Evaporative Cooling Rebate Program Evaluation

Prepared for
Xcel Energy

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1. Executive Summary

This report provides findings for the process and impact evaluation of the Xcel Energy Evaporative Cooling Rebate Program in Colorado (the Program), conducted by The Cadmus Group Inc. (Cadmus), along with Integrative Growth, Inc.(IG), and Population Research Systems (PRS), collectively referred to as the Cadmus Team, or the Team. The evaluation findings and conclusions were informed by an array of data collection activities, including program staff interviews; surveys of customers who purchased Program incented evaporative coolers; surveys of customers who chose central air conditioning over evaporative cooling; in-home metering of evaporative coolers; and surveys of HVAC contractors, retailers, distributors, manufacturers, and builders.

The Xcel Energy Evaporative Cooling Rebate Program was launched as a pilot in 2003. The Program has since been offered continuously with modifications to reflect current market conditions. For homes in dry climates, such as Colorado, evaporative cooling provides similar comfort benefits to air conditioning, but with significantly less energy use. Evaporative coolers use approximately 75% less energy than central air conditioners, and can typically lower the home temperature by 30 degrees. The Xcel Energy Program offers three rebate levels for evaporative cooling products: two for residents and one for builders. Xcel Energy monitors the effectiveness of the Program by tracking participation and responses to the various marketing, training, and outreach efforts.

The primary objective of the Program is to provide kWh savings for Xcel Energy's DSM Residential Program Portfolio. In 2009, the Program reported 1,960 MWh of savings, with 2,670 residential customers participating; however, there were no builder participants. The Program as executed in 2009 fell somewhat short of goals submitted to the Colorado Public Utilities Commission and previous years' performance. In 2009, the program had a goal of 3,800 residential participants in the Program, and a goal of 2.07 MWh of savings. This evaluation provides insight on contributing factors to this shortfall and potential program improvements.

The overall evaluation objectives included determining the effectiveness of current Program attributes, delivery, and marketing approaches; measuring Program satisfaction and identify evaporative cooler purchase barriers; and providing evaluated net and gross savings impacts associated with the Program. The summary below describes how these research objectives were addressed.

Objectives

Task 1. Conduct Project Initiation Meeting and Present Evaluation Plan

Objective: *To provide a forum for all interested parties to discuss the evaluation goals, clarify basic research and analyses methods, identify data required from Xcel Energy, and finalize the project schedule and time frame.*

The Cadmus Team conducted planning meetings in Denver, Colorado to clarify research objectives and plan for the evaluation data collection activities.

Task 2. Internal Review/Development of Logic Model

Objective: *Interview relevant program managers/administrators, call center agents, and operational personnel regarding their experiences with the Program. This should identify the internal workings of the Program and any problematic issues or areas within the Program that might impact the data development or analysis.*

With input from Xcel Energy, the Cadmus Team developed an interview guide and conducted interviews with Program staff, the Xcel Energy trade channel manager, and with the implementation vendor, Wisconsin Energy Conservation Corporation (WECC). Based on these interviews, the Team created a process flow diagram (Figure 3) and logic model (Figure 4) that document how the Program is delivered to customers, as well as the Program inputs, outputs, and expected outcomes.

Program staff interviews confirmed that the logic model and process flow model accurately depict the Program activities. Xcel Energy promotes the Program to customers through bill inserts, direct mail pieces, and the Xcel Energy Website, as well as via communication to customers from HVAC contractors, WECC field representatives, and builders.

Task 3. Primary Research—Participant and Nonparticipant Surveys

Objective: *Collect customer input on program awareness, satisfaction, and market barriers. Capture attribution factors, measure freerider and spillover effects within the nonparticipant community, and measure the free driver impacts.*

With input from Xcel Energy, the Cadmus Team developed interview guides for participating and nonparticipating residential customers which informed freeridership, spillover, the overall NTG ratio as well as a number of other findings.. A participating customer is someone that bought an eligible evaporative cooling unit and received a rebate from Xcel Energy in 2009. A nonparticipant is a residential customer who bought a central air conditioning system instead of an evaporative cooling unit in 2009.

Most participants are satisfied with the Program; 93% were satisfied with the evaporative cooling rebate application process, 97% were satisfied with the ability of the evaporative cooler to cool their house, and 93% were satisfied with the electricity cost to operate the evaporative cooler.

Evaporative cooling faces a number of market barriers among nonparticipants, including negative impressions of older evaporative cooling technology and competing messaging about the benefits of central air conditioning. Many consumers are more familiar with central air conditioners, and need to be convinced of the benefits of evaporative cooling. Some perceive that evaporative coolers require regular maintenance, including monthly inspections and water changes. This is considered a burden and may dissuade some consumers from purchasing evaporative coolers. A maintenance service plan similar to what is offered for air conditioning through Xcel Energy's HomeSmart program may also represent an opportunity the program could use to reduce this barrier.

Task 4. Primary Research—Interviews with Trade Allies and Other Program Actors

Objective: *Interview program actors to determine satisfaction with the Program, assess impacts of interactions, and determine how improvement can be attained.*

With input from Xcel Energy, the Cadmus Team developed interview guides for participating and nonparticipating contractor, retailers, manufacturers, distributors, and builders. Any contractor, retailer, manufacturer, or distributor who made, distributed, or sold eligible units in 2009 were considered participant trade allies, while those who did not manufacture, distribute, or sell participating units in 2009 were considered nonparticipants. Builders were considered nonparticipants, as no Tier 3 rebates were issued in 2009.

The trade ally surveys revealed several market barriers and perceptions regarding evaporative cooling, including:

- Some trade allies perceive that the evaporative cooling product has performance issues, which may discourage some customers from purchasing this technology.
- Trade respondents indicated that cooler than normal summers resulted in customers delaying purchase of a cooling system, lower sales for trade partners, and ultimately fewer Program participants.
- Home Depot is currently selling the majority of participating evaporative cooler units. Continued partnership with Home Depot is recommended considering their success in generating participation thus far.
- The decline in the new home construction market has decreased the opportunities for builders to take advantage of the Tier 3 whole-house portion of the Program, which is designed for new homes or homes with major remodeling.

Task 5a. Calculate Program Gross and Net Savings

Objective: *Contractor should estimate the energy savings attributable to the Program.*

Gross Savings Estimates

The Cadmus Team calculated gross savings for each tier and location, netting four savings values. New baseline usage assumptions were computed as outlined in the Technical Assumptions (Chapter 11) portion of the evaluation, in which room AC energy and demand usage for both Grand Junction and Denver were applied. Based on survey responses and analysis of the measures that customers had been using prior to purchasing their new evaporative cooler, the Cadmus Team recommends modifying the baseline assumption used in both the 2006-2009 and 2010 program filing.

The filing (for 2009) assumed that the baseline unit was a central air conditioner for each customer site. Participants reported that in most cases they would not have purchased a central air conditioner in the absence of the program, and that a room air conditioner is a more realistic baseline comparison. In the 2010 program modification filing, Xcel Energy did use a single 1.5 ton window AC unit as the baseline. Because of the relative cost of the units, the usage patterns,

the relative size of homes using the equipment, and the cooling capacities of the units, the Cadmus Team recommends using a baseline of a single room air conditioner for Tier 1 evaporative coolers, and two room air conditioners as the baseline for Tier 2 evaporative coolers.

The Cadmus Team also measured greater hours of use relative to the assumptions in the filing. Taking into account the differences in baseline and the hours of use, the Cadmus Team is recommending the gross ratios shown in Table 1 by location and evaporative cooling technology.

Table 1. Gross Savings per Unit based on Tier and Location (At the Meter)

Tier	Location	Baseline	Gross Energy Savings (kWh)	Gross Demand Savings (kW)
1	Grand Junction	1 RAC	914	1.29
1	Denver	1 RAC	559	1.29
2	Grand Junction	2 RACs	2,041	2.74
2	Denver	2 RACs	1,294	2.74

Gross savings on the customer side were 2,488,970 kWh and 4,836 kW. After applying Xcel Energy's 7.14% line loss factor, the overall gross savings were 2,680,347 kWh and 5,208 kW at the generator.

Net Savings Estimates

The Team calculated and applied freeridership and spillover to the above gross savings. Net-to-gross was 51.6% for Tier 1 and 58.6% for Tier 2. Table 2 shows the savings per unit for each of the four areas.

Table 2. Net Savings per Unit Based on Tier and Location (At the Meter)

Tier	Location	NTG	Net Energy Savings kWh	Net Demand Savings kW
1	Grand Junction	51.6%	472	0.67
1	Denver	51.6%	288	0.67
2	Grand Junction	58.6%	1,196	1.61
2	Denver	58.6%	758	1.61

Overall net savings on the customer side were 1,383,930 kWh and 2,680 kW. After applying Xcel Energy's 7.14% line loss value, the overall net savings for the Program were 1,490,340 kWh and 2,886 kW at the generator.

Task 5b. Recommend Net-to-Gross Ratio for Future Program Use

Objective: *Contractor should assess freeriders, free drivers, and spillover for the Program. In the recommendation, Contractor should specify all technical, methodological, and analytical procedures that will be used to assess all attribution factors.*

With input from Xcel Energy, the Cadmus Team prepared survey questions for the participant residential customers, which informed freeridership, spillover, and the overall NTG ratio.

Freeridership: The Team determined freeridership for each Tier 1 and Tier 2 separately using a scoring matrix algorithm and calculating in SAS. Tier 1 freeridership was found to be 50% and Tier 2 was 43%. Furthermore, we discovered that first time buyers had a much lower freeridership percentage of 35%, compared to previous evaporative cooler owners of 53%.

Spillover: The Team also determined spillover during the survey, in which participants were asked what additional energy-efficient equipment they had installed since participating in the Program, and to what degree they would attribute the influence of the Program to those actions. Survey results indicated that approximately 1.6% of gross reported Program savings amount could be counted as spillover effects. Nonparticipant spillover was explored but not included in the analysis for the reasons discussed on pages 69 -70.

Net-to-Gross Calculation: The Team determined net-to-gross (NTG) for Tier 1 and Tier 2 separately using the following equation: 100% - Freeridership + Spillover. This analysis yielded NTG percentages of 51.6% for Tier 1 and 58.6% for Tier 2. The higher NTG for Tier 2 was due in large part to first time buyers, for whom freeridership was lower.

Task 5c. Verify Baseline and Technical Assumptions, and Recommend any Appropriate Changes

Objective: *Outline the technical, methodological, and analytical procedures that will be used to validate and modify the Company's baseline and technical assumptions. Review these assumptions and make recommendations for any modifications and improvements.*

Cadmus found examples in which Xcel Energy's technical assumptions are supported, and also where more recent studies and Cadmus' 2010 metering study could offer updated values and techniques. Key variables associated with evaporative cooling run time and baseline usage data as mentioned above have a sizable impact on savings attributable to evaporative cooling. Specific recommended changes are provided at the end of this chapter.

Task 6: Peer Utility Benchmarking

Objective: *Identify specifics of evaporative cooling programs offered by peer companies.*

The Cadmus Team completed a benchmarking study comparing design elements of the Xcel Energy Evaporative Cooling Rebate Program with seven other evaporative cooling rebate programs across the United States. Overall, relatively few evaporative cooling programs exist, as the technology is most useful in the arid regions of the west and southwest United States. Cadmus reviewed all existing and some former programs for which information was public.

Many evaporative cooling programs have struggled to meet participation quotas, which in one case led to discontinuing the program. Despite falling short of the 2009 participation and savings goals, Xcel Energy's Program had the highest number of participants compared to other programs. While Xcel Energy's rebates for evaporative cooler purchases are similar in value to other program rebates, Xcel Energy's Program may benefit from incentives directed to contractors and dealers. Offering incentives to business customers also represents a possible area to expand the Program, as other programs have experienced success with this approach.

Task 7. Progress Reporting

The Cadmus Team provided monthly/weekly progress reports to Xcel Energy to communicate our progress and any challenges, including their resolutions.

Task 8a, 8b, 8c. Draft Report/Executive Summary(s), Final Report, Results Presentation

This document is the report of findings and includes the following recommendations from the evaluation.

Recommendations

Xcel Energy's Evaporative Cooling Rebate Program stands out as having the highest number of participants compared to similar programs across the country. Clearly, many aspects of the Program are functioning effectively. In an effort to gain even higher levels of participation as seen in previous years, this study revealed a few ways Xcel Energy could expand and improve the Program to attract even greater participation.

Evaporative Cooling Process

1. **Enhance Marketing Efforts**

   A. **Focus messaging on non-energy benefits of evaporative cooling to offset key barriers identified by nonparticipants.** Messaging about improved evaporative cooling technologies and their associated benefits may be one way to address this market barrier.

   B. **Communicate explicit cost benefits for installing, operating, and maintaining an evaporative cooler**. Consider placement of detailed information, targeting places where customers seek this type of information, such as in stores, energy audit reports, on the Xcel Energy (and ResponsiblebyNature) Websites, and adjacent to information about other cooling products.

   C. **Consider using a variety of media tactics to raise Program and rebate awareness,** including use of the ResponsibleByNature and Xcel Energy Websites and customer testimonials.

      i. **Consider conducting a usability study** to ensure the Websites have maximum impact, and provide a compelling call to action to drive traffic to Program-specific sites.

      ii. **Expand marketing tactics to include customer testimonials**. This may be another method to communicate the non-energy benefits and improved technology.

   D. **Address barriers to Tier 3 participation**.

      i. **Consider providing information on the potential incremental cost savings builders might also experience** by installing Tier 3 evaporative cooling systems compared to central AC.

ii. **Partner with a large production builder**, perhaps in coordination with the ENERGY STAR New Homes Program, and establish that builder as a champion for evaporative cooling. Barriers may be reduced if builders can see examples of the Tier 3 technology installed and understand potential benefits, in addition to the Tier 3 rebate provided, such as faster new home sales and/or higher customer satisfaction.

iii. **Develop outreach to Home Owner Associations** (HOA's) describing benefits and design improvements for evaporative cooling. Despite the concern about HOA restrictions by both builders and homeowners, Colorado State law now no longer allows HOAs to restrict the use of evaporative coolers on the exterior or roof of a home.

2. **Continue Trade Ally Outreach and Support**

   A. **Continue to provide support for industry trade allies through training and education**. Continue to support dealers and retailers with current information about the Program-approved models and any changes to the Program incentives.

   B. **To increase customer participation, consider offering an incentive to trade allies to help motivate evaporative cooler sales and off-set the negative cost incentive that currently exists.** An incentive to trade allies in a sales role could help off-set the negative financial and perceived 'hassle' factors in promoting a more efficient evaporative cooler.

3. **Consider adjusting program incentives to reduce freeridership**

   Changes to Program design must also be considered in light of overall Program cost-effectiveness. Possible Program design approaches for achieving this incentive structure change include:

   A. **Explore the implications of offering higher rebate amounts for first-time evaporative cooler purchasers.** This strategy may reduce freeridership, as first time purchasers tend to report a lower freeridership when surveyed. Program resources, however, would need to be evaluated to ensure that an increase or reallocation of incentive amounts is cost effective.

   B. **Further incenting Tier 2 participation through enhanced rebate amounts or tighter participation requirements.**

4. **Improve Program Processes**

   A. **Simplify rebate processing.** Streamlining this process electronically may potentially reduce the possibility for errors in data tracking.

   B. **Initiate a quality control process on data tracking and documentation.** The participant database provided by Xcel Energy had inconsistencies between tier label, rebate amount paid, and type of previous cooling system. A consistency check of these variables from application to program database is warranted, as they provide critical inputs to program savings calculations.

C. **Consider expanding evaporative cooling rebates to business customers.** An opportunity exists to offer the Program to small to mid-size commercial and industrial customers without the challenges of completely re-designing the program or coming up with all new technical assumptions.

D. **Continue to monitor changes in evaporative cooling penetration through the Home Use Survey in successive years.** This survey may be the best measure through which to observe market transformation effects over time.

Evaporative Cooling Impact

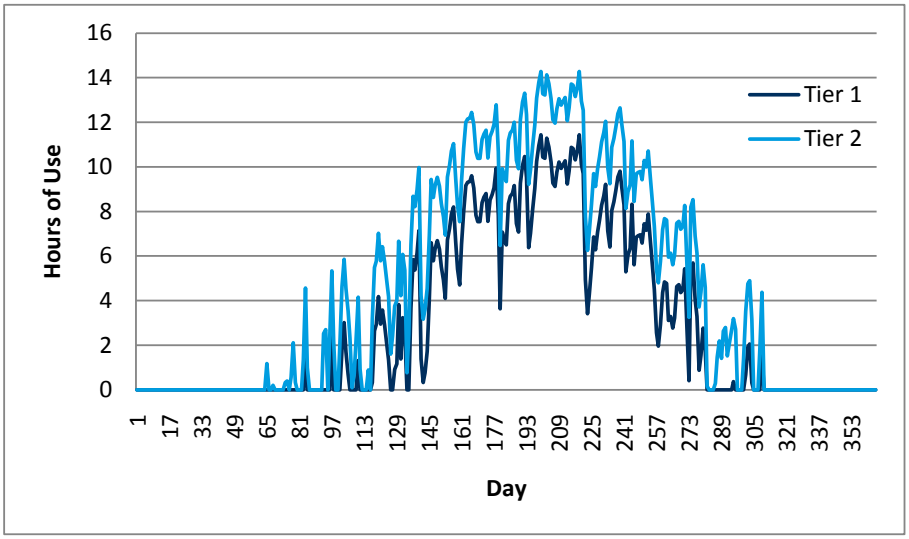
1. **Update Technical Assumptions**

A. **Consider climate as a component of calculating savings achieved for evaporative cooling**.

B. **Update the run hours with information obtained from this metering study. Also use Denver and Grand Junction regions for location-specific hours of use and associated annual energy usage values.** Actual run time was collected from a sample of 70 evaporative cooling rebate recipients over the summer of 2010. These data were weather normalized and found to align with the weather station data and BINMAKER data.[1] The average annual Tier 1 hours of use for Denver was measured as 866 and 1,069 for Grand Junction. Tier 2 average annual HOU is 1,353 for Denver and 1,620 for Grand Junction.

