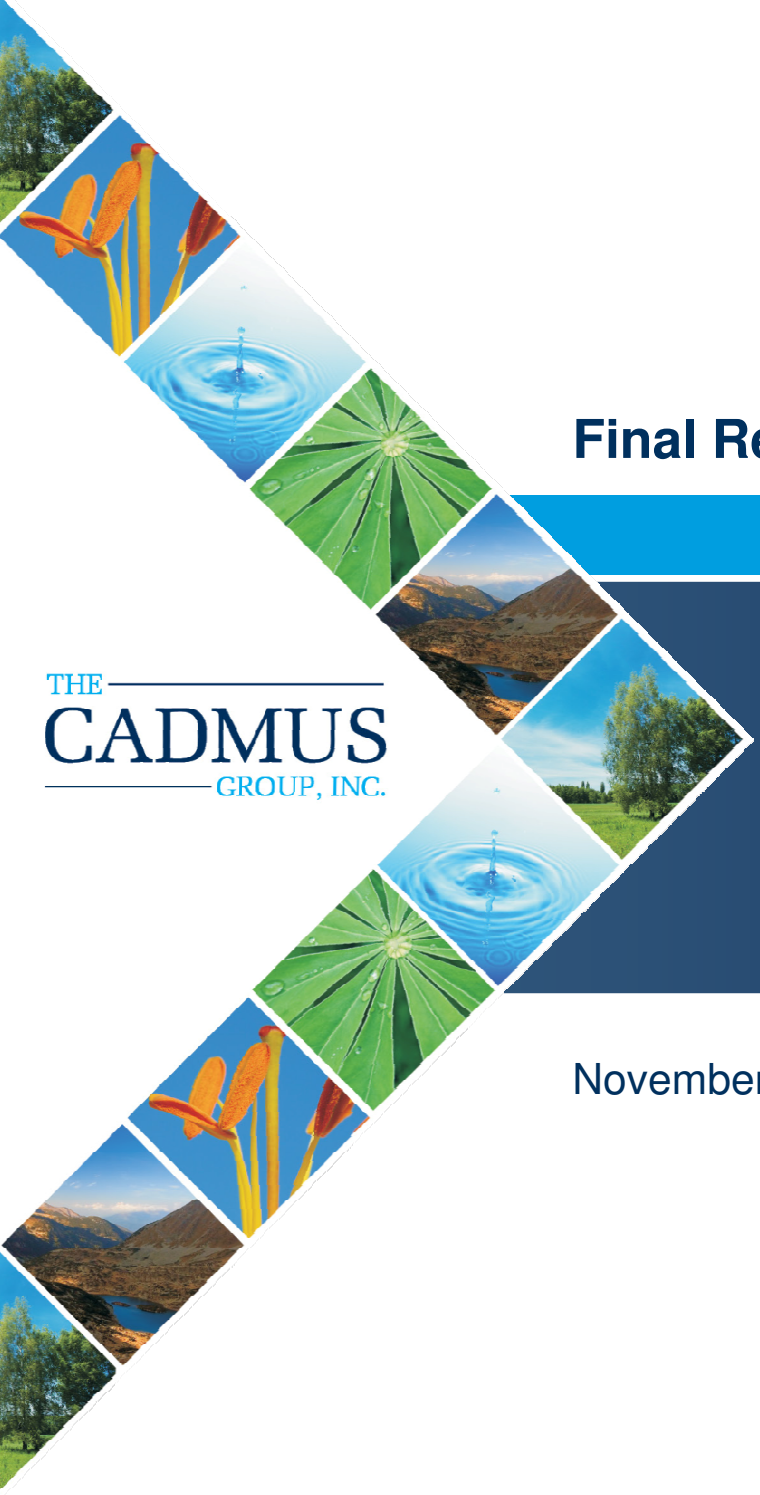

THE CADMUS GROUP, INC.

Final Report

Colorado High Efficiency Air Conditioning Product Program Evaluation

November 2012

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1. EXECUTIVE SUMMARY

The Cadmus Group, Inc. evaluated Xcel Energy's 2011 Colorado High Efficiency Air Conditioning Product Program (HEAC Program), a residential demand-side management (DSM) program. Cadmus conducted this evaluation according to the best practices outlined in the *California Evaluation Framework* and in consultation with Xcel Energy.

Xcel Energy launched the HEAC Program in 2009 to encourage customers to buy high-efficiency central air conditioners (CACs) and air-source heat pumps (ASHPs) as new units or to replace older, less efficient CACs already installed. Through the program, Xcel Energy provides a cash rebate to their electric customers who purchase a qualifying CAC or ASHP and have the unit installed by a registered contractor. Registered contractors are listed on Xcel Energy's program Website after they complete a required certification course, pass an examination, and commit to following specified quality installation (QI) guidelines.

The program includes two equipment rebate plans. The Plan A Equipment Rebate promotes the installation of new qualifying equipment in: existing homes without CAC; existing homes replacing an old, burned-out CAC unit; and new homes. Xcel Energy added the Plan B Early Retirement Equipment Rebate in June 2010, which promotes the installation of new qualifying equipment in existing homes that replaces existing units that are operable or in need of minor repair to make them operable. Both Plans A and B include a contractor QI incentive.

Xcel Energy based the incentive for this prescriptive rebate program on the new unit's seasonal energy efficiency ratio (SEER) rating. Customer rebates start for 14.5 SEER units, which aligns the program with the new ENERGY STAR® minimum SEER rating. The new equipment customer rebate is higher for 15 SEER units, and even higher still for 16 SEER units. The customer early retirement rebate (Plan B) is $500 for all units from 14 SEER through 16 SEER. To encourage QI for units below the ENERGY STAR level but at or above the federal minimum standard, Xcel Energy offers contractors a cash incentive to properly install and test 13 SEER through 16 SEER-rated units.

Method

Cadmus relied on both primary and secondary data for evaluating the program. Primary data came from surveys with customers who received a rebate for participating in Xcel Energy's HEAC Program, from surveys with participating and nonparticipating installation contractors, and from focus groups with participating contractors. Secondary data, presented in the Peer Utility Benchmarking chapter and the M&V Benchmarking chapter, came from our evaluation of multiple programs that included a CAC rebate.

We based the net-to-gross (NTG) analysis on self-report data from the phone surveys with participating and nonparticipating contractors and participating customers, in which we asked questions about freeridership and spillover. Freeridership is the percent of savings that would have occurred in the absence of the program, and spillover is the savings that are attributable to customers purchasing additional energy-efficient measures because of the program but that are

beyond those savings tracked in program databases. An outline of how we analyzed the NTG data is included in the Net-To-Gross Ratio chapter.

Objectives

The objectives of the HEAC Program evaluation are outlined below. The task numbers correspond to specific Xcel Energy objectives across multiple program evaluations, and thus may not be sequential.[1]

Task 1. Conduct Project Initiation Meeting and Present Evaluation Plan

Objective: *To provide a forum for program staff to discuss the evaluation goals, clarify basic research and analyses methods, identify data required from Xcel Energy, and finalize the project schedule timeframe.*

Task 2. Internal Review/Development of Process Flow and Logic Model

Objective: *To obtain a description of the internal workings of the program and identify any problematic issues or areas that might impact the implementation, data development, or analysis of the program.*

Task 3. Primary Research - Participant Surveys

Objective: *To gather data regarding program satisfaction, program processes, incentive levels, and marketing from program participants.*

Task 4. Primary Research - Participant and Nonparticipant Trade Ally Interviews

Objective: *To define the process for reaching out to the program actors; to identify the questions for understanding the success of the program operation; and to assess how improvement can be attained.*

Task 5b. Validate and Recommend Net-to-Gross

Objective: *To assess freeriders, free drivers, and spillover for an analysis of the program NTG ratio. The recommended NTG ratio should consider program design changes and program NTG ratios from other utilities.*

Task 6. Peer Utility Benchmarking

Objective: *To identify the specifics of CAC rebate programs offered by peer companies and compare those specifics to Xcel Energy's program.*

Task 10. Measurement and Verification Benchmarking

Objective: *To understand the current measurement and verification (M&V) process as a basis for comparing this program to similar program M&V procedures and best practices.*

[1] Xcel Energy and Cadmus standardized this task numbering across other program evaluations, and it is not intended to be sequential where supplemental tasks were added.

Task 9. Participating Contractor Focus Groups

Objective: *To represent balanced, qualitative insights and memorable highlights, designed to help Xcel Energy continue to enhance the HEAC Program and fine-tune the program planning and marketing strategies.*

Task 11. Nonparticipant Site Visits

Objective: *To enhance the NTG analysis by assessing QI freeridership based on QI components completed in nonparticipating homes.*

Task 7. Progress Reporting

Objective: *To provide monthly/weekly progress reports to Xcel Energy communicating progress and any challenges, including their resolutions.*

Task 8. Final Report

Objective: *To submit a final report to Xcel Energy that includes program finding and recommendations.*

Key Findings

A summary of key findings for the HEAC Program are outlined by task below.

Task 2. Internal Review/Development of Process Flow and Logic Model

With input from Xcel Energy, Cadmus developed an interview guide and conducted interviews with program staff. Staff reported that the program did not meet its 2011 savings goals as filed with the State of Colorado, but did meet an internal goal set by program staff.

Several staff indicated that the filed goals may have been unrealistic, given that they were filed in 2010 for 2011-2013, before the impacts of the economic recession were fully understood. One staff member indicated that the filed goals were based on the 2010 program, which was driven predominantly by previous sales that were supported at a higher level by the American Recovery and Reinvestment Act (ARRA) federal tax credits. Despite not achieving program goals, the program staff said there is potential for program growth based on its recent performance.

Based on these interviews, Cadmus created a process flow diagram that documents the program delivery to customers (Figure 1 and Figure 2), as well as a logic model that shows the program inputs, outputs, and expected outcomes (Figure 3).

Task 3. Primary Research - Participant Surveys

Program Awareness

- **Contractors and retailers are key sources of participants' program awareness and program information.** Just over two-thirds (68%) of participants reported first hearing about the program from a contractor or retailer. Of the customers who had heard about the QI component of the program, just over two-thirds (68%) reported hearing about it from a contractor or retailer. Finally, just over three-quarters (79%) of the participants reported hearing about the early retirement rebate from a contractor or retailer.
- **Not all participating customers are aware of the QI component of the program.** Sixty-three of the surveyed participants (23%) did not know about the QI requirement.
- **Some customers that are aware of the QI component recognize that this requirement helps to ensure their unit operates more efficiently (31%) and saves energy and lowers energy bills (26%).**

Decision Making

- **Two-thirds (66%) of participants reported that one of their primary reasons for buying a qualifying CAC was to save energy or money**. Just over one-third (37%) of participants bought an eligible unit because their old one had broken down.
- **Few customers are using Xcel Energy's registered contractor list.** Only 3% of participants reported using the registered contractor list as their primary source to find a contractor.
- **Customers focus on the unit efficiency level and price when deciding on a new CAC**. The most commonly reported primary decision factors for customers buying a new CAC were the new unit's efficiency level and/or energy savings (44%) and price (33%). Only 17% of participants reported choosing a unit primarily because of the available rebate.

Satisfaction

- **Participants expressed strong levels of satisfaction with Xcel Energy and with the HEAC Program.** Most participants (90%) reported satisfaction with Xcel Energy as a service provider, and 94% of participants are satisfied with the HEAC Program overall.

PRIZM Segments

- **Four PRIZM life stage categories accounted for almost three-quarters (74%) of the HEAC Program participants in 2011:** Affluent Empty Nests (22%), Midlife Success (20%), Young Accumulators (18%), and Conservative Classics (14%).
  - Cadmus found that Affluent Empty Nests, Midlife Success, and Young Accumulators have high participation potential when comparing their HEAC Program participation rate to the overall Colorado residential population.
  - One other life stage category—Conservative Classics—although not as strongly represented in the Colorado residential homeowners population, did have a higher

representation in the HEAC Program population. By virtue of its proportion in the populations, we classified this category as having medium potential for participation.

Task 4. Primary Research - Participant and Nonparticipant Trade Ally Interviews

Satisfaction

- **The vast majority of participating trade allies are satisfied with the HEAC Program in general**, with 32 out of 33 surveyed (97%) reporting they are satisfied (giving a rating between 6 and 10 on a 0 to 10 point scale).
- **All participants who received training through the program reported that they found the training valuable** (giving a rating between 6 and 10 on a 0 to 10 point scale).

Awareness

- **All of the nonparticipating trade allies we surveyed are aware of the program,** and none of them had previously participated in the program. Interviewees most commonly reported hearing about the program from an Xcel Energy employee.
- **Participating trade allies reported that roughly half of their customers (46%), on average, were already aware of the rebate** offered through the program before they mentioned it.

Challenges

- **The most frequently mentioned challenge participating contractors brought up was ensuring that equipment qualified under the program given the parameters of the house.** The house parameters could cause issues with proper sizing or with matching existing systems, such as duct size or square footage. Another common difficulty participating contractors mentioned was properly calculating the heat loads.[2]
- **A common difficulty for participating contractors was the number of requirements included in the QI component of the program**.
- **Nonparticipating contractors most often reported the North American Technician Excellence, Inc. (NATE) certification as the biggest barrier to their participation in the program.** When we asked what would make it more likely for them to participate, nonparticipating trade allies most often reported either eliminating the NATE certification requirement or reducing the cost of obtaining the NATE certification.

[2] Heat load is the amount of energy the furnace must deliver to the home in order to maintain the indoor temperature.

Marketing

- **Just over half (52%) of participating trade allies did some form of program marketing in 2011,** and the majority (79%) of participating trade allies reported high satisfaction ratings with the marketing support provided by Xcel Energy (giving a rating between 6 and 10 on a 0 to 10 point scale).
- **Almost half of the nonparticipating trade allies (47%) reported a decrease in their marketing practices in 2011 as compared to 2010**, with five (33%) reporting no change in their practices, and three (20%) reporting that they had increased their marketing.
- **Participating trade allies most often reported print and Web advertising as strategies they use to promote their products**, while nonparticipating trade allies' most effective promotional methods are customer referrals, print ads or brochures, and the internet or Website.
- **Participating trade allies often present high-efficiency options to customers first or discuss the benefits of high-efficiency units**. Many trade allies, both participating and nonparticipating, emphasize the potential to lower electric bills and reduce energy consumption when discussing the advantages of higher-efficiency CAC units with their customers.

CAC Sales Trends

- **Participating contractors tend to sell higher-efficiency CAC units than nonparticipating contractors**. Participants sold the highest average number of rebate-eligible units in the SEER 15 to 15.9 range, while nonparticipants reported the majority of their sales (84% of their sales) were for units below SEER 14.
- **Just over half of the participating trade allies said that the availability of the federal tax credit in 2011 made a positive impact on their overall unit sales** by influencing customers' decisions to upgrade to higher-efficiency units (i.e., 16 SEER or higher). Only two nonparticipating contractors stated that the federal tax credit impacted their CAC sales positively, and only minimally.
- **Participating trade allies most often mentioned the warmer summer weather and manufacturer rebates** as factors outside of the Xcel Energy HEAC Program and the federal tax credit that impacted their sales of CAC units in 2011. They reported these factors as having a significant positive impact on sales. Nonparticipating trade allies also cited the economy, which they reported as having a negative impact on sales.

Program Impacts

- **The majority (two-thirds) of participating trade allies reported that they changed their standard CAC installation practices based on what they learned from the QI training required for becoming an Xcel Energy registered program contractor**. The most significant change was the frequency of recording dry bulb temperatures: on average, participants reported doing this for 54% of their CAC installations before participating versus 92% after participating.
- **According to participants, the CAC units impacted most by the program were SEER 15 to 15.9***,* with contractors reporting that, on average, only 18% would have sold without the program.

Task 5b. Validate and Recommend Net-to-Gross

Cadmus based our recommendation of the NTG to use for planning purposes on our analysis of freeridership and spillover (participant and nonparticipant), indications of market transformation based on the current program, and benchmarking of these values for similar programs.

- **For the 2011 program, we calculated freeridership to be 42.8% and spillover to be 10.5%. These findings indicate that 67.6%** of Xcel Energy's claimed gross electric savings can be attributed to its HEAC Program. Our benchmarking of NTG values for similar programs in other jurisdictions revealed that the NTG estimate for Xcel Energy's 2011 program is within the range of NTG values found when similar programs are evaluated.
- **By making two program changes—eliminating the equipment incentive for 14.5-14.9 SEER units and changing the QI M&V analysis methodology—this NTG ratio would be 71.1%.**
- **Cadmus' initial measurement of market transformation indicates that the program has affected the adoption of higher efficiency units and QIs in the market**. Further discussion on market transformation measurement is available in Appendix F.

Task 6. Peer Utility Benchmarking

Cadmus completed a benchmarking study comparing design elements of the Xcel Energy HEAC Program with 13 other similar programs offered throughout the county. A few of these benchmarked programs focus on only CAC, while others include multiple measures in addition to CAC.

The studies we reviewed for this analysis vary somewhat in their program structure. While some programs, like the Xcel Energy program, offer rebates to customers and limited or no incentives to trade allies, others offer greater incentives to contractors at all SEER levels. Although all programs require some form of QI and the use of a program-registered contractor, some programs offer the contractor an additional incentive for completing the QI component for any SEER-level rebated unit. Three other programs also offer an early retirement component.

- **The calculated 67.6% NTG ratio for Xcel Energy's HEAC Program is consistent with those of comparable programs, which had NTG values ranging from 44% to 74%.**

Task 10. M&V Benchmarking

- **Xcel Energy differs from some other QI programs in document collection and review practices.** Xcel Energy currently collects load calculations and conducts a file review for only a sample of installations, while many QI programs collect load calculations and conduct a file review for every installation, as recommended by the Air Conditioning Contractors of America (ACCA) verification protocol.
- **Like Xcel Energy, most QI program sponsors include on-site verification for a sample of installations; however, unlike Xcel Energy, several program sponsors use a tiered approach for site selection.** Several program sponsors follow a contractor-based tiered sampling protocol, in which a higher percentage of installations are verified for contractors that are new to the program. Once contractors have successfully completed several installations and proven their knowledge of QI, a smaller sample of their installations are selected for verification.
- **Xcel Energy's program differs from most of the benchmarked programs in the criteria for airflow and duct sealing.** Most programs base the desired airflow level on system design and allow for the measured airflow to vary within 15% of the design level, while Xcel Energy currently requires a set airflow level for all installations. Most duct sealing programs require a measurement of the air leakage from ducts, and set either a maximum percentage of airflow allowed as leakage or a minimum required leakage reduction. The Xcel Energy program requires only that contractors seal exposed ductwork and alert the customer if they identify any substantial airflow issues.
- **Xcel Energy is currently evaluating equipment sizing based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) estimated capacity, which is not the most precise approach for the climate in Colorado.** A more precise approach would be to calculate the matched equipment capacity using the Manual S requirements, and to then use the Manual S methodology to estimate the desired airflow.[3]

[3] Changing the analysis methodology for QI would also impact program gross savings and program aspects, such as contractor training. Program gross savings were not a part of this evaluation, therefore the impacts this change would most likely have on gross savings is not quantified.

Task 9. Participating Contractor Focus Groups

Cadmus conducted two focus groups with 13 Colorado HVAC contractors who installed CACs as part of the Xcel Energy HEAC Program in 2011. Our goal in reporting the focus group results is to represent balanced, qualitative insights and memorable highlights, designed to help Xcel Energy continue to enhance the HEAC Program and fine-tune the program planning and marketing strategies.

- **Contractors who participated in the focus groups[4] rated high satisfaction with Xcel Energy's products and service.**
  - All but one contractor rated this as a 7 or higher on a 0 to 10 point scale. One contractor gave a rating of 6.
  - The most common rating was 8 (n=5).
- **QI activity is unclear based on contractors' self-reports**. Although the majority (n=8) of contractors reported that 50% or more of their jobs were rebated, and therefore included QI, there was a discrepancy between the number of QIs reported in the focus groups and the number recorded in the program data.
- **Contractors reported that only a few customers asked about rebates.** Furthermore, only a few contractors said they stress the importance of QI when talking to customers.
- **The majority said they are better contractors due to their experience with the program.** Initially, however, a majority found it challenging to participate due to paperwork and program requirements.
- **Contractors are quite familiar with the program requirements and QI components.**
- **Contractors reported that customers express no concerns regarding initial program participation**.
- **Contractors indicated that when customers do not purchase high-efficiency equipment, it is because of the customer's budget limitations or status as a renter**.

Task 11. Nonparticipant Site Visits

Cadmus conducted 18 site visits from July through October 2012, with customers who had a new CAC installed in the last three years and did not participate in the HEAC Program (referred to as nonparticipants). Cadmus gathered information to assess whether each component of QI passed or failed based on the criteria the third-party M&V contractor (Residential Science Resources, or RSR) had used in 2011. Cadmus provides the pass/fail rating for each component of QI in the Nonparticipating Customer Site Visits chapter, comparing HEAC Program nonparticipants to participants.

Cadmus also identified a more accurate way to evaluate the pass/fail of each QI component than the criteria used by the M&V contractor in the previous evaluation year.

[4] Two contractors did not fill out the pre-group exercise, so "all" in this sentence applies to the 11 contractors who did complete the exercise.

The findings from these site visits are also a component of the freeridership analysis and were factored into the final NTG.

- **Although the pass/fail rates of participants and nonparticipants are similar, the degree of failure from the acceptable value for nonparticipants was greater than the degree of failure for participants.** The study conducted by RSR with participating customers in 2011 found high fail rates for sizing, refrigerant charge, and airflow. Cadmus found similarly high fail rates for these components for the nonparticipant installs we evaluated in 2012. Detailed review of the data shows that nonparticipants who failed refrigerant charge and sizing failed with a greater deviation from the acceptable value than program participants. Further details on this can be found in Appendix G.
- **The quality of duct sealing is lower for nonparticipants.** Duct sealing assessment is subjective, and therefore pass/fail rates are difficult to compare. RSR found issues with approximately 25% of the ducts inspected in participant customer homes. Cadmus found that 50% of the ducts in the nonparticipating homes we visited were only partially sealed or were not sealed at all.
- **The target subcooling is calculated correctly.** We found no issues with the pass/fail criteria used to assess proper refrigerant charge.
- The 2011 target airflow measurement was calculated using a target airflow of 400 cfm/ton for every site. This estimate of tons was based on the system capacity. However, **target airflow should be based on the original equipment manufacturer (OEM) data or on the ACCA Manual S methodology.** Both of those methods include a correction for high altitude conditions.[5]
- The 2011 target sizing measurement was calculated by comparing the AHRI capacity to the Manual J load calculation to assess proper system sizing. The AHRI capacity is based on how the system operates at sea level; at high altitude, the condenser (outdoor unit) loses cooling capacity. **A more precise way to assess proper sizing is to use the HVAC cooling capacity that correlates to the Manual J peak load calculation, by using the manufacturer OEM data or Manual S calculations.**

Recommendations

Process

1. **Continue to build relationships with contractors.** With the majority of participants not only reporting having first heard about the program from their contractor, but also that their contractor was the key source of other energy-saving information, contractors and retailers are clearly key sources of program information for participants and a critical part of program success.

[5] Changing the analysis methodology for QI would also impact program gross savings and program aspects, such as contractor training. Program gross savings were not a part of this evaluation, therefore the impacts this change would most likely have on gross savings is not quantified.

a) **Continue having the residential channel manager** serve as a direct line of communication between trade allies and Xcel Energy. Survey and focus group results indicated that this is an effective source of contractor program awareness.

b) **Continue providing program information** to contractors through mail and e-mail.

c) **Explore expanding trade ally participation to include opportunities for friendly competition and rewards for increased equipment installations.** The sponsors of two benchmarked programs implemented an online HVAC contractor scorecard that tracks contractors' tune-up and installation completions, and they provide a free lunch to the contractor completing the most installations. Program management indicated that the online scorecard was successful and increased contractor participation. Although Xcel Energy typically prefers to recognize all contractors equally, a performance-based reward or award may be appropriate.

d) **Explore sponsoring contractor round tables** to: (1) promote industry discussion among participating contractors, and (2) provide an opportunity for participating contractors to share program benefits and positive experiences with nonparticipating contractors to order to encourage greater participation.

e) **Continue to recognize participating contractors** by providing them with program-specific marketing, such as truck magnets and yard signs to help them distinguish themselves, as well as continuing to recognize top performers within the participating contractor group with awards and plaques.

f) **Consider enhancing existing customer-focused QI handouts and brochures to include talking points for contractors to share with customers** that specifically address lifetime cost and savings, key customer questions, and QI benefits.

g) **Explore ways in which training can be enhanced to better serve the contractors.**

i. **Consider allocating more training time to discussing how the sizing requirement can be met** to help contractors better understand what equipment could meet the needs of a home and to cut down on the time it takes them to research the information.

ii. **Consider adding a specific training component around duct sizing,** explaining how old or improperly sized ducts can impact an installation.

iii. **Explore ways to facilitate contractors' ability to meet the NATE certification requirement** by either offering an incentive to help offset the upfront cost of the certification or by updating the contractor training to more closely reflect the language and structure used in NATE certification. Although Xcel Energy's HEAC Program currently bases certification requirements on other factors and also accepts NATE certification, by integrating more of the NATE training protocol, contractors will experience the additional benefit of achieving the NATE endorsement.

2. **Consider a tiered approach for file review and M&V site selection.**

a) **Explore a tiered approach to document submittal** requirements by initially requiring contractors to submit recorded measurements, load calculations, and the

AHRI reference number for every installation, but decreasing this requirement after they have completed a certain number of jobs. Once a contractor has successfully completed a certain number of installations, submitting the load calculations could be required only for sites selected for an M&V visit.

b) **Explore selecting installations for on-site verification based on the contractor, using a tiered system** rather than conducting a random sample of all submitted applications. Consider using a tiered approach in which each contractor's sampling rate decreases once they pass a certain number of verifications.

3. **Increase program awareness and explore the possibility of expanding customer-focused marketing** by highlighting the benefits of QI, the available rebates, and the online list of registered contractors available through the Xcel Energy Website. Specific recommendations for increasing awareness include:

   a) **Consider investigating ways to increase customer awareness about the QI component of the program and its value.** Almost one-quarter (23%) of participants did not know about the QI requirement. Increasing customer awareness of the QI component would provide them with a deeper understanding of program benefits, particularly the added energy savings that can be achieved with QI. QI-aware customers are more likely to ask their contractor about QI, which in turn could increase the likelihood of program participation.

   b) **Consider exploring strategies to increase customer awareness and use of Xcel Energy's registered contractor list.** Only 3% of participants reported using the registered contractor list to find a contractor or retailer. As customers turn to Xcel Energy for this resource, contractors may more fully appreciate the program as a potential referral source.

      i. **Re-examine the program Website structure to ensure that the contractor list is easy to access within one or two page levels.**

   c) **Explore advertising on Websites geared toward an older audience,** given that the highest rates of program participation occur with Affluent Empty Nests and Midlife Success.

   d) **Explore the possibility of expanding customer-focused marketing and advertising by highlighting the benefits of QI through the use of educational videos and social media channels.**

   e) **Consider leveraging contractor testimonials** by highlighting them on communication and outreach collateral targeting new contractors.

4. **Consider investigating marketing segmentation efforts specifically to reach Affluent Empty Nests, Midlife Success, and Young Accumulators.** These three PRIZM segments have high participation potential.

5. **Consider increasing cross-marketing with Home Performance, Furnace and Boiler Rebate, and Saver's Switch programs.** Furnaces were the most frequently installed additional measure for participants having a CAC installed, indicating that customers often replace their furnace and CAC at the same time.

6. **Explore implications of modifying the M&V requirements and process.**
   a) **Consider requiring more stringent qualifications for verification staff (e.g., a highly skilled HVAC technician or engineer).** In the past, installation contractors expressed a lack of confidence in Xcel Energy's M&V contractor. HVAC verifiers must have technical expertise and experience to earn contractor confidence, and to ensure an accurate assessment of the quality of HVAC system installation.
   b) **Explore the implications of modifying the pass/fail criteria for equipment sizing and airflow,** considering factors such as the energy and demand impacts associated with each component and the accuracy of measurement equipment.
   c) **Explore the implications of re-evaluating the target airflow and equipment capacity calculations.** These two important components of QI could be assessed differently. Cadmus found some systems that failed according to the current M&V method but should have passed, and vice-versa. Data is available to recalculate the target airflow and equipment capacity at peak conditions specific to the location of system installation.[6]
   d) **Consider claiming savings from an undersized system.** Although most undersized systems do not provide adequate cooling on the hottest days, this actually saves energy. Therefore, an undersized system should receive a pass rating.

Impact

1. **Consider assessing the amount of savings allocated to QI components.** The freeridership attributable to the QI element of the program is the highest at 54.2% (whereas freeridership for efficient equipment is 29.3% and for early replacement is 39.4%). We recommend reassessing the deemed savings attributable to correct QI by using the verified EER (through field measurements) and regional HVAC unit energy consumption. This method does not include savings attributable to proper equipment sizing. Another method of reducing freeridership could be to incentivize only the portions of a QI that are least frequently met (such as sizing).
2. **Consider the program changes of removing SEER 14.5-14.9 equipment incentives and changing the methodology of analyzing QI savings.** These two program components have the highest impact on freeridership. When these changes were applied to 2011 data, the NTG value increased from the observed 67.6% to 71.1%.

[6] Changing the analysis methodology for QI would also impact program gross savings and program aspects, such as contractor training. Program gross savings were not a part of this evaluation, therefore the impacts this change would most likely have on gross savings is not quantified.

3. Explore the costs and benefits associated with a tiered early retirement incentive approach based on the SEER level of the replaced unit. One benchmarked program offers $110 to customers who replaced a working CAC greater than 10 SEER or any nonworking CAC with any new, efficient unit, but offers a much higher incentive ($600) for a new efficient unit that replaces a working CAC with less than 10 SEER.
4. **Perform addition nonparticipant site visits in a future study to more accurately determine QI freeridership and market conditions.** The study Cadmus performed showed great variability in QI component failure in nonparticipating program homes versus self-reported conditions, but sample limitations made it difficult to generalize to the population with confidence. Because QI is a significant portion of the program and has a large impact on NTG, we recommend that Xcel Energy consider expanding on this research and determining the actual market conditions with a larger sample in the future.

2. INTRODUCTION

This chapter describes the research methods and data collection activities Cadmus conducted for the HEAC Program evaluation, and presents an overview of the remaining report chapters.

