RCMs of participating customers and attended the RCM annual meeting in Bellevue, Washington to gather information about program implementation and customer experience. Cadmus identified several potential improvements to PSE's M&V approach that PSE can easily implement and that can increase the accuracy of its reported savings.

Conclusions and Recommendations

Cadmus made the following specific conclusions and recommendations for improving the program based on its evaluation:

Conclusion #1: PSE followed industry-standard practice and guidance from the previous evaluation report when it excluded negative RCM savings estimates from the realization rate calculation. Following these guidelines, Cadmus obtained RCM program savings realization rates of 107% for electricity and 92% for natural gas. SBW observed that reporting negative savings estimates as zero savings had the potential to bias the savings estimate upward but that the potential for overestimating savings could be minimized by adopting a fixed annual baseline.[4] When Cadmus adopted the industry

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[2] Both PSE and Cadmus obtained negative estimates of RCM program savings for some facilities, but this does not necessarily imply that the true RCM savings were negative. The RCM savings estimate may be negative because of modeling error (e.g., omitted variables in the regression model) or because the estimate of savings for capital projects incentivized by PSE's energy efficiency programs were overestimated.

[3] *Resource Conservation Manager Program Evaluation.* Report. SBW Consulting, Inc. November 25, 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840.

[4] Resource Conservation Manager Final Report: Submitted to PSE. SBW Consulting. 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840. See p. 71 and p. 141.

standard of not recording negative savings estimates, the realization rate was 107% for electricity and 92% for natural gas in 2015 and 2016.

Conclusion #2: PSE can obtain more accurate estimates of RCM program performance by including negative savings estimates in the savings realization rate calculation. Negative savings estimates may be due to incorrectly specified baseline consumption models, overestimated capital project savings, or a program-driven increase in energy consumption. But while modeling error is more likely responsible than a program-caused increase in consumption, often it is not possible to determine the cause. When a modeling error can be identified but not corrected, researchers should report zero savings for the facility and exclude it from the realization rate calculation. When a modeling error cannot be ruled out, it means that a negative program effect was possible and it is best practice for researchers to report the savings estimate. In addition, the same modeling and estimation limitations that result in savings estimates that are lower than the true savings will also result in positive savings estimates that are higher than the true savings. Omitting negative savings estimates from the calculation of program savings therefore has the potential to bias the estimate of program savings upward. When Cadmus included negative RCM savings estimates in the savings realization rate calculation, the realization rate was 88% for electricity and 48% for natural gas in 2015 and 2016.

> ***For consideration #1: It is best practice for energy management programs to report negative RCM savings estimates unless omitted variables or other modeling issues can be identified.***[5] If there is evidence that either the baseline consumption model is incorrectly specified and cannot be improved or capital project savings are overestimated, Cadmus suggests that PSE report zero savings or declare that the facility is not evaluable. Otherwise, we suggest that PSE report the savings estimate, regardless of the estimate's sign.

Conclusion #3: RCM participants achieved significant incremental energy savings from O&M and BB measures. The evaluation found that in 2015 and 2016, RCM participants saved 1.5% of electricity consumption and 1.2% of gas consumption from O&M and BB measures relative to the previous year under the assumption of a three-year measure life. These measures contributed incremental savings of 8,319 MWh and 264,288 therms at RCM facilities in 2015 and 2016. The savings estimates were statistically significant at the 10% significance level and included savings estimates from facilities with negative savings estimates.

Conclusion #4: Capital projects contributed significant energy savings at RCM facilities. In 2015 and 2016, total incremental energy savings at RCM facilities were 2.7% of electricity consumption and 2.0% of natural gas consumption. Again, the estimates were statistically significant at the 10% significance

[5] *Strategic Energy Management (SEM) Evaluation Report.* Report. SBW Consulting, Inc. & The Cadmus Group. February 2017. https://www.bpa.gov/EE/Utility/research-archive/Documents/Evaluation/170222_BPA_Industrial_SEM_Impact_Evaluation_Report.pdf.

level and included capital project savings from RCM facilities with negative savings estimates. Capital projects accounted for 44% of incremental electricity savings (1.2% of electricity consumption) and 40% of incremental natural gas savings (0.8% of natural gas consumption).

> ***Recommendation #1: PSE should continue to promote energy efficiency capital projects at RCM facilities.*** Although other PSE energy efficiency programs take credit for energy savings from incentivized capital projects in RCM participant facilities, PSE should continue to promote them to RCM program participants. RCMs reported that the program's technical assistance was important in the decision to implement many capital projects.

Conclusion #5: Although some RCM participants did not achieve incremental savings, they still saved relative to adjusted baseline consumption calculated using the fixed baseline year. The evaluation found that in 2015 and 2016, RCM participants saved 4.4% of adjusted baseline electricity consumption and 7.0% of adjusted baseline natural gas consumption. Both estimates were statistically significant at the 10% significance level and included savings from facilities with negative savings estimates. Annual savings differ from incremental annual savings because they ignore the three-year measure life and are calculated relative to adjusted baseline consumption using the fixed baseline year.

Conclusion #6: PSE can improve the accuracy of its savings estimates by making changes to its savings methodology. PSE follows industry standard practices for estimating RCM savings. However, PSE could improve how it calendarizes heating degree days (HDDs) and cooling degree days (CDDs), test the significance of school closure days in school facility models, and optimize its selection of HDD and CDD base temperatures to achieve more accurate estimates of facility savings.

> ***For consideration #2: When using monthly billing data to estimate savings, PSE should consider calendarizing billing-cycle HDDs and CDDs.*** Calendarizing billing-cycle HDDs and CDDs maintains the relationship between energy consumption and weather because both variables are measured over the same period. Currently, PSE calculates monthly HDDs and CDDs by summing degree days for days in each calendar month. PSE may be able to increase the accuracy of its baseline models and savings estimates by calendarizing billing-cycle HDDs and CDDs. At the program level, differences in weather calendarization methods have little impact on savings estimates, because over- or under-estimation of savings for individual facilities appear to cancel out.[6] However, facility level results may be less accurate, as suggested by the lower model adjusted R-

[6] When comparing PSE's and Cadmus' savings estimates (using PSE's convention for negative savings), the realization rate is 107% for electricity and 92% for therms. The differences are partially attributable to differences in weather calendarization.

square statistics using PSE's calendarization method.[7] These findings are discussed further in the *A*ssessment *of Reported Savings Calculation Methodologies* section.

For consideration #3: PSE should consider improving its selection of HDD and CDD base temperatures. Currently, PSE selects base temperatures using its knowledge of facilities and information about thermostat settings from RCMs. Cadmus suggests PSE look for data-driven methods of selecting base temperatures, including the method Cadmus used. This method selects the best CDD and HDD base temperature pairs by testing pairs of CDDs and HDDs using different base temperatures ranging between 45°F and 85°F and selecting the pair that maximizes the model adjusted R^2. Cadmus consistently selected lower base temperatures for both HDD and CDD. On average, we selected CDD base temperatures 8.5 and 4.4 degrees lower than PSE for electric and natural gas models, respectively. For natural gas models, Cadmus selected average HDD base temperatures 6.6 degrees lower than PSE. PSE may consider a different range of acceptable base temperatures based on its knowledge of facilities, but it should consider that true set points may differ from (and tend to be lower than) what RCMs report.[8]

Recommendation #2: PSE should collect and incorporate data on facility closures—schools, in particular—into its baseline models. Cadmus found that the accuracy and predictive ability of its baseline regression models often improved when the number of facility closure days was included as an explanatory variable. PSE is in the process of making this enhancement.

Conclusion #7: Government facilities may have higher savings potential than schools. Cadmus estimated that government facilities saved 8.4% of electricity consumption and 5.8% of natural gas consumption, compared to the previous year. These savings estimates include negative savings estimates. School districts saved only 0.6% of electricity consumption and did not save natural gas compared to the previous year. These results suggest differences in savings potential may exist between government facilities and schools; however, the results are not definitive because Cadmus did not design the sample to estimate or test for differences in customer type savings, and the analysis sample included only eight government facilities.

Recommendation #3: The next evaluation should test more definitively for differences in savings between government facilities and schools. This can be accomplished by

[7] On average, Cadmus increased electric model adjusted R-squares by 0.37 and increased natural gas model adjusted R-squares by 0.064.

[8] A comparison of HDD and CDD base temperatures selected by Cadmus and PSE is provided in the *HDD and CDD Base Temperatures* section of this report.

significantly increasing the number of sampled government buildings and maintaining or increasing the number of sampled schools. PSE should sample enough facilities of each type to detect a hypothesized difference in savings (e.g., 2%) with 80% or 90% likelihood (the statistical power of the test). If significant differences are found, PSE may be able to direct more program marketing resources to increasing the enrollment of government facilities or making changes to RCM program implementation to increase savings in schools.

Conclusion #8: Schools present a challenging environment for implementing O&M and BB measures. Our evaluation found that school districts saved only 0.6% of electricity consumption and did not have significant natural gas savings, relative to the previous year. These savings estimates align with anecdotes from RCMs about the difficulty of implementing O&M and BB measures in schools. Teachers and administrators have unusual autonomy over energy consumption in their offices and classrooms and may override energy efficiency measures. Although schools can pose challenges for implementing O&M and BB measures, they may still be fertile ground for achieving energy savings through capital projects.

Recommendation #4: Assist school RCMs in outreach about energy efficiency to teachers, administrators, and students. At the RCM annual meeting, schools RCMs shared challenges with implementing O&M and BB measures and requested training from PSE about how to engage building occupants in energy efficiency efforts.

Conclusion #9: It is not possible to verify PSE's assumption of a three-year measure life for the RCM program using billing analysis. Cadmus developed an analytical framework for estimating savings persistence and measure life through analysis of customer monthly energy bills. Estimating measure life requires the ability to observe the energy consumption of customer facilities after they stop participating in the RCM program. However, because of high customer satisfaction with the program, approximately 90% of participants renew their participation at the end of their three-year terms. Because of PSE's and Cadmus' shared concern that customers who left the program may not have been representative of the program population, Cadmus did not perform the measure life analysis for customers who left.

Recommendation #5: PSE should continue to use the three-year measure life estimate from the previous evaluation.[9] The three-year estimate is based on a bottom-up analysis of measure life of individual measures adopted by RCM participants. Although an estimate of measure life based on billing analysis would be preferable, the bottom-up analysis is defensible and can serve as a placeholder until a more rigorous

[9] *Resource Conservation Manager Program Evaluation.* Report. SBW Consulting, Inc. November 25, 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840.

billing analysis can be performed. PSE should look for opportunities to estimate measure life based on billing analysis.

Conclusion #10: In general, PSE customers were pleased with the RCM program. Customers reported a high level of satisfaction with the program. Eleven of the 15 RCMs Cadmus interviewed said they were very satisfied or somewhat satisfied with the program. Seventy-nine percent of participants planned to continue participating in the program.

Conclusion #11: PSE's hands-on technical support for RCMs was a key component of participant satisfaction and motivation to continue with the program. Participants reported that the most valuable aspects of the program were technical assistance via training provided or paid for by PSE, access to energy consumption data, and data analysis tools. Many RCMs rated these features of the program more important than financial incentives.

For consideration #4: As PSE rebrands the RCM program, it should highlight the program's hands-on technical assistance and ensure that the program is adequately staffed and resourced to continue this level of support. Energy management programs often involve close working relationships between utility staff and customers to implement energy efficiency projects. PSE should consider adding staff to the program to maintain the current level of support.

Conclusion #12: PSE could increase customer satisfaction and improve the customer experience by changing some administrative aspects of the program delivery. Some RCMs expressed concern about the burden of filling out quarterly reports, frustration with the functionality of MyDataManager, and confusion about how energy savings used in calculating incentive payments are estimated.

For consideration #5: PSE should investigate potential improvements to the program in these areas. PSE has already simplified the reporting requirements, but it may be possible to simplify them further without hindering PSE's ability to collect data for measurement and verification. For example, consider consolidating parameter and performance metrics on a single page. PSE should also consider increasing the frequency of MyDataManager trainings, providing "office hours" for RCMs who are struggling with the software, and using email blasts to highlight the software's features.

Conclusion #13: PSE may be able to increase customer satisfaction through better communication with participants. In expressing dissatisfaction with some aspects of the program, some RCMs demonstrated misunderstanding of some of the program's offerings. PSE has already addressed many of the issues that RCMs raised concerning MyDataManager, incentive payment calculations, and reporting requirements. This suggests that PSE could improve the customer experience by enhancing its communication.

Recommendation #6: PSE should communicate program improvements to RCMs multiple times and through several channels, including program newsletters, annual incentive payment reports, and the RCM Annual Meeting.

Conclusion #14: PSE can enhance the effectiveness of RCMs and increase program savings by sponsoring trainings on behavior change. RCMs said engaging building occupants in BB changes is challenging. Many would like to implement more BB measures, but they lack knowledge and need additional training in this area.

Recommendation #7: PSE should consider sponsoring trainings about implementing BB measures. This training could incorporate content about the psychology of behavior change as well as offer strategies and supporting materials for RCM's to utilize.

Conclusion #15: RCMs need help communicating the value of energy efficiency to their managers. RCMs said that energy efficiency projects compete for financial and human resources in their organizations, and they must convince executives, managers, and boards of energy efficiency's value. RCMs would like more assistance in making the business case for energy efficiency.

Recommendation #8: PSE should develop case studies to highlight the value of energy efficiency and successes of the RCM program. The case studies should demonstrate how the RCM program helped organizations overcome barriers to implementing energy efficiency projects and build a business case for making energy efficiency improvements.

Conclusion #16: PSE may be able to increase the effectiveness of RCMs by developing new training modules. RCMs rated the PSE trainings highly, but some RCMs were unable to attend the trainings. Also, RCMs have different levels of technical understanding, meaning some trainings may not be suitable for everyone.

For consideration #6: PSE should consider developing basic training modules and an online library of trainings. Developing basic training modules would ensure that new RCMs have a basic level of knowledge. Also, PSE should consider building an online library of webinars to deliver training modules for common O&M issues. PSE could conduct a brief survey of RCMs to identify a list of most-pressing training needs.

PUGET SOUND ENERGY

Introduction

Program Description

Changes in operations and maintenance (O&M) and occupant behaviors constitute a significant and often overlooked potential source of energy savings for large commercial utility customers. Puget Sound Energy (PSE) encourages its large commercial customers to implement these forms of energy efficiency through its Resource Conservation Manager (RCM) Program, one of the largest and longest-running energy management programs in North America.

The RCM program provides financial incentives, technical trainings, and energy consumption analysis software to participating medium and large commercial customers and a small number of industrial customers. To be eligible, participating customers must receive electric or gas service from PSE and enroll facilities that collectively consume more than 1,000 MWh or 135,000 therms annually. Customers may enroll multiple facilities. Table 1 shows the count of facilities and customers enrolled in the RCM program during the 2015-2016 reporting years and their reported electricity and natural gas savings. Thirty-seven customers and 861 facilities were enrolled in the program during this time.[10] PSE estimated that these customers saved 9,439 MWh and 552,632 therms during the 2015-2016 reporting years. Government customers and school district customers constituted the largest percentage of customers, facilities, and program savings, but the program also enrolled health care facilities, non-profit organizations, and higher education customers. When customers enroll, they make a three-year commitment to the program.

Table 1. Population Reported Electricity and Natural Gas Savings

Customer Type	Facilities	Customers	Population Reported Electricity Savings[(1)] (kWh)	Population Reported Natural Gas Savings[(2)] (therms)
Government	170	9	5,053,716	232,873
Higher Education	67	3	1,224,260	97,930
Hospital	22	2	267,444	-7,233
Non-Profit	35	1	211,623	0
School District	567	22	2,682,150	229,061
Program Total	**861**	**37**	**9,439,194**	**552,632**

[(1)] Incremental annual electricity savings assuming a three-year measure life.
[(2)] Incremental annual electricity savings assuming a three-year measure life.

Participants are eligible to receive several types of incentive payments. S*tart-up incentives* fund the development of a resource management plan and facility action plan. Incentives are paid upon completion of these first-year tasks. Participants must also hire, contract with, or designate an existing

[10] PSE had not completed its savings analysis for all 2016 participating facilities; therefore, counts reflect only those facilities with completed reported savings.

employee as a resource conservation manager. The RCM is responsible for implementing energy savings projects and fulfilling the program's planning and reporting requirements.

In 2014, PSE transitioned the RCM program to a pay-for-performance model that rewards customers for achieving energy savings. In addition to the start-up grant, PSE provides *performance incentives* to participants that complete all program deliverables. The incentive payments are provided on a per unit basis for electricity or natural gas savings, with the marginal payment per unit of savings depending on the level of verified annual savings. PSE also provides a *target incentive*, which is paid to customers that achieve combined gas and electricity savings of three percent or more from either capital projects or O&M and behavior-based (BB) measures.

PSE provides participants with a training allowance up to $2,000 per year, pro-rated based on the customer's program portfolio size, to cover the costs of energy management trainings. The training allowance encourages participants to stay informed of new developments in energy management.

PSE also provides nonfinancial support. It sponsors in-person energy management trainings and workshops, which create more opportunities for RCMs to learn from experts and share ideas about energy management. Finally, PSE provides participants with *MyDataManager*, proprietary software to track and analyze facility energy consumption.

After finishing their three-year commitments, most customers re-enroll in the program. In 2015–2016, more than 90% of customers that completed the program re-enrolled for another three years.

PSE is in the process of rebranding the RCM program as strategic energy management (SEM). By rebranding, PSE will align the RCM program with industry standard branding and be able to capitalize on the utility industry's acceptance and promotion of energy management.

Measurement and Verification of RCM Program Savings

Each year, PSE conducts measurement and verification of savings for all participating facilities. Using monthly billing or daily interval consumption data, PSE calculates individual customer baselines to estimate annual electricity and gas savings. These savings estimates serve as the basis for calculating the performance and target incentive payments for customers.

To calculate electricity or gas savings for a participant facility, PSE first selects a baseline year and then adjusts the baseline consumption for differences in weather and facility closures between the baseline and reporting years.[11] For example, PSE may calculate a facility's adjusted baseline consumption for 2015 and 2016 based on a regression analysis of consumption and weather data for 2013. Using a fixed annual baseline and assuming a measure life of three years, PSE calculates a facility's annual savings as the difference between the adjusted baseline consumption and metered consumption. Incremental

[11] For 41% of sampled facilities and years, PSE used baseline-year annual consumption to estimate adjusted baseline consumption. PSE adopted this approach when none of the candidate explanatory variables such as HDD or CDD had statistically significant effects on consumption in the baseline year.

annual savings are the change in annual savings from the previous year, assuming a three-year measure life for the program.

To illustrate PSE's calculation of savings and the impact of the fixed annual baseline and the multiyear measure life on savings, consider the following example in Table 2. Assume a facility started participating in 2014 and, for simplicity, did not implement any capital projects. Relative to adjusted baseline consumption in 2013, the facility saved 50,000 kWh in 2014, 50,000 kWh in 2015, and 75,000 kWh in 2016. The incremental annual savings are of 50,000 kWh in 2014, zero kWh in 2015, and 25,000 kWh in 2016. Under the assumption of a three-year measure life, 100% of the 2014 savings persist through 2016. PSE would report these incremental annual savings values.

However, now consider what happens in 2017. In this year, none of the 2014 savings are assumed to persist. We provide two scenarios: one in which the facility saves 100,000 kWh in 2017 relative to the 2013 adjusted baseline (Scenario 1), and one in which the facility saves zero kWh in 2017 relative to the 2013 adjusted baseline (Scenario 2). In Scenario 1, the incremental annual savings in 2017 are 75,000 kWh year because the incremental savings were zero kWh in 2015 and 25,000 kWh in 2016. PSE would report savings of 75,000 kWh for 2017. In contrast, in Scenario 2, the incremental savings in 2017 are -25,000 kWh, but PSE reports zero savings for this year since its policy is to report zero kWh savings for negative savings estimates (following industry standard practice and guidance from the previous evaluation).[12]

Table 2. Illustration of Impacts of Fixed Annual Baseline and Measure Life on Savings Calculation

	2013 (baseline year)	2014	2015	2016	2017 (Scenario 1)	2017 (Scenario 2)
Annual savings (kWh) relative to 2013 baseline	0	50,000	50,000	75,000	100,000	0
Incremental annual savings (kWh)	0	50,000	0	25,000	75,000	-25,000
PSE reported incremental annual savings (kWh)	0	50,000	0	25,000	75,000	0

If the facility implemented capital projects during the reporting period and PSE verified the savings from the projects, PSE would subtract the capital project savings from the annual savings to isolate the annual savings from O&M and BB measures. Then PSE would calculate the RCM incremental annual savings under a three-year measure life.

[12] *Resource Conservation Manager Program Evaluation.* Report. SBW Consulting, Inc. November 25, 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840

PSE reports and pays incentives for positive incremental savings under the assumption of a three-year measure life. For example, in Table 2, PSE would recognize and pay incentives for the 50,000 kWh of savings in 2014 measured relative to the 2013 baseline but not for the 50,000 kWh of savings in 2015, because in 2015 the facility achieved zero (incremental) savings. However, in Scenario 1 for 2017, PSE would pay incentives for 75,000 kWh of incremental savings in 2017, because the 2014 savings would have "expired" under the assumption of a three-year measure life. Thus, PSE rewards participants for achieving and maintaining savings for longer than three years.

Previous RCM Program Evaluation

The RCM program was last evaluated in 2013.[13] The evaluation verified 85% of the RCM-reported electricity savings and 70% of natural gas savings using a mix of top-down and bottom-up savings estimation approaches. The savings estimates from the top-down and bottom-up approaches did not always agree, however. The evaluators concluded, "Program documentation did not provide enough detail to support the analysis-heavy bottom-up approach." Moreover, because the evaluation estimated savings for only 17 participating facilities, there was significant uncertainty about the evaluated savings, with 90% confidence intervals around savings realization rates of [0.51, 1.19] and [0.39, 1.01] for electricity and natural gas respectively. Based on analysis of the mix of O&M and BB measures that RCMs adopted, the evaluation found that PSE's assumption of a three-year measure life was justified, though it was "likely too short." In interviews, RCMs reported high satisfaction with the program, with more than 80% saying they were satisfied overall. RCMs recommended that PSE move the program to a pay-for-performance standard, which PSE did, and that it improve the Utility Manager software tool used for tracking savings. Cadmus reviewed all conclusions and recommendations from the previous evaluation and identified whether PSE had addressed recommendations. The review can be found in *Appendix C. PSE's Implementation of Previous Evaluation Recommendations*.

Evaluation Objectives

The conclusions and recommendations from the previous evaluation and PSE's current research agenda helped shape this evaluation's priorities. PSE indicated its primary objectives were to validate the reported energy savings in 2015 and 2016, to assess the program's current measure life assumption, and to identify improvements to the RCM program delivery and customer experience.

In consideration of these objectives, PSE and the evaluation team established the following key research objectives:

- Obtain accurate and precise gross electricity and natural gas savings estimates.
- Calculate electricity and natural gas savings realization rates for PSE's reported savings.
- Verify PSE's current measure life assumption and recommend a new assumption if appropriate.

[13] *Resource Conservation Manager Program Evaluation.* Report. SBW Consulting, Inc. November 25, 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840

- Explore and identify risks to persistence of savings and contributors to degradation of savings over time.
- Evaluate PSE's reported savings calculation methodology and recommend improvements.
- Identify opportunities for improving program delivery and customer experience.

Evaluation Overview

Table 3 summarizes the RCM program activities, including their outputs and relevance to research objective.

Table 3. Evaluation Activity Summary

Activity	Description	Outputs	Relevance to Study Research Objectives
Sample design	Designed and implemented sampling strategy to obtain accurate estimate of program and customer type savings	Analysis sample of participant facilities for savings estimation and RCM interviews	1, 2, 3, 6
Facility savings estimation	Developed individual facility baseline regression models and estimated electric and gas savings for 2015 and 2016	Incremental annual and annual electric and gas savings estimates for individual facilities in the analysis sample	1, 2, 3, 5, 6
Program savings estimation	Estimated savings realization rates for the program and facility type by comparing evaluated and reported facility savings	Savings realization rates and annual savings estimates for 2015 and 2016	1, 2, 6
Review of PSE savings estimation methodology	Assessed expected accuracy of methodology used by PSE to estimate savings	Findings regarding expected accuracy and recommendations for improvement	4, 5
Evaluation of RCM measure life assumption	Developed conceptual framework for estimating measure life and proposed plan for estimating measure life through analysis of participant energy consumption billing data. Cadmus did not implement framework and estimate measure life by agreement with PSE.	Framework for estimating measure life of SEM programs that could be implemented in future if required data become available	3, 4

Activity	Description	Outputs	Relevance to Study Research Objectives
Interviews with RCMs	Performed interviews with 16 RCMs to assess participant experience	Findings regarding customer satisfaction, motivations for participation, and program implementation success and challenges	4, 6
Attendance at the RCM Annual Meeting	Facilitated small-group discussions about various aspects of the RCM program experience at the RCM Annual Meeting on February 1, 2018.	Findings regarding RCM training needs, occupant behaviors, capital project financing, RCM reporting requirements, recognition of achievement in energy efficiency, and energy management performance indicators	6

In the following sections, Cadmus briefly describes the evaluation tasks. More detailed descriptions of the tasks are included in this report's appendices.

Sample Design

Approximately 40 customers and more than 1,000 facilities receiving electricity or gas service participated in PSE's RCM program in the 2015 or 2016 reporting years.[14] Because the evaluation budget would not permit Cadmus to verify savings for the population of facilities, it sampled participating facilities to verify electricity and natural gas savings and to estimate program savings realization rates. Cadmus implemented a sampling plan designed to meet the following goals:

- Satisfy the regulatory requirement of estimating electricity and natural gas savings from the RCM program with 90% confidence and ±10% precision.
- Achieve a representative sample of program savings.
- Verify as much of the program savings as possible.

Cadmus stratified the population of facilities by customer type and type of service (electricity and/or gas) to meet these goals. To verify as many of PSE's estimated (PSE-estimated[15]) RCM program savings as possible through sampling, Cadmus selected facilities with probability proportional to size (PPS)

[14] PSE's program year ran from the beginning of September through August of the following year for most facilities. For example, the 2015 program ran from September 2014 to August 2015. The 2016 program year was defined analogously.

[15] PSE reports zero savings when it estimates negative savings. Cadmus wants to distinguish between "PSE-estimated" (or simply "estimated") savings and "reported savings", where negative savings are reported as zero.

sampling, by which each facility's estimated savings determined its size. Facilities could have been selected for inclusion in the sample based on either their electricity or natural gas savings; however, once Cadmus sampled a facility, it verified savings for both fuel types for facilities receiving electricity and gas service from PSE. Although Cadmus evaluated savings for PSE's 2015 and 2016 reporting years, it did not set year-specific quotas when sampling. More details about the sample design are provided in *Appendix A. Impact Methodology and Detailed Findings*.

Cadmus sampled 47 facilities from 25 unique customers to verify savings, which amounted to 17% of PSE's estimated electricity savings and 9% of estimated natural gas savings. Table 4 shows the number of sampled facilities by customer type and fuel.

Table 4. Sampled Facilities by Customer Type

Customer Type	Electric Facilities	Gas Facilities	Total Facilities[(1)]
Government	4	8	8
Higher Education	4	1	4
Hospital	2	2	2
Non-profit	2	N/A	2
School District	29	21	31
Program Total	**41**	**32**	**47**

[(1)] Count of unique facilities included in the final sample, and therefore not equal to the sum of electric and gas facilities in this table.

Because school districts represented the largest share of RCM program facilities and savings, they dominated the evaluation sample. Cadmus estimated savings by customer type, but the samples sizes are small for all customer types except schools, so savings estimates for individual customer types should be interpreted cautiously.

Savings Estimation

Cadmus estimated savings for each sampled facility and for the program overall, details for which follow. In calculating RCM program savings, Cadmus and PSE adopted different conventions for addressing negative estimates of savings at RCM facilities. Negative savings estimates can occur for several reasons, including modeling errors or, less likely, program-induced increases in consumption.[16] Following guidance from the previous evaluation report,[17] PSE reported negative savings estimates as zero savings when it estimated negative incremental annual savings for a participant facility. As explained at greater length below, Cadmus maintains that including negative savings estimates in the

[16] Both PSE and Cadmus obtained negative estimates of RCM program savings for some facilities, but this does not necessarily imply that the true RCM savings were negative. The RCM savings estimate may be negative because of modeling error (e.g., omitted variables in the regression model) or because the estimate of savings for capital projects incentivized by PSE's energy efficiency programs were overestimated.

[17] *Resource Conservation Manager Program Evaluation.* Report. SBW Consulting, Inc. November 25, 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840

calculation of program savings and realization rate results in a more accurate assessment of program performance (discussed further in the *A*ssessment *of Reported Savings Calculation Methodologies* section). To illustrate the impacts of the differing methodologies, Cadmus reports two estimates of the RCM program savings and realization rates, one using PSE's convention for negative savings estimates and another using the convention that Cadmus recommends.

Facility-Level Savings Estimation

Cadmus collected PSE's program tracking savings data for the population of program participants. These data included definitions of each facility's baseline and reporting periods, annual adjusted baseline consumption, annual consumption, annual RCM savings estimates, and annual capital project savings. PSE provided monthly billing data for the population of RCM participants and annual reports in PDF file format for facilities in the final analysis sample.

To estimate savings for each sampled facility, Cadmus developed separate regression models of facility consumption using data from the facility's baseline period. Separate electric and gas models were developed for facilities that received dual-fuel service from PSE. The baseline models, which captured "business-as-usual" energy consumption, were built by selecting the combination of heating degree days (HDDs), cooling degree days (CDDs), and facility closures that optimized the adjusted R-squared and Akaike information criterion (AIC).

Cadmus estimated a facility's annual RCM savings by predicting baseline consumption in the reporting year (referred to as the adjusted baseline consumption), and taking the difference between adjusted baseline and metered consumption. The adjusted baseline consumption is a prediction of what the facility's consumption would have been during the RCM reporting period if the facility had not participated. The difference between the baseline and metered consumption includes savings from both O&M and BB measures and implementation of capital projects.

To isolate program savings from O&M and BB measures, Cadmus deducted savings from currently or previously reported capital projects receiving incentives through other PSE programs. This yielded an estimate of the facility's annual RCM savings. Cadmus obtained an estimate of the incremental annual RCM savings under a three-year measure life by subtracting RCM incremental annual savings reported for the previous two years from the annual savings estimate.

Program-Level Savings Estimation and Realization Rates

After estimating incremental annual savings for all sampled facilities, Cadmus calculated weighted realization rates for each stratum to estimate program incremental savings. Additional details on the weights and the methods Cadmus used to estimate program savings are in *Appendix A. Impact Methodology and Detailed Findings*.

Cadmus estimated negative incremental annual RCM savings for some facilities. Cadmus calculated two savings realization rates: one that includes negative savings estimates and another that excludes them.

Review of PSE Savings Estimation Methodology

Cadmus investigated whether PSE's savings estimation methodology followed industry best practices by reviewing PSE's program tracking data, project documentation, data collection and preparation, regression model development, and savings calculations. Cadmus identified differences between the evaluation and PSE's methodology that may have contributed to differences between PSE's reported savings and the evaluated savings.

RCM Savings Persistence and Measure Life

The previous evaluation recommended a measure life of three years for RCM program savings.[18] This recommendation was based on a bottom-up analysis of the measure life of individual capital and O&M measures implemented by RCM program facilities. For this evaluation, PSE asked Cadmus to estimate measure life based on analysis of utility customer monthly consumption and persistence of savings. PSE was concerned that the previous evaluation had overlooked that through adoption of new measures RCM savings could persist even if individual measures did not.

Cadmus developed a savings persistence-based methodology for calculating measure life and presented the methodology to PSE in a memo, which is included in *Appendix E. Savings Persistence and Measure Life Memo*. However, Cadmus and PSE determined that the required data were not available to perform the analysis. To estimate savings persistence, it is necessary to observe RCM participant facilities during and after participation. Only by studying savings after a facility concludes its participation is it possible to distinguish between savings from previous and current activities and to discern savings persistence. However, there were only a small number of former RCM program participants because most participants (approximately 90%) renew their contracts after three years. Cadmus investigated the approach of estimating savings persistence by analyzing the savings of previous program participants, that is, those customers that recently quit the program. Although this approach was expected to yield a valid estimate of savings persistence and measure life for recent previous participants, Cadmus and PSE were concerned that the estimate would not be valid for existing participants and chose not to move forward with the analysis. As a result, Cadmus did not conduct a savings persistence analysis or verify the three-year measure life assumption.

Through interviews with RCMs (described below) and participation in the RCM Annual Meeting, Cadmus identified threats to savings persistence for current participants. These threats concern (among other factors) the customer and facility type, whether savings require the participation or cooperation of building occupants, and organizational commitment to energy efficiency. By identifying factors that threaten savings persistence, PSE may be able to direct program resources to activities that would preserve or increase savings.

[18] *Resource Conservation Manager Program Evaluation.* Report. SBW Consulting, Inc. November 25, 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840

RCM Interviews

Cadmus performed in-depth interviews with 16 RCMs in November 2017. The interviews had the following research objectives:

- To understand participants' motivations for participating in the RCM program
- To understand participants' perceived successes and challenges with RCM program implementation
- To understand customer satisfaction and experiences with recent changes to the program delivery
- To solicit ideas for improvement to the program delivery and customer experience

For interviews, Cadmus sampled RCMs of facilities that had been randomly selected for the impact evaluation. By sampling from the impact analysis sample, Cadmus expected to complement the impact estimates with insights from the RCM interviews.

Cadmus achieved a representative sample of RCMs by randomly sampling customers in the impact analysis sample. As shown in Table 5, most interviewed participants worked in school districts, the largest customer type in the program. Also, 14 of the 16 RCMs worked onsite and were employed by their organizations; two were outside consultants. The RCMs working as outside consultants did not feel comfortable answering some satisfaction questions on behalf of their clients. Therefore, in some cases, the interview results total 14 respondents rather than 16.

Table 5. Please tell me your role as the Resource Conservation Managers?

Customer type	Number of Interviews	RCM is a Facility Employee	RCM is an Outside Consultant
School District	9	8	1
Government	4	4	0
Hospital	1	1	0
Nonprofit	1	0	1
Higher Education	1	1	0
Program Total	**16**	**14**	**2**

Source: Puget Sound Energy Resource Conservation Manager Program (2014–2016) Participant Interview Guide (QB1).

Cadmus also attended PSE's RCM Annual Meeting in Bellevue, Washington.[19] During this meeting, RCMs, who attended the meeting voluntarily, participated in seven breakout sessions—facilitated by PSE or Cadmus—covering the following topics:

- RCM training needs
- Gaining management buy-in for RCM projects
- Building occupants
- Financing energy efficiency capital projects
- PSE RCM program reporting requirements
- Recognition of energy efficiency work (from PSE or nationally)
- Performance indicators

Highlights of the RCM interviews and breakout sessions are reported later in the *Resource Conservation Manager Experience section*. A complete report of the interviews is provided in *Appendix B. RCM Participant Findings Memo*, and a summary of the annual meeting breakout sessions is provided in *Appendix D. Annual Meeting Summary Memo*.

[19] Seven (of 17) RCM organizations attending the annual meeting also participated in the RCM program evaluation surveys.