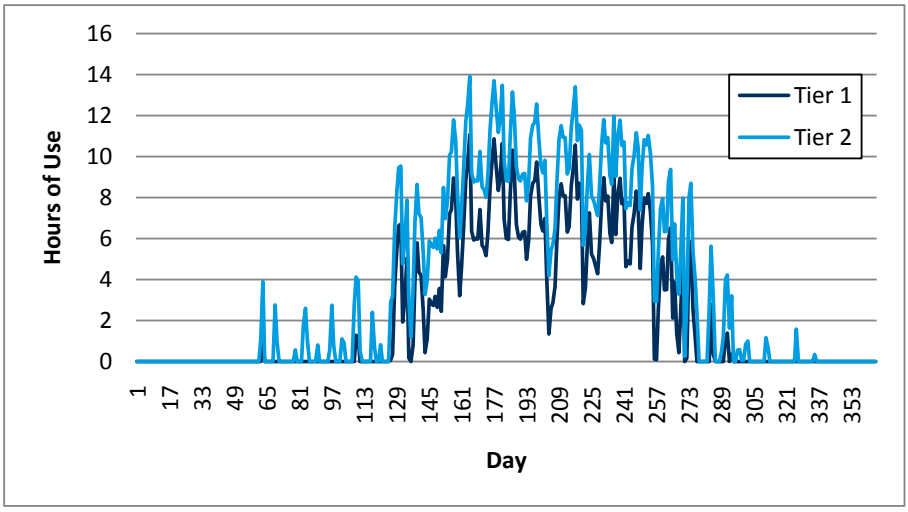
Figure 1 and Figure 2 show the load profiles measured in average daily HOU for each region and tier for a typical year.

Figure 1. Annual HOU - Grand Junction



[1] BINMAKER is a standard engineering software for identifying weather conditions, including cooling degree days and climate by geography.

Figure 2. Annual HOU - Denver



C. Use one 1.5-ton room AC for Tier 1 and two 1.5-ton room ACs for Tier 2 as the baseline for calculating energy and demand savings.

D. **Update assumptions where more current supporting data were found:**

i. Update motor HP for both Tier 1 and Tier 2 evaporative coolers (0.52 HP for Tier 1units and 1.02 HP for Tier 2 and Tier 3 units)

ii. Consider accounting for pump motor energy use

iii. Consider also using 0.7 as the coincidence factor

iv. Consider 15 years as the expected useful life of an evaporative cooler

2. **Net-to-Gross:** We recommend **52% of Xcel Energy's claimed gross savings for Tier 1** evaporative coolers and **59% of savings for Tier 2** evaporative coolers can be attributed to the Evaporative Cooling Rebate Program in Colorado.

2. Introduction

This chapter states research objectives, describes the methodological approach and data collection activities conducted for the Program evaluation, and gives a report overview.

Research Objectives

This evaluation focused on the following major objectives:

1. Develop flow diagram, theory, and logic model documenting information and activity flow between implementers and market actors and compare current strategies and activities to theory and logic models.
2. Understand market barriers and customer and trade ally perceptions of evaporative cooling.
3. Assess satisfaction among Program participants.
4. Calculate gross savings, net savings, and net-to-gross (NTG) ratios.
5. Capture attribution factors, measure freeridership among participants, measure spillover effects among nonparticipants, and measure free driver impacts.
6. Determine areas where improvements to Program implementation can lead to more cost-effective energy savings.

Research Methods

Data collection activities were conducted from May 2010 through October 2010. These activities focused on providing inputs to inform the process and impact evaluation. The research approach used by the Team to evaluate the Program consisted of the following activities:

- Review of Xcel Energy's Program participant tracking database.
- Primary data collection via surveys and interviews with the following market actor groups:
    - Program staff (n=6)
    - Participating (n=339) and nonparticipating (n=118) residential customers
    - Participating (n=19) and nonparticipating (n=21) trade allies
- Benchmarking of evaporative cooling rebate programs (n=7)
- Metering of evaporative cooling equipment (n=70)

Table 3 presents a brief description of each task and survey instrument used for the evaluation. Subsequent chapters provide additional details regarding methodologies for each evaluation task.

Table 3. Summary of Evaluation Approach

Task	Impact		Process	Details
	Gross Ratios	Net-to-Gross		
End-user Survey (Customer Participant)	X	X	X	Used for calculating NTG and assessing implementation (n=339)
End-user Survey (Customer Nonparticipant)	X	X	X	Used for calculating NTG and assessing implementation (n=118)
Trade Ally Participant Survey			X	Used for assessing implementation (n=19)
Trade Ally Nonparticipant Survey	X	X	X	Used for assessing implementation (n=21)
Engineering Analysis	X			Used for verification of technical assumptions
Metering Study		X		Collected actual energy use, temperature conditions, and run-time data to inform engineering analysis
Program Staff Interviews			X	Provides insight into Program design and delivery (n=6)
Secondary Research			X	Reviews results of peer companies in regard to specifics of this or similar programs

Program Staff Interviews

The Cadmus Team conducted five in-depth interviews with Xcel Energy Program staff and one with a WECC representative to assess the processes involved in delivering the Program, the effectiveness of those processes, and the basic theory on which the Program was designed. Topics covered in the interviews included:

- The Program goals and objectives and how they have changed over the life of the Program.
- The key market barriers to participation in the Program and activities designed to address those barriers.
- The most and least successful aspects of the Program design process.
- Delivery of Program activities and the roles of the various parties involved.
- Overall Program function, including opportunities to improve the current administrative approach.
- Dealer application processes, internal inspections, and participation tracking.
- Program reporting processes, including quality control and the accuracy and timeliness of data collected.
- Confidence in the Program's ability to meet its goals in the coming year.
- Program marketing in 2009, methods how participants learned about the Program, and the most effective promotional activities.

- Dealer responses to the Program, positive and negative.
- Homeowner perceptions of the Program and follow up processes.
- Future developments for the Program.

End-User Surveys

The Team conducted separate surveys for participants and nonparticipants. Table 4 shows the survey completions for residential customers based on a goal of a 95% confidence level for participants and 90% confidence level for nonparticipants.

Table 4. Survey Completions—Residential Customers

Category	Total
Participants	339
Nonparticipants	118

Xcel Energy provided a sample of Program participants and nonparticipants. Nonparticipants were defined as customers that had installed a cooling system other than evaporative cooling within the 2009 time frame. As these were difficult to identify in the general marketplace, sample lists were generated from Xcel Energy AC Rebate and Saver's Switch participants. The Team conducted interviews via random selection from the sample provided by Xcel Energy. Interviewers confirmed the respondents were qualified either as participants or nonparticipants before proceeding with the survey.

Survey objectives varied by category (i.e., participants vs. nonparticipants), but primarily focused on the following areas:

- Awareness
- Satisfaction
- Market barriers
- Freeridership
- Spillover
- Demographics

All survey instruments are included in Appendix A.

After data were collected, the Team analyzed responses using cross tabulations and statistical analysis to identify differences within or between groups. Differences reported throughout the detailed findings for the end-user surveys met a minimum confidence/precision threshold of $p<0.10$.

Trade Ally Surveys

The Team conducted separate surveys for participating and nonparticipating contractors, retailers, manufacturers, distributors, and builders. Table 5 shows the survey completion distribution for trade allies.

Table 5. Survey Completions—Trade Allies

Trade Ally	Participant	Nonparticipant	Total
Contractors	7	6	13
Builders	0	8	8
Retailers	10	5	15
Manufacturers	1	1	2
Distributors	1	1	2
Total	**19**	**21**	**40**

Xcel Energy provided a sample of participant and nonparticipant trade allies. The Team conducted interviews via random selection from the sample provided by Xcel Energy.

The 40 trade ally interviews were conducted in July 2010, and included questions regarding changes in evaporative cooling stocking, sales trends, promotions, and pricing practices that have occurred over the last several years, with a focus on the 2009 cooling season.

Survey objectives varied by category (i.e., participants vs. nonparticipants), but primarily focused on the following areas:

- Marketing efforts and trends
- Evaporative cooler sales trends and stocking patterns
- Program impact
- Cost to consumer
- Awareness
- Satisfaction
- Market barriers
- Freeridership
- Spillover
- Demographics

Additionally, all surveys are included in Appendix A.

Report Overview

This report is organized into the following chapters.

- Chapter 3 presents Program description, history, and design.
- Chapter 4 provides a summary of interviews with Program staff.
- Chapter 5 presents the results from the telephone surveys and site visits.
- Chapter 6 highlights findings from the upstream interviews with trade allies.
- Chapter 7 describes Program gross savings.
- Chapter 8 presents the net-to-gross analysis and findings.
- Chapter 9 provides benchmarking for the Program.
- Chapter 10 describes findings from the metering study.
- Chapter 11 outlines the baseline and technical assumptions analysis.

Appendices are included separately with copies of all data collection instruments and summary tables of collected data.

3. Program Description

The Xcel Energy Evaporative Cooling Rebate Program provides a cash rebate to eligible electric customers who purchased qualifying high-efficiency evaporative cooling equipment for residential use in Xcel Energy's Colorado electric service territory. This Program dedicates resources to increasing energy efficiency in residential homes by encouraging consumers and builders to purchase and install evaporative coolers rather than central air conditioning. Residential customers benefit by purchasing energy-efficient units at a discounted price due to the rebate, and also experience energy savings throughout the lifetime of the equipment. Builders benefit by purchasing energy-efficient units at a discounted price due to the rebate, when installing a whole-house, closed duct evaporative cooling system.

Incentive Levels

Program incentives are generally intended to encourage customers to purchase more efficient measures than they would have purchased without the Program. Typically, the greater purchase price of the more efficient measures is one of the main reasons customers do not buy them. Consequently, incentive levels are intended to offset this barrier to the adoption of efficient measures. Evaporative cooling systems currently cost less than SEER 13 air conditioners and are significantly more efficient, but due to limits in their cooling ability in some weather and environmental conditions, along with other real and perceived shortcomings, they hold a significantly smaller market share than air conditioning units. The Program consequently encourages the adoption of this technology by offering an incentive that further increases the price advantage of evaporative cooling equipment. In 2009, incentives were offered to customers and builders as outlined below.

Customer incentives for:

- Tier 1: Direct, indirect, or two-stage new, permanently installed evaporative cooler with a minimum airflow of 2,500 cubic feet per minute (CFM).
- Tier 2: Direct, indirect, or two-stage new, permanently installed evaporative cooler with a minimum airflow of 2,500 CFM, remote thermostat control, and periodic purge water control.[2]

Builder incentive for:

- Tier 3: Indirect or indirect/direct, whole-house, closed systems with a minimum airflow of 1,000 CFM.

[2] Units with add-on equipment do not qualify.

Table 6. 2009 Program Assumptions and Incentives

Measure	Annual Planned Gross Savings (kWh/yr/unit)	Annual Planned Net Savings (kWh/yr/unit)	Measure Life (years)	Per unit Customer Incentive	Per unit Builder Incentive
Tier 1 Evaporative Cooler	854	499	10	$200	
Tier 2 Evaporative Cooler	435	254	10	$500	
Whole-house Evaporative Cooler	N/A	N/A	10		$1000

Program History and Design

The Xcel Energy Evaporative Cooling Rebate Program originated as a pilot in 2003. At that time, Nexant Inc. was hired to administer the Program. Marketing efforts targeted builders and the Program was limited to new residential homes. A rebate amount of $500 per eligible installed unit was offered to the builder. In 2004, the Program expanded to include residential electric customers in eligible areas of Xcel Energy's Colorado service territory, primarily along the Front Range. The marketing efforts were revised to target residential customers instead of builders. The rebate amount was adjusted from $500 to $250 per household, and became available to residential customers and HVAC contractors. Even with a lower incentive per household, the participation increased substantially due to offering the rebate directly to residential customers..

In 2005, marketing efforts continued to target residential electric customers and the rebate amount was reduced to $200 per household.

The 2006 Program continued to offer a $200 rebate to residential customers, but expanded the geographic reach to include all residential electric customers in the Colorado service territory. The Program administration and processing of rebates was taken over by Xcel Energy at that time, and the Program exceeded its annual goal.

The Program remained unchanged in 2007. It again exceeded its annual participation goal, providing over 3.5 GWh of savings.

In 2008, the addition of a Tier 2 rebate was introduced. This allowed customers the option to receive a $500 rebate for installing a high efficiency unit with a media saturation effectiveness of 85% or higher, remote thermostat control, and periodic purge water control.

In 2009, the addition of a Tier 3 rebate was introduced, offering a $1,000 rebate to builders for a whole-house ducted evaporative cooling system in new homes or homes with major remodeling. Tier 3 evaporative cooling units must be indirect or indirect/direct combination units to qualify.

Process Flow Diagram

The process flow diagrams shown in Figure 3 and Figure 4 graphically represent the current operation of the Program, consisting of activities and the connections between those activities.

Logic Model

As part of the Program evaluation, we developed a logic model to document information and activity flows between implementers and market actors. The key activities depicted are Program advertising and marketing, outreach and education, rebate processing, and measurement and verification.

These activities lead to outputs essential to Program success, including an advertising campaign and education aimed at residents and trade allies, and trained WECC field representatives. Over the short-term, Xcel Energy benefits from increased Program and energy conservation awareness, a maintained database, and accurate reporting, and residents enjoy a more comfortable and efficient home. In the intermediate-term, benefits to Xcel Energy include increased Program participation and reduced system load at peak. In the long-term, Xcel Energy benefits from demand savings reductions and increased end-user engagement in additional energy conservation activities. Additional long-term outcomes include fewer electric rate increases, a reduced need for additional power plants, environmental preservation, increased sales of evaporative coolers, and reduced market barriers (Figure 5 and Table 7).

Program Elements

The Program contains multiple elements including:

- Advertising and marketing
- Rebate processing
- Data tracking

Figure 3. Evaporative Cooling Process Flow (Tier 1 & 2)

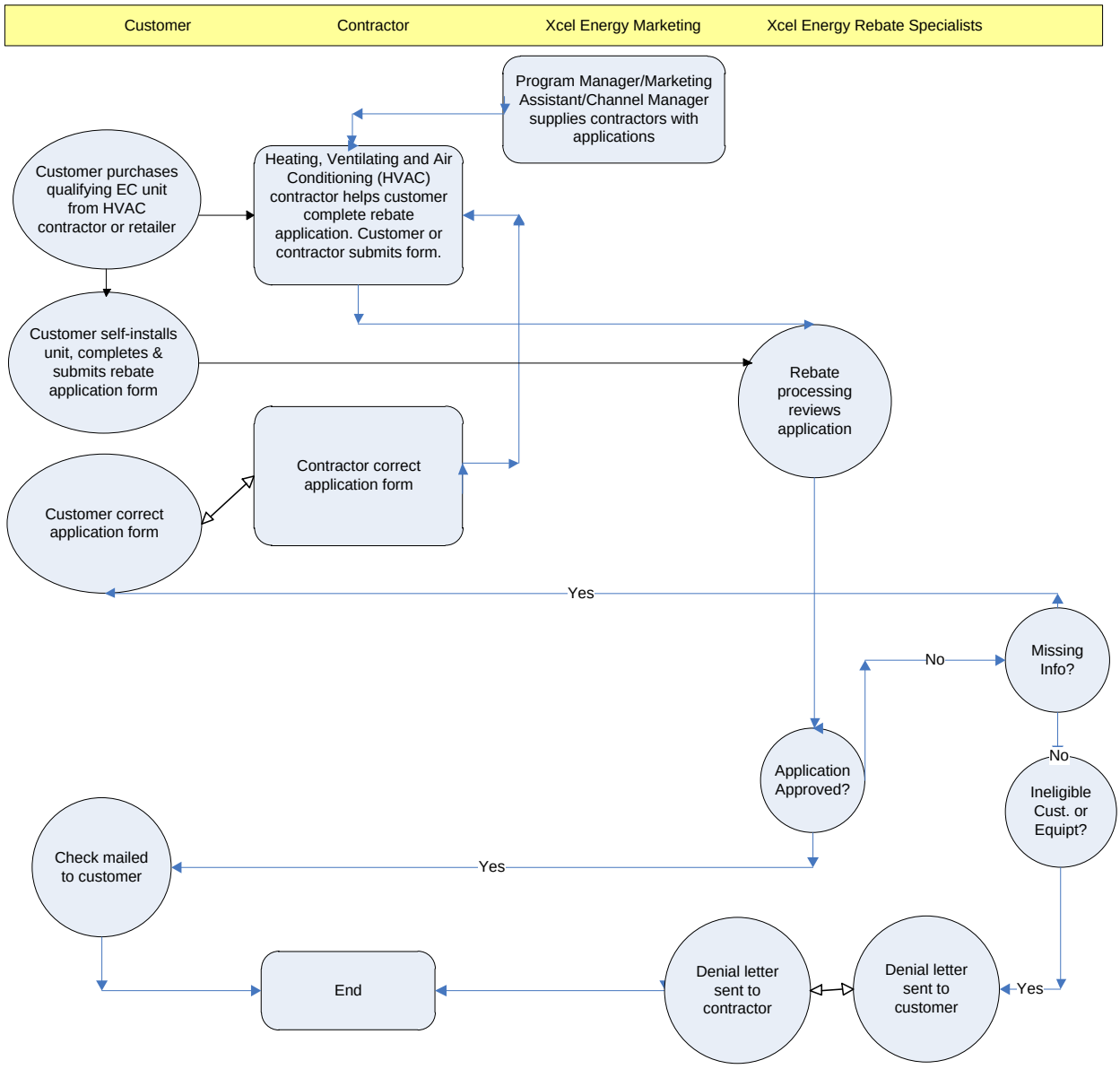


Figure 4. Evaporative Cooling Process Flow (Whole-house)