Research Method

Cadmus conducted data collection activities from March 21 through July 31, 2012. We focused these activities on collecting inputs to inform the process and impact evaluations. The research approach we used to evaluate the program consisted of the following activities:

- Reviewed Xcel Energy's program participant tracking database
- Conducted primary data collection via surveys and interviews with the following market actor groups:
  - Program staff (n=8)
  - Participating customers (n=300)
  - Participating (n=33) and nonparticipating (n=15) trade allies
- Conducted focus groups with participating trade allies (n=13)
- Conducted nonparticipating customer site visits (n=18)
- Performed benchmarking of other similar CAC rebate programs (n=13)
- Reviewed program technical assumptions

Report Overview

This report is organized into the following chapters:

- Chapter 3 presents the program description, history, and design, as well as results from program staff interviews
- Chapter 4 presents results from the participant customer surveys
- Chapter 5 presents results from the trade ally surveys
- Chapter 6 describes focus group findings
- Chapter 7 presents results from the nonparticipating customer site visits
- Chapter 8 our NTG ratio analysis and findings
- Chapter 9 provides overall benchmarking for the program
- Chapter 10 provides M&V benchmarking for the program
- The appendices include all data collection instruments, detailed survey results, focus group materials, and benchmarking and technical assumptions bibliographies.

3. PROGRAM DESCRIPTION

Through their HEAC Program, launched in 2009, Xcel Energy provides a cash incentive to electric customers who purchase qualifying equipment, such as a CAC or ASHP, and have it installed by a contractor who is registered in the program. Xcel Energy also offers cash incentives to registered contractors who perform QIs.

Xcel Energy designed the program to increase energy efficiency in residential homes by encouraging consumers to purchase high-efficiency CACs and ASHPs as new units or to replace older, less efficient CACs already installed. ENERGY STAR® ASHPs are eligible for incentives when customers purchase them and have them installed, but they are not subject to QI requirements. Cadmus did not evaluate ASHPs.

The program includes two customer focused incentive plans:

1. ***Plan A Equipment Rebate:*** CACs and ASHPs that meet certain energy-efficiency standards are eligible for an incentive. The goal is to encourage consumers to purchase units that meet or exceed the ENERGY STAR efficiency standard of a 14.5 SEER rating.
2. ***Plan B Early Retirement Equipment Rebate:*** Xcel Energy added this option in June 2010, in order to motivate homeowners to replace older but operable, lower-efficiency residential CAC units. These units can be working well or be in need of repair. Customers are required to replace them with high-efficiency units (14 SEER or higher) before the end of the unit's useful life.

While QI is a required component for receiving an incentive, the amount of that incentive is dependent on the SEER rating of the new CAC. The customer incentives start for 14.5 SEER units, aligning the program with the ENERGY STAR minimum efficiency standards. Xcel Energy offers higher customer incentives for 15 SEER and 16 SEER units.

To encourage QI for equipment below ENERGY STAR efficiency standards but above the federal minimum standard, Xcel Energy offers a cash incentive to contractors for properly installing and testing units between 13 SEER and 14.4 SEER. Since these units are incentivized for the QI portion only, a minimum energy efficiency ratio (EER) rating is not required; all EER levels for the 14.0-14.4 SEER range are acceptable.

The incentives that were offered to customers and contractors in 2011 are shown in Table 1.

Table 1. 2011 HEAC Program Incentive Levels by SEER and EER

Equipment Tier	SEER	EER	Plan A: Customer Equipment Rebate	Plan B: Customer Early Retirement Equipment Rebate	Total Rebate for Plan B Customers	Total Contractor QI Incentive
	13	below 12	$0	$0	$0	$100
	14	below 12	$0	$500	$500	$100
Tier 1	14.5	12	$250	$500	$750	$100
Tier 2	15	12.5	$350	$500	$850	$100
Tier 3	16	13	$500	$500	$1,000	$100

Program Goals and Objectives

The HEAC Program objective is to increase energy efficiency in residential homes through the installation and optimal efficient performance of CACs and ASHPs in Xcel Energy's electric customers' homes. This is achieved through the purchase and proper installation of higher-efficiency equipment.

The program did not meet its 2011 savings goals that were filed with the State of Colorado (Table 2), but did meet an internal goal set by program staff. Several staff indicated that the filed goals may have been unrealistic, given that the goals were filed in 2010 for 2011-2013, before the impacts of the economic recession were fully understood. One staff member indicated that the goals were based on the 2010 program, which was driven predominantly by previous sales that were supported at a higher level by ARRA federal tax credits. Despite not achieving program goals, the program staff said there is potential for program growth based on the historic performance.

Table 2. 2011 HEAC Program Goals and Achievements

	Generator kW	Generator kWh	Participants
2011 Goal	2,548	2,181,463	1,785
Achieved	2,189	1,748,254	1,642
Percent of Goal	86%	80%	92%

Program Management

This program is managed and implemented by several Xcel Energy employees:

- The program manager is responsible for the program from beginning to end: overseeing the budget and marketing responsibilities, managing the M&V implementer, and coordinating with the rebate processing group, the residential channel manager, trade allies (regarding program training), and other Xcel Energy staff.
- The residential channel manager works with contractors to address their installation concerns and to discuss the HEAC Program guidelines and Xcel Energy's expectations for optimal efficiency practices.

- The Rebate Operations group processes all submitted rebate applications.
- The Advertising and Marketing Communications group works with the program manager to develop the marketing message and strategy, and to manage the production of all marketing materials and strategy implementation.
- Engineering staff provide equipment savings technical support for filings and respond to technical inquiries.

In addition, Xcel Energy works with an M&V contractor, who conducts on-site visits for 10% of the submitted rebate forms to verify that the contractor performed a QI that met the program requirements. In the past, Xcel Energy worked with RSR, but hired another firm for the 2012 season. The M&V contractor verifies that the registered installation contractor performed a load calculation and used the QI checklist, and conducts an on-site visit to confirm that the refrigeration charge, airflow, and duct leakage are within acceptable ranges. The program process, including M&V, is reflected below in Figure 1 and Figure 2.

The Colorado HEAC Program was originally managed out of Xcel Energy's Minnesota office. In 2010, Xcel Energy moved the program management to Colorado and assigned interim program management to the residential channel manager. In early 2011, Xcel Energy assigned the program to a full-time program manager, and in late 2011, reassigned it again to a different program manager, who is currently managing the program. Overall, staff said that the program management is effective. However, two staff indicated that greater continuity in management might have a positive impact on the program.

Contractor Registration, Training, and Standings

Xcel Energy informs contractors of the HEAC Program through direct mail, and they can sign up to participate online. Contractors must attend training, and at least one member of their staff must be NATE certified for the company to qualify to participate in the program and be included in the list of registered contractors on Xcel Energy's Website. Contractors must also pass an installation field test in addition to the training. The contractor registration and training process is reflected in Figure 1 and Figure 2.

Last year, Xcel Energy started using Brainshark, an online tool for sharing presentations and trainings. This granted some flexibility to contractors who wished to participate in the program but could not attend the required scheduled training. A few staff discussed the idea of offering more online training opportunities to encourage more contractors to participate. Contractors receive training, a quarterly newsletter, and various communications from the residential channel manager throughout the year, all of which help them navigate the program.

When the M&V process reveals that a contractor did not follow the program requirements, Xcel Energy informs them of this and gives them a strike. Participating contractors must have fewer than three strikes in the current program year to remain on the list of participating contractors on Xcel Energy's Website. Contractors initially viewed this three-strikes policy as a deterrent to participation, explaining one reason why initial participation levels were low. However, with program resources focused on training, and perhaps competition among contractors, the list of qualified contractors has grown substantially. One program staff member noted, however, that

approximately 50% of the 200 contractors on the list have not submitted applications for rebates for an extended period of time.

Process Flows and Logic Model

The following process flow diagrams illustrate the program process (Figure 1) and contractor registration and training process (Figure 2). More information regarding the Colorado HEAC Program process flow was outlined in the Program Management section above. More information regarding the contractor registration and training was outlined in the Contractor Registration, Training, and Standings section above.

The program logic model is shown in Figure 3.

Figure 1. HEAC Program Process Flow

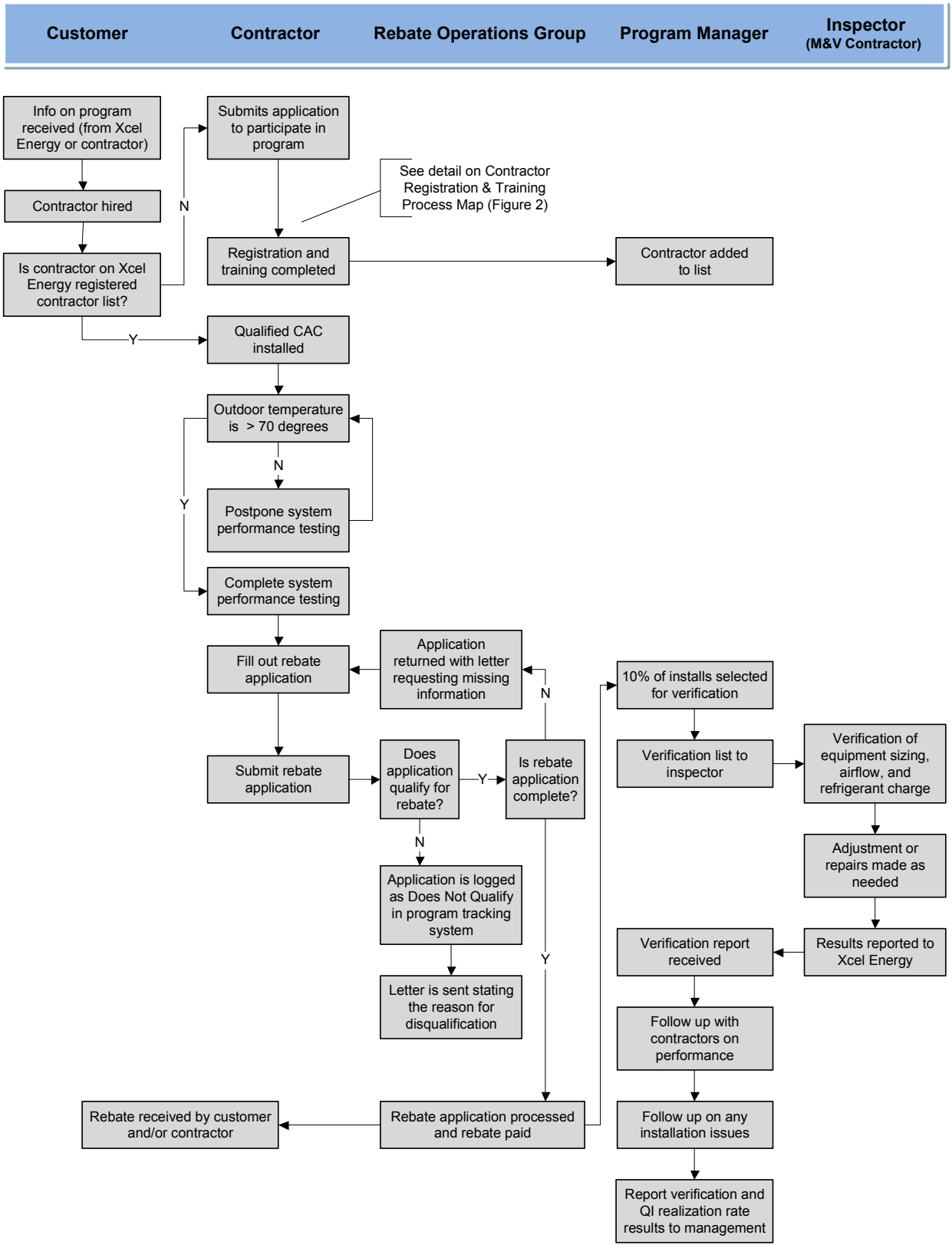


Figure 2. HEAC Rebate Program Process Flow, Continued
(Contractor Registration and Training Process Map)

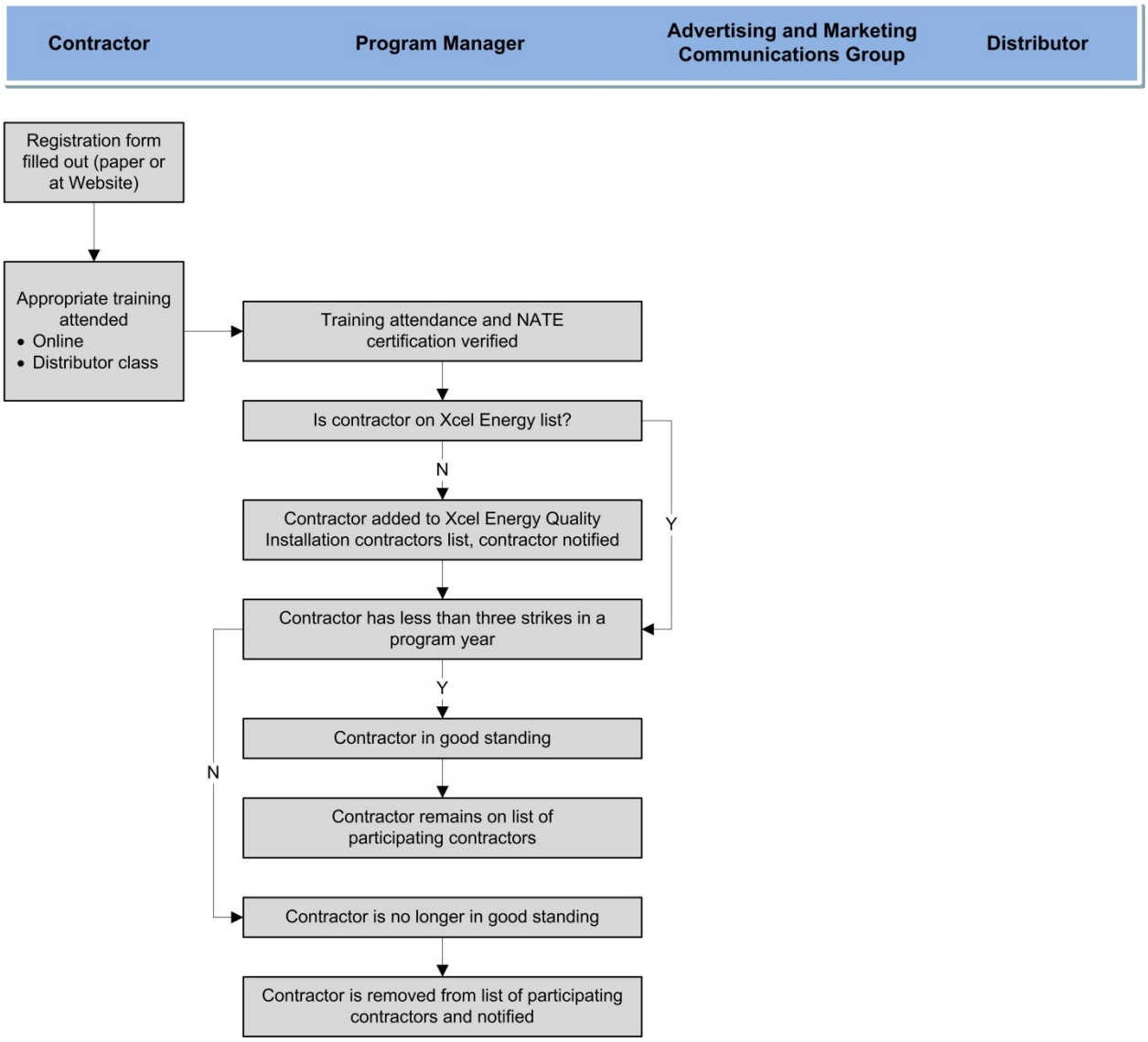
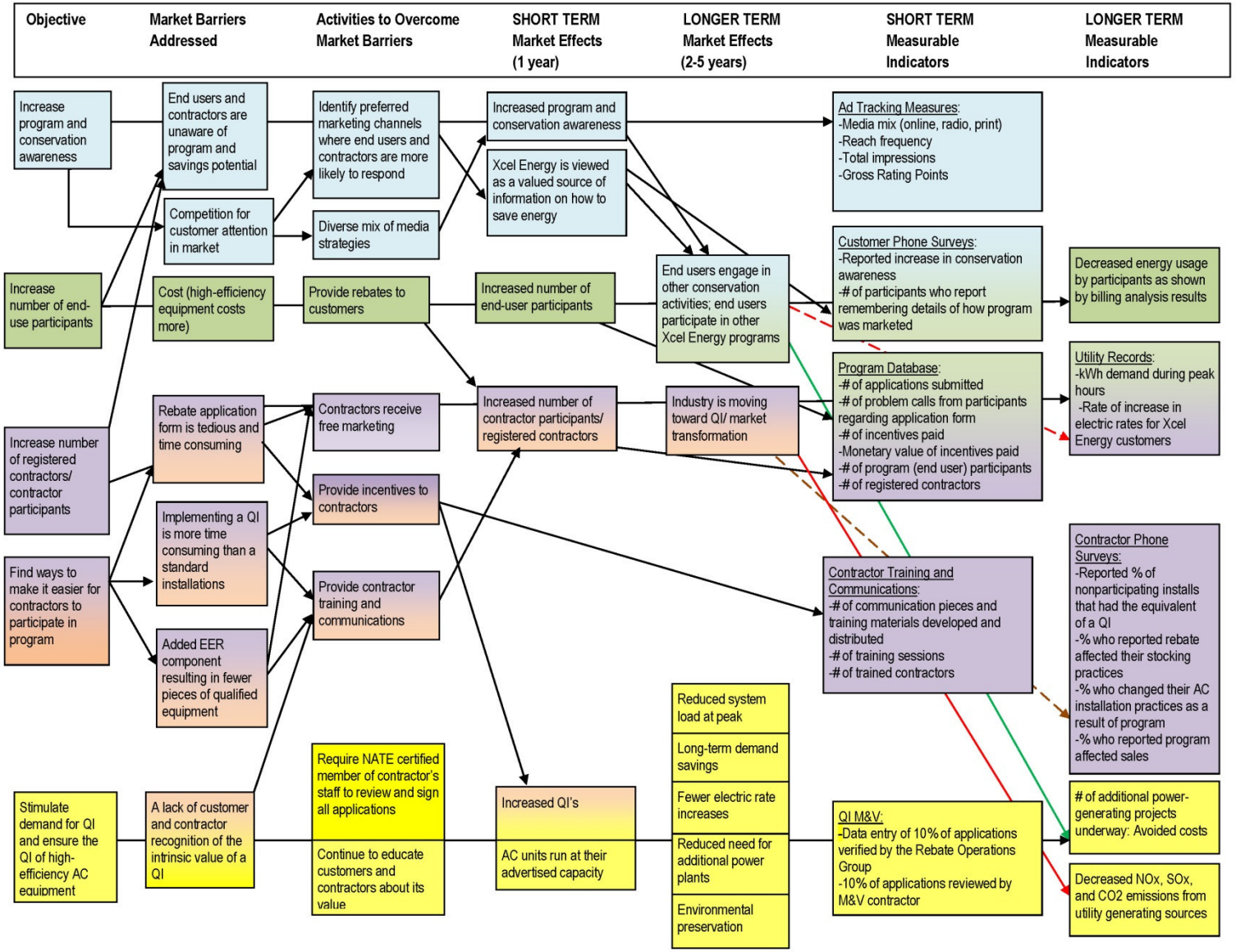


Figure 3. HEAC Program Logic Model



Program Implementation

Customers learn about the HEAC Program through Xcel Energy marketing or from a participating contractor.

To qualify for the incentive, a customer must be a Colorado Xcel Energy electric customer, a participating contractor must install the new equipment, and the installation must meet the QI requirements. A proper QI requires a series of steps:

1. The contractor must first perform a load calculation to ensure that the unit is properly sized for the space.
2. Next, the contractor must verify the equipment eligibility by following and filling out the QI checklist, and is responsible for sealing any exposed duct work.
3. Once the installation is completed and when the outside temperatures are at or above 70 degrees Fahrenheit (° F), the contractor is required to test and document that the system is performing according to manufacturer specifications. If the temperature is below 70° F, the contractor must postpone system testing until temperatures are warmer.
4. Once all of these steps are completed, the contractor submits the rebate application, invoice, and the installed unit's AHRI certification to Xcel Energy in order to receive payment. The contractor is required to keep the additional paperwork (the equipment sizing worksheet and the QI checklist) in case the M&V contractor selects the install for verification.

Customers send their rebate applications to the Xcel Energy processing center, where Xcel Energy staff first check them for customer and equipment eligibility. If the application does not qualify (DNQ), staff enter it into the program system as DNQ and send a letter to the customer stating the reason for disqualification. They enter qualifying applications into the system, including entering the site and unit specification into the rebate calculator that then also calculates the energy savings. Then the staff process the incentive and send the rebates to the customer and the contractor, if applicable.

Many Xcel Energy staff noted that participating contractors struggle with aspects of the QI process: some of the program contractors fail the installs, and only 7% of the contractors complete all components of the installation correctly. The most common issue is load calculations. Some contractors do not think that the calculations are necessary, and others have difficulty conducting the calculations correctly. Staff noted that this issue was further compounded because contractors are not required to submit the sizing calculations unless the installation is chosen for M&V.

Another issue staff identified was the contractors' incomplete understanding of the refrigerants, which resulted in their not using the proper tools or, in some cases, overcharging systems. Almost all of the staff noted that the QI process lacks any true accountability for the contractors, as incentives are paid based only on the complete rebate application. Although 10% of the installations are subject to M&V, by the time M&V takes place the incentives have already been paid, so there is no true recourse for low quality or fraudulent work, except to give the contractor a program strike.

Measurement and Verification

There are two M&V steps in the program. The first is during incentive processing when Xcel Energy staff verify the customer and equipment eligibility. The second is when the M&V contractor verifies that a QI was conducted for 10% of the installations. Xcel Energy had contracted with RSR as the M&V contractor for the first two program years, and program staff members engaged a new contractor for the 2012 season.

The third-party verification contractor selects a random sampling of 10% of the projects that received incentives for auditing. This M&V contractor works with the customer and the installation contractor to verify that a load calculation was performed, the Quality Installation Checklist was used, and that refrigeration charge, airflow, and duct leakage are within acceptable ranges as defined by the program requirements.

All of the staff indicated that the program's M&V implementation has been challenging. Staff reported that the realization rate is 65% to 70%, and seems to be improving. However, the staff expressed a lack of confidence that the M&V testing is configured correctly and that the realization rates are correct. Several staff noted that there is pushback from the installation contractors who often do not agree with the M&V results. Most of the staff agreed that the M&V process often produces incorrect results for two-stage cooling systems. They also noted that the M&V needs to occur earlier in the process, and that contractors need to receive feedback closer to the time they installed the unit in order for M&V to be more effective.

Marketing

Xcel Energy targets customers and participating contractors through a variety of marketing and communication efforts. One of the HEAC Program's primary promotion channels is the trade community. In fact, one staff member stated that contractor participation had doubled in the last year, which may have been due primarily to marketing to the trade community.

The Xcel Energy residential channel manager is the primary point of contact, informs the trade community about the program, and increases awareness among new contractors through trainings, meetings, telephone calls, e-mails, letters, and quarterly newsletters. Participating contractors receive a plaque and their names are included in the program newsletter. In addition, Xcel Energy supports the participating contractors' marketing with an *Ask Me About Xcel Energy Rebates* truck magnet and includes them on the Xcel Energy Website list of contractors.

Xcel Energy's Advertising and Marketing Communications group develops and implements campaigns to create awareness for the rebate program among potential customers. They employ a variety of media strategies to reach the target audience.

Xcel Energy also conducts monthly advertising tracking surveys to ask customers for feedback on the success of the advertising and marketing for all programs, and they gather product-specific data quarterly. Staff also track the online Website clicks and direct response marketing strategies.

The marketing strategy has remained consistent, as the HEAC Program has not implemented any new changes that would affect its marketing strategy. However, staff members reported that

marketing has become more customer focused. Furthermore, the Xcel Energy Advertising and Marketing Communication group is working to align all the program campaigns. This will ensure a greater consistency of messaging and more coordinated timing across channels.

The Advertising and Marketing Communication group is also working with the program manager earlier in the process to better support the program goals. The biggest challenge to coordinating the program and marketing planning is that the program's regulatory filing schedule does not coincide with the marketing schedule.

The strategic marketing efforts include:

- Print, banner, and radio advertising
- Bill inserts and articles in the Xcel Energy electronic newsletter
- Advertising on the Xcel Energy Website
- Communications from the residential channel manager to dealer and distributor channels

Market Barriers

Program staff identified a range of market barriers facing the HEAC Program. Most of the program staff indicated that educating customers about the program is a challenge; there is a lot of competition for customers' attention in the market and there are no effective outlets for marketing to the customers. In addition, the HEAC Program is competing with Xcel Energy's own Evaporative Cooling Program, and it is difficult to explain the technology differences to customers. Several program staff indicated that, because people in Colorado do not use their CAC units very often, the cost benefit of purchasing a higher-efficiency unit is harder to demonstrate.

Another market barrier the program staff agree on is the challenge in recruiting and keeping contractors involved. They stated several reasons for this: some contractors find the rebate application complicated, others do not see any value in changing their installation process, and accomplishing the QI standards is time consuming. In addition, staff indicated that the lack of buy-in from both the contractors and the customers into the intrinsic value of a QI is a significant barrier.

Two program staff indicated that the HEAC Program may be too complicated for customers and contractors. There are many steps to the process: the customer must confirm that the contractor is an Xcel Energy-registered contractor, the contractor must figure out which units would make a customer eligible for the Plan B Early Retirement Equipment Rebate, and EER requirements have been added. There are also several requirements for submitting the rebate application, including all the data required for the QI portion of the form. This already complex process has been compounded by program changes, making it difficult for contractors to feel fully confident in representing it to their customers. Several staff stressed a desire to avoid complicating the program further with more program requirements, especially for contractors, as this may discourage contractor participation.

Two program staff members reported that contractors had expressed the need to eliminate "*low riders*," those who underbid the other contractors and make it difficult to compete. They defined

low riders as contractors who cut corners, such as not pulling permits or representing themselves as program participants when they are not. While staff mentioned that requiring permit numbers or load calculations for all rebate applications could help with this issue, they noted it would further complicate the process for contractors.

Lastly, Colorado's weather is a factor in the lower-than-expected participation. The summer months in Colorado are not as hot or humid as other parts of the country, which can result in less participation in general. Also, in an environment where a cooling system is not used often, it is harder to sell more expensive high-efficiency units, therefore the contractors do not promote them as often.

Data Tracking and Reporting

Xcel Energy's Rebate Operations group processes all submitted applications. Currently, there is no automated validation or quality control system in the rebate entry and tracking system, so the majority of quality control is implemented manually. Every month, the Rebate Operations group audits 5% of the processed rebate applications for accuracy, quality, and to identify areas for potential training. The program manager has access to the rebate data, and the Rebate Operations group encourages monthly review of the information.

Xcel Energy is transitioning to a new customer relationship management system, called Salesforce. Staff reported that the new automated system will support timely data verification and enhanced data tracking and reporting capabilities, and also that they will need time to learn the new system.

Trade Allies and Interveners

The participating contractors are the primary trade allies for the program. In addition, Xcel Energy works closely with a few industry organizations for the HEAC Program. The Energy Efficiency Building Coalition (EEBC) is the most involved. The EEBC advocated for the program's existence, and continues to actively provide input. Staff indicated that, in general, the EEBC thinks the program could perform at a higher level. However, staff also said that the EEBC's opinion has begun to improve, and staff members are now reaching out to the EEBC for input more than in the past. In addition, the EEBC is taking over the contractor training. Staff noted that the program interveners would like Xcel Energy to have greater oversight of the QI process; they especially want the Rebate Operations group to review more of the load calculations.

Program Changes and Future Success

There were several changes to the program structure, implementation, and marketing during 2010 and 2011 to support its continued growth. HEAC Program changes in 2010 and 2011 include:

- New program manager.
- The program requirement that the AHRI certificate be submitted with the rebate application. Since this became a requirement, there was been a reduction in the rebate application return rate, from approximately 70% to approximately 25%.
- The addition of the Plan B Early Retirement Equipment Rebate for replacing older but operable, lower-efficiency residential CAC units.

HEAC Program changes for 2012 include:

- Hiring a new M&V contractor.
- The training component of the program will be run by the EEBC.
- The advertising and marketing strategy for the program is more customer focused.
- The Advertising and Marketing Communication group is working with the program staff earlier in the planning process to better support the program goals.

The staff made several comments about the future of the program. They expressed optimism for the potential of the program, noting that the program is young, has a lot of growth potential, and will be positively impacted by consistent management. One staff member wants the program to have a larger role in the residential program portfolio.

Staff also indicated several trends that could create program challenges. Energy-efficiency standards continue to rise, specifically the SEER levels, which increases the equipment baseline. In addition, the program has to be ready for technological advances and ongoing changes in the market.

Key Items for Further Investigation

The following program items could be investigated:

- Ways to simplify the participation process for contractors and customers.
- Approaches to recruiting participating contractors.
- Coordinated marketing and program strategies.
- Methods for improving program contractors' accountability.
- Barriers to contractor participation.
- Maintaining an accurate online list of registered contractors.
- Xcel Energy's strategies to increase the number of participating contractors in Minnesota that could be applied in Colorado (e.g., the program could pay for initial contractor testing).

- Strategies to improve the effectiveness of marketing materials.
- Ways to leverage the new tracking system.
- Strategies to improve the effectiveness of the QI M&V process.
- Strategies to improve the rebate processing M&V procedure.
- Effectiveness of incentive levels.

4. PARTICIPANT SURVEYS

This chapter outlines the results of 300 surveys Cadmus conducted in July and August 2012 with customers who participated in the HEAC Program. Cadmus gathered information to assess the program from customers' perspectives, exploring the following topics:

- Program Awareness
- Decision Making
- Federal Tax Credit Influence
- Satisfaction
- Equipment Use and Temperature
- Installation and Contractor
- Spillover Responses
- PRIZM Segments
- Residential Participation Profile

Key Findings

Program Awareness

- **Contractors and retailers are key sources of participants' program awareness and program information.** Just over two-thirds (68%) of participants reported first hearing about the program from a contractor or retailer. Of the customers who had heard about the QI component of the program, just over two-thirds (68%) reported hearing about it from a contractor or retailer. Finally, just over three-quarters (79%) of the participants reported hearing about the early retirement rebate from a contractor or retailer.
- **Not all participating customers are aware of the QI component of the program.** Sixty-three of the surveyed participants (23%) did not know about the QI requirement.
- **Some customers that are aware of the QI component recognize that this requirement helps to ensure their unit operates more efficiently (31%) and saves energy and lowers energy bills (26%).**

Decision Making

- **Two-thirds (66%) of participants reported that one of their primary reasons for buying a qualifying CAC was to save energy or money**. Just over one-third (37%) of participants bought an eligible unit because their old one had broken down.
- **Few customers are using Xcel Energy's registered contractor list.** Only 3% of participants reported using the registered contractor list as their primary source to find a contractor.
- **Customers focus on the unit efficiency level and price when deciding on a new CAC**. The most commonly reported primary decision factors for customers buying a new CAC

were the new unit's efficiency level and/or energy savings (44%) and price (33%). Only 17% of participants reported choosing a unit primarily because of the available rebate.