Evaluation Findings

This section presents the main evaluation findings. Details about sample design and savings estimation can be found in *Appendix A. Impact Methodology and Detailed Findings* while details about the customer experience may be found in *Appendix B. RCM Participant Findings Memo*.

Savings Estimates

In this section, we report estimates of RCM program savings by fuel and customer type.[20] We present estimates of incremental annual savings under the assumption of a three-year measure life and annual savings calculated relative to consumption in the fixed annual baseline year.[21] By comparing the evaluation and reported incremental annual savings, Cadmus calculated electricity and natural gas savings realization rates, which were used to calculate program annual savings for 2015 and 2016.

We calculated gas and electric savings realization rates following guidance in the previous RCM evaluation report to exclude facilities with negative RCM savings estimates.[22] However, Cadmus maintains that PSE can more accurately assess program performance by including these facilities in the savings realization rate calculation. For comparison, we also report savings realization rates that include facilities with negative savings estimates.

A discussion of how negative savings estimates may occur—and the implications for the realization rates of including or not including them—is provided in the *Negative Savings Estimate Facilities* section within *A*ssessment of Reported Savings Calculation Methodologies.

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[20] Cadmus stratified the sample by noting whether a facility reported net positive or negative savings across reporting years. PSE did not investigate facilities with negative reported savings to the same degree as those with positive reported savings. This resulted in less information about facilities with negative savings estimates, which possibly increased the variability of the savings estimates for these facilities.

[21] Incremental savings are the change in annual savings from the previous year. To illustrate, suppose a facility's annual savings are 100 kWh in 2015 and 150 kWh in 2016, and savings in both years are measured relative to baseline consumption in 2014. Then, under the assumption of a multiyear measure life, the incremental savings for 2014 are 100 kWh and the incremental savings for 2015 are 50 kWh.

[22] *Resource Conservation Manager Program Evaluation.* Report. SBW Consulting, Inc. November 25, 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840.

Evaluated RCM Savings and Realization Rates

The savings realization rates were 107% for electricity and 92% for natural gas when Cadmus excluded negative savings estimates. Following guidance in the previous evaluation report[23] and industry standard practice, Cadmus first estimated the program savings realization rates with negative savings estimates excluded. Table 6 and Table 7 provide these results for electricity and natural gas savings. Cadmus estimated that in 2015 and 2016 PSE saved approximately 23.5 million kWh and 1.4 million therms. The savings realization rates for government and school districts, the two sectors with the largest number of participants and reported savings, were, respectively, 93% and 117% for electricity and 83% and 94% for natural gas. Overall, Cadmus evaluated a realization rate of 107% for electricity savings and 92% for natural gas savings when excluding negative savings estimates.

Table 6. Incremental RCM Electricity Savings Excluding Negative Savings Estimates for 2015-2016

Customer Type	Count of Facilities	Realization Rate	PSE-Estimated Population Savings (kWh)	Evaluated Population Savings (kWh)	Relative Precision
Government	4	93%	6,498,294	6,072,831	30%
Higher Education	4	96%	2,313,236	2,216,837	16%
Hospital	2	117%	849,646	998,222	62%
Non-Profit	2	62%	343,790	213,807	63%
School District	29	117%	11,970,916	14,025,699	39%
Program Total	**41**	**107%**	**21,975,882**	**23,527,396**	**25%**

Table 7. Incremental RCM Natural Gas Savings Excluding Negative Savings Estimates for 2015-2016

Customer Type	Count of Facilities	Realization Rate	PSE-Population Estimated Savings (therms)	Population Evaluated Savings (therms)	Relative Precision [(1)]
Government	8	83%	349,587	291,525	31%
Higher Education	1	100%	119,665	119,917	N/A
Hospital	2	92%	20,879	19,161	68%
School District	21	94%	989,107	929,992	17%
Program Total	**32**	**92%**	**1,479,238**	**1,360,594**	**13%**

[(1)] Note that Cadmus cannot calculate relative precision when verifying savings for fewer than two facilities in a stratum. However, variance from these strata is still included in total relative precision.

[23] *Resource Conservation Manager Program Evaluation.* Report. SBW Consulting, Inc. November 25, 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840.

Evaluated RCM Savings Realization Rates Including Negative RCM Savings Estimates

Cadmus also estimated the program savings and savings realization rate including negative RCM savings estimates. As explained further below, including negative savings estimates in the calculation of the savings realization rate will result in a more accurate estimate of program savings.

Electricity Savings Realization Rates and Savings

When negative savings estimates are included, the RCM program saved 8,319 MWh in 2015 and 2016, yielding an electricity savings realization rate of 88%. Table 8 presents electricity savings realization rates and evaluation estimates of incremental kWh savings for the program. For the 2015 and 2016 program years, Cadmus evaluated an electricity savings realization rate of 88% and incremental annual savings of 8,319,549 kWh. While the evaluated savings were smaller, the difference was not statistically significant, because the 90% confidence interval for the evaluated savings includes PSE's estimate.

Government facilities, which accounted for 54% of PSE's estimated electricity savings, had a savings realization rate of 92% and were the most important determinant of the program savings realization rate. Schools, which were responsible for the next largest percentage (28%) of PSE's estimated savings, had a realization rate of 66%. The relative precision of the savings estimates varied. The low precision for school districts was the result of sampling uncertainty; realization rates between school facilities varied drastically, resulting in an imprecisely estimated realization rate.

Table 8. Incremental RCM Electricity Savings Including Negative Savings Estimates for 2015-2016

Customer Type	Count of Sampled Facilities	Realization Rate	PSE-Estimated Population Savings (kWh)	Evaluated Population Savings (kWh)	Relative Precision [1]
Government	4	92%	5,053,716	4,630,005	18%
Higher Education	4	122%	1,224,260	1,490,655	10%
Hospital	2	164%	267,444	439,710	1%
Non-Profit	2	-10%	211,623	-21,453	5%
School District	29	66%	2,682,150	1,780,633	94% [2]
Program Total	**41**	**88%**	**9,439,194**	**8,319,549**	**23%**

[1] Note that Cadmus cannot calculate relative precision when verifying savings for fewer than two facilities in a stratum. However, variance from these strata is still included in total relative precision.

[2] The low precision for school district resulted from the large amount of variability in realization rates between school facilities.

Table 9 presents the evaluated incremental electricity savings by reporting year. Since Cadmus only estimated an average realization rate for 2015 and 2016, the realization rates are assumed to be the same in both years. Differences in program total realization rates by year are due to differences in how reported savings were distributed across customer types between years. Because PSE had not completed estimating 2016 savings for many facilities when Cadmus began the evaluation, the savings verified in this evaluation do not represent all 2016 program savings.

Table 9. Incremental Electric Savings Including Negative Savings Estimates by Reporting Year

Year	Customer Type	Count of Facilities	Realization Rate	PSE-Estimated Population Savings (kWh)	Evaluated Population Savings (kWh)
2015 Reporting Year	Government	4	92%	3,946,829	3,615,921
	Higher Education	4	122%	1,076,945	1,311,285
	Hospital	2	164%	392,491	645,301
	Non-Profit	2	-10%	211,623	-21,453
	School District	28	66%	1,697,161	1,126,716
	Program Total	**40**	**91%**	**7,325,049**	**6,677,769**
2016 Reporting Year	Government	2	92%	1,106,887	1,014,084
	Higher Education	3	122%	147,315	179,371
	Hospital	1	164%	-125,047	-205,592
	School District	22	66%	984,989	653,917
	Program Total	**28**	**78%**	**2,114,144**	**1,641,780**

The distribution of savings was similar across years. In both 2015 and 2016, government facilities contributed more than 50% of population savings. School districts, though still the second largest contributor of savings in both years, nearly doubled its contribution from 2015 to 2016 (from 23% of savings in 2015 to 47% in 2016), which heavily contributed to the lower program total realization rate in 2016. Again, Cadmus did not receive PSE's savings estimates for all facilities in 2016, so the true distribution of savings in 2016 may be more similar to that in 2015.

Natural Gas Savings Realization Rates and Savings

When negative savings estimates are included, the RCM program saved 264,288 therms in 2015 and 2016, yielding a gas savings realization rate of 48%. Table 10 provides the natural gas savings realization rates and evaluated incremental natural gas savings for the program. Cadmus evaluated a natural gas realization rate of 48% and incremental natural gas savings of 264,288 therms. The evaluated and PSE-estimated program savings estimates are statistically different, because the 90% confidence interval for the evaluated savings does not include PSE's estimate of savings.

School districts contributed 42% of the reported savings, but only 2% of the savings were verified, resulting in a 48% realization rate for the program. The realization rate for school districts is low because Cadmus evaluated smaller savings from net-positive stratum facilities and higher savings for net-negative stratum facilities. (See *Appendix A. Impact Methodology and Detailed Findings* for details on net-positive and net-negative results.) The relative precision around school district savings is low because, like the electricity savings, the variability between facility realization rates was large while the realization rate was low. Although the variance of savings was large for schools, Cadmus still estimated statistically significant program total savings.

Table 10. Incremental RCM Natural Gas Savings Including Negative Savings Estimates for 2015-2016

Customer Type	Count of Facilities	Realization Rate	PSE-Estimated Population Savings (therms)	Population Evaluated Savings (therms)	Relative Precision [1]
Government	8	73%	232,873	171,048	20%
Higher Education	1	100%	97,930	98,137	N/A
Hospital	2	127%	-7,233	-9,172	8%
School District	21	2%	229,061	4,275	2004% [2]
Program Total	**32**	**48%**	**552,632**	**264,288**	**35%**

[1] Note that Cadmus cannot calculate relative precision when it verified savings for fewer than two facilities in a stratum. However, variance from these strata is still included in total relative precision.

[2] The relative precision around school districts is large because the variability between facility realization rates was large and overall realization rate was low. While the precision is large, note the reasonableness of error bars in Figure 3.

Table 11 presents the evaluated incremental natural gas savings by year. As previously mentioned, the 2016 evaluated savings estimates are significantly lower than the estimates for 2015. This is primarily because PSE had not completed its 2016 savings estimation when the evaluation began.

Table 11. Incremental RCM Natural Gas Savings Including Negative Savings Estimates by Year

Year	Customer Type	Count of Facilities	Realization Rate	PSE-Estimated Population Savings (therms)	Population Evaluated Savings (therms)
2015 Reporting Year	Government	8	73%	163,071	119,778
	Higher Education	1	100%	89,593	89,782
	Hospital	2	127%	-3,458	-4,384
	School District	20	2%	237,983	4,442
	Program Total	**31**	**43%**	**487,190**	**209,617**
2016 Reporting Year	Government	5	73%	69,802	51,270
	Higher Education	0	100%	8,337	8,355
	Hospital	1	127%	-3,776	-4,787
	School District	20	2%	-8,922	-167
	Program Total	**26**	**84%**	**65,442**	**54,671**

The distributions of PSE estimated savings across customer types are not similar in 2015 and 2016 because of school districts. In 2015, PSE estimated school districts contributed 49% to program total savings. However, in 2016 PSE estimated that school districts achieved net negative incremental savings (prior to adjusting negative facility estimates to zero). Government facilities, like incremental electricity savings, contributed heavily to both 2015 and 2016 PSE-estimated population incremental savings.

Program Percentage Savings

Cadmus estimated RCM program savings as a percentage of consumption in two ways. First, we estimated the percentage incremental annual savings. These estimates assume a three-year measure

life and measure the change in RCM savings from the previous year. Second, we estimated the percentage annual RCM savings, measured relative to adjusted baseline consumption (and net of reported incentivized capital project savings) Although PSE only claims incremental annual savings, Cadmus thought it would be useful to present savings estimates from this perspective as well. All estimates of percentage savings reported below include negative RCM savings estimates.

Percentage Electricity Savings

RCM program participants saved 1.5% of electricity consumption relative to savings from the previous year from adoption of O&M and BB measures. Figure 1 shows evaluation and PSE estimates of incremental RCM electric savings as a percentage of adjusted baseline consumption. Overall, the evaluation estimated incremental program savings of 1.5% of electricity consumption, which was statistically indistinguishable from PSE's estimate. The estimated precision for incremental program savings was ±23% at the 90% confidence level. As shown by the error bars, the confidence interval around incremental program savings did not include zero, indicating that the estimated electricity savings are statistically different from zero. By customer type, the percentage electricity savings ranged between -0.4% (non-profits) and 8.4% (government).

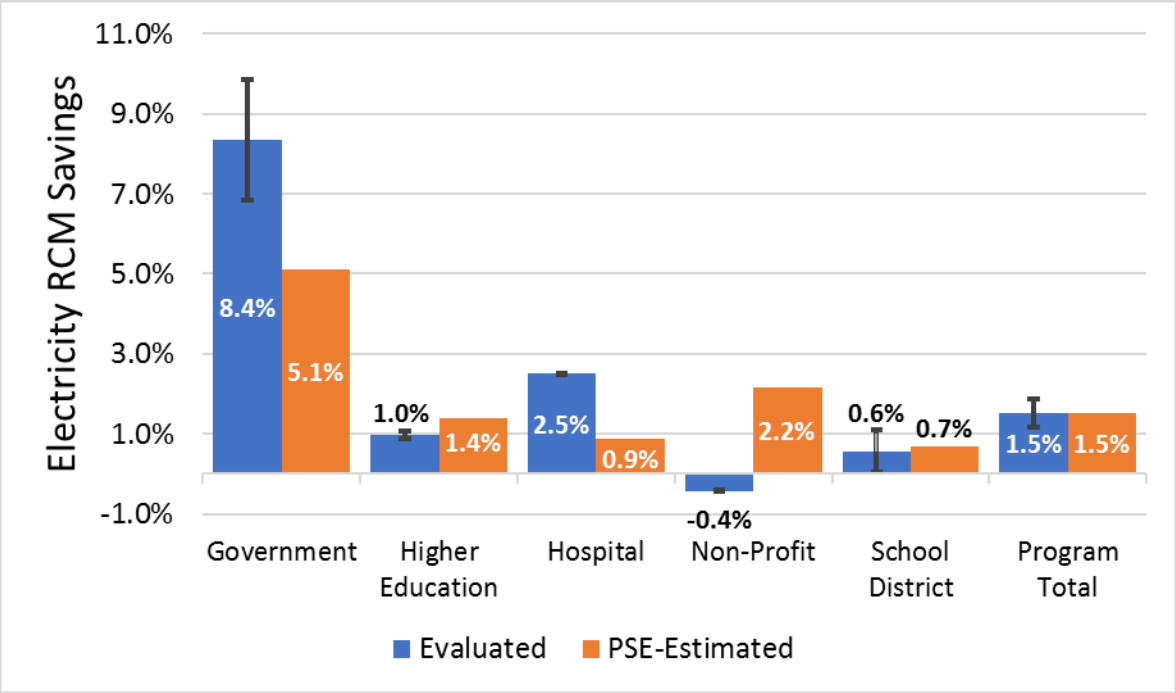

Figure 1. Percentage Incremental RCM Electricity Savings by Customer Type

Note: Evaluated savings (blue) are based on Cadmus' analysis of individual facility consumption for sampled facilities, and they are shown as a percentage of Cadmus' adjusted baseline consumption. Error bars provide the 90% confidence interval around point estimates. Estimated savings (orange) are based on PSE's analysis of individual facility consumption for sampled facilities, and they are shown as a percentage of PSE's adjusted baseline consumption.

The RCM program saved 4.4% of electricity consumption from O&M and BB measures in 2015 and 2016. Figure 2 shows percentage annual RCM electricity savings by customer type. Although incremental savings were small (Figure 1), all customer types still saved relative to the adjusted baseline, and achieved significant savings at the program level. Annual program estimates were within the expected range of savings for commercial energy management programs and are statistically indistinguishable from PSE's estimated program total percentage savings.[24] Percentage annual savings ranged from 16.6% (government facilities) to 2.6% (hospital facilities and school districts). The baseline years ranged from 2010 to 2014.

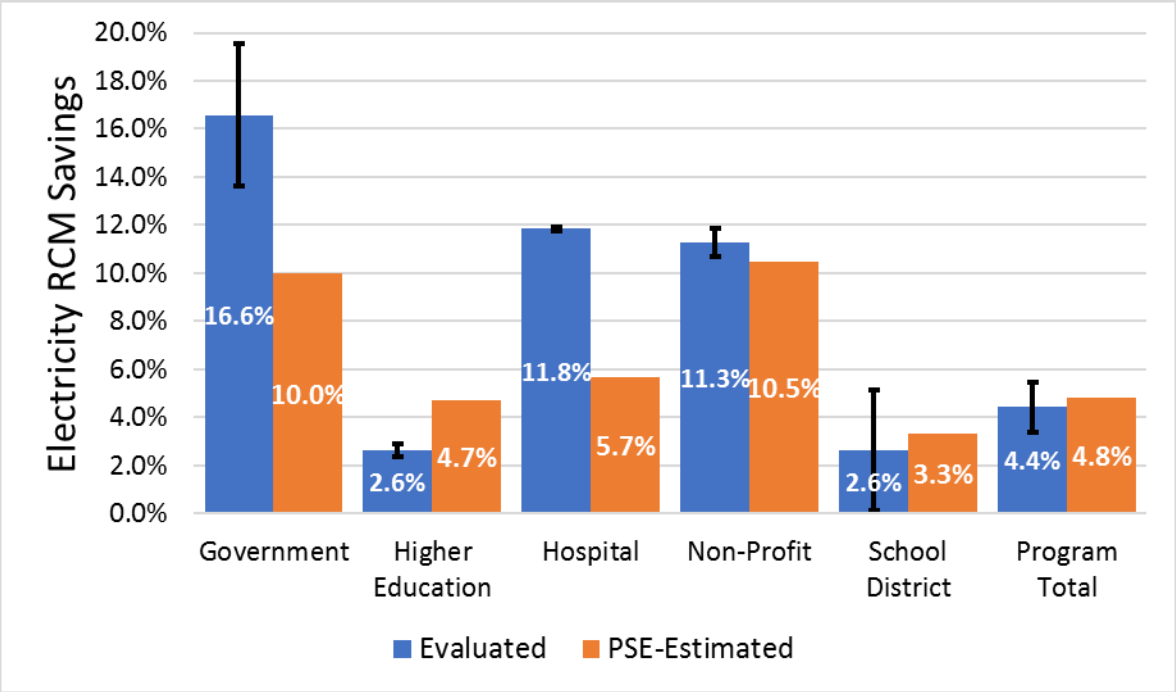

Figure 2. Percentage Annual RCM Electricity Savings by Customer Type

Note: Evaluated savings (blue) are based on Cadmus' analysis of individual facility consumption for sampled facilities, and they are shown as a percentage of Cadmus' adjusted baseline consumption. Error bars provide the 90% confidence interval around point estimates. Estimated savings (orange) are based on PSE's analysis of individual facility consumption for sampled facilities, and they are shown as a percentage of PSE's adjusted baseline consumption.

[24] Cadmus evaluated 2013 savings for NEEA's Commercial Real Estate (CRE) SEM program, and estimated incremental electricity energy savings of 1.84% for the Office Competition track and 3.79% for the Market Partners Program. *NEEA: Commercial Real Estate Participant Cohorts Market Progress Report.* Report. The Cadmus Group, Inc. March 4, 2015. http://neea.org/docs/default-source/reports/cadmus-2013-cre-sem-evaluation_final_2014-12-31.pdf.

Natural Gas Savings

RCM program participants saved 1.2% of gas consumption relative to savings from the previous year from adoption of O&M and BB measures. Figure 3 shows evaluated and PSE's estimates of incremental RCM natural gas savings as a percentage of adjusted baseline consumption. The evaluation estimated incremental savings of 1.2% of natural gas consumption, which was lower and statistically different from PSE's estimate of 2.8%. The 90% confidence interval for natural gas savings did not include zero, indicating that the estimated savings were statistically significant. By customer type, the percentage incremental gas savings ranged between -2.1% (hospitals) to 11.3% (higher education). Cadmus evaluated zero incremental natural gas savings for school districts, estimated with a wide margin of error. Between-facility variability in school district realization rates was large, leading to significant uncertainty around these savings.

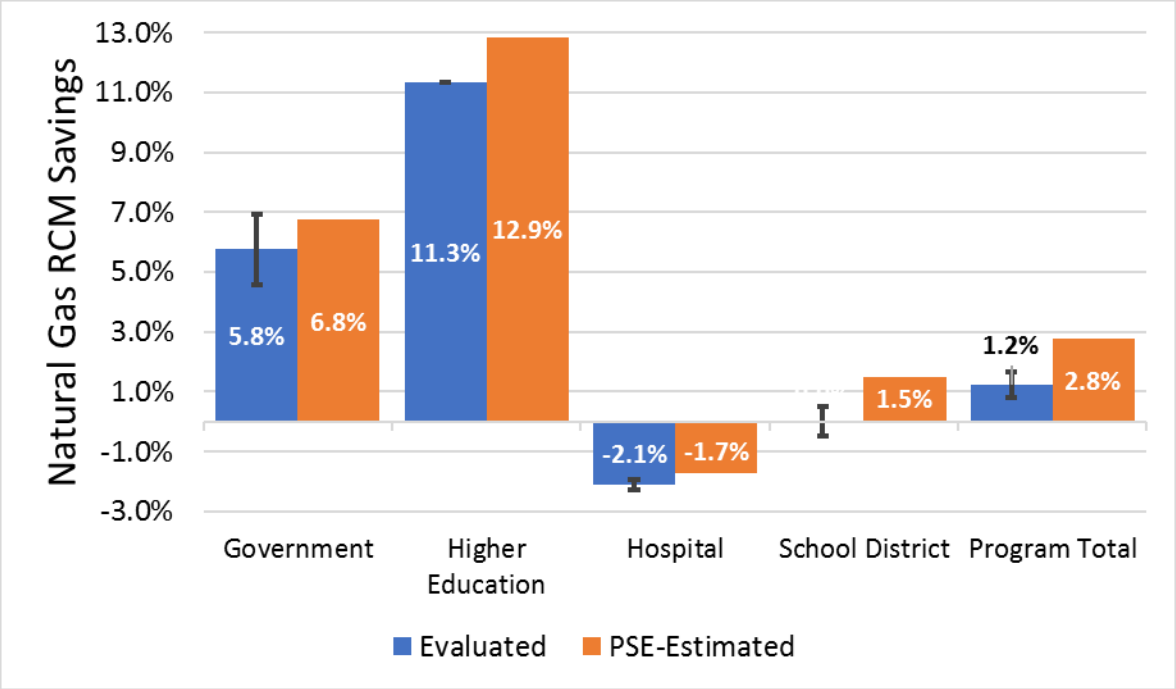

Figure 3. Percentage Incremental RCM Natural Gas Savings by Customer Type

Note: Evaluated savings (blue) are based on Cadmus' analysis of individual facility consumption for sampled facilities, and they are shown as a percentage of Cadmus' adjusted baseline consumption. Error bars provide the 90% confidence interval around point estimates. Estimated savings (orange) are based on PSE's analysis of individual facility consumption for sampled facilities, and they are shown as a percentage of PSE's adjusted baseline consumption.

The RCM program saved 7.0% of natural gas consumption from O&M and BB in the 2015 and 2016 reporting years. Figure 4 shows the percentage annual RCM natural gas savings by customer type.[25] It is evident that although estimates of percentage incremental gas savings were small, participants still saved relative to adjusted baseline consumption. In contrast to electricity, Cadmus estimated significantly lower percentage annual natural gas savings than PSE estimated. Nonetheless, the estimated gas savings are still within the expected range for energy management programs. [26] Percentage annual savings ranged from 16.0% (government facilities) to 0.9% (hospital facilities).

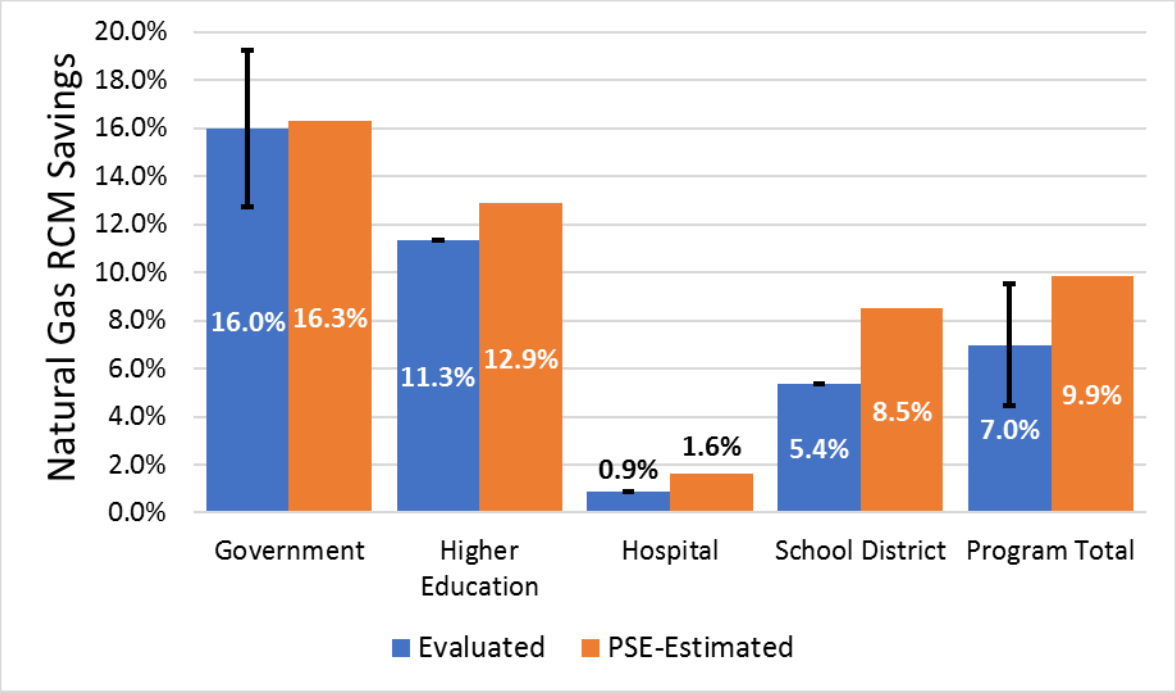

Figure 4. Percentage Annual RCM Natural Gas Savings by Customer Type

Note: Evaluated savings (blue) are based on Cadmus' analysis of individual facility consumption for sampled facilities, and they are shown as a percentage of Cadmus' adjusted baseline consumption. Error bars provide the 90% confidence interval around point estimates. Estimated savings (orange) are based on PSE's analysis of

[25] Note that Cadmus did not include error bounds around its estimate of percentage school district savings in Figure 4. Because the point estimate was large and imprecisely estimated, error bounds extended well beyond the limits of the figure. However, variance from school district savings has been incorporated into the error bound around program total savings.

[26] Cadmus evaluated 2013 savings for NEEA's Commercial Real Estate (CRE) SEM program, and it estimated incremental gas energy savings of 7.53% for the Office Competition track and 7.95% for the Market Partners Program. *NEEA: Commercial Real Estate Participant Cohorts Market Progress Report.* Report. The Cadmus Group, Inc. March 4, 2015. http://neea.org/docs/default-source/reports/cadmus-2013-cre-sem-evaluation_final_2014-12-31.pdf.

individual facility consumption for sampled facilities, and they are shown as a percentage of PSE's adjusted baseline consumption. Cadmus did not include error bounds around its estimate of percentage school district savings. Because the point estimate was large and imprecisely estimated, error bounds extended well beyond the limits of the figure.

Contribution of Capital Projects to Facility Savings

Capital projects at RCM facilities saved 1.2% of electricity consumption. Many RCM facilities implemented capital projects [evaluated capital measures (ECMs)] during the 2015 and 2016 reporting years. ECMs are incentivized by PSE's other energy efficiency programs, but they contribute to RCMs' savings targets for their facilities. Figure 5 presents the evaluated ECM electricity savings as a percentage of consumption in 2015 and 2016, compared to the evaluated RCM electricity savings. Percentages of ECM savings ranged from 1.0% to 5.3%.

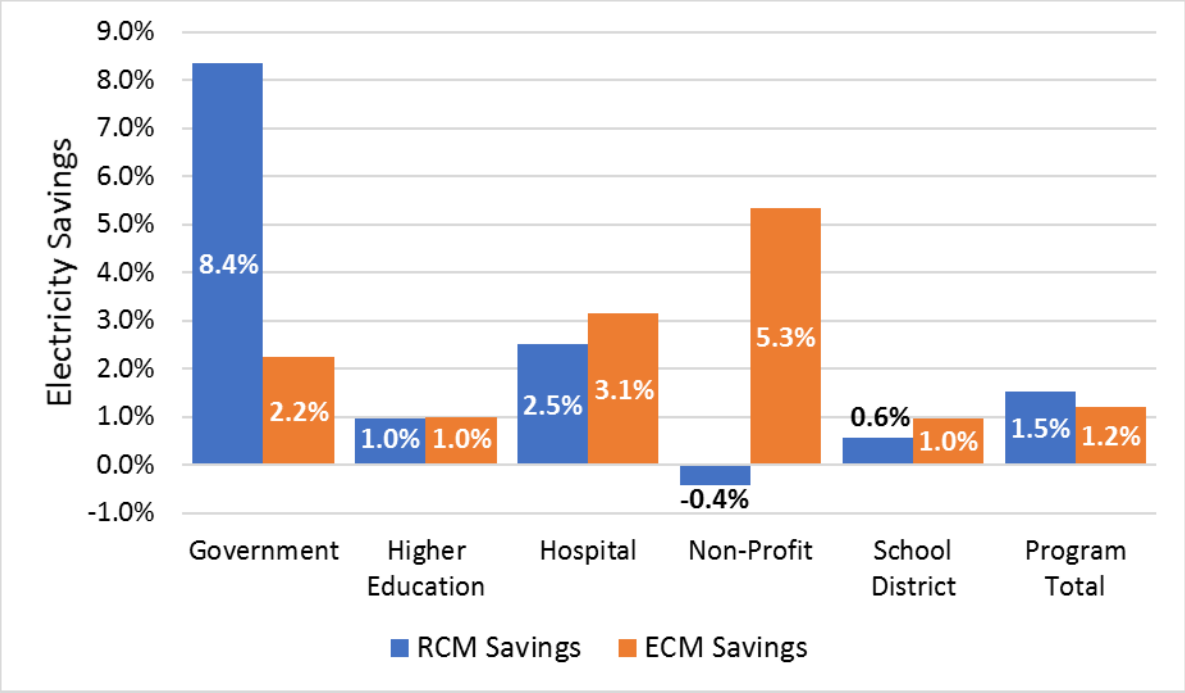

Figure 5. Evaluated RCM and ECM Electricity Savings by Customer Type

Note: Electricity RCM (blue) and ECM (orange) savings are shown as a percentage of adjusted baseline consumption.

Table 12 provides the evaluated ECM kWh savings by customer type and for the program.

Table 12. Evaluated ECM Electricity Savings by Customer Type

Customer Type	ECM Savings (kWh)	Percentage ECM Savings
Government	1,245,062	2.2%
Higher Education	1,523,018	1.0%
Hospital	551,431	3.1%
Non-Profit	265,299	5.3%

School District	2,998,802	1.0%
Program Total	**6,583,611**	**1.2%**

RCM facilities saved 0.8% of natural gas consumption from capital projects. Capital projects saved 0.8% of natural gas consumption. Figure 6 presents the evaluated ECM gas savings and RCM gas savings estimated for 2015 and 2016. Percentage ECM gas savings ranged from 0.3% to 5.0%, which is approximately equal to the range of ECM electric savings.

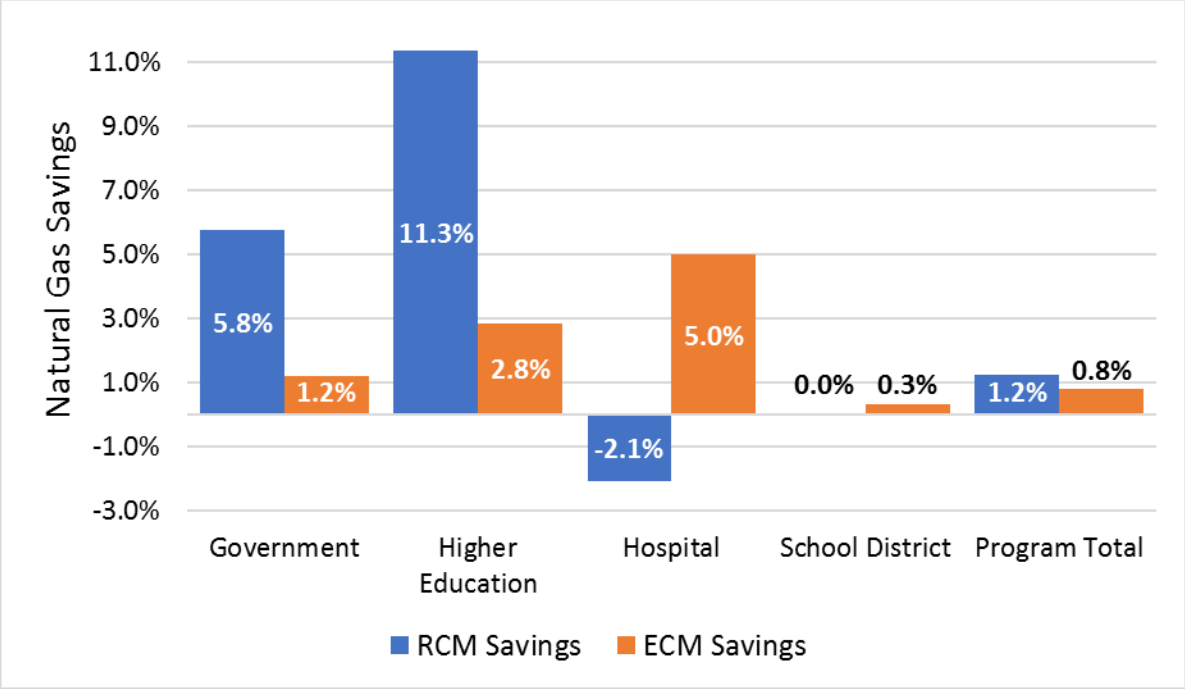

Figure 6. Evaluated RCM and ECM Natural Gas Savings by Customer Type

Note: Natural gas RCM (blue) and ECM (orange) savings are shown as a percentage of adjusted baseline consumption.

Table 13 provides the ECM natural gas savings in therms and again as a percentage of adjusted baseline consumption.

Table 13. Evaluated Natural Gas ECM Savings by Customer Type

Customer Type	ECM Savings (therms)	Percentage ECM Savings
Government	35,553	1.2%
Higher Education	24,484	2.8%
Hospital	21,786	5.0%
School District	57,168	0.3%
Program Total	**138,992**	**0.8%**

Assessment of Reported Savings Calculation Methodologies

For most evaluated facilities, Cadmus estimated incremental annual savings approximately equal to what PSE had estimated. Figure 7 provides a comparison of evaluation- and PSE-estimated annual incremental RCM electricity and natural gas savings. The PSE-estimated savings may not equal PSE's reported savings because negative savings estimates are reported as zero savings. The 45-degree line shows where the reported savings equal the evaluated savings, indicating a 100% realization rate. The savings estimates are presented as natural logarithms to improve the visibility of savings estimates for individual facilities. However, the natural logarithm of negative numbers is not defined, so only facilities with positive RCM savings estimates are shown.