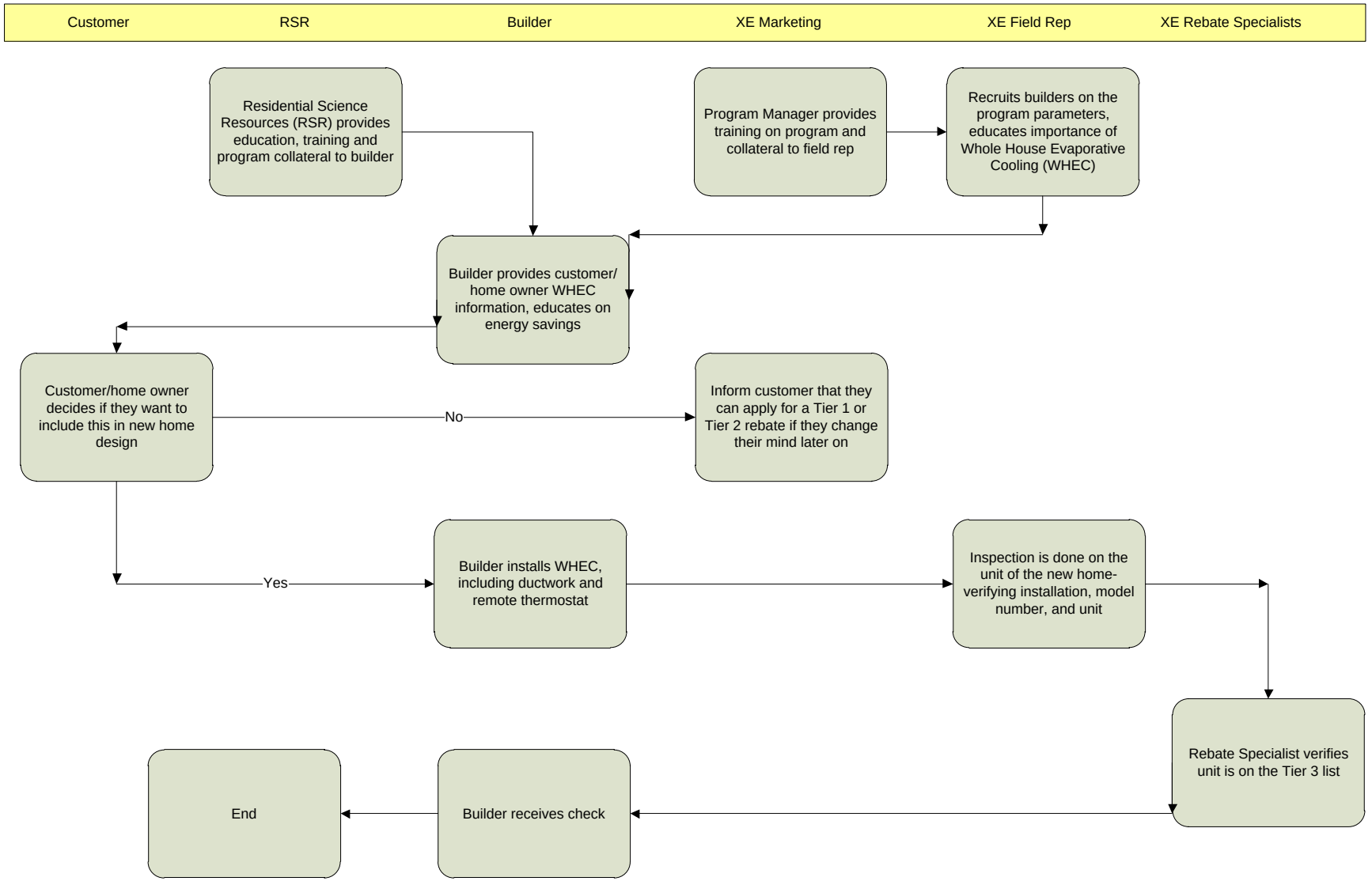


Figure 5. Logic Model

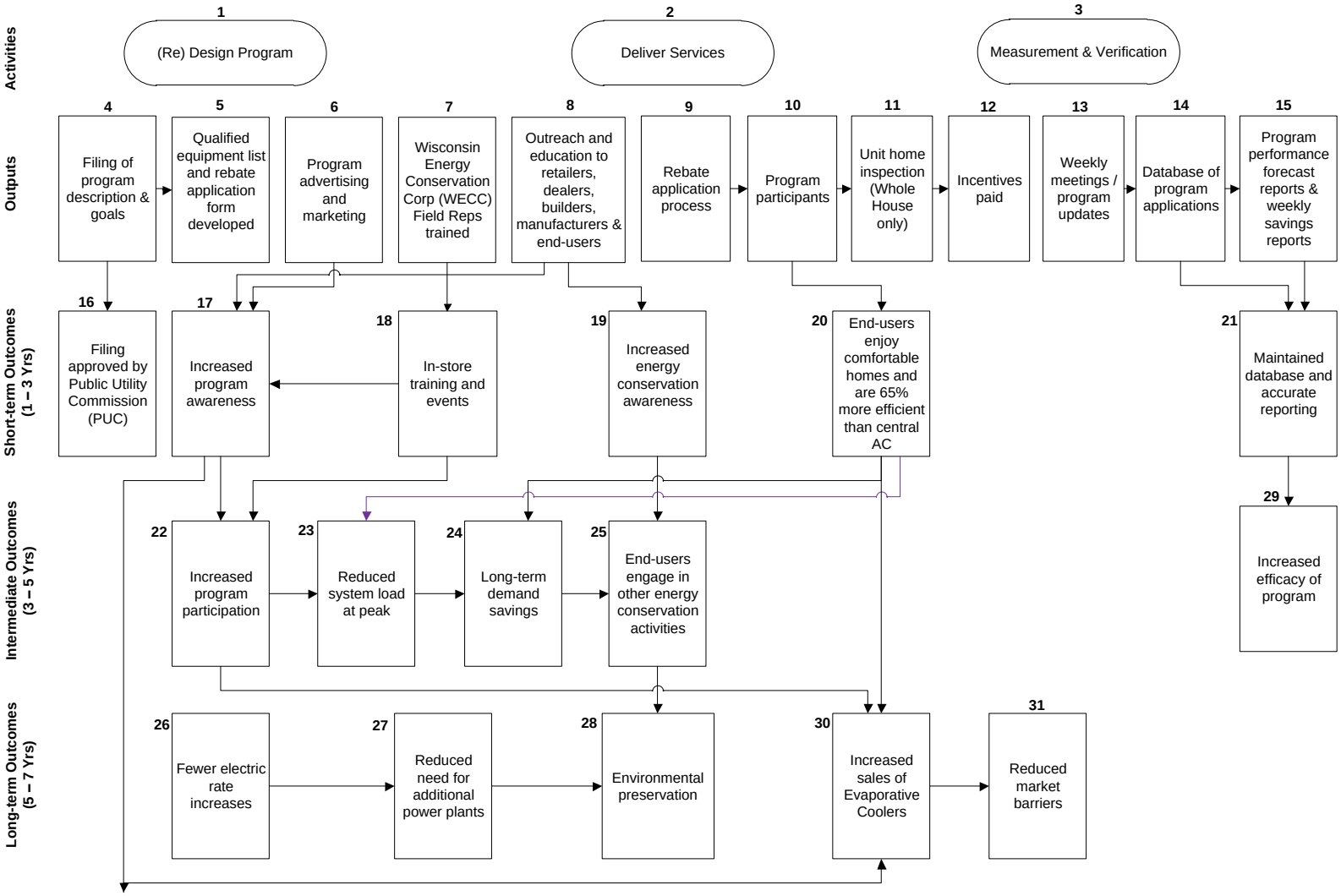


Table 7. Program Theory and Indicators

Link	Program Theory	Indicators
1	Program design fills market need.	• Number of end-users (Tier 1 & 2) participating. • Number of builders (Tier 3) participating.
2	Services delivered are valued by end-users and builders.	• Builder retention in the Program. • Builder feedback.
3	Measurement and verification are essential for Program success.	
4-5	Program revisions and recommended changes are reflected in Program materials.	• Revised materials prepared for Program year.
6	Program advertising and marketing leads to increased Program awareness.	• Number of advertising and marketing collateral pieces developed. • Number of participants and trade allies who remember details of Program marketing.
7	Training provided to WECC field reps leads to in-store training sessions and events, as well as retailer awareness of Program.	• Number of in-store training sessions and events. • Number of retailers attending training sessions and events. • Number of retailers trained and aware of the Program.
8	Outreach and education to retailers, dealers, builders, manufacturers, and end-users leads to increased Program and energy conservation awareness.	• Number of outreach and educational sessions offered. • Number of outreach and educational session attendees. • Number of retailers, dealers, builders, manufacturers, and end-users aware of Program and energy conservation.
9-11	The processing of applications enrolls participants in the Program. Home unit inspections are performed for Tier 3.	• Number of applications completed by end-users or contractors. • Number of problem calls about application. • Number of unit home inspections verifying installation, model number, and unit (Tier 3 only).
12	Participants (end-users and builders) receive incentives for participating in the Program.	• Number of incentives paid to end-users and builders. • Number of end-user and builder participants. • Monetary value of incentives paid to end-users and builders.
13-15	Measurement and verification provides meaningful data for continuous improvement.	• Maintained database and reporting.
16	Commissioners see the value of Program.	
17-18	Increased Program awareness and in-store training and events lead to increased participation and increased sales of evaporative coolers.	• Number of applications submitted. • Number of home inspections on the unit (Tier 3 only). • Number of Program participants. • Year-over-year comparison of EC sales.
19	Increased energy conservation awareness leads to end-users engaging in other energy conservation activities.	• Additional energy conserving actions undertaken by end-users, as evidenced by survey results.
20	End-users enjoying comfortable homes that are 65% more energy efficient than AC, leading to reduced system load at peak, long-term demand savings, and increased EC sales.	• End-user reported satisfaction with EC in home. • kWh demand during peak hours for EC versus AC. • Year-over-year comparison of EC sales.
21	Well-maintained databases and accurate reports lead to increased efficacy of Program.	• Accuracy of database validated. • Program forecast reports and weekly savings reports timely.
22	Increased Program participation leads to reduced	• kWh demand during peak hours.

Link	Program Theory	Indicators
	system load at peak and increased sales of evaporative coolers.	• Year-over-year comparison of EC sales.
23-28	Reduced system load at peak leads to: a. Long-term demand savings. b. Fewer rate increases. c. A reduced need for additional power plants. d. Environmental preservation.	• kWh demand during peak hours on both control and non-control days. • Rate of increase in electric rates for XE customers. • Number of additional power-generating projects underway. • Decreased NOx, SOx, and CO2 emissions from utility generating sources.
29	Having a well-maintained database and accurate reporting will result in increased Program efficacy.	• KW for Program ECs during peak heating season.
31	Increased sales of evaporative coolers lead to reduced market barriers.	• End-users attitude more favorable toward ECs, as evidenced by future survey results.

Advertising and Marketing

Xcel Energy targets customers through a variety of marketing efforts, including promoting the Program through the following strategic marketing efforts:

- Local newspaper advertising
- Internet advertisements
- Monthly customer E-mail updates
- Bill inserts each spring and mid-summer

In addition, Xcel Energy has partnered with over 350 dealers and over 50 retailers who receive product literature and help promote the product. WECC field representatives educate and train retailers on the benefits of evaporative cooling and the rebates offered. Contractors and builders are essential to the customer awareness effort, and they receive information on product and Program changes regularly. Furthermore, Xcel Energy utilizes a channel manager to assist with communicating product details to dealer and distributer channels.

Rebate Processing

To participate in the Xcel Energy Evaporative Cooling Rebate Program, eligible customers must submit a completed application with a copy of their invoice or receipt. Customers may self-install the unit, or hire an HVAC contractor to install it for them. To qualify for a Tier 1 ($200) rebate, the equipment must be new and have a minimum Industry Standard Rated (IRS) airflow of 2,500 CFM. It must be a permanently installed direct, indirect, or two-stage evaporative cooling unit.

To qualify for a Tier 2 ($500) rebate, equipment must be new and have a media saturation effectiveness of 85% or higher, with remote thermostat control and periodic purge water control. Rebates are limited to one per household.

To qualify for a Tier 3 ($1,000 to the builder) rebate, equipment must be installed by a builder and be an indirect or indirect/direct whole-house ducted evaporative cooling system in a new home or installed as part of a major remodel.

Data Tracking

Xcel Energy monitors Program effectiveness by tracking participation and response to various Program efforts. Table 8 lists the data measures used for tracking participation, as well as exposures to marketing and training activities.

Table 8. Program Data Tracking

Data Tracking Measure	Proposed Metric
Residential and builder participation	Number of residential participants, number of builder participants.
Newspaper advertising	Number of newspaper advertisements.
Customer E-mail updates	Number of customer E-mail updates sent, number of customers receiving E-mail updates.
Bill inserts	Number of bill inserts created, number of customers receiving bill inserts.
Builder kits	Number of builder kits created, number of builders receiving kits.
Contractor packets	Number of contractor packets created, number of contractors receiving packet.
WECC field representative training, in-store training, and events	Number of WECC field representatives trained, number of in-store training sessions and events, number of retailers trained on the Program.
Outreach and education to residential participants and trade allies	Number of outreach and educational sessions offered, number of outreach and educational session attendees.
Application and rebate processing	Number of applications completed by residents and contractors, number of home unit inspections verifying installation, model number, and unit (Tier 3 only), number of incentives paid to residents and builders.

Market Barriers

The market barriers for the Program include:

- Builder and residential customers perceive that evaporative coolers are hard to maintain, noisy, and create mold due to elevated moisture levels in the home. Because of historical evaporative cooling use in mobile and manufactured homes, they are also perceived as an air conditioner for the lower income population.
- Lack of participation from retail stores. Currently, Home Depot sells the majority of participating units.
- The decline in the new home construction market creates less opportunity for participation in the Tier 3 level.
  - Builders we surveyed reported that disinterest from new homebuyers and the lack of information about evaporative cooling technology contributed to no Tier 3 systems being installed in 2009.
- Evaporative cooling sales and use are weather sensitive. Cooler than normal summers in the past couple of years has resulted in lower participation, as some customers delay purchasing a unit if weather is mild.
- Evaporative cooling competes with central air conditioning, which is already the established cooling system of choice for many people, and is particularly popular for new homes.
- Customers perceive that evaporative coolers require maintenance more often than central air conditioning.

- Evaporative coolers are larger in size, and some customers and homeowner associations (HOAs) do not like the way they look mounted on the roof or side of the house.

Program Achievements

Table 9 lists the Program participation and savings by year.

Table 9. Colorado Evaporative Cooling Participation and MWh Savings

Year	Annual Participation	Reported MWh Gross Savings
2003	21	
2004	3,053	663
2005	2,882	625
2006	3,211	3,085*
2007	3,713	3,568
2008	3,276	3,116
2009	2,670	1,960

* In 2006, the kWh savings changed from 217 per system to 961 per system.

Table 10 outlines the Program goals and achievements for 2009.

Table 10. Program Achievements for 2009 Program Year

Parameter	Goal	Evaluated Actual
Participation	3,800	2,670
Net Energy Savings	2,071MWh	1,490 MWh
Demand Savings	3,803 kW	2,886 kW

4. Program Staff Interviews

Program Staff Interview Findings

Below are key findings from the Program interviews.

- **The Program objective mentioned most often by Program staff is to meet participation goals.**
- **The key market barrier mentioned most often by Program staff is the negative perception of evaporative cooling.**
    - There is a perception among some builders and residents that evaporative cooling products are cheap, do not work, and create mold.
    - According to Program staff, the Program change needed most is an increased network of builders and retailers, and education provided to those groups that focuses on the benefits of evaporative coolers.
    - The activity that should be conducted to address key market barriers mentioned most often by Program staff is to raise product awareness and promote evaporative cooling technology. Some ideas from program staff included promotional radio events at stores, newspaper ads, cooperative advertising in the retailer's circular, and partnering with knowledgeable contractors when doing Home & Garden shows because event staff don't have a detailed knowledge of the technology.
- **Suggestions for improving future program performance**
    - One Program staff member suggested increasing builder, vendor, and customer education to change poor perceptions of the product.
    - Another idea involved providing more education about the unit value and more customer forums about energy efficient cooling practices.
- **The rebate processing has challenges.**
    - The requirement for residents to include the model number in order to receive a rebate is a challenging aspect, according to some Program staff.
    - The model number must be recorded on the rebate application, yet the number is sometimes missing from the receipt and can be hard to find on the unit, especially once installed.
    - Some customers suggested that the application form be available online via the Xcel Energy Website, where they could submit it electronically. Program staff confirmed that the current rebate form is available online, but must be printed out and mailed in.
- **The trade allies play a key role in promoting the Program.**
    - The WECC field representatives are responsible for retailer outreach and informing retailers of the rebates and benefits of the Program.

  - Contractors, installers, and wholesalers receive Program information through newsletters and the Xcel Energy Website, and are knowledgeable resources on the Program for customers.
  - HERS raters communicate the value of the Program to builders.
  - Xcel Energy holds an annual contest for contractors, awarding those who submit the most rebate forms.

- **Program participation varies by geography and weather.**
  - All Program staff members mentioned that participation varies greatly by weather conditions. Typically, cooler summers result in lower participation, as customers may choose to delay purchasing a unit.
  - Dealers have indicated to staff that Grand Junction, Glenwood Springs, and Vail are primary markets for evaporative cooling and appear to have the least resistance to the technology. Although Mountain and Western Slope regions represent key sales markets, arranging training can be problematic due to the remote nature of these locations.

5. Participant and Nonparticipant Surveys

Summary of Participant Key Findings

- **Bill inserts and retailers are key sources of Program awareness for participants.** More than one-fourth (26%) of participants reported that they first heard about the Xcel Energy Evaporative Cooling Rebate Program from a bill insert, and 25% heard about the Program from a retailer.

- **Most participants were satisfied with their evaporative coolers and the rebate.** Most participants (93%) said they were satisfied with the evaporative cooling rebate application process, 97% were satisfied with the ability of the evaporative cooler to cool the whole house, and 93% of those who gave a rating were satisfied with the electrical cost to operate the evaporative cooler. However, a large proportion (33% of all asked) were unable to respond (said they did not know) about their satisfaction with operation costs, most likely indicating they had not yet received a bill for their summer usage with the new unit.