Satisfaction

- **Participants expressed strong levels of satisfaction with Xcel Energy and with the HEAC Program.** Most participants (90%) reported satisfaction with Xcel Energy as a service provider, and 94% of participants are satisfied with the HEAC Program overall.

PRIZM Segments

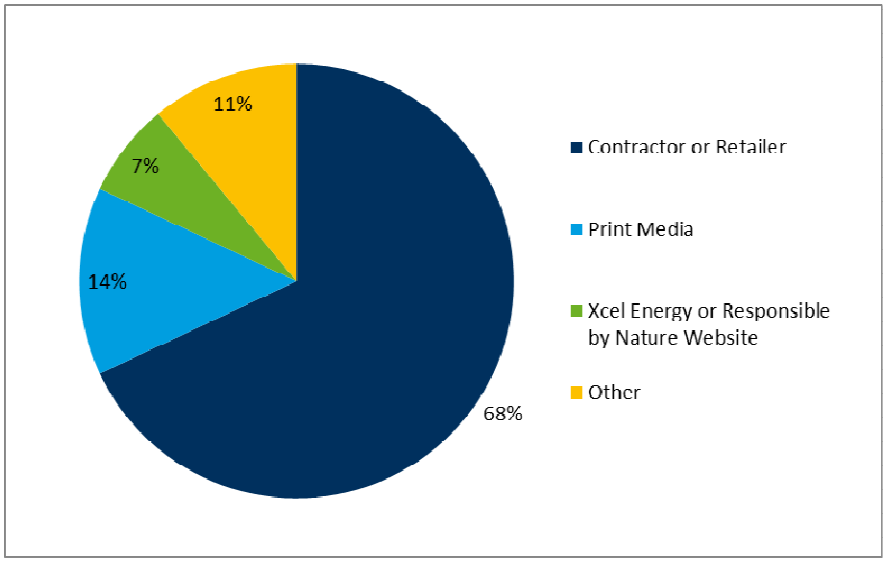
- **Four PRIZM life stage categories accounted for almost three-quarters (74%) of the HEAC Program participants in 2011:** Affluent Empty Nests (22%), Midlife Success (20%), Young Accumulators (18%), and Conservative Classics (14%).
  - Cadmus found that Affluent Empty Nests, Midlife Success, and Young Accumulators have high participation potential when comparing their HEAC Program participation rate to the overall Colorado residential population.
  - One other life stage category—Conservative Classics—although not as strongly represented in the Colorado residential homeowners population, did have a higher representation in the HEAC Program population. By virtue of its proportion in the populations, we classified this category as having medium potential for participation.

Detailed Participant Findings

Program Awareness

Contractors, retailers, and print media are the sources participants mentioned most often as the ways they first heard about the Xcel Energy HEAC Program; however, almost three-quarters (73%) of participants reported that they had already decided to buy a high-efficiency CAC before hearing about the Xcel Energy rebate. Participants most commonly heard about the program through a contractor or retailer (68%), print media (14%), or through Xcel Energy or the Responsible by Nature Website (7%). Other responses included hearing about the program through a friend or family member, other online Websites or advertising, and other rebate or energy-efficiency programs. Figure 4 illustrates the full distribution of how customers reported becoming aware of the program.

Figure 4. How Customers Learned About the HEAC Program

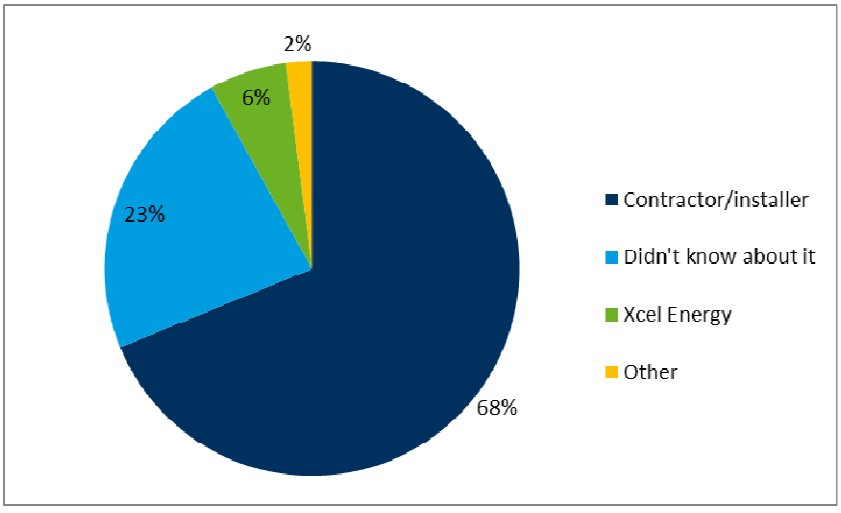


Source: Survey question B1; n=282.

Quality Install and Early Retirement Awareness

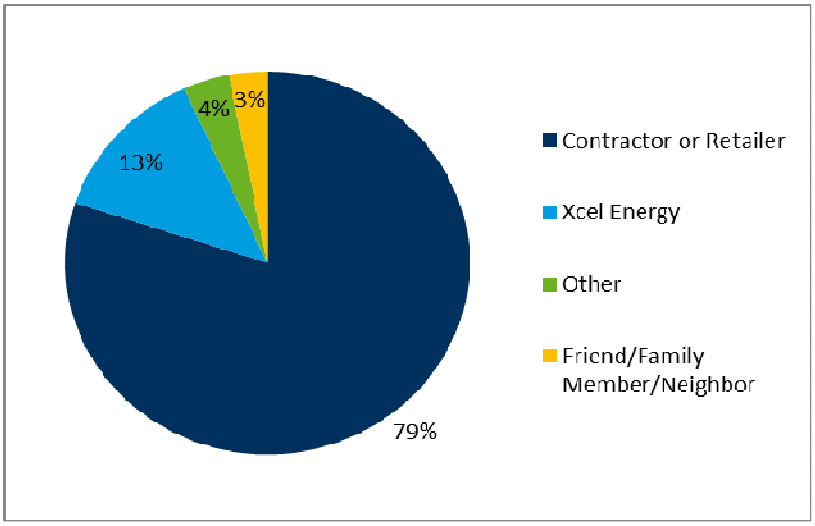
Participants reported that contractors and retailers are also the most common information sources about the QI requirement of the rebate program (68%; Figure 5) and the early retirement rebate (79%; Figure 6). However, almost one-quarter of the customers (23%) said they did not know about the QI requirement. Thirty-one customers could not recall how they learned of the QI requirement.

Figure 5. How Customers First Learned About the Program QI Requirement



Source: Survey question B13; n=269.
Note: Percents may not sum to 100% due to rounding.

Figure 6. How Customers First Learned About the Early Retirement Rebate



Source: Survey question B9; n=164.
Note: Percents may not sum to 100% due to rounding.

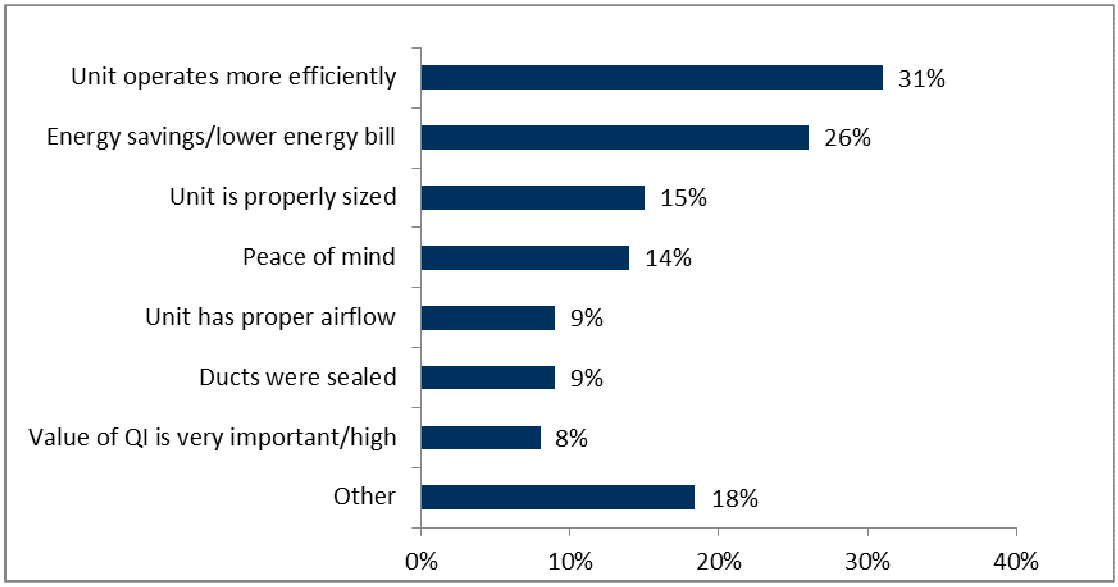
Value of QI

When Cadmus asked customers what they saw as the value of QI, 31% said the unit operates more efficiently, and 26% said it ensures energy savings and therefore lowers utility bills (Figure 7). Additional responses included:

- Peace of mind (or knowing the unit was installed correctly and there would be no problems in the future)
- Confirming the unit is properly sized
- Unit has proper airflow
- Ducts were sealed
- Other responses shown in the figure include:
  - Increased comfort
  - Ensures quality work
  - Third-party oversight

Other customers responded that they did not know or think about QI (11%) or saw little value in it (1%). Another 2% said they expected QI, and 3% had a neutral response, caring only that the unit worked.

Figure 7. What Customers See as the Value of the Quality Install

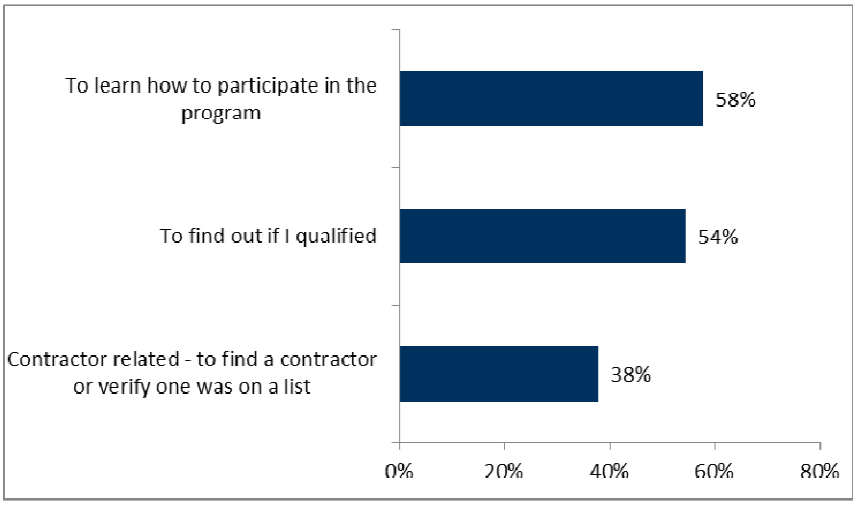


Source: Survey question B14; n=261, multiple responses allowed.

Xcel Energy Website

Thirty percent of participating customers reported visiting Xcel Energy's Website for information about the HEAC Program. When asked to list all of their reasons for going to Xcel Energy's Website, the most common responses were to learn how to participate in the HEAC Program (58%) and to find out if they qualified (54%; Figure 8). Customers also reported using the Website to find a contractor or verify that one was on the list (38%), to verify information they were told by a contractor, or to find other rebates.

Figure 8. Reason for Visiting the Xcel Energy Website



Source: Survey question C12; n=90, multiple responses allowed.

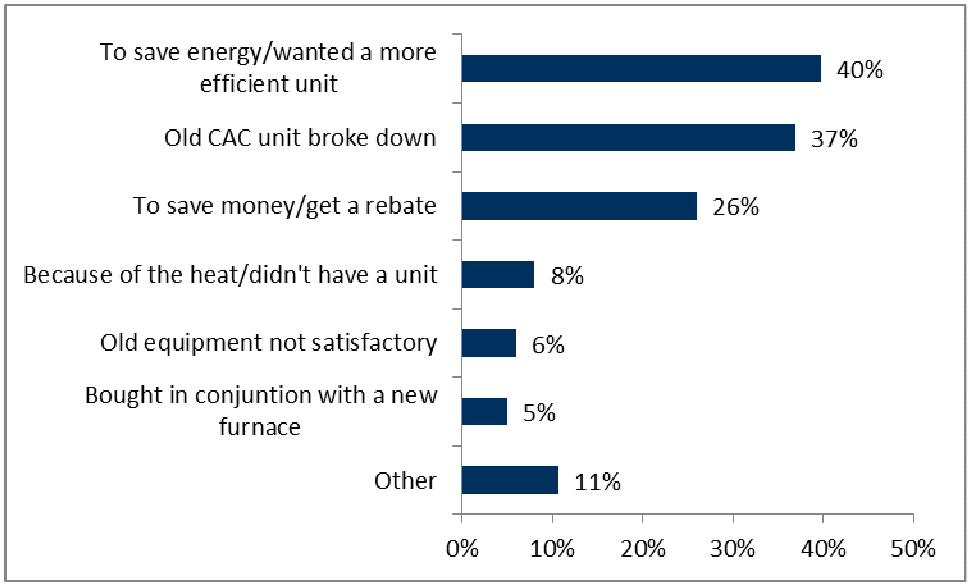
Other Rebate Program Participation

Just under one-third of survey respondents (29%) had participated in a different rebate program of some kind; the most commonly cited programs were for furnaces or heating systems (41%), with 10% of those participants mentioning the Xcel Energy Furnace Program specifically.

Decision Making

Two-thirds (66%) of participants reported that one of their primary reasons for buying a qualifying CAC and participating in the program was to save energy or money, with 40% of respondents mentioning saving energy and wanting a more efficient unit, and 26% mentioning saving money or getting a rebate. Just over one-third (37%) of participants bought an eligible unit because their old CAC had broken down (Figure 9).

Figure 9. Primary Reason(s) for Buying a CAC That Qualified for the HEAC Rebate



Source: Survey question B12; n=299, multiple responses allowed.

Other reasons given for buying a qualifying CAC included:

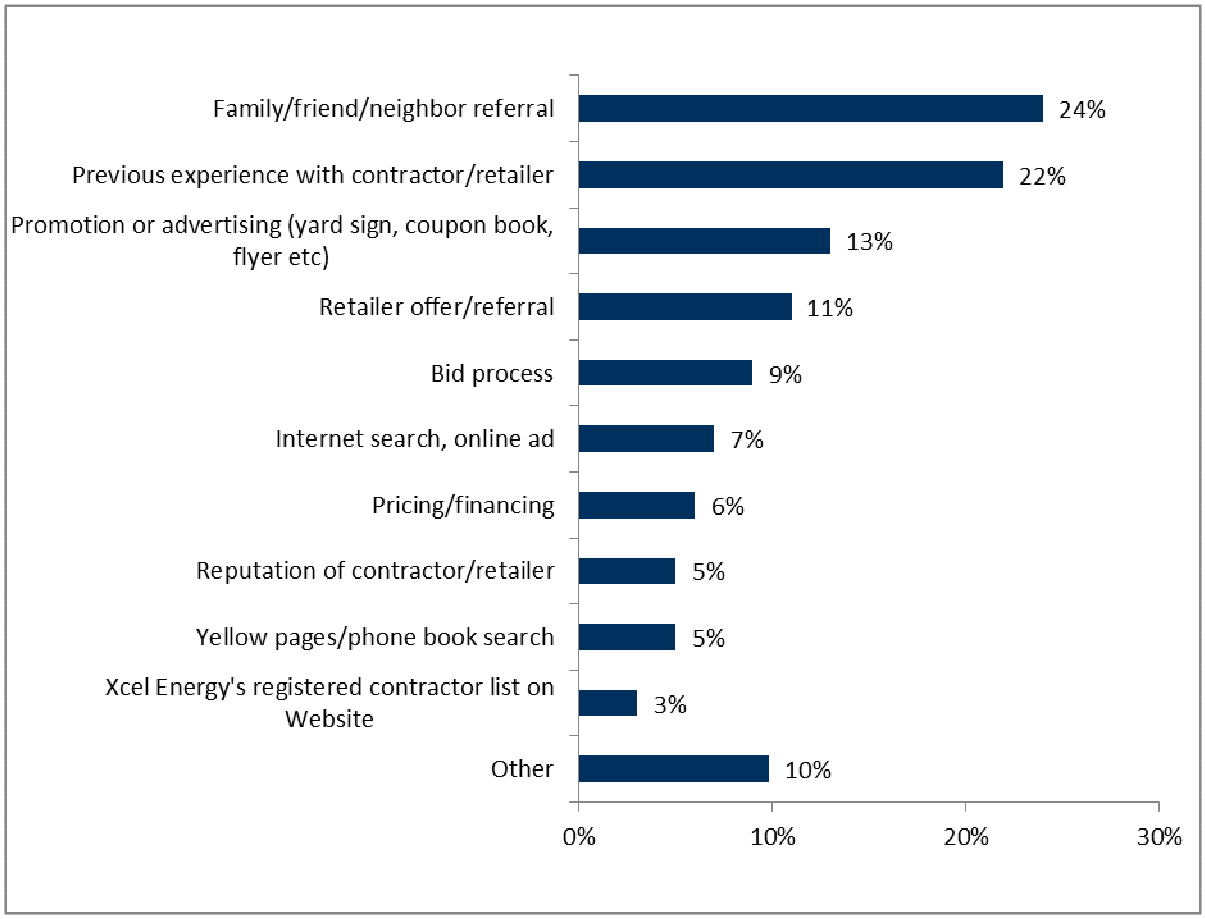
- To reduce noise
- Health reasons
- Environmental reasons
- Contractor recommended it

Cadmus compared customers' choice of SEER level with their reasons for participating in the program. We found that a larger portion of those who purchased a 14 to 14.9 SEER did so because their old unit broke down (52%), compared to only 26% of those who purchased a 15 to 15.9 SEER, and 32% of those who purchased a 16+ SEER. Those who purchased a 16+ SEER unit were more likely to report that their old unit was not very efficient or was not cooling their house sufficiently as their reason to get a new unit (32%), compared to just 18% of those who bought a 14 to 14.9 SEER unit.

Contractor or Retailer

The two most common responses participating customers gave for how they chose the contractor or retailer to install their new CAC were a referral from a friend, family member, or neighbor (24%) and previous experience with the contractor retailer (22%). Only 3% of participants reported using Xcel Energy's registered contractor list as the primary source when choosing a contractor (Figure 10).

Figure 10. How Customers Decided Which Contractor or Retailer to Use for Installing CAC

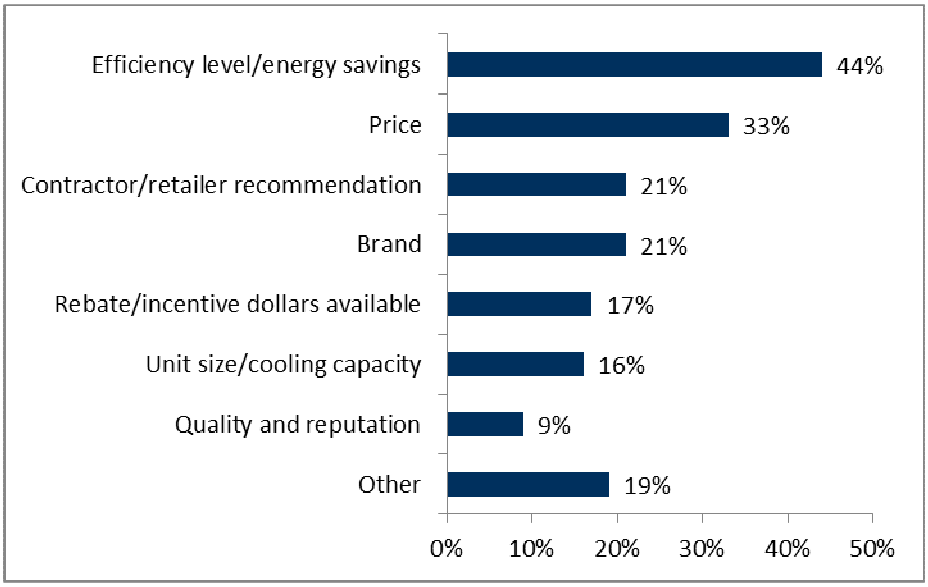


Source: Survey question D3; n=295, multiple responses allowed.

Decision Factors on Unit

When asked what their primary decision factor was in choosing specifically which CAC to buy, participating customers most often mentioned the efficiency level or energy savings (44%). Price (33%) was mentioned the second most often, followed by relying on their contractor or retailer's recommendation (21%), and the CAC brand (21%). Only 17% of participants reported choosing a unit primarily because of the available rebate or incentive dollars (Figure 11).

Figure 11. Primary CAC Unit Decision Factors for Customers



Source: Survey question E1; n=289, multiple responses allowed.

Federal Tax Credit Influence

Less than half (39%) of participating customers received financial assistance for their new CAC from a source other than Xcel Energy: of those 109 participants, 66% received a federal tax credit for their rebated CAC. The majority of those participants that reported receiving a federal tax incentive were aware of that tax incentive before purchasing their unit (76%), and most of those respondents (78%) cited the additional incentive as being somewhat or very influential in their decision to purchase higher-efficiency equipment. Other sources of financial assistance they mentioned included State tax incentives, local governments, and a dealer or manufacturer discount.

Satisfaction

Participants express strong satisfaction[7] with Xcel Energy, with the HEAC Program, and with their rebated measures and the contractors who installed them. The following satisfaction levels were reported:

- Satisfied with Xcel Energy as a service provider: 90%
- Satisfied with the HEAC Program overall: 94%
- Satisfied with the CAC unit purchased through the program: 98%
- Satisfied with the CAC unit installation process: 96%
- Satisfied with the contractor or installer: 95%

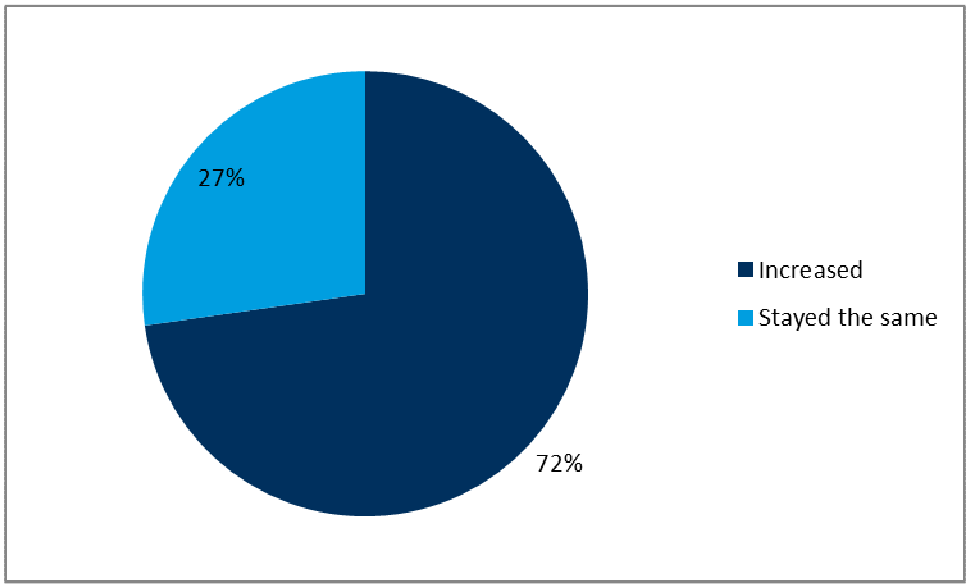
[7] We gauged satisfaction on a scale of 0 to 10, where 0 indicates being not at all satisfied and 10 indicates being completely satisfied. We considered participants to be unsatisfied if they rated between 0 and 4, and considered participants satisfied if they rated between 6 and 10.

Out of the customers who reported being satisfied with Xcel Energy, 34% gave a response rating of 10, indicating they were completely satisfied. For satisfaction ratings with the HEAC Program, the installation process, the contractor, and the information provided by the contractor, even more customers gave ratings of 10, indicating being completely satisfied:

- Completely satisfied with Xcel Energy as a service provider: 34%
- Completely satisfied with the HEAC Program overall: 59%
- Completely satisfied with the CAC unit purchased through the program: 55%
- Completely satisfied with the CAC unit installation process: 59%
- Completely satisfied with the contractor or installer: 59%

Overall, nearly three-quarters (72%) of participants said that their participation in the program has given them a higher level of familiarity with energy-saving equipment (Figure 12). Just over half (54%) of participants have encouraged a friend, family member, or neighbor to take part in the program.

Figure 12. Program Impact on Participants Familiarity with Energy-Saving Equipment



Source: Survey question C10; n=292.

Equipment Use and Temperature

The majority of participants (65%) were already using a CAC unit as their primary cooling mechanism prior to purchasing a rebated unit. Others had an evaporative cooler (14%) or ceiling or window fans (9%).

Cadmus asked customers who had a cooling system installed prior to installing their new CAC about the condition of the previous cooling system. Over half of the customers surveyed (52%) reported that their prior cooling system was either inefficient and did not cool their home or was

too old. Another 37% said their previous system was broken or was working but in need of repair.

A larger portion of those who bought 16+ SEER units had an evaporative cooler previously (20%), compared to 10% of those who bought a 15 to 15.9 SEER unit, and 8% of those who bought a 14 to 14.9 SEER unit. Most of those who bought a 14 to 14.9 SEER unit reported having CAC previously (73%).

Installation and Contractor

A vast majority of participating customers reported that their contractor mentioned the rebate (84%) and discussed the QI component of the program (82%). Nearly all of these participants (95%) said that the information was useful. With contractors playing a central role in presenting the rebate and QI component, this influence was also likely a factor in the number and types of units they presented to customers.

The majority of participants reported that their contractor discussed further energy-savings opportunities with them. The majority of participants reported that their contractor:

- Showed them how to adjust their cooling temperatures: 93%
- Discussed the energy savings associated with the new CAC: 86%
- Showed them how to maintain their new CAC: 85%
- Discussed adjusting the temperature at different times of day: 85%
- Gave them literature about ways to save energy: 64%

Those who gave high satisfaction ratings with Xcel Energy and their contractor tended to report that their contractor shared energy-saving information. For example, of those who reported being satisfied with their contractor:

- 85% said the contractor discussed the QI program component with them,
- 88% reported that the contractor showed them how to maintain the new CAC,
- 88% reported that the contractor discussed the potential energy savings that might be achieved by installing an energy-efficient CAC, and
- 94% reported that the contractor showed them how to adjust their temperature.

Of those who reported being satisfied with Xcel Energy:

- 84% said the contractor discussed the QI program component with them,
- 67% reported that the contractor gave them brochures or literature discussing ways to save energy in the home, and
- 94% reported that the contractor showed them how to adjust their temperature.

Spillover Responses

The surveyed customers' responses to the survey spillover questions are reported in the Net-To-Gross Ratio chapter.

PRIZM Segments

Xcel Energy provided Cadmus with customer segmentation data for each survey sample point using the Nielsen Claritas PRIZM Market Segmentation model.[8] Xcel Energy appended codes for the 11 life stages to each response record, and provided Cadmus with summary data for their Colorado customer population and for the HEAC Program participant population (Table 3).

Table 3. PRIZM Segments Provided by Xcel Energy and Survey Results

Life Stage Category	PRIZM Life Stage	Colorado Residential Customers		Colorado HEAC Participants		Survey Participants	
		Count	%	Count	%	Count	%
F1	Accumulated Wealth	80,491	6%	109	7%	16	5%
F2	Young Accumulators	156,862	11%	294	18%	56	19%
F3	Mainstream Families	151,985	10%	75	5%	9	3%
F4	Sustaining Families	59,254	4%	8	1%	3	1%
Y1	Midlife Success	273,299	19%	325	20%	50	17%
Y2	Mainstream Singles	214,301	15%	75	5%	13	4%
Y3	Striving Singles	101,818	7%	6	0%	2	1%
M1	Affluent Empty Nests	116,866	8%	353	22%	66	22%
M2	Conservative Classics	134,157	9%	223	14%	60	20%
M3	Cautious Couples	103,343	7%	75	5%	19	6%
M4	Sustaining Seniors	63,242	4%	26	2%	4	1%
	Unknown	164	0%	29	2%	2	1%
Total		**1,455,782**	**100%**	**1,598**	**100%**	**300**	**100%**

Note: Columns may not sum to 100% due to rounding.

Through random selection, participant survey respondents tended to mirror the life stage proportions in the HEAC Program population. Thus, the survey respondents are representative of the participant population.

According to the data provided in Table 3, four PRIZM life stage categories account for almost three-quarters (74%) of the HEAC Program participants: Affluent Empty Nests (22%), Midlife Success (20%), Young Accumulators (18%), and Conservative Classics (14%).

Note that the segment proportions for HEAC Program participants and for survey respondents differ from the Colorado customer population. For example, the overall population has a higher percentage of Mainstream Singles and Striving Singles and a slightly lower percentage of Young Accumulators, Conservative Classics, and Affluent Empty Nests compared to the HEAC Program participant and survey populations. One possible explanation is that age could be a driver for these differences, and young single customers are less commonly in the market for a new CAC due to associated demographics such as higher percentage of renters, fewer years living in the same home, and living in newer homes where the chances of the CAC breaking down is lower.

[8] Xcel Energy selected this comprehensive consumer segmentation system for marketing across all DSM programs: http://www.tetrad.com/demographics/usa/claritas/prizmne.html.

Calculating Participation Potential

To determine the participation potential, we first ranked all 11 life stage categories by the HEAC Program participation rate, and then compared that ranking to the overall population. The three life stage categories that stood out as having the greatest participation potential were Affluent Empty Nests, Midlife Success, and Young Accumulators.

One other life stage category—Conservative Classics—though not as strongly represented in the Colorado residential homeowners population, did have a higher representation in the HEAC Program population. By virtue of its proportion in the populations, we classified this category as having medium potential for participation.

We classified the remaining seven life stage categories and the unclassified records as having low participation potential based on their lower proportions in the population and lower representation in the program. Table 4 outlines the participation potential by PRIZM segment.