For most facilities, annual savings estimates fall along the 45-degree line. Although Cadmus estimated larger or smaller RCM savings for many facilities, overall, the savings estimates closely agree.

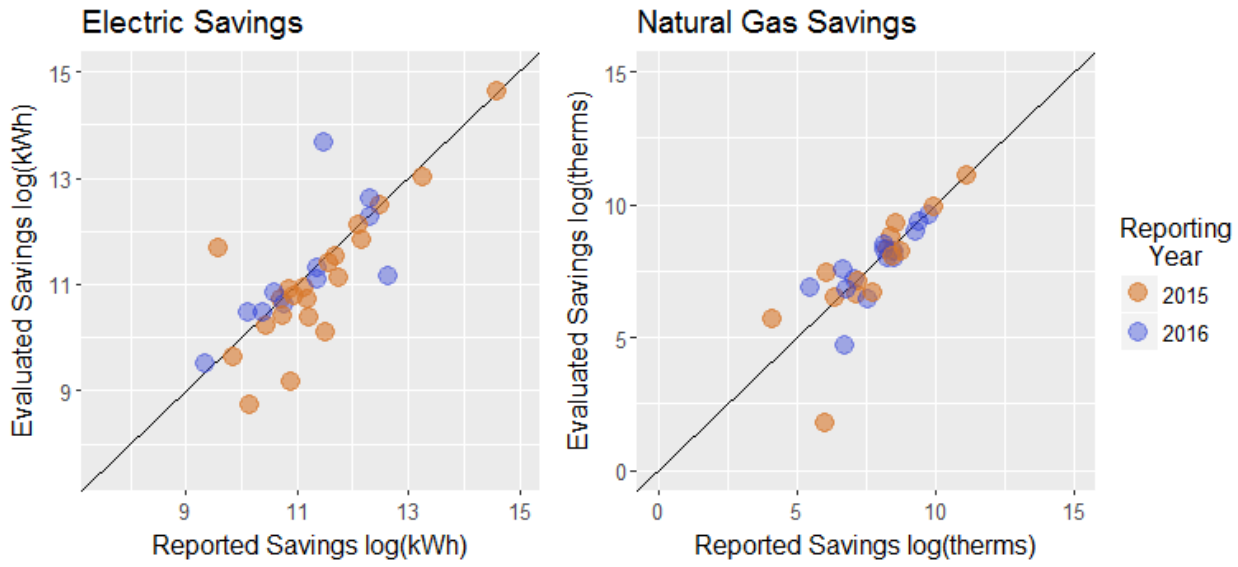

Figure 7. Evaluated and Reported Incremental RCM Electric and Natural Gas Savings

Note: Graphs show the log of evaluated savings against the log of reported savings for electric savings (left) and natural gas savings (right). The 45° line shows where facilities with 100% realization rates will fall. Savings are provided by year (orange dots are 2015 savings, and blue dots are 2016 savings).

Cadmus and PSE employed similar methodologies to estimate facility savings. Following industry standard practices, PSE developed individual customer baseline regression models and calculated facility savings as the difference between the adjusted baseline and metered consumption. In reviewing the reported savings, Cadmus identified several potential improvements to PSE's savings estimation methodology that could increase the accuracy of its estimated savings. If PSE were to implement some or all of these suggested improvements, PSE could align its methodology more closely with industry best practices and reduce the scope for differences between reported and evaluated savings in future evaluations.

Calendarization

Cadmus tended to fit models with higher adjusted R-squares than those achieved by PSE. Figure 8 presents the adjusted R-squares achieved by Cadmus and PSE, by fuel type and customer type.[27] Though several factors likely contributed to this trend (school closure days and optimal selection of HDD and CDD base temperatures, discussed in the following sections), a driving factor is differences in how Cadmus and PSE calculated monthly HDD and CDD variables. Cadmus calendarized monthly billing consumption by allocating the consumption in each billing cycle to a calendar month. This method is standard and aligns with the way PSE calendarized billing data. However, Cadmus calendarized HDD and CDD data differently, by first calculating HDDs and CDDs for each billing cycle using daily weather data and then calendarizing degree days alongside consumption. Doing so ensured that billing cycle HDDs, CDDs, and consumption were allocated similarly to calendar months. In contrast, when PSE calculated HDDs and CDDs, it summed daily HDDs and CDDs for days within calendar months, which meant that weather did not align with the allocated consumption. This method likely weakened the relationship between weather and consumption and may be one of the reasons Cadmus tended to fit baseline consumption models with higher R-square statistics than did PSE.

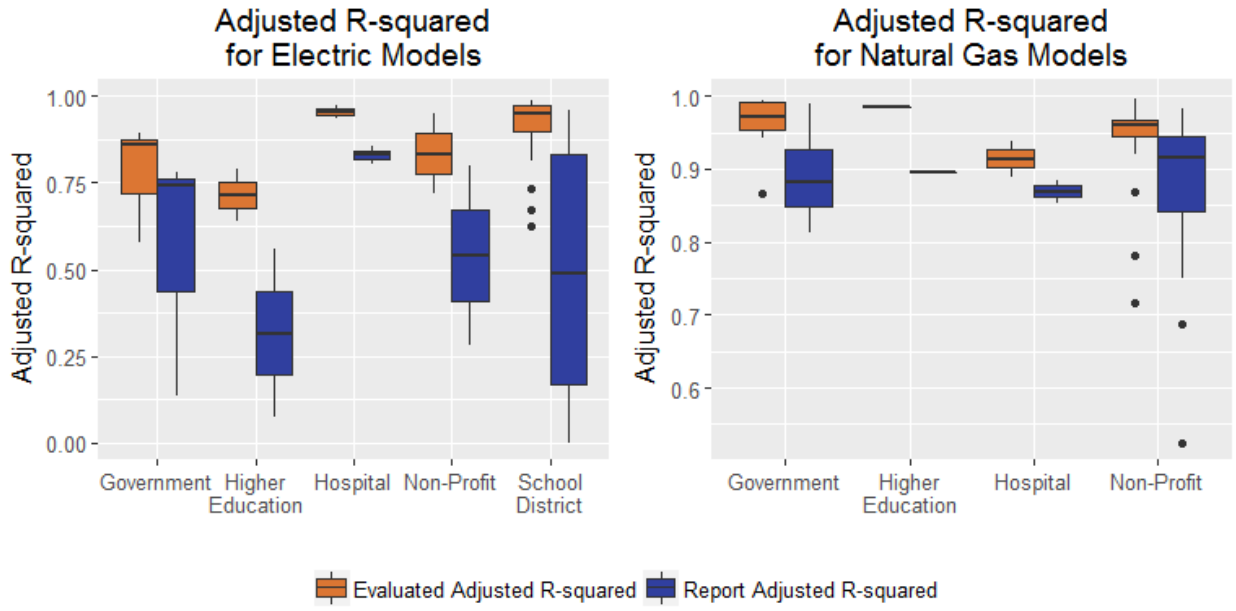

Figure 8. Adjusted R-Squares for Cadmus and PSE-Estimated Electric and Gas Models

Note: The height of each box describes the variability in adjusted R^2 statistics between facilities. Taller boxes indicate more variability. The data is broken into three components: The box itself contains 50% of the facilities,

[27] In cases where PSE was unable to achieve greater than a certain threshold, it did not use the model to estimate savings and instead estimated savings using the difference in reporting year consumption and baseline consumption. However, Cadmus included PSE's highest achieved adjusted R-squares regardless of whether they adjusted baseline consumption for comparison.

and each extending segment contains 25% of the facilities. The mean is located in the center of each box, and the median is described by the line running through each box.

When PSE analyzes daily interval data from MyDataManager, PSE calculates daily HDDs and CDDs and merges them with daily consumption, rendering calendarization a moot issue. In the future, PSE expects to increase its reliance on daily interval data for estimating RCM savings.

School Closure Days

Cadmus included school closure days as a candidate variable when fitting baseline models for schools and found that the variable was often a significant driver of consumption. PSE now incorporates school closure days into its models, but it had not included them when estimating 2015 and 2016 reported savings. Controlling for school closure days in school models reduces noise in the models and increases the probability of detecting savings. Also, when PSE analyzes daily interval data from MyDataManager, it collects facility occupied hours and uses this variable as a model explanatory variable.

HDD and CDD Base Temperatures

Cadmus selected base temperatures for HDD and CDD variables for each sampled facility by choosing the pair that maximized model adjusted R-squares. This method was data driven, but Cadmus restricted the range of possible base temperatures to between 45 and 85 degrees, and it required that the CDD base temperature be higher than or equal to HDD base temperature. Figure 9 shows the HDD and CDD base temperatures selected by Cadmus (orange and blue, respectively) and PSE (purple) for electricity and natural gas models. On average, Cadmus selected lower base temperatures for HDDs and CDDs (electric models only) than PSE. PSE currently uses base temperatures between 55 and 65, and it chose these based on information about temperature settings in RCM facilities. PSE is considering incorporating an optimal base temperature selection process into its future savings analyses.

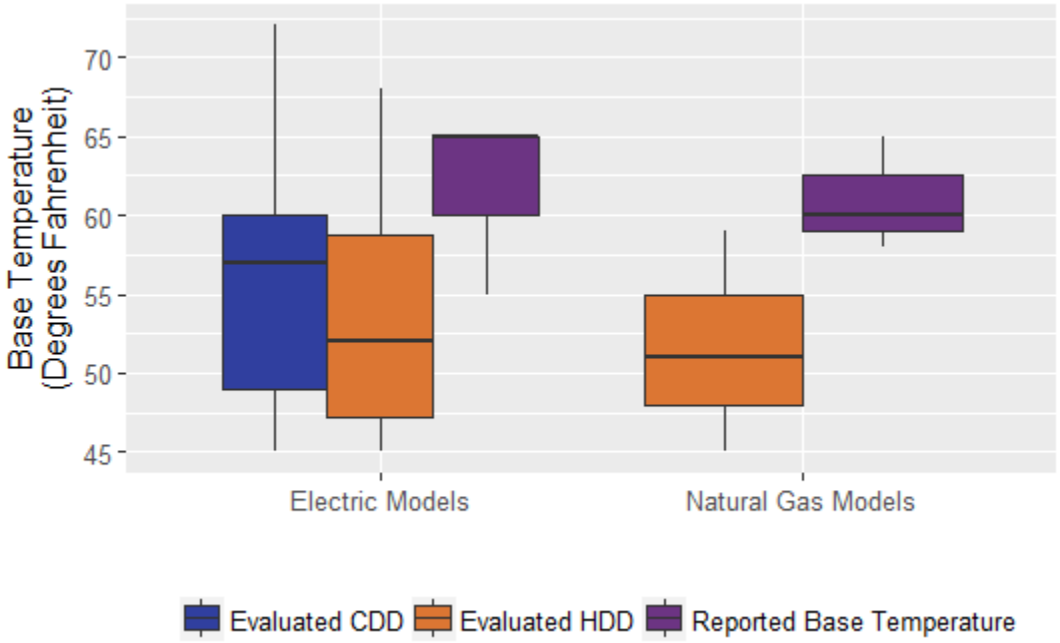

Figure 9. HDD and CDD Base Temperatures for Electricity and Natural Gas Models by Cadmus and PSE

Note: The height of each box describes the variability in adjusted R^2 statistics between facilities. Taller boxes indicate more variability. The data is broken into three components: The box itself contains 50% of the facilities, and each extending segment contains 25% of the facilities. The mean is located in the center of each box, and the median is described by the line running through each box.

Negative Savings Estimate Facilities

PSE estimated negative incremental electricity or gas savings for about 40% of facility-years. A negative savings estimate does not necessarily imply that the true RCM savings are negative. Negative savings can occur because of errors in modeling or capital project savings estimation. [28] Specifically, three factors can lead to negative savings estimates:

- ***The baseline consumption model is incorrectly specified such as from an omitted variable.*** Electricity consumption in some facilities may be complex. The largest known energy drivers—demand for space heating and cooling—are typically measured indirectly through CDDs and HDDs and included as inputs in the regression model. However, other factors affecting consumption may not be measured and, therefore, omitted from the model. For example, building equipment could break or malfunction and operate without being identified. If these omitted factors coincide with the program implementation, the RCM savings estimates may be biased and negative.
- ***Capital project savings are overestimated.*** Even if the baseline consumption model is correctly specified, overestimation of incentivized capital project savings will lead to underestimation of RCM savings from O&M and BB measures. If the capital project savings are overestimated to the point that they become larger than the estimated facility savings, the RCM savings estimate will be negative.
- ***The RCM program causes energy consumption to increase.*** Situations in which RCM implementation leads to an increase in energy consumption are expected to occur rarely. For this to occur, the facility would have to intensify its use of energy in certain processes such as space heating or water heating. Energy consumption intensity could increase if an efficiency strategy was implemented incorrectly or with an incorrect understanding of the facility's energy processes.

When PSE obtained a negative incremental annual savings estimate, it reported zero savings, following guidance in the previous evaluation report[29] and industry standard practice. Furthermore, under the assumption that a negative savings estimate indicated that the baseline consumption model was invalid and that a reliable estimate of savings could not be obtained, PSE did not collect as much data and supporting M&V information for facilities with negative savings estimates as for facilities with positive savings estimates.

Cadmus recommends implementing a different approach for addressing negative savings estimates. We did not differentiate between savings estimates based on sign. Above, we included negative incremental annual savings estimates in the calculation of program savings and the realization rate unless there was

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[28] Also, the incremental RCM savings estimate will be negative if the annual savings measured relative to the fixed annual baseline are less than the sum of the incremental savings in the two previous years.

[29] *Resource Conservation Manager Program Evaluation.* Report. SBW Consulting, Inc. November 25, 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840.

evidence to suggest a modeling error or an error in calculating capital project savings. If Cadmus determined that a facility's baseline consumption model was incorrectly specified and that a better one could not be constructed, it deemed that the facility's savings were not evaluable. Cadmus removed unevaluable facilities from the sample frame prior to sampling facilities for the evaluation. Ultimately, we did not deem any sampled facilities unevaluable.

Cadmus recommends including negative savings estimates in the calculation of program savings and the realization rate for two reasons. First, although it is more likely than not that a negative RCM savings estimate reflects error in modeling consumption or capital project savings, it is not possible to rule out a program-induced increase in energy consumption. Results including negative savings estimates are more defensible because they allow for unintended consumption impacts and do not assume a priori that negative savings estimates are erroneous. Second, including negative savings estimates will result in more accurate estimates of the savings realization rate and program savings. Modeling errors can occur for facilities with negative or positive savings estimates. For example, estimated savings may be higher than the true savings because capital project savings were underestimated. Excluding facilities with negative savings estimates increases the likelihood that negative errors are excluded and positive errors are included. Since no adjustments are made for positive errors, excluding negative savings estimates introduces bias. Negative savings estimates and positive savings estimates should be treated similarly to avoid biasing the results.

A factor that mitigates concern about bias is that over multiple years, the bias from reporting zero savings with a fixed baseline is expected to be less than the bias for any individual year. To see this, consider Table 14, which reproduces the 2016 and 2017 savings for the example facility from Table 2 and also shows 2018 savings. This facility had negative incremental savings of 25,000 kWh in 2017, and PSE would report zero savings for the facility in this year. In 2018, assume this facility saved 100,000 kWh relative to the 2013 baseline, which implies incremental annual savings of 100,000 kWh.

Table 14. Illustration of Long-Run Impact of Reporting Zero Savings for Negative Savings Estimate Facilities

	2013 (baseline year)	2014	2015	2016	2017	2018
Annual savings (kWh) relative to 2013 baseline	0	50,000	50,000	75,000	0	100,000
Incremental annual savings (kWh)	0	50,000	0	25,000	-25,000	100,000
PSE reported savings	0	50,000	0	25,000	0	75,000

PSE would obtain the same estimate of total savings between 2016 and 2018 whether it sums the incremental annual savings or the PSE-reported savings. With a multiyear measure life and a fixed annual baseline, reporting zero savings for negative savings estimates affects savings in each year, but not the sum of savings across years. The total savings are 100,000 kWh whether it sums the incremental annual savings or the reported savings. Reporting zero savings will affect the sum only if savings in the

last year of participation are negative, if savings are negative for three or more consecutive years, or if the baseline is reset.

Thus, for evaluation of the RCM program in one or two years, reporting zero savings for facilities with negative savings estimates will bias the program savings. But over a longer period of three or more years, this convention may have little effect on the program savings.

Resource Conservation Manager Experience

In this section of the evaluation report, we first profile the RCMs that we interviewed and then highlight the key findings from interviews with RCMs and participation in the RCM Annual Meeting. A complete discussion of these events and findings is reported in *Appendix B. RCM Participant Findings Memo* and *Appendix D. Annual Meeting Summary Memo*.

RCM Profile

RCMs held a variety of roles within their organizations. Of the 16 RCMs interviewed, 13 served as utility managers or energy managers for their facilities, two represented outside consultancies that serve as RCMs for a variety of clients on PSE's behalf, and one worked as a general operations manager at the facility level.

RCMs' responsibilities consisted primarily of tracking energy expenditures over time and ensuring that facility operations aligned with the organization's stated energy policies and goals. Additionally, the outside consultants took responsibility for ensuring that required paperwork, such as quarterly checklists, was filled out for their clients.

All organizations represented by the interviewed RCMs had participated in the program for more than five years, with all organizations going through the renewal process at least once. Most of the RCMs interviewed indicated their organization planned to remain in the program:

- Eleven RCMs said they intended to renew their participation agreement.
- One RCM, representing a healthcare facility, did not plan to renew, citing a lack of on-site support from PSE and excessive paperwork required by the program.
- Two school districts' RCMs were unsure if they would renew, one citing the need for more support from PSE, and one reporting not receiving expected data. Citing dissatisfaction with the software provided by the program, this client elected to use another data-collection software.
- The remaining two consultants said they did not know their clients' renewal intentions.

Participation Motivations

Organizations participated in the RCM program to achieve energy and cost savings, and the program provided them with technical support to achieve these goals. Incentives played a relatively small role in decisions to participate. As shown in Table 15, although most RCMs reported their organization participated in the RCM program to save money or energy, some organizations were also motivated by environmental stewardship, a desire to arrest climate change, or the benefit of gaining access to energy

consumption data from PSE. One RCM, whose organization did not intend to renew its contract, did not report a motivation for participation.

Table 15. What is your organization's current motivation for participating in the RCM program?

	Cost Savings	Energy Savings	Environmental Stewardship and Climate Change	Data Access and Availability	Not Motivated
RCM 1	X	X	X		
RCM 2	X			X	
RCM 3		X	X		
RCM 4			X		
RCM 5			X		
RCM 6		X		X	
RCM 7		X			
RCM 8	X	X			
RCM 9		X			
RCM 10	X				
RCM 11	X				
RCM 12	X				
RCM 13	X				
RCM 14	X				
RCM 15					X
Total	**8**	**6**	**4**	**2**	**1**

Source: Puget Sound Energy Resource Conservation Manager Program (2014-2016) Participant Interview Guide (QD1) (n=15).

Program Implementation

Twelve RCMs implemented a combination of O&M initiatives or BB measures and capital improvements (Table 16). O&M initiatives reported by RCMs varied, from programming existing equipment to teaching facilities managers to use equipment efficiently. Eleven respondents reported implementing BB measures. Of the five RCMs not implementing BB measures, two said other employees at their school districts managed green initiatives, and two reported receiving internal pushback from school district officials.

Table 16. Types of Projects Implemented by RCMs

	Operational Improvements	Behavior-Based Measures	Capital Projects
RCM 1	x		
RCM2	x		
RCM3	x	x	x
RCM4	x	x	x
RCM5	x	x	x
RCM6	x	x	x

RCM7	x		
RCM8	x	x	x
RCM9			
RCM10	x		x
RCM11	x	x	x
RCM12	x	x	x
RCM13	x	x	x
RCM14	x	x	x
RCM15	x	x	x
RCM16	x	x	x
Total	**15**	**11**	**12**

Source: Puget Sound Energy Resource Conservation Manager Program (2014-2016) Participant Interview Guide (QD3 through E5) (n=16).

The RCMs' authority to make decisions about energy efficiency improvements varied. Eight respondents could make some decisions unilaterally. The projects they could approve included lighting retrofits, operational adjustments, filter changes, and facility control changes. However, for capital projects or policy changes, 11 respondents had to follow a process to receive implementation approval. Examples of approval processes included an eleven-month project design and tendering project for lighting retrofits and extensive consultation with multiple stakeholders across city agencies.

RCM Challenges

RCMs face significant challenges in implementing energy efficiency improvements, including these:

- Communicating with facility managers about the value of energy efficiency
- Obtaining buy-in from executives
- Engaging building occupants in energy efficiency activities
- Coping with limited staff resources
- Managing staff turn-over
- Ensuring access to financing for capital improvements
- Finding contractors familiar with energy efficient equipment

The three challenges RCMs mentioned most frequently were finding funding for improvements; communicating the value of energy efficiency; and obtaining buy-in from management, staff, or building occupants.

Energy efficiency often competed for funding with other organizational priorities. As illustrated in Figure 10, interviewed RCMs were most likely to encounter financial challenges when implementing capital projects. RCMs said they needed strong value propositions to secure funds for energy efficiency improvements and to compete against other organizational funding priorities. As further challenges, RCMs also reported budgetary requirements to spend allocated funds within a limited timeframe and project delays while waiting for school boards to approve funding. Participants agreed that it is optimal

to dedicate funds to finance energy efficiency projects, eliminating competition for financing from other capital projects. Dedicated funds could revolve, financed with cost savings from recent energy efficiency improvements or energy efficiency program incentive payments.

RCMs needed strategies for engaging building occupants in saving energy. It was difficult to engage building occupants in saving energy since most did not have a financial interest in reducing energy consumption. Also, RCMs said they lacked basic knowledge about and training for influencing building occupants to make lasting behavior changes and that without strong messaging to motivate building occupants, operational changes could be undone by facilities staff or building occupants.

RCMs needed strategies for communicating the value of energy efficiency to their executives. RCMs noted the importance of establishing trusting relationships with executives and demonstrating the value of energy efficiency to their organizations. RCMs asked PSE for support in conveying the benefits of energy efficiency to their executives and managers through case studies.

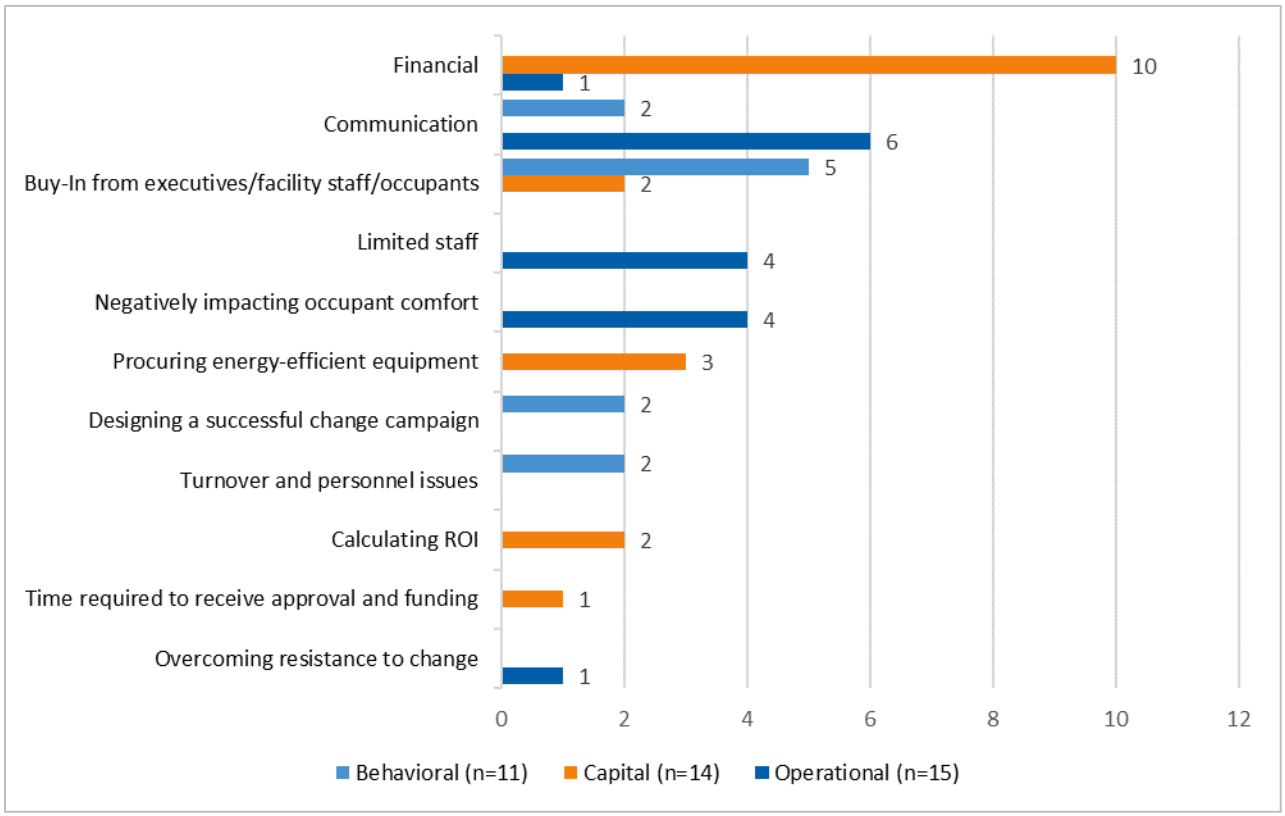

Figure 10. What are the biggest challenges to making changes at your organization?

Puget Sound Energy Resource Conservation Manager Program (2014-2016) Participant Interview Guide (QE3-E5).

Savings Persistence

Many of the challenges reported by RCMs in Figure 10 also posed threats to savings persistence. RCMs participating in the interviews and those attending the annual meeting spoke about these threats and

measures to counter them. The RCMs identified occupant behaviors, staff turnover, and lack of organizational commitment as common threats.

Occupant behavior presents both an obstacle to and an opportunity for achieving energy savings. Building occupants may not cooperate in managing energy consumption. Occupants may override control settings, leave windows and doors to the outside open, or neglect to turn off equipment upon leaving the facility. Building occupants may be uninformed or have other priorities besides saving energy.

To engage building occupants, RCMs can educate them about program objectives, benefits of energy efficiency, and steps they can take to save energy. This could be done through emails, posters, or face-to-face conversations. RCMs agreed that to the extent possible, they should make it "fun" to save energy. One RCM said trainings were among the most valuable tools they had to encourage persistence: "Trainings are very applicable to what a team does. It is easier to get persistence through operational changes that those trainings support." Other RCMs wanted to provide building occupants with real-time feedback about facility energy use "to prove that behavior change works."

When an RCM leaves the organization or changes position in the organization, a lot of knowledge about the organization and facility operations may be lost. It may take a new RCM months or years to establish relationships and to gain equivalent understanding about a facility's operations.

To prevent loss of critical knowledge, RCMs should document facility operations and energy efficiency activities as PSE requires in the quarterly reports and, if possible, do an in-person handoff of or training about RCM responsibilities. PSE trainings are also important for bringing new RCMs up to speed.

A lack of organizational commitment to energy efficiency can raise the barriers to implementing new projects. Organizations may change their spending priorities in response to external influences (e.g., school budget decreases) or internal influences (e.g., personal preferences of top managers). When incentives to support energy efficiency projects dry up, some organizations may not be sufficiently committed to keep spending on energy efficiency.

PSE's policy of allowing customers to renew their participation contracts gives resource-constrained or tepidly-committed organizations incentives to keep spending on energy efficiency. The ability to renew gives RCMs additional time and resources to develop the organization's commitment to energy efficiency and to change the workplace culture.

Program Design and Customer Experience

RCMs valued the support they receive from PSE and requested more in the future. RCMs provided feedback about several aspects of program support including trainings, data management and analysis software, and reporting.

Trainings

RCMs found PSE's financial support and sponsorship of trainings valuable. PSE provided RCMs with an annual training allowance that could be spent on external trainings and led both mandatory and

optional RCM trainings. Nine RCMs said they used the training allowance to take external trainings. The most commonly cited training, reported by five RCMs, was Building Operator Certification (BOC). Thirteen RCMs said they attended trainings offered directly by PSE. Eight RCMs utilized external funding and attended PSE trainings.

RCMs attending the annual meeting reported that PSE's monthly trainings were valuable and that they were interested in acquiring "all of the training they can." Meeting participants requested more training about motivating behavior change, including about understanding the psychology of behavior change. While RCMs preferred in-person trainings to webinars, they thought webinars might enable outside subject-matter experts to reach RCMs. One PSE staffer noted the Strategic Energy Management (SEM) hub—launched in 2018—will provide energy management resources in one place, making access to them easier. The hub could also serve as a repository for a webinar library.

In 2018, PSE launched an on-line training system with different technical levels of curricula.

Access to Energy Consumption Data

RCMs highly valued access to facility energy consumption data provided by the program. RCMs cited the importance of receiving high-quality, easy-to-access data on facility electricity and gas consumption, which they used to track progress towards energy savings goals, to identify energy savings opportunities, to verify equipment schedules, and to determine if energy efficiency projects reduced consumption.

RCMs requested more on-site, in-person support from PSE with MyDataManager. Some RCMs complained that the MyDataManager software could be slow and difficult to manipulate. Eight respondents accessed consumption data through MyDataManager, while other RCMs employed other software, citing its steep learning curve, inability to customize fields, and lack of access to gas consumption data. PSE verified that MyDataManager does provide access to gas data.

Contracting

Some RCMs disliked aspects of the contract renewal process. Since most RCM participants were longtime participants, they were experienced with the contract renewal process. Several stated that the process could be more organized. One RCM reported not receiving renewal paperwork until the end of the first year of the renewal period. The RCM said, "It was surprising that they renewed it one year into the three-year agreement."

RCMs said the renewal process could be improved by increasing the transparency of methods used for calculating incentives and better explaining the rationale for the targets. Others commented that upon renewal it became more difficult to meet the program's savings goals and to justify to management why the goals could not be met. One RCM said the goals were "impossible to meet, so we don't try"; another said, "the low-hanging fruit is gone, so it's getting very difficult to get any savings doing operational improvements." However, PSE noted that under the pay-for performance incentive structure, customers can meet their savings targets if their savings persist from one year to the next.

Change to Pay-for-Performance Incentive System

PSE's adoption of pay-for-performance injected financial uncertainty into planning for some RCMs. Four of the seven RCMs who experienced the 2014 changes in the program's pay-for-performance incentive structure said the changes had a negative effect on their organization's participation; two said it had no effect; and one said it had a positive effect. One RCM said it was now difficult to predict savings and grant funding, which complicated planning of energy efficiency projects. Also, this organization wanted more visibility into the savings calculations. Another said the pay-for-performance system made it more difficult to achieve deeper savings. One RCM said the pay-for performance system was an improvement because it facilitated making capital upgrades.

Reporting

Fewer than 20% of RCMs found the program reporting requirements burdensome. Three of 16 RCM participants believed the filing reports were unnecessary and did not submit required paperwork to PSE, especially the Site Quarterly Checklists (SQC). While non-compliers with the paperwork requirement constitute fewer than 20% of respondents, PSE could look for opportunities to simplify the program's reporting requirements. RCMs suggested PSE include two checkboxes where RCMs could select "changes made," or "no changes made" and make it optional to complete the quarterly reporting if no changes occurred at a facility. PSE noted that the program provides a reporting spreadsheet that allows customers to identify facilities where changes were not made, allowing customers to avoid reporting for these facilities. RCMs also suggested modifying the report template to collect parameters and performance metrics (e.g., number of meters, number of building occupants, operations and maintenance projects, and facility and occupancy schedules) on a single page. PSE reiterated its flexibility and commitment to work with individual RCMs on reporting and to minimize reporting burdens on customers.

Satisfaction

Most of the RCMs interviewed were very or somewhat satisfied with the program. Overall, 11 out of 15 RCMs interviewed reported satisfaction with the program. Of the 15 reporting, four were very satisfied, seven were somewhat satisfied, and four were not very satisfied (Figure 11). Although challenges occurred, one RCM, who replied he was "very satisfied," said, "The support from PSE has been great" and "they have designed a valuable program." While those reporting to be somewhat satisfied also complemented the program, one RCM needed more timely billing information; two said they would like more direct communication with PSE or more on-site support. One not very satisfied RCM said the incentive was not enough to justify the paperwork required by the program.

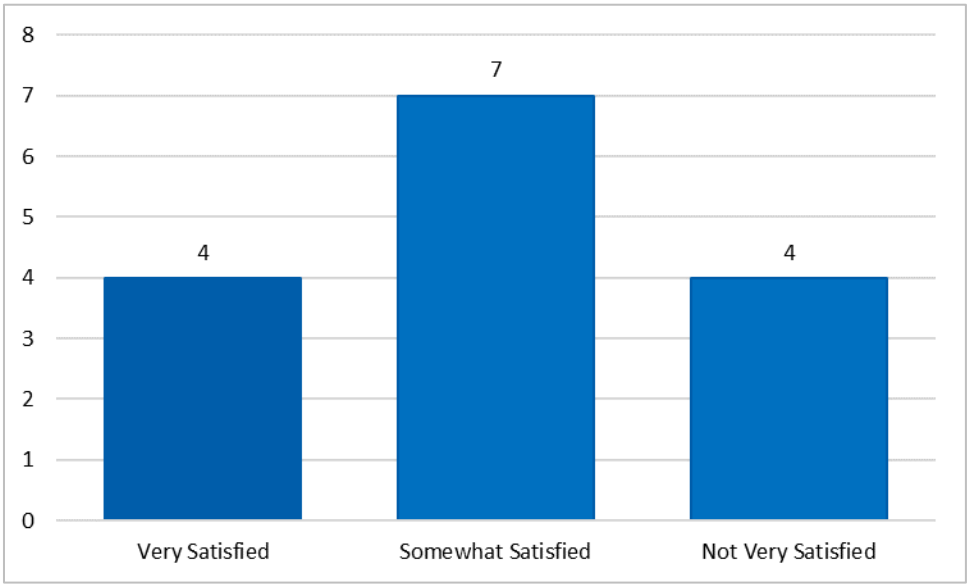

Figure 11. Overall, how satisfied are you with PSE's RCM program?

Puget Sound Energy Resource Conservation Manager Program (2014-2016) Participant Interview Guide (QJ1) (n=15)

RCMs benefited from PSE's technical support and the exchange of ideas through peer networks. Throughout the interviews, RCMs mentioned multiple ways that the program made their jobs easier or provided direct value to their organizations. Primarily, they cited the data provided by the program, with one RCM saying, "Incentives are just frosting for us. My only incentive for being part of the RCM program is to get the software and the data." Another RCM cited the peer network, with the greatest value obtained from partnering with PSE and networking with other organizations doing similar work.

Factors Contributing to Successful RCMs

Through the RCM interviews, Cadmus identified four factors common in successful RCMs. For this analysis, Cadmus defined successful RCMs as those who implemented O&M or BB measures in addition to capital projects.