- **Participants like that they can have the windows open when using their evaporative cooler and that it is energy efficient. They dislike the noise.** Participants reported that what they like most about their evaporative coolers is that they can have air flow by opening their windows (25%), and that the unit is energy efficient (25%). The airflow of the evaporative cooler was noted most often among those 65 years of age or older (31%) compared to those between 55 and 64 years of age (19%). The energy efficiency of the evaporative cooler was noted more often by 35 to 54 year olds (33%) compared to 55 to 64 year olds (20%) and those 65 and older (20%). The price of the evaporative cooler was noted more often by 18 to 34 year olds (15%) and 35 to 54 year olds (11%) compared to 55 to 64 year olds (3%) and those 65 years or older (5%). Noise was cited by participants as being liked least about their evaporative cooler (23%), followed by the unit capacity to cool the whole house (12%), usability and maintenance issues (11%), and excessive moisture and humidity issues (10%).

- **Few participants expressed concerns about owning an evaporative cooler; those who did named cost and unit functionality as their primary concerns.** Only 12% of participants said they had initial concerns about owning an evaporative cooler. Those aged 65 and older were less likely to report concerns about buying an evaporative cooler (7%) compared to those between 35 and 54 years old (17%). Of those with concerns, 28% cited the potential expense, 18% were concerned about excess humidity or moisture, and 15% were not positive that the unit has the capacity to cool the whole house. Some participants reported that their personal experience using evaporative coolers helped them resolve their concerns (22%), and another 22% said the dealer helped them resolve their concerns.

- **Most participants had used an evaporative cooler before, and the primary reason they participated in the Program was to replace or upgrade their current evaporative cooler.** A large majority (68%) of participants had used an evaporative

cooler before installing the rebated evaporative cooler. Of the participants aged 55 to 64 and 65 or older, 80% reported having used an evaporative cooler before installing the rebated evaporative cooler. This percentage is much higher than their younger counterparts, with only 49% of those 18 to 34 years old and 55% of 35 to 55 year olds reporting having used an evaporative cooler before installing the rebated unit.

- **Previous purchase experience and advertising in the store were primary sources for participants deciding where to purchase an evaporative cooler.** One-quarter (25%) of participants reported that they decided where to purchase their new evaporative cooler based on a past purchasing experience, 22% said they decided based on advertising (e.g., in-store signage), and 15% decided based on word-of-mouth. In-store signage was mentioned more by those 65 years or older (30%) than those between 18 and 34 years old (10%). Internet searches were mentioned more by those between 18 and 34 years old (13%) and 35 to 54 years old (12%), versus those 65 and older (3%).

- **Most participants are satisfied with the dealer or retailer who sold them their evaporative cooler, especially when they had previous experience using evaporative coolers.** Almost all (95%) of participants said they are satisfied with the dealer or retailer who sold them their evaporative cooler. They were most satisfied with the dealer or retailer when the primary reason for purchasing an evaporative cooler was to upgrade or replace an existing cooler (99%), compared to when the primary reason for purchasing an evaporative cooler was for non-energy benefits (90%), to conserve energy (91%), or to save money compared to air conditioning (93%). Those who had previously used an evaporative cooler were more satisfied with the dealer or realtor (97%) than those who had only used fans/ceiling fans (90%). Those who had initial concerns about buying an evaporative cooler were less satisfied with the dealer or retailer (84%) than those who did not have initial concerns (97%).

- **The rebate was a higher importance factor in purchasing an evaporative cooler for 18 to 34 year olds compared to those aged 65 or older.** The primary reason participants said they purchased a rebated evaporative cooler was to upgrade or replace their current evaporative cooler (39%), followed by the rebate (25%). The rebate was a more important factor in purchasing an evaporative cooler for 18 to 34 year olds (37%) compared to those aged 65 or older (17%).

- **Over one-third of residential participants said they installed additional energy-efficient equipment or appliances after installing their evaporative cooler.** The energy-efficient equipment or improvement mentioned most often were windows and insulation. Most installed these energy-efficient measures without participating in a utility-sponsored program.

- **The number of participants visiting XcelEnergy.com and ResponsibleByNature.com is moderate.** Overall, 34% of participants said they visited either XcelEnergy.com or ResponsibleByNature.com. Residential customers in the Cautious Couples segment were less likely to say they visited XcelEnergy.com (18%) compared to Young Accumulators (50%), Mainstream Families (38%), Affluent Empty Nesters (38%), and Midlife Success (33%).

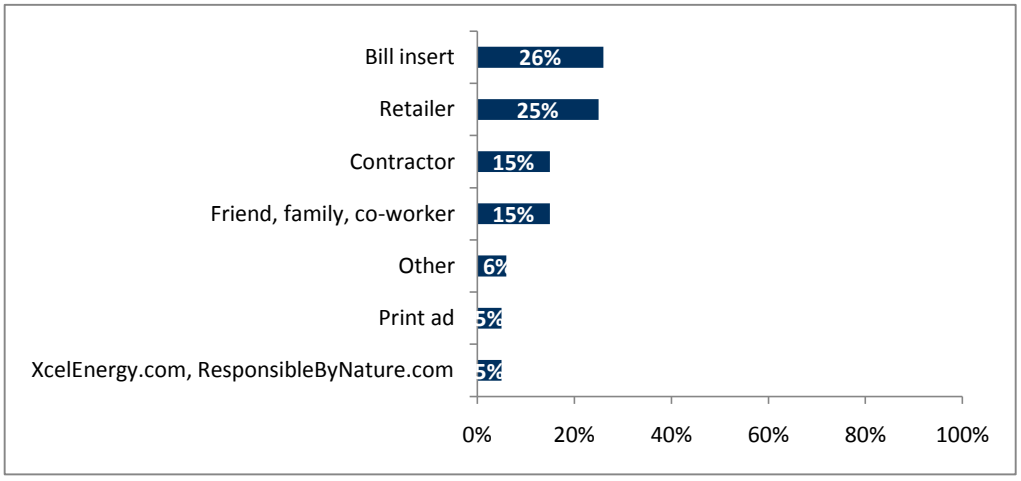
- **Freeridership in this Program is very high;** most participants (81%) reported that they would have purchased the same evaporative cooler without the rebate. Additional responses were also considered when evaluating freeridership.

Participant Detailed Findings

Program Awareness

Bill inserts and retailers were the sources mentioned most often by participants when asked how they first heard about the Xcel Energy Evaporative Cooling Rebate Program. Over one-fourth (26%) of participants said they first heard about the Program incentive from a bill insert, and another 25% heard about the Program from a retailer (Figure 6).

Figure 6. Source of Awareness of Xcel Energy Evaporative Cooling Incentive (n=307)



D1. How did you first hear about the Xcel Energy Evaporative Cooling Rebate Program incentive? Unaided, mark one.

The XcelEnergy.com and ResponsibleByNature.com Websites were not mentioned as the top sources for information on the Xcel Energy Evaporative Cooling Rebate Program. Only a third (34%)of participants reported having visited either Website, and those who did visit one or both of the Websites said they did not first hear about the Program through the Website(s). However, the Websites were cited by participants as being useful sources of information in other ways.

- Residential customers who said they installed additional energy-efficient equipment or improvements after installing their rebated evaporative cooler were more likely to say that they visited XcelEnergy.com or ResponsibleByNature.com (40% versus 31%).
- Furthermore, residential customers who considered purchasing and installing CAC before purchasing and installing their evaporative cooler were more likely to say they visited XcelEnergy.com or ResponsibleByNature.com (41%) compared with those who did not consider purchasing and installing CAC (31%).

Overall, 34% of participants who did not first hear about the Program incentive from the XcelEnergy.com or ResponsibleByNature.com Websites had visited one of the Websites.

PRIZM Segments

Xcel Energy provided customer segmentation data on each survey sample point using the Nielsen Claritas PRIZM Market Segmentation[3] model. Codes for the 11 life stages were appended to each response record, and summary data for the Xcel Energy customer population and Evaporative Cooling Participant population were also provided (Table 11).

According to the data provided, four PRIZM life stage categories account for over half (53%) of the Evaporative Cooling Participants: Conservative Classics (17%), Cautious Couples (13%), Affluent Empty Nests (10%), and Young Accumulators (14%). These four life stage categories were labeled "High Index," having the highest index scores that identify them as key prospects for participation in the Evaporative Cooling program. Two additional life stage categories, Mainstream Families (14%) and Midlife Success (12%), are strongly represented in both the Colorado residential and the evaporative cooling populations. These two by virtue of their proportion in the populations were classified as a "Mid Index" grouping. The remaining five life stage categories and one unclassified record were classified as a "Low Index" group on the basis of lower proportions in the population and lower index scores.

Table 11. PRIZM Segments for Evaporative Cooling

Life Stage Category	PRIZM Life Stage Name	Colorado Residential Customers		CO Evaporative Cooling Participants			Survey Responses		
		Count	%	Count	%	INDEX	Index Category	Count	%
M2	Conservative Classics	135192	10%	1153	17%	169	High	62	19%
M3	Cautious Couples	110609	8%	885	13%	159	High	52	16%
M1	Affluent Empty Nests	103529	8%	675	10%	129	High	41	12%
F2	Young Accumulators	153519	11%	989	14%	128	High	40	12%
F3	Mainstream Families	161300	12%	964	14%	118	Mid	32	10%
Y1	Midlife Success	232680	17%	838	12%	71	Mid	44	13%
M4	Sustaining Seniors	79121	6%	438	6%	110	Low	22	7%
F4	Sustaining Families	56365	4%	205	3%	72	Low	17	5%
Y2	Young Achievers	187426	14%	501	7%	53	Low	13	4%
Y3	Striving Singles	78766	6%	183	3%	46	Low	8	2%
F1	Accumulated Wealth	84305	6%	144	2%	34	Low	3	1%
	Unknown						Low	1	*
Total		1382812	100%	6975	100%			335	

[3] Xcel Energy has selected the Nielsen Claritas comprehensive consumer segmentation system, PRIZM for marketing segmentation across all DSM programs. For more information see the Nielsen Claritas Web site: http://en-us.nielsen.com/tab/product_families/nielsen_claritas/prizm.

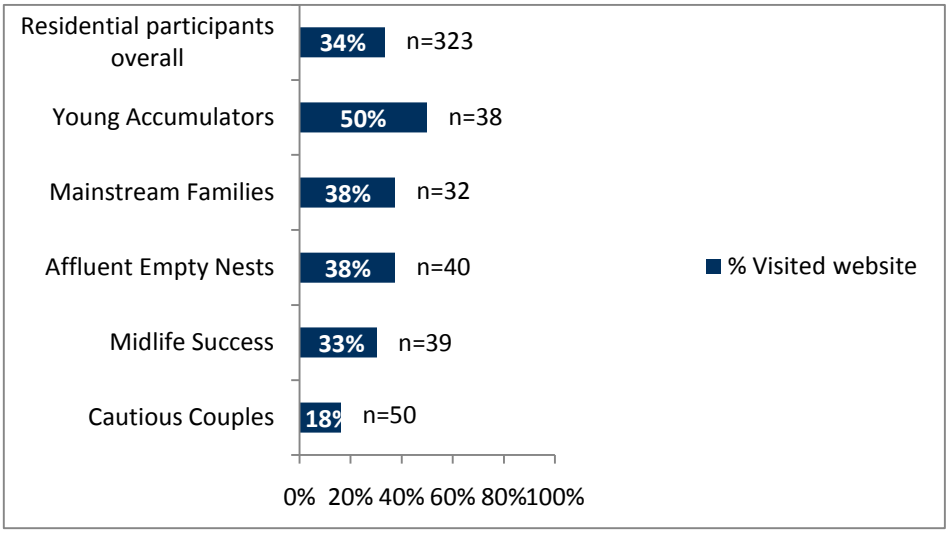
Participant survey responses tended to mirror the life stage proportions found in the evaporative cooling population. Thus, the survey respondents were considered representative of the segmentation categories in the evaporative cooling population.

Note that the segment proportions for evaporative cooling and survey respondents differ from the Colorado customer population. For example, evaporative cooling tends to have higher proportions of Cautious Couples and Affluent Empty Nests and lower proportions of Young Achievers. Age is likely the driver of these differences, with older customers more inclined to evaporative cooling. This is consistent with the age demographic proportions found in the participant survey responses and the references to differences between age groups reported for several topic areas.

The Team used the high, mid, and low index categories to analyze survey data, finding differences between those that are considered key prospects and those that may be less inclined to participate. Detailed results for segment differences are described within the topic areas that follow.

Participants in the Cautious Couples segment were less likely to say they visited XcelEnergy.com or ResponsibleByNature.com (18%) compared with Young Accumulators (50%), Mainstream Families (38%), Affluent Empty Nests (38%), and Midlife Success (33%; Figure 7).

Figure 7. Visited XcelEnergy.com or ResponsibleByNature.com



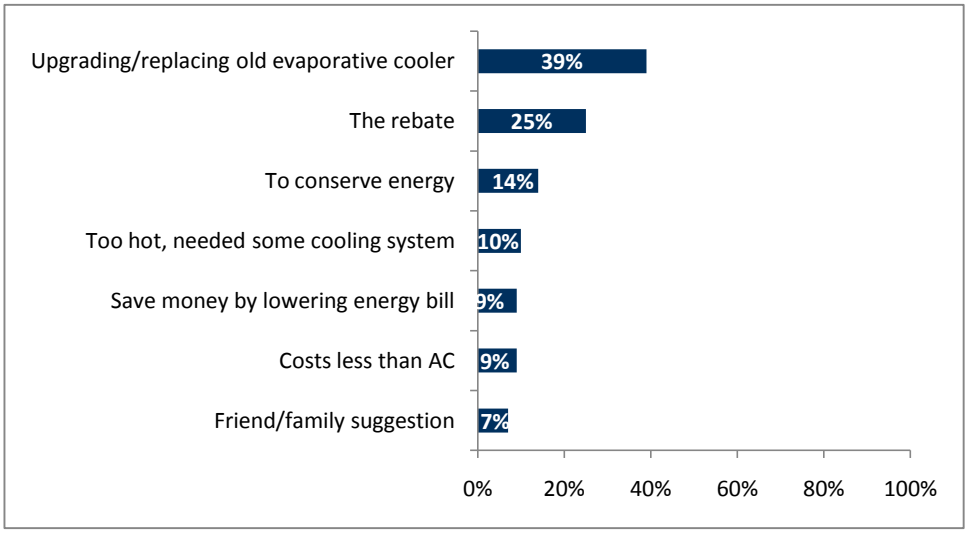
D2. Have you visited the Xcel Energy Website or the Responsible by Nature Website?

Reason for Purchase

The primary reason participants said they purchased a cooling system that qualified for a Program rebate was to upgrade or replace an old evaporative cooler (39%), followed by the rebate (25%), and the desire to conserve energy (14%; Figure 8). The rebate was a more

important factor for those 18 to 34 years of age (37%) compared with those 65 years or older (17%).

Figure 8. Primary Reason for Buying a Rebated Evaporative Cooler (n=335)



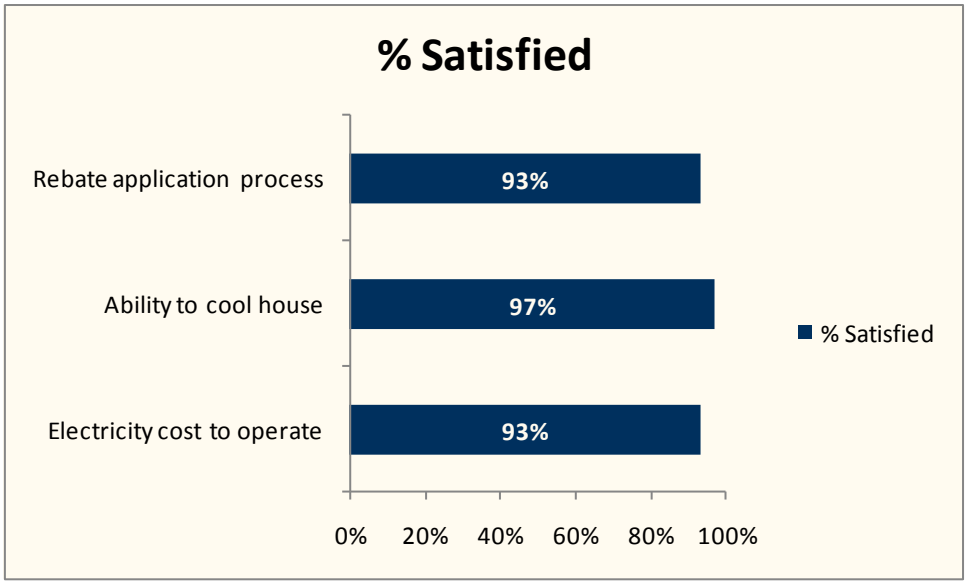
D3. What was your primary reason(s) for buying a cooling system that qualified for the evaporative cooling rebate? Unaided, multiple responses.

Satisfaction

Participants reported being satisfied with their evaporative cooling system (Figure 9).

- Most (93%) participants said they were satisfied with the rebate application process.
- Most (97%) participants said they were satisfied with the ability of the evaporative cooler to cool the whole house; while 25 respondents said they did not know as there were too few hot days this past summer to be able to judge the effects of the cooler.
- Almost all who gave a rating said they were satisfied with the electrical cost to operate the evaporative cooler (93%); an additional 33% said they did not know, most likely indicating they had not yet received an electric bill reflecting usage of the new unit at the time of the interview.

Figure 9. Satisfaction with Rebated Evaporative Cooler (n=339)



On a scale of 0 to 10 where 0 is not at all satisfied and 10 is completely satisfied, how satisfied have you been with:

- D6. The evaporative cooling rebate application process?
- D4. The ability of your evaporative cooler to cool your house on very hot days?
- D5. The electrical cost to operate the evaporative cooler?