Table 4. Participant Potential by PRIZM Segment

Life Stage Category	PRIZM Life Stage	% HEAC Program Participation	% Colorado Residential Customers	Participation Potential
M1	Affluent Empty Nests	22%	8%	High
Y1	Midlife Success	20%	19%	High
F2	Young Accumulators	18%	11%	High
M2	Conservative Classics	14%	9%	Medium
F1	Accumulated Wealth	7%	6%	Low
F3	Mainstream Families	5%	10%	Low
Y2	Mainstream Singles	5%	15%	Low
M3	Cautious Couples	5%	7%	Low
M4	Sustaining Seniors	2%	4%	Low
F4	Sustaining Families	1%	4%	Low
Y3	Striving Singles	0%	7%	Low
	Unknown	2%	0%	Low

Residential Participant Profile

Participants who responded to the survey typically live in a single family detached home (83%) that is between 1,000 and 2,500 square feet (69%) and was built before 2000 (95%). On average, there are two members in the household (51%), and over three-quarters (76%) of participants are age 50 or older.

See Table 5 for a full breakdown of participant demographics.

Table 5. Participant Demographics

Household Characteristics	Participants
Type of home:	
Single family detached	83%
Single family attached	13%
Condo/apartment	5%
Year home was built:	
Before 1980	46%
1980-2000	49%
2001-2004	3%
2005-2008	2%
After 2008	1%
Home square footage:	
Under 1,000 square feet	3%
1,000 – 1,499 square feet	18%
1,500 – 1,999 square feet	18%
2,000 – 2,499 square feet	33%
2,500 – 2,999 square feet	16%
3,000 – 3,999 square feet	11%
4,000 or more square feet	3%
Number of people living in household:	
1	15%
2	51%
3	16%
4	12%
5+	5%
Age:	
18 – 29	3%
30 – 39	11%
40 – 49	11%
50 – 59	24%
60 – 69	34%
70 - 79	14%
80 or older	4%

Note: Percentages may not sum to 100% due to rounding.

Recommendations

1. **Continue to build relationships with contractors.** With the majority of participants not only reporting having first heard about the program from their contractor, but also that their contractor was the key source of other energy-saving information, contractors and retailers are clearly key sources of program information for participants. Xcel Energy already has a residential channel manager who is dedicated to reaching out to trade allies. This is an important resource for engaging contractors in program outreach.

2. **Consider investigating ways to increase customer awareness about the QI component of the program and its value.** Almost one-quarter (23%) of participants did not know about the QI requirement. Increasing customer awareness of the QI component would provide them with a deeper understanding of program benefits, particularly the

added energy savings that can be achieved with QI. QI-aware customers are more likely to ask their contractor about QI, which in turn could increase the likelihood of program participation, especially among those customers considering high-efficiency CAC units.

3. **Consider exploring strategies to increase customer awareness and use of Xcel Energy's registered contractor list**. Only 3% of participants reported using the registered contractor list to find a contractor or retailer. As customers turn to Xcel Energy for this resource, contractors may more fully appreciate the program as a potential referral source.

   a) **Explore advertising on Websites geared toward an older audience,** given that the highest rates of program participation occur with Affluent Empty Nests and Midlife Success.

   b) **Re-examine the program Website structure to ensure that the contractor list is easy to access within one or two page levels.**

4. **Consider investigating marketing segmentation efforts specifically to reach Affluent Empty Nests, Midlife Success, and Young Accumulators.** These three PRIZM segments have high participation potential.

5. TRADE ALLY SURVEY FINDINGS

This chapter outlines the results of Cadmus' interviews during June through August 2012 with 48 trade allies—33 participating and 15 nonparticipating contractors—to assess the Xcel Energy HEAC Program from their perspectives. For the purposes of this report, trade allies are contractors who install CACs in the State of Colorado.

Through the trade ally surveys, Cadmus explored a number of topics, including:

- Program Satisfaction
- Program Awareness
- Challenges
- Marketing Practices
- CAC Sales Trends
- Program Impacts
- Installation Practices
- Challenges with Installation
- Federal Tax Credit Influence

Key Findings

Program Satisfaction

- **The vast majority of participating trade allies are satisfied with the HEAC Program in general**, with 32 out of 33 surveyed (97%) reporting they are satisfied (giving a rating between 6 and 10 on a 0 to 10 point scale).
- **All participants who received training through the program reported that they found the training valuable** (giving a rating between 6 and 10 on a 0 to 10 point scale).

Program Awareness

- **All of the nonparticipating trade allies we surveyed are aware of the program,** and none of them had previously participated in the program. Interviewees most commonly reported hearing about the program through an Xcel Energy employee.
- **Participating trade allies reported that roughly half of their customers (46%), on average, were already aware of the rebate** offered through the program before they mentioned it.

Challenges

- **The most frequently mentioned challenge participating contractors brought up was ensuring that equipment qualified under the program given the parameters of the house.** The house parameters could cause issues with proper sizing or with matching existing systems, such as duct size or square footage. Another common difficulty participating contractors mentioned was properly calculating the heat loads.
- **A common difficulty for participating contractors was the number of requirements included in the QI component of the program**.
- **Nonparticipating contractors most often reported the NATE certification as the biggest barrier to their participation in the program.** When we asked what would make it more likely for them to participate, nonparticipating trade allies most often reported either eliminating the NATE certification requirement or reducing the cost of obtaining the NATE certification.

Marketing Practices

- **Just over half (52%) of participating trade allies did some form of program marketing in 2011,** and the majority (79%) of participating trade allies reported high satisfaction ratings with the marketing support provided by Xcel Energy (giving a rating between 6 and 10 on a 0 to 10 point scale).
- **Almost half of the nonparticipating trade allies (47%) reported a decrease in their marketing practices in 2011 as compared to 2010**, with five reporting no change in their practices, and three reporting that their marketing had increased.
- **Participating trade allies most often reported print and Web advertising as strategies they use to promote their products**, while nonparticipating trade allies' most effective promotional methods are customer referrals, print ads or brochures, and the internet or Website.
- **Participating trade allies often present high-efficiency options to customers first or discuss the benefits of high-efficiency units**. Many trade allies, both participating and nonparticipating, emphasize the potential to lower electric bills and reduce energy consumption when discussing the advantages of higher-efficiency CAC units with their customers.

CAC Sales Trends

- **Participating contractors tend to sell higher-efficiency CAC units than nonparticipating contractors**. Participants sold the highest average number of rebate-eligible units in the SEER 15 to 15.9 range, while nonparticipants reported the majority of their sales (84% of their sales) were for units below SEER 14.
- **Just over half of the participating trade allies said that the availability of the federal tax credit in 2011 made a positive impact on their overall unit sales** by influencing customers' decisions to upgrade to higher-efficiency units (i.e., 16 SEER or higher). Only two nonparticipating contractors stated that the federal tax credit impacted their CAC sales positively, and only minimally.

- **Participating trade allies most often mentioned the warmer summer weather and manufacturer rebates** as factors outside of the Xcel Energy HEAC Program and the federal tax credit that impacted their sales of CAC units in 2011. They reported these factors as having a significant positive impact on sales. Nonparticipating trade allies also cited the economy, which they reported as having a negative impact on sales.

Program Impacts

- **The majority (two-thirds) of participating trade allies reported that they changed their standard CAC installation practices based on what they learned from the QI training required for becoming an Xcel Energy registered program contractor**. The most significant change was the frequency of recording dry bulb temperatures: on average, participants reported doing this for 54% of their CAC installations before participating versus 92% after participating.
- **According to participants, the CAC units impacted most by the program were SEER 15 to 15.9,** with contractors reporting that on average, only 18% would have sold without the program.

Participating Trade Ally Findings

Program Satisfaction

Overall, participating trade allies are very satisfied with the HEAC Program, with 32 out of 33 (97%) reporting that they are satisfied (indicated by giving a rating between 6 and 10 on a scale of 0 to 10, where 0 indicates being very dissatisfied and 10 indicates being very satisfied). The average program satisfaction rating is 8.1.

All respondents, except one who did not know, said they received training as a part of the process of becoming a registered contractor in the program. All of those who remembered receiving training said that the training was valuable, giving a rating between 6 and 10 on a scale of 0 to 10, where 0 indicates being not at all valuable and 10 indicates being very valuable.

Participating trade allies also discussed the marketing support provided by Xcel Energy, with 26 (79%) reporting high satisfaction ratings between 6 and 10 on a scale of 0 to 10, where 0 indicates being very poor and 10 indicates being excellent.

Program Awareness

Trade allies reported that almost half (46%) of their customers, on average, were already aware of the rebate offered through the program before they mentioned it.

Challenges

When asked what challenges they encountered with the program's QI process, respondents gave a variety of answers. The most frequently mentioned challenge was ensuring that equipment qualified for the program based on the parameters of the house. As one interviewee said: "*It's tough finding the equipment that is the right size for the job, but also meets the rating*." Another respondent said: *"[You have to] make sure that the systems match."*

Other frequently mentioned issues included properly calculating the heat loads and meeting all the standards required for the QI component of the program. One interviewee said: "*The standards are too high. It's difficult to get some of these homes to pass [the test] because the ductwork in Denver is really poor.*" Another said: "*[These calculations] are hard because you need to take Denver's [high] altitude into consideration. It'd be great to have more time to ensure that tests and calculations are performed correctly.*"

Other challenges participants mentioned included completing the paperwork associated with the rebate process, correctly recording the air measurement, and meeting the cfm requirement.

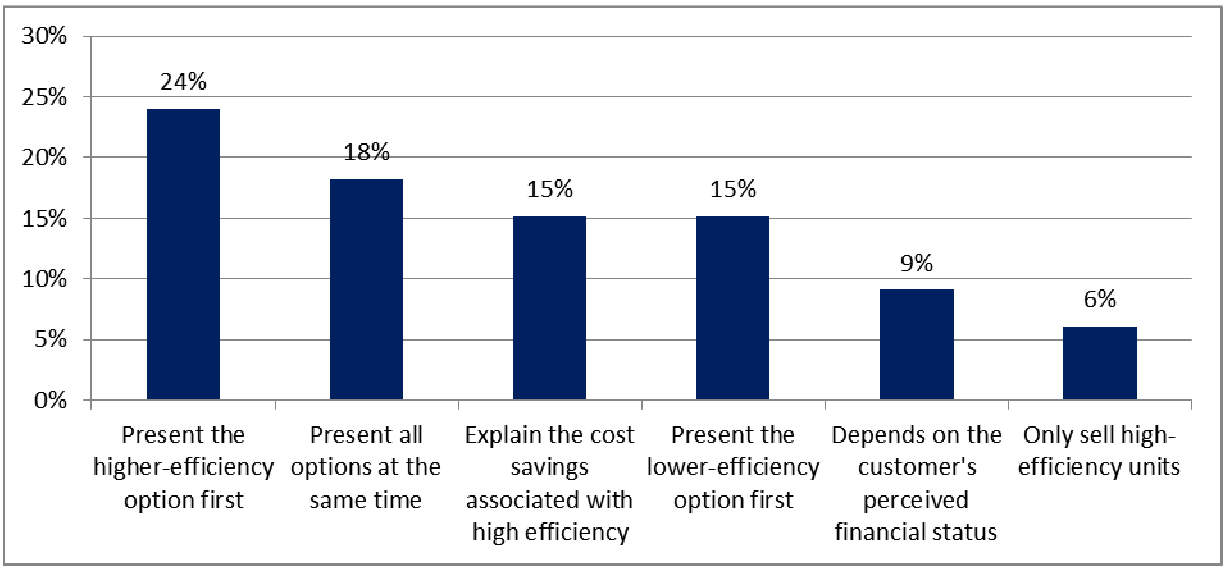
Marketing Practices

Just over half (52%) of participating trade allies did some form of marketing the Xcel Energy HEAC Program in 2011. Participating trade allies most often use print and Web advertising to promote their products, although respondents also mentioned using radio and TV ads, phone solicitations, coupons, and putting signage on their trucks.

Participants also discussed a variety of ways in which they present CAC options to their customers. About one-quarter of participating trade allies (24%) reported presenting the high-efficiency CAC options to their customers first. Six participants said they give their customers all the options at the same time. Five said they explain the cost savings associated with the higher-efficiency units, another five reported presenting the lower efficiency options first, three stated that they make their recommendations based on their perception of the customers financial situation, and two respondents said they exclusively sell only high-efficiency units.

Roughly one-third of the participating contractors we spoke with seem to be invested in promoting high-efficiency equipment, with 6% that only sold high-efficiency units and 24% that present high-efficiency options first. These results are presented in Figure 13.

Figure 13. Methods Participants Use to Present CAC Options to their Customers



Source: Survey question G1; n=33.

When asked what advantages they discuss with customers regarding higher-efficiency units, the most frequently mentioned advantage, cited by 15 respondents (45%), is the ability to lower electric bills and reduce energy consumption. Other popular responses included the advantage of being able to save energy and electricity, the rebate or incentive dollars available, that higher-efficiency units are quieter, and the unit size or cooling capacity.

When asked why customers do not opt for the rebate, including the QI component, the majority of respondents said the cost of the unit and the cost of the labor were the two biggest deterrents. Three participants also mentioned barriers caused by ductwork.

The majority (70%) of participants reported that their customers did not understand the early retirement portion of the rebate before they explained it. Those with customers that did understand estimated that, on average, roughly 40% of their customers understood.

CAC Sales Trends

Cadmus asked participating trade allies to discuss their CAC sales trends.[9] Respondents reported that their companies sold between nine and 700 CAC units in 2011, averaging 143 units each. The majority of these units (60% on average) were replacements for existing homes; 21% on average were first-time installations in existing homes, and 5% on average were for new construction. Participating trade allies reported selling between one and 298 units *within Xcel Energy's electric service territory* in 2011, averaging 82 units each. On average, 15% of these units were reportedly below 14 SEER.

We also asked participating trade allies how many of the units they sold received rebates, by SEER level. They reported selling more units between SEER 15 and 15.9 than any other SEER level, with an average of 81 units sold per contractor (Table 6).

Table 6. Average Rebated CAC Units Sold by SEER by Surveyed Participating Trade Allies Within Xcel Energy's Electric Service Territory in 2011 (n=33)

AC Unit	Average Number of Units Sold
SEER 14–14.4	19
SEER 14.5–14.9	8
SEER 15–15.9	81
SEER 16+	11

When we asked participating trade allies what they expect for high-efficiency (SEER 14+) CAC sales in the next five years, the majority (76%) reported that they expect to see an increase in sales due to more awareness about energy efficiency. However, these respondents said that this increase would be contingent on the availability of utility rebates and tax incentives, and improvements in the economy. Others reported that homeowners have been delaying purchases of equipment and that rising energy costs will cause customers to look for more ways to save energy and money. Six contractors reported that high-efficiency CAC sales would remain the same over the next five year. None expect a decrease in high-efficiency CAC sales.

[9] The contractors we interviewed disproportionately represent those with higher program CAC installs than the general contractor participant population.

Program Impacts

Stocking Practices

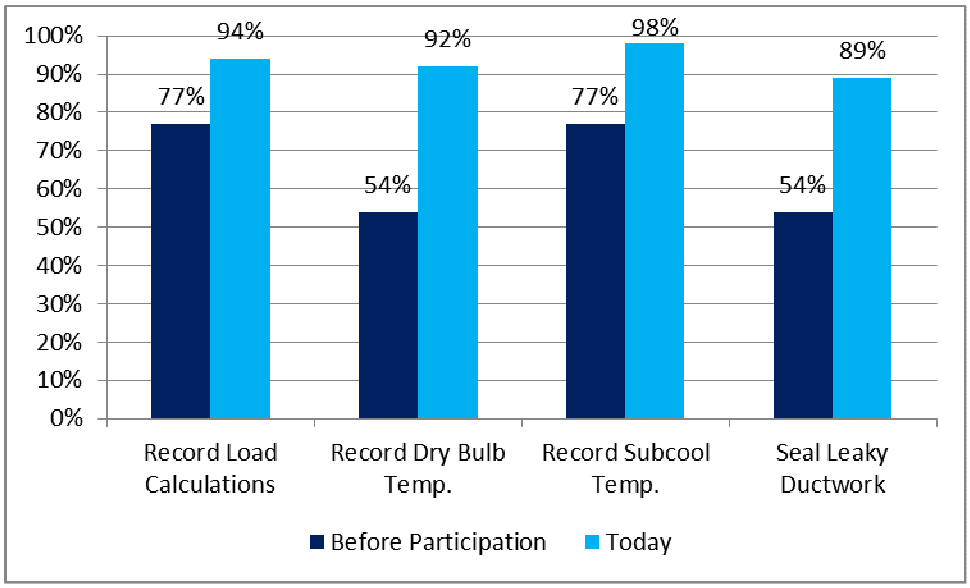
Cadmus asked participating contractors if Xcel Energy's HEAC Program had affected their stocking practices in 2011: 20% reported that the Xcel Energy *rebate* for CAC units affected their stocking practices or decisions in 2011, and that they now offer more high-efficiency units. The majority (85%) reported that their current 2012 stocking practices are similar to 2011.

Installation Practices

When we asked respondents if they changed their standard CAC installation practices based on what they learned from the QI training required for becoming an Xcel Energy registered program contractor, 22 answered yes and 11 answered no. The majority who answered yes reported that they are now more diligent about ductwork and airflow. They also reported that they have started performing load calculations, recording subcooling temperatures, improved their documentation, and increased their attention to quality control.

We also asked participating trade allies to estimate what percentage of their company's CAC installations included sealing leaky ductwork and recording load calculations, dry bulb temperatures, and subcooling temperatures, both before their participation in Xcel Energy's HEAC Program and at the time of the interview. In all four categories, participants reported that they conduct QI on a greater percentage of CAC installations today than before they participated in the program. The most significant change was in the frequency of recording dry bulb temperatures, where on average, participants reported only doing this for 54% of their CAC installations before participating versus 92% of their CAC installations after participating (Figure 14).

Figure 14. Average Percentage of CAC Installations Receiving Quality Install Practices, Before Participation and Today



Source: Survey questions D1-D8; n=33.

Note: Percentages are a straight average of responses and do not reflect any weighting by unit sales.

Nonparticipating Sales

We then asked participating trade allies about high-efficiency CAC units they installed but that did not result in a rebate to them or the customer. Just under half (14 out of 33) reported that they did not have any nonparticipating installs in 2011. Of those who did, almost all reported providing the equivalent of a QI, including conducting formal load calculations that they keep on file as part of the customer records for all their installs.

Federal Tax Credit Influence

Just over half of participating trade allies reported that the availability of the federal tax credit in 2011 had a great effect on customers' decisions to upgrade to a higher-efficiency unit (SEER 16+). Seven said the federal tax credit had an effect in some capacity, while seven others reported that the tax credit availability had no effect. Those that said the federal tax credit had an effect predicted that, on average, just under 60% of rebated SEER 16+ units would have sold with just the Xcel Energy HEAC Program and not the federal tax credit.

When we asked respondents what, if any, factors outside of the Xcel Energy HEAC Program and the federal tax credit affected their sales of CAC units in 2011, the most common responses included:

- The weather, which they reported has a strong positive impact;
- The availability of other utility rebates or tax incentives, which has strong positive impact;

- The economy, which has a strong negative impact; and
- Rising electricity costs, which has a strong negative impact.

Nonparticipating Trade Ally Findings

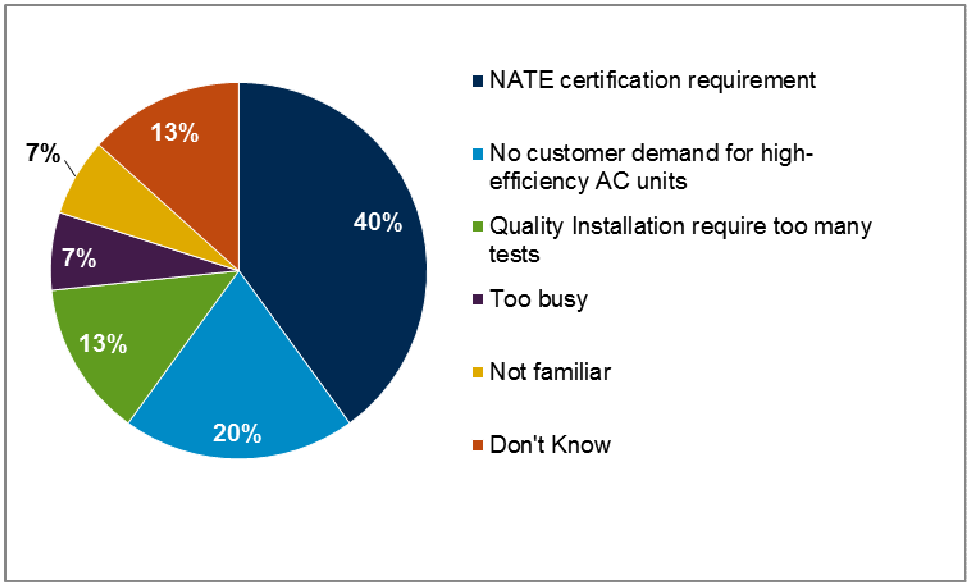
To supplement what we learned from participating trade allies, Cadmus interviewed 15 nonparticipating trade allies. Through these interviews, we explored CAC sales and installation practices outside of the program, and we sought to understand why some contractors are not currently participating in the program.

Program Awareness

All of the nonparticipating trade allies we surveyed are aware of the HEAC Program, and none of them had participated previously. Interviewees reported first learning about the program through a variety of channels. The most frequently mentioned channel, cited by seven interviewees, was through an Xcel Energy employee or the residential channel manager. Three others first heard about the program at an event, and others mentioned learning about it from Xcel Energy's call center, customers, and a manufacturer.

Six respondents (40%) stated that the primary barrier to trade ally participation in the program is the NATE certification requirement. Three nonparticipants said that their customers did not want a qualifying CAC unit or QI install, and that there is no customer demand for high-efficiency CACs. Two others explained that they decided not to participate because the QI requires too many tests. One contractor said he was too busy to fill out the program paperwork, another said he was not very familiar with the program, and two did not know why they do not participate. These results are presented in Figure 15.

Figure 15. Barriers to Participation



Source: Survey question B4; n=15.

When we asked if they would participate if the requirements were different, 14 said yes and one said they did not know. When we asked what would make it more likely for them to participate,

nonparticipating trade allies most often reported either eliminating the NATE certification requirement or reducing the cost of obtaining the NATE certification, followed by reducing the amount of paperwork and increasing the rebate amount.

Nonparticipating trade allies also discussed the best ways to give them information about how to save energy or energy-savings opportunities to offer their customers. Many respondents (n=6) said they prefer mail, five prefer e-mail, and others mentioned manufacturers or distributers, other Websites, events, or from Xcel Energy.

Marketing Practices

When asked how their marketing practices have changed from 2011 to the time of the interview, seven said their marketing and promotions have decreased, five said they stayed the same, and three said they increased. Customer referrals, print ads or brochures, and the internet or a Website are the most effective methods nonparticipating trade allies reportedly use to promote their products. Almost all respondents, with the exception of one, reported educating their customers on the benefits of higher-than-minimum-SEER equipment.

When we asked nonparticipating trade allies how they present high-efficiency CAC options to customers, their responses were mixed. Many said they emphasize the potential energy and cost savings of higher-efficiency CAC options, while others highlight the payback period or cost-effectiveness, or provide a variety of options at the same time based on a customer's particular situation (e.g., type of home, finances, quality of ductwork). Two respondents also said they specifically stress how the higher-efficiency CAC option is quieter than other units and often comes with a better manufacturer warranty, which may decrease costs over time. All respondents said they give their customers more than one equipment option, specifying categories such as good, better, and best.

CAC Sales Trends

Nonparticipating trade allies reported selling between one and 100 CAC units in 2011, averaging 34 units each. They also reported the percentage of units sold within Xcel Energy's electric service territory by SEER rating. The majority (84%) of units sold by nonparticipating trade allies were below 14 SEER (Table 7).

Table 7. Average CAC Units Sold Within Xcel Energy's Electric Service Territory in 2011 by Nonparticipating Trade Allies (n=15)

AC Unit	Average % of Units Sold
Below SEER 14	84%
SEER 14–14.4	12%
SEER 14.5–14.9	3%
SEER 15–15.9	0%
SEER 16+	4%

Note: The reported percentages are a straight average of responses and do not reflect any weighting by unit sales, and therefore may not sum to 100%.

When asked what it would take to increase sales of higher-efficiency units (SEER 14+), the majority of respondents (66%) stated that increased rebates would help offset the increased cost and encourage customers to make a bigger investment. Three interviewees also mentioned it

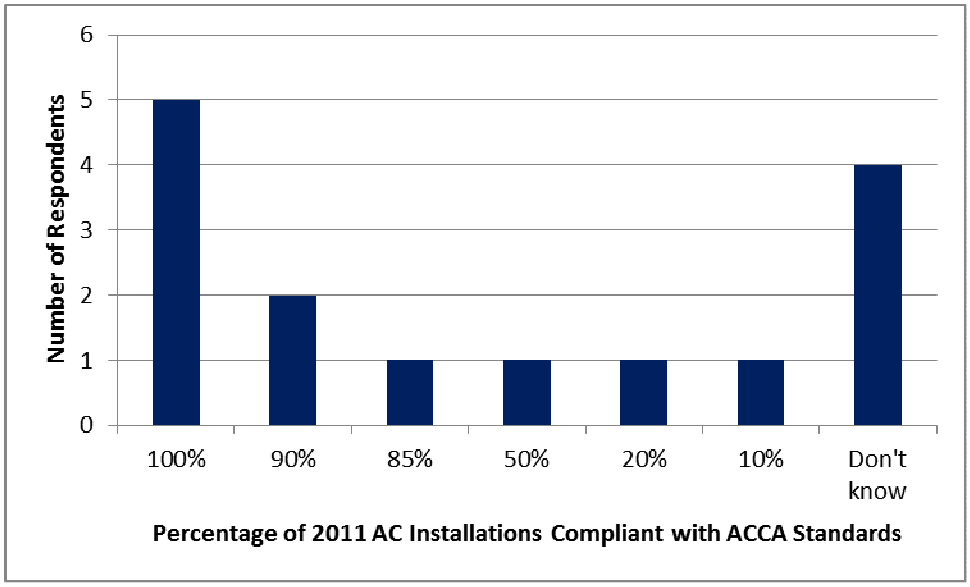
would increase their higher-efficiency sales if there was increased customer education about the benefits of energy efficiency: "*getting clients to see value in long-term savings can be difficult.*"

Installation Practices

We asked nonparticipating trade allies to estimate what percentage of their company's 2011 CAC sales complied with the refrigerant, airflow, and sizing requirements of the manufacturer. All but four nonparticipating trade allies (73%) reported being familiar with the ACCA's refrigerant charge, airflow, and sizing recommendations. Five said that 100% of their sales were compliant, four reported percentages at or above 50% (and below 100%), two reported below 50%, and four said they did not know. These results are presented below in Figure 16.

Ten respondents (67%) said they present their customers with a QI component as a part of their standard practice. Two said they provide this as an option, and three do not provide any QI component.

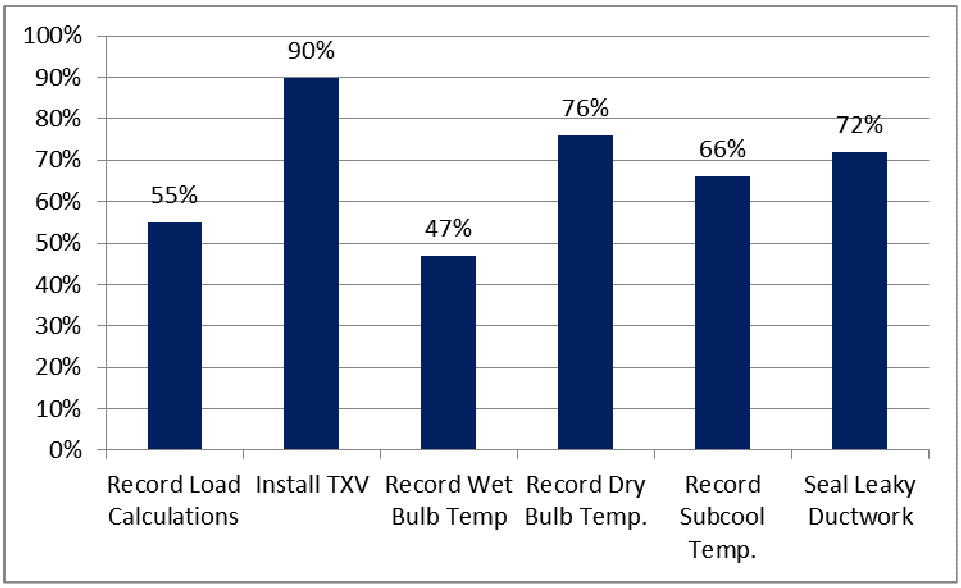
Figure 16. Percentage of 2011 Nonparticipant Contractor CAC Installations Reported as Compliant with ACCA Standards



Source: Survey question D3; n=15.

Nonparticipants also discussed their practices for completing load calculations, installing a thermostatic expansion valve (TXV), recording dry and wet bulb temperatures, recording actual subcooling temperatures, and sealing leaky ductwork. The most commonly reported performed action was installing a TXV, which respondents included in an average of 90% of all yearly CAC unit installations. Recording dry bulb temperatures and sealing leaky ductwork were also commonly performed. Figure 17 illustrates these practices in more detail.

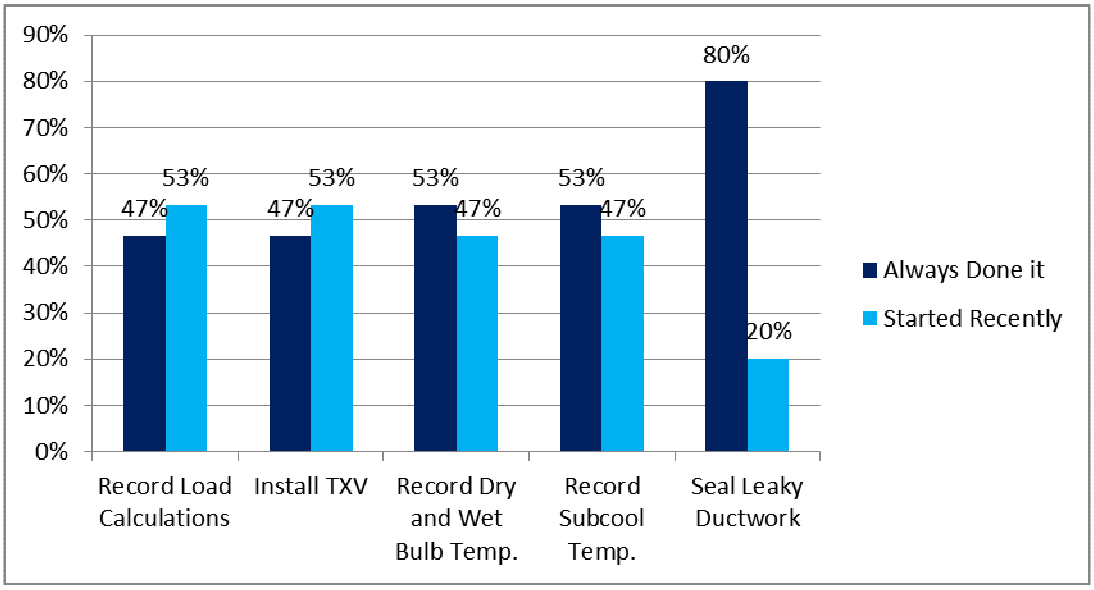
Figure 17. Average Percentage of Yearly CAC Installations Receiving Quality Install-Equivalent Practices Among all Nonparticipants



Source: Survey questions D5, D8, D11, D12, D15, and D18; n=15.