Energy Management as a Primary Responsibility

RCMs whose full-time job was energy management were more likely to implement O&M and BB measures. Interviewed RCMs reported job titles that ranged from director of facilities and operations to full-time RCM. Those who identified as facility directors or who oversaw multiple facilities and departments described their primary job responsibility as greater than energy manager. The RCM program at these facilities was more likely to be limited in scope to facility maintenance, quarterly reports, and little else. Employees with a range of responsibilities were also less likely to find the time to engage employees in energy management. Conversely, employees for whom energy management was their primary or a major responsibility were more likely to focus on behavioral initiatives, advance green policies within their organizations, and perform energy management.

Regular Contact with Utility

RCMs who regularly engaged with PSE were more likely to implement O&M and BB measures. One RCM described working with PSE as a partnership and attributed success in the program to that partnership. This theme emerged in the interviews with the RCMs who expressed less satisfaction with the program as well. Those RCMs who felt they did not receive enough support from the program implemented fewer O&M and BB measures projects than the RCMs who felt supported by the utility. Finally, RCMs who said they enjoyed their work reported receiving a high level of support from PSE.

Access to Outside Resources or Partnerships

Access to outside resources could empower RCMs to implement BB measures. Most RCMs are engineers, not social scientists, and many are unfamiliar with behavioral science. As a result, many RCMs lacked knowledge about implementing BB measures. At the RCM Annual Meeting, many RCMs asked PSE for additional assistance with implementing BB measures.

An RCM who reported success with implementing behavioral and operational initiatives attributed this success to a partnership with a local "green schools program." The partnership provided an additional incentive to decrease trash, increase composting and recycling, and reduce energy waste. This outside partnership helped the organization design the program and engage the entire school district in resource conservation.

Regarding Energy Management as a Continuous Process

RCMs who perceived energy management as a continuous process following the "plan-do-act-check" model had more success. Fourteen RCMs considered O&M and behavioral improvements to be a key component of energy efficiency. However, one RCM who reported having picked the low-hanging fruit added that new O&M changes would not lead to additional savings. In contrast, RCMs that successfully implemented O&M and BB projects recognized that there were always new potential opportunities for savings and never considered their work finished.

RCM's Ideas for Program Improvements

Throughout the interviews and annual meeting breakout sessions, RCMs were invited to offer ideas to further improve the program. The RCMs made the following suggestions.

Training

- Include information about the intended audience and required background knowledge in training advertisements, so RCMs can determine whether they are signing up for expert or novice training.
- Increase training allowances or help RCMs find ways to train more staff.
- Distribute brief, specific case studies rather than lengthy whitepapers (e.g., diagnostic training with instructions, such as "If you hear this sound, check this item").
- RCMs also suggested PSE consider a "roadshow," visiting customers' sites to discuss energy efficiency basics, such as controls and occupancy sensors.

Access to Consumption Data

- Provide RCMs with the ability to connect to interval consumption data through an application programming interface (API).[30]
- Offer an option to merge current and historical consumption data (currently in different and incompatible formats).
- Provide more reporting features, so RCMs can easily pull reports to compare consumption at different facilities.
- Provide quicker consumption data delivery, allowing RCMs to see the previous month's usage immediately, rather than after several months.[31]

Contracting

- Make the grant renewal process timelier, and make the savings estimation on which incentive payments are based more transparent.
- Simplify the site quarterly checklist, and make completing it optional unless changes occurred at the facility.
- Provide RCMs with more on-site support and technical assistance to gain buy-in from management and staff. This could include tools to help RCMs make the business case for capital upgrades, written reports after site walkthroughs, and assistance communicating with management and staff.
- Provide RCMs with support for engaging building occupants in behavior change. This could include more communications materials designed to educate building occupants about the benefits of operational and behavior change programs.

Pay-for-Performance Incentives

- Provide more training on how incentives are calculated.[32]
- Provide a way for RCMs to track progress toward their savings targets.

Reporting

- Benchmark facility energy consumption against consumption at other similar facilities or in other business sectors.

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[30] An API would help RCMs develop their own software to interface with PSE. PSE noted that an API was not possible because of security constraints.

[31] PSE noted that it makes efforts to make data available quickly, but that billing issues outside the program's control could arise from time to time.

[32] PSE noted that the program provides trainings on how incentives are calculated annually.

Conclusions, Considerations, and Recommendations

Through the RCM program, PSE provided commercial customers with financial and technical support to help them to identify energy savings opportunities, implement projects, and track energy savings. Overall, the program achieved significant electricity and natural gas savings in the 2015 and 2016 reporting years, and the program was well received by RCMs. Opportunities exist to improve aspects of the program delivery and customer experience.

Cadmus makes the following specific conclusions and recommendations for improving the program based on our evaluation:

Conclusion #1: PSE followed industry-standard practice and guidance from the previous evaluation report when it excluded negative RCM savings estimates from the realization rate calculation. Following these guidelines, Cadmus obtained RCM program savings realization rates of 107% for electricity and 92% for natural gas. SBW[33] observed that reporting negative savings estimates as zero savings had the potential to bias the savings estimate upward but that the potential for overestimating savings could be minimized by adopting a fixed annual baseline. When Cadmus adopted the industry standard of not recording negative savings estimates, the realization rate was 107% for electricity and 92% for natural gas in 2015 and 2016.

Conclusion #2: PSE can obtain more accurate estimates of RCM program performance by including negative savings estimates in the savings realization rate calculation. Negative savings estimates may be due to incorrectly specified baseline consumption models, overestimated capital project savings, or a program-driven increase in energy consumption. But while modeling error is more likely responsible than a program-caused increase in consumption, often it is not possible to determine the cause. When a modeling error can be identified but not corrected, researchers should report zero savings for the facility and exclude it from the realization rate calculation. When a modeling error cannot be ruled out, it means that a negative program effect was possible and it is best practice for researchers to report the savings estimate. In addition, the same modeling and estimation limitations that result in savings estimates that are lower than the true savings will also result in positive savings estimates that are higher than the true savings. Omitting negative savings estimates from the calculation of program savings therefore has the potential to bias the estimate of program savings upward. When Cadmus included negative RCM savings estimates in the savings realization rate calculation, the realization rate was 88% for electricity and 48% for natural gas in 2015 and 2016.

For consideration #1: It is best practice for energy management programs to report negative RCM savings estimates unless omitted variables or other modeling issues can

[33] *Resource Conservation Manager Program Evaluation*. Report. SBW Consulting, Inc. November 25, 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840. See p. 71 and p.141.

be identified.[34] If there is evidence that either the baseline consumption model is incorrectly specified and cannot be improved or capital project savings are overestimated, Cadmus suggests that PSE report zero savings or declare that the facility is not evaluable. Otherwise, we suggest that PSE report the savings estimate, regardless of the estimate's sign.

Conclusion #3: When including negative savings estimates, RCM participants achieved significant incremental energy savings from O&M and BB measures. The evaluation found that in 2015 and 2016, RCM participants saved 1.5% of electricity consumption and 1.2% of gas consumption from O&M and BB measures relative to the previous year under the assumption of a three-year measure life. These measures contributed incremental savings of 8,319 MWh and 264,288 therms at RCM facilities in 2015 and 2016. The savings estimates were statistically significant at the 10% significance level and included savings estimates from facilities with negative savings estimates.

Conclusion #4: Capital projects contributed significant energy savings at RCM facilities. In 2015 and 2016, total incremental energy savings at RCM facilities were 2.7% of electricity consumption and 2.0% of natural gas consumption. Again, the estimates were statistically significant at the 10% significance level and included capital project savings from RCM facilities with negative savings estimates. Capital projects accounted for 44% of incremental electricity savings (1.2% of electricity consumption) and 40% of incremental natural gas savings (0.8% of natural gas consumption).

Recommendation #1: PSE should continue to promote energy efficiency capital projects at RCM facilities. Although other PSE energy efficiency programs take credit for energy savings from incentivized capital projects in RCM participant facilities, PSE should continue to promote them to RCM program participants. RCMs reported that the program's technical assistance was important in the decision to implement many capital projects.

Conclusion #5: Although some RCM participants did not achieve incremental savings, they still saved relative to adjusted baseline consumption calculated using the fixed baseline year. The evaluation found that in 2015 and 2016, RCM participants saved 4.4% of adjusted baseline electricity consumption and 7.0% of adjusted baseline natural gas consumption. Both estimates were statistically significant at the 10% significance level and included savings from facilities with negative savings estimates. Annual savings differ from incremental annual savings because they ignore the three-year measure life and are calculated relative to adjusted baseline consumption using the fixed baseline year.

Conclusion #6: PSE can improve the accuracy of its savings estimates by making changes to its savings methodology. PSE follows industry standard practices for estimating RCM savings. However, PSE could

[34] *Strategic Energy Management (SEM) Evaluation Report*. Report. SBW Consulting, Inc. & The Cadmus Group. February 2017. https://www.bpa.gov/EE/Utility/research-archive/Documents/Evaluation/170222_BPA_Industrial_SEM_Impact_Evaluation_Report.pdf.

improve how it calendarizes heating degree days (HDDs) and cooling degree days (CDDs), test the significance of school closure days in school facility models, and optimize its selection of HDD and CDD base temperatures to achieve more accurate estimates of facility savings.

For consideration #2: When using monthly billing data to estimate savings, PSE should consider calendarizing billing-cycle HDDs and CDDs. Calendarizing billing-cycle HDDs and CDDs maintains the relationship between energy consumption and weather because both variables are measured over the same period. Currently, PSE calculates monthly HDDs and CDDs by summing degree days for days in each calendar month. PSE may be able to increase the accuracy of its baseline models and savings estimates by calendarizing billing-cycle HDDs and CDDs. At the program level, differences in weather calendarization methods have little impact on savings estimates, because over- or under-estimation of savings for individual facilities appear to cancel out. [35] However, facility level results may be less accurate, as suggested by the lower model adjusted R-square statistics using PSE's calendarization method. [36] These findings are discussed further in the Assessment of Reported Savings Calculation Methodologies section.

For consideration #3: PSE should consider improving its selection of HDD and CDD base temperatures. Currently, PSE selects base temperatures using its knowledge of facilities and information about thermostat settings from RCMs. Cadmus suggests PSE look for data-driven methods of selecting base temperatures, including the method Cadmus used. This method selects the best CDD and HDD base temperature pairs by testing pairs of CDDs and HDDs using different base temperatures ranging between 45°F and 85°F and selecting the pair that maximizes the model adjusted R2. Cadmus consistently selected lower base temperatures for both HDD and CDD. On average, we selected CDD base temperatures 8.5 and 4.4 degrees lower than PSE for electric and natural gas models, respectively. For natural gas models, Cadmus selected average HDD base temperatures 6.6 degrees lower than PSE. PSE may consider a different range of acceptable base temperatures based on its knowledge of facilities, but it should consider that true set points may differ from (and tend to be lower than) what RCMs report.

[35] When comparing PSE's and Cadmus' savings estimates (using PSE's convention for negative savings), the realization rate is 107% for electricity and 92% for therms. The differences are partially attributable to differences in weather calendarization.

[36] On average, Cadmus increased electric model adjusted R-squares by 0.37 and increased natural gas model adjusted R-squares by 0.064.

Recommendation #2: PSE should collect and incorporate data on facility closures—schools, in particular—into its baseline models. Cadmus found that the accuracy and predictive ability of its baseline regression models often improved when the number of facility closure days was included as an explanatory variable. PSE is in the process of making this enhancement.

Conclusion #7: Government facilities may have higher savings potential than schools. Cadmus estimated that government facilities saved 8.4% of electricity consumption and 5.8% of natural gas consumption, compared to the previous year. School districts saved only 0.6% of electricity consumption and did not save natural gas compared to the previous year. These results suggest differences in savings potential may exist between government facilities and schools; however, the results are not definitive because Cadmus did not design the sample to estimate or test for differences in customer type savings, and the analysis sample included only eight government facilities.

Recommendation #3: The next evaluation should test more definitively for differences in savings between government facilities and schools. This can be accomplished by significantly increasing the number of sampled government buildings and maintaining or increasing the number of sampled schools. PSE should sample enough facilities of each type to detect a hypothesized difference in savings (e.g., 2%) with 80% or 90% likelihood (the statistical power of the test). If significant differences are found, PSE may be able to direct more program marketing resources to increasing the enrollment of government facilities or making changes to RCM program implementation to increase savings in schools.

Conclusion #8: Schools present a challenging environment for implementing O&M and BB measures. Our evaluation found that school districts saved only 0.6% of electricity consumption and did not have significant natural gas savings, relative to the previous year. These savings estimates align with anecdotes from RCMs about the difficulty of implementing O&M and BB measures in schools. Teachers and administrators have unusual autonomy over energy consumption in their offices and classrooms and may override energy efficiency measures. Although schools can pose challenges for implementing O&M and BB measures, they may still be fertile ground for achieving energy savings through capital projects.

Recommendation #4: Assist school RCMs in outreach about energy efficiency to teachers, administrators, and students. At the RCM annual meeting, schools RCMs shared challenges with implementing O&M and BB measures and requested training from PSE about how to engage building occupants in energy efficiency efforts.

Conclusion #9: It is not possible to verify PSE's assumption of a three-year measure life for the RCM program using billing analysis. Cadmus developed an analytical framework for estimating savings persistence and measure life through analysis of customer monthly energy bills. Estimating measure life requires the ability to observe the energy consumption of customer facilities after they stop participating in the RCM program. However, because of high customer satisfaction with the program,

approximately 90% of participants renew their participation at the end of their three-year terms. Because of PSE's and Cadmus' shared concern that customers who left the program may not have been representative of the program population, Cadmus did not perform the measure life analysis for customers who left.

> ***Recommendation #5: PSE should continue to use the three-year measure life estimate from the previous evaluation.*** [37] The three-year estimate is based on a bottom-up analysis of measure life of individual measures adopted by RCM participants. Although an estimate of measure life based on billing analysis would be preferable, the bottom up analysis is defensible and can serve as a placeholder until a more rigorous billing analysis can be performed. PSE should look for opportunities to estimate measure life based on billing analysis.

Conclusion #10: In general, PSE customers were pleased with the RCM program. Customers reported a high level of satisfaction with the program. Eleven of the 15 RCMs Cadmus interviewed said they were very satisfied or somewhat satisfied with the program. Seventy-nine percent of participants planned to continue participating in the program.

Conclusion #11: PSE's hands-on technical support for RCMs was a key component of participant satisfaction and motivation to continue with the program. Participants reported that the most valuable aspects of the program were technical assistance via training provided or paid for by PSE, access to energy consumption data, and data analysis tools. Many RCMs rated these features of the program more important than financial incentives.

> ***For consideration #4: As PSE rebrands the RCM program, it should highlight the program's hands-on technical assistance and ensure that the program is adequately staffed and resourced to continue this level of support.*** Energy management programs often involve close working relationships between utility staff and customers to implement energy efficiency projects. PSE should consider adding staff to the program to maintain the current level of support.

Conclusion #12: PSE could increase customer satisfaction and improve the customer experience by changing some administrative aspects of the program delivery. Some RCMs expressed concern about the burden of filling out quarterly reports, frustration with the functionality of MyDataManager, and confusion about how energy savings used in calculating incentive payments are estimated.

> ***For consideration #5: PSE should investigate potential improvements to the program in these areas.*** PSE has already simplified the reporting requirements, but it may be possible to simplify them further without hindering PSE's ability to collect data for

[37] *Resource Conservation Manager Program Evaluation. Report*. SBW Consulting, Inc. November 25, 2013. https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?rid=1840.

measurement and verification. For example, consider consolidating parameter and performance metrics on a single page. PSE should also consider increasing the frequency of MyDataManager trainings, providing "office hours" for RCMs who are struggling with the software, and using email blasts to highlight the software's features.

Conclusion #13: PSE may be able to increase customer satisfaction through better communication with participants. In expressing dissatisfaction with some aspects of the program, some RCMs demonstrated misunderstanding of some of the program's offerings. PSE has already addressed many of the issues that RCMs raised concerning MyDataManager, incentive payment calculations, and reporting requirements. This suggests that PSE could improve the customer experience by enhancing its communication.

Recommendation #6: PSE should communicate program improvements to RCMs multiple times and through several channels, including program newsletters, annual incentive payment reports, and the RCM Annual Meeting.

Conclusion #14: PSE can enhance the effectiveness of RCMs and increase program savings by sponsoring trainings on behavior change. RCMs said engaging building occupants in BB changes is challenging. Many would like to implement more BB measures, but they lack knowledge and need additional training in this area.

Recommendation #7: PSE should consider sponsoring trainings about implementing BB measures. This training could incorporate content about the psychology of behavior change as well as offer strategies and supporting materials for RCM's to utilize.

Conclusion #15: RCMs need help communicating the value of energy efficiency to their managers. RCMs said that energy efficiency projects compete for financial and human resources in their organizations, and they must convince executives, managers, and boards of energy efficiency's value. RCMs would like more assistance in making the business case for energy efficiency.

Recommendation #8: PSE should develop case studies to highlight the value of energy efficiency and successes of the RCM program. The case studies should demonstrate how the RCM program helped organizations overcome barriers to implementing energy efficiency projects and build a business case for making energy efficiency improvements.

Conclusion #16: PSE may be able to increase the effectiveness of RCMs by developing new training modules. RCMs rated the PSE trainings highly, but some RCMs were unable to attend the trainings. Also, RCMs have different levels of technical understanding, meaning some trainings may not be suitable for everyone.

For consideration #6: PSE should consider developing basic training modules and an online library of trainings. Developing basic training modules would ensure that new RCMs have a basic level of knowledge. Also, PSE should consider building an online

library of webinars to deliver training modules for common O&M issues. PSE could conduct a brief survey of RCMs to identify a list of most-pressing training needs.

Appendix A. Impact Methodology and Detailed Findings

Impact Evaluation Sampling

Cadmus sampled facilities from the population of approximately 40 participating customers and more than 1,000 facilities. We designed an evaluation sample to satisfy the regulatory requirement of estimating electricity and gas savings from the RCM program with 90% confidence and ±10% precision. The sampling plan and savings analysis addressed sampling uncertainty and regression uncertainty—the main factors that govern the final precision of our estimates.

Sample Design

Cadmus designed a stratified sample plan in which it stratified the population of participants by customer type and whether facilities had net-positive or net-negative savings during the 2015 and 2016 reporting years (referred to hereinafter as the net-savings stratum). We followed these steps to develop a final and optimal sample design:

Step 1. Reviewed program data and defined the sample frame

Cadmus requested savings summary and billing consumption data for all PSE customers that participated in the RCM program in 2015 and 2016. Cadmus cleaned and combined all data to develop a sample frame that included the following information about each facility:

- Facility name
- Baseline- and reporting-period start and end dates
- Total usage during baseline and reporting periods
- Metered usage
- Previously or currently claimed savings from capital projects
- Previously claimed RCM savings
- Meter numbers included in PSE's estimate of savings
- Baseline adjustments

Cadmus matched facilities in the savings summaries to account numbers in the monthly billing data that PSE provided and reviewed the final data for completeness and errors. PSE reviewed data for Cadmus' final sample as well.

Step 2. Determined stratification

Cadmus stratified the participant population by customer type and by whether PSE estimated net positive or negative RCM savings for each facility in the 2015 and 2016 reporting years. Based on guidance from the previous evaluation, PSE did not report negative savings estimates or investigate negative savings estimates as rigorously as it did positive savings estimates. Because facilities with negative RCM savings estimates experienced less rigorous data collection, Cadmus was concerned that the savings estimates for these facilities may be less accurate. Cadmus' stratification of facilities allowed

for the possibility that those with positive savings estimates could achieve different savings realization rates than those with negative savings estimates.

Step 3. Identified confidence and precision requirements

Cadmus designed the sample to meet 90% confidence and ±10% precision for verified RCM program savings estimates.

Step 4. Determined sample sizes

Cadmus determined the number of facilities to sample to meet the confidence and precision requirements by estimating the expected variation between evaluated savings across facilities within strata using PSE's estimated savings as a proxy for this variability. After estimating total sample sizes, Cadmus applied Neyman's Allocation[38] to distribute sample points to the strata. Neyman's Allocation incorporates the expected variability within each stratum and the number of facilities in each stratum's population. To ensure that the sample included facilities from each stratum, Cadmus set a minimum sample size of one customer in each stratum.

Step 5. Chose the sampling procedure

Cadmus sampled facilities in each stratum with probabilities proportional to the size of that facility's PSE-estimated savings. We chose this sampling procedure to ensure that we directly verified facilities that accounted for large portions of total program savings. This resulted in more accurate and precise estimates of program savings than simple stratified random sampling. Cadmus reviewed the resulting sample with PSE to ensure it met the evaluation requirements.

The following section describes the achieved sample sizes and savings distributions.

Achieved Sample Disposition

Table 17 displays the number of sampled facilities by reporting year. Cadmus did not set sampling targets for specific years, but instead ensured that facilities with savings reported in both 2015 and 2016 had a higher chance of selection to achieve reasonable counts in both reporting years.

[38] Cochran, William Gemmell. *Sampling Techniques*. 2nd ed. John Wiley & Sons, 1977.

Table 17. Sampled Facilities by Customer type and Year

Customer Type	Electric Facilities		Gas Facilities	
	2015 Reporting Year	2016 Reporting Year [1]	2015 Reporting Year	2016 Reporting Year [1]
Government	4	2	8	5
Higher Education	4	3	1	0
Hospital	2	1	2	1
Non-Profit	2	0	N/A	N/A
School District	28	22	20	20
Program Total	**40**	**28**	**31**	**26**

[1] PSE had not completed its savings estimates for the 2016 reporting period when the evaluation began for many participating facilities, which resulted in fewer facilities in the 2016 reporting period than in the 2015 reporting period. This does not indicate a loss of participants in 2016.

Cadmus verified all savings estimated for sampled facilities, regardless of the stratum into which the facility was originally selected. For example, Cadmus selected some facilities receiving gas and electricity service for the gas sample, but Cadmus estimated both gas and electricity for these facilities. While this increased the share of overall program savings Cadmus verified, it also, at times, violated the assumptions of PPS sampling. However, Cadmus chose to sample with probability of selection proportional to facilities' estimated savings to increase the probability that the largest savers would be sampled. Table 18 provides the proportion of overall stratum estimated savings captured by sampled facilities. Cadmus accounted for any violations of PPS sampling when applying weights to estimate final program savings.

Table 18. Proportion of Program Estimated Savings Sampled by Stratum

Customer Type	Proportion of Electricity Savings		Proportion of Natural Gas Savings	
	Positive Estimated Savings	Negative Estimated Savings	Positive Estimated Savings	Negative Estimated Savings
Government	54%	1%	16%	20%
Higher Education	5%	12%	55%	N/A
Hospital	20%	44%	23%	53%
Non-Profit	21%	30%	N/A	N/A
School District	13%	15%	7%	4%

[1] Table provides proportion of electricity and natural gas savings as estimated by PSE.

To check whether the final sample met the assumptions of PPS sampling, Cadmus compared the distribution of sampled estimated savings to the population estimated savings, by stratum. Cadmus determined whether the sample within each stratum met the assumptions of PPS sampling based on the following criteria:

- The correlation between estimated and evaluated savings was not strong (< 0.95).
- The distribution of estimated savings was similar between the sample and the population, suggesting that simple random sampling would have produced a similarly distributed sample.
- The sample comprised of fewer than three facilities.[39]

Table 19 lists whether each stratum met PPS sampling assumptions or appeared as if simple random sampling (SRS) had been used. Note that the weighted and unweighted realization rates are the same for strata with only one sampled facility. Weighted and unweighted realization rates for strata with two facilities were within 2.3% of each other.

Table 19. Sampling Assumptions for Weights

Customer Type	Electric Facilities		Natural Gas Facilities	
	Positive	Negative	Positive	Negative
Government	PPS	SRS(3)	PPS	PPS
Higher Education	SRS(3)	SRS(3)	SRS(3)	SRS(3)
Hospital	SRS(3)	SRS(3)	SRS(3)	SRS(3)
Non-Profit	SRS(3)	SRS(3)	N/A	N/A
School District	SRS(1)	SRS(1)	SRS(1)	SRS(2)

(1) Correlation less than 0.95.
(2) Distribution of sample estimated savings representative of population estimated savings.
(3) Sample comprised of fewer than three facilities.

Table 20 shows the average daily electricity consumption for the baseline and reporting periods, as well as the average base temperatures for HDD and CDD for the sampled electricity facilities. Table 21 shows the same elements for sampled natural gas facilities. Standard deviations describing the amount of spread in the data are provided below point estimates in parentheses. All customer types showed a large spread in average daily consumption across facilities, which was expected because of the wide variety of facility types, even within customer types, in the RCM population and sample.

The spread around HDD and CDD base temperatures used in electricity and natural gas models was smaller, suggesting that within customer type and fuel, base temperatures tended toward point estimates with more regularity.

[39] Correlation cannot be determined from fewer than three observations.

Table 20. RCM Analysis Electricity Sample Summary Statistics

Customer type	Average Daily Consumption (kWh)			Average Base Temperature (°F)	
	Baseline Period	2015 Reporting Period	2016 Reporting Period	HDD	CDD
Government	9,299 (9,177)	6,342 (5,902)	7,799 (7099)	49 (4.2)	54 (9.0)
Higher Education	8,601 (11,946)	8,271 (11,396)	2,572 (1,716)	50 (N/A)	50 (0.7)
Hospital	9,415 (9,405)	9,370 (9,990)	2,212 (N/A)	52 (N/A)	53 (10.6)
Nonprofit	1,718 (428)	1,569 (452)	N/A	48 (N/A)	49 (0.7)
School District	3,069 (2,421)	2,652 (2,200)	2,623 (2,187)	54 (7.4)	58 (5.8)
All Facilities	**4,309 (5,279)**	**3,865 (4,908)**	**2,973 (2,769)**	**53 (7.1)**	**55 (6.7)**

(1) Table presents sample means for average daily consumption and average base temperatures.
(2) Standard deviations of sample means are provided below point estimates in parentheses. Standard deviations cannot be calculated when there are fewer than two facilities in the customer type.

Table 21. RCM Analysis Natural Gas Sample Summary Statistics

Customer type	Average Daily Consumption (therms)			Average Base Temperature (°F)	
	Baseline	2015 Reporting Period	2016 Reporting Period	HDD	CDD
Government	103 (74)	72 (74)	70 (64)	58 (4.8)	N/A
Higher Education	1,053 (N/A)	790 (N/A)	N/A	62 (N/A)	N/A
Hospital	226 (219)	195 (201)	54 (N/A)	62 (7.1)	59 (N/A)
School District	107 (119)	75 (60)	76 (56)	57 (5.6)	48 (4.2)
All Facilities	**143 (201)**	**105 (148)**	**74 (55)**	**58 (5.4)**	**52 (7.0)**

(1) Table presents sample means for average daily consumption and average base temperatures.
(2) Standard deviations of sample means are provided below point estimates in parentheses. Standard deviations cannot be calculated when there are fewer than two facilities in the customer type.

Estimated Facility and RCM Savings

Cadmus estimated incremental annual electric and natural gas savings in 2015 and 2016 for each sampled RCM participant as follows: First, we verified the PSE-estimated incremental savings for each

sampled facility. Next, we calculated realization rates and estimated incremental savings for all facilities in the population. The sections below describe these steps in detail.

Facility-Level Savings Estimation

Cadmus estimated the incremental electricity and gas *facility* and *RCM savings* for each sampled facility. Incremental facility savings are gross energy savings that include any energy savings from capital projects that received incentives from PSE energy efficiency programs, relative to the previous year. We estimated incremental facility savings by taking the difference between the *adjusted baseline consumption* and *metered consumption* during the *reporting period* (the period over which savings were measured) and subtracting all RCM savings reported in the previous two years and any previously reported capital project savings. Adjusted baseline consumption was a regression-based prediction of what the facility's consumption would have been during the reporting period if the facility had not participated in the RCM program.

Incremental RCM savings are defined as net energy savings and calculated as the difference between facility savings and savings from incentivized projects. It is expected that the RCM energy savings are primarily from O&M and BB measures, though RCM savings could also include savings from capital projects that did not receive PSE incentives.

Review Documentation

Cadmus requested and reviewed project documentation for each of the sampled facilities. The documentation included details about RCM activities, such as implementation dates and descriptions of O&M and BB measures as well as claimed savings and installation dates of capital projects rebated through other PSE energy efficiency programs. Using a combination of savings summaries and project documentation, Cadmus verified the following in the data review:

- ***Facility boundaries (the area over which energy use was measured).*** Cadmus verified that the facility boundaries were measured consistently over time by graphing energy consumption over time and investigating anomalous spikes or drops. Cadmus also compared total usage in the baseline year and reporting year to the usage PSE reported in its savings summaries. Cadmus reached out to PSE when questions arose to better understand and account for unexpected results. Many school districts added portables to meters we used to estimate facility savings. In these cases, Cadmus increased consumption in the months before the portables were added to reflect the additional square footage.
- ***Facility baseline period definition.*** Cadmus determined the evaluability of facilities in part by verifying that their baseline periods included at least 12 months to account for any seasonality in facility energy use. Cadmus also verified that the baseline period it used to estimate savings aligned with the baselined period PSE used.
- ***Facility reporting period definition.*** Cadmus verified that the months it included in its reporting period aligned with the months PSE used to estimate savings.

Estimate Adjusted Baseline Consumption

Cadmus used the forecast regression method to estimate the adjusted baseline consumption for each facility. The forecast model approach is recommended for estimating facility savings in IPMVP Option C and in the U.S. DOE's Uniform Methods Project Strategic Energy Management Program Evaluation Protocols.[40]

Cadmus built a separate regression model for each sampled facility and fuel delivered by PSE (i.e., one model for facilities with *either* gas or electric savings estimates and two for those with savings estimates for *both* types of fuel). Details of the main steps in building the models follow.

Step 1. Identified Candidate Variables

Cadmus identified candidate variables for the regression model by selecting factors that were potential significant drivers of facility energy consumption. Because all facilities in the RCM program during the 2015 and 2016 reporting years were commercial facilities, Cadmus considered the following candidate variables for all sampled facilities:

- **Facility shutdowns or closures:** Facility shutdowns or closures were expected to reduce energy consumption. Cadmus accounted for these days by including school closure days (for school models) and federal holidays for other facility-type models as candidate variables in the model selection.
- **Weather*:*** Weather was expected to be a significant driver of energy consumption in commercial facilities. Cadmus included HDDs and CDDs as candidate variables in the model selection. HDDs and CDDs were calculated from daily mean temperatures obtained from the National Oceanic and Atmospheric Administration (NOAA).[41] To model monthly billing consumption, we aggregated daily HDDs and CDDs across days within each billing cycle and then calendarized them alongside consumption. Cadmus optimized the selection of HDD and CDD base temperatures by testing all pairs of HDD and CDD base temperatures between 45°F and 85°F, which Cadmus considered reasonable set points. The final base temperature pair maximized model adjusted R^2.

Step 2. Selected and estimated final baseline regression model

Equation 1 provides the general form of the baseline consumption model:

Equation 1

$$e_t = \alpha + f(weather_t, \beta) + g(other_t, \gamma) + \varepsilon_t$$

[40] Stewart, James. "Chapter 24: Strategic Energy Management (SEM) Evaluation Protocol." *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures,* May 2017. doi: 10.2172/1358337.

[41] "National Centers for Environmental Information." National Climatic Data Center. Accessed March 30, 2018. https://www.ncdc.noaa.gov/.

with model variables defined as follows:

t = The t^{th}month, $t = 1, \ldots, T$. For example, $T = 12$ if monthly energy use was modeled and energy-use data were available for a full year.

e_t = Energy consumption of the facility during the t^{th} month.

α = Intercept indicating facility average base load energy use per interval.

$weather_t$ = A vector of different outdoor temperature variables (e.g., HDD and CDD) affecting facility energy use during the t^{th} month.

β = A vector of coefficients that indicates the relationship between energy use and weather. For example, the coefficient on HDD would indicate average energy use per additional heating degree day.

$other_t$ = A vector of additional explanatory variables and/or indicators related to a facility's energy consumption during the t^{th} month. This typically only included facility closures.

γ = A coefficient vector that indicates the relationship between the additional explanatory variables and energy consumption.

ε_t = The model error term representing unobservable influences on energy consumption in month t.

Cadmus fit and tested several baseline model specifications for each facility, selecting the model that best fit the facility's baseline period energy consumption. Because of the small number of candidate variables (HDDs, CDDs, and closures), Cadmus fit a separate model for every combination. For example, for a facility receiving electricity service, Cadmus fit seven candidate models (three with an intercept and one variable, three with an intercept and two variables, and one with an intercept and three variables). Cadmus estimated all models by ordinary least squares (OLS).

We selected the final adjusted baseline consumption model based on the following criteria:

- ***Accuracy of within-sample prediction:*** Cadmus verified that the model accurately predicted consumption during intervals included in the baseline period.
- ***Expected signs and statistical significance of the coefficients:*** Cadmus verified that the regression coefficients had the expected signs and were statistically significant using standard *t* tests and *F* tests.
- ***Overall explanatory power:*** Cadmus checked the adjusted R^2 of the regression. A high adjusted R^2 indicated that the explanatory variables in the model explained most of the variation in consumption. Regression models with adjusted R^2 values of less than 0.6 were considered inadequate.

Step 3. Estimated adjusted baseline

For each month of a facility's reporting period, Cadmus used the best baseline model to calculate the adjusted baseline energy use:

Equation 2

$$\widehat{e_t} = \hat{\alpha} + f\left(outside\ temperature_t, \hat{\beta}\right) + g(other_t, \hat{\gamma})$$

where $\widehat{e_t}$ is the adjusted baseline energy use for month t and ˆ denotes an estimate. The outside temperature and other variables are the actual values of these variables during the reporting period. As previously noted, adjusted baseline consumption is an estimate of energy consumption if the RCM program had not been implemented and the facility operated in the reporting period as it had during the baseline period.

Estimate Facility Savings

Cadmus estimated energy savings during month t of the reporting period,s_t, according to Equation 3:

Equation 3

$$\hat{s}_t = \widehat{e_t} - e_t$$

Energy savings during the reporting period,S, equal the sum of savings over the T intervals of the reporting period (Equation 4):

Equation 4

$$S = \sum_{t=1}^{T} \hat{s}_t$$

Cadmus estimated RCM savings for each i^{th} facility ($\hat{y}_i$) by subtracting any capital projects incentivized through other PSE programs (S_K) during the reporting period from S (Equation 5):

Equation 5

$$\hat{y}_i = S - S_K$$

Cadmus obtained estimates of the facility's capital project savings from the program savings summaries.

Non-routine Adjustments

A non-routine adjustment is an out-of-model adjustment to metered energy use that accounts for a change in the facility's energy consumption that was unrelated to the RCM program. Cadmus made several non-routine adjustments to the energy consumption of schools to account for the addition or removal of portable classrooms. We adjusted energy consumption in the baseline period by the ratio of new square footage to old square footage at the facilities. PSE applied the same methodology and provided Cadmus with the floor square footage to make the adjustments.

Illustration of Model Selection and Savings Estimation

The following example illustrates model selection by outlining the process for estimating electricity savings at an example facility.

Cadmus used baseline period consumption to select HDD and CDD base temperatures by choosing the pair that maximized the adjusted R^2. Cadmus included facility closures as an independent variable when selecting best base temperatures, but removed them and re-selected base temperatures if facility

closures were not included in the final model. In the example facility, the data selected base temperatures of 53°F and 59°F for HDD and CDD, respectively.