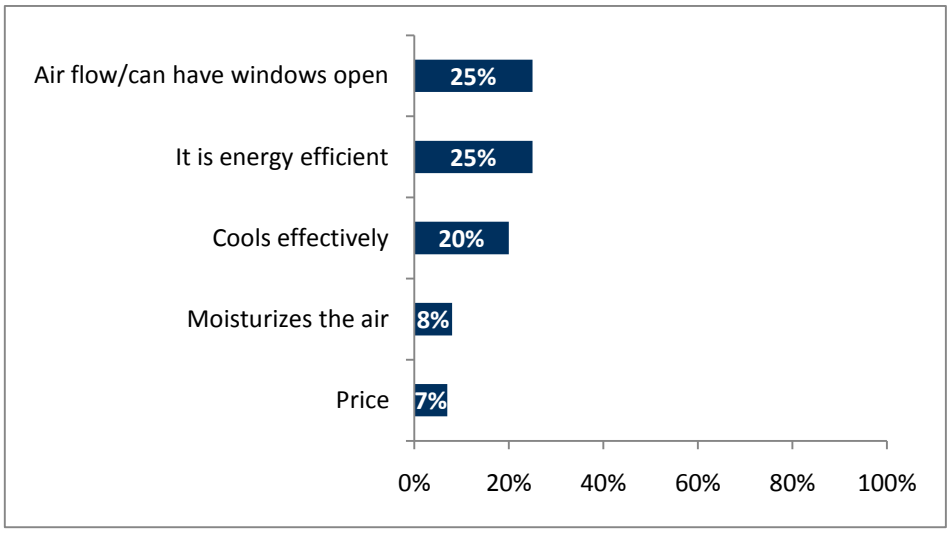
Satisfaction is depicted on the chart by ratings of 6 to 10.

When participants were asked what they like most about their evaporative cooler, 25% mentioned air flow and that they can have their windows open, another 25% said they like that the unit is energy efficient, and 20% said the unit cools effectively (Figure 10).

The benefits participants reported liking most about their evaporative coolers varied by respondent age:

- The benefit of airflow associated with the evaporative cooler was reported more often among those 65 years or older (31%) compared with those 55 to 64 years of age (19%).
- The energy efficiency of the evaporative cooler was noted more among 35 to 54 year olds (33%) compared with those 55 to 64 (20%) and those 65 or older (20%).
- The price of the evaporative cooler was more important to those 18 to 34 years old (15%) and 35 to 54 years old (11%) compared with those 55 to 64 (3%) and 65 or older (5%).

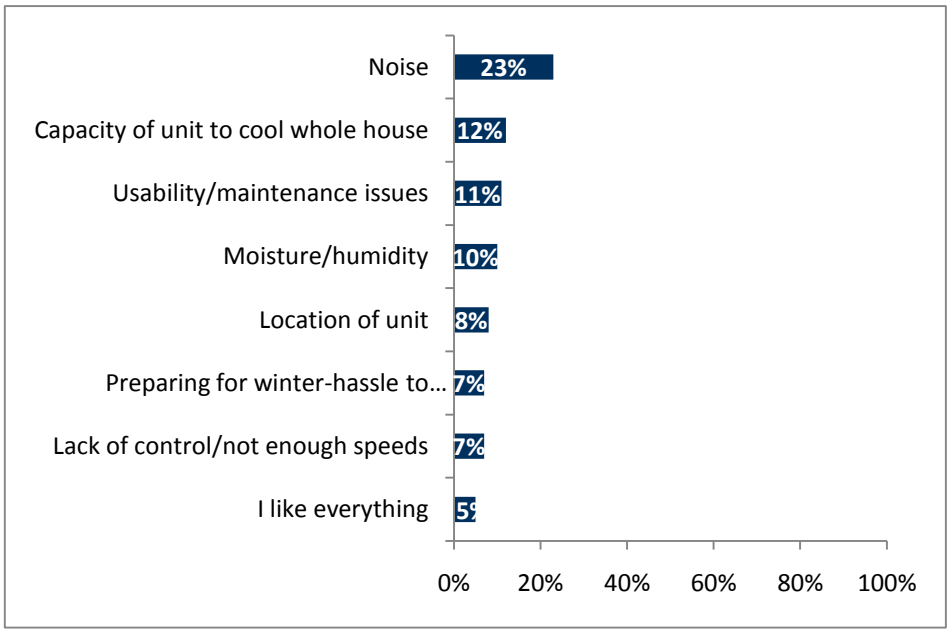
Figure 10. What Participants Like Most about Their Evaporative Cooler (n=327)



D7. What do you like most about your evaporative cooler?

When participants were asked what they like least about their evaporative cooler, noise was mentioned most often (23%), followed by the capacity of the unit to cool the whole house (12%), maintenance issues (11%), and excessive moisture/humidity (10%; Figure 11).

Figure 11. What Participants Like Least about Their Evaporative Cooler (n=204)

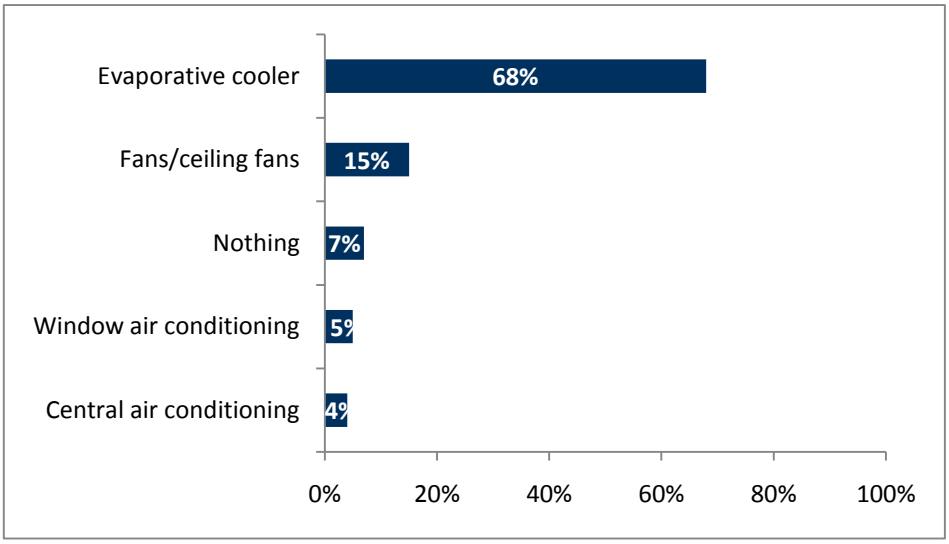


D8. What do you like least about your evaporative cooler?

Previous Owners of Evaporative Cooling Versus First Time Buyers

Overall, 68% of participants said they had used an evaporative cooler before installing their rebated evaporative cooler (Figure 12). Residential customers in the Hi Index segment (M2, M3, M1, F2) were more likely to have used evaporative cooling before installing the rebated evaporative cooler (74%) compared with the Mid Index segment (F3, Y1; 63%) and the Low Index segment (M4, F4, Y2, Y3, F1; 59%). More residential customers in the Low Index segment used fans or ceiling fans before installing the rebated evaporative cooler (22%) compared with those in the Hi Index segment (13%). Participants aged 55 to 64 (80%) and 65 and older (80%) were more likely to have used evaporative cooling before installing the rebated evaporative cooler compared to 18 to 34 year olds (49%) and 35 to 54 year olds (55%).

Figure 12. Cooling Equipment Participants Used Before Installing Rebated Evaporative Cooler (n=336)



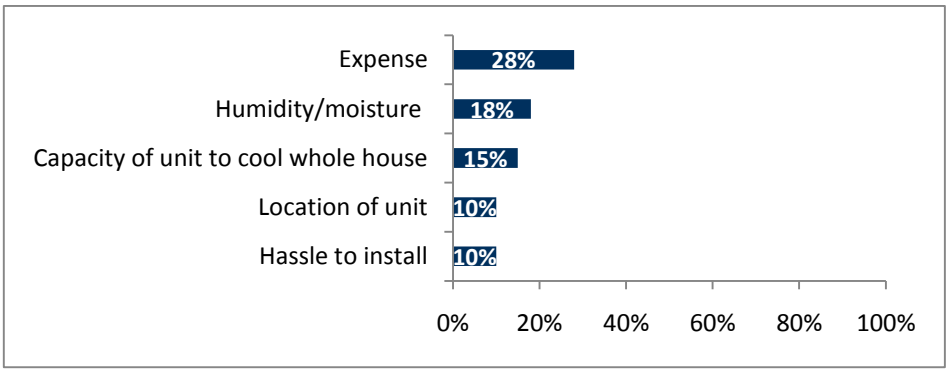
D9. What kind of cooling equipment did you use before installing the rebated evaporative cooler?

Customer Concerns

Overall, 12% of participants had initial concerns about buying an evaporative cooler. Those in the Hi Index segment (M2, M3, M1, F2) were more likely to say they had concerns (14%) compared with those in the Low Index segment (M4, F4, Y2, Y3, F1; 6%). Only 7% of residential customers age 65 and older reported having concerns about buying an evaporative cooler compared to 17% of those between 35 and 54 years of age.

Of those (40 respondents) who had concerns about buying an evaporative cooler, 28% said they were concerned about the expense, 18% were concerned about humidity or moisture, and 15% were concerned about the capacity of the unit to cool the whole house (Figure 13).

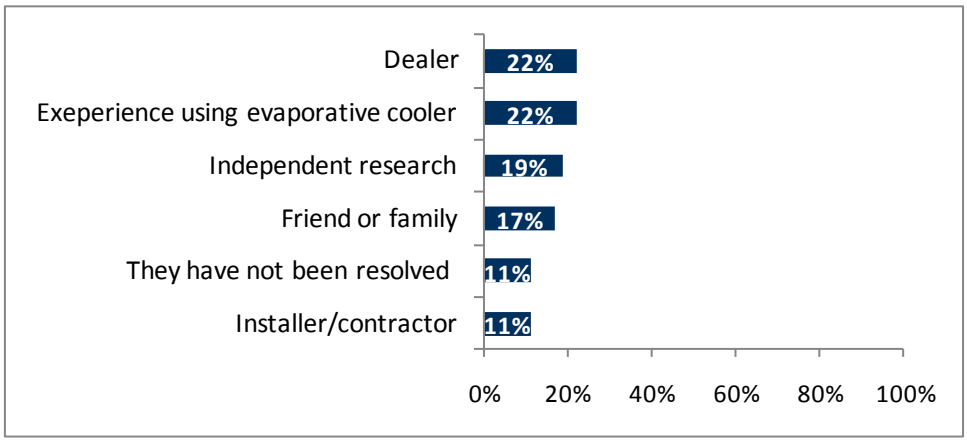
Figure 13. Residential Participant Concerns About Evaporative Cooling (n=40)



D10. What concerns did you have? Unaided, multiple responses.

Of those who had concerns about buying an evaporative cooler, 22% said the dealer helped them resolve those concerns, and another 22% said their past personal experience using evaporative coolers helped resolve their concerns. Another 19% cited independent research, and 17% reported that a friend or family member helped them resolve their concerns (Figure 14).

Figure 14. Who or What Helped Resolve Concerns about Evaporative Cooling (n=36)

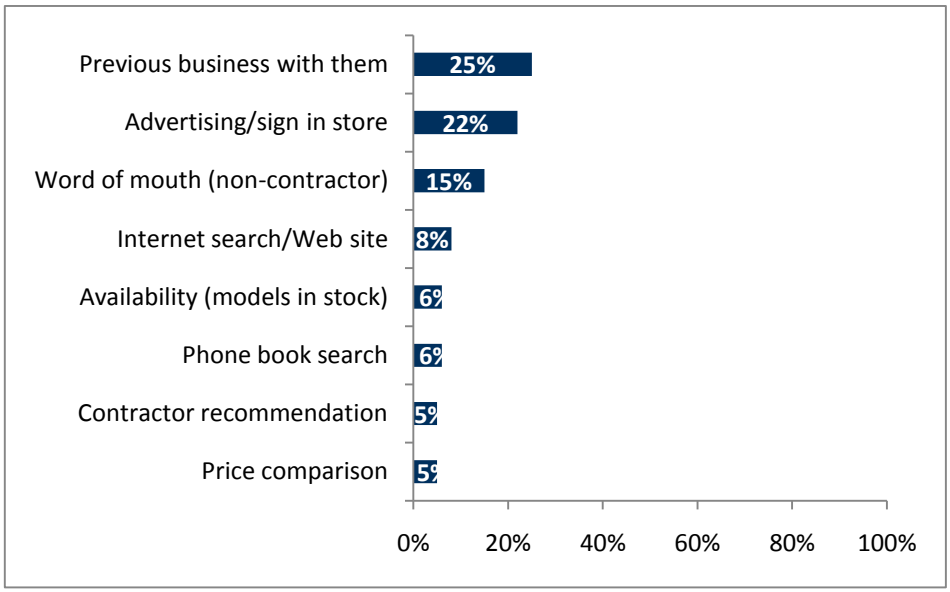


D11. Who or what helped resolve those concerns? Unaided, mark all that apply.

Purchase Source

One-quarter (25%) of participants decided where to purchase their evaporative cooler based on where they had purchased a cooling system in the past, 22% decided based on advertising (e.g., in-store signage), and 15% decided based on word-of-mouth (Figure 15).

Figure 15. Source for Deciding Where to Buy Evaporative Cooler (n=326)



D14. How did you identify or decide on the dealer/store from whom you bought the equipment?

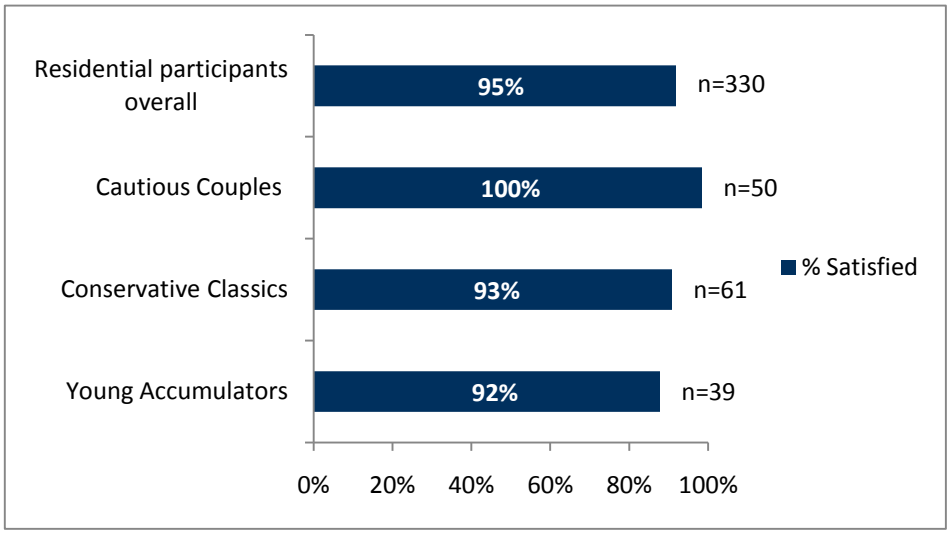
Location of where they purchased a cooling unit in the past (29%) and advertising (26%) were more likely to be mentioned by Tier 1 participants as the source for deciding where to buy an evaporative cooler than for Tier 2 participants (19% and 17%). Advertising was mentioned more often by those 65 years or older (30%) than those 18 to 34 (10%). Internet searches were mentioned more often by those 18 to 34 (13%) and 35 to 54 (12%) versus those 65 and older (3%).

Satisfaction with Contractor or Retailer

Residential participant satisfaction with the dealer or retailer from whom the evaporative cooler was purchased was high, with 95% reporting they were satisfied. Cautious Couples were more satisfied (100%) than Young Accumulators (92%) and Conservative Classics (93%; Figure 16).

- When the primary reason for purchasing a Program evaporative cooler was to upgrade or replace an existing evaporative cooler, participants were more satisfied with the dealer or retailer (99%) than when the primary reason for purchasing an evaporative cooler was for non-energy benefits (90%), to conserve energy (91%), or to save money compared to air conditioning (93%).
- Those who said they had initial concerns about buying an evaporative cooler also said they were less satisfied with the dealer or retailer (84%) than those who did not have initial concerns about buying an evaporative cooler (97%).
- Those who said they had used evaporative cooling before were more satisfied with the dealer or retailer (97%) than those who used fans/ceiling fans to cool their home previously (90%).

Figure 16. Residential Participant Satisfaction with Dealer/Retailer (n=330)



D15. On a 0 to 10 scale where 0 is not at all satisfied and 10 is completely satisfied, how satisfied were you with the dealer/retailer from whom you purchased your evaporative cooler? Chart depicts responses of 6 – 10.

Only eight participants said they were dissatisfied with the dealer or retailer from whom they purchased their evaporative cooler. Of these, four were dissatisfied with poor customer service, two said they were not offered enough assistance or troubleshooting on how to use the evaporative cooler, one was dissatisfied with the price, and one reported that the installer did not clean up after installation.

Freeridership Responses

Freeriders are defined as participants who would have purchased the energy saving equipment even if they had not received a rebate from the utility. We evaluated the level of freeridership in this Program by asking multiple questions of Program participants to gauge their likelihood of participating without the influence of rebates. As discussed in Chapter 8, freeridership for this Program is high; most participants said they would have purchased an evaporative cooler without the rebate.

- When Participants were asked if they would have installed the same evaporative cooler without a rebate, 73% said yes, 17% said no, and 10% said they don't know. Of those 73% who said they would have installed the same evaporative cooler without a rebate, 96% said they would have installed the same type and size of evaporative cooler, while 4% may have selected a different unit. Of those who said they would have installed the same type and size of evaporative cooler, 88% would have installed it within the same year, 11% would have installed it in within one to two years, and 1% would have installed it within three to five years.
  - Of those who said they would not have installed the same type of evaporative cooler without the rebate, 12% said they would not have installed any evaporative cooler at all and 88% said they would still have installed a different evaporative cooler. Those who said they would

have still installed an evaporative cooler were asked again if they would have selected an evaporative cooler of a different type or size; 96% said yes and 4% said no. Of those who said yes, 68% would have installed it within the same year, 26% would have installed it within one to two years, and 5% would have installed it within three to five years.