Cadmus asked respondents that reported having these installation practices if they have always had them, or if they had recently started to perform these practices. Sealing leaky ductwork, followed by recording subcooling and dry and wet bulb temperatures, is the practice that most respondents have always performed (Figure 18).

Figure 18. Respondents' History of Performing CAC Installation Practices (n=15)



Source: Survey questions D6, D9, D13, D16, and D19; n=15.

Challenges with Installation

Existing ductwork that is improperly sized from previous installations was the most commonly cited challenge by nonparticipants to achieving proper airflow during an install. Other challenges they mentioned included issues with accessibility and insufficient return air. Nonparticipating trade allies also mentioned insufficient airflow and improper ductwork as challenges associated with achieving proper refrigerant charge during an install.

The most commonly reported challenges to achieving proper sizing during an install are a lack of or inaccurate information about the way the home was constructed and improperly sized ductwork or furnaces.

Program Impacts

We asked the 15 nonparticipating trade allies the extent to which the program affected their CAC sales in 2011. Ten (67%) reported that there was no change in their sales, two said their sales had increased, and one said his sales decreased. The other two did not know.

Only four respondents stated that Xcel Energy's rebate for CAC units affected their equipment selection decisions for 2011. These four said they were able to stock and offer higher-efficiency units.

When we asked respondents what they expect for high-efficiency (i.e., above minimum SEER) CAC sales in the next five years, all but one said they expect an increase. Many reasoned that this increase will be heavily dependent on factors such as the weather, the economy, the cost of electricity, the rate of new construction, the need for CAC replacements, utility rebates, and consumer awareness of energy efficiency.

Federal Tax Credit Influence

Thirteen out of the 15 nonparticipating trade allies we interviewed (87%) reported that the availability of the federal tax credit in 2011 made no difference to their sales of 16+ SEER CAC units, while two reported that the tax credit increased their sales by an average of 7%.

When we asked what, if any, factors outside of the Xcel Energy HEAC Program and the federal tax credit impacted their sales of CAC units in 2011, the most common responses included:

- The economy, which they reported had a strongly negative impact;
- The weather, which had a negative impact;
- Rising electricity costs, which had a strong negative impact; and
- The availability of utility rebates, which had a positive impact.

Recommendations

Communication

1. **Continue funding a residential channel manager** to serve as a direct line of communication between trade allies and Xcel Energy. Survey results indicated this is an effective source of contractor program awareness.
2. **Continue providing program information** to contractors through mail and e-mail.

Program Requirements

1. **Consider allocating more training time to discussing how the sizing requirement can be met** to help contractors better understand what equipment could meet the needs of a home and to minimize the time it takes them to research the information.
    a. **Consider adding a specific component around duct sizing,** explaining how old or improperly sized ducts can impact an installation.
2. **Explore ways to help contractors meet the NATE certification requirement more easily** by either offering an incentive to help offset the upfront cost of the certification or by updating the contractor training to more closely reflect the language and structure used for NATE certification.

6. FOCUS GROUP FINDINGS

Cadmus conducted two focus groups with 13 Colorado HVAC contractors who installed CACs as part of the Xcel Energy HEAC Program in 2011. The goal in reporting these focus group results is to represent balanced, qualitative insights and memorable highlights, designed to help Xcel Energy continue to enhance the HEAC Program and fine-tune the program planning and marketing strategies.

Cadmus developed both the contractor recruitment screener and the discussion guide—which provided structure for the focus groups—with input from Xcel Energy.

The focus groups were held on the evening of June 6, 2012, at a professional market research facility. We selected this location based on the convenience it offered the participants and Xcel Energy staff to maximize focus group and observer participation.[10] The number of attendees in each group is listed in Table 8.

Table 8. Focus Group Respondents

Groups	Number of Respondents
5:30 p.m.	7
7:30 p.m.	6
Total	**13**

Each group lasted approximately 1-1/2 hours, and the participants received a financial incentive for attending. Although the same questions were discussed within each group, the wording and amount of time spent discussing each question varied.

As with all qualitative research, although we included actual numbers in the findings presented in this report, the sample size for each segment is not representative of all Xcel Energy HVAC contractors. However, this qualitative research provides insight into how contractors' talk and feel about important issues, which allows their perspectives to be incorporated into program communications and program planning.

Methodology and Objectives

The focus group format is designed to take advantage of the dynamics that occur when contractors are able to share with their peers, while Cadmus gathered their perspectives on program awareness, equipment use, QI components, program requirements, and future technologies. This group process provided an atmosphere in which contractors were more likely to compare notes with each other than to withhold information.

The contractor recruitment list provided by Xcel Energy contained contractors who had participated in an Xcel Energy internal group discussion in January 2012 and contractors who had not. We decided to allow this overlap in order to include some of the large companies (which represent a larger share of the program installs) while maintaining some diversity in the size of companies, thus ensuring that all perspectives were represented.

[10] Some staff members from Xcel Energy were present in an observation room.

The key research items Cadmus addressed during the focus groups included:

- Explore contractors' perceptions of and ability to meet program requirements and processes.
- Determine how often QIs are performed and contractor knowledge and understanding of the QI components.
- Gather information on what kind of QI information is shared with customers and what would encourage more customers to request a QI.
- Gather insight on perceived program participation barriers and discuss how to alleviate them.

Summary of Key Findings

The key findings of the two focus groups with 13 contractors are as follows:

- **Contractors who participated in the focus groups[11] rated high satisfaction with Xcel Energy's products and service.**
  - All but one contractor rated this as a 7 or higher on a scale of 0 to 10. One contractor gave a rating of 6.
  - The most common rating was 8 (n=5).
- **QI activity is unclear based on contractors' self-reports**. Although the majority (n=8) of contractors reported that 50% or more of their jobs were rebated, and therefore had QI, there was a discrepancy between the number of QIs reported in the focus groups and the number recorded in the program data.
- **Contractors reported that only a few customers asked about rebates.** Furthermore, only a few contractors said they stress the importance of QI when talking to customers.
- **The majority said they are better contractors due to their experience with the program.** Initially, however, a majority found it challenging to participate due to paperwork and program requirements.
- **Contractors are quite familiar with the program requirements and QI components.**
- **Contractors reported that customers express no concerns regarding initial program participation.**
- **Contractors indicated that when customers do not purchase high-efficiency equipment, it is because of the customer's budget limitations or status as a renter**.

Detailed Findings

The focus groups were composed of one branch manager, one field supervisor, two sales staff, and nine owner/presidents. (Of those nine, five said they "*do it all*"—sales, installations, and paperwork.)

[11] Two contractors did not fill out the pre-group exercise, so "all" in this section applies to the 11 contractors who did complete the exercise.

When asked about the number of years spent in the industry, the contractors' responses ranged from four to 50 years, with just over half (n=7) reporting over 20 years. Also, most (n=8) said their company has participated in the HEAC Program "*since it began*."

Following a pre-group activity, Cadmus discussed the following topics with contractors in both groups:

- Program Awareness and Satisfaction
- Equipment Trends
- Quality Installation
- Program Requirements
- Best Advice

Pre-Group Activity

As part of a pre-group activity, we asked contractors three questions. Note that the "all" in the pre-group activity section applies to 11 contractors, since two contractors did not complete the pre-group exercise. The purpose of these questions was to assess their satisfaction with Xcel Energy, the importance of rebates, and the importance of incentives. Specifically:

1. *Considering the price you pay relative to the quality of the product and service you receive, how you would rate Xcel Energy's overall value? Please use a scale where 10 means Very Good Value and 0 means Poor Value to rate Xcel Energy's overall value.*

   All of the contractors who responded rated Xcel Energy positively, giving a rating of 6 or above.[12] The most common rating was 8 (n=5).

2. *How important are the rebates for getting customers to invest in high-efficiency equipment?*

   Nearly all focus group participants rated the rebate importance as 6 or above (n=8),[13] with the remaining three giving a rating of 5.

3. *How important are the incentives to contractors for doing quality installation on central air conditioners?*

   The ratings varied from 0 to 9,[14] with only three contractors giving the same rating, of 6. However, six contractors rated the importance of incentives as a 6 or higher.

Program Awareness and Satisfaction

The majority of contractors reported first hearing about the HEAC Program from Xcel Energy (through e-mail, direct mail, or a company representative). Several contractors said they had

[12] Of those 11, two contractors rated Xcel Energy as a 10; one rated it a 9; five rated it an 8; two rated it a 7; and one rated it a 6.

[13] Two contractors rated the importance of rebates as a 10; two rated it a 9; one rated it an 8; two rated it a 7; one rated it a 6; and three rated it a 5.

[14] One contractor rated the importance of incentives as a 9; two rated it an 8; three rated it a 6; two rated it a 5; one rated it a 1; and two rated it 0.

reached out to Xcel Energy to inquire about the program, and one learned about the program from an equipment supplier/manufacturer.

When asked to describe the program, nearly all contractors were able to articulate the key aspects, with one summing it up by saying: "*It offers customers a rebate [for high efficiency equipment] and ensures that it will be installed correctly.*"

In addition to focusing on the customer benefits, many of the contactors mentioned that the program: "*makes better contractors out of the people [contractors] who participate.*" This perception was emphasized when contractors debated the challenges of participation (such as meeting the QI components and completing paperwork).

The majority of the contractors agreed with one who reported that the program: "*leveled the playing field.*" Although participation had created burdens initially for these contractors, it is no longer a challenge after three years.

A small minority expressed concern that the program is: "*a double-edged sword,*" in that it rewards contractors who have always conducted QI while encouraging "*junky*" (i.e., untrustworthy) contractors to enter the market.

Customer Participation

During the recruitment screening, we asked contractors how many QI units they had installed, to which they reported a range from one to 240, with the majority (n=8) recalling 25 or less. Then, during the discussion, when we asked contractors what percentage of their customers participated in the HEAC Program, they reported a range from 20% to 95%, with the majority (n=8) reporting at or above 50%.

The primary reasons given for a customer choosing not to participate in the program include:

- The customer's budget (the higher qualifying SEER unit was not affordable).
- They customer is a renter.
- The customer does not differentiate on quality. One contractor said: "*They do not understand the install is at least as important as brand or rating.*"

Contractors reported that only a few customers ask about rebates. The majority of contractors said the only time they do not tell their customers about the rebate is if the customer is: (1) committed to a price that does not cover the cost of a high-efficiency unit, (2) a renter, or (3) committed to purchasing equipment that does not qualify or cannot be sized to qualify. For example, one contractor said it: "*depends on the house, [someone with a] 900 square-foot house is not going to ask for 16 SEER…it doesn't make sense.*"

Customer Education and Program Promotion

When asked how often they tell customers about the program, contractors gave an array of answers from a casual by-the-way approach to presenting the program routinely in their sales pitch.

- One contractor said: "*Most of the time, we tell the customer about the [Xcel Energy] program.*"
- Another contractor said: "*We see it as an opportunity [to sell high-efficiency equipment] for every customer*."

However, a few contractors are still struggling with the program requirements and indicated they would: "*rather see the entire program [happen] between Xcel Energy and the customer,*" thus removing the contractor from the process.

When we asked contractors what they tell customers about the program, most said they describe the unit options and allow the customers to select based on their budget, comfort needs, and the importance of energy efficiency. As one contractor reminded the group: "*Customers are making a value judgment*" and efficiency is only one of their decision-making factors.

The majority of contractors said they discuss the general long-term benefits of having a QI installation with customers, stressing that: "*properly installed systems last longer and have fewer repairs, are more comfortable, and use less energy.*" However, only a few contractors indicated rigorously explaining the importance of a QI with their customers.

- One contractor said he gives all his customers a QI: "*101 class, [including] showing them warranty differences, [the program's] accountability requirements [to] keep us [contractors] sharp, [and] the difference in savings.*" He said this effort only adds 15 minutes to his sales pitch.
- The most creative explanation of QI was: "*it's like buying a cake mix at the store…it's not a cake until you assemble it correctly.*" This point was echoed throughout both groups as contractors pressed that a QI job means that customers get what they paid for. One contractor said: "*if you are paying for a 16 SEER you want it to perform to that level.*"

No contractors reported that their customers had any initial concerns regarding participating in the program. However, several contractors did report having customers who were frustrated at waiting for their rebate until after the warm-weather testing was complete, or delays due to the result of application mishaps (such as incorrect submission), or equipment that was deemed ineligible.

Receiving Information

Contractors reported receiving information about the program through the following methods: e-mails, the annual trade ally packet from Xcel Energy, Xcel Energy's Website, the DSM round table, and direct outreach from the residential channel manager. Contractors were all in agreement that their preferred method of receiving information is e-mail.

Cadmus asked contractors in the second focus group how important the residential channel manager is to their connection with Xcel Energy. All six of these contractors indicated that the residential channel manager is a great: "*line of communication back to Xcel Energy.*" A minority of these contractors mentioned wanting Xcel Energy to provide more opportunities for meeting with other HVAC contractors to discuss market trends and challenges.

Contractors reported belonging to a few trade organizations that provide them with industry updates. Primary associations include: NATE, ACCA, and the American Society of Heating, Refrigerating and Air Conditioning Engineers; other associations that were mentioned by only one or two contractors include the Sheet Metal and Air Conditioning Contractors' National Association, Boulder Green Building Guild, Energy Efficiency Business Collation, National Comfort Institute, and the Building Performance Institute. All contractors considered these associations to be trusted sources of information, although the type of information depends on the association. For example, the ACCA provides: "*great national-level business and technical stuff*," but another association may be focused on other information, such as training or local trends.

Contractor-Reported Benefits and Challenges

Cadmus asked about the benefits and challenges of participating in the program, and the contractors' responses also generated suggestions for improvements.

Benefits

When we asked about the benefits attributable to the program, most contractors mentioned one or more of the following key benefits, which reflect the sense that the contractors are doing a good job:

- Fewer call-backs
- Personal satisfaction
- Increased homeowner awareness of energy efficiency

The majority of contractors zeroed in on fewer call backs, elaborating that this translates to less lost revenue and happier clients.

- One contractor said the program: "*has changed how we do it [installs], it's how the industry should do it.*"
- Another contractor echoed this sentiment saying: "*It [QI] makes a home comfortable, it is what we should be doing, [and] it makes the equipment last longer.*"

Challenges

The two program challenges mentioned most frequently across both groups were: (1) the format of the current paper rebate application submission, and (2) warm weather testing, including the limitations of the testing tool. In the second group, two other common challenges noted were the proof of equipment eligibility and the third-party verification contracted by Xcel Energy.

Generally, while contractors agreed that the paper forms are burdensome (in that they take time to complete), they disagreed on how much of an issue the forms are. A specific aspect of the paperwork that contractors called out was the three carbon copies of the rebate form. As one

contractor said, it is: "*out of sequence [and it should be ordered as] Xcel Energy, customer, contractor.*"

Contractors in both groups suggested using electronic forms as an alternative to the hard copies, and the majority of the contractors found this appealing. During this discussion, Cadmus determined that their interest stemmed in part from the possibilities of: (1) being able to collect an electronic customer signature, and (2) an electronic form that could be programmed with drop-down menus to minimize human errors.

The second program challenge mentioned by contractors centered on warm-weather testing. This involves a follow-up visit during warmer months to complete the QI testing when a unit is installed during cold months. As explained by the contractors, the problem is two-fold:

1. First, the customers want their rebate right away and gets frustrated with the installer when they have to wait for the testing to be complete months later before sending in the rebate form.
2. Second, the installers view the return visits as lost revenue when they could otherwise schedule new jobs.

Despite their frustration, the majority of contractors were resigned to doing the warm-weather testing as needed. One contractor summarized the general feeling by saying: "*It just is what it is.*" Another said: "*If you did anything [i.e., drop the requirement], you would give up the quality of the program.*"

Only a few contractors thought there was a viable alternative to warm-weather testing, which was testing under a tent. However, others were opposed to this approach, citing difficulties in balancing indoor and outdoor air temperatures under those conditions.

In addition to the timing delay caused by warm-weather testing, contractors also reported frustration with the tool (from Field Diagnostic Services, Inc.) that Xcel Energy encourages them to use in the testing. Several contractors said the tool is temperamental. When asked if additional training would help, one contractor responded: "*I don't need training, the tool doesn't work.*" Several other contractors mentioned that other similar tools are available, and wanted to know why they could not use one of those tools instead.

In the second group, the proof-of-equipment eligibility requirement was a common frustration. Several contractors shared stories of replacing equipment so old that no identification could be found, and therefore the customer was ineligible for the program. "*Proof of trade-in needs to be common sense,*" said one contractor who described replacing a unit that was so old, the identifying brand and serial numbers were unreadable. He felt this unit clearly qualified for program. Several contractors suggested taking a picture of such units and sending them into Xcel Energy to serve as supplemental proof.

The last mutual frustration among the second group was the on-site verification requirement that is performed by the M&V contractor for 10% of the jobs that received a rebate. This verification involves the M&V contractor scheduling a visit with the contractor at the site of selected jobs to test and verify that QI procedures were executed properly. One contractor said: "*Don't tell me*

it's random. I got 24 out of 70 [verified], and he [indicating another focus group participant] got 1 out of 55."

Similar to the concerns expressed by Xcel Energy program staff about M&V testing, the contractors reported not completely trusting the M&V contractors' work. One contractor said his staff had to train the M&V contractor. Another contractor noted that he resented the time his staff had to take off from actual work to attend the verification, saying: "*They are my customer [so] we will be there with the auditor, [but it's] time consuming for us.*" Despite these frustrations, the majority of contractors understand the value in having a third party verify the work.

SEER

Contractors were unified in their exasperation when using the AHRI Website. They use this resource to verify that the indoor unit model (furnace motor/fan) and outdoor unit model (CAC compressor) make up the correct combination to achieve an independently certified SEER/EER rating.

While the Website was helpful in some instances, the contractors reported that many of the equipment combinations they used were not listed, so they had to create them. One contractor summarized this issue with the statement: "*There is such a vast amount of equipment, so finding the right combination is very time consuming…and often it's not there.*" Despite their frustration, the majority of the contractors were resigned to the reality that there is not currently: "*any other place to go to find this information.*"

Training

All of the focus group contractors remembered either attending the Xcel Energy program training or sending someone from their company to the training. Of those who reported attending training, a few indicated that going through the paperwork was helpful. However, the majority did not find it useful, as they have been participating in the program for several years. Their comments included these:

- It [the training]: *"covered requirements but was more of a sales pitch; trying to get us to do it [the program], and explaining how we can make money."*
- "*In the past, it [the training] has been focused on more technical aspects,*" and he appreciated those details more than the sales pitch.

When asked how Xcel Energy might improve the training, the contractors agreed that offering two levels would be more efficient (one for new contractors and a second for those with experience). New contractors would still get all the general program details, and more experienced contractors could just focus on program changes and more technical training.

Equipment Trends

When we asked what SEER levels contractors currently stock and install, the majority said they do not stock equipment, and they reported sales of SEER levels ranging from 13 to 21.

All contractors agreed that their cost per unit increases in parallel with the SEER level, with most ranging from $2,000 to $10,000.[15]

Despite the discontinuation of enhanced federal tax credits for SEER 16 units, contractors agreed that they would continue offering these units to customers. As one contractor said: "*Not as many people will want it, but there will still be demand,*" and as long as customers want high-end units, contractors will be willing to install them.

When we asked if customer demand for energy efficiency was likely to increase, stay the same, or decrease in the next year or two, the majority of contractors agreed that the demand for energy-efficient equipment will continue to rise as standards and awareness increases. Two contractors held a contrary opinion, stating that because the rebates have been lowered and the economy is down, customers will be less likely to invest their own money into high-end units.

Future Considerations

When we asked what (if any) cooling technologies Xcel Energy should consider for future program rebates, the contractors' main suggestion was to include ductless mini-splits. Two contractors also suggested the Coolerado, but others in this group disagreed. As the Coolerado is closer to an evaporative cooler technology, it may be more applicable for the Evaporative Cooling Program.

Quality Installation

Both focus groups spent the majority of the discussion on the QI component of the program, with which all contractors were quite familiar. During this part of the discussion, we asked contractors to describe what, if any, extra steps are needed to conduct a QI job. The majority of the contractors reported that only minimal extra steps are needed for program installations. Specifically, they called out duct sealing and the paperwork as additional steps.

Although contractors agreed that following all the QI components adds an additional four to six hours per job, they do not tend to think of this as additional time spent on-site, as the majority of the contractors reported that most of their jobs already include most, if not all, of the QI components. When asked if they charge more for a QI job, the majority said they did not. However, a few noted that they do highlight costs by task, such as one contractor who has a line item in his billing for the additional paperwork and duct sealing required. The contractors agreed that they appreciate that Xcel Energy discontinued the QI checklist requirement in 2012, as this reduced some of the paperwork burden.

To understand how installation practices have changed since the program introduced QI rebate requirements, we asked if contractors had conducted key QI testing components prior to participating in the program, such as load calculations, dry and wet bulb temperature checks, actual sub cool temperature checks, and duct sealing. Contractors gave a mixed response on whether they had always conducted load calculations, with a slight majority of contractors (n=7) reporting that they have completed load calculations for years and the others (n=6) noting that they had not included load calculations prior to the program, although (as one stated) they: "*now do it for every Xcel Energy job.*"

[15] Two outliers quoted a combined equipment costs at or above $20,000.

One contractor mentioned that although he now conducts Manual J for Xcel Energy jobs, he prefers his own method, which he believes is more accurate. One contractor argued that Manual J was not enough, and thought that the program should require Manual S as well. Although the contractors were not uniform in their enthusiasm about the load calculation requirements, the majority do see value in it, with several pointing out that they do not want just anyone participating in the program. One contractor summed it up this way: "*[I'm] glad it is not the easiest program to participate in, [as the requirements] separate the men from the boys.*"

Contractors provided mixed feedback regarding checking and recording dry and wet bulb temperatures and the actual subcooling temperature, with seven reporting they had previously checked, but not recorded the temperatures, three noting that they sometimes checked, and two indicating they had not checked or recorded temperatures prior to participating in the program.

Contractors were almost evenly split between those who had and those who had not included duct sealing as part of a standard installation prior to program participation.

Program Requirements

When asked to describe the HEAC Program requirements, contractors gave simple answers beyond following the QI components. These included the NATE certification, paperwork submissions, and warm weather testing. Although the majority of the contractors reported what one stated, that: "*right off the bat [the program had been] a bit of a headache. [It is] now a piece of cake,*" and that meeting requirements is pretty easy, a few were still struggling with the paperwork component.

When we asked how Xcel Energy could confirm that the installation met the program requirements if QI documentation was not required, contractors could not think of a concrete change in the program that would still capture the installation requirements. A few suggested that a simple approach could be acceptable, such as: "*a good performing air conditioner should indicate a good install.*" The majority, however, were unable to elaborate on what that actually meant or how it could work, and they accepted that Xcel Energy had to be able to document that installations met QI standards.

Still, a few resisted, asking a question summed up by one: "*Why does the paperwork matter if testing should show it [the installation] was done well?*" When asked to elaborate, one contractor declared that he tests his own installs and they performed to specifications, and that should be enough.

Best Advice

When asked to offer their best advice to Xcel Energy for encouraging participation in the HEAC Program, contractors focused on several key areas, including marketing to customers and adjusting the application form for contractors. Specifically, the majority of contractors reported that advertising the program to customers is critical, indicating that Xcel Energy should: "*make customer more aware of [what] the things [QI components] we do actually cost, so it take less time getting past the sticker shock.*" Specifically, contractors suggested focusing on why quality matters and expanding traditional marketing (e.g., bill inserts) to include YouTube-type videos or contractor-driven blogs that would act as information sources for potential customers interested in QI.

Although, unsurprisingly, a handful of contractors mentioned increased incentives, the majority focused on adjusting the application form to increase their participation. As discussed earlier, many were enthusiastic about the idea of an online version, in addition to the hardcopy form, that would include drop-down menus and would not allow them to continue if there was missing information. As one contractor said: "*Just tell me what I have done wrong, and I will fix it.*" The majority of contractors thought this might streamline the process for them as well as for Xcel Energy as they review the applications.

Conclusions

As specified by the research questions and outlined in the Methodology and Objectives section above, with this research effort Cadmus sought to explore participating contractors' perceptions of and ability to meet program requirements and processes. Although contractors did feel it was challenging to complete the program requirements when they first started participating, focus group contractors were able to articulate the advantages to their involvement in the program and suggested that it helped them stand apart from less qualified contractors.

Cadmus also used this focus group effort to determine how often QIs are performed and to assess contractor knowledge and understanding of the QI components. As discussed throughout the detailed findings in this chapter, the majority of contractors reported that due to their participation in the Xcel Energy HEAC Program, they now conduct QI on nearly all their jobs. However, there remains discrepancy between the number of units documented in Xcel Energy's records and the number reported by contractors during recruitment. This gap indicates that there remains room for improvement in the overall number of QIs conducted within the Xcel Energy service territory.

Xcel Energy staff expressed concern over a potential lack of buy-in during interviews as to the intrinsic value of a QI, from both contractors and customers. However, contractors demonstrated an understanding of the many benefits associated with QI during the focus group discussion, although they did share the staff concerns over their customers' lack of understanding and recognizing the value of QI.

Cadmus also used the focus groups to gather information on what, if any, QI education the contractors share with customers, as well as what might encourage customers to request QIs. The majority of contractors indicated they do not spend very much time, if any, discussing QI with customers and that customers do not understand its value. Therefore, there is an opportunity for contractors and the HEAC Program to continue and/or increase customer education on the benefits of QI.

We also gathered insight on perceived program barriers, seeking to determine possible avenues to alleviate them. Due to the rigorous efforts of the Xcel Energy staff to build relationships with contractors and address barriers in the first few years of the program, very few true barriers remain. While it's evident that contractors are not excited to conduct all the required testing or submit all the necessary paperwork, the majority do accept that Xcel Energy needs to be able to document QI.

Xcel Energy staff expressed a desire for the number of participating contractors to grow, and expressed some apprehension over progress in this department. While this is a logical goal, the

program understanding, awareness, and buy-in expressed by the contractors in these focus groups highlights the depth of quality of many current participating contractors that likely has a correlation to staff efforts and program development. Continuing to support the existing program contractors as a way to develop an even stronger network, could, in turn, attract the attention of other contractors and spark their interest in exploring participation.

Recommendations

The following recommendations support Xcel Energy's continued efforts to refine and achieve quality and active contractors, increase customer participation, and address the remaining challenges and perceived barriers, such as limited customer awareness, additional testing tools, and alternatives for verifying equipment eligibility.

Marketing and Program Awareness

- **Explore the possibility of expanding customer-focused marketing and advertising** by highlighting the benefits of QI through the use of educational videos and social media channels.
- **Consider enhancing existing customer-focused QI handouts and brochures** by including key customer questions and topics, such as pricing and QI benefits, which contractors could use when discussing program benefits with customers.
- **Continue providing program information** to contractors through e-mail.
- **Consider leveraging contractor testimonials** by highlighting them on communication and outreach collateral targeting new contractors.

Communication

- **Continue having the residential channel manager** serve as a direct line of communication between trade allies and Xcel Energy.
- **Explore sponsoring contractor round tables** to: (1) promote industry discussion among participating contractors, and (2) provide an opportunity for participating contractors to share program benefits and positive experiences with nonparticipating contractors, in order to encourage greater participation.
- **Continue to recognize participating contractors** by providing them with program-specific marketing, such as truck magnets and yard signs, to help them distinguish themselves. Also continue to recognize top performers within the participating contractor group with awards and plaques.

Program Requirements

- **Explore additional testing tools** that contractors could use in cooler temperatures, such as Testo products[16] or the Digi-Cool system.[17] This would enable contractors to conduct the testing closer to the time the unit was installed, thus addressing customer concerns about delayed rebates.
- **Consider alternatives for proof-of-equipment eligibility** for units with illegible or missing model numbers.
- **Explore providing additional contractor spiffs** to offset the time they spend and potential revenue they lose when selected for third-party verifications, if cost-effective.
- **Consider restructuring training** to ensure that only program-specific information, valuable to contractors, is discussed, as well as to reward successful experienced contractors with more advanced training while ensuring that new contractors understand the program requirements and processes.
- **Consider adding an online rebate application,** in addition to the hardcopy, with controlled drop-down menus to increase the ease of submission and reduce human error.
- **Consider restructuring M&V** such that experienced contractors who pass M&V routinely are placed into a group where M&V is conducted on a fewer number of jobs, while continuing the existing M&V procedures with new contractors and those who have trouble passing the M&V audit.

[16] http://www.testo.com/online/abaxx-?$part=PORTAL.USA.SimpleContentDesk&$event=show-from-menu&categoryid=49804543

[17] http://www.trutechtools.com/Digi-CoolRSA

7. NONPARTICIPATING CUSTOMER SITE VISITS

This chapter outlines the results of 18 site visits Cadmus conducted from July through October 2012, with customers who had a new CAC installed in the last three years and did not participate in the HEAC Program (referred to as nonparticipants). Cadmus gathered information to assess whether each component of QI passed or failed based on the criteria the third-party M&V contractor had used the previous year. The four QI components are correct refrigerant charge, airflow, sizing, and duct sealing. This chapter provides the pass/fail rating for each component of QI, comparing HEAC Program nonparticipants to participants. The findings from these site visits are a component of the freeridership analysis and were factored into the final NTG.

To assess QI, Cadmus performed the following activities:

- Recruited nonparticipants by identifying new CAC installations through billing analysis, public records research, and a newspaper advertisement.
- Conducted site visits to gather information to assess the four components of QI.
- Analyzed each QI component for nonparticipants, using the same methodology as was used by the M&V contractor to assess the QI of participants in the previous year.
- Analyzed each QI component using a secondary methodology that more accurately tests QI specific to HVAC systems in Colorado.

Cadmus also identified a more accurate way to evaluate the pass/fail of each QI component than the criteria used by the M&V contractor in the previous evaluation year. This chapter explains the new method in detail and describes the differences in the methodologies.