Table 22 provides the model specifications Cadmus tested and fit statistics used to select a final model. Cadmus looked at both the adjusted R^2 and Akaike Information Criteria (AIC)[42] for each tested model specification. Smaller AIC values suggest better-fitting models. In the example, all three candidate variables on their own controlled for more than 36% of the variability in consumption in the baseline period, but including all three resulted in the best-fitting model according to both the adjusted R^2 and AIC. Therefore, Model 7 was selected for this example facility.

Table 22. Model Fit Statistics for Example Facility

Model	HDD 53	CDD 59	Closures	Adjusted R^2 (1)	AIC (2)
1	●			0.79	133
2		●		0.60	140
3			●	0.36	146
4	●	●		0.87	128
5	●		●	0.94	120
6		●	●	0.58	142
7	●	●	●	***0.97***	***112***

(1) The model with the highest adjusted R^2 controls for the most variation in the data.

(2) The model with the smallest AIC controls for the most variation in the data but penalizes for the inclusion of unnecessary variables.

Table 23 displays the estimated coefficients and significance of variables included in the selected model. Cadmus looked for significance of variables as well as interpretability of coefficient estimates. All three variables in the example were significant at the 5% significance level, suggesting that true coefficients are significantly different from zero. The signs of coefficients were what Cadmus expected: as HDDs and CDDs increased, consumption increased (positive coefficients). When the facility was closed, consumption decreased (negative coefficient).

[42] Like the adjusted R^2, the AIC informs users of the model quality, considering the amount of variability controlled for by the current model. It puts a greater penalty on including additional variables and is more likely than the adjusted R^2 to suggest simpler models.

Table 23. Final Model Specification for Example Facility

Term	Coefficient Estimate (average kWh/day)	Standard Error (kWh/day)	Test Statistic	p-value [(1)]
Intercept	1,425	61	23.44	< 0.0001
HDD 53	99	10	10.30	< 0.0001
CDD 59	84	27	3.13	0.0141
Closures	-65	12	-5.33	0.0007

[(1)] There is evidence to suggest the true coefficient value is significantly different from zero at the 5% significance level when the p-value is less than 0.05.

Cadmus also looked at the graph of consumption over time to investigate the model fit (provided in Figure 12 for the example facility), specifically identifying where Cadmus' adjusted baseline (purple) did not accurately predict consumption in the baseline period and noting when PSE's adjusted baseline (green) may fit better.[43] At this example facility, consumption clearly follows a seasonal pattern, which was captured by the HDD and CDD variables, and is affected by facility closures. During the reporting period, savings are suggested by the consistently higher-than-metered adjusted baseline consumption.

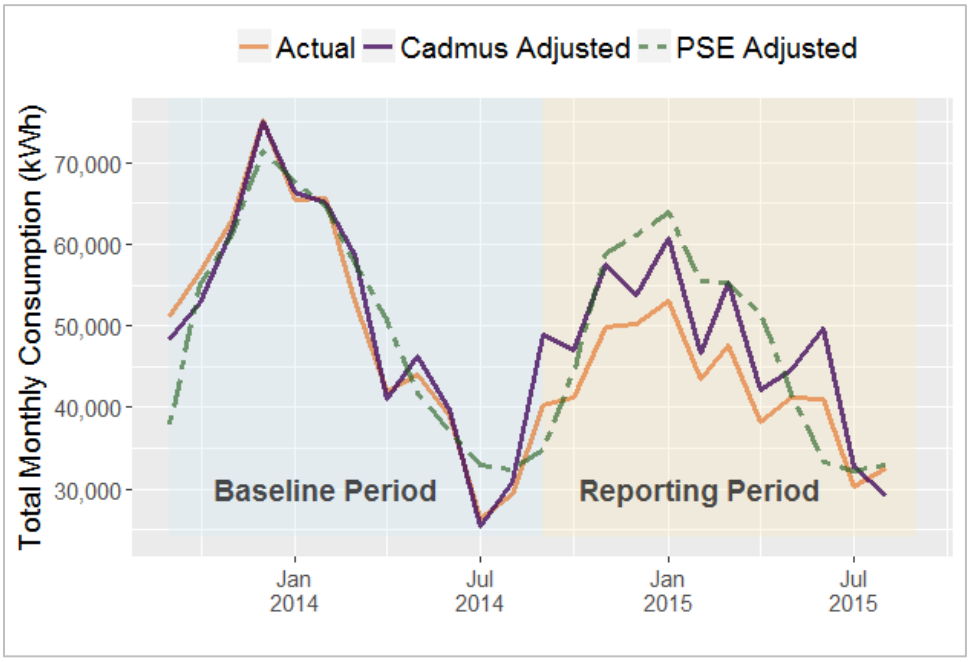

Figure 12. Consumption Over Time at Example Facility

Note: This graph shows the consumption over time plot for an example facility based on actual metered consumption (orange), Cadmus' adjusted baseline consumption (purple), and PSE's adjusted baseline consumption (green, based on PSE's model specification and Cadmus' calendarized weather and monthly bills). The blue shaded region shows the baseline period, while the shaded orange region shows the reporting period.

[43] To estimate PSE's adjusted baseline (green), Cadmus specified PSE's model and base temperatures, but used Cadmus' calendarized HDD and CDD variables, which does not reflect how PSE calendarized HDDs and CDDs.

Facility-Level Regression Details

The following sections present results of the facility-level analyses of electricity and natural gas consumption.

HDD and CDD Selections for Electricity and Natural Gas Models

Cadmus selected HDD and CDD base temperatures for each facility by choosing the pair of base temperatures that maximized adjusted R^2. Table 24 shows the count of models that included the candidate explanatory variables (HDD, CDD, and facility closures). As expected, natural gas models rarely included CDD as a significant explanatory variable.[44]

Table 24. Count of Electricity and Natural Gas Models Including Candidate Variables

Sector	Electricity Models			Natural Gas Models		
	HDD	CDD	Facility Closures	HDD	CDD	Facility Closures
Government	2	3	0	8	0	0
Higher Education	1	2	2	1	0	1
Hospital	1	2	1	2	1	1
Non-Profit	1	2	1	N/A	N/A	N/A
School District	24	15	28	20	2	8
Program Total	**29**	**24**	**32**	**23**	**3**	**10**

Figure 13 provides the distribution of base temperatures of used in the baseline electricity consumption models. Cadmus only allowed base temperatures in the range of 45°F and 85° and required that HDD base temperatures be equal to or lower than CDD base temperatures at each facility. Actual HDD base temperatures ranged between 45°F and 68°F; 50% of electric models had a base temperature less than 52.5°F. Actual CDD base temperatures ranged between 45°F and 72°F.

[44] Cadmus included CDD as an explanatory variable in only three natural gas models (one hospital facility and two school facilities). In these cases, the signs of the CDD coefficient estimates were negative, indicating a slope change in the relationship between temperature and natural gas consumption. Cadmus believed that the CDD variable was picking up other effects not controlled for by separate regressors in the regression model and included CDD as an explanatory variable in these cases because it significantly improved model fit.

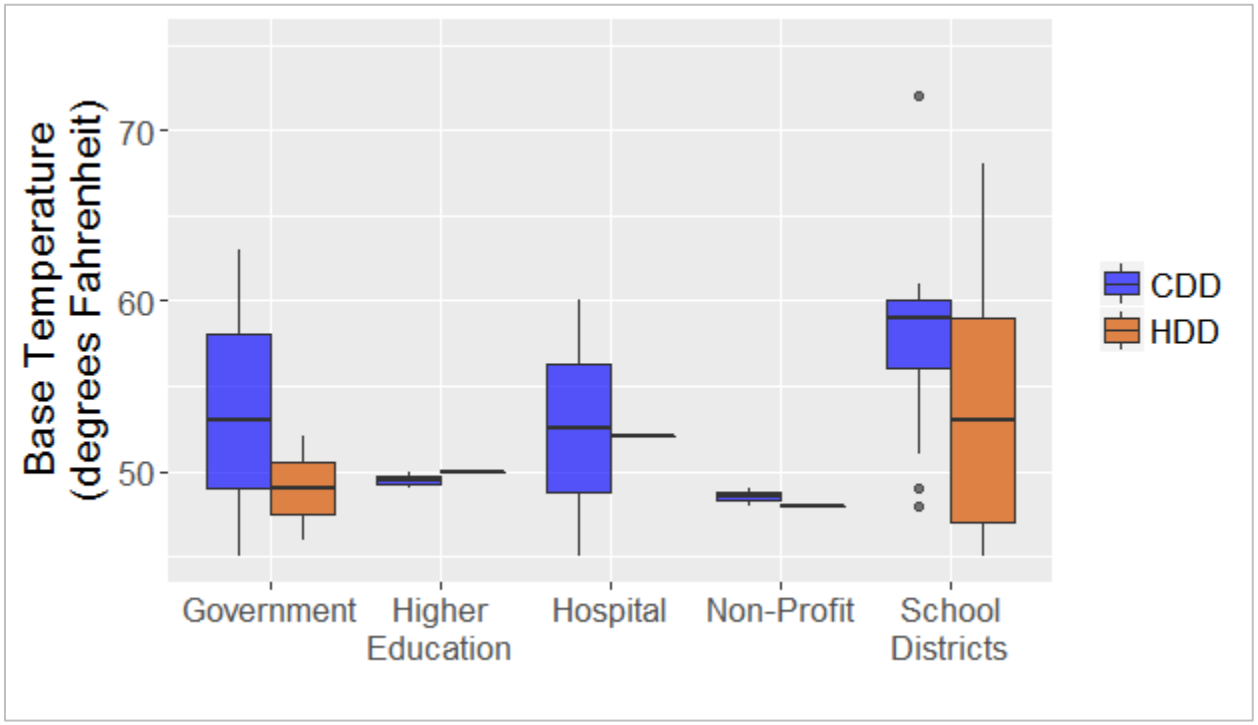

Figure 13. Distribution of HDD and CDD Base Temperatures in Electric Models

Note: The height of each box describes the variability in adjusted R^2 statistics between facilities. Taller boxes indicate more variability. The data is broken into three components: The box itself contains 50% of the facilities, and each extending segment contains 25% of the facilities. The mean is located in the center of each box, and the median is described by the line running through each box.

As with electric models, Cadmus chose HDD and CDD base temperatures for natural gas models by selecting the pair of base temperatures that maximized the adjusted R^2. However, because of how infrequently natural gas models included CDD as a significant explanatory variable, Cadmus usually selected only the HDD base temperature that maximized the adjusted R^2. Figure 14 provides the distribution of HDD base temperatures used in natural gas models. On average, natural gas models selected a base temperature for HDD of about 58°F: across all natural gas models the HDD base temperatures ranged from 45°F to 67°F. Note that Cadmus used an HDD base temperature of 45°F for both school facility models that included CDD.

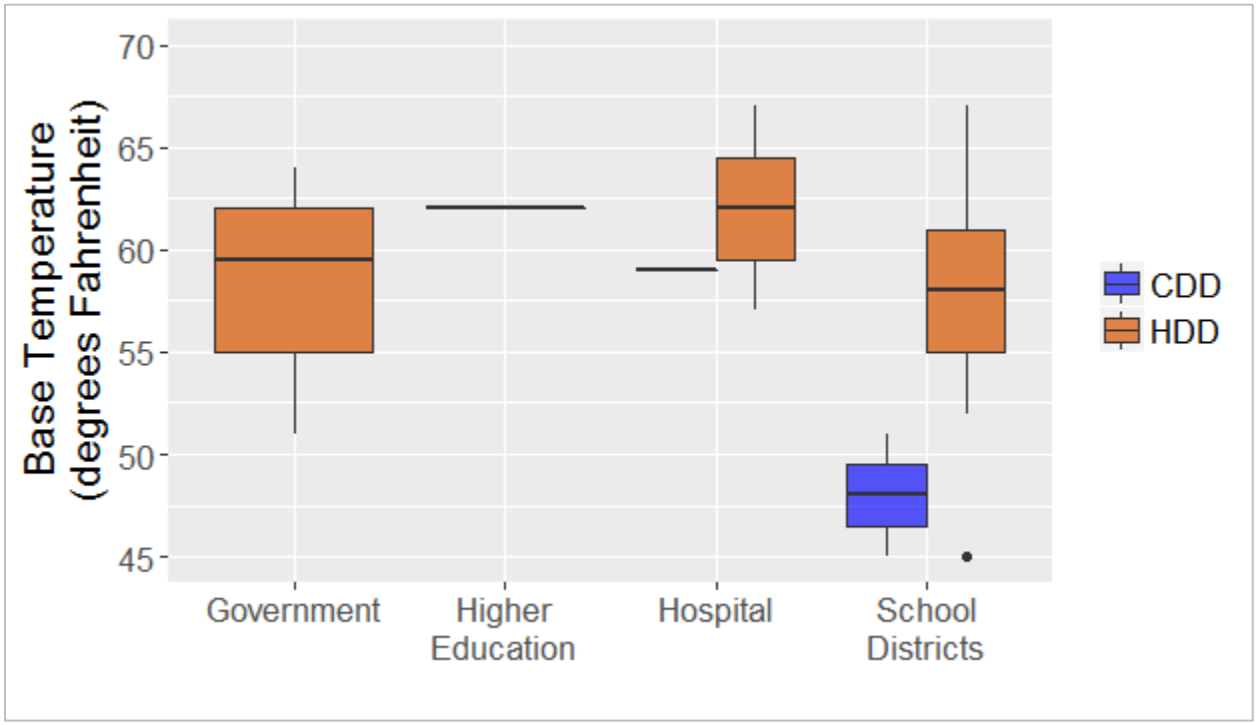

Figure 14. Distribution of HDD and CDD Base Temperatures in Natural Gas Models

Note: The height of each box describes the variability in adjusted R^2 statistics between facilities. Taller boxes indicate more variability. The data is broken into three components: The box itself contains 50% of the facilities, and each extending segment contains 25% of the facilities. The mean is located in the center of each box, and the median is described by the line running through each box.

Fit Statistics for Electricity and Natural Gas Models

Cadmus reduced modeling uncertainty by allowing the data to determine optimal HDD and CDD base temperatures and the combination of HDD, CDD, and facility closure days variables that maximized the model adjusted R^2. Figure 15 provides the distribution of adjusted R^2 statistics for sampled facilities. The adjusted R^2 measures the variability in consumption explained by the model independent variables. For most strata, the regressions explained most of the month-to-month variability of consumption. The average adjusted R^2 exceeded .85 for all customer types except higher education. Cadmus fit the intercept to evaluate savings only in cases when it could not exceed an adjusted R^2 of 0.6 and none of the variables were statistically significant (this was the case for only three facilities).

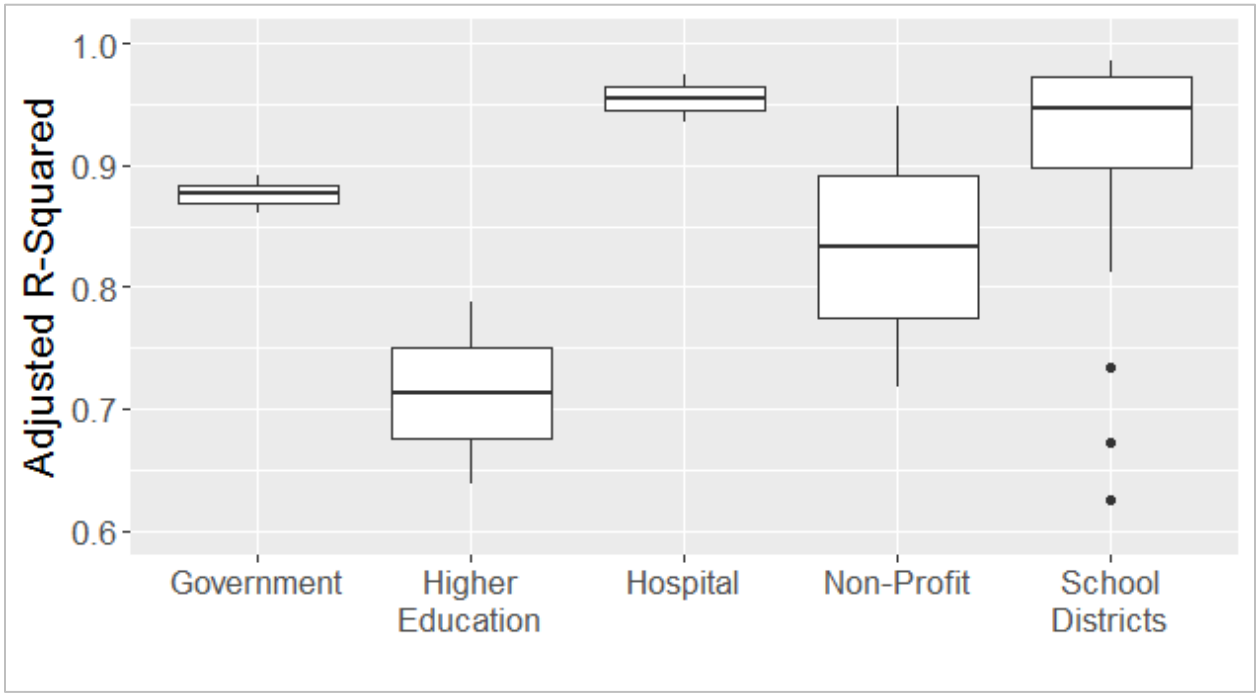

Figure 15. Distribution of Adjusted R2 Statistics Across Electric Models within Each Customer Type

Note: The height of each box describes the variability in adjusted R^2 statistics between facilities. Taller boxes indicate more variability. The data is broken into three components: The box itself contains 50% of the facilities, and each extending segment contains 25% of the facilities. The mean is located in the center of each box, and the median is described by the line running through each box.

Figure 16 shows the distribution of natural gas regression model adjusted R^2 statistics for each customer type. Cadmus consistently built baseline models that exceeded an adjusted R^2 of 0.9. We more frequently achieved lower adjusted R^2 values for school facilities, which was consistent with the adjusted R^2 statistics for the electric models. However, all natural gas models met the adjusted R^2 threshold of 0.6.

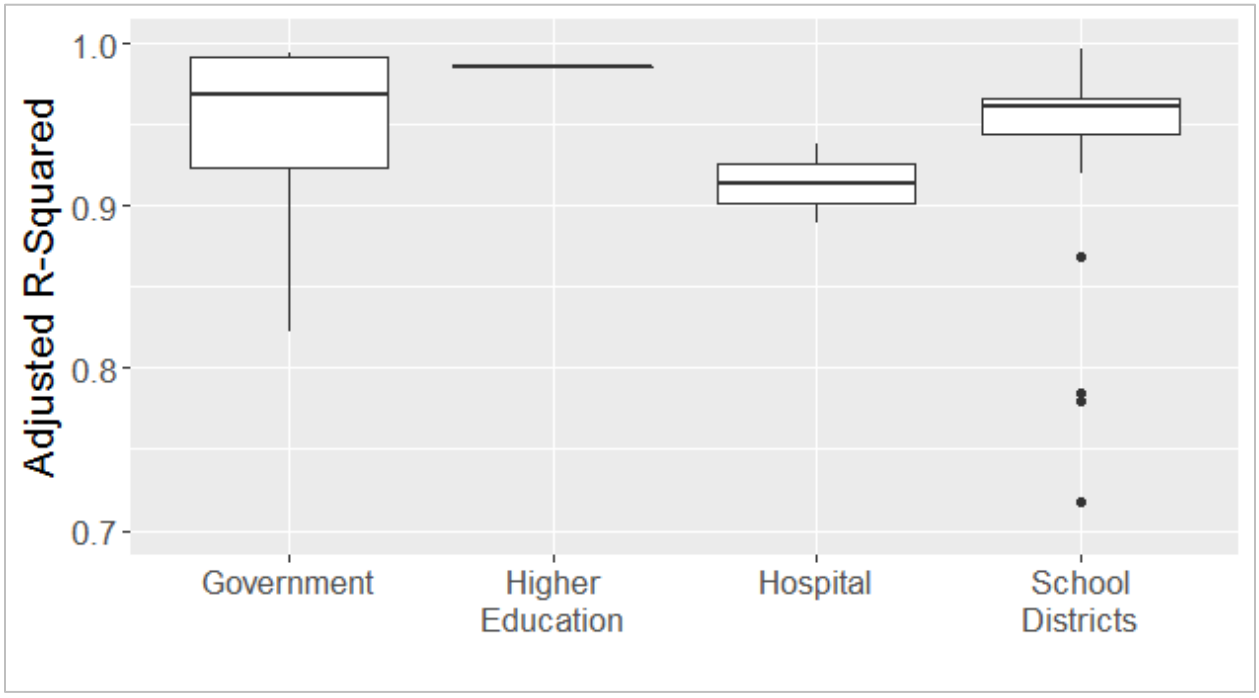

Figure 16. Distribution of Adjusted R2 Values Across Natural Gas Models

Note: The height of each box describes the variability in adjusted R^2 statistics between facilities. Taller boxes indicate more variability. The data is broken into three components: The box itself contains 50% of the facilities, and each extending segment contains 25% of the facilities. The mean is located in the center of each box, and the median is described by the line running through each box.

Individual Facility RCM Savings Estimates

Figure 17 illustrates the distribution of unweighted electricity incremental percentage savings for sampled facilities by customer type. Across customer types, the spread of incremental percentage savings was consistent, though school districts experienced the most variability in percentage savings. The distribution of percentage savings in government and school district facilities was heavily skewed; the middle of each box (the mean) is much lower than the line in each box (the median), demonstrating that while a few facilities pulled down the group mean, Cadmus estimated more than 50% of facilities achieved greater savings. Most customer types experienced similar percentage savings between net-savings strata.

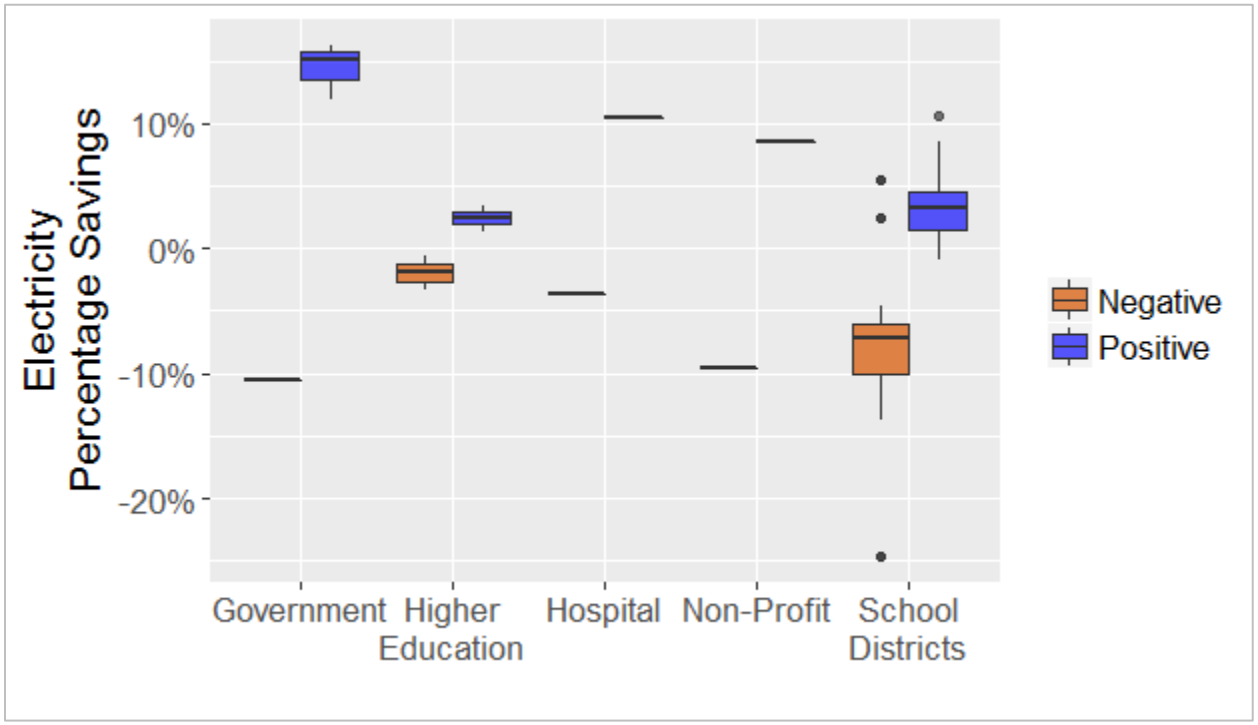

Figure 17. Distribution of Sample Electricity Incremental Percentage Savings by Customer Type and Net-Savings Stratum

Note: The height of each box describes the variability in adjusted R^2 statistics between facilities. Taller boxes indicate more variability. The data is broken into three components: The box itself contains 50% of the facilities, and each extending segment contains 25% of the facilities. The mean is located in the center of each box, and the median is described by the line running through each box.

Figure 18 displays the distribution of natural gas incremental percentage savings for the sampled facilities. Natural gas government facilities experienced more variability in incremental percentage savings than did electric government facilities, though like the previous figure, the distribution is skewed. Cadmus estimated incremental natural gas percentage savings of greater than 20% for more than 50% of government facilities. Most customer types experienced similar incremental percentage savings between net-savings strata, though variability in percentage savings for net-negative school district facilities was greater than net-positive facilities and further away from zero.

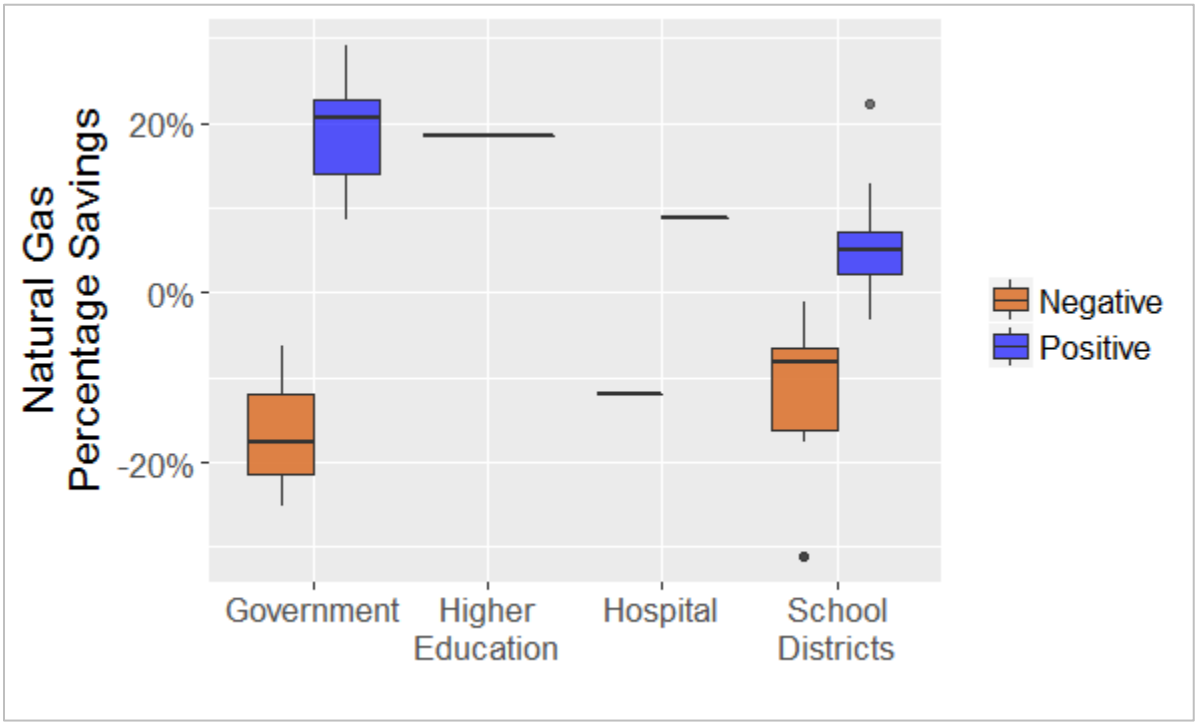

Figure 18. Distribution of Sample Natural Gas Percentage Savings by Customer Type and Net-Savings Stratum

Note: The height of each box describes the variability in adjusted R^2 statistics between facilities. Taller boxes indicate more variability. The data is broken into three components: The box itself contains 50% of the facilities, and each extending segment contains 25% of the facilities. The mean is located in the center of each box, and the median is described by the line running through each box.

RCM Program Savings Estimation

After estimating incremental savings for all sampled facilities, Cadmus calculated a weighted realization rate for each customer type and net-savings stratum. Because we sampled facilities with probability proportional to PSE's estimated savings, we weighted realization rates according to each facility's probability of selection. The weights standardize facility-level realization rates so that facilities with large estimated savings do not overrepresent the population. Cadmus used Equation 6 to estimate a realization rate for each stratum:

Equation 6

$$\widehat{RR}_h = \frac{1}{\hat{X}_h n} \sum_{i=1}^{n} w_{hi} \hat{y}_{hi}$$

where

$\widehat{RR}_h$ = Estimated RCM savings realization rate for stratum h

$\hat{X}_h$ = PSE's estimated RCM savings in stratum h

n = Number of sampled facilities in stratum h

w_{hi} = Weight of facility i in stratum h, calculated as the inverse probability of selection

$\hat{y}_{hi}$ = Estimated RCM savings for facility i in stratum h

Cadmus applied unweighted realization rates to strata that did not meet PPS sampling assumptions (provided previously in Table 19), calculated according to Equation 7:

Equation 7

$$\widehat{RR}_h = \frac{\sum_{i=1}^{n} \hat{y}_{hi}}{\sum_{i=1}^{n} x_{hi}}$$

where x_{hi} is the estimated savings for facility i in stratum h. Cadmus calculated program total evaluated savings, $\hat{Y}$, using Equation 8:

Equation 8

$$\hat{Y} = \sum_{h=1} X_h * \widehat{RR}_h$$

The following provide details of program savings broken out by net-savings strata.

Electricity Evaluated Savings Detailed Findings

Cadmus evaluated an overall program realization rate of 77% for facilities with net-positive incremental savings across the 2015 and 2016 reporting years. We stratified by net-positive and net-negative facilities because facilities with negative savings estimates did not experience the level of rigor when savings were initially estimated as did facilities with positive savings. Cadmus and PSE expected facilities with negative savings to be estimated with less accuracy than net-positive sites.

Table 25 presents the evaluated incremental electricity savings by customer type for facilities with net-positive savings. School districts primarily drove the realization rate, as savings from this stratum accounted for 41% of program evaluated savings for positive-saving electric facilities; Cadmus estimated a realization rate of 61% for this stratum.

Table 25. Positive-Saving Electric Facilities

Customer type	Count of Facilities	Realization Rate	PSE- Estimated Population Savings (kWh)	Evaluated Population Savings (kWh)	Relative Precision [1]
Government	3	93%	6,434,261	6,012,989	14%
Higher Education	2	96%	2,073,487	1,987,078	6%
Hospital	1	120%	665,587	801,975	N/A
Non-Profit	1	62%	343,790	213,807	N/A
School District	16	61%	10,250,352	6,290,780	20%
Program Total	**23**	**77%**	**19,767,476**	**15,306,630**	**10%**

[1] Note that Cadmus cannot calculate relative precision when it verified savings for fewer than two facilities in a stratum. However, variance from these strata is still included in total relative precision.

Table 26 provides the evaluation results for facilities with net-negative estimated incremental savings. Cadmus evaluated an overall program realization rate of 68% for this subset of facilities, meaning that overall, Cadmus found smaller negative savings than PSE estimated. Like the positive-saving facilities, the school district customer type drove the overall realization rate because it accounted for 68% of the total evaluated savings in this subset.

Table 26. Negative-Saving Electric Facilities

Customer type	Count of Facilities	Realization Rate	PSE-Estimated Population Savings (kWh)	Evaluated Population Savings (kWh)	Relative Precision [1]
Government	1	100%	-1,380,544	-1,382,985	N/A
Higher Education	2	58%	-849,226	-496,423	14%
Hospital	1	91%	-398,143	-362,266	N/A
Non-Profit	1	178%	-132,167	-235,261	N/A
School District	13	60%	-7,568,202	-4,510,147	24%
Program Total	**18**	**68%**	**-10,328,283**	**-6,987,081**	**16%**

[1] Note that Cadmus cannot calculate relative precision when it verified savings for fewer than two facilities in a stratum. However, variance from these strata is still included in total relative precision.

Figure 19 provides evaluated incremental electric savings as a percentage of adjusted baseline consumption by customer type and net-savings stratum. The government customer type positive-saving facilities showed the largest percentage saving (14.4% of electricity consumption on average) when compared to their adjusted baseline. The hospital and non-profit positive-saving facilities also achieved high percentage savings (10.5% and 8.5%, respectively), but these figures are based on savings from only one facility in each customer type.

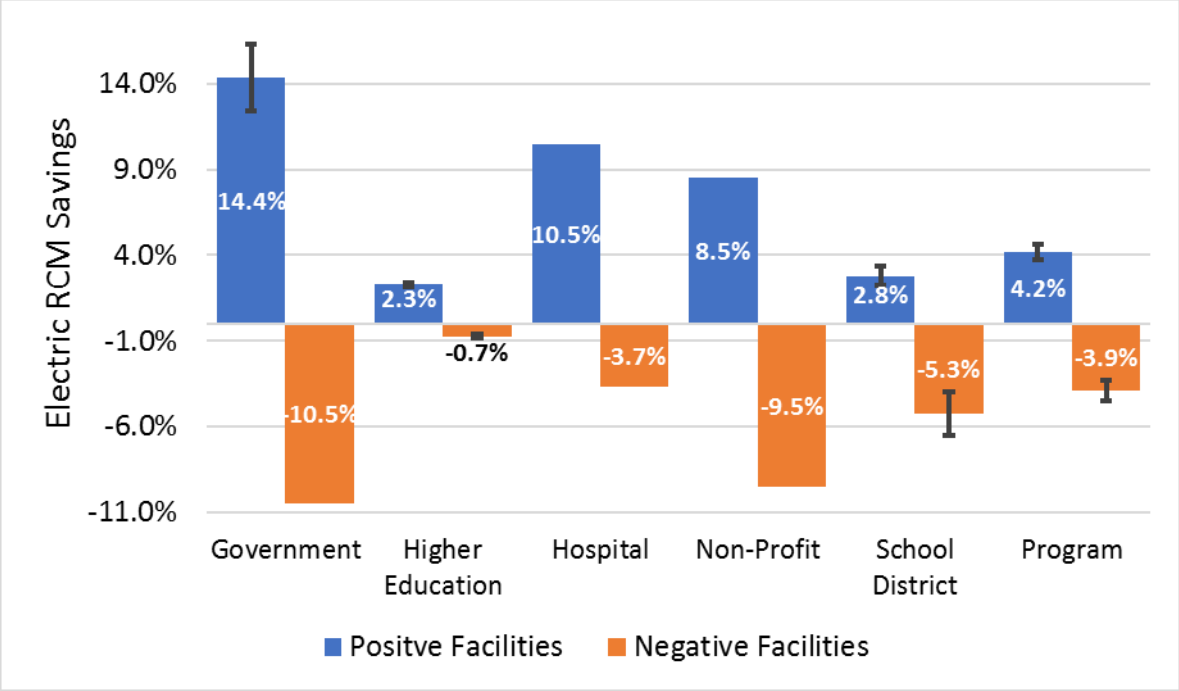

Figure 19. Electric Evaluated Incremental Savings as Percentage of Adjusted Baseline Consumption, by Customer Type and Net-Savings Stratum

Note: Positive and negative facility savings shown as a percentage of adjusted baseline consumption. Error bars show the 90% confidence intervals around point estimates. In some cases, confidence intervals could be calculated because there were too few facilities in a stratum.