- Participants were also asked if they had they ever installed the same type of evaporative cooler before participating in the Program; 29% said yes and 71% said no[4].
- Participants were asked if they considered purchasing and installing a central air conditioner before deciding on purchasing and installing their evaporative cooler; 32% said yes and 68% said no.
- When participants were asked what other factors affected their decision to buy an evaporative cooler over a central air conditioning unit, 61% mentioned purchase or installation costs and 20% mentioned the cost to operate.

Freeridership scoring of these responses is presented in Appendix D.

Spillover Responses

One-third (33%) of participants said they installed additional energy-efficient equipment or appliances after installing their evaporative cooler. The energy-efficient equipment participants installed most frequently were windows (n=27) and Other-Specify (n=27), which includes an exterior door, low-flow toilet, thermostat, storm door, and/or stove (Table 12).

Most participants installed these additional energy-efficiency measures without participating in a utility-sponsored program. When participants did install these additional energy-efficiency measures through a utility-sponsored program, those mentioned most often included an Xcel Energy rebate LEAP or federal government or tax rebates.

Participant responses to these items are analyzed in greater detail for spillover in Chapter 8.

[4] This was based on a single question that was recorded as two separate items (E4 and E8)to accommodate branching questions. All participants were asked this question once and responses were combined in the summary above.

Table 12. Energy-Efficient Equipment Participants Installed After Installing Evaporative Cooler

Equipment / Improvement	Year Installed		Utility-sponsored Program	Utility
	2009	2010		
Clothes washer (n=14)	8	7	2	Frigidaire rebate (1), Xcel Energy rebate (1)
Dishwasher (n=10)	5	5	4	Federal rebate program (1), Xcel Energy rebate (2), Don't know (1)
Duct sealing (n=2)	2	0	0	NA
Furnace (n=6)	3	3	3	Tax rebate (1), Don't know (2)
Insulation (n=16)	11	5	3	LEAP Program (1), Xcel Energy and Recharge Colorado (1), Xcel Energy rebate (1)
Lighting (n=17)	11	6	1	LEAP Program (1)
Refrigerator/freezer (n=14)	6	8	3	Lowe's rebate (1), Xcel Energy rebate (1), Don't know (1)
Solar system (n=1)	1	0	0	NA
Water heater (n=7)	6	1	3	LEAP Program (1), Tax rebate (1), Xcel Energy rebate (1)
Whole-house fan (n=2)	2	0	0	NA
Windows (n=27)	18	9	5	Tax credit (2), Federal program (1), Don't know (2)
Other (n=27)	19	8	5	Rebate from Denver Water (2), Tax credit (1), Xcel Energy rebate (1), Don't know (1)

F1. Did you install any additional energy-efficiency equipment, or make any additional energy-efficiency improvements to your home after installing your evaporative cooler in [MONTH, year]? If yes, we would like to know about a few of the types of equipment or improvements that are energy efficient.
F2. If mentioned, was it through a program that was sponsored by a utility? If yes, which utility or rebate program was it?

Residential Participant Profile

Participants who responded to the survey typically live in a single family detached home (91%), between 1,000 and 2,000 square feet (62%), that was built before the 1970s (46%). On average, there are two members in the household (52%) with over one-third (33%) of participants age 65 or older.

Most participants who responded to the survey were willing to participate in the onsite portion of the study for the incentive offered, involving having a meter installed on their evaporative cooler for three months over the summer (85%). Evaporative coolers were typically hard-wired (70%) and located on the roof (72%).

See Table 13 for a full breakdown of participant demographics.

Table 13. Participant Demographics

Household Characteristics	Participants
Type of home:	
Single family detached	91%
Single family attached	5%
Unit in a multifamily building with three or more units	2%
Manufactured home or house trailer	2%
Year home was built:	

Household Characteristics	Participants
Before 1970s	46%
1970s	29%
1980s	14%
1990s	8%
2000s	3%
Home square footage:	
Under 1,000 square feet	8%
1,000 – 1,500 square feet	31%
1,501 – 2,000 square feet	31%
2,001 – 2,500 square feet	19%
2,501 – 3,000 square feet	6%
3,001+ square feet	5%
Number of people living in household:	
1	17%
2	52%
3	11%
4	14%
5+	7%
Age:	
18 – 24	2%
25 – 34	9%
35 – 44	13%
45 – 54	22%
55 – 64	22%
65 or older	33%
Interest in participating in on-site portion of study:	
Yes	85%
No	15%
Location of evaporative cooler:	
Ground beside house	6%
In a window	21%
On the roof	72%
Evaporative cooler plugged in or hard wired:	
Plugged in	30%
Hard-wired	70%

Summary of Nonparticipant Key Findings

- **Nonparticipants had lower awareness of the Xcel Energy Evaporative Cooling Rebate Program compared to other Xcel Energy sponsored programs.** While over one quarter (30%) of nonparticipants said they were aware of the Xcel Energy Evaporative Cooling Rebate Program, and over a third (36%) had heard about the Program through a bill insert, nearly two-thirds (65%) of nonparticipants said they were aware of other energy saving programs or rebates offered by Xcel Energy. The programs they were most aware of included central air conditioning rebates (47%), Saver's Switch (37%), and furnace rebates (32%).

- **Most nonparticipants said they did not visit ResponsibleByNature.com or XcelEnergy.com.** Nearly two-thirds (63%) of nonparticipants had not visited either the ResponsibleByNature.com or XcelEnergy.com Website. One-fourth (25%) reported they

had visited XcelEnergy.com, 2% visited ResponsibleByNature.com, and 11% reported visiting both Websites. Nonparticipants age 65 or older more often had not visited either Website (91%) compared to 35 to 54 year olds (42%) and 55 to 64 year olds (67%).

- **Most nonparticipants said they have used central air conditioning before, and the primary reason they chose central air conditioning again was to replace an old unit**. Nonparticipants most frequently cited central air conditioning (39%), followed by no previous cooling system (17%) and evaporative cooling (17%) as the system used before installing their current central air conditioner. The most frequently mentioned reason why nonparticipants chose central air conditioning for their homes was that their old central air conditioner broke down (22%).

- **Nonparticipants considered other cooling systems such as evaporative cooling, but their concerns and previous experience owning an evaporative cooler prevented them from purchasing one again.** The most frequently mentioned reason nonparticipants chose central air conditioning over evaporative cooling was their concerns about evaporative coolers (38%). Over one-quarter (27%) of nonparticipants said they considered other types of cooling systems, and the cooling system they considered most often was evaporative cooling (84%). Of those who did not consider another type of cooling system before their 2009 purchase of a central air conditioner, 29% said that at some point they had considered buying an evaporative cooler. Of those, 64% said they had concerns about evaporative coolers including the capacity of the unit to cool the whole house (38%) and excess moisture and humidity (34%). Nonparticipants most often reported that their concerns were based on a previous experience using evaporative coolers (45%) and independent research (26%).

- **Most nonparticipants were satisfied with their central air conditioning unit.** Most (96%) said they were satisfied overall with their central air conditioning unit; 94% said they were satisfied with the ability of their unit to cool the house, and 76% said they were satisfied with the electrical cost to operate the central air conditioner. Some (17%) were dissatisfied with the operational costs, and 19% said they did not know.

    - Satisfaction with energy saving information from Xcel Energy is moderate, with 73% reporting they are satisfied with the information available.

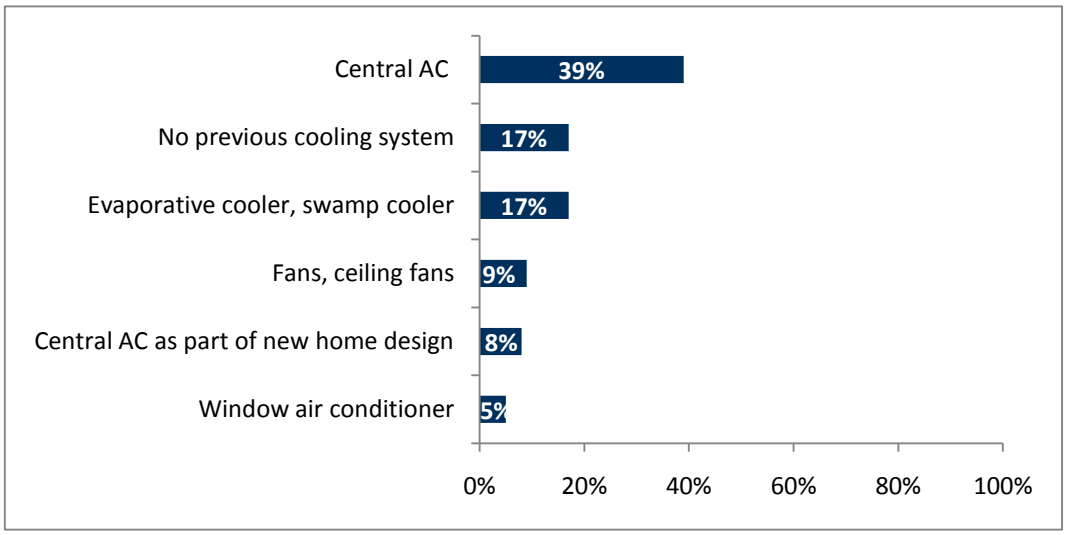
    - Nonparticipants who are aware of energy saving programs and rebates offered by Xcel Energy are more satisfied with the energy saving information provided by Xcel Energy (79%) compared to those who are not aware of energy saving programs or rebates offered by Xcel Energy (60%).

- **Almost half (44%) of nonparticipants said they installed additional energy-efficient equipment or made additional energy-efficiency improvements to their homes after installing central air conditioning.** The equipment they installed most often was an energy-efficient furnace or boiler (37%).

Nonparticipant Detailed Findings

Nonparticipants were asked what type of cooling equipment they used before installing their new central air conditioning unit. Central air conditioning (39%) was most frequently mentioned, followed by no previous cooling system (17%), and evaporative cooling (17%; Figure 17).

Figure 17. Cooling Equipment Nonparticipants Used Before Installing Central AC (n=115)

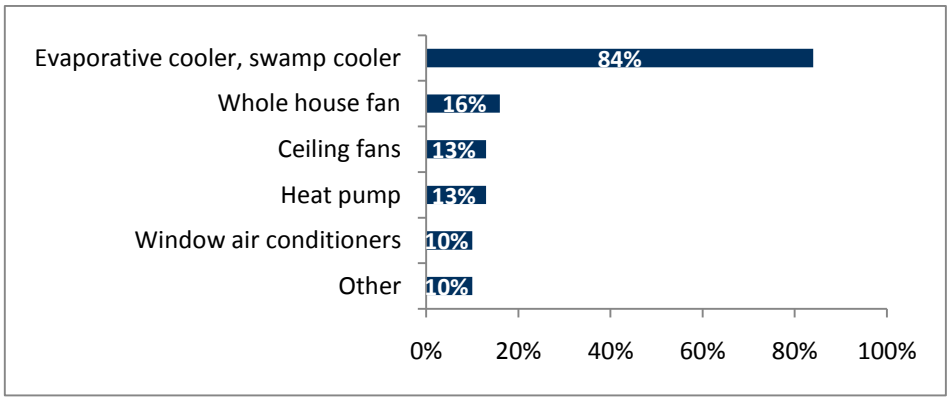


C2. What type of cooling equipment did you use before you installed the new central AC unit?

Decision Process

The most frequently mentioned reason why nonparticipants chose central air conditioning was that the old central air conditioner broke down (22%), followed by Other (21%), which includes the perception that central air conditioning works better than evaporative coolers, a new furnace was needed so they added air conditioning as well, and to increase their house resale value. Over a quarter (27%) of nonparticipants said they considered other types of cooling systems when they purchased their central air conditioning unit, and of those, most (84%) considered evaporative cooling (Figure 18).

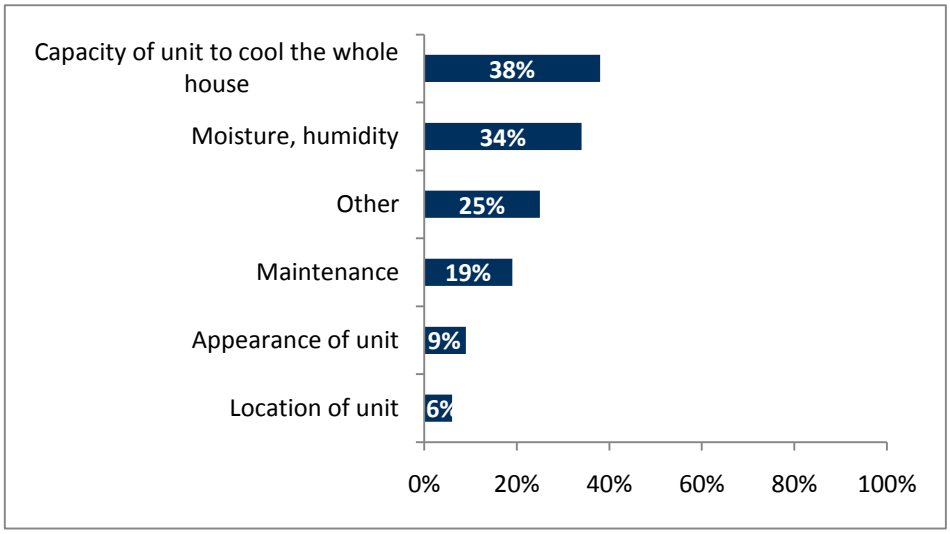
Figure 18. Other Types of Cooling Systems Nonparticipants Considered (n=31)



D2. At the time you purchased your central AC unit, did you consider any other types of cooling systems?
D3. What other types of cooling systems did you consider before purchasing your central air conditioner?

Of those who did not consider another type of cooling systems before purchasing their current central air conditioner, 29% said they had previously considered buying an evaporative cooler, but of those 29%, 64% reported having concerns about buying this type of unit. The concern mentioned most often was the capacity of the unit to cool the whole house (38%), followed by excess moisture and humidity (34%; Figure 19).

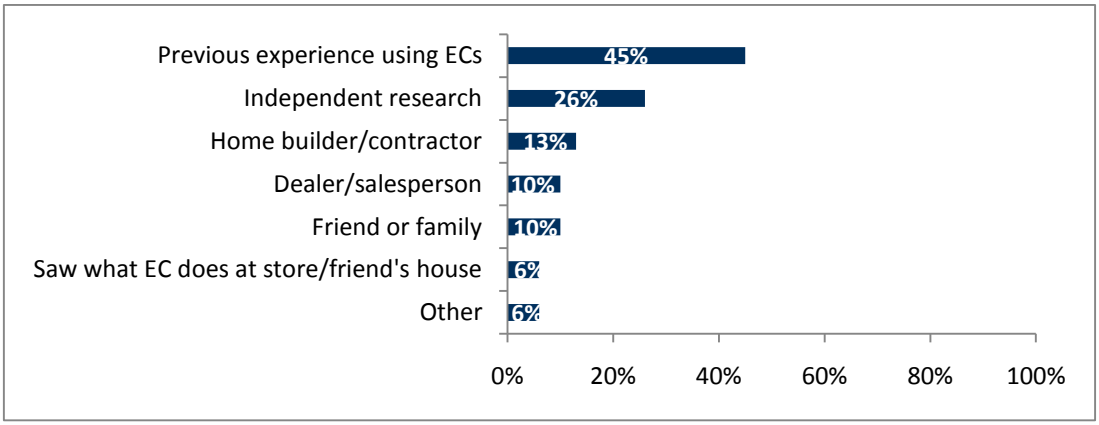
Figure 19. Nonparticipant Concerns Regarding Evaporative Cooling (n=32)



D6. What concerns did you have about evaporative coolers?

Nonparticipants who reported having concerns about evaporative cooling were asked how they became aware of those concerns. Previous experience using an evaporative cooler was most frequently mentioned (45%), followed by independent research (26%; Figure 20).

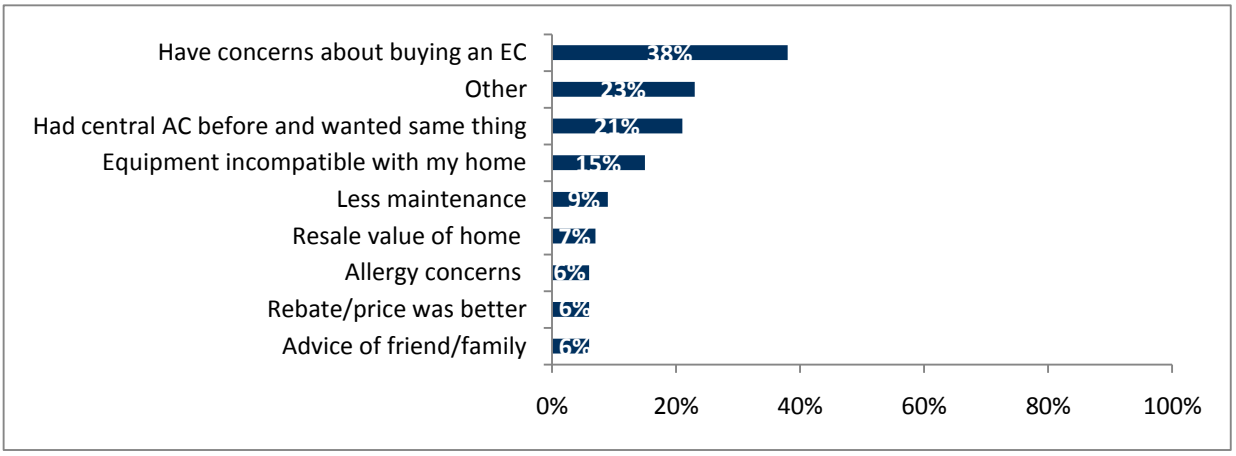
Figure 20. Source of Concerns Regarding Evaporative Cooling (n=31)



D7. How did you become aware of these concerns?

The most frequently mentioned reason nonparticipants chose central air conditioning over evaporative cooling was concerns about evaporative cooling (38%), followed by Other (23%), which included ease of installation, energy efficiency, and the ability to cool whole house. Some (21%) chose central air conditioning over evaporative cooling because they had central air conditioning previously.

Figure 21. Nonparticipant Reasons for Choosing Central AC over Evaporative Cooling (n=53)



D8. What were your main reasons for choosing central AC over an evaporative cooler?