Key Findings

Pass/Fail Comparisons From Site Visits

- **The pass/fail rates of participants and nonparticipants are similar. The degree of failure from the acceptable value for nonparticipants was greater than the degree of failure for participants.** The study conducted by RSR with participating customers in 2011 found high fail rates for sizing, refrigerant charge, and airflow. Cadmus found similarly high fail rates for these components for the nonparticipant installs we evaluated in 2012. A comparison of pass/fail rates is provided in Table 9. Detailed review of the data shows that nonparticipants who failed refrigerant charge and sizing failed with a greater deviation from the acceptable value than program participants.
- **The quality of duct sealing is lower for nonparticipants.** Duct sealing assessment is subjective, and therefore pass/fail rates are difficult to compare. RSR found issues with approximately 25% of the ducts they inspected in participant customer homes. Cadmus found that 50% of the ducts in the nonparticipating homes we visited were only partially sealed or were not sealed at all.

Table 9. Participant and Nonparticipant Fail Rates for QI Components

Participant Type	Refrigerant Charge	Airflow	Sizing	Duct Sealing
Participant	54%	20%	40%	25%
Nonparticipant	50%	22%	78%	50%

Necessary Pass/Fail Criteria Adjustments

- The 2011 target airflow measurement was calculated using a target airflow of 400 cfm/ton for every site. This estimate of tons was based on the system capacity. However, **target airflow should be based on the original equipment manufacturer (OEM) data or on the ACCA Manual S methodology.** Both of those methods include a correction for high altitude conditions.[18]
- The 2011 target sizing measurement was calculated by comparing the AHRI capacity to the Manual J load calculation to assess proper system sizing. The AHRI capacity is based on how the system operates at sea level, with 95 °F outdoor dry bulb, 80 °F indoor dry bulb, and 67 °F wet bulb indoor temperatures. At high altitude, the condenser (outdoor unit) loses cooling capacity. The peak design conditions in Denver are not 95 °F. **A more precise way to assess proper sizing is to use the HVAC cooling capacity that correlates to the Manual J peak load calculation, by using the manufacturer OEM data or Manual S calculations.**
- **The target subcooling is calculated correctly.** We found no issues with the pass/fail criteria used to assess proper refrigerant charge.

Method

Site Visit Scheduling and Procedure

Cadmus used several tactics to recruit nonparticipant customers for this study. We began the process with a call list provided by Xcel Energy. This list included the historical energy use for customers whose monthly summer bills deviated significantly from 2010 to 2011. This deviation allowed Cadmus to identify possible recipients of a new, more efficient HVAC system. Cadmus made a total of 962 phone calls to customers on this list, plus several call-backs. Cadmus also left voice messages whenever possible, resulting in a few returned calls from customers requesting more information on the study. Unfortunately, many customers on this list were not eligible, as they had no CAC unit or they had not purchased one in the last three years. Because of this, Cadmus also researched public permit records to identify customers who had a CAC installed in the previous three years. From this additional list, we made 260 phone calls, plus call-backs.

With the low response rate to the calling effort, Cadmus and Xcel Energy agreed that an advertisement in the Denver newspaper might yield a better result. Cadmus ran an advertisement in a Denver newspaper for four weeks, resulting in 45 responses from interested customers.

[18] Changing the analysis methodology for QI would also impact program gross savings and program aspects, such as contractor training. Program gross savings were not a part of this evaluation, therefore the impacts this change would most likely have on gross savings is not quantified.

Cadmus promptly replied to any customer who responded to the advertisement with a full explanation of the study.

Cadmus made a total of 1,222 calls over the course of three and a half months, and sent out 78 e-mail responses as part of the recruitment effort. These efforts resulted in 18 qualified customers who had received a new HVAC system and were willing to allow an engineer to perform a QI inspection.

Quality Installation Testing Methodology

The four components of a CAC QI are proper equipment sizing, correct airflow across the evaporator coil, correct refrigerant charge, and a sealed duct system. Cadmus tested and evaluated each of these components with a specific test procedure. Cadmus collected the same information using the same methods as the 2011 program M&V contractor used for participant QI inspections, in order to allow for like comparisons.

Equipment Sizing

Cadmus used the ACCA Manual J to determine the cooling load of each home. Engineers used Right-J Mobile software installed on electronic notebooks (iPads) to perform the load calculations on site. The following data were collected and input into the software program to estimate the cooling load:

- Home measurements: perimeter, square footage, wall area, and ceiling area.
- Orientation of the home.
- Foundation type.
- Windows data: sizes, number of panes, frame material, and heat reflective coatings.
- Number of occupants.
- Appliances, lighting, and other large plug loads.
- Leakiness or infiltration load.
- Duct system parameters: location, sealing, and insulation.

The engineers also took photographs of the home and recorded all available HVAC system information. This generally included AHRI certificate information and the nameplate information off the condenser, furnace, and evaporator coil.

Evaporator Airflow

Cadmus measured the airflow across the evaporator coil using the TrueFlow plate system and a DG-700 manometer manufactured by The Energy Conservatory. We tested the airflow during the steady state cooling mode in the highest stage of cooling (for systems with more than one stage of cooling), after at least 15 minutes of constant runtime. The TrueFlow measures airflow with a flow plate that temporarily replaces the air filter. The stated accuracy of the flow measurement is ±7%. Cadmus made the proper high-altitude corrections, tested the airflow, and recorded the current and voltage of the fan while the fan was still running. Along with the airflow, we recorded the supply and return dry bulb and wet bulb temperatures inside the airstream of the closest register to the air handler or at the air handler itself.

Refrigerant Charge

Cadmus measured refrigerant charge with the Testo 556 Refrigerant System Analyzer. This device is compatible with all residential refrigerants and simultaneously measures liquid and suction pressure and temperature. We conducted the tests when outdoor temperatures were at or greater than 65 °F. When outdoor temperatures were below 65 °F, we did not perform the test and attempted to reschedule the appointment.

Cadmus recorded the system measurements after at least 15 minutes of runtime (steady state). We calibrated the Testo 556 to the system refrigerant type, with an altitude adjustment. The Testo's internal computer calculates subcooling and super-heating while correcting for altitude. Cadmus recorded those values, along with the corresponding pressures and temperatures of the liquid and suction lines. The Testo collects a small amount of refrigerant during the test. After the testing was complete, we discharged the liquid refrigerant back into the CAC system to ensure that the test only had very little impact on the amount of refrigerant in the system.

We also recorded the steady state condenser current, voltage, true power, and power factor.

Duct Sealing

Cadmus visually inspected duct systems for proper sealing techniques. We inspected the joints of sealed hard duct and rigid duct systems to determine whether they were sealed with mastic, foil tape, or another approved method. For sealed flexible duct systems, we inspected the joints to ensure that the draw bands were tight. We also took photographs of the duct systems.

Results

Findings from Site Visits

To compare results from the 2011 RSR participant study to Cadmus' 2012 nonparticipant study, we collected all the information in the same or a very similar manner. The results of both studies are presented and compared below for each component of QI.

Equipment Sizing

RSR found a participant equipment sizing fail rate of 40%, while Cadmus found a nonparticipant sizing fail rate of 78%.

Cadmus and RSR both used the ACCA Standard 5 criteria to assess whether the systems were properly sized. The Manual J load calculation is considered the correct system capacity (Figure 19). We compared this capacity to the AHRI-rated capacity for installed systems (Figure 20). The installed system includes the fan, the evaporator coil, and the condenser coil.

ACCA Standard 5 states: "*System capacity must be no greater than 115% and no less the 95% of the peak load capacity or the capacity must be between the next largest nominal piece of equipment, per OEM increment that is available to satisfy the latent and sensible requirements.*"

Figure 19. Example of Manual J Output

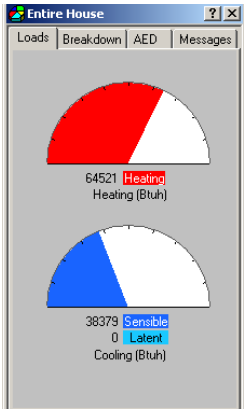
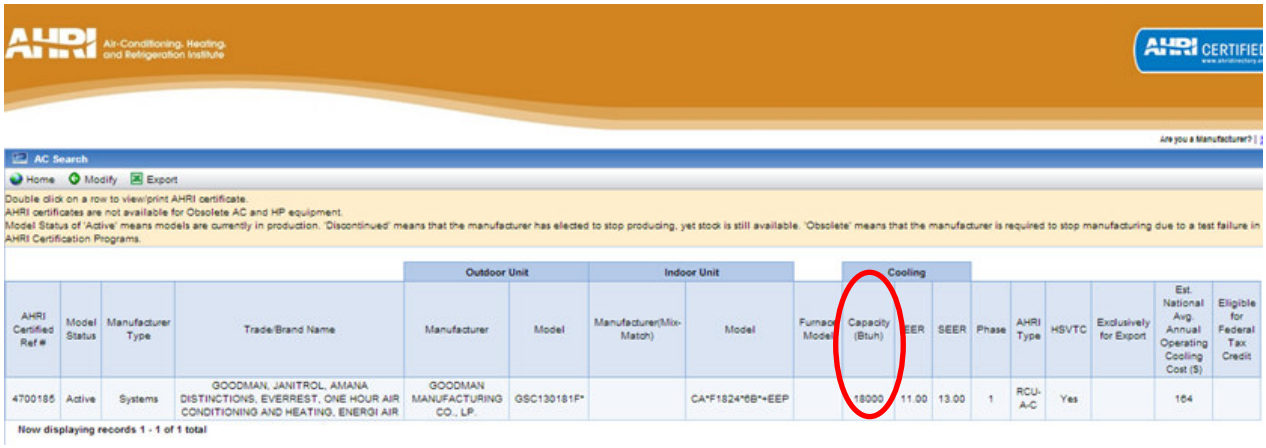


Figure 20. Example of AHRI Certificate Information



Approximately 20% of the systems that failed in each group (participant and nonparticipant) failed because they were undersized; the remaining 80% failed because they were oversized. In general, the nonparticipant oversize failures were related to units sized much bigger than the participant oversize failures: the oversized nonparticipant systems were sized incorrectly by nearly 100% (twice as large as needed), while the oversized participant systems failed by an average of 40%. In short, the nonparticipant sizing failures were far more oversized than the participating sizing failures.

We are not reporting results from the undersized systems because there were few, and because undersized systems use less energy and have less demand than properly sized systems, especially during the peak period. Further, undersized systems should not be failed for the QI sizing requirement, as they result in energy savings.

Evaporator Airflow

RSR found an airflow failure rate of 20% for participants while Cadmus found an airflow failure rate of 22% for nonparticipants. Cadmus and RSR both used the ACCA Standard 5 criteria (partially) to assess whether the airflow rate was set correctly. ACCA Standard 5 states:

1. *"Airflow through the unit, at fan design airflow under steady state condition is within 15% of the airflow required per the system design.*
2. *Airflow through the unit is within the CFM range listed in the OEM product data.*
3. *Measured external static pressure is within the OEM specified range.*" (sic)

A system only failed if airflow was less than 15% of the target airflow. Airflow that was measured at greater than 15% of the target airflow did not fail. In other words, if the airflow rate was greater than 340 cfm/ton, the airflow QI component passed. We determined the target airflow using the AHRI-rated capacity (an example was shown in Figure 20). For our analysis, we assumed that the target airflow is 0.0333 cfm/Btu, or 400 cfm/ton.

Refrigerant Charge

The refrigerant charge fail rate was 54% for participants and 50% for nonparticipants. Cadmus and RSR both used the ACCA Standard 5 criteria to assess whether the systems were properly charged with refrigerant. In all cases, the new systems had TXV's installed, so we based the assessment on target subcooling.

The ACCA Standard 5 states: "*For SUBCOOLING method, system refrigerant should be charged per OEM data/instructions and within ±3°F of the OEM-specified subcooling value.*" (See example in Figure 21.)

Figure 21. Example of Manufacturer Subcooling Specification

UNIT SIZE–VOLTAGE, SERIES	REQUIRED SUBCOOLING °F (°C)
18–30	10 (5.6)
24–30	10 (5.6)
30–30	11 (6.1)
36–30	10 (5.6)
42–30	12 (6.7)
48–30	9 (5.0)
60–30	9 (5.0)

Although the fail rate was similar for each group, we found that several nonparticipant systems were grossly overcharged or grossly undercharged. The QI participant systems that failed did not fail to the same degree as the nonparticipant systems.[19]

A system that fails a component of QI loses all savings for that component. If measured subcooling is greater than 3.0 °F, no savings are claimed for correct refrigerant charge. Table 10 provides an example of the degree to which a system deviates from the specifications of QI based on the percentage of being undercharged. As the degree of refrigerant overcharge or

[19] It is not possible to quantify the degree of this failure, because efficiency losses (shown in Table 10) are based on the amount (mass) of refrigerant, not on superheating or subcooling temperatures. The mass of refrigerant added or removed can only be determined by adjusting the system to the manufacturers' specifications (by adding or removing refrigerant). Cadmus and RSR only observed the systems.

undercharge increases, the system efficiency decreases. Savings should be assessed based on the degree of the system's overcharge or undercharge.

Table 10. Refrigerant Charge Level and Air Conditioner Efficiency

Percent Undercharged	Efficiency Loss
0 (properly charged)	0.0
5	0.04
10	0.10
15	0.19
20	0.28
Percent Overcharged	**Efficiency Loss**
0 (properly charged)	0.0
5	0.05
10	0.09
15	0.11
20	0.14

Source: Proctor Engineering. *New Buildings Institute, Small HVAC System Design Guide*. Prepared for the California Energy Commission. Available online: http://www.apscservices.info/EEInfo/TRM.pdf

Duct Sealing

RSR found issues with approximately 25% of the participant ducts they inspected. Cadmus found that 50% of nonparticipant ducts were only partially sealed or were not sealed at all. Duct sealing assessment is subjective, and therefore pass/fail rates are difficult to compare. Without a better understanding of why RSR failed certain systems, we do not recommend making a direct comparison.

The systems with issues that Cadmus inspected had the following problems in common:

- Sporadic and haphazard use of duct tape to partially seal ducts.
- No sealing on joints of sheet metal ducts.
- Partial sealing with foil tape near the furnace only.
- Ducts in unconditioned crawlspaces were not sealed.
- Ducts with significant leakage into conditioned spaces.

Pass/Fail Criteria Adjustment

The pass/fail criteria for duct sealing and refrigerant charge are reasonable. The pass/fail criteria for equipment sizing and airflow should be modified to follow industry best practices. This section explains some issues with the way the M&V contractor is assessing equipment sizing and airflow.

Airflow Assessment

Target Airflow Estimates

ACCA Standard 5 is that the OEM data should be used to estimate target airflow. Cadmus and RSR estimated target airflow based on the AHRI capacity, with an airflow rate of 400 cfm/ton. This 400 cfm/ton is a standard, and often erroneous, airflow setpoint. Humid climates require a much lower airflow because air needs to move more slowly across the coil to efficiently remove more latent load (more water from the air). The airflow requirement in dry climates is therefore higher, and is even higher yet in dry climates at high altitude. As altitude increases, a blower moves the same volume of air, but the mass flow decreases because the air is less dense.

Manufacturers provide altitude correction factors, as does Manual S. At 6,000 feet, the target airflow should be increased by 25% to deliver the same cooling capacity that the system would deliver at sea level. We would expect the target airflow to be closer to 500 cfm/ton in most cases for Colorado. Using this methodology, the fail rate for 2012 nonparticipants increases from 22% to 56%.

In addition, correction factors are required for the flow grid plate used by RSR and Cadmus. We do not know if RSR considered the flow correction for high altitude. A 70 °F return air temperature in a home at an elevation of 5,000 feet requires an increase of measured cfm to actual cfm of approximately 10%.[20]

System Size Estimates

Cadmus and RSR used the ACCA Standard 5 criteria to assess whether the systems were properly sized. The Manual J load calculation is considered to be the correct system capacity. We compared the Manual J to the AHRI-rated capacity for the systems installed. The installed systems include the fan, the evaporator coil, and the condenser coil.

ACCA Standard 5 states: *"System capacity must be no greater than 115% and no less the 95% of the peak load capacity or the capacity must be between the next largest nominal piece of equipment, per OEM increment that is available to satisfy the latent and sensible requirements."*

System capacity and AHRI capacity are not the same thing. The AHRI capacity is the capacity a system provides when operating at sea level with 95 °F outdoor dry bulb, 80 °F indoor dry bulb, and 67 °F indoor wet bulb temperatures. The peak design conditions for Denver are not necessarily 95 °F. According to ACCA Standard 5, the equipment should be selected to meet the design sensible load at the actual outdoor and indoor design conditions. ACCA recommends using 75 °F dry bulb and 63 °F wet bulb for indoor air for the Denver and front range areas of Colorado.

During each QI inspection, Cadmus obtained and used the actual indoor conditions (albeit not during peak load days). The actual indoor and outdoor conditions of the region for a system operating on a peak design day should be used to properly assess system size. Figure 22 provides an example of the data typically available to estimate system capacity. Cadmus then adjusted the capacity based on correction factors for the coil and furnace matched to each condenser.

[20] http://www.energyconservatory.com/sites/default/files/documents/trueflow_manual_-_dg700.pdf.

Figure 22. Example of Manufacturer Equipment Performance Sheet

EVAPORATOR AIR		CONDENSER ENTERING AIR TEMPERATURES °F (°C)																	
		75 (23.9)			85 (29.4)			95 (35)			105 (40.6)			115 (46.1)			125 (51.7)		
CFM	EWB °F (°C)	Capacity MBtuh		Total Sys. KW**	Capacity MBtuh		Total Sys. KW**	Capacity MBtuh		Total Sys. KW**	Capacity MBtuh		Total Sys. KW**	Capacity MBtuh		Total Sys. KW**	Capacity MBtuh		Total Sys. KW**
		Total	Sens‡		Total	Sens‡		Total	Sens‡		Total	Sens‡		Total	Sens‡		Total	Sens‡	
24ACS342A30 Outdoor Section With CAR**2414** Indoor Section																			
1225	72 (22.2)	47.31	25.07	2.97	45.67	24.45	3.26	43.98	23.81	3.59	42.20	23.15	3.95	40.35	22.46	4.34	38.40	21.75	4.77
	67 (19.4)	42.97	30.79	2.94	41.46	30.16	3.23	39.89	29.51	3.55	38.27	28.84	3.91	36.57	28.16	4.30	34.79	27.44	4.73
	62 (16.7)	39.35	36.51	2.91	38.02	35.86	3.20	36.64	35.17	3.52	35.23	34.43	3.88	33.73	33.73	4.27	32.42	32.42	4.70
	57 (13.9)	38.54	38.54	2.91	37.44	37.44	3.20	36.29	36.29	3.52	35.07	35.07	3.88	33.78	33.78	4.27	32.42	32.42	4.70
1400	72 (22.2)	48.07	26.24	3.05	46.36	25.60	3.33	44.59	24.95	3.66	42.75	24.28	4.02	40.83	23.58	4.41	38.81	22.86	4.84
	67 (19.4)	43.67	32.66	3.01	42.12	32.03	3.30	40.50	31.38	3.62	38.82	30.71	3.98	37.07	30.01	4.37	35.24	29.27	4.80
	62 (16.7)	40.28	39.02	2.99	38.95	38.30	3.28	37.57	37.57	3.60	36.33	36.33	3.96	34.97	34.97	4.35	33.53	33.53	4.78
	57 (13.9)	40.04	40.04	2.98	38.86	38.86	3.27	37.63	37.63	3.60	36.34	36.34	3.96	34.97	34.97	4.35	33.53	33.53	4.78
1575	72 (22.2)	48.64	27.35	3.12	46.87	26.71	3.41	45.05	26.05	3.73	43.15	25.37	4.09	41.18	24.67	4.48	39.11	23.94	4.91
	67 (19.4)	44.25	34.52	3.08	42.65	33.87	3.37	40.99	33.21	3.69	39.26	32.52	4.05	37.46	31.80	4.44	35.60	31.04	4.87
	62 (16.7)	41.22	41.22	3.06	40.03	40.03	3.35	38.73	38.73	3.67	37.37	37.37	4.03	35.94	35.94	4.43	34.43	34.43	4.86
	57 (13.9)	41.28	41.28	3.06	40.04	40.04	3.35	38.73	38.73	3.67	37.37	37.37	4.03	35.94	35.94	4.43	34.43	34.43	4.86

There are additional adjustments for systems at high altitude. At high altitude, the condenser (outdoor unit) loses cooling capacity. Many outdoor condensing units only operate at one fan speed. As with the indoor fan, the outdoor fan will move the same volume of air, but will not remove the same amount of heat that a system operating at sea level will remove. The correction factor for a condenser at 6,000 feet derates the condenser capacity by approximately 5%.

Estimating HVAC system capacity with the best known method is more thorough, and potentially more tedious, than simply using the AHRI-rated capacity. It is important to assess QI using the most accurate techniques.

Pass/Fail Rate Variation Using Different Techniques

This section compares two methods using Cadmus' data (Table 11), but not using RSR's data. Recalculating their data using the correct method would be very time consuming.

Table 11. Pass/Fail Rate Comparison of Nonparticipants Using Different Savings Methodologies

Methodology	Refrigerant Charge	Airflow	Sizing	Duct Sealing
Nonparticipant Fail Rate (Original Methodology)	50%	22%	78%	50%
Nonparticipant Fail Rate (Most Accurate Known Methodology)	50% (No change, method is the same)	56%	67%	N/A

Table 11 shows that the airflow failure rate increased from 22% to 56% when using the most accurate known methodology. The original savings methodology assumes that all airflow above 340 cfm/ton is acceptable. The most accurate savings methodology uses detailed manufacturer specification and follows Manual S protocol.

The most accurate methodology shows that the sizing fail rate improves slightly. For the original methodology, the capacity was assessed using Manual S, not the AHRI-rated capacity. When Manual S capacity was used, the capacity of all systems was derated (was less than the AHRI-rated capacity because of the high altitude and climate). This meant systems that were deemed as being oversized may actually have been properly sized. It appears that many of the participant sample failed because they were oversized. A re-calculation of the capacity at local conditions might result in a decreased failure rate.

Freeridership Impact

The following chapter, Net-To-Gross Ratio, discusses the overall NTG value, including the QI freeridership, which incorporates the findings of the nonparticipant site visits. Although the nonparticipating contractors and the site visits yielded a savings-weighted QI freeridership value of nearly the same percentage as for the participating contractors and customers, it is important to note the discrepancies between self-reported compliance rates and those found in the field. For example, airflow was under-reported by 46%, but proper duct sealing and sizing were over-stated by 38% and 37%, respectively. Because the QI freeridership is defined as that which is happening outside of the program, the measurement method for nonparticipating QI installs can have a large impact on the final NTG.

Furthermore, as was discussed above, it appears that the M&V methodology may be incorrect for the region. Changing the analysis methodology for QI would have a direct effect on freeridership in the form of a higher failure rate for nonparticipants, thus lowering freeridership for participants.[21]

Recommendations

1. **Consider assessing the savings attributable to each component of QI.** Deemed savings are based on the assumption that poor installation practice is the baseline. We found that some nonparticipant systems were installed to the specifications of a QI. Other nonparticipant systems were installed very poorly, therefore operating inefficiently as assumed. We recommend reassessing the deemed savings attributable to correct QI by using the verified EER (through field measurements) and regional HVAC unit energy consumption. This method does not include savings attributable to proper equipment sizing.
2. **Consider claiming savings from an undersized system.** Although most undersized systems do not provide adequate cooling on the hottest days, this actually saves energy. Therefore, undersized systems should receive a pass rating.
3. **Consider the implications of re-evaluating the target airflow and equipment capacity calculations.** These two important components of QI could be assessed differently. Cadmus assessed some systems that failed according to the current M&V method but should have passed, and vice-versa. Data is available to recalculate the target airflow and equipment capacity at peak conditions specific to the location of system installation.

[21] Changing the analysis methodology for QI would also impact program gross savings and program aspects, such as contractor training. Program gross savings were not a part of this evaluation, therefore the impacts this change would most likely have on gross savings is not quantified.

8. NET-TO-GROSS RATIO

This chapter provides Cadmus' methodology, analysis, and findings for determining freeridership and spillover for the 2011 Xcel Energy HEAC Program in the State of Colorado.

The equation below is the Xcel Energy formula for determining the program's recommended NTG value.

$$NTG\ Recommendation = 1 - Freeridership + Spillover + Program\ Changes + Benchmarking$$

Cadmus calculated freeridership and spillover using multiple sources: participating customer surveys, participating contractor surveys, and nonparticipating contractor surveys. Cadmus also performed field work on nonparticipating CAC installs in Xcel Energy's service territory in order to determine a more accurate measure of QI freeridership (as was discussed above in the Nonparticipating Customer Site Visits chapter).

Freeridership

Cadmus determined freeridership, or the percent of savings that would have occurred in the absence of the program, by calculating freeridership values for each of the three program elements (efficient equipment, QI, and early replacement). The methods and results of each element are presented separately, followed by the savings-weighted average freeridership value. Table 12 shows the components of freeridership and the source of the data.

Table 12. Freeridership Components and Data Sources

Freeridership Component	Data Source
Efficient Equipment	Participating Contractor Surveys
Quality Install	Nonparticipating Customer Site Visits
Early Replacement	Participating Customer and Participating Contractor Surveys

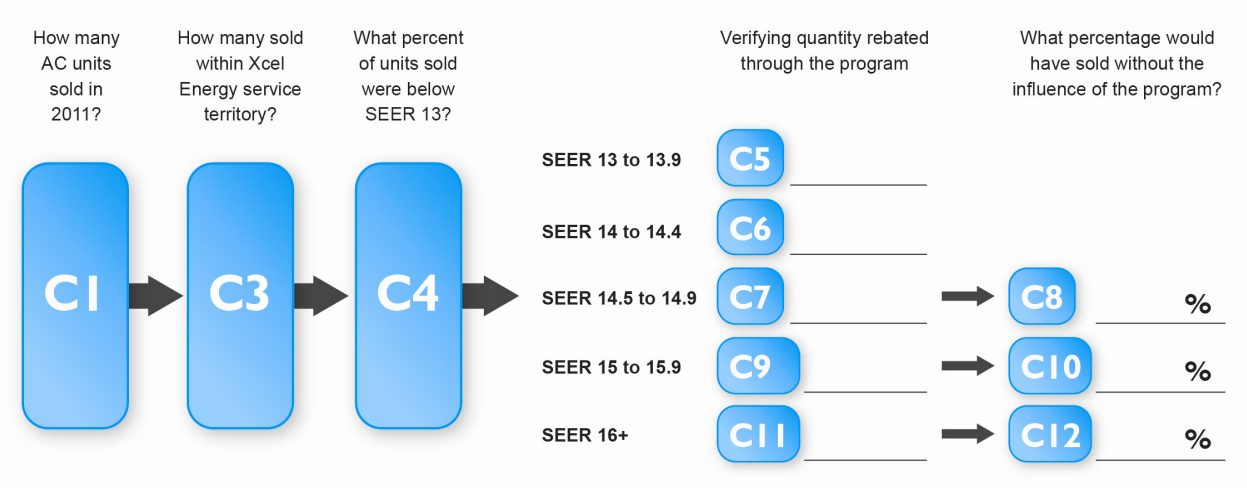
Efficient Equipment Freeridership

Method

Cadmus calculated the efficient equipment freeridership value by conducting and gathering data from telephone surveys with 33 participating contractors. These surveys included several questions to determine the level of influence the Xcel Energy HEAC Program had on contractors' sales of higher-efficiency units, as well as what choices they offered to customers and the impact of the program on the participants' purchasing decisions.

The freeridership questions shown in Figure 23 illustrate our analysis method for verifying quantities and asking hypothetical questions about what sales would have been without the influence of the program rebates.

Figure 23. Efficient Equipment Freeridership Questions Asked of Participating Contractors



Cadmus calculated freeridership for this program QI component using contractor responses instead of customer responses, because Cadmus determined that contractors were in a better position to know what systems were a viable option for each home, and were therefore better able to answer hypothetical questions than the customers themselves. Typical freeridership analyses that use participants' self-reports enable an individualized score that could indicate a full, partial, or non-freerider. Since contractors were answering multiple questions about numerous customers at once, the freeridership calculations are already a weighted average. The designation of full, partial, or non-freerider is therefore not relevant for this methodology.

Cadmus weighted the estimates of freeridership at each SEER level based on each contractors' unit sales, then weighted the total freeridership by the savings for each SEER level so that it most accurately reflects the program activity for all contractors in the program.

Results

The freeridership analysis results, presented in Table 13, yield an overall QI component freeridership rate of 29% for efficient equipment. The freeridership rate for each of the program's three SEER efficiency tiers is also presented in Table 13. The overall freeridership rate of 29% indicates that contractors reported that just under one-third of the program savings would have occurred in absence of the program.

Table 13. Efficient Equipment Freeridership Percentages by SEER Level and Overall

SEER	Savings Weight	Freeridership Score
14.5-14.9	13%	56.7%
15-15.9	23%	28.4%
16+	64%	24.2%
Total	**100%**	**29.3%**

Note: Total columns may not sum due to rounding.

Because of the additional incentive in the form of the ARRA-funded tax credit offered for the installation of a 16 SEER or higher unit during 2010, Cadmus also assessed the possible

influence of the ARRA federal tax credits on the SEER 16+ units sold. We asked contractors to estimate the percent of units they would have sold without the influence of either incentive for each SEER level. The results of this analysis determined that there was no influence from the residual ARRA tax credits on the 2011 program year. The 29% freeridership is comparable to the post-ARRA value calculated for Xcel Energy's 2010 Air Conditioning Quality Install Program in Minnesota of 32%.

Quality Install Freeridership

Method

For the QI component of the HEAC Program, Xcel Energy provides an incentive directly to the contractor to ensure that the various components of a QI take place, and therefore maximizes the energy efficiency of the new unit. Determining the freeridership of QI is best accomplished by examining the practices of contractors who were not influenced by the program. This gives a more reliable measure of what would happen in the absence of the program.

Results

Cadmus used results from our site visits to 18 nonparticipating homes to determine compliance with a QI. The previous chapter, Nonparticipating Customer Site Visits, details the method and results for assessing each of the four QI components. That analysis yielded a failure rate for each component. Homes that satisfied the QI requirements received a passing score, and were the basis for the freeridership value, as this is a direct indicator of what happens outside of the program. Cadmus then used the relative savings attributable to each of the QI components to weight the overall QI freeridership value, as shown in Table 14. The resulting QI freeridership value is 54.2%.

Table 14. Quality Install Freeridership Percentages by Component and Overall

Quality Install Component	Savings Weight	Freeridership Score
Load Calculation	11%	22.2%
Dry/Wet Bulb	26%	77.8%
Refrigerant Charge	49%	50.0%
Duct Sealing	14%	50.0%
Total	**100%**	**54.2%**

Note: Total columns may not sum due to rounding.