Natural Gas Evaluated Savings Detailed Findings

Cadmus estimated an overall realization rate of 81% for incrementally positive-saving natural gas facilities. Table 27 presents all results for these facilities by customer type. As with the distribution of electricity savings across customer types, school districts contributed the majority of positive incremental natural gas estimated savings (62%) and were therefore the primary drivers of the overall realization rate.

Table 27. Positive-Saving Natural Gas Facilities

Customer type	Count of Facilities	Realization Rate	PSE- Estimated Population Savings (therms)	Evaluated Population Savings (therms)	Relative Precision [1]
Government	5	83%	337,142	281,147	11%
Higher Education	1	100%	119,665	119,917	N/A
Hospital	1	92%	20,146	18,489	N/A
School District	11	78%	872,179	674,740	11%
Program Total	**18**	**81%**	**1,349,133**	**1,094,293**	**7%**

[1] Note that Cadmus cannot calculate relative precision when it verified savings for fewer than two facilities in a stratum. However, variance from these strata is still included in total relative precision.

Table 28 provides the evaluation results for incrementally negative-savings natural gas facilities. Cadmus evaluated additional negative savings, leading to a realization rate of 104% for these facilities overall. Results were consistent across customer types, but were again primarily driven by the large negative evaluated savings in school districts, which contributed 82% to total evaluated savings.

Table 28. Negative-Saving Natural Gas Facilities

Customer type	Count of Facilities	Realization Rate	PSE- Estimated Population Savings (therms)	Evaluated Population Savings (therms)	Relative Precision [1]
Government	3	106%	-104,269	-110,099	12%
Higher Education [2]	0	100%	-21,734	-21,780	N/A
Hospital	1	101%	-27,380	-27,661	N/A
School District	10	104%	-643,118	-670,465	7%
Total	**14**	**104%**	**-796,501**	**-830,005**	**6%**

[1] Note that Cadmus cannot calculate relative precision when it verified savings for fewer than two facilities in a stratum. However, variance from these strata is still included in total relative precision.

[2] Cadmus sampled one higher education net-negative facility for natural gas that did not report natural gas savings. In this case, Cadmus applied the positive-saving realization rate evaluated for higher education facilities.

Cadmus evaluated incremental natural gas savings with a relative precision of 35%, resulting from a combination of modeling uncertainty and sampling uncertainty. Cadmus attempted to minimize sampling uncertainty by developing strata by customer type and net-savings to group together facilities likely to achieve similar realization rates, thus reducing the variability in each stratum. Cadmus achieved its goal of 10% precision with 90% confidence across customer types within net-positive and net-negative facilities (6% and 7% relative precision, respectively).

Figure 20 shows evaluated natural gas incremental savings as a percentage of adjusted baseline consumption for each customer type and net-savings stratum. Net-positive facilities tended to save natural gas at a rate of consumption higher than that of electricity. Net-negative facilities also tended to consume natural gas at a rate of consumption incrementally higher than that of electricity.

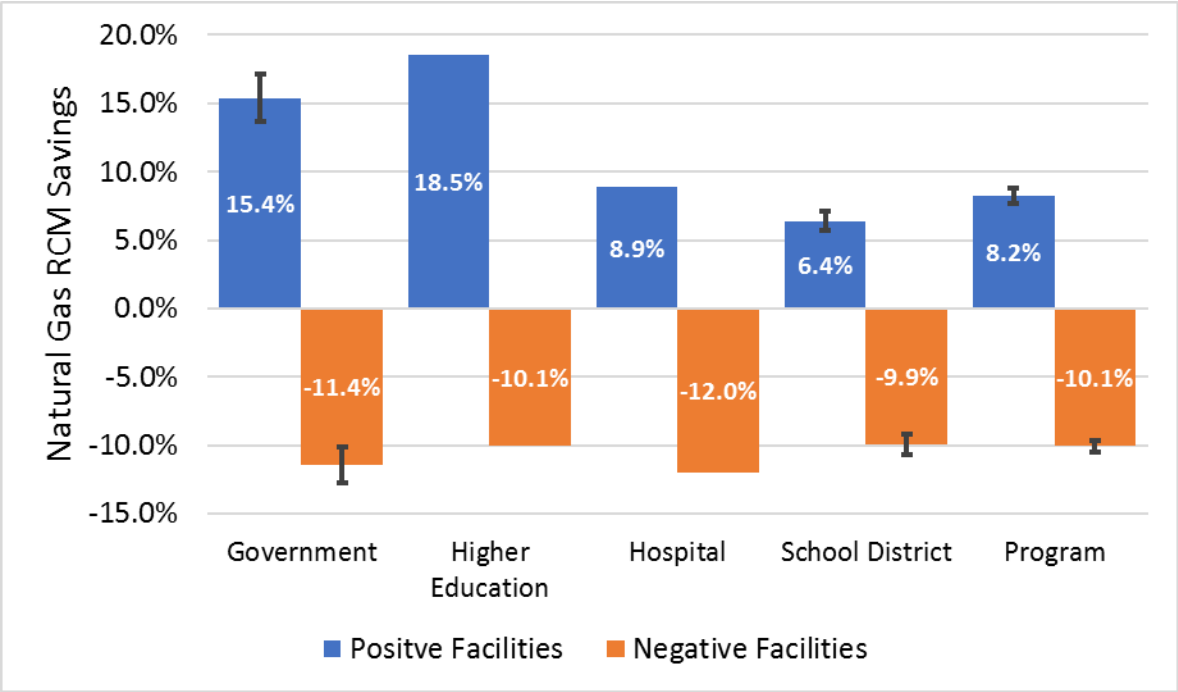

Figure 20. Natural Gas Evaluated Incremental Savings as a Percentage of Adjusted Baseline Consumption, by Customer Type and Net-Savings Stratum

Note: Positive and negative facility savings shown as a percentage of adjusted baseline consumption. Error bars show the 90% confidence intervals around point estimates. In some cases, confidence intervals could be calculated because there were too few facilities in a stratum.

PUGET SOUND ENERGY

Appendix B. RCM Participant Findings Memo

MEMORANDUM

To: Jim Perich-Anderson; Puget Sound Energy

From: Anna Kelly, Jeremy Eckstein, Bitsy Broughton, Jim Stewart, Karen Horkitz; Cadmus

Subject: Summary of Findings from In-Depth Interviews with Resource Conservation Managers

Date: December 29, 2017, Revised March 8. 2018

This memo summarizes the process evaluation findings from in-depth interviews with 16 Resource Conservation Managers (RCM), which Cadmus conducted in November 2017. Cadmus collaborated with Puget Sound Energy (PSE) to identify the following research objectives:

- Understand participants' motivation for participating in the RCM program
- Understand participants' perceived successes and challenges to RCM program implementation
- Understand responses to recent/ongoing program changes
- Solicit ideas for program improvement

While the findings will be incorporated into Cadmus' full program evaluation report, the purpose of this memo is to provide PSE with an initial review of the findings and identify topics for further discussion with RCMs, during meetings currently targeted for early 2018. We identify these suggested topics at the end of this memo. Additional detail may be uncovered from these interviews, as the overall program evaluation proceeds. Cadmus will share any relevant information with PSE and include that in the final report.

This memo frequently discusses RCM feedback on the three elements of the program: operational improvements, capital projects, and behavioral campaigns. Operational improvements include adjusting building schedules and set points. Capital projects include replacing existing equipment at or before the end of its useful life with efficient equipment. Behavioral campaigns include initiatives to change building users' behavior. Examples of behavior that can be addressed include leaving lights or computers on when they are not needed.

Interview Findings

RCM Profile

Cadmus asked RCMs about decision-making processes within their organizations as well as about RCMs' individual roles. This section presents findings about the types of organizations in which the RCMs worked, decision-making processes within these organizations, and plans for renewing their participation in the program. Cadmus also asked about RCMs' roles, how long they participated in the program, and their understanding of the program.

Participating Organization

As shown in Table 29, most interviewed participants worked in school districts. Fourteen of the 16 RCMs worked as on-site RCMs employed by their organizations; two were outside consultants. One outside consultant worked for a school district and one worked for a group of nonprofit organizations. The two RCMs working as outside consultants did not feel comfortable answering some satisfaction and intention questions on behalf of their clients. Therefore, in some cases, the interviews total 14 respondents rather than 16.

Table 29. Please tell me your title and then about your roles and responsibilities as the Resource Conservation Manager?

Customer type	Number of Interviews	RCM is a Facility Employee	RCM is an Outside Consultant
School District	9	8	1
Government	4	4	0
Hospital	1	1	0
Nonprofit	1	0	1
Higher Education	1	1	0
Total	**16**	**14**	**2**

Source: Puget Sound Energy Resource Conservation Manager Program (2014-2016) Participant Interview Guide (QB1).

All of the organizations had worked with the program for over five years, with all organizations going through the renewal process at least once (although RCMs for some organizations changed since they began participating). Eleven of the 14 facility employee RCMs said they intended to renew their participation agreement. Table 30 provides details on renewal plans by customer type.

Table 30. Does your company plan to continue participating in PSE's RCM program? *

Customer type	Years in Program (mean)	Planning to Renew			Total
		Yes	No	Not Sure	
School District	11.0	6	0	2	8
Government	7.5	4	0	0	4
Hospital	8	0	1	0	1
Higher Education	12	1	0	0	1
Total	**9.5**	**11**	**1**	**2**	**14**

Source: Puget Sound Energy Resource Conservation Manager Program (2014-2016) Participant Interview Guide (QJ5) and program data.

*Two respondents, representing consulting firms that handled RCM implementation for participants, could not answer if their clients intended to renew and are not represented in the table above. One consultant represented a school district and one consultant represented a nonprofit

The hospital participant that did not plan to renew, said they did not receive as much on-site support as they required for the program to create value for them. Additionally, they felt burdened by the amount of paperwork required by the program.

Similarly, of the two school district RCMs reporting they were not sure if they would renew, one said they needed more support from PSE to continue participation. This RCM had recently taken over the position from an RCM who left and did not feel PSE provided sufficient support for the transition. The second RCM claimed they did not receive data that PSE promised as part of their participation, making participation not worth the effort. PSE noted they make every effort to provide consumption data to customers and encouraged customers to identify any specific data needs.

Participating RCMs

RCMs held a variety of roles within their organizations. Of 16 RCMs, 13 served as utility managers or energy managers for their facilities, two represented outside consultancies that served as RCMs for a variety of clients on PSE's behalf, and one worked as a general operations manager at the facility level.

RCMs' responsibilities primarily consisted of tracking energy expenditures over time and ensuring that facility operations aligned with the organization's stated energy policies and goals. Additionally, the outside consultants took responsibility for ensuring that required paperwork (i.e., quarterly checklists) was filled out for their clients.

Participation Motivations

As shown in Table 31, most RCMs stated that their organizations participated in the program to save money (8 of 16) and/or to save energy (6 of 16). Respondents were also motivated by environmental stewardship and a desire to arrest climate change, or the data received from PSE as part of their engagement. One RCM was not motivated at all (this RCM's organization did not intend to renew its contract).

Table 31. What is your organization's current motivation for participating in the RCM program?

Motivation	Cost Savings	Energy Savings	Environmental Stewardship and Climate Change	Data Access and Availability	Not Motivated
RCM 1	X	X	X	X	
RCM 2	X			X	
RCM 3		X	X		
RCM 4			X		
RCM 5			X		
RCM 6		X			
RCM 7		X			
RCM 8	X	X			
RCM 9		X			
RCM 10	X				
RCM 11	X				
RCM 12	X				
RCM 13	X				
RCM 14	X				
RCM 15					X
Total	8	6	4	2	1

Motivation	Cost Savings	Energy Savings	Environmental Stewardship and Climate Change	Data Access and Availability	Not Motivated

Source: Puget Sound Energy Resource Conservation Manager Program (2014-2016) Participant Interview Guide (QD1) (n=15).

The four RCMs who noted that their organizations were motivated to address environmental or climate change challenges mentioned that the RCM program helped them address organizational policies or action plans. One RCM mentioned that the school district had specific carbon foot print reduction policies that the RCM program helps the district address. Two RCMs, working for a city government, said that the program helps them implement official city goals, including a ten-year comprehensive plan, which includes energy reduction goals, and a goal to reduce energy consumption 20% by 2020. Another RCM, working for a university, said that the RCM program helps him address the University's action plan to be carbon neutral by 2035. One RCM explained how the program helped: "We are able to demonstrate to upper management that facilities are helping to contribute to sustainability. It's great to demonstrate that we have the partnership with (the) utility to do RCM."

Throughout the interviews, RCMs mentioned multiple ways that the program made their jobs easier or provided direct value to their organizations. Primarily, they cited the program providing data, with one RCM saying, "Incentives are just frosting for us. My only incentive for being part of the RCM program is to get the software and the data." Another RCM cited social benefits, with the greatest value obtained from partnership with PSE and peer networking with other organizations doing the same work.

Program Implementation

All RCMs implement a combination of operational and capital improvements as part of the program. All 16 worked on capital project implementation as part of their work. All RCMs engaged in operational energy-saving initiatives, from programming existing equipment, to teaching facilities managers how to use the equipment efficiently. Twelve respondents reported implementing behavioral initiatives. Two of the four RCMs that do not implement behavioral campaigns said that implementing behavioral campaigns was not their job, and that other people at their school districts managed green initiatives (which were, however, unrelated to energy savings and included recycling and solid waste reduction campaigns). The other two RCMs who do not implement behavioral campaigns reported too much internal pushback occurred at the school district level for behavioral change initiatives to be effective, with one noting, "Occupants said that region was already green."

Identification of Energy-Saving Opportunities

RCMs discussed several ways in which they generally identified energy-saving opportunities.[45] These methods included the following:

- Facility audits or walk-throughs (9 RCMs)
- Taking advantage of existing grant opportunities to implement projects, including grants offered by the Washington Department of Commerce (6 RCMs)
- Meeting regularly with facility maintenance staff to get feedback on opportunities (6 RCMs)
- Monitoring the state of existing equipment and replacing it with efficient equipment at appropriate times (6 RCMs)
- Analyzing utility bills or energy consumption data (5 RCMs)
- Having ad-hoc discussions with staff (3 RCMs)
- Analyzing heating and cooling schedules (1 RCM)

While not all RCMs described in detail how they complementarily utilize the methods above, one RCM, who works for a school district, described the work flow of identifying projects as follows:

- Starts by analyzing utility bills and identifies energy use intensities that can be improved at specific facilities.
- Analyzes the facility's gas and electric interval data to search for anomalies such as overventilation or facility control issues.
- If still unable to identify the issue, visits the facility and meets with the district's HVAC technicians to identify the opportunity.

Coordinating and Implementing Changes

The RCMs' authority to make unilateral decisions about implementation varied. Eight respondents could make some decisions unilaterally without seeking approval. The projects that they could approve included lighting retrofits, operational adjustments, filter changes and facility control changes. However, for capital projects or policy changes, 11 respondents had to undergo a process to receive implementation approval. This process varied from an eleven-month project design and tendering project for lighting retrofits, to a six-month project implementation for a lighting retrofit, to extensive consultation with multiple stakeholders across city agencies, to collaboration with team members to submit projects for management approval. Much of this discussion related to capital project implementation rather than behavioral or operational projects.

Measuring Savings

RCMs used data differently and with different levels of sophistication in order to measure energy savings from changes that they made at their facilities. Respondents tracked energy data in a variety of

[45] Cadmus asked: "Generally speaking, how do you go about identifying opportunities to make energy-saving improvements at your facilities?"

ways, even though the program provided access to energy consumption data through MyDataManager. Eight respondents reported using MyDataManager for their data needs. Other software used included the following:

- EnergyCap
- Portfolio Manager
- UtilityManager
- WigoWize
- Tableau
- Energy Center

RCMs used data sources other than MyDataManager for several reasons, with two reasons most commonly cited:

- MyDataManager had limitations, including not being able to make custom data fields
- MyDataManager did not include natural gas data, keeping RCMs from using it for whole-organization tracking.[46]

Notably, one RCM reported substantial initial frustration with MyDataManager and did not feel that it worked. After attending multiple MyDataManager trainings, the respondents learned much more about how to retrieve desired data from the tool. Only one RCM reported not using interval data because they submetered their entire facility.

RCM Challenges

Cadmus asked RCMs to describe the challenges they face when implementing operational projects, upgrading capital equipment, or implementing behavioral campaigns. While fewer RCMs implement behavioral campaigns than operational projects or capital upgrades, RCMs spoke extensively about the challenges they face when implementing behavioral campaigns. Details are provided below.

Operational Projects

Of the 16 RCMs who reported implementing operational projects, 15 reported experiencing challenges in implementing these projects. These included:

- Information exchange with facilities staff and facility users (6 RCMs) – two RCMs noted that without strong communication operational changes can be undone by facilities staff or building occupants
- Negative impact on building occupant comfort (4 RCMs) – all four RCMs noted that they could receive pushback regarding temperature settings, which could affect the persistence of the changes. This challenge was reiterated at the annual meeting in which RCMs discussed the

[46] PSE noted MyDataManager does include gas data.

importance of making sure energy efficiency does not becoming a burden for building occupants by negatively impacting the work environment or occupants' comfort.

- Limited staff to implement projects (4 RCMs) – two RCMs noted that lack of staff affected their ability to be proactive in finding additional energy-saving opportunities, and one RCM noted that he would be more effective in maintaining energy efficient changes with additional staff
- Difficulty securing funding to implement projects (1 RCM)
- Resistance from facility managers to making changes (1 RCM) – the RCM noted that facility managers can at times make it difficult to implement changes, such as wanting to run facility heat continuously throughout the facility to stop pipes from freezing

Information Exchange with Staff and Facility Users

Six RCMs mentioned that they faced challenges in ensuring appropriate information exchange between themselves and facilities staff and users when implementing operational projects. This challenge included sharing information with staff and gathering information from staff and facility users. In terms of sharing information with staff, one RCM offered an example of implementing a seasonal operational change. He noted that if the facility operator saw a "weird" change in, for example, a temperature set point, and was not aware that the change was made, the operator would likely change the setting to its original point. The RCM noted that his job was "being a liaison between the standard way of doing things and energy management." In terms of receiving information from facility users, one RCM noted that he seeks to schedule HVAC hours of operation, to align with when the school facility is in use. In this case he said that he had asked teachers to provide information on when they use the facilities, but that "they'll say they don't have time" to provide schedules.

Negative Impact on Building Occupant Comfort

Four RCMs noted that operational changes can affect building occupants' comfort. When facility users experience discomfort, according to the RCMs, they will make complaints to managers who in turn pressure facility operators to override established temperature set points.

Limited Staff to Implement Projects

Four RCMs said that staffing constraints were a challenge to implementing operational projects. One RCM noted that facility maintenance staff "have more issues than [they] can resolve [and that they are] constantly reacting to issues, always fixing things, [and that] preventive issues aren't addressed." Another RCM noted that with "limited staff and time, energy is not necessarily the first priority; tenant comfort and productivity may override energy efficiency as a goal." Another RCM noted that she has a team of two HVAC engineers for the entire [city] department", and that she "cannot have someone constantly adjust controls." She noted that she would be "more effective with more staff."

Ensuring Persistence of Changes

Several RCMs provided insight into maintaining persistence of operational improvements. Some RCMs from school districts said student-led programs were difficult to maintain due to student and staff turnover. Additionally, one RCM from city government noted that turnover at fire stations sometimes caused HVAC schedules to be readjusted. The RCM noted that addressing persistence of these schedules

involved communicating policies with the right point of contact; in the case of the fire station the position with the least turn-over: the fire captain. Another RCM said trainings were among the most valuable tools they had to encourage persistence: "Trainings are very applicable to what [a] team does. It is easier to get persistence through operational changes that those trainings support."

Capital Improvements

Of the 16 RCMs who reported making operational improvements at their facilities, 14 reported experiencing challenges making these improvements (one RCM reported no challenges because according to the RCM capital improvements are not part of the RCM's scope of work). As shown below, most of these challenges were financial. The challenges included:

- Financial challenges (10 RCMs)
- Procuring efficient equipment (3 RCM)
- Calculating return on investment (2 RCM)
- Buy-in from executives (1 RCM)
- Time required to receive approval and funding (1 RCM)
- Buy-in from facility staff (1 RCM)
- Finding upgrades eligible for incentives (1 RCM)

During the annual meeting, a small group of RCMs elaborated on financial challenges, such as competition with non–energy related projects for scarce funding, organizational requirements to spend allocated funds within a limited timeframe, and, in the case of schools, projects that are delayed one or more years while waiting for school boards to allocate funds. Participants agreed that the optimal financing strategy would dedicate funds to energy efficiency projects to avoid competition for financing with other capital projects. Dedicated funds could revolve, financed with cost savings from recent energy efficiency improvements or energy-efficiency program incentive payments.

Financial Challenges

Ten RCMs cited finances as the driving challenge when implementing capital projects. These challenges were primarily centered on having access to sufficient capital to make upgrades. RCMs elaborated on some of the nuances of securing capital for energy efficiency upgrades. One RCM said that there is internal competition for funding projects, and that he has to justify that an HVAC upgrade is as important as "new carpet". Another RCM highlighted that justifying HVAC upgrades was especially difficult when equipment was still working."

Three RCMs noted that accessing state grants and utility incentives outside the RCM program was an important part of making capital upgrades and that they had experienced difficulties accessing these resources. One RCM said that PSE grants had been "super helpful" in spurring investment and another said that "Sixty percent of projects happen because of grants through custom projects or commercial equipment incentives". However, the RCM noted that the requirement for site visits to happen prior to receiving an incentive was a challenge and that the visit "takes a lot of energy to schedule." One RCM

also wanted incentives for fuel-switching, reporting that fuel switching presented a major issue in their city, but incentives were not available to help.

Procurement Process

Three RCMs noted challenges associated with procuring efficient equipment. One noted that there are only a "handful of contractors who […] are thinking about efficiency of specific measures" and that "contractors aren't schooled on the [efficient] products that are out there". Two other RCMs said that procuring efficient equipment was generally "rigorous" and required "levels of managerial approval"; posing challenges to making capital improvements.

Calculating Project Return on Investment

Two RCMs also noted that calculating a capital project's financial benefits was challenging. One RCM noted that "wading through all the financing problems and figuring out loan length and cash flow and return on investment" was challenging. Another RCM noted, regarding financial calculations, that "there are just limited hours in a day."

School Bonds Funding Cycles

Three RCMs representing school districts said that school construction bond funding cycle affected their ability to make energy-saving capital improvements, although five others said that the school bonds cycle did not affect their role as an RCM. One RCM, describing how school bonds affected his work, said that "There [have] been years in the past when they were blowing out dirty filters, it was that bad. It's feast or famine. Have your projects printed up and ready to go because you never know when people are going to say yes." However, another RCM, who said that the school bonds funding cycle did not affect her work said that, "School bonds are for capital projects." She, highlighted her RCM role as a professional service and said, "I don't implement RCM recommended changes with school bonds." Interestingly, a different RCM said that it was not the school bonds funding cycle that affected her work, but that it was rather the state-level budget process. She noted that much of her work, related to operational programs was funded through the school district's general fund, and was subject to uncertainty and shortfalls stemming from the legislative process.

Behavioral Campaigns

Of the 11 RCMs that implemented behavioral campaigns, all reported challenges with the campaigns. These RCMs most frequently reported four challenges. Each is discussed in more detail below.

- Buy-in from facility users and management (5 RCMs) — In addition to the five RCM's interviewed, annual meeting participants noted building occupants frequently had no financial interest in reducing energy consumption. One RCM suggested that "green leases"—placing limits on energy amounts that renters can consume—may effectively incentivize behavior change. Another RCM suggested implementing strict workplace schedules of five days and 10 hours per week by not heating or cooling or using central lighting outside of those main work hours, and several RCMs noted the importance of finding energy efficiency champions to model energy saving behaviors.
- Communication challenges (2 RCMs)

- Turnover and personnel issues (2 RCMs)
- Designing a successful behavior change campaign (2 RCMs)

Annual meeting participants discussing building occupants' impact on energy savings described successful strategies for encouraging energy-efficient behaviors. These included providing occupants with more education about energy=efficiency benefits and possible ways to save energy, and utilizing posters to disseminate information and remind occupants to save energy. RCMs highlighted the importance of tailoring messaging to a specific audience and allowing sufficient time for messages to achieve their maximum impact. As RCMs explained, they have one or two chances per year to reach occupants before occupants "tune out."

RCMs asked PSE to help them provide occupants with real-time feedback about facility energy use (for example, through monitors or dashboards), to demonstrate the results of energy-efficiency campaigns and to motivate additional savings. RCMs also sought more financial support from PSE for behavior-change marketing materials like posters. Finally, RCMs asked for assistance in identifying new strategies to make energy conservation "fun."

Buy-In from Facility Users and Management

The most common challenge cited by RCMs was achieving buy-in from people affected by behavioral campaigns. This included the following:

- Persuading employees (both management and staff) to continue engaging in behavior change after a particular activity ended
- Persuading people to provide their time to the organization without an obvious benefit to themselves

One RCM said that when money is tight, and they ask employees to engage in energy saving activities they say, 'Why, I don't care. What's my incentive?' This respondent favored PSE providing newsletters, handouts, or additional information notices that could be given to school staff to inform them about the benefits of behavioral change.

Turnover and Personnel

Another challenge arose from staff turnover and difficulties in bringing new facilities managers up to speed on the program. One RCM addressing this issue said that, although overall awareness and participation was positive, the program's success depended on "organizational muscle memory" and that: "Administrators and teachers move on frequently or change schools, and so [for example] the recycling program that may be working will fall apart. [However,] the other school [where administrators or teachers move on to] will benefit."

Other personnel issues cited by RCMs included the following:

- Retraining facilities staff to not override thermostats
- Training teachers to not prop open doors under hot conditions
- Teaching principals that they did not receive an exception from the "no space heaters" rule

Communication

RCMs reporting communication as a challenge said although they sent fliers and attempted to empower facilities managers with data to help them understand the benefits and savings associated with their behavioral campaigns, "Facility managers still have ultimate power to make adjustments."

Designing Successful Behavior Change Campaigns

Two RCMs noted that designing campaigns to affect building occupants' behavior was a challenge. One RCM noted that she had insufficient resources to do so and another noted that it took significant "effort to run a good campaign", which requires "being thoughtful about the behavior that [they] want to change", and that "posters and fliers will not be enough". However, both RCMs noted that PSE support had been helpful in implementing behavioral campaigns. One said that an idea to substitute space heaters with low-energy floor mats came from PSE.

Program Design

RCMs provided feedback about the RCM program's design, including training, technical support, incentives, contracting, and reporting requirements. Overall, RCMs expressed satisfaction with the trainings offered, but they suggested additional on-site support and made several suggestions for improving their access to energy data. While the financial incentives were not an important part of the program for most RCMs, several of them expressed that they didn't understand how savings targets and incentives were calculated.

Training Participation and Feedback

RCMs provided feedback on two types of trainings: those funded through the RCM program's training allowance; and those offered by PSE directly. Nine RCMs said they used the training allowance to take trainings; seven said they did not use it. Thirteen RCMs said they attended trainings offered directly by PSE; two said they did not. The remaining RCM was an outside consultant who was unsure if their clients attended PSE trainings. As shown in Table 32, eight participant organizations utilized both the training allowance and PSE training.

Table 32. Did you or anyone in your organization attend training provided or funded by PSE?

Organizations Utilizing Training Funds	Organizations Attending PSE Trainings or Events	Organizations Utilizing Training Funds and Attending PSE Trainings
9	13	8

Source: Puget Sound Energy Resource Conservation Manager Program (2014-2016) Participant Interview Guide (QI1-QI4).

RCMs most commonly (reported by five RCMs) utilized program funding for the Building Operator Certification (BOC), with one RCM in the government customer type saying they put 40 people through BOC. Other trainings utilized with program funds included Certified Energy Manager training (three RCMs). Other trainings, less frequently cited by RCMs, included LEED accreditation, the Northwest

Water and Energy Education Institute's energy management certification training, trainings offered through the Northwest Energy Efficiency Alliance, and the Powerful Business Conference.

One RCM described value received beyond the subject and content of the training saying, "Trainings about how to engage with your employees have been most valuable because (it) is a difficult skill to deploy."

Regarding the trainings offered by PSE directly, RCMs provided some suggestions for improving the training experience. One RCM expressed frustration in not knowing which trainings PSE would help pay for or why. Other suggestions included the following:

- Conducting more web-based trainings
- Holding trainings in Seattle rather than Bellevue
- Including information about appropriate levels in training advertisements so RCMs could determine whether they are signing up for expert or novice training

Technical Support and Data

Interviewed RCMs provided insights into what they needed from energy data, and what kinds of support they wanted PSE to provide when implementing energy efficiency projects. Notably, RCMs first cited the importance of receiving high-quality data. They explained that data should include gas consumption to be most useful, and software provided by PSE could be slow, presenting difficulties in procuring the desired data in a single attempt. As RCMs used the data to report the impacts of their energy-saving initiatives to their company stakeholders and financial staff, they required the ability to efficiently pull accurate and up-to-date data. RCMs used PSE's data to identify anomalies in energy use, track energy consumption month to month, verify set schedules, and analyze if their system changes affected consumption.

RCMs offered suggestions to make data easier to use and more useful for their tracking and analysis purposes. Multiple RCMs said that they wanted the ability to connect through an application programming interface (API).[47] PSE noted that an API was not possible due to security constraints. Additionally, a common theme emerged: current data that appeared incompatible with older data could not be merged. Consequently, RCMs wanted an export option that allowed them to export current data in historical formats. They also wanted the data to include more reporting features, so they could easily pull reports to compare different facilities. RCMs sought to speed the data delivery process, so they could see their previous month's usage immediately, rather than after several months. PSE noted that they make efforts to make data available quickly, but that billing issues outside the program's control could arise from time to time.

Aside from data, RCMs requested more on-site support from PSE. One RCM said, "More on-site technical assistance. For a long time, they offered the 'three for-free building walkthroughs' with an

[47] An API will help RCMs develop their own software to interface with PSE.

engineer, but there were no written reports provided after those walkthroughs. Nothing bona fide that could be forwarded up the chain." Other RCMs echoed this feeling, wanting PSE to provide more on-site help communicating with management and staff.

Incentives

Only one RCM said the program incentives provided a motivating factor for their program participation. Although the incentives did not appear to play a major role in motivating participation, one RCM considered the incentive important when trying to receive approval for projects: "The incentive is huge. Whenever I propose a project, I remind them that it might end up being free." Additionally, an RCM said they did not understand how incentives were calculated and, throughout the year, they did not know how close they were to receiving an incentive.

Contracting

Due to its maturity, the RCM program has seen its participant organizations involved for many years. As a result, none of the RCMs could remember the program's start-up process. Some RCMs even thought their organizations had been involved with the program since the 1980s or 1990s, even though the program had not started at that time. Although they did not provide feedback on program startup, RCMs addressed the contract renewal process, with these discussions largely covering the renewal process timeline, transparency in the incentive process, and reporting requirements.

The RCMs felt the renewal process could be more organized. In describing the renewal process, one RCM reported not receiving renewal paperwork before completing the first year of the renewal period. The RCM said, "It was surprising that they renewed it one year into the three-year agreement."

RCMs commonly said the renewal process could be improved by increasing the transparency of methods used for calculating incentives and better explaining the reasons behind the targets. Other common comments about the renewal process included that it became progressively more difficult for RCMs to meet savings goals and to justify to management why they could not meet these goals. One RCM said the goals were "impossible to meet, so we don't try"; another said, "the low hanging fruit is gone, so it's getting very difficult to get any savings doing operational improvements." However, PSE noted that under the new incentive structure, customers can meet their targets through persistence of savings from one year to the next.

Change to Pay-for-Performance Incentive System

Seven RCMs said that they were involved in the 2014 program changes to the pay-for-performance incentive structure. Of these RCMs, four said that the change had a negative effect on their organization's participation, two said that it had no effect on their participation, and one said that it had a positive effect. Two RCMs provided details on how the pay-for-performance system negatively affected their participation. One of the RCMs said that it was now difficult to predict savings and grant funding, and that his organization relied on PSE to calculate savings. The other RCM said that the new system made it difficult to achieve deeper savings. Three RCMs suggested that PSE could improve the pay-for-performance system by:

- Offering continuing support to achieve deeper energy savings
- Provide more clarity on how incentives are calculated[48]
- Provide a way for the RCM to track on an ongoing basis how close they are to achieving their targets

Of the two RCMs who said that the change had a neutral effect, one said that this was the case because it was the only system the RCM has known, and one said this was because the organization would not have achieved its goals under any system. The RCM who said that the pay-for performance system had a positive effect said that it was now also possible to make capital upgrades, which she did not believe to be possible under the previous incentive system.

Reporting

The RCM interviews indicated that some RCMs who participate in the program believe the required paperwork is not necessary for their success. RCMs infrequently complete and submit the required paperwork to PSE, especially the Site Quarterly Checklists (SQC). RCMs provided suggestions for PSE to make this process easier, including providing two checkboxes where RCMs select “changes made," or "no changes made" and making it optional if no changes occurred at a facility. PSE noted that the RCM program provides a reporting spreadsheet that allows customers to identify sites that have not had any changes and allows customers to not report on these sites.

Satisfaction

Overall, 11 out of 15 RCMs interviewed reported satisfaction with the program. Of the 15 reporting, four were very satisfied, seven were somewhat satisfied, and four were not very satisfied (Figure 21). Although challenges occurred, one RCM, who said that they were “very satisfied”, said, “the support from PSE has been great” and “they have designed a valuable program.”

[48] PSE noted that the Program provides trainings on how incentives are calculated annually

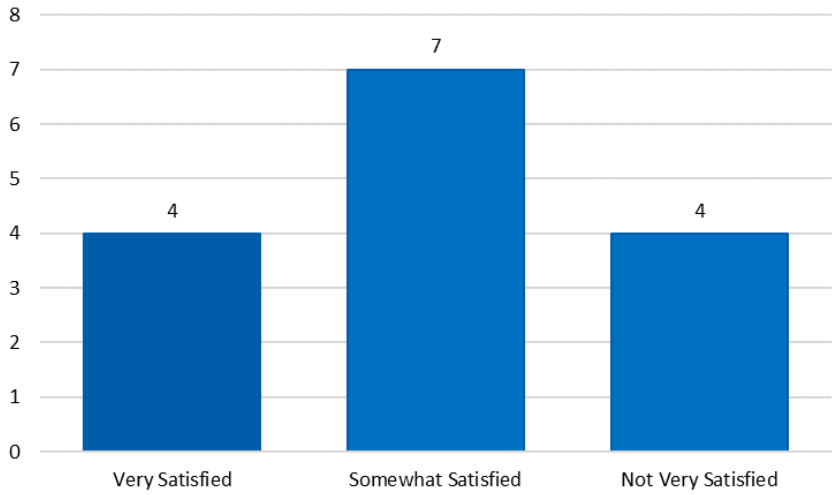

Figure 21. Overall, how satisfied are you with PSE's RCM program?