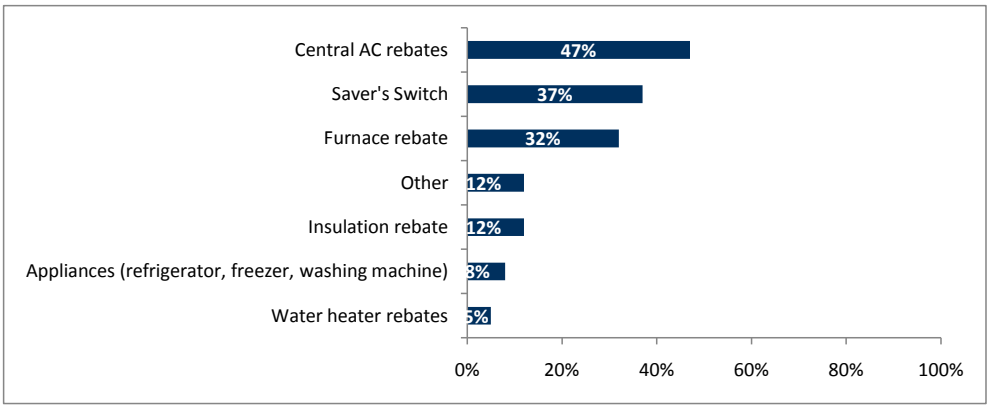
Program Awareness

Two-thirds (65%) of nonparticipants were aware of other energy saving programs or rebates offered by Xcel Energy, while only one-third (30%) were aware of the Xcel Energy Evaporative Cooling Rebate Program. Of those who were aware of the Xcel Energy Evaporative Cooling Rebate Program, the most frequently named source of awareness was the bill insert (36%),

followed by XcelEnergy.com or ResponsibleByNature.com (12%), and through a contractor (12%).

Of those who were aware of other energy saving programs or rebates offered by Xcel Energy, the programs or rebates mentioned most often include central air conditioning rebates (47%), followed by Saver's Switch (37%), and furnace rebate (32%; Figure 22).

Figure 22. Xcel Energy Programs Nonparticipants are Aware of (n=75)



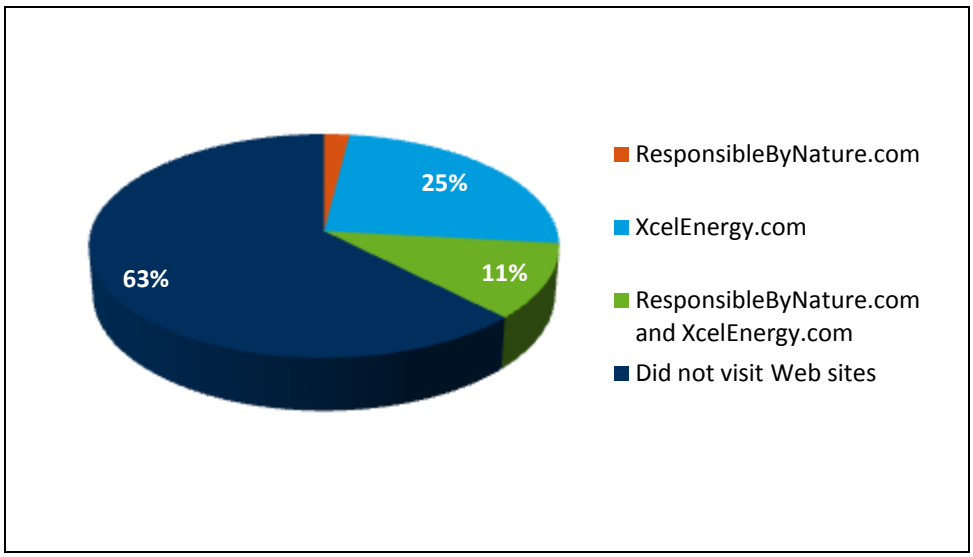
E4. What other programs are you aware of? Multiple responses.

Nearly two-thirds (63%) of nonparticipants had not visited the ResponsibleByNature.com or the XcelEnergy.com Websites. A quarter (25%) had visited XcelEnergy.com, 2% had visited ResponsiblyByNature.com, and 11% had visited both Websites (Figure 23). Most nonparticipants age 65 or older had not visited XcelEnergy.com or ResponsibleByNature.com (91%) compared with 35 to 54 year olds (42%) and 55 to 64 year olds (67%).

Eight of the 15 nonparticipants who had visited ResponsibleByNature.com found the Website to be useful, and 25 of the 33 nonparticipants who had visited XcelEnergy.com found the Website to be useful, while three found it not useful. Nonparticipants provided the following suggestions for improving XcelEnergy.com:

- Make the Website easier to navigate. The links to forms and other information were reportedly hard to find.
- Allow bill pay online.
- Allow rebates to be credited to customers' accounts electronically.

Figure 23. Xcel Energy Website Usage among Nonparticipants (n=118)



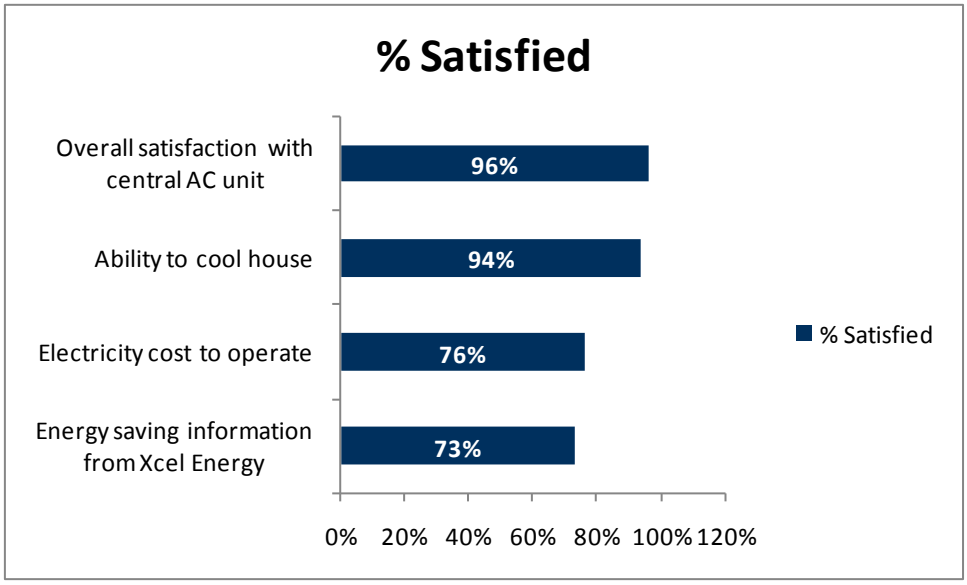
E6. Have you visited the ResponsibleByNature.com Website, the XcelEnergy.com Website, both, or neither?

Satisfaction

Nonparticipants reported high levels of satisfaction with their central air conditioning (Figure 24).

- Nearly all (96%) said they are satisfied overall with their central air conditioning unit.
- Most (94%) said they are satisfied with the ability of their central air conditioner to cool the house.
- Over three-quarters (76%) said they are satisfied with the electrical cost to operate their central air conditioner. The primary reasons given by the 17% who are dissatisfied with the electrical cost to operate their air conditioning unit is that the bill is expensive, the rates are high, or they are dissatisfied with tiered rates.
- Satisfaction with energy saving information from Xcel Energy is moderate, with 73% reporting they are satisfied.
- Nonparticipants age 65 or older are more satisfied with their central air conditioner unit overall compared with those aged 35 to 54 (100% vs. 92%).
- Nonparticipants who were aware of energy saving programs or rebates offered by Xcel Energy are more satisfied with the energy saving information provided by Xcel Energy (79%) than those who were not aware of energy saving programs or rebates offered by Xcel Energy (60%).

Figure 24. Satisfaction with Central Air Conditioning and Energy Saving Information (n=118)



F1. On a scale of 0 to 10 where 0 means not at all satisfied and 10 means completely satisfied, how satisfied are you with your central AC unit overall?
F3. Using the same 0 to 10 scale, how satisfied are you with the ability of your central AC unit to cool the house on very hot days?
F4. Again using the same 0 to 10 scale, how satisfied are you with the electrical cost to operate your central air conditioner?
F6. Using the same 0 to 10 scale, how satisfied are you with the energy saving information provided by Xcel Energy?
Satisfied equals responses between 6 and 10.

Nearly half (44%) of nonparticipants said they installed additional energy-efficiency equipment or made additional energy-efficiency improvements to their home after installing central air conditioning (Table 14).

Table 14. Energy-Efficient Equipment Nonparticipants Installed After Installing Central AC (n=52)

Equipment / Improvement	Purchased – Received Xcel Energy Rebate	Purchased – Did Not Receive Xcel Energy Rebate	Did Not Purchase
Energy-efficient appliances including refrigerator, dishwasher, clothes washer	0%	13%	87%
Energy-efficient furnace or boiler	37%	10%	54%
Energy-efficient water heater	10%	4%	87%
Energy-efficient cooling system	2%	0%	98%
Replaced a window or windows	6%	15%	79%
Insulation to attic or walls	4%	10%	87%
Programmable thermostat	0%	0%	100%
Water heater blanket / water heater pipe insulation	0%	2%	98%
Home energy audit	0%	0%	100%
Other*	0%	31%	69%

*Other includes CFLs (3), thermal curtains or blinds (3), and weather stripping or caulking (3).

Nonparticipant Profile

Nonparticipants who responded to the survey typically live in a single family detached home (84%) that is between 1,000 and 2,000 square feet (48%) or 2,001 and 3,000 square feet (42%). The year the home was built varied, with 24% built before the 1970s, 19% built during the 1970s, 26% built during the 1980s, 19% built during the 1990s, and 12% built during the 2000s. There were typically two members in the household (59%), with 31% aged 35 to 54, 26% aged 55 to 64, and 29% aged 65 and older.

Table 15. Demographics

Household Characteristics	Nonparticipants
Type of home:	
Single family detached	84%
Single family attached	13%
A unit in a multifamily building with three or more units	3%
Year home was built:	
Before 1970s	24%
1970s	19%
1980s	26%
1990s	19%
2000s	12%
Home square footage:	
Under 1,000 square feet	2%
1,000 – 2,000 square feet	48%
2,001 – 3,000 square feet	42%
Over 3,000 square feet	8%
Number of people living in household:	
1	13%
2	59%
3	15%
4+	13%
Age:	

Household Characteristics	Nonparticipants
18 – 34	14%
35 – 54	31%
55 – 64	26%
65 or older	29%

6. Trade Ally Survey Findings

The trade ally surveys explored a number of topics, including marketing efforts and trends, sales and stocking patterns, incremental cost, promotional efforts, market barriers, pricing practices, and Program impacts, awareness, and satisfaction. Each of these is discussed below.

Trade Ally Surveys

Cadmus interviewed 40 trade allies in July 2010—19 participating and 21 nonparticipating—to assess the Program from a trade ally perspective. Trade allies include manufacturers and distributors of evaporative coolers, retailers of evaporative cooling units, and contractors who install evaporative coolers. In addition, Cadmus interviewed builders who had the option to participate in the Program but chose not to.

See Table 16 for a full breakdown of the survey efforts.

Table 16. Trade Ally Survey Efforts

Trade Ally	Participant	Nonparticipant	Total
Contractors	7	6	13
Builders	0	8	8
Retailers	10	5	15
Manufacturers	1	1	2
Distributors	1	1	2
Total	**19**	**21**	**40**

Summary of Key Findings

- **The data collected through our evaluation shows that most participants believe the Program operates successfully.** Most participating trade allies were satisfied with the Program and with separate aspects of the Program, including Program staff and materials.
- **For the most part, nonparticipating trade allies had not heard of the Program and had several concerns about evaporative coolers, which are outlined below.**
- **The majority of both participant and nonparticipant trade ally complaints stemmed from customers having little or no knowledge about the benefits of evaporative coolers.** Trade allies in general would like more information for themselves and their customers in order to increase sales of evaporative coolers and to address any concerns they or their customers have about the units.

Program Satisfaction

Overall, trade allies were very satisfied with the Program. When asked to rate their experience on a scale of 0-10, where 0 is not at all satisfied and 10 is extremely satisfied, retailers rated the Program an average of 9 out of 10, with 100% of them rating it positively (i.e., 6 - 10 out of 10). Retailers also rated the rebates offered through the Program an average of 7.3 out of 10, with

76% of respondents rating them positively. Two participating retailers reported a lack of experience with the Program (although they were participating trade allies), and were unable to give ratings. One of these retailers said that "*people aren't into the rebates. They either don't care about it, or don't know anything about it.*"

Contractors rated their satisfaction with the Program and the rebates both at an average of 9.4. The single participating distributor rated the program an 8.5.

Table 17 illustrates these satisfaction ratings by trade type.

Table 17. Satisfaction Ratings by Trade Type

Trade Type	Average Rating (Out of 10)	% Positive (6-10)
Contractor (n = 7)	9.4	100%
Retailer (n = 8)	9	100%
Distributor (n = 1)	8.5	100%

Marketing Efforts and Trends

Participating retailers and contractors were asked about their marketing efforts for the Program. Only four of the 10 retailers and five of the seven contractors marketed the Program in 2009. Table 18 shows a breakdown of marketing efforts by participant type.

Table 18. Breakdown of Promotions Used by Participant Type

Types of Promotions	Retailers	Contractors	Total
Print Ads Only	--	2	**2**
In-Store Signs Only	2	--	**2**
Print Ads & In-Store Signs	1	--	**1**
Print Ads & Radio Ads	1	2	**3**
Print Ads & TV Ads	--	1	**1**
Total	**4**	**5**	**9**

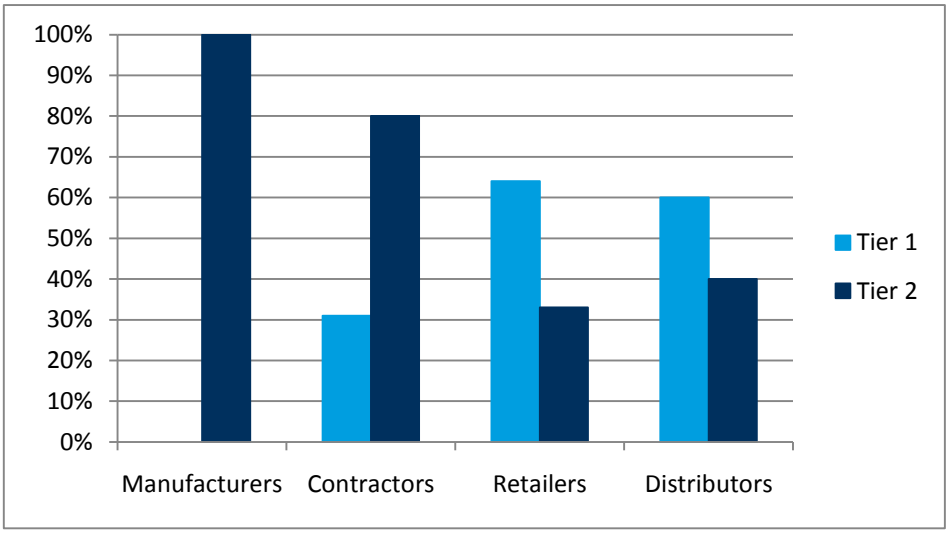
Two of the retailers who did not market the Program explained that a lack of knowledge about the Program kept them from advertising. The cost involved in marketing was the reason given by both contractors who did not marketing the Program. One contractor added that they "*reach business capacity without having to spend money on promotions and marketing.*"

Evaporative Cooler Sales Trends

All participating trade allies were asked about sales trends for evaporative coolers. Retailers reported selling between one and 800 evaporative coolers in Colorado in 2009, contractors between 25 and 250, the distributor sold over 2,000, and the manufacturer sold 150.

All participating trade allies were asked what percent of their evaporative cooling units qualify for Tier 1 and Tier 2. Figure 25 illustrates percentages of units that qualify for each tier by trade ally type.

Figure 25. Percent of Units Sold by Tier Types (N=40)



Participating retailers and contractors were asked how their evaporative cooler sales were affected by the Program in 2009. Six retailers claimed an increase in sales by an average of 43%, one claimed a decrease of 10%, and the remaining retailers said there was no change in sales. Four contractors claimed an average of a 59% increase in sales, one claimed a 10% decrease in sales, one said their sales remained the same, and the remaining respondent didn't know. Two retailers said the Program affected their stocking decisions by "*having to increase inventory to keep up with demand.*"

Retailers reported having the impression that most of their evaporative cooling customers were already planning to make the purchase before they found out about the rebate Program. According to retailers, 87% of Tier 1 customers and 67% of Tier 2 customers would have bought the same unit without the Program. Contractors, similarly, estimated that 71% of customers would buy the same Tier 1 unit, and 46% would buy the same Tier 2 unit without the Program.

Program Impact

Seven of the ten retailers believe the Program had an impact on customers' evaporative cooling purchasing decisions. Retailers agreed that the rebate motivates customers. One respondent said "*Customers get more for their money. [They] can buy a bigger unit for the same price as a smaller one because of the rebate.*"

Similarly, most (six out of seven) contractors believe the Program has affected purchasing decisions among customers. One contractor said *"People are purchasing the more efficient systems to get the higher rebate. A lot more people are buying the evaporative coolers now because of the Program."*

Cadmus asked manufacturers and distributors if the Program affected retailer and contractor stocking decisions. The manufacturer thought the Program did have an effect, explaining that "*contractors call asking if we are eligible under the rebate Program.*" The distributor believes the Program did not affect stocking decisions among retailers and contractors. Table 19

illustrates trade ally responses of how the rebated evaporative cooler sales compared with non-rebated unit sales during the 2009 Program year.

Table 19. Sales of Rebated Units versus Non-Rebated Units

Trade Ally	Rebated vs. Non-Rebated EC Sales		
	Rebated Unit Higher	Same	Don't Know
Retailers	4	5	1
Contractors	5	1	1
Manufacturers	1	--	--
Distributors	1	--	--
Total	**11**	**6**	**2**

When asked what, if any, factors outside the Program impacted sales of evaporative coolers in 2009, the most common answer among retailers and the distributor was weather, which had a negative effect due to the cool summer. The most common answer among contractors and the manufacturer was the economy, which they believe had a negative impact on sales in 2009.