Early Replacement Freeridership

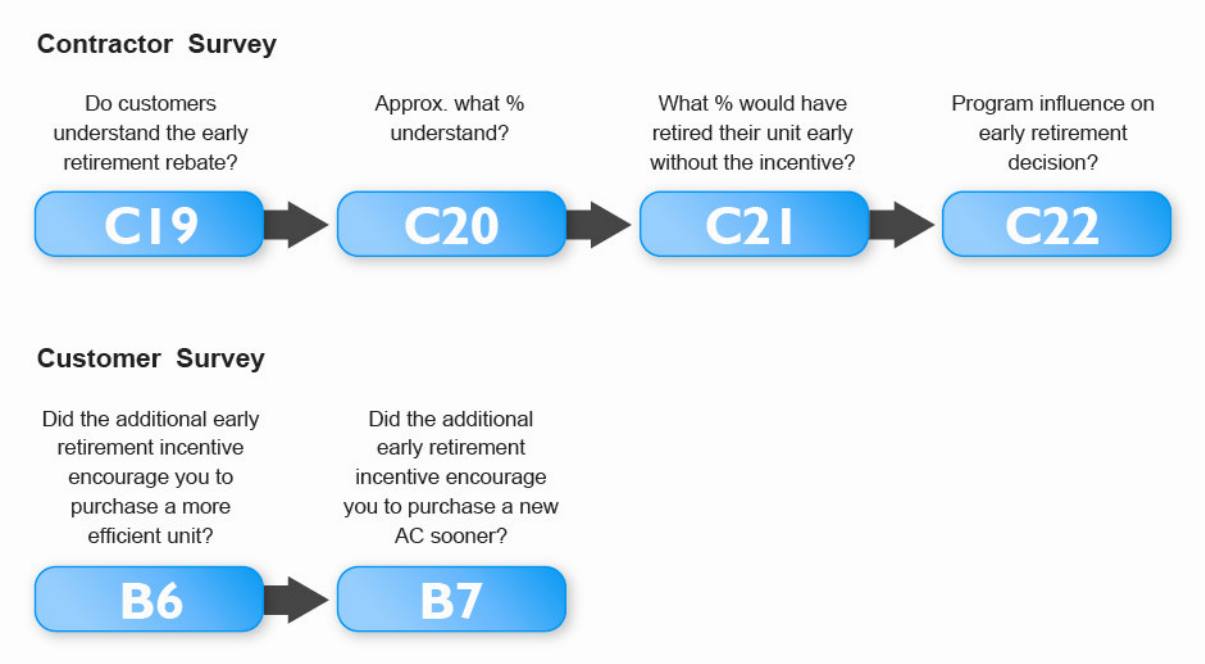
Method

Cadmus determined freeridership for the program early replacement component from the participating contractor surveys and the participating customer surveys. This gave us two perspectives on freeridership for each of two freeridership parameters: efficiency and timing. We asked contractors what proportion of their customers would still have retired equipment early without the program incentive, and whether those customers purchased a more efficient unit because of the early replacement incentive. We then sales-weighted the contractors' responses.

We measured customer self-reported freeridership by asking respondents whether they would have replaced their CAC at the same time and whether they would have chosen an equally efficient unit without the program.

The freeridership questions shown in Figure 24 illustrate our analysis methodology of attaining timing and efficiency from the contractors and customers.

Figure 24. Early Retirement Freeridership Questions Asked of Participating Contractors and Customers



Because of the differing perspectives of contractors and customers on each element of freeridership, we gave inverse weights to their responses. Because most contractors provide customers with a selection of units, we assumed that contractors have a better understanding of the customers' likelihood of purchasing a higher-efficiency unit than the customers themselves, so we assigned a 75% weight to the contractors' responses and a 25% weight to the customers' responses to these questions. Inversely, we assumed that the customers knew more about the factors that affected the timing for their CAC replacement decision than contractors, so we assigned a 75% weight to customers' responses and a 25% weight to the contractors' responses to these questions. Please note that Cadmus asked the customer survey questions in a manner that confirmed *non*-freeridership behavior, and therefore the negative responses indicate freeridership.

Results

The contractor freeridership was 20.5% and the customer self-reported freeridership was 58.3% for the early replacement program component. Cadmus combined both response types to yield a final early replacement freeridership value of 39.4%, as shown in Table 15.

Table 15. Early Replacement Freeridership Percentages by Respondent and Overall

Early Replacement Component	Contractor Freeridership Responses	Customer Freeridership Responses
Sooner Retirement	52.6% (25% weight)	62.0% (75% weight)
Higher Efficiency	9.8% (75% weight)	47.0% (25% weight)
Respondent Freeridership	**20.5%**	**58.3%**
Combined Total Freeridership	**39.4%**	

Note: Total columns may not sum due to rounding.
Note: The early replacement freeridership analysis assumes only first-year savings. Any application of these numbers to the unit lifetime or lifecycle may be inappropriate.

Total Program Freeridership

The three freeridership components represent different aspects of the program, and thus their freeridership values must be combined to form a final program-level freeridership value. Cadmus combined the values described above using deemed program savings to derive the final, savings-weighted freeridership value of 42.8%, shown in Table 16.

Table 16. Total HEAC Program Freeridership Percentages by Element and Overall

Freeridership Element	Savings Weight	Freeridership %
Efficient Equipment	26%	29.3%
Quality Install	41%	54.2%
Early Replacement	34%	39.4%
Combined Total Freeridership	**100%**	**42.8%**

Note: Total columns may not sum due to rounding.

Spillover

Cadmus estimated spillover, defined as the additional savings generated by the program but not otherwise captured by program records, through surveys with participating customers and participating and nonparticipating contractors. Table 17 shows the components of spillover and the type of spillover data we analyzed, which are outlined in the following sections.

Table 17. Spillover Components and Types

Spillover Component	Spillover Type
Customer Spillover	Additional equipment installed in the home due to participation in the program
Participating Contractor Spillover	QIs for nonparticipating customers by participating contractors
Nonparticipating Contractor Spillover	Actions by nonparticipating contractors attributable to the existence of the program

Customer Spillover

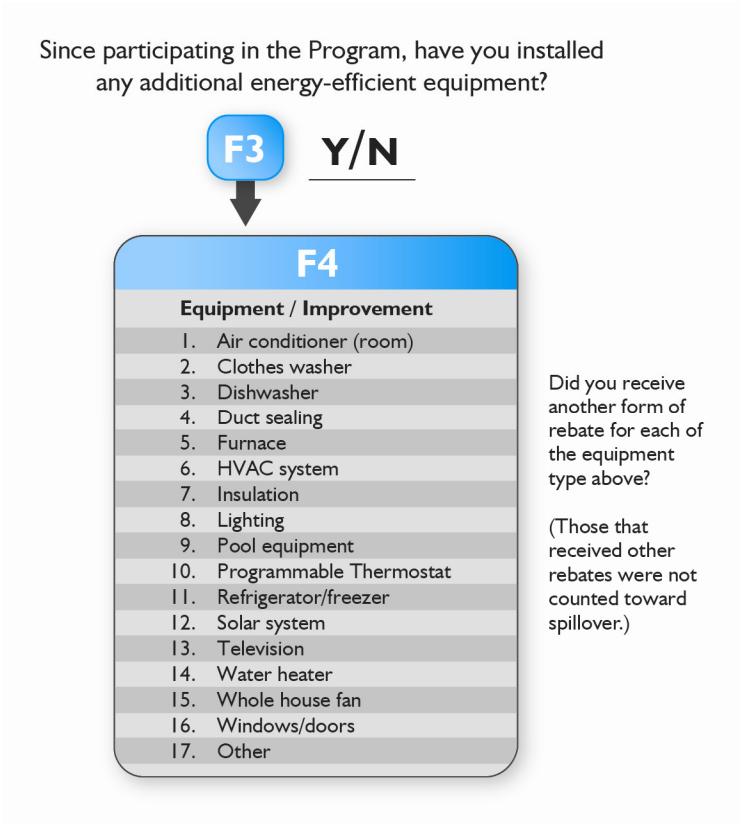
Method

During the participating customer surveys, Cadmus asked customers if they performed any additional work related to their CAC installation or if they installed any additional energy-

efficient equipment after participating in the Xcel Energy program. A single participant may have installed one or many additional measures, all of which we took into consideration when calculating spillover.

We asked respondents who answered affirmatively if they had received any funding for the measure from another source, and then we asked them if participating in the program influenced them to make the additional energy-efficiency improvements. We removed measures that had been rebated by another source from the spillover attribution. We then assigned full savings to those measures stated to have been very influenced by the program, gave 50% savings credit to those that were somewhat influenced by the program, and did not count any savings for measures with a lower influence. Figure 25 shows the spillover questions in the survey.

Figure 25. Customer Spillover Survey Questions



Results

Of the 300 participants surveyed, 131 said they had additional work done related to the CAC installation, and 89 said they had installed additional energy-efficient measures since participating in the program. Of the 272 total measures or improvements respondents mentioned having installed or performed, 200 had received a rebate or were said not to have been influenced by participating in the program. After this screening, 72 energy-efficient measures remained for the spillover savings analysis. Table 18 provides details on the qualifying spillover measure counts and savings per unit.

Table 18. Customer Spillover Counts and Savings per Unit

Equipment Type	Somewhat Influenced by Program	Very Influenced by Program	Unit Savings (kWh)
Clothes Washer	1	8	182.5
Dishwasher	3	6	53.3
Dryer	1	2	83
Furnace	10	9	0
Heat Pump	0	1	336.5
Insulation	1	0	39
Lighting	1	2	41
Microwave	1	1	10
Oven	1	0	0
Refrigerator/Freezer	2	7	114
Stove	0	2	3
Tankless Water Heater	1	0	0
Thermostat	0	1	18
TV	0	1	119
Water Heater	1	5	179
Window/Door	0	4	80

Although furnaces were the most frequent additional measure participants installed, no additional savings were attributed to this measure. Gas furnaces do not impact measureable electric savings, and there is little incremental difference between efficiency levels for electric furnaces; therefore neither type of furnace contribute electric savings to spillover.

Participant Spillover Quantification

Calculating participant spillover from survey responses is limited by the inability to document the energy use or efficiency level of the replaced equipment or the specific efficiency ratings of the new equipment. For this reason, it is necessary to use information from secondary sources as a proxy for average savings values by technology. The sources we used for this included the ENERGY STAR Website appliance calculators, the Northwest 6th Power Plan, various technical reference manuals, and the Database for Energy Efficient Resources.

Table 19 shows the steps for quantifying spillover. We calculated the total savings for the survey population and then extrapolated the results to the program population. The total savings projected for the program participants is 26,588 kWh, which is 1.5% of the total reported gross savings for the program.

Table 19. Customer Spillover Quantification

	Step	Value
Survey Population (n=300)	Electric Spillover Savings from Sample	4,991.5 kWh
Total Program Population (n=1,598)	Extrapolation Multiplier (total population / survey population)	5.33
	Spillover Population Savings (sample savings * multiplier)	26,588 kWh
	Total Program Reported Gross Savings	1,756,828 kWh
	Spillover Percentage	**1.5%**

Participating Contractor Spillover

Method

Participating contractor spillover is defined as installations performed by participating contractors that received a QI and could have participated in the program, but did not. We asked both the participating and nonparticipating contractors about four components of a QI, and how often they perform them. We sales-weighted the answers from each contractor population. We then savings-weighted the compliance rate for each of the QI components to determine an overall value. Table 20 shows the responses from surveyed contractors and the resulting QI compliance rates. Overall, participating contractors satisfy QI on 84% of their installations, while nonparticipating contractors only comply 55% of the time. This finding coincides with focus group findings where the majority of participating contractors reported that most of their jobs already include most, if not all, of the QI components.

Table 20. Contractor Self-Reported Compliance Rates for Quality Installations

Quality Install Component	Savings Weight	Nonparticipating Contractors	Participating Contractors
Load Calculation	11%	59%	80%
Wet/Dry Bulb	26%	32%	86%
Refrigerant Charge	49%	58%	84%
Duct Sealing	14%	88%	83%
Total	**100%**	**55%**	**84%**

Note: Total columns may not sum due to rounding.

Finally, we asked the participating contractors how many of their CAC sales that could have qualified under Xcel Energy's program did not apply for a rebate.

Results

The 29% difference in QI compliance between participating and nonparticipating contractors represents the spillover attributable to the program from participation. Table 21 shows the analysis steps Cadmus followed to derive the contractor spillover of 8.9%.

Table 21. Participating Contractor Spillover Quantification

Step	Value
Average Program Quality Install Savings per Unit	462 kWh
Participating Contractor Rebates of Total Rebates	42%
Surveyed Participating Contractor Nonparticipating Sales (number of units)	499
Population of Nonparticipating Units	1,177
Quality Install Spillover Percentage	29%
Spillover Population Savings	157,129 kWh
Total Program Reported Gross Savings	1,756,828 kWh
Spillover Percentage	**8.9%**

Nonparticipating Contractor Spillover

Method

Cadmus asked nonparticipating contractors about their QI practices for the four different components. We asked how often they perform the QI activities, and whether they have always conducted their installations that way or if they had changed their behavior recently, and why. We then counted any responses giving credit to Xcel Energy's program as spillover.

Results

Although nonparticipating contractors perform QI activities over half the time, they gave no influence to the existence of Xcel Energy's program. Therefore, the nonparticipating contractor spillover is 0%.

Total Program Spillover

The three spillover components represent different aspects of spillover and can be added together to form a final program-level spillover value. The total program spillover is 10.5% (Table 22).

Table 22. Total Program Spillover Percentages by Component and Overall

Spillover Component	Spillover %
Customer Spillover	1.5%
Participating Contractor Spillover	8.9%
Nonparticipating Contractor Spillover	0%
Combined Total Spillover	**10.5%**

Note: Total may not sum due to rounding.

Calculated Net-To-Gross

Table 23 shows the freeridership and spillover percentages, and the resulting NTG percentage for the HEAC Program. We calculated the NTG percentage by subtracting freeridership from 100% and adding spillover.

As outlined above, the savings-weighted freeridership is 42.8%. Also outlined above, we determined that the program can attribute approximately 1.5% of gross program savings to participant spillover measures, and 8.9% to participating contractor spillover (totaling 10.5%). The HEAC Program had an overall NTG ratio of 67.6% for 2011.

Table 23. Calculated NTG for 2011 HEAC Program

NTG Component	Value
Freeridership	42.8%
Spillover	10.5%
Total	**67.6%**

Note: Total may not sum due to rounding.

Possible Program Changes

At the present time, Xcel Energy is not considering any program design changes that would substantially affect the program delivery. However, Cadmus ran analyses based on two possible program design changes that aim at removing or reducing components with the highest freeridership. These changes are:

1. **Consider eliminating the efficient equipment incentive for 14.5-14.9 SEER units.** The 14.5-14.9 SEER units accounted for a small proportion of the efficient equipment overall savings, and have the highest level of freeridership, at 56.7%. The program NTG may be positively impacted by eliminating this incentive and redirecting those dollars toward units with a higher SEER level and lower freeridership. Applying this change to the existing program information results in a decrease in efficient equipment freeridership from 29.3% to 26.3%.
2. **Consider changing the M&V method for sizing and airflow components.** As described in detail in the Nonparticipating Customer Site Visits chapter, when Cadmus completed the nonparticipating home site visits we uncovered flaws in the method, which did not account for the altitude in Colorado. We recommended an alternative method that does account for altitude. This new method increases the sizing freeridership slightly (11%), but decreases the airflow freeridership significantly (34%).

The following scenarios outline the calculated change in overall NTG if either or both of the above program changes were made.

Removing 14.5-14.9 SEER Efficient Equipment Incentive

As indicated above, removing the 14.5-14.9 SEER category of efficient equipment decreases the freeridership from 29.3% to 26.3% for the remaining two categories of this component. If the equipment rebate for 14.5-14.9 SEER units were not offered, it is reasonable to assume that these customers would still participate in the program on some level because there would still be two other forms of incentive (QI and early replacement). The most conservative option is that those who purchased a 14.5-14.9 SEER unit would either purchase the same 14 SEER unit, or would instead purchase a SEER 13 unit. The more optimistic scenario is that the 14.5-14.9 SEER purchasers would instead purchase a 15 SEER unit. The assumption of a different SEER level therefore changes the weighting for other freeridership components. Table 24 shows how both of these scenarios would affect the overall NTG value.

Table 24. Resulting NTG from Removal of SEER 14.5-14.9 Units Only

Hypothetical Change	NTG Value
All remain below SEER 15	68.0%
All move to SEER 15	68.5%

Changing QI M&V Analysis Methodology

The Nonparticipating Customer Site Visits chapter suggested that Xcel Energy change the method for M&V assessment of unit sizing and airflow. This change would cause the sizing freeridership score to change from 22% to 33%, and the airflow freeridership score to decrease from 78% to 44%. System sizing only accounts for 11% of the overall QI savings, whereas

airflow accounts for 26%, so these changes together would reduce the overall QI freeridership percentage from 54.2% to 46.5%. Making only this change would result in a new NTG of 70.7% (as shown in Table 25).

Table 25. Resulting NTG From Changing QI M&V Analysis Methodology

Component	Previous Value	New Value
QI Freeridership	54.2%	46.5%
Resulting NTG	67.6%	70.7%

Removing 14.5-14.9 SEER and Changing the QI Analysis Methodology

Changing both elements at once also results in a spread of NTG values based on whether assuming the more conservative or more optimistic hypothetical movement of the 14.5-14.9 SEER customers to either remain below 15 SEER or not. Table 26 shows the resulting NTG values for these two possibilities combined.

Table 26. Resulting NTG From Removal of SEER 14.5-14.9 and Changing the QI Analysis Methodology

Hypothetical Change	NTG Value
All remain below SEER 15	71.1%
All move to SEER 15	71.6%

Benchmarking

As part of the benchmarking research Cadmus conducted (detailed in the Peer Utility Benchmarking chapter), we compiled and compared NTG values for similar programs. NTG analyses were available for 11 of the 13 programs we compared, and all 13 evaluation reports we reviewed presented participation numbers for evaluated program years. New Jersey's CoolAdvantage Program had the highest participation, which may be a function of a densely populated region and several utilities sponsoring the program.

The evaluated NTG ratio reported by the 11 programs ranged from 44% to 74%. Five of the benchmarked programs use an assumed 80% NTG value; however, this value has not been verified through evaluation. The calculated NTG for the Xcel Energy HEAC Program of 67.6% falls within the high end of the range for programs we benchmarked, and is the second highest evaluated NTG reported. Table 27 illustrates our full analysis of participation and NTG for each benchmarked program.

Table 27. Benchmarking of Participation and NTG

Program	Evaluated Year	Participation[a]	NTG[b]
Xcel Energy, Colorado	2011	1,785	68%
Ameren Illinois; Illinois	2009-2010	8,242	63%
Arizona Public Service; Arizona	2011	12,000[c]	N/A
Atlantic City Electric, Jersey Central Power & Light, Public Service Enterprise Group, and Rockland Electric Company; New Jersey	2005	17,710	52%
	2006	13,241	
Baltimore Gas & Electric; Maryland	2009-2010	19,185[d]	80%[e]
Connecticut Light & Power (CL&P) and The United Illuminating Company (UI); Connecticut	2008	3,269	CL&P = 58% UI = 74%
DPL; Maryland	2010	35[d]	80%[e]
Potomac Edison; Maryland	2010	893[d]	80%[e]
PEPCO; Maryland	2010	265[d]	80%[e]
Rocky Mountain Power, Utah	2007	4,295	49%
	2008	2,385	44%
SDG&E; California	2006-2008	3,237	54%
SCE; California	2006-2008	3,437	56%
Southern Maryland Electric Cooperative; Maryland	2011	843[d]	80%[e]

a. Participation is reported at the program level and may include installations of other measures in excess of CAC.

b. NTG is reported at the measure level (specific to CAC) in all cases except for the California and Maryland programs. These NTG ratios are reported at the program level.

c. Approximate participation.

d. Reflects program activity through September 30, 2010.

e. This is an assumed, not evaluated, NTG.

Market Transformation

Program outreach, training, and support can influence market transformation in several ways. In the focus groups, for example, the majority of participating contractors reported that the program made them better contractors. Several contractors also expressed appreciation for the communication provided by the residential channel manager. A more in-depth discussion on market transformation and program indicators can be found in Appendix F.

Recommendations

Cadmus has the following recommendations for the HEAC Program:

1. **Consider reducing the amount of savings allocated to QI components.** The freeridership attributable to the QI element of the program is the highest at 54.2% (whereas efficient equipment is 29.3% and for early replacement is 39.4%). Another method of reducing freeridership could be to incentivize only the portions of a QI that are least frequently met (such as sizing).
2. **Consider the program changes of removing SEER 14.5-14.9 equipment incentives and changing the methodology of analyzing QI savings.** As shown in the Possible Program Changes section, the most beneficial and realistic program changes would be to make both program changes, as they have the highest impact on freeridership. The most likely result of removing the 14.5-14.9 SEER portion of the equipment would be for customers to remain with units below 15 SEER. Therefore, the NTG value would increase from the observed 67.6% to 71.1%.
3. **Perform addition nonparticipant site visits in a future study to more accurately determine QI freeridership and market conditions.** The study Cadmus performed showed great variability in QI component failure in nonparticipating program homes versus self-reported conditions, but sample limitations made it difficult to generalize to the population with confidence. Because QI is a significant portion of the program and has a large impact on NTG, we recommend that Xcel Energy consider expanding on this research and determining the actual market conditions with a larger sample.

9. PEER UTILITY BENCHMARKING

Cadmus conducted a benchmark study to compare design elements of the Xcel Energy HEAC Program with other CAC rebate programs across the country. Cadmus selected 13 programs that offered rebates for CACs between 2005 and 2011 (Table 28). These programs are administered in Arizona, California, Connecticut, Illinois, Maryland, New Jersey, New Mexico, and Utah. The Arizona, California, New Mexico, and Utah programs represent CAC rebate programs in states with similar climate characteristics as Xcel Energy's Colorado service territory; the other programs show how similar programs operate across the country.

Table 28. Comparison of Central Air Conditioning Rebate Programs

Program State	Program Name	Utility
Arizona	Residential CAC Rebate Program	Arizona Public Service
California	Quality Installation Program	Southern California Edison
	The Premium Efficiency Cooling and Motors Program*	San Diego Gas & Electric
Connecticut	Home Energy Solutions Program	Connecticut Light & Power The United Illuminating Company
Illinois	Heating and Cooling Equipment Program	Ameren Illinois
Maryland	Residential Gas and HVAC Efficiency Program	Baltimore Gas & Electric
	Residential HVAC Efficiency Program	Potomac Electric Power Company
	Residential HVAC Efficiency Program	Delmarva Power and Light
	High Efficiency HVAC and Water Heater Equipment Program	Southern Maryland Electric Cooperative
	Watt Watchers Residential Air Conditioner and Heat Pump Efficiency Program	Potomac Edison (formerly Allegheny Power)
New Jersey	CoolAdvantage	Atlantic City Electric Jersey Central Power & Light Public Service Electric and Gas Company Rockland Electric Company
New Mexico	The EPESaver Residential Cooling Rebate Program	El Paso Electric Company
Utah	Cool Cash Incentive Program	Rocky Mountain Power

*This program is no longer offered.

We compared the following key program design elements:

- Incentive Types and Levels
- Efficiency Requirements
- QI Requirements
- Contractor Training Opportunities
- Early Retirement Requirements
- Marketing and Outreach Activities
- M&V
- Participation and NTG

- Cost-Effectiveness
- Evaporative Cooling Options

Findings

The Xcel Energy HEAC Program is comparable to the 13 programs we researched for this benchmarking study. All of the programs offer prescriptive rebates for the installation of a qualified CAC, ASHP, and/or ground-source heat pump.[22] In all programs, the rebate eligibility requirements are within the same range. Like Xcel Energy, all utilities in this benchmarking study have a QI component to their program, although some utilities offer additional incentives for following proper sizing, refrigerant charge, and load calculation criteria. These findings are discussed in more detail below.

Incentive Types and Levels

For all programs, the rebated equipment must have been installed at the home of a rate-paying customer of the utility offering the rebate. As shown in Table 29, all 13 programs offer a cash rebate for the purchase and installation of a qualified CAC. Similar to Xcel Energy's program, most of the comparable programs offer different incentive tiers for various efficiency levels. Incentive amounts range from $110 for any efficient unit in Ameren Illinois' Heating and Cooling Equipment Program to $2,500 offered by Southern California Edison (SCE) for a packaged CAC system with 16 SEER and 12 EER or for a split CAC with 18 SEER and 13 EER.

All but one program assign the customer as the eligible party for the programs' efficiency-based incentives. Instead of offering a customer rebate, San Diego Gas and Electric's (SDG&E's) program offered the financial incentive to participating HVAC contractors for each qualifying system they properly installed, as a way to stimulate sales of higher-efficiency CAC units. Contractors could choose to use the incentive to pass on savings to their customers or to increase their own profit when installing energy-efficient equipment.

Efficiency Requirements

Xcel Energy's SEER and EER requirements fit into the range of the comparable programs. The federal minimum standard for HVAC efficiency is currently set at 13 SEER. All of the programs, including Xcel Energy's, offer rebates for equipment above the federal minimum standard. The current ENERGY STAR minimum is 14.5 SEER for split systems and 14 SEER for single-package equipment. Most of the programs we compared offer rebates for units at the ENERGY STAR minimum and also offer rebates for equipment that achieves higher SEER levels.

[22] While Xcel Energy's program includes rebates for qualifying ASHPs and ground-source heat pumps, these measures were not included in the 2011 program evaluation. No comparisons of these two measures are included in this benchmark study.

Table 29. Rebate Amounts and Requirements of Benchmarked Programs

Program	Incentive	Requirements		
		SEER	EER	Other
Xcel Energy; Colorado	$250	14.5	12	
	$350	15	12.5	
	$500	16	13	
Ameren Illinois; Illinois	$110	Replaced a working CAC with SEER > 10 (or replace any non-working CAC)		Installed a new efficient CAC
Arizona Public Service; Arizona	$270	≥ 13	10.8	
Atlantic City Electric, Jersey Central Power & Light, Public Service Enterprise Group, and Rockland Electric Company; New Jersey	$500	16	13	
Baltimore Gas & Electric; Maryland	$200	14.5	12	
	$400	15	12.5	
Connecticut Light & Power and The United Illuminating Company; Connecticut	$300- $500	> 11	> 14	
Delmarva Power and Light; Maryland	$150	14	11.5	
	$300	15	12.5	
El Paso Electric Company; New Mexico	$200	14.0-15.9	≥ 12	Split CAC
	$400	≥ 16	≥ 12.5	Split CAC
	$200	14.0-15.9	≥ 11	Packaged CAC
	$400	≥ 16	≥ 11.5	Packaged CAC
Potomac Edison; Maryland	$100	14.5		
	$150	15		
	$200	≥ 16		
Potomac Electric Power Company; Maryland	$150	14	11.5	
	$300	15	12.5	
Rocky Mountain Power; Utah	$150	≥ 15	12.5	
San Diego Gas & Electric; California	Up to $650 (installer)	≥ 13		Residential system ≤ 5 tons
Southern California Edison; California	$1,500	14.5	12	Split CAC
	$1,750	16	13	Split CAC
	$2,500	18	13	Split CAC
	$1,500	14	11	Packaged CAC
	$1,750	14	12	Packaged CAC
	$2,500	16	12	Packaged CAC
Southern Maryland Electric Cooperative; Maryland	$175	14.5	12	
	$350	15	12.5	

Quality Install Requirements

All of the comparable programs include a QI component. The Xcel Energy HEAC Program focuses on four QI elements:

1. Load calculation and equipment sizing
2. Refrigeration charging, testing, and performance
3. Airflow testing, adjustment, and performance
4. Duct sealing and repairs where feasible

Like Xcel Energy's program, 11 of the 13 programs require a QI for equipment to be eligible for a rebate. Also like Xcel Energy, four of these QI-required programs offer additional incentives to either the contractor or the customer to compensate for completing the proper installation. The Xcel Energy, Delmarva Power and Light (DPL), and Potomac Electric Power Company (PEPCO) programs each offer an incentive to the installation contractor for performing a QI on a customer's rebated equipment. DPL and PEPCO's programs, however, encourage contractors to transform their business practices by using a tiered incentive approach, where contractors receive higher incentives as they complete more QIs.

Only two utilities, Ameren Illinois and Rocky Mountain Power, offer an optional QI component to their program. Ameren Illinois offers an additional $120 to any customer who elects to have the CAC unit properly installed, while Rocky Mountain Power offers incentives to both the installation contractor and the customer for proper sizing and installation. Although many factors contribute to a program's reported participation rate, including climate, territory size, and population size and density, the lack of QI as a program requirement could also contribute to the high participation rates in both these programs.

Manual J sizing, AHRI criteria, NATE certification, and ACCA specifications are all methods the programs use to ensure QI processes. Table 30 illustrates the full requirements of each programs' QI component.

Table 30. QI Component Rebate and Requirements

Program	QI Incentive	QI Component
Xcel Energy; Colorado	$100 (installers)	All new equipment rebates must also include a QI. The QI process is based on ACCA standards. This QI measure, which starts with a load calculation to determine the proper size of the equipment to be installed, helps ensure that the total energy-savings potential of newly installed CAC equipment is realized. At least one technician at the installation company must be NATE certified.
Ameren Illinois; Illinois	$120	Correctly sized new CAC units based on Manual J specifications.
Arizona Public Service; Arizona	No additional incentive	QI is required for customer to receive equipment rebate. The QI standards require that the airflow and refrigerant charge are correct and that a Manual J sizing calculation is completed.
Atlantic City Electric, Jersey Central Power & Light, Public Service Enterprise Group, and Rockland Electric Company; New Jersey	No additional incentive	CAC rebate amounts were based on the unit's SEER and EER, as well as documentation that the proper installation requirements were met. Both the condenser and coil must have been replaced or installed as a matched set, as rated in the AHRI certified performance criteria. The customer must have selected a properly trained contractor certified by NATE.