Puget Sound Energy Resource Conservation Manager Program (2014-2016) Participant Interview Guide (QJ1) (n=15)

Summary of Findings

Participants in PSE's RCM program consistently renew their participation year after year and report general satisfaction with the program. Customers were motivated by other program factors (e.g., training, data, peer exchange) more so than the programs' financial incentives. Opportunities exist for PSE to increase technical support and possibly reduce RCM frustrations with the program paperwork. Cadmus provides summaries of opportunities and topics for future RCM engagement below.

Participants' Motivations for Participating in the RCM Program

Participants participate in the RCM program to achieve energy savings for their respective institutions, and the RCM program provides them with technical support to achieve this goal. The incentives play a relatively small role in decisions to participate. One organization noted that they would no longer participate because they don't feel like PSE is supporting them enough.

RCM Successes and Challenges to Implementation

RCMs reported the program made their jobs easier, facilitated the exchange of ideas with peer networks, provided software needed to achieve their savings objectives, and PSE provided useful ideas for implementing behavior changes among the RCM's internal customers. RCMs also noted a number of challenges faced, including communication with facility managers, obtaining buy-in for changes, making due with limited staff resources and managing staff turn-over, ensuring access to capital for capital improvements, and finding contractors familiar with energy efficient equipment. Additionally, one RCM noted that "low hanging fruit" for operational changes had been achieved, making it more difficult to continue to achieve deeper savings. One RCM also reported challenges and delays when scheduling verification site visits with PSE.

Responses to recent program changes

RCMs stated that incentives proved a relatively minor motivation for program participation. However, more RCM's reported negative effects from the change to pay-for-performance (e.g., difficulty predicting savings and grant money, achieving deeper savings) than reported neutral or positive effects.

Ideas for program improvement

RCMs mentioned several opportunities for program improvement. Cadmus combined similar suggestions to reflect common themes.

- Make the grant renewal process timelier and more organized including providing greater clarity about how incentives are calculated.
- Simplify and make the Site Quarterly Checklist optional unless changes occurred at the facility.
- Provide RCMs more on-site support and technical assistance to gain buy-in from management and staff. This could include more communications materials designed to educate facilities on the benefits of operational and behavior change programs, tools to help RCMs make the business case for capital upgrades, written reports after site walkthroughs, and assistance communicating with management and staff.

Cadmus suggests PSE create more frequent training opportunities, including training on the use of MyDataManager, and provide online training modules that RCMs and facility staff may access as needed to reduce the impact of knowledge lost through staff turnover.

Topics for Follow-up

PSE's proposed follow-up engagement, to be attended by PSE staff, Cadmus, and the RCMs, will provide an opportunity to gather additional details on topics raised during the interviews. Based on the RCM interviews and preliminary discussions with PSE regarding their goals for a follow-up meeting, Cadmus suggests the following topics be included in the discussion.[49]

Topic 1: Most RCMs participated to save money and/or to save energy. However, respondents were also motivated by environmental stewardship and a desire to arrest climate change.

Discussion opportunity: What internal discussions are the RCMs' companies having about environmental stewardship and arresting climate change? Are these discussions occurring between company management and shareholders/stakeholders, participants across an industry, or between a

[49] Following additional discussions between PSE, Cadmus, and input by RCMs at PSE's RCM annual meeting, PSE finalized seven topics for discussion during the annual meeting breakout sessions (i.e., RCM Training Needs, Gaining Management Buy-In for RCM Projects, Building Occupants, Financing Capital Projects, Recognition of Energy Efficiency Work, and Performance Indicators). Summaries of those breakout session discussions can be found in Appendix D. Annual Meeting Summary Memo of the Resource Conservation Manager Program Evaluation, dated March 30, 2018

company and its supply chain? What stage are these discussions in (early theoretical, planning, or execution)? What do companies need to move forward? Is there a role for PSE?

Topic 2: What effects are operational changes having long-term on program savings?

Discussion opportunity: How frequently do building uses change and what effect does this have on RCMs' ability to achieve savings goals, or sustain savings achieved earlier in the program? What is the number one most impactful event on gaining and sustaining savings over time? What can be done to minimize negative impact? Can changes be executed in a way to benefit savings? What is needed?

Topic 3: Not all RCMs understand how incentives were calculated and, throughout the year, they did not know how close they were to receiving an incentive.

Discussion opportunity: Provide a breakout session where incentive calculations are carefully explained and demonstrated. Seek comments from RCMs about what is most confusing, and what would make this process more transparent and useful to them. (In a follow-up conversation, PSE noted that the Program provides trainings annually on how incentives are calculated. PSE may want to consider increasing the frequency of this training or provide an online guide or webinar RCM's could review on-demand)

Topic 4: Some RCM's are finding it difficult to achieve savings goals.

Discussion opportunity: How does the program need to evolve for customers over time as easy or moderate savings opportunities are exhausted?

Topic 5: RCM's are challenged to gain buy-in from senior management, building occupants and facility staff. This includes approval for capital upgrades, cooperation with behavioral programs, as well as maintaining system settings, which occupants and staff may override if the space temperature feels too hot or too cold to occupants.

Discussion opportunity: Ask RCM's to elaborate on challenges and what they need from PSE to more effectively gain senior management buy-in. How are RCMs dealing with occupant discomfort? Do RCM's have successful strategies for dealing with this?

Topic 6: Two RCMs noted that calculating a capital project's financial benefits was challenging.

Discussion opportunity: What makes this so challenging? Can PSE provide an online tool or technical assistance to streamline this?

Appendix C. PSE's Implementation of Previous Evaluation Recommendations

#	Issue/Topic	SBW Recommendation	Completed Recommendation?
1	Evaluated savings	Exclude sites with unknown anomalous energy use from the overall program savings estimate. This includes situations where RCM impacts are clearly being obscured by other unrelated effects. Document the reasons for such exclusions in the program documentation. Refer to subsequent recommendations for other ways to potentially improve evaluation realization rates.	**Implemented.** PSE excluded facilities where RCM impacts were obscured by unrelated effects, such as major construction at a facility unrelated to the program.
2a	Documenting site actions	Have RCMs report specific energy actions, including the type of intervention, the site, the date(s), and any other relevant changes (e.g. different occupancy, building additions, etc.). Emphasize the importance of this information, and encourage RCMs to record this information in conjunction with their employer's time reporting, although the information could be delivered to PSE quarterly or annually. Provide easy-to-use record-keeping systems. Improve record-keeping so that it is simple, standardized, focuses on major items, and comes with clear expectations. Consider developing simple tools to estimate the magnitude of the savings from such actions, which could help validate top- down analysis results. This could be incorporated in the functionality of the improved software from #3. Document baseline adjustments. If PSE adopts a fixed baseline approach to estimating savings, establish guidelines for making adjustments to account for changes, such as building additions or demolitions. Document RCM Value. PSE has already developed a closeout letter template, available upon customer request, so RCMs can convey their value to the organization. The letter summarizes RCM cost savings and participation in other PSE programs.	**Partially implemented.** PSE initiated the Site Quarterly Checklist (SQC) with mixed results. While PSE has worked to explain to RCMs the importance of the data required, RCMs frequently provide incomplete data, particularly when no changes have occurred at their facilities. RCMs have recommended substituting or adding other metrics that they believe would be more useful to them. However, PSE currently lacks staffing capacity to streamline and increase the information provided to customers (this would require automating PSE software) or to create baselines in the software. PSE documents baseline adjustments in its savings workbooks by noting the original and additional square feet metered. RCMs request more support conveying value of their work to their organizations.
2b	Documentation for future verification and evaluation	Possible approaches to improve future evaluations include: Enhance internal verification with a random QC sample, in the vein of V-Team, to verify that RCM actions indeed occurred, and that documentation is sufficient to support savings claims and evaluation efforts. PSE has already begun tracking QC reviews by engineer/project	**Partially implemented.** PSE must provide reasonable justification to claim all positive estimated savings. However, documentation for facilities with negative

#	Issue/Topic	SBW Recommendation	Completed Recommendation?
		manager, which helps staff allocate the workload more evenly and encourage a more timely QC review process of RCM documentation. Apply stratified random sampling techniques to reduce the QC/evaluation workload to something manageable, and to focus on facilities that are yielding a disproportionate amount of savings. Consider establishing guidelines that set savings amount and/or savings percentage thresholds that would trigger closer scrutiny. Evaluate on a more ongoing basis. Consider a more frequent evaluation cycle that occurs more frequently than the four- year minimum interval. This will also facilitate participant recall, so they can provide more accurate information to evaluators, which will make for more accurate savings estimates.	estimated savings is limited. To Cadmus' knowledge, PSE reviews documentation for all positive savings estimates, not just for a random sample. PSE evaluates the RCM program only every four years, according to the minimum requirements.
3	Billing analysis software	Add features to UM replacement. The software to replace Utility Manager should be user-friendly, web-based, have data import/export capabilities to applications such as Microsoft Excel and Energy Star Portfolio Manager, and have multi-user capability. PSE is already developing internal mockups of a replacement software package, which they hope to release to customers in early 2014. This web-based Utility Manager Software replacement that will provide users the ability to document projects and facility action plans.	**Implemented with mixed results.** PSE rolled out MyDataManager, an improvement to UM, but results have been less satisfying than hoped. While some RCMs have adopted MyDataManager, others find the software confusing and difficult, and choose to utilize external software tools. PSE is aware of these issues but has not been able to further streamline MyDataManager. PSE is considering allowing training incentives to pay for alternative software that is not provided by the program.
4	Incentive structure	Change the incentive structure to a straight pay-for-performance approach. PSE staff members have indicated that they are considering a hybrid approach that combines pay-for-performance with a bonus payment for hitting a specific target. While this partly addresses the dis-incentive issues identified by decision-makers, any non-linearity in the incentive structure creates opportunities to strategically time energy projects to maximize bonus payments. As of this writing, PSE has already developed such a proposal for stakeholder review and approval.	**Implemented.** PSE rolled out a pay-for-performance incentive in 2014. PSE also pays incentives to customers who achieve graduated savings targets.

#	Issue/Topic	SBW Recommendation	Completed Recommendation?
5	Weather data	Develop more rigorous procedures for assigning weather data to sites. Billing data analyses (Utility Manager or its successor) should select the closest weather station to the facility being analyzed to maximize the accuracy of the regression. For better accuracy, we recommend subscribing to a weather data service that combines weather station data with weather satellite data. PSE has already begun making changes to their weather station selection process.	**Implemented.** Each facility is assigned a specific weather station.
6	Measure life	Use current industry references to develop case for longer measure life. The latter can also be based on the distribution of actual measures found in this evaluation, using already-applied measure lives for other program measures. The case for doing so is strong. In conjunction with this, acknowledging that some savings would likely degrade in the absence of continuing RCM vigilance, attribute some of the savings maintained by RCM renewal customers to the program. PSE is already considering "reclaiming" such savings for renewal customers that continue to implement RCM practices at their facilities, using a variant of the fixed baseline methodology.	**Attempted.** Current industry standards do not work for this program as participants do not drop out at a rate that allows for a top-down analysis of the decay rate. The three-year measure-life assumption in place now is the most reasonable assumption at this point.
7a	Non-energy-related savings activities - savings	Given the magnitude of non-energy benefits, develop strategic partnerships with those involved in other resource conservation arenas, particularly water conservation. We recognize that in 2013, PSE has already begun reaching out to water agencies. Claim non-energy benefits. PSE should continue considering defensible claims for the financial value of RCM non-energy- benefits, which could offset a significant percentage of the program costs. Key findings from the process and impact components of this evaluation could inform the establishment of this percentage. The ideal mechanism for accounting for NEBs should be simple to apply across the board.	**Implementation unknown.** Cadmus did not review such documents and saw no evidence of this.
7b	Non-energy-related activities – RCM impacts	Develop agreements on allocating efforts. Consider establishing clear, written agreements with customers outlining expectations of how RCMs might allocate their efforts to make the greatest impact. Make sure that customer management buys into this approach.	**Implementation unknown.** Cadmus did not review such documents and saw no evidence of these agreements.
8	Participant satisfaction	Refer to subsequent recommendations for ways to improve participant satisfaction.	
9	RCM staffing	Provide turnkey RCM service. If PSE ever wishes to expand the program, it should consider reducing barriers to participation by offering RCM services as a turnkey service, with RCMs employed by PSE or a third-party provider. Since this approach would be more expensive	**Implemented.** PSE In PSE offered turnkey services to RCM customers in 2015-2016. However, these services have been

#	Issue/Topic	SBW Recommendation	Completed Recommendation?
		and also require a lower level of engagement from the customer, it would be most appropriate for customers not large enough to be eligible for a full-time RCM. PSE is launching this approach by procuring a third party to run a Strategic Resource Management program for 2014-15. Customers already identified, but not eligible for the RCM program, may be strong candidates for this new program.	discontinued due to lack of customer interest and participation.
10	Training	Offer enhanced training options. PSE should offer some of its trainings in a web-based format, particularly shorter, advanced, and specialized training courses. Offer more advanced training courses to benefit more experienced RCMs. In addition to PSE-led trainings, individual RCMs could present case studies or share experience through a webinar. In 2013, PSE has focused on improving their offerings, in response to a 2012 survey on this topic. They are providing 12 different trainings this year, with a third being provided in webinar format, with information posted to the RCM Conduit website run by NEEA. Provide supplemental tools. During trainings, RCMs could be coached on what types of actions produce the greatest savings and therefore justify the effort to document, such as HVAC and lighting schedule changes. Although RCMs are mostly aware of this, providing tools and means to simplify their reporting (for example, a simple checklist for each facility that is completed on a regular basis) could help their efforts. It would also help PSE assess RCM actions on an ongoing basis.	**Implementation in progress.** PSE continues to expand training offerings from both PSE and third parties. PSE rolled out a central hub to house on-demand web-based training for RCMs. Further development of training to influence behavior change, and supplemental tools, such as, additional case studies and single-page guides of common energy management problems and solutions, have been requested by RCMs and are under consideration by PSE. RCMs have also requested further simplification of reporting requirements.
11	Key RCM qualities	Expand assessment. As part of a future study, PSE should consider expanding this analysis to factors not collected or considered for this study. In particular, it would be interesting to examine whether information from the RCM's resume (skill, years of experience, type of job experience, education, etc.) predicts success.	**Partially implemented.** At PSE's request, Cadmus reported four factors contributing to RCM success. Additional study could enhance these results.
12	EIS software	Continue developing EIS replacement. To the extent possible, PSE should work with participants to overcome technical barriers to the use of the EIS software, such as meter-compatibility issues. PSE believes that the replacement package (mentioned in #3) will address these issues, and provide customers with a "one-stop shopping" solution.	**Implementation unknown.**
13a	Capital projects – program policy	Allow organizations to count savings from capital projects toward their program target. PSE is currently developing new program components that would make this possible.	**Implemented.** Customers can count savings from evaluated capital measures toward their RCM program savings targets.
13b	Capital projects	Improve ECM accounting practices. During the course of	**Implemented as stated.**

#	Issue/Topic	SBW Recommendation	Completed Recommendation?
	– evaluation impacts	this study, PSE improved their CSY system by adding an ECM implementation date field, making more accurate assessments of savings from these measures possible.	
14	Site-level savings – over reporting	Improve estimation by using a fixed baseline, coupled with rigorous documentation of actions. Should PSE adopt a fixed baseline approach for the whole-building energy analysis (with provisions for baseline adjustments for major non- RCM site changes), then this, coupled with better documentation of RCM actions recommended in #2a, should provide more defensible RCM savings estimates.	**Implemented.** PSE uses a fixed baseline for all facilities and makes appropriate baseline adjustments for non-RCM site changes. It subtracts previously claimed RCM savings for two years after they are initially reported.
15	Negative saver sites	None. This issue becomes moot if PSE adopts a fixed baseline approach, per #14.	**No recommendation.** PSE reports zero savings when it estimates negative savings as it did prior to the previous evaluation. Though implementing a fixed baseline likely mitigates negative savings, the issue is not moot as suggested in the previous evaluation.
16	Summer actions at schools	Consider more comprehensive study of summer energy use and RCM actions. Given anecdotal evidence that RCM actions lead to summer savings, we do not recommend zeroing out summer effects across the board	**Implemented.** PSE does not zero out summer savings, and is beginning to include school closures in its models.
17	Savings, evaluation guidelines and protocols	Collaborate with stakeholders on guidelines. Consider working with the Regional Technical Forum, ASHRAE, and other interested stakeholders to develop guidelines or protocols for quantifying savings and evaluating RCM-type programs. Incorporate into future evaluations. Should protocols or guidelines emerge, consider how they would be deployed in future evaluations, and structure program data collection activities to support these.	**Implementation unknown.**

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Appendix D. Annual Meeting Summary Memo

MEMORANDUM

To: Jim Perich-Anderson; Puget Sound Energy

From: Jim Stewart, Bitsy Broughton; Cadmus

Subject: Summary of RCM Annual Meeting Small Group Discussions

Date: February 15, 2017

This memo summarizes small group discussions that occurred during Puget Sound Energy's (PSE) annual Resource Conservation Managers (RCM) meeting, held in Belleview, Washington, on February 1, 2018.

PSE staff facilitated three of the discussion groups, and invited Cadmus to facilitate four groups and the report-out process that followed. Prior to the meeting, PSE and Cadmus collaborated to identify discussion topics that interested PSE based partly on findings from the RCM program process evaluation interviews. Seven topics emerged from this collaboration:

- RCM training needs
- Gaining management buy-in for RCM projects
- Building occupants
- Financing energy efficiency capital projects
- PSE RCM program reporting requirements
- Recognition of energy efficiency work (from PSE or nationally)
- Performance indicators

Summaries follow for each discussion group.

RCM Training Needs

The discussion group addressing RCM training focused on RCM feedback about current training opportunities, financed or provided directly by PSE. Questions raised included the following:

- Do RCMs get the training they need?
- What additional training would they find beneficial?
- How could training be improved?

Group participants included members of the PSE Building Performance team, staff from Business Services, and RCM's from Bellevue College, Issaquah School District, and Snohomish County.

RCMs agreed that PSE's monthly training proved valuable, and that RCMs are motivated to acquire all the training they can. Participants found the social marketing training particularly useful as it described the necessity of aligning peoples' practices with their beliefs to facilitate sustained change. RCMs also discussed that training could be too "homogeneous" and would prefer training tailored to their specific

needs. They also considered the Energy Accounting class unnecessarily complicated, and that it assumed RCMs had a visibility level into their data that they may not possess.

RCMs preferred more training on how to motivate behavior change within their companies, including a more in-depth understanding of the psychology behind behavior change. One RCM noted that different audiences required different approaches, with some municipal employees set in their ways. They also preferred in-person training to webinars, which one RCM said, "are easy to drift off from." Still, RCMs thought webinars could provide a valuable resource by presenting subject matter experts outside of PSE. One PSE staffer noted the Strategic Energy Management (SEM) hub—launched in 2018—will provide program resources in one place, offering RCMs easier access. The hub could also serve as a repository for a webinar library.

The group suggested PSE consider a "roadshow," visiting customers' sites to discuss energy efficiency basics, such as controls and occupancy sensors, and to speak to HVAC and plumbing trades at schools, thus building credibility for RCMs, whose efforts can be undermined by facilities staff who doubt their approaches.

Finally, RCMs suggested three simple steps to further enhance training:

- Provide RCMs with a list of approved third-party classes to reduce the RCMs' need to submit requests for approval each time.
- Increase training allowances or help RCMs find ways to spread training across more staff. Currently, a certification course for a single person can exhaust an entire budget.
- Provide brief, specific case studies rather than lengthy whitepapers (e.g., diagnostic training with instructions such as "IF you hear this sound, check this item").

Getting Management Buy-In

This discussion group focused on barriers and help required to achieve management buy-in for RCMs' sustainability efforts. This well-attended group represented City of Bellevue, Bellevue College, Seattle Public Schools, Western Washington University, Stillwater Energy, and PSE's Building Performance Team.

Group members agreed, when competing for funding and resources within their organizations, that they faced challenges in getting their projects prioritized as "must have" vs "nice to have." One RCM resorted to seeking funding outside of the organization, through grants, incentives, and other sources. Group members also described a perspective among some facility staff that sustainability is a "feminine issue." Staff turnover presented another challenge to successfully implementing RCM initiatives, when staff—who have bought into the efforts—leave the organization, and new support must be found and cultivated.

RCMs face staff that hold beliefs about energy efficiency that no longer remain relevant to new technology. For example, some users thought they should not turn off their computer monitors at night (or turn off a CFL at all) because they take so long to start up. As with the training group discussed

above, group participants expressed a need to tailor different approaches to different groups within their organizations.

The group discussed elements necessary to improve their ability to move projects forward. City representatives particularly emphasized the need for buy-in and accountability at the highest levels—from their mayors to their city councils. They preferred to achieve this though positive engagement and collegial peer pressure. RCMs wanted executives to have both public reporting opportunities and accountability for efforts they support. City staff also wanted grants received to be tagged specifically for conservation efforts, so funds would not be redirected to other city projects.

Group members agreed on the necessity to train their organizations' executives and facility staff to think of sustainability efforts as a choice rather than a loss or punishment. The discussion focused on engaging these individuals' hearts and values by determining elements that matter to them, engaging them through those issues. Members also agreed that lasting change requires teaching energy efficiency to school-age children; so sustainability practices become the norm, and those children influence their parents and families, similar to the way the country transitioned to seat belts laws in the 1960s.

RCMs suggested that improving buy-in from executives and stakeholders within their organizations will require the following:

- Sustained follow-through, including education about the necessity and benefits of sustainability efforts
- Providing advance notice and information to those responsible for budgets, so funds are allocated and protected
- Developing messaging to reach different groups, and repeating those messages until the audience begins to embrace the message
- Identifying decision-makers' resistance to sustainability, and providing messaging and solutions to address their concerns

Team members asked for PSE's assistance by providing an online list of available incentives to which RCMs can direct their executives, utilizing existing relationships between executives at PSE and executives at the RCM's organizations to reduce barriers. The discussion also addressed building trust and credibility for RCM projects, and providing RCMs with a formal process or outline on overcoming barriers.

Building Occupants

The building occupant discussion group focused on RCMs' perspectives regarding building occupants. Questions addressed included the following:

- How do occupants influence a program's success?
- What successes have RCMs enjoyed in engaging building participants through reduced energy consumption?
- What tools are available for accomplishing such engagement?

- How can PSE help engage participants?

The building occupant small group discussion brought together participants from McKinstry, Snohomish Public School District, King County Housing Authority, Stillwater, the General Services Administration, and Snohomish County. Participants brought a range of perspectives and experiences about engaging building occupants in energy saving.

All participants agreed on one main obstacle to engaging building occupants: those occupants had no financial interest in reducing energy consumption. This absence of financial interest removed a primary motivation for saving energy, and required new and creative strategies for engaging building occupants. Participants also commonly discussed the importance of energy efficiency not becoming a burden for building occupants or of energy efficiency negatively impacting the work environment or occupants' comfort.

The RCMs discussed some challenges that occupants presented for saving energy. The GSA RCM explained that, in the federal courts, employees had little interest in saving energy, with building occupants more concerned with properly lighted and space conditioned courtrooms and chambers. Some occupants perceived energy efficiency as a potential disruption to everyday work activities, not a cause to be embraced.

The Snohomish School District RCM noted that many teachers and administrators brought refrigerators, space heaters, and coffee machines (Keurigs) from home for personal use, and he expressed shock from how many of these appliances he found in his facilities. Other RCMs (including the King County RCM) reported similar experiences with a proliferation of personal appliances. The Snohomish School District RCM has banned (or is working to ban) such personal appliances and encourages staff to use shared appliances in staff lounges and other communal areas.

The building occupant group discussed several strategies for motivating building occupants to save energy. Everyone agreed on the need for more education about energy efficiency benefits and about steps occupants could take to save energy. Several participants found posters useful for disseminating information and for reminding occupants to save. Others noted the importance of tailoring messaging to an audience and of allowing sufficient time for messages to achieve their maximum impacts. Often, RCMs only have one or two chances per year to reach occupants before they "tune out."

One RCM suggested that "green leases"—placing limits on energy amounts that renters can consume—may effectively incentivize behavior change. The GSA RCM suggested implementing a strict workplace schedule of five days and 10 hours per week by not heating or cooling or using central lighting outside of those main work hours, and several RCMs noted the importance of finding energy efficiency champions to model energy saving behaviors.

In discussing ways that PSE could provide support, the RCMs wanted options for providing real-time feedback about building energy use to occupants (for example, through monitors or dashboards). All agreed that timely feedback could be used to motivate behavior change. Further, such feedback would make it easier to demonstrate the results of energy efficiency campaigns and to motivate additional

savings. RCMs also sought more financial support from PSE for behavior-change marketing materials (e.g., posters). Finally, the RCMs asked for assistance in identifying new strategies to motivate occupants to save energy. They wanted strategies that made energy conservation "fun."

Financing Energy Efficiency Capital Projects

The financing small group discussion addressed barriers to and strategies for financing energy efficiency capital projects. Primary questions included the following:

- Who decides which capital projects move forward?
- What are the decision points in the process?
- How much control do administrators have over the process?
- Would a revolving fund help enable this control?

Participants included representatives of the Bellevue School District, General Services Administration, Western Washington University, McKinstry (representing Lake Washington and Northshore Schools), and Jessica Raker of PSE.

Participants shared a variety of barriers to financing energy efficiency capital projects:

- Energy efficiency projects must wait until school boards or general funds allocate financing, often causing waits one or more years, and adding time to project completion
- Energy efficiency projects compete for scarce funding with other capital projects, which do not prioritize energy efficiency
- Some organizations require that money allocated to energy efficiency projects must be spent within a year or RCMs risk losing the funds

In discussing multiple strategies for financing energy efficiency capital projects, participants agreed that the optimal method dedicated funds for financing energy efficiency projects; consequently, energy efficiency projects would not have to compete for financing with other capital projects. Dedicated funds could revolve, financed with cost savings from recent energy efficiency improvements or energy efficiency program incentive payments.

The Bellevue School District RCM spoke about the importance of prioritizing energy efficiency capital projects ("plan with priorities") and sharing one's vision with stakeholders in one's organization. His comments echoed those of an RCM speaker in the morning session about establishing strong relationships in organizations and gaining the trust of key decision makers. Other RCMs agreed with the importance of gaining buy-in from "those who hold the purse strings."

The RCMs agreed that it would be helpful for PSE to assemble case studies to share success stories and strategies for securing capital project financing. These case studies might give RCMs ideas about financing capital projects.

PSE RCM Program Reporting Requirements

As reporting plays an important role in PSE's RCM program, this discussion group drew a large crowd, including Western Washington University, Bellevue School District, Sumner and Enumclaw School Districts, King County Housing Authority, Shoreline Schools, Bellevue College, McKinstry (Lake Washington and Northshore Schools), the PSE Building Performance Team and Beth Robinweiler.

Group members discussed simplifying the reporting process by changing RCM reporting to a single sheet for each property. Some customers have modified PSE's template to include information such as meters, numbers of students, operations and maintenance (O&M) projects, after- hours scheduling, community events during off-hours, and addresses in order to have everything on 1 page. Reporting should tell a story and provide context for understanding the facility's energy consumption.

Reporting group members also discussed metrics that they report on internally that they could leverage. Some use Portfolio Manager, or third-party software (such as Energy Manager by Dude Solutions) that contains modules for O&M and capital projects in addition to energy use.

Participants suggested the following changes would make a difference in reporting efforts:

- Consideration of the Energy Utilization Index
- Year-over-year changes in energy consumption (e.g., December 2016 vs. December 2017)
- Comparing facilities to each other through benchmarking
- Receiving invoice data ($) vs. meter data (kWh/therms) in PSE's proposed report. Participants agreed these reports could serve as triggers for action (like submitting quarterly reports), or could help prioritize which facilities to go after based on increased use.

The RCMs also requested that PSE provide an annual report summary and approval to start quarterly prompting reports. As Cadmus did not facilitate this session, it cannot provide more details about the discussions.

After the meeting, one RCM followed up with Cadmus, offering two additional suggestions. For the Site Quarterly Checklist (SQC) PSE should "flip the requirements on their head." Currently, RCMs must convey whether there has been a schedule change has occurred or a major project undertaken, triggering a SQC. The RCM suggested it should be the opposite, with PSE asking, "Has there been a change in the energy use (not related to weather)? If so, tell us why." The RCM explained this simple change could be accomplished by adding a column to the litmus test spreadsheet.

The RCM also said that, though the MyDataManager software has improved, the dashboard functionality still does not work well due to the number of sites in their RCM program portfolio. The RCM suggested PSE select just the few sites required for the SQCs. This would reduce issues resulting from trying to load too much data and would help the RCM better meet PSE's SQC reporting requirements.

Recognition of Energy Efficiency Work (from PSE or Nationally)

The Recognition group focused on how to improve the image and increase the cachet of energy efficiency work. Participants included representatives from Issaquah School District, Western Washington University, Seattle Public Schools, and the PSE Building Performance Team. Group members shared these perspectives about energy efficiency industry:

- Energy efficiency work required a value proposition
- Gaining an ENERGY STAR rating is expensive, at $1,000 dollars per building
- More than energy managers are needed to visit different sites and provide education

RCMs saw opportunities in using use PSE's recognition of regional energy efficiency (i.e., excellence in energy management) to market strategic energy management programs to nonparticipant customers in the Pacific Northwest and other segments of the country. Members also suggested conducting a forum for sharing best practices.

Group participants suggested the following tactics to promote recognition of energy efficiency:

- Certificates should be "masculine" and specific
- Results should be quantified for each specific value proposition
- Presenting an energy-specific national award

RCMs also suggested a 1+ phone number or other source, where building owners seeking ENERGY STAR certification could find qualified consultants to provide pro bono services. Additionally, PSE could provide free facilitation for groups working toward ENERGY STAR certification.

Other suggestions for improving energy efficiency work's cachet included more "big check" presentations when awarding large incentives, PSE funding for recognition campaigns within the RCMs' organizations, and additional marketing through press releases.

Performance Indicators

These RCMs discussed nuances tied to different performance indicators, including the following questions:

- Should PSE help build a carbon business case for efficiency?
- What other Key Performance Indicators (KPI) are used or would be helpful?

This group was well attended by Western Washington University, City of Bellevue, Bellevue College, McKinstry, Stillwater Energy (a consultant), the PSE Building Performance Team, and Beth Robinweiler.

RCMs noted that avoided costs can be difficult for people to understand, and KPI library measures awareness and is non-quantifiable. Carbon reduction offers a well-defined goal, with generally agreed-upon metrics. Carbon neutrality, on the other hand, can be interpreted in more than one way and does not offer standardized metrics. Use of leading indicators (e.g., findings from night walkthroughs of

facilities, holiday schedules, changes in student enrollment) provides information different from lagging indicators. Demand costs offered an additional KPI discussed.

RCMs suggested two additional performance indicators:

- Avoided Cost Reports (ACR) that track each building's predicted vs. actual monthly energy consumption
- Quarterly data for heating degree days and cooling degree days—provided it indicated the percentage increase or decrease over the prior quarter

Evaluation Findings

The RCMs made many insightful comments and suggestions, which Cadmus will evaluate and utilize in developing final recommendations and considerations for the RCM program. A summary of findings follows:

- Occupant behavior presents both an obstacle to and an opportunity for achieving energy savings.
- Though energy efficiency capital projects can be financed differently, it is essential to earn the trust of an organization's key financial decision-makers.
- Engaging and influencing decision-makers and key stakeholders requires a sustained multifaceted approach that includes targeted messaging, designed to address their values and solve their acute problems, and peer-to-peer conversations to build confidence and credibility.
- Sustainability should be reframed as a human issue, not a feminine issue.
- Energy efficiency often loses when competing for funding against other organizational needs. A stronger value proposition is necessary to secure and protect funds.

PUGET SOUND ENERGY

Appendix E. Savings Persistence and Measure Life Memo

MEMORANDUM

To: Jim Perich-Anderson, Michael Noreika, and Jessica Raker

From: Anna Kelly, Jim Stewart, Maggie Buffum

Subject: Measure life analysis and data request

Date: December 8, 2017

Cadmus proposes to test the three-year measure life assumption for the RCM program by analyzing the savings persistence of former RCM participant facilities. This memo proposes a billing analysis approach and requests data to perform the analysis. As PSE and Cadmus discussed, a billing analysis would provide the most rigorous and accurate means for testing and establishing a RCM program measure life. However, the proposed approach also has some limitations, which we discuss below.

Analysis Approach

To assess measure life, we propose a billing analysis of facilities that previously participated in the RCM program. Cadmus would estimate the average annual savings decay rate (or, its complement, the average annual savings persistence rate) after participation ended and use the rate to calculate measure life. Cadmus would perform the analysis on a sample of facilities for customers who stopped participating in the program since 2011. We chose this cutoff year to focus the analysis on the most recent former participants, who, we expect, will be more like existing participants than customers who stopped participating long ago.

Definition of Measure Life

Measure life for the RCM program can be defined as the ratio of lifetime savings to average annual savings during program participation:

$$Measure\ life\ = \frac{Lifetime\ Savings}{Average\ Annual\ Savings\ During\ Participation}$$

According to this definition, RCM measure life is the number of years with savings equal to average savings per year during participation that would equal lifetime savings. For example, if a facility only participated for one year, measure life would be expressed as the number of first-year savings equivalents obtained over the life of the measure.

To estimate lifetime savings, we require an estimate of the savings decay rate, the rate at which savings decay over time after participation ends:

$$\text{Annual savings decay rate, } \alpha, = \frac{s_t - s_{t+1}}{s}$$

where *s* = annual savings and *t* denotes the year.

Figure 22 illustrates savings decay. The slope of the arrow is the savings decay rate.

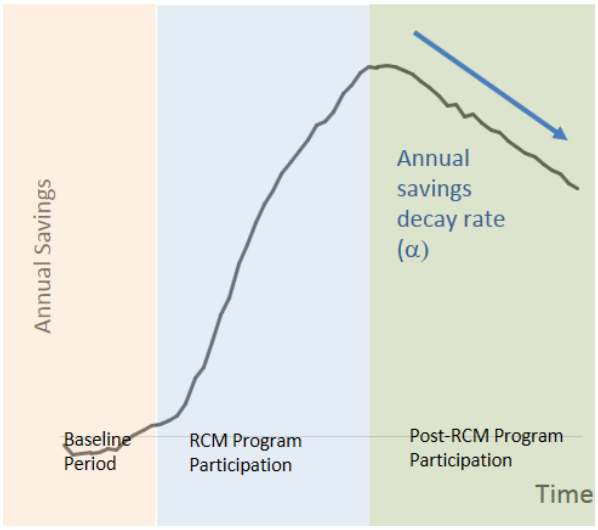

Figure 22. Savings Decay

Suppose savings during the first and only year of participation equal *s* and savings decay at annual rate of α, $0 < \alpha < 1$, after participation ends. Then lifetime savings equals:

$$\text{Lifetime Savings} = s + s(1-\alpha) + s(1-\alpha)^2 + \ldots$$

$$= s/(1-(1-\alpha))$$

$$= s/\alpha$$

Measure life would equal $\frac{\frac{s}{\alpha}}{s} = \frac{1}{\alpha}$.

For example, if savings decay at 25% per year ($\alpha = 0.25$), lifetime savings would equal four years of first year savings, and measure life would equal four years.

Estimation of Savings Decay Rate

Cadmus would estimate α in two steps. First, we would use regression analysis of individual facility consumption to estimate annual savings of each sampled facility for each year during and after RCM

program participation. For example, if a facility started participating in 2012 and stopped participating in 2015, Cadmus would estimate annual savings for participation years 2012, 2013, and 2014 and annual savings for post-participation years 2015 and 2016.

In the second step, Cadmus would pool the facility-year savings estimates and estimate the rate of savings decay using the following panel model regression:

$$s_{it} = \gamma_i + \beta\tau_{it}^{prog} + \alpha\tau_{it}^{post} + \mu_t + \varepsilon_{it}$$

where

s_{it} = The percentage of annual RCM savings of facility i in year t. This is a Cadmus estimate.

γ_i = A fixed effect for facility i, which captures the facility's average annual savings over the sample period. The fixed effects account for differences between facilities in average annual savings (i.e., some facilities are big savers and others are small).

τ_{it}^{prog} = A time trend for savings during program participation. This variable = 1 during a facility's first year, = 2 during a facility's second year, etc.

β = Average rate of change of annual savings during participation.

τ_{it}^{post} = A time trend for savings after program participation ends. This variable equals 1 during a facility's first year after participation, 2 during a facility's second year after participation, etc.

α = Average rate of change of annual savings after participation ends (the savings decay rate).

μ_t = A fixed effect for the calendar or program year (i.e., 2014-2015, 2015-2016), which captures year-specific factors affecting the savings of all facilities. For example, mild weather may have decreased demand for space conditioning and the energy savings achieved by RCM facilities. The year fixed effects account for differences between years in average annual savings.

ε_t = Error term for facility i in year t, capturing idiosyncratic effects on savings for the facility in the year.

Cadmus would estimate this model by ordinary least squares (OLS) and cluster the standard errors on the facility to account for within facility correlation of savings. Importantly, our approach does not assume that savings decay after RCM program participation ends since there is no restriction on the sign of α. If savings increase on average after participation, this coefficient will be positive. If we obtain a

positive coefficient, we would interpret our results to mean that there is zero savings decay over the range of the first post-participation years that we observe in our analysis sample.[50]

In the first stage of the analysis, Cadmus will estimate separate gas and electricity consumption models for dual-fuel facilities. Depending on the analysis sample size, we may then convert the facility gas and electricity savings estimates to kBTU, pool the gas and electric kBTU savings estimates, and estimate one second-stage savings decay model. This approach would yield an estimate of the average savings decay rate for gas and electric savings. Alternatively, we may estimate separate decay rates for gas and electricity savings and then combine the estimates.

Threats to Analysis Validity

Cadmus identified two main threats to the validity of the persistence analysis:

- **Facility annual savings estimates are not accurate**. Cadmus expects that information about previous participant facilities will be less available and of lower quality than information for current participants. This may affect Cadmus' ability to accurately estimate facility savings.

  Solution: This is an important limitation of our analysis and the results should be taken with some caution. Nevertheless, to be valid, the analysis only requires that the savings estimates are accurate *on average across facilities*, not that the savings estimates for individual facilities be accurate. Error in the estimates of individual facility annual savings will reduce the precision of the estimated savings decay rate but will not bias the estimate. Cadmus will take all cost-effective steps to obtain valid individual facility savings estimates.

- **Previous participants are not representative of current participants**. Previous participants may have left the program for reasons related to their ability to save. Therefore, the estimated savings decay rate may not be representative of current participants.

  Solution: To the extent possible, Cadmus will attempt to minimize sample selection bias by sampling facilities that left the program for reasons unrelated to their ability to save energy. Based on notes in the program tracking data, we identified several such customers. To assess the representativeness of sampled previous participants, Cadmus will compare the savings of previous participants during participation with the savings of current participants during the same calendar years or at the same stage of their participation. If the savings trends are similar, this would suggest that sample selection bias may not be significant. If the savings trends are not similar, this would call into question the validity of applying the estimated savings decay rate to existing participants.

[50] Taken literally, a positive coefficient would imply an infinite measure life. If we only include facilities that left the RCM program after 2010, the maximum number of post-participation years for a facility would be six.

Requested Data

To perform the measure life analysis, Cadmus will require the following data for sampled previous participants:

- Customer and facility RCM program participation tracking data
- PSE energy-efficiency program tracking data since the most recent baseline year (which, for most facilities, will be the year before the first year of participation). These data are necessary to calculate the facility savings attributable to incentivized capital projects and the RCM savings attributable to behavior, operations, and maintenance changes.
- Monthly billing consumption data for all years since the most recent baseline year (which, for most facilities, will be the year before the first year of participation)
- Savings summary reports (if available)

Please see below for the specific data fields that we request.

Sampling Frame

Table 33 lists previous RCM participants that left the program since 2011 and that would constitute Cadmus' sampling frame. Facilities in the sampling frame satisfied these criteria:

- Stopped participating since 2011
- Was a PSE gas or electric customer for one or more years after RCM program participation ended
- Reported RCM program energy savings during participation

Cadmus will work with PSE to determine if any of these facilities should be excluded from the sampling frame, because either they re-engaged with the RCM program, the required data are not available, or they are not representative of the current RCM program participants.

Table 33. Sample Frame of Eligible Customer for Estimating Measure Life

Name / Shared Organization	Status	Active?	Last Measure Paid Date
Bainbridge Island SD	Left	No	4/14/2011
City of Auburn	Left	No	11/6/2013
City of Bellingham	Left	No	6/17/2011
City of Bonney Lake	Left	No	12/10/2013
City of Bremerton	Left	No	12/19/2012
City of Edmonds	Left	No	11/7/2012
City of Issaquah	Left	No	8/12/2011
City of Kent	Left	No	3/1/2011
City of Lacey	Left	No	5/6/2011
City of Mercer Island	Left	No	10/8/2013
Edmonds Community College	Left	No	3/3/2011
King County Library System	Left	No	7/12/2011
Kitsap County	Left	No	11/11/2014
Olympia SD	Left	No	12/19/2014
Town of Coupeville	Left	No	4/3/2013
Whatcom County	Left	No	8/29/2012

Cadmus will analyze a random sample of facilities of former participants. For sampling, Cadmus requests a list of formerly-active facilities of customers in the sampling frame. Cadmus will randomly select a minimum of 30 facilities for the measure life analysis.[51] Although government customer type participants heavily dominate the list of customers in Table 33, Cadmus will attempt to achieve a sample that better represents the distribution of school district facilities in the RCM program population.

Requested Data Fields

Cadmus requests the following data for customers who left the program since 2011. Cadmus requires customer and facility data for the sample frame and to draw the sample. Cadmus will only require billing and energy efficiency program participation data for sampled facilities.

[51] If the average former participant has data for three post-participation years, a facility sample size of 30 would yield approximately 90 observations of post-participation savings with which to estimate the savings decay rate. If the analysis would benefit from increasing the sample size and the evaluation budget would allow it, Cadmus will discuss with PSE the possibility of increasing the number of sampled facilities.

Table 34. Requested Data Fields

Data	Description
RCM Customer Data	Please include the following fields: Customer ID/Name of organization Customer address (street, city, zip) Customer account number Customer type Program participation start date Years of participation Status Active? Annual claimed kWh and therm savings Annual incentives paid Customer type/customer type
RCM Facility Data	PSE to provide a list of former RCM program facilities since 2011. Please include the following fields: Customer ID/Name of organization Customer account number Facility ID/premise number Facility address (street, city, zip) Fuel types Program participation start date Years of participation Is active? Annual claimed kWh and therm savings
Energy Consumption Data	PSE to provide monthly consumption data (date read) from the facility baseline year through end of 2016 for sampled former participant facilities. If only calendarized data are available, that would be acceptable. Please include the following fields: Account ID Facility ID Meter ID Meter read date Meter type (gas/electric) Usage Value Reading type (estimated or actual) Consumption Units
Other energy efficiency program participation data	PSE to provide data on PSE incentivized EE measures for former participant facilities since baseline year. Account ID Facility ID Program job id PSE EE Program Name Measure Name Measure Detail Installation Date Quantity Claimed Savings

Budget and Timeline

In the evaluation contract, Cadmus budgeted $22,880 for the measure life and savings persistence tasks. Cadmus expects to complete the proposed work for this amount by leveraging the methods and tools it developed for the RCM program savings estimation task.

The following table shows the measure life tasks and the cost to complete the analysis.

Table 35. Measure Life Budget

Task	Approximate Budget	Deliverable	Due Date
Research Design and sample selection	$3,000	Memo summarizing approach and data request	12/08/2017
Data collection and preparation	$3,000	None	1/12/2018
Individual facility savings estimation	$13,000	None	2/02/2018
Savings persistence panel data analysis	$4,000	None	2/16/2018
Reporting	Original reporting budget	Presentation of draft results and write-up to be included in the final report	2/2018 - 03/2018

Assuming Cadmus receives the billing consumption data by the end of December 2017, Cadmus expects to complete the measure life analysis by the end of February 2018. Cadmus will share preliminary findings of the analysis with PSE in our regular check-in meetings and present the study methodology, findings, and conclusions in the draft and final reports.

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Appendix F. Puget Sound Energy Resource Conservation Manager Program (2014–2016) Participant Interview Guide

The objective of the participant interview is to:

- Understand customers' motivation for participating in the RCM program, and opportunities to qualify for performance grants and target grants (factors influencing motivation related to length and type of experience of RCM, length of time of facility participation, public or private ownership)
- Understand participants' perceived successes and challenges to RCM program implementation
- Understand responses to recent/ongoing program changes
- Solicit ideas for program improvement
- Gather information that will Inform the impact evaluation

Objective	Researchable Question	Question*
Understand participants' motivation for participating in the RCM program	RCM Roles and Responsibilities	C1, F1, G1
	Why do organizations participate in the program?	0
	How do participants implement and track projects?	D2-D5
	How do participants select specific facilities to include in the program?	F2
Understand participants' challenges to RCM program implementation	What challenges do participants face during the Project Identification and Implementation phases and Start-up and Renewal Agreement process?	E1-E6, F3-0
	How much do financial incentives vs. other benefits (access to data, community events, etc.) drive participation?	G1-G3
	Do participants have challenges meeting the incentive goals?	G2, G3
	What is participants' experience with the reporting requirements?	H1-H4
	What feedback do participants have regarding the services offered by the program, including training and energy data?	I1-I6
	What additional support could the program offer?	J6
	What would make the program more attractive to Industrial and Property Management customers?	J4
	Are participants satisfied with the program? Will the participant continue in the RCM program?	J1-J5
Understand responses to recent/ongoing program changes	What were participants' responses to switching from the target performance model, to pay-for-performance?	G1, G2

Target Quota = 15 interviews

Interview Date:
Interviewer:
Interviewee:
Organization:

PUGET SOUND ENERGY

THESE INTERVIEWS WILL BE CONDUCTED AS TRUE CONVERSATIONS. QUESTIONS WILL BE ASKED IN AN OPEN-ENDED MANNER AND RESPONDENTS ENCOURAGED TO ELABORATE, TO CAPTURE CONCERNS, CHALLENGES OR SUCCESSES WITH THE RCM PROGRAM. BEFORE BEGINNING ANY INTERVIEW, INTERVIEWER WILL THOROUGHLY REVIEW THE CUSTOMER MASTER LIST TO BECOME AWARE OF THE PROGRAM PHASE, FACILITIES INVOLVED AND MEASURE STATUS FOR EACH PARTICIPANT.

A. Introduction

Thank you for taking the time to talk with us today about the Puget Sound Energy (PSE) Resource Conservation Manager (RCM) program. Our goal is to understand your experience with the program over the last two years, including your motivation for participating and your satisfaction with the program. We would also like to hear your ideas about improving the program. We expect this interview to take one hour. Do you have any questions before we begin?

B. Data Confirmation

Thank you. Before we get into a discussion about your experience in the RCM program may I confirm the data we received from PSE, about your facilities?

B1. We understand that your organization is in its **[PHASE]** of participation in the RCM program; is this correct?

1. The data shows **[ORGANIZATION NAME]** has been in the program **[YEARS]** years. How long have you been the Resource Conservation Manager at **[ORGANIZATION NAME]**?
2. And your facilities fall into the **[TYPE]** business sector. Is that correct?

C. Roles and Responsibilities

C1. Can you please tell me your title and then about your roles and responsibilities as the Resource Conservation Manager? **[PROBE: IS THERE A CORE TEAM FOR THE PROGRAM, ARE THERE OTHER PEOPLE AT THE ORGANIZATION WHO HAVE THE DESIGNATION "RCM"]**

1. Do you have other responsibilities within your organization other than as the RCM? What are those?

D. Motivation and Decision Making

D1. What is your organization's current motivation for **[PARTICIPATING/RENEWING ITS PARTICIPATION]** in the RCM program?

D2. Generally speaking, how do you go about identifying opportunities to make energy-saving improvements at your facilities? **[PROBE: WHO IS INVOLVED, HOW ARE IDEAS ADVANCE UP THROUGH THE COMPANY, WHO HAS THE AUTHORITY TO AUTHORIZE, WHAT ROLE DOES THE RCM PLAY IN THIS—CAN THE RCM AUTHORIZE OR ONLY ADVISE?]**

D3. **ONCE AN ENERGY-SAVING OPPORTUNITY IS IDENTIFIED, HOW DO YOU GO ABOUT IMPLEMENTING AN OPPORTUNITY? [PROBE: WHO IS INVOLVED, HOW IS THE CHANGE COMMUNICATED THROUGH THE COMPANY, WHAT ROLE DOES THE RCM PLAY IN THIS—CAN THE RCM AUTHORIZE OR ONLY ADVISE?]**

D4. **H**ow do you measure the impacts of energy-saving improvements and track progress toward meeting your savings goals? **[PROBE: HOW ARE THESE REPORTED OR SHARED WITH STAKEHOLDERS?]**

D5. **SINCE YOU BEGAN PARTICIPATING IN THE RCM PROGRAM, HAVE YOU NOTICED ANY UNEXPECTED CHANGES IN YOUR ENERGY USE?**

1. **[IF D5=YES] PLEASE TELL US ABOUT THAT? TO WHAT DO YOU ATTRIBUTE THE UNEXPECTED CHANGE?**

E. Customer Barriers to Project Identification and Implementation

I'd like to ask you about barriers or challenges your organization faces when identifying and making energy-saving changes.

E1. First, in general, do you encounter decision-making bottlenecks or other barriers within your organization when making or implementing energy-saving improvements? Please tell us about those?

E2. **[SCHOOL PARTICIPANTS ONLY]** Do you find the timing of school construction bonds funding cycles, affects your ability to implement RCM improvements or achieve savings?

1. If so, please tell us about those effects, both positive, and or negative? **[PROBE TO DETERMINE IF FUNDING CYCLES CREATE PEAKS AND TROUGHS IN REPORTED SAVINGS AND HOW THOSE ALIGN WITH THE RCM PROGAM REPORTING PERIODS.]**
2. **[IF NOT ANSWERED ABOVE]** Can you give us an example of an improvement you implemented and the positive or negative impact caused by the funding cycle?

Now, speaking more specifically, the PSE RCM program focuses on three types of improvements to reduce energy consumption—operational, capital, and behavioral. I'd like to ask you about each of those.

E3. What are the biggest challenges to making operational improvements at your organization?

1. What can PSE do to help your organization overcome these challenges?

E4. What are the biggest challenges to making capital improvements at your organization?

1. What can PSE do to help your organization overcome these challenges?

E5. What are the biggest challenges to making behavioral changes at your organization?

1. What can PSE do to help your organization overcome these challenges?

E6. What are the one or two key things your company needs to be able to go further in achieving energy savings? For example, does your company need additional technical expertise or assistance, staffing, help getting buy-in from executives or staff at your company, funding, etc.?

F. Startup and Renewal Agreements

Now I'd like to get into some of the details about the program operation and how well that works for your company. Let's start by talking about your experience when you, personally, first engaged with the program and initiated your project.

F1. Were you involved in the start-up of the program? **[SKIP TO F3 IF RCM WAS NOT INVOLVED IN LAUNCH OF PROGRAM]** Please describe the process of launching the program. What worked and where are areas for improvements? **[PROBE FOR HOW EASILY THEY UNDERSTAND HOW PSE CALCULATES TARGET SAVINGS GOALS AND INCENTIVES, AND HOW BASELINES ARE SET AND PERFORMANCE CALCULATED. IF THEY ARE CONFUSED BY THESE, ASK FOR SPECIFICS THEY DO NOT UNDERSTAND AHD WHAT WOULD MAKE IT EASIER.]**

F2. **[SKIP IF RCM WAS NOT INVOLVED IN LAUNCH OF PROGRAM]** How did you select the specific facilities that participated in the program? How did the energy audits shape the selection of these facilities?

F3. Once you began the program, was there anything that surprised you that you had not expected based on your conversations with PSE during the agreement phase (an example might be the time required to participate, or the reporting requirements)? **[IF RCM WAS NOT INVOLVED IN LAUNCH OF PROGRAM ASK]** Once you began the program, was there anything that surprised you that you had not expected?

F4. **[ASK IF RENEWAL CUSTOMER]** Please describe the process of renewing your program agreement. What worked and where are areas for improvements? **[IF NEEDED: THE GRANT AGREEMENT CONTAINS THE SCOPE OF WORK WHICH LAYS OUT THE SAVINGS TARGETS FOR EACH YEAR OF THE AGREEMENT, THE DELIVERABLES REQUIRED BY PSE, AND THE FINANCIAL INCENTIVES PROVIDED IF SAVINGS TARGETS ARE MET AND DELIVERABLES RECEIVED. PROBE FOR HOW EASILY THEY UNDERSTAND HOW PSE CALCULATES TARGET SAVINGS GOALS AND INCENTIVES, AND HOW BASELINES ARE SET AND PERFORMANCE CALCULATED. IF THEY ARE CONFUSED BY THESE, ASK FOR SPECIFICS THEY DO NOT UNDERSTAND AHD WHAT WOULD MAKE IT EASIER.]**

F5. **[ASK IF RENEWAL CUSTOMER]** How did program renewal affect your participation in the program? **[PROBE: WAS THE HIGHER SAVINGS TARGET CHALLENGING TO MEET (5% VS 3% IN THE START-UP PHASE; DID YOU CHANGE THE FACILITIES YOU INCLUDED IN THE PROGRAM, WHAT HAS BEEN THE OUTCOME OF THAT CHANGE?]**

G. Program Incentives

Thank you. I'd like to ask you about the program incentives.

[ASK INTRO AND G1-G2 IF RCM IN PLACE BEFORE 2014] In 2014 PSE changed from an incentive model in which participants were rewarded for meeting energy savings targets at the end of their three-year engagement, to its current pay-for-performance model in which participants earn incentives each year. This meant that as participants' grant agreements were completed, those grants were closed out and the participants could renew under the new incentive payment structure.

G1. Were you involved in this transition to the pay-for-performance incentive structure?

G2. **[IF G1=YES]** Did this change have a positive, negative or neutral effect on your organization's participation? Why do you say that? **[PROBE FOR EASE OF REACHING SAVINGS TARGETS, INCENTIVES EARNED.]**

1. **[IF G2=NEGATIVE]** What could PSE do to help you overcome this negative impact? **[PROBE FOR SPECIFICS.]**

G3. In addition to the Start-up incentive available the first year of participation, PSE also offers annual Performance Incentives and Target Incentives. The Performance Incentive is paid for each unit of energy saved and the Target Incentive is paid when your organization's total savings meets or exceeds your target goal. Have you encountered any challenges achieving these incentives? Which incentives(s)?

1. What are the challenges? **[PROBE: ARE THE INCENTIVE AMOUNTS ENOUGH TO DRIVE CHANGE?]**
2. What is needed to overcome those? **[PROBE FOR SPECIFICS AND WHICH KIND OF IMPROVEMENTS THESE CHALLENGES RELATE TO: OPERTAIONAL, CAPITAL OR BEHAVIORAL]**

H. Customer Requirements

I'd like to shift now and ask you about the customer documentation requirements your organization agreed to as an RCM Program participant. To participate in the program your organization is required to:

- Complete and Implement a Resource Management Plan (RMP) (within the first year of the contract)
- Complete Facility Action Plans or a Portfolio Action Matrix (within the first year of the contract)
- Submit Site Quarterly Checklists (SQCs)

H1. Has your organization completed each of these requirements**? [IF PARTIAL OR IN PROCESS, LIST WHICH HAVE BEEN COMPLETED.]**

H2. **[IF H1=NONE ASK H2 THEN SKIP TO SECTION I]** Why have you not yet completed any of these?

H3. Did you encounter any challenges in completing any of these? What challenges?

H4. What would make it easier for you to complete these? **[PROBE FOR WHAT ELSE THEY NEED TO MAKE THESE MORE USEFUL TO THEIR COMPANIES?]**

I. Training and Other PSE Services

Next, I'd like to ask you about the training and other services you receive from PSE as part of the RCM Program.

I1. PSE offers RCM participants a training allowance each year to offset RCM-related training costs such as Building Operator Certification, or training provided by ASHRAE. Does your organization use that allowance each year?

I2. **[IF I1=YES]** Which trainings are particularly useful to you or the staff that attended? Why?

1. What could be improved about the training?

I3. PSE also offers training directly to RCM participants. These include trainings such as Managing Solid Waste and Recycling, Social Marketing and Behavior Change, and many others. Did you or anyone from your organization attend trainings offered by PSE in the last year? **[IF NONE IN THE LAST YEAR, ASK ABOUT THE PRIOR YEAR.]**

I4. **[IF I3=YES]** Which trainings offered by PSE directly did you or someone from your organization attend as part of the RCM program? **[PROBE: PAY FOR PERFORMANCE LUNCH AND LEARN, MANAGING SOLID WASTE AND RECYCLING, SOCIAL MARKETING AND BEHAVIOR CHANGE, FINANCING ENERGY EFFICIENCY, WHOLE BUILDING ANALYSIS, CONDUCTING AN ENERGY WALKTHROUGH, WATER/WASTEWATER SYSTEM O&M SAVINGS, SMART IRRIGATION SYSTEMS, RETRO COMMISSIONING AND BUILDING SCOPING FOR AN O&M TUNE-UP, PLUGLOAD MANAGEMENT SOLUTIONS, USING MYDATAMANAGER, INNOVATIONS IN OCCUPANT ENGAGEMENT, BUILDINTOOL DIAGNOSTICS HANDS-ON TRAINING, ON-SITE RENEWABLE GENERATION]**

1. Which trainings were particularly useful to you or the staff that attended? Why?
2. What could be improved about the training?

I5. What other trainings currently not funded or provided by the program would help your organization save energy? Can you tell us who provides that training?

I6. Other than training we've already discussed, PSE also provides interval electric and consumption data to RCM participants.

1. How does your organization use this data to implement the program?
2. Is there anything about the electric and/or gas use data that you would recommend improving?

J. Closing/Satisfaction

I have just a few remaining questions.

J1. Overall, how satisfied are you with PSE's RCM program? **(VERY SATISFIED, SOMEWHAT SATISFIED, NOT VERY SATISFIED, NOT AT ALL SATISFIED)** Why do you say that?

J2. Is the program helping you accomplish the goals your company had when they first decided to participate in the RCM program? **[IF NO, PROBE WHY NOT]**

1. **WHAT ABOUT ANY GOALS THAT YOUR COMPANY HAS DEVELOPED DURING YOUR PARTICIPATION? [PROBE FOR AND RECORD SEPARATELY, GOALS IN THE LAST TWO YEARS]**

J3. What elements of the program provides the greatest value to your company and why?

J4. **[ASK IF CLIENT IS INDUSTRIAL OR PROPERTY MANAGEMENT COMPANY]** What could be done to make the program more attractive to **[INDUSTRIAL/PROPERTY MANAGEMENT]** customers like yourself?

J5. Does your company plan to continue participating in PSE's RCM program? **[IF NO, PROBE WHY NOT]**

J6. Other than what we've already discussed, what additional support would you like to see the program offer to help you achieve energy efficiency gains at your facilities? **[PROBE SPECIFIC SERVICES/TOOLS/CHANGES TO PROGRAM DESIGN]**

PUGET SOUND ENERGY

Evaluation Report Response

Program:	Resource Conservation Manager Program
Program Manager(s):	Jessica Raker
Study Report Name:	Resource Conservation Manager Program Evaluation Final Report
Primary Author(s):	The Cadmus Group LLC
Report Date:	June 2018
Evaluation Analyst(s):	Jim Perich-Anderson
Date of ERR:	June 2018

PUGET SOUND ENERGY

Evaluation Overview, Key Findings, Recommendations and Considerations, and Program Responses:

A. Overview

Puget Sound Energy's (PSE) Resource Conservation Manager (RCM) program seeks energy savings from operations and maintenance (O&M) and behavior-based (BB) measures in commercial buildings. The RCM program provides financial incentives, technical trainings, and other assistance to participating customers.

Objectives of the Evaluation

Cadmus evaluated the electricity and natural gas savings from the program in 2015 and 2016 with the following main evaluation objectives:

- Estimate the electricity and natural gas savings from O&M and BB measures in the 2015 and 2016 reporting years
- Identify potential improvements to PSE's approach for measurement and verification (M&V) of savings
- Verify the program's measure life assumptions
- Assess customer satisfaction and experience with the program
- Identify potential improvements to program delivery and customer experience

Cadmus verified 107% of PSE's reported electricity savings and 92% of its natural gas savings in 2015 and 2016. Cadmus also found that RCM participants saved an average of 1.5% of electricity consumption and 1.2% of gas consumption from O&M and BB measures and 1.2% of electricity consumption and 0.8% of gas consumption from capital projects. In general, participants reported high levels of satisfaction with the program but also identified some opportunities for improving program delivery. The findings show that utilities can engage commercial utility customers in managing energy consumption through implementation of O&M and BB measures.

B. Evaluation Considerations and Recommendations and Program Responses

This section 1) excerpts from the attached report the consultant-identified items for consideration and recommendations; and 2) provides PSE program responses.

Considerations

For consideration #1: It is best practice for energy management programs to report negative RCM savings estimates unless omitted variables or other modeling issues can be identified. If there is evidence that either the baseline consumption model is incorrectly specified and cannot

be improved or capital project savings are overestimated, Cadmus suggests that PSE report zero savings or declare that the facility is not evaluable. Otherwise, we suggest that PSE report the savings estimate, regardless of the estimate's sign.

> ***PSE Response:*** As stated by Cadmus on page 28 of this report, 'Situations in which RCM implementation leads to an increase in energy consumption are expected to occur rarely.' However, in cases where energy use at an RCM site has increased, PSE will document and review information on programmatic and non-programmatic activities that may contribute to the unexpected increase in energy use ("negative savings.") In cases where it is clear that non-program related onsite activities have created a significant increase or decrease in energy use, the baseline may be adjusted accordingly. f. However, if there is any question about the impact of capital projects, modeling issues, or non-routine adjustments that indicate actual savings may be masked, the site will be excluded from the analysis of program performance for that year.

For consideration #2: When using monthly billing data to estimate savings, PSE should consider calendarizing billing-cycle HDDs and CDDs. Calendarizing billing-cycle HDDs and CDDs maintains the relationship between energy consumption and weather because both variables are measured over the same period. Currently, PSE calculates monthly HDDs and CDDs by summing degree days for days in each calendar month. PSE may be able to increase the accuracy of its baseline models and savings estimates by calendarizing billing-cycle HDDs and CDDs. At the program level, differences in weather calendarization methods have little impact on savings estimates, because over- or under-estimation of savings for individual facilities appear to cancel out. However, facility level results may be less accurate, as suggested by the lower model adjusted R-square statistics using PSE's calendarization method. These findings are discussed further in the Assessment of Reported Savings Calculation Methodologies section.

> ***PSE Response:*** Starting in 2017, PSE started using daily data with correlating HDDs and CDDs to estimate savings wherever possible. This addresses the issue of different methods of calendarization for weather and consumption data. (Note that for those sites with only invoice data available, weather data will continue to be calendarized separately from consumption data until a tool is developed that can easily do both for the large number of sites in the program.)

For consideration #3: PSE should consider improving its selection of HDD and CDD base temperatures. Currently, PSE selects base temperatures using its knowledge of facilities and information about thermostat settings from RCMs. Cadmus suggests PSE look for data-driven methods of selecting base temperatures, including the method Cadmus used. This method selects the best CDD and HDD base temperature pairs by testing pairs of CDDs and HDDs using different base temperatures ranging between 45°F and 85°F and selecting the pair that maximizes the model adjusted R2. Cadmus consistently selected lower base temperatures for both HDD and CDD. On average, we selected CDD base temperatures 8.5 and 4.4 degrees lower than PSE for electric and natural gas models, respectively. For natural gas models, Cadmus

selected average HDD base temperatures 6.6 degrees lower than PSE. PSE may consider a different range of acceptable base temperatures based on its knowledge of facilities, but it should consider that true set points may differ from (and tend to be lower than) what RCMs report.

> ***PSE Response:*** Starting in 2017, PSE began to vary the base temperatures for the determination of HDDs and CDDs for those sites with daily data available. As of 2018, PSE will do the same for those sites with only invoice data. In those cases where a different base temperature results in a better model fit, the base temperature will be adjusted and the optimized temperature documented.

For consideration #4: As PSE rebrands the RCM program, it should highlight the program's hands-on technical assistance and ensure that the program is adequately staffed and resourced to continue this level of support. Energy management programs often involve close working relationships between utility staff and customers to implement energy efficiency projects. PSE should consider adding staff to the program to maintain the current level of support.

> ***PSE Response:*** PSE will continue to balance the needs of RCM (CSEM) customers with the budgetary decisions necessary to ensure the cost effectiveness of the program. Additional engineers in Business Energy Management are currently being trained to reduce the load on RCM (CSEM) team members and leave them more time for customer support.

For consideration #5: PSE should investigate potential improvements to the program in these areas. PSE has already simplified the reporting requirements, but it may be possible to simplify them further without hindering PSE's ability to collect data for measurement and verification. For example, consider consolidating parameter and performance metrics on a single page. PSE should also consider increasing the frequency of MyDataManager trainings, providing "office hours" for RCMs who are struggling with the software, and using email blasts to highlight the software's features.

> ***PSE Response:*** PSE is exploring additional options for customer reporting including sending out a quarterly report highlighting the sites with the most and least savings as a prompt to customers, asking customers to send in "hit lists" instead of site quarterly checklists, and asking for frequent feedback on reporting requirements. PSE offered weekly office hours on MyDataManager in 2017, but stopped due to a lack of interest. PSE will restart these office hours as a once/month meeting and continue to hold annual MyDataManager in-person training.

For consideration #6: PSE should consider developing basic training modules and an online library of trainings. Developing basic training modules would ensure that new RCMs have a basic level of knowledge. Also, PSE should consider building an online library of webinars to

deliver training modules for common O&M issues. PSE could conduct a brief survey of RCMs to identify a list of most-pressing training needs.

> ***PSE Response:*** In February of 2018, PSE rolled out a PSE-specific portion of NEEA's SEMHub. This platform provides on-line learning tools and allows PSE to set curricula for existing and new customers. This platform will also contain recordings of PSE webinars. Trainings will continue to be set based on an annual survey sent out to participating customers to identify the most pressing training needs.

Recommendations

Recommendation #1: PSE should continue to promote energy efficiency capital projects at RCM facilities. Although other PSE energy efficiency programs take credit for energy savings from incentivized capital projects in RCM participant facilities, PSE should continue to promote them to RCM program participants. RCMs reported that the program's technical assistance was important in the decision to implement many capital projects.

> ***PSE Response:*** PSE will continue to promote a holistic approach to energy management for its RCM/CSEM customers. This holistic approach includes O&M improvements, behavior change campaigns, and capital projects that reduce energy use. PSE's financial incentive structure and communication with customers will continue to support all of these approaches.

Recommendation #2: PSE should collect and incorporate data on facility closures—schools, in particular—into its baseline models. Cadmus found that the accuracy and predictive ability of its baseline regression models often improved when the number of facility closure days was included as an explanatory variable. PSE is in the process of making this enhancement.

> ***PSE Response:*** In 2017, PSE started using an on-line analysis tool that incorporates site occupied hours information into the baseline models. Wherever possible, PSE will continue to use occupied hours as an explanatory variable when calculating predicted energy consumption.

Recommendation #3: The next evaluation should test more definitively for differences in savings between government facilities and schools. This can be accomplished by significantly increasing the number of sampled government buildings and maintaining or increasing the number of sampled schools. PSE should sample enough facilities of each type to detect a hypothesized difference in savings (e.g., 2%) with 80% or 90% likelihood (the statistical power of the test). If significant differences are found, PSE may be able to direct more program marketing resources to increasing the enrollment of government facilities or making changes to RCM program implementation to increase savings in schools.

> ***PSE Response:*** PSE will include this recommendation in the next evaluation.

Recommendation #4: Assist school RCMs in outreach about energy efficiency to teachers, administrators, and students. At the RCM annual meeting, schools RCMs shared challenges with implementing O&M and BB measures and requested training from PSE about how to engage building occupants in energy efficiency efforts.

> ***PSE Response:*** PSE is working to develop a training series targeted at building Energy Champion communication pathways with building occupants and upper management. The training will include the development of an action plan and follow-up meetings will track the successes and lessons learned during the implementation of these action plans. PSE will also offer a limited amount of 1-on-1 coaching by a selected contractor for customers facing specific communication issues.

Recommendation #5: PSE should continue to use the three-year measure life estimate from the previous evaluation. The three-year estimate is based on a bottom-up analysis of measure life of individual measures adopted by RCM participants. Although an estimate of measure life based on billing analysis would be preferable, the bottom up analysis is defensible and can serve as a placeholder until a more rigorous billing analysis can be performed. PSE should look for opportunities to estimate measure life based on billing analysis.

> ***PSE Response:*** PSE will continue to use the three-year measure life until another estimate based on billing analysis of continuing and leaving RCM/CSEM customers is available to distinguish the measure life of these two different groups.

Recommendation #6: PSE should communicate program improvements to RCMs multiple times and through several channels, including program newsletters, annual incentive payment reports, and the RCM Annual Meeting

> ***PSE Response:*** The RCM/CSEM team will continue to work on a communication strategy for participants. Tactics include:
>
> - Quarterly check-ins with designated PSE point of contact
> - Quarterly emails with program updates
> - Annual customer meeting with PSE point of contact, RCM, and others on customer team
> - RCM Annual Meeting

Recommendation #7: PSE should consider sponsoring trainings about implementing BB measures. This training could incorporate content about the psychology of behavior change as well as offer strategies and supporting materials for RCM's to utilize.

> ***PSE Response:*** PSE held trainings on behavior-based energy savings in 2016, 2017, and plans to do so in 2018.
>
> - 2016 – Innovations in Occupant Engagement

- 2017 – Social Marketing/Behavior Change
- 2018 – Communicating Up and Down

We will continue to hold trainings on this topic annually as long as customers express interest. We will also identify on-line options and include them on the PSE portion of the SEMHub.

Recommendation #8: PSE should develop case studies to highlight the value of energy efficiency and successes of the RCM program. The case studies should demonstrate how the RCM program helped organizations overcome barriers to implementing energy efficiency projects and build a business case for making energy efficiency improvements.

PSE Response: PSE is currently working on a case study of one of its successful RCM/CSEM customers and will look into developing additional case studies.