Program	QI Incentive	QI Component
Baltimore Gas & Electric; Maryland	$200	Installed equipment must meet ACCA Manual J (or similar) sizing standards.
Connecticut Light & Power and The United Illuminating Company; Connecticut	No additional incentive	Customer must have used an authorized contractor to install equipment.
DPL; Maryland	$100 for first 10 jobs; $300 for next 40 jobs; $600 for next 100 jobs (installers)	QI is required for customers to receive equipment rebate. Installed equipment must meet ACCA Manual J (or similar) sizing standards. Participating contractors must purchase and use *Service Assistant*, a diagnostic tool that analyzes system operating efficiency.
El Paso Electric Company; New Mexico	No additional incentive	Customer must have used an authorized contractor to install equipment.
Potomac Edison; Maryland	No additional incentive	Customer must have used an authorized contractor to install equipment.
PEPCO; Maryland	$100 for first 10 jobs; $300 for next 40 jobs; $600 for next 100 jobs (installers)	QI is required for customers to receive equipment rebate. Installed equipment must meet ACCA Manual J (or similar) sizing standards. Participating contractors must purchase and use *Service Assistant*, a diagnostic tool that analyzes system operating efficiency.
Rocky Mountain Power; Utah	$50	Must use properly sized CAC equipment. System capacity must be within 6,000 Btus/hour of the load calculation cooling load results. Load calculation must follow Manual J methodology.
	$25 (installers)	
	$50	Must have proper CAC equipment installation. Technicians must be NATE certified to receive the charge and airflow incentive.
	$75 (installers)	
SDG&E; California	No additional incentive	Universal QI required for SEER 13+ units. QI includes: refrigerant charge and airflow, duct testing and sealing, economizer optimization, and condenser coil cleaning.
SCE; California	No additional incentive	ACCA QI specification: must have had unit installed by participating contractor to be eligible for equipment rebate.
Southern Maryland Electric Cooperative; Maryland	$200	Installed equipment must meet ACCA Manual J (or similar) sizing standards.

Contractor Training Opportunities

The continued success of Xcel Energy's HEAC Program depends on having participating contractors who understand the QI process. To ensure this, Xcel Energy appointed an internal residential channel manager who is responsible for communicating with the contractor community. The residential channel manager also helps coordinate training that keeps trade allies informed and engaged in the program, which covers QI requirements, best practices, and load calculation requirements.

Several of the compared programs also include strong training components. In these programs, training is provided to contractors but is not always required for participation. Arizona Public Service (APS) focuses its QI training approach on Manual J load calculations to correctly set the refrigerant charge and airflow. SDG&E provides extensive training in the use of QI services through the third-party CAC TIMe Program, which conducted both sales and technical training. All five Maryland program sponsors offer training opportunities to HVAC contractors to help ensure high-QI practices. For their CoolAdvantage Program, the New Jersey utilities provide

training through the Eastern Heating and Cooling Council, which offers a portfolio that includes NATE training and certification, Manual J, Airflow and Charging, and other related courses.

Like Xcel Energy's HEAC Program, Rocky Mountain Power's Cool Cash Incentive Program requires any HVAC contractor performing a QI to be NATE certified.[23] However, a market barrier to meeting the installation requirements is that many contractors in Rocky Mountain Power's territory are not NATE-certified technicians. To remedy this issue, the program's third-party implementation staff collaborated with NATE to refine the Cool Cash training language to be consistent with NATE training language, enabling contractors to become more familiar with the concepts, more easily participate in the program, and become NATE certified.

Early Retirement Requirements

In June 2010, Xcel Energy added the Plan B Early Retirement Equipment Rebate component to the HEAC Program. The early retirement rebates are intended to motivate homeowners to replace older, lower-efficiency but still operable, residential CACs with more efficient models. Three of the comparable programs have a similar program component. Ameren Illinois' offers different incentive tiers based on the working condition and efficiency of the unit being replaced, rather than based on the efficiency level of the new unit. Ameren Illinois offers $110 to customers who replace a working CAC greater than 10 SEER or any nonworking CAC with any new, efficient unit; and offers a much higher incentive ($600) for a new efficient unit that replaces a working CAC with less than 10 SEER. SDG&E offered increased incentives to contractors who got customers to retire older inefficient equipment.

For the Home Energy Solutions Program, Connecticut Light & Power and The United Illuminating Company do not offer additional incentives to customers or contractors for trading in an old CAC unit; however, the program includes training for contractors to target early retirement opportunities in an effort to remove inefficient CAC systems from the grid.

Marketing and Outreach Activities

Similar to Xcel Energy, most of the comparable programs use the HVAC contractor community as the primary marketing channel. Because contractors have more direct contact with end-use customers, they can influence customers' purchasing decisions and stimulate demand for efficient CACs. For this reason, Ameren Illinois chose to limit its direct marketing activities for the Heating and Cooling Equipment Program, relying instead on the established marketing networks of its program allies.

To assist contractors in selling high-efficiency equipment, SDG&E's third-party CAC TIMe Program provided contractors with computer software sales tools, marketing support, and customized marketing materials. APS provides training opportunities for the entire contractor team—owners, office staff, managers, sales, and technicians—in technical details, sales, and marketing techniques.

[23] Under the parameters of Xcel Energy's HEAC Program, any individual technician who has passed the QI exam, holds the NATE certification, or who works under the supervision of someone within the same company who has met these criteria is allowed to perform QI and testing.

Many of the comparable programs use supplemental marketing channels to increase customer awareness. Direct marketing tactics include print advertising, bill inserts, newsletters, and interactive online strategies (including Websites, Facebook, and Twitter). In addition to publishing program information on their utility Website, PEPCO and DPL also implemented an online HVAC contractor scorecard that tracks contractors' tune-up and installation completions. The utilities provide a free lunch to the contractor completing the most installations. Program management indicated that the online scorecard is successful and has increased contractor participation.

Measurement and Verification

The M&V process for the Xcel Energy HEAC Program consists of two components: application review and on-site verification. Similar to Xcel Energy, most of the comparable programs include a desk review of program application data to verify customer information, equipment eligibility, and rebate amounts.

Three of the comparable programs also conduct on-site quality control inspections. The New Jersey utilities and Ameren Illinois' programs include on-site audits to verify that work was completed as described in the submitted application. SDG&E's program required verification through on-site testing at *every* installation to ensure proper refrigerant charge.

Rocky Mountain Power uses an alternative method for Cool Cash Incentive Program on-site inspections. The program's third-party implementer conducts telephone interviews with customers that have atypical applications, as well as with a random sample (3% to 5%) of the applications received. During this telephone interview, staff members confirm installation, gather information about pending documentation, confirm the manufacturer of the installed unit, and obtain the name of the installing contractor.

Participation and Net-to-Gross

NTG analyses were available for 11 of the 13 programs we compared, and participation data was available for 12 of the programs. As presented in Table 31, New Jersey's CoolAdvantage Program has the highest participation, which may be a function of a densely populated region and several utilities sponsoring the program. The average NTG ratio is 0.55.

The evaluated NTG ratio reported by the 11 programs ranged from 44% to 74%. Five of the benchmarked programs use an assumed 80% NTG value; however, this value has not been verified through evaluation. The calculated NTG for the Xcel Energy HEAC Program of 67.6% falls within the high end of the range for programs we benchmarked, and is the second highest evaluated NTG reported. Table 31 illustrates our full analysis of participation and NTG for each benchmarked program.

Table 31. Benchmarking of Participation and NTG

Program	Evaluated Year	Participation[a]	NTG[b]
Xcel Energy, Colorado	2011	1,785	68%
Ameren Illinois; Illinois	2009-2010	8,242	63%
Arizona Public Service; Arizona	2011	12,000[c]	N/A
Atlantic City Electric, Jersey Central Power & Light, Public Service Enterprise Group, and Rockland Electric Company; New Jersey	2005	17,710	52%
	2006	13,241	
Baltimore Gas & Electric; Maryland	2009-2010	19,185[d]	80%[e]
Connecticut Light & Power (CL&P) and The United Illuminating Company (UI); Connecticut	2008	3,269	CL&P = 58% UI = 74%
DPL; Maryland	2010	35[d]	80%[e]
Potomac Edison; Maryland	2010	893[d]	80%[e]
PEPCO; Maryland	2010	265[d]	80%[e]
Rocky Mountain Power, Utah	2007	4,295	49%
	2008	2,385	44%
SDG&E; California	2006-2008	3,237	54%
SCE; California	2006-2008	3,437	56%
Southern Maryland Electric Cooperative; Maryland	2011	843[d]	80%[e]

a. Participation is reported at the program level and may include installations of other measures in excess of CACs.

b. NTG is reported at the measure level (specific to CACs) in all cases except for the California and Maryland programs. These NTG ratios are reported at the program level.

c. Numbers reflect approximate participation.

d. Reflects program activity through September 30, 2010.

e. This is an assumed, not evaluated, NTG.

Cost-Effectiveness

Cadmus reviewed cost-effectiveness results for the Rocky Mountain Power Cool Cash Incentive Program. Similar to Xcel Energy, Rocky Mountain Power uses the Total Resource Cost (TRC) test to assess cost-effectiveness. The TRC test examines program benefits and costs from the utility and customer perspectives, combined. On the benefit side, it includes avoided energy costs, capacity costs, and line losses. On the cost side, it includes costs incurred by both the utility and participants. Table 32 details the results of the 2007-2008 Cool Cash Incentive Program's TRC test.

Table 32. Rocky Mountain Power Cost-Effectiveness Summary

Program	Evaluated Year	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/ Cost Ratio
Rocky Mountain Power; Utah	2007	$0.075	$509,174	$978,425	$469,251	1.92
	2008	$0.093	$343,229	$544,400	$201,170	1.59

Note: Total may not sum due to rounding.

Evaporative Cooling Options

The climate in the Western United States is ideally suited for evaporative cooling. Cadmus researched the benchmarked programs' evaporative cooling rebates and information that is offered to customers. Rocky Mountain Power, El Paso Electric Company (EPE), APS, SCE, and SDG&E each provide information on their Websites about evaporative cooling.

SDG&E's Website includes a *Facts About Home Cooling* brochure with information about five different cooling options available in California. The brochure does not use language that would persuade a customer to choose any particular option. The Rocky Mountain Power, EPE, and APS Websites, however, directly compare evaporative cooling costs to those of CACs, clearly emphasizing the saving opportunities associated with evaporative coolers.

Similar to Xcel Energy, EPE, SCE, and Rocky Mountain Power each offer equipment rebates for evaporative coolers. These rebates range from $100 offered by Rocky Mountain Power for a replacement unit to $500 offered by EPE for a unit with a saturation efficiency rating of 85% or above. Rocky Mountain Power is unique in that they offer all cooling rebates under the same program (Cool Cash Incentive Program); therefore, the measures do not compete with one another for the utility savings and participation goals.

Recommendations

1. **To broaden the network of qualified trade allies, consider incorporating NATE-specific language and concepts in the contractor training or including NATE training and certification as part of contractor training opportunities.** Rocky Mountain Power included language in their training protocol consistent with NATE training language. Because of this effort, contractors were able to more easily participate in the program and/or become NATE certified, as the concepts and language were familiar. Although Xcel Energy's HEAC Program currently bases certification requirements on other factors and also accepts NATE certification, by integrating more of the NATE training protocol, contractors may experience the additional benefit of achieving the NATE endorsement.
2. **To increase trade ally engagement in the HEAC Program, explore expanding trade ally participation to include opportunities for friendly competition and rewards for increased equipment installations.** PEPCO and DPL implemented an online HVAC contractor scorecard that tracks contractors' tune-up and installation completions, then they provide a free lunch to the contractor completing the most installations. Program management indicated that the online scorecard is successful and increased contractor participation. Although Xcel Energy typically prefers to recognize contractors equally, a performance-based reward or award may be appropriate.
3. **Consider exploring the costs and benefits associated with a tiered early retirement incentive approach based on the SEER level of the replaced unit.** Ameren Illinois offers $110 to customers who replaced a working CAC greater than 10 SEER or any nonworking CAC with any new, efficient unit, but offers a much higher incentive ($600) for a new efficient unit that replaces a working CAC with less than 10 SEER.

10. M&V BENCHMARKING

Cadmus examined Xcel Energy's 2011 HEAC Program M&V protocol, and benchmarked how these practices compare to similar utility programs. This chapter presents the benchmarking results and our recommended best practices.

Cadmus selected six programs to benchmark that currently offer QI for CAC (Table 33). Three of the programs are in the neighboring states of Arizona and Utah, while the remaining programs—in California and Connecticut—are examples of similar programs across the country. Many additional utility programs include individual components of QI, such as duct sealing or proper sizing, and some utilities offer QI programs focused on heat pumps; however, Cadmus chose to benchmark these six programs because they are similar to the comprehensive program offered by Xcel Energy and will provide the best comparison of M&V approaches.

Table 33. QI Programs Included in M&V Benchmarking

Program State	Program Name	Utility
Arizona	Residential CAC Rebate Program	APS
	Cool Cash Rebate Program	Salt River Project
California	Quality Installation Program	SCE
	AC Quality Care Program	SDG&E
Connecticut	Quality Installation and Verification Program	Connecticut Light & Power The United Illuminating Company
Utah	Cool Cash Incentive Program	Rocky Mountain Power

The benchmarking findings are followed by recommendations for Xcel Energy based on our review of other programs and Xcel Energy's current practices.

Cadmus considered the following key elements of the programs and M&V processes:

1. Program Components
2. Contractor Participation Requirements
3. Documentation and File Review
4. On-Site Verification
5. Pass/Fail Criteria

Summary of Xcel Energy's Current M&V Practices

Xcel Energy contracts with a third-party M&V contractor, who verifies "*that an Xcel Energy-approved load calculation was performed; the unit was sized properly; and refrigeration charge, airflow, and duct leakage are within acceptable ranges.*"[24] The M&V process for the Xcel Energy HEAC Program consists of a document review and on-site verification. The M&V contractor conducts ongoing random sampling for document review and on-site verification, with a sample size designed to achieve 90% confidence with ±10-20% precision. Xcel Energy staff

[24] Public Service Company of Colorado. *2011 Demand-Side Management Plan, Electric and Natural Gas.* Docket No. 10A-471EG. Revised March 2011.

also check each application for customer and equipment eligibility. The current M&V process for the Colorado HEAC Program is detailed in Public Service Company of Colorado, 2011.

In recent interviews Cadmus conducted, Xcel Energy staff indicated that the M&V process has been challenging for contractors. Xcel Energy hired a new M&V contractor for 2012, and is examining its M&V practices to identify potential areas for improvement.

Benchmarking Findings

Program Components

QI programs typically include some or all of the following four components:

1. Load calculation and equipment sizing
2. Installing the system with the proper amount of refrigerant
3. Setting the proper airflow level
4. Sealing ducts to reduce leakage

Xcel Energy requires that all of these components are addressed during installation in order for new equipment to be eligible for any program rebate. As shown in Table 34, each of the benchmarked programs include at least three of these four components. Like Xcel Energy, four of the programs require QI or selected QI components for new equipment rebates, while the other two programs offer QI as an option in addition to rebates for new, high-efficiency equipment. Rocky Mountain Power's program structure is the most different, in that it offers separate, optional rebates for proper system sizing, proper installation (requires both refrigerant charge and airflow), and duct sealing and insulation.

Table 34. Benchmarked Programs' Quality Installation Components

Utility	Is QI Required For New Equipment Rebates?	QI Component(s)
Xcel Energy; Colorado	Yes	• Load calculation and proper equipment sizing • Correct airflow level • Correct refrigerant charge level • Duct sealing
APS; Arizona	Yes	• Load calculation and proper equipment sizing • Correct airflow level • Correct refrigerant charge level
Connecticut Light & Power and The United Illuminating Company; Connecticut	No, QI is optional for high-efficiency equipment in addition to equipment rebates	QI is optional, but if done must include all of these components: • Load calculation and proper equipment sizing • Correct airflow level • Correct refrigerant charge level • Duct sealing
Rocky Mountain Power; Utah	No, QI components are optional in addition to equipment rebates	Each of these components is optional: • Load calculation and proper equipment sizing • Correct airflow and refrigerant charge levels • Duct sealing and insulation

Utility	Is QI Required For New Equipment Rebates?	QI Component(s)
Salt River Project; Arizona	Yes, but duct sealing is optional	• Load calculation and proper equipment sizing • Correct airflow level • Correct refrigerant charge level • Duct sealing (optional)
SDG&E; California	Yes	• Load calculation and proper equipment sizing • Correct airflow level • Correct refrigerant charge level • Duct sealing
SCE; California	Yes	• Load calculation and proper equipment sizing • Correct airflow level • Correct refrigerant charge level • Duct sealing

Contractor Participation Requirements

Each of the benchmarked utilities has a contractor network, typically requiring some specialized training in addition to meeting state licensing requirements. All but the Salt River Project (SRP) program require that installations are conducted by participating contractors in order to be eligible for QI rebates. This requirement is intended to ensure that all contractors are familiar with the QI program, and therefore decrease M&V failures, although implementers of some QI programs have reported difficulty ensuring that each participating contractor company properly trains and updates all of their staff on QI.

Documentation and File Review

To receive a rebate, each of the programs require that the customer or contractor submit a form with the contractor's documented QI results. Each form includes basic information about the customer, contractor, and equipment installed. Most of the forms also require detailed measurements and calculations for each QI component included, except for SRP, which only requires contractors to sign and certify that the system was installed according to the manufacturer guidelines and meets the program QI requirements.

Xcel Energy requires program contractors to keep their project load calculations on file and provide them if the installation is selected for M&V, while all the other programs that include sizing require submission of the Manual J or comparable load calculation. As in the Xcel Energy program, utility or implementer staff typically review applications to verify customer and equipment eligibility, and conduct a more thorough technical file review for at least a sample of installations.

SDG&E and SCE have ENERGY STAR HVAC QI (ESQI) programs, offered in partnership with the U.S. EPA. ESQI requires a file review for all applications, in accordance with the

ACCA verification protocol.[25] The Connecticut Light & Power (CL&P) and United Illuminating Company (UI) program also requires a file review for all QI applications.

On-Site Verification

Like Xcel Energy, all of the benchmarked programs except SRP's conduct on-site verification for a sample of installations, as detailed in Table 35. For most programs, this verification is conducted by a third-party M&V contractor, although in some programs the implementation contractor handles it. CL&P and UI have a M&V contractor conduct on-site verification, and then utility staff review the contractor's work and conduct additional verification of a sample of those installations.

The SDG&E, SCE, and CL&P and UI programs all use a tiered sampling approach, as recommended by the ACCA protocol and by the ESQI Program, in which a higher percentage of installations are verified for contractors that are new to the program. Once contractors have successfully completed several installations and proven their knowledge of QI, the sampling rate for their installations is reduced.

The protocol recommended by ACCA is as follows:

1. ***Level 1 Verification:*** On-site verification of the first three installations by each contractor
2. ***Level 2 Verification:*** On-site verification of at least 10% of installations by each contractor, or at least one installation per quarter
3. ***Level 3 Verification:*** On-site verification of at least 3% of installations by each contractor, or at least one installation per year

Contractors may be demoted to a previous level if they do not continue to display a high level of proficiency. Administrators of some programs that use the tiered sampling approach have reported that it helps them to identify and address issues early on, and ensures a high level of competence among participating contractors.

[25] Air Conditioning Contractors of America. *ACCA Standard 9, HVAC Quality Installation Verification Protocols.* 2009.

Table 35. On-Site Verification Approach for Benchmarked Programs

Program	Approach
Xcel Energy; Colorado	On-site verification by M&V contractor for a random sample of installations. Sample size designed to achieve 90% confidence with ±10-20% precision.
APS; Arizona	On-site verification for a random sample of installations.
CL&P and UI; Connecticut	On-site verification by M&V contractor for a sample of installations: • Level 1: All 10 of the first 10 jobs completed by each contractor • Level 2: At least 10% of installations by each contractor • Level 3: At least 3% of installations by each contractor
Rocky Mountain Power; Utah	On-site verification for a random 5% sample of installations.
SRP; Arizona	On-site verification is not currently conducted.
SDG&E; California	On-site verification by program implementer for a sample of installations: • Level 1: Three consecutive jobs completed by each contractor must pass verification • Level 2: At least 10% of installations by each contractor
SCE; California	On-site verification by M&V contractor for a sample of installations: • Level 1: All 10 of the first 10 jobs completed by each contractor • Level 2: At least 10% of installations by each contractor • Level 3: At least 3% of installations by each contractor

Pass/Fail Criteria

The ACCA QI specification details each component of QI and its pass/fail criteria, based on industry consensus.[26] While many QI programs are based on the ACCA specification, some programs have different requirements for certain components. Table 36 shows the pass/fail criteria used by each of the benchmarked programs.

As the table shows, Xcel Energy's program differs from most of the benchmarked programs in the criteria for airflow and duct sealing:

- In accordance with the ACCA QI specification, most programs base the desired airflow level on system design and allow for the measured airflow to vary within 15% of the design level. This encourages a well-trained contractor to optimize the performance of each system, and allows them a reasonable level of flexibility in measuring airflow and meeting design goals. The current Xcel Energy requirement is for all systems to have airflow of 400 cfm/ton.
- Most duct sealing programs require a measurement of the air leakage from ducts, and set either a maximum percentage of airflow allowed as leakage or a minimum required leakage reduction. The Xcel Energy program, however, requires only that contractors seal exposed ductwork and alert the customer if they identify any substantial airflow issues.

[26] Air Conditioning Contractors of America. *ACCA Standard 5, HVAC Quality Installation Specification.* 2010.

Table 36. Quality Installation Criteria for Benchmarked Programs

Program	Equipment Sizing	Airflow	Refrigerant Charge	Duct Sealing*
Xcel Energy; Colorado	Equipment sized within 1/2 ton of the calculated cooling load	400 cfm/ton	Meet the manufacturer specifications	Seal exposed ductwork (inaccessible ductwork does not need to be modified)
APS; Arizona	Equipment sized within 15% or 1/2 ton of the calculated cooling load	Measured airflow within 15% of system design level and within range recommended by the manufacturer	Meet the manufacturer specifications	N/A
CL&P and UI; Connecticut	Equipment sized between 95-115% of calculated cooling load	Measured airflow within 15% of system design level	Subcooling within 3 °F of goal	Leakage no more than 20% of total airflow, or leakage reduced 50% from initial measurement
Rocky Mountain Power; Utah	Equipment sized within 1/2 ton of the calculated cooling load	Unknown	Meet the manufacturer specifications	Reduce duct leakage to outside by at least 50% and 100 cfm
SRP; Arizona	Equipment sized within 15% or 1/2 ton of the calculated cooling load	Airflow within 10% of blower's rated capacity	Within 5% of the manufacturer specifications	No required duct leakage level or reduction
SDG&E; California	Equipment sized between 95-115% of calculated cooling load	Measured airflow within 15% of system design level	Subcooling within 3 °F of goal, or superheat within 5 °F of goal	Leakage no more than 15% of total airflow, or leakage reduced 60% from initial measurement
SCE; California	Equipment sized between 95-115% of calculated cooling load	Measured airflow within 15% of system design level	Subcooling within 3 °F of goal, or superheat within 5 °F of goal	Leakage no more than 15% of total airflow, or leakage reduced 60% from initial measurement

* The SDG&E, SCE, and CL&P and UI programs have different criteria for duct leakage in new construction. This table only reflects the existing construction criteria for ease of comparison to the Xcel Energy program.

Program Detail Comparison

Documentation and File Review

The ACCA verification protocol recommends a file review for 100% of installations, while Xcel Energy currently collects and reviews a sample of files. Because Xcel Energy requires load calculations as part of QI, the program could collect them for every installation at the start of the next program cycle, rather than only for installations sampled for M&V. This could better ensure that contractors are conducting load calculations for every installation, and prepare them for future random verifications.

Xcel Energy could also consider using a tiered approach for on-site verification, similar to that recommended by ACCA. For example, a thorough file review could be conducted for the first five installations by each contractor, with a reduced sample conducted for contractors who have proven themselves.

On-site Verification

As detailed above, several utilities use a tiered sampling plan for on-site verification, as recommended by ACCA. With this approach, program staff use their discretion to advance a contractor from one level to the next, or to demote a contractor to a previous level if necessary. This change from Xcel Energy's current QI verification sampling methodology would reward the more skilled contractors by demonstrating Xcel Energy's increased confidence in them as they prove the quality of their work, while providing the necessary oversight for less experienced or less skilled contractors.

M&V was a topic of discussion during the contractor focus groups that Cadmus held in June 2012 as part of this evaluation. We invited participating contractors to join in a focus group, where we encouraged them to share their experience with the HEAC Program and any suggestions or feedback they had based on that experience. During the focus groups, some contractors reported that a disproportionate number of systems are inspected for some HVAC companies, perhaps because of their convenient location. The tiered sampling protocol would address that concern and improve the consistency of the contractors' M&V experiences.

To reduce program costs, some utilities use a less rigorous approach to M&V than the protocol outlined in the ACCA standard, but there is no widely accepted alternative protocol. Currently, the Xcel Energy M&V contractor tests refrigerant charge and airflow, develops independent load calculations, and visually inspects ducts.

At least one of the larger HVAC companies included in the focus groups insists that a technician attend the inspection of their installations. Some administrators of other programs have reported that their program benefited from this practice, because during verification the contractor can receive useful feedback to improve the quality of their future work, and it gives them the opportunity to quickly address any issues found by the M&V contractor. This practice may also reduce the number of visits that need to be scheduled with the customer, although most customers are receptive to the additional visit because of the increased confidence the additional testing gives them in their new HVAC system. Alternatively, the contractor's presence during verification may introduce test bias. Xcel Energy should consider emphasizing the importance of conducting an objective evaluation of each system to the M&V contractor, and emphasizing the benefits of independent verification to contractors and customers.

Pass/Fail Criteria

Equipment Sizing

In 2011, Xcel Energy assumed no energy savings if the equipment capacity deviated from the calculated load by more than 1/2 ton (6,000 Btu). Investigating this assumption could prove useful for the following reasons:

1. As shown in Table 37, larger systems fail more often because the criterion is based on 6,000 Btu, rather than on a percentage of the total required capacity.

Table 37. Xcel Energy 2011 Fail Rate vs. System Size

System Size (ton)	Fail Rate
1.5	0%
2.5	22%
3	33%
4	50%
5	67%

2. The Building Science Corporation found in one study that oversized systems consume the same amount of energy as properly sized systems, but they increase demand.[27] Undersized systems may consume less energy than properly sized systems, but may not achieve the desired comfort level.
3. The *Equipment Size Installed* field of the M&V dataset that is used to pass or fail savings appears to match the AHRI estimated capacity. The AHRI estimate of the capacity of peak demand is inaccurate, unless the peak demand condition is the same as the AHRI condition (95 °F outdoor, 75 °F indoor, and 50% relative humidity indoor). For dry climates, Manual S may oversize by approximately 20% compared to Manual J. The result is three different capacity calculations. Consider having the M&V contractor compare the Manual S total capacity to the Manual J total capacity, then consider latent and sensible capacity differences.
4. Contractors often oversize systems to reduce call backs and complaints. Some homeowners ask for a lower temperature setpoint than the standard 75 °F indoor temperature assumed for proper sizing.[28]

The list above does not include all the technical details necessary to properly assess sizing, but they do delineate the main points of contention in the HVAC community.

Airflow

The M&V contractor currently assumes that airflow delivered should always be 400 cfm/ton, and they pass or fail systems based on this assumption. As described above, this is different than the criteria used by the benchmarked programs. Cadmus has several concerns about this assumption:

1. The M&V contractor estimates the total airflow target using the AHRI cooling capacity, which is not accurate for conditions in Colorado.
2. The ACCA QI specification requires airflow to be "*within 15% of the airflow required per the system design*" and "*within the CFM range listed in the OEM product data.*" The specification also states that "*Airflow across the coil is typically between 350 to 450 cfm per ton*," which is how the M&V contractor derived the estimate of 400 cfm. However, the high altitude and dry climate in Colorado might require 450 cfm or more.
3. The inaccuracy of the measuring device used by the M&V contractor is 10-15%, which must be considered when evaluating airflow measurements.

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[27] Building Science Corporation. *Effects of Air Conditioner Sizing on Energy Consumption and Peak Demand in a Hot-Dry Climate*. 2008. Available online: http://www.aceee.org/proceedings-paper/ss08/panel01/paper23.

[28] http://www.proctoreng.com/articles/sidebar.html#recommend

Refrigerant Charge

Xcel Energy's refrigerant charge pass/fail criteria follow the ACCA QI specification, and are similar to the requirements for benchmarked programs.

Duct Sealing

Numerous utilities implement duct sealing programs, some with low participation rates and limited success because duct repairs are often difficult and costly, even with utility incentives. Contractors in some programs have expressed hesitation to recommend duct sealing when they are not confident that they will be able to repair the ducts to meet the leakage reduction requirements without major work, which the customer might consider as too costly or invasive.

The contractors should balance the airflow to provide comfort throughout the home. If the existing ductwork was poorly designed, however, proper balancing may not be possible without entirely replacing the ductwork. A visual inspection of accessible ducts is reasonable given the high cost of evaluation. If the airflow is set correctly, the HVAC system, irrespective of the ducts, will operate as efficiently as expected.

Alternatively, because leaky ducts, especially those in unconditioned space, may result in significant energy loss, Xcel Energy could consider increasing the energy savings from duct sealing by expanding their program to include more thorough duct repair. Some other utilities provide a separate rebate for duct leakage measurement and duct sealing, tasks that could be conducted by installation contractors or by others, such as home performance contractors who may have more of the necessary equipment for and experience with ductwork.

Recommendations

Based on Cadmus' review of other programs and Xcel Energy's current practices, we recommend that Xcel Energy consider the following changes to their M&V protocol for QI:

1. **Consider a tiered approach for file review and M&V site selection.**
    a. **Explore initially requiring contractors to submit recorded measurements, load calculations, and the AHRI reference number for every installation.** Once a contractor has successfully completed a certain number of installations, submitting the load calculations could only be required for sites selected for an M&V visit.
    b. **Explore selecting installations for on-site verification based on the contractor,** rather than conducting a random sample of all submitted applications. Consider a tiered approach in which the sampling rate decreases for each contractor once they have passed a certain number of verifications.
2. **Consider requiring more stringent qualifications (a highly skilled HVAC technician or engineer) for verification staff.** In the past, contractors expressed a lack of confidence in Xcel Energy's M&V contractor. HVAC verifiers must have technical expertise and experience to earn contractor confidence, and to ensure an accurate assessment of the quality of HVAC system installation. Xcel Energy hired a new M&V contractor for the 2012 program year, so this may already be addressed.
3. **Explore the implications of modifying the pass/fail criteria for equipment sizing and airflow,** considering factors such as the energy and demand impacts associated with each component and the accuracy of measurement equipment.

4. **Consider the implications of calculating the matched equipment capacity using the Manual S requirements,** rather than using the AHRI capacity estimate.[29]
5. **Consider the implications of using the Manual S methodology to estimate the desired airflow** based on specific manufacturer targets that account for the altitude and humidity characteristics in a typical Colorado home. For example, the target airflow for a home with a sensible heat ratio above 0.85 is 450 cfm.[30]

Cadmus developed the above recommendations with Xcel Energy's current process in mind. Notably, there are very few utilities like Xcel Energy that implement their own QI or tune-up programs.

[29] Changing the analysis methodology for QI would also impact program gross savings and program aspects, such as contractor training. Program gross savings were not a part of this evaluation, therefore the impacts this change would most likely have on gross savings is not quantified.

[30] http://www.acca.org/Files/?id=67