We asked all participating trade allies how evaporative cooler sales would change in 2010 if the Program were to end. Only four said sales would stay the same. The remaining fifteen said sales would decrease.

Retailers and contractors were asked if they had noticed any trends in evaporative cooler sales over the past few years. Four retailers and four contractors said sales have increased. Four retailers and one contractor said they have stayed the same, and the remaining two retailers and two contractors believe sales have decreased.

Cost to Consumer

Cadmus asked retailers and contractors what the average retail cost is for the evaporative coolers offered through the Program in 2009, before applying the rebate. Retailers responded with a range between $250 and $599, while contractors responded with a range between $1,600 and $4,900. This difference is due to retailers selling mainly Tier 1 units, for which customers do not need a contractor, while contractors are hired to install larger, more expensive units, making their cost range higher. We then asked these groups if customers face any additional cost when purchasing a rebated unit over other standard units in the market. All contractors said no, while five retailers said yes, with a range between $68 and $800 extra. When asked how much additional cost consumers face when purchasing a Tier 2 unit as opposed to a Tier 1 unit, all contractors answered around $1,000 extra, while retailers gave a range between $150 and $350 extra. The difference likely involves installation and wiring expenses associated with Tier 2 units.

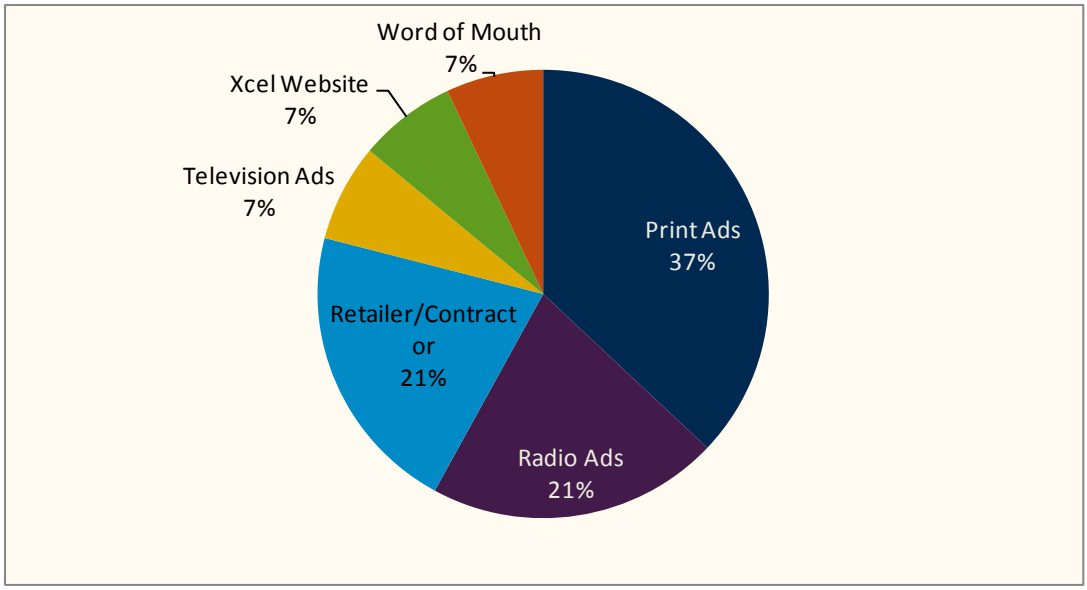
Trade Ally and Customer Awareness

Participating trade allies were asked to rate the helpfulness of the information and materials they received from the Xcel Energy Program field representatives on a scale from 0 – 10, where 0 indicates not at all helpful and 10 indicates extremely helpful. Contractors rated the information

and materials an average of 9.6, while retailer ratings averaged 6.2, with seven out of 10 rating them a 7 or higher. The remaining three respondents (i.e., two manufacturers and one distributor) rated the information and materials low because they had not heard from any Xcel Energy representatives, and therefore did not receive any information from a representative.

In general, trade allies believe that customers are aware of the Program. Only one retailer said they usually have to inform their customers of the Program, while two said half their customers already know of the Program. The remaining retailers reported that most of their customers know about the Program. Six of the seven contractors said their customers were aware of the Program, and the remaining contractor reported usually needing to inform customers. Figure 26 shows a breakdown of the ways in which trade ally participants think customers find out about the Program. Most trade allies believe customers hear about the program through print and radio ads.

Figure 26. Channels through Which Trade Allies Believe Customers Heard of the Program



By contrast, the most common channel through which customers actually heard of the Program was through a retailer or contractor (40%), followed closely by bill inserts (26%). This difference in responses between trade allies and participants points to a relative lack of awareness on the part of trade allies for the level of influence they have in promoting the program. Training and education to trade partners could emphasize the importance of their role and address any concerns they may have about promoting the technology.

Market Barriers

No participating trade allies had concerns about selling evaporative coolers; however, they did report that some customers had concerns. Customer concerns included location of the unit; capacity of the unit to cool the whole house; mold, moisture, and water damage; appearance; and maintenance.

When asked what they thought it would take in general for more evaporative coolers to be sold, the most common answer among retailers and contractors was to increase public awareness of

evaporative coolers. Trade allies agreed that the lack of knowledge about evaporative coolers is a market barrier. The distributor said to increase sales, "*more advertising, educating, and training is needed for contractors.*"

Nonparticipant Trade Ally Surveys

To supplement what we learned from participating trade allies, Cadmus interviewed 21 nonparticipating trade allies. Interviews with these trade allies explored equipment selection and installation practices outside of the Program, and sought to understand why previously participating dealers no longer participate. The interviews covered the following topics:

- Awareness
- Sales Practices
- Stocking and Installation Practices
- Cost to Consumer
- Marketing
- Market Barriers

Awareness

With few exceptions, nonparticipating trade allies are not aware of the Program. Only two contractors and one retailer were aware of the Program (and the retailer found out about the Program from another retailer).

When asked their reasons for not participating in the Program, retailers said there were no tax credits available and no consumer demand. Most contractors (four of the six) said there is no consumer demand, and the distributor and manufacturer said they do not deal with evaporative coolers.

Sales Practices

Nonparticipating trade allies were asked what the primary benefits are of evaporative coolers. Common answers included:

- Energy efficiency
- Saving money
- Environmentally friendly

Contractors reported that an average of 4% of their customers specifically ask for evaporative coolers, while retailers claimed that 11% of their customers specifically ask for evaporative coolers.

Sales Practices

Nonparticipating retailers stocked between four and 12 models of evaporative coolers in 2009 and sold between zero and five units. Contractors sold between zero and 850 units.

With only one exception, contractors and retailers were not aware of what tier level their stocked units qualify for in the Program.

Only two respondents, both contractors, said they would have participated in the Program if the requirements were different. Additionally, one of these respondents said that if the economy were better or the weather would cooperate and get hot in the summer, they would be more likely to participate. The other said they would participate if the application was less complicated, if the customers would benefit, or if it was easier to participate.

Cost to Consumers

When asked the average retail cost for evaporative coolers in 2009, retailers responded with a range from $200 to $700. Contractors answered between $1,700 and $3,000. This difference can be explained similarly to the participant trade allies, in that retailers sell smaller, less expensive units, such as Tier 1, while contractors deal with larger, more expensive units.

Marketing

During the last few years, one retailer and two contractors have increased marketing of their products, one retailer and one contractor have decreased marketing, and the remaining three retailers and three contractors have kept marketing at the same level. The most effective mediums for advertising reported were print ads, TV ads, radio ads, Websites, and word-of-mouth.

Market Barriers

Four out of the six contractors and one out of the five retailers expressed concerns about selling evaporative coolers. Their concerns include:

- Mold
- Moisture
- Location
- Water damage
- Allergies
- Air quality

One retailer identified a concern about the cost of the units and the inability of customers to pay: *"We have a very low price point range in our store and worry the unit would be too expensive for our market."*

One contractor and two retailers said that customers have the following concerns about evaporative coolers:

- Moisture
- Appearance
- HOA's do not allow them

Builder Surveys

Builders in Colorado had the opportunity to participate in the Program in 2009, but none did. Cadmus interviewed eight builders to explore the following topics:

- Awareness
- Energy-efficient building practices
- Current building practices
- Costs and trends
- Marketing

Awareness

Only two of the eight builders had heard of the Program at the time of our interview. One did not know how she heard of the Program, and the other had heard of it from a trade ally.

Energy-Efficient Building Practices

Builders were asked how many homes they had built since January of 2009 (and how many were single family versus multifamily). One builder said he hadn't built any homes since January 2009 because of the recession. One respondent had built only multifamily buildings in 2009; 22 condo buildings. The remaining six builders claimed to have only built single family homes, ranging from two to 21 total homes.

We then asked respondents how many of their buildings were ENERGY STAR® rated. The multifamily builder did not know, four respondents said that 100% of the single family homes they built were ENERGY STAR rated, and the remaining two reported that 8 of 10 and 18 of 21 homes they built in 2009 were ENERGY STAR.

Four builders reported that 100% of their homes were custom built, meaning that the buyer had their own land and hired a contractor to build the home. Two builders, including the multifamily home builder, built 100% spec homes, meaning the home was either completed or under construction before the buyer became involved. The remaining respondent built 66% custom and 34% spec homes.

Builders believe the primary benefits of evaporative coolers include energy efficiency and the low installation cost. Five of the eight builders had concerns about presenting evaporative coolers as an option to homebuyers. These concerns included:

- Lack of knowledge about evaporative coolers
- Moisture/humidity
- Location of unit

- Water damage
- Air quality
- Capacity of the unit to cool the entire house
- Appearance of the unit
- Perception that the unit lacks value

Six of the eight builders said that none of their customers had ever requested evaporative coolers. One said their customers rarely make this request, and the remaining builder said that 25% of his customers request evaporative coolers. Two respondents said that customers have concerns about the cost and their own lack of knowledge with installing evaporative coolers.

Builders were asked to describe how they presented high efficiency cooling options to their customers in the construction planning process. One builder said *"We push for high SEER A/C and high efficient furnaces/boilers. That is the most important equipment to push for high efficiency because it creates a "quality shell of a home." We also persuade clients with tax incentives on high efficient options."* Another respondent said *"Energy efficiency is more important to us than initial cost. We discuss the ease of taking care of a high efficiency home and the savings in the long run."*

For the builders we surveyed, energy efficiency is standard in their building practices. Energy-efficient equipment can be upgraded as requested by the customers based on their comfort and personal preference.

Current Building Practices

Seven out of the eight builders said that 100% of the homes they build include some kind of a cooling system. The remaining builder includes a cooling system in 75% of homes they build. Seven builders said that the cooling system installed is a central air system 100% of the time, while one said that 25% of homes include an evaporative cooling system. This particular respondent had not built any homes since the beginning of the Program, so he did not have the opportunity to participate in the Program in 2009.

None of the respondents have installed a Tier 3, whole-house, indirect evaporative cooler.

Three builders said they would have participated in the Program if the requirements had been different or if another technology had been available. One builder reported that *"More info is needed to learn more about evaporative coolers and benefits versus A/C."*

The builder who had not built any homes since January 2009 said he "*would have participated if I had built any new homes. This type of evaporative unit is only good on new home construction.*" Additionally, one respondent suggested *"It would help if someone put together a brochure comparing installation costs of evaporative coolers and A/C and distributed to both builders and HVAC contractors."*

Costs and Trends

Builders were asked what they thought it would take in general for more evaporative coolers to be sold on the market. Three builders believe public education about evaporative coolers and

their benefits would increase sales. One builder said "*perception must change about EC. People think they are inefficient and don't work well.*"

Another builder said that *"Technology needs to be improved drastically and for more HVAC contractors to offer it as an option. If the contractors are behind it the builders will be too … EC technology is bad and A/C efficiency is increasing by leaps and bounds. Carrier does not supply EC to builders so builders don't use them."*

Marketing

Builders were asked how the marketing and promotion of their homes has changed during the last few years. Five said it hasn't changed, two said it has increased, and the remaining builder said it has decreased.

Respondents were then asked about the most effective method used to promote their homes. Table 20 illustrates their answers.

Table 20. Channels through Which Builders Promote Their Homes

Response	Number of Builders
Print ads or brochures	1
Through another builder or sales agent	1
Leave a packet of information at the house	1
Word-of-mouth (friend, coworker, acquaintance)	3
Model home tour	1
Website/Internet [unspecified]	1

Market Transformation

Market transformation is "the process whereby energy-efficient innovations are introduced into the marketplace and over time penetrate a large portion of the eligible market"[5]. Market transformation is particularly challenging for evaporative cooling because it is competing with other types of equipment with the same function, whereas other programs may only compete with a less-efficient version of the same equipment. Yet, transforming the residential cooling market away from central air conditioning equipment to evaporative cooling is a primary objective of the Program.

Market transformation is also something that happens over a several year span. A single point-in-time measure would yield little evidence of an effect that may have shorter term gains or losses.

One way to assess market transformation effects of evaporative cooling is by observing trends in the type of cooling equipment installed in Colorado homes over time. Xcel Energy conducted a study of energy using equipment[6] present in Colorado homes in 2008 and repeated the same survey in 2010. In 2008, 22% of Colorado customers had evaporative cooling and 44% had

[5] Market Transformation Strategies to Promote End-Use Efficiency, Howard Geller and Steven Nadal. ACEEE Annual Review Energy Environment 1994. 19:301-46.

[6] Colorado Residential Home Use Survey.

central air conditioning. In 2010, 18% had evaporative cooling and 46% had central AC. Although this data was not analyzed as part of this evaluation, evidence of increased penetration of evaporative cooling is not supported. The lack of increased penetration indicates that efforts to transform the cooling market away from central AC have yet to see appreciable gains in the overall marketplace. Monitoring changes to the proportions of cooling equipment types through the same survey may in future years provide longitudinal evidence of market transformation or lack thereof for evaporative cooling.

Evidence of market transformation from trade allies is somewhat mixed. Due to the small number of interviews conducted with each trade type, the following observations are considered qualitative evidence relating to market transformation.

Indicators of possible market transformation:

- One contractor said that they "*reach business capacity without having to spend money on promotions and marketing.*"
- Two retailers said the Program affected their stocking decisions by "*having to increase inventory to keep up with demand.*"
- Retailers reported having the impression that most of their evaporative cooling customers were already planning to make the purchase before they found out about the rebate Program.
- The manufacturer thought the Program did have an effect, explaining that "*contractors call asking if we are eligible under the rebate Program.*"

Indicators for remaining market transformation opportunities:

- The distributor believes the Program did not affect stocking decisions among retailers and contractors.
- Trade allies agreed that the lack of knowledge about evaporative coolers is a market barrier. The distributor said to increase sales, "*more advertising, educating, and training is needed for contractors.*"
- When asked their reasons for not participating in the Program, retailers said there were no tax credits available and no consumer demand.
- One builder said *"We push for high SEER A/C and high efficient furnaces/boilers. That is the most important equipment to push for high efficiency because it creates a "quality shell of a home."*
- Seven builders said that the cooling system installed is a central air system 100% of the time, while one said that 25% of homes include an evaporative cooling system.
- Another builder said that *"Technology needs to be improved drastically for more HVAC contractors to offer it as an option. If the contractors are behind it the builders will be too … EC technology is bad and A/C efficiency is increasing by leaps and bounds."*

Recommendations

1. **The Cadmus Team recommends that Xcel Energy considers providing an incentive for contractors and retailers to encourage their participation in the Program.**

2. **Continue to support industry trade allies through training and education, including information about how evaporative cooling technology has improved.** A common concern among trade allies was that there isn't enough information about evaporative coolers and the benefits that go along with using them instead of air conditioners. These training programs could also be an opportunity to enhance and expand relationships between Xcel Energy and the trade allies

3. **In addition, we recommend that Xcel Energy consider providing information to trade allies to address customer concerns.**

4. **Continue to monitor potential evaporative cooling market transformation through the Home Use Survey in successive years.**

7. Program Gross Savings

The Evaporative Cooling Rebate Program reported savings of 1,969,959 kWh and 2,771 kW per year. This chapter provides the analysis and findings of the gross savings and Ex-Post to Ex-Ante Gross Savings Ratios for energy and demand.

The 2009 Program had a total of 2,670 participants, of which 1,710 received a Tier 1 rebate and 960 received a Tier 2 rebate. Nearly 90% of participants were located in either Grand Junction or the greater Denver metro area. To best represent the differences in geography and weather, we divided the population into these two areas using the zip codes of participants. Those who fell outside of these two major areas were separated into tier and location groups based on existing percentages from the population. Table 21 shows the distribution of participants within each tier and location.

Table 21. Participation by Tier and Location

Tier	Grand Junction	Denver	Total
1	310	1,400	1,710
2	242	718	960
Total	**552**	**2,118**	**2,760**

Baseline Assumptions

Xcel Energy used central AC (CAC) for the Program baseline in 2009. This assumed that if evaporative cooling were not an option, participants would instead use CAC to cool their homes. The savings resulting from participating evaporative coolers was then compared to the electricity that would have been used by CAC instead.

Based on participant survey responses, however, Xcel Energy customers recognize that there are alternative cooling options to CAC. While CACs use more energy and the use of CAC as a baseline results in higher savings from evaporative cooling, a plausible alternative is that some would opt for room air conditioners (RAC) or non-system cooling, such as fans. As RAC energy use has a per unit value between that of CAC and non-system cooling, it offers a more realistic estimate of the energy that evaporative cooling is displacing.

An RAC baseline, however, should also consider an equivalent size of unit and functionality. Since most evaporative coolers rebated by the Program are closer to 3-tons, a 3-ton equivalent RAC or two 1.5-ton RACs offer a more appropriate baseline value for Tier 2. The Tier 1 baseline is one 1.5-ton RAC because of the decreased functionality.

Gross Savings Quantification

Table 22 shows the major input values and source of the baseline and evaporative cooler equipment consumption. We calculated consumption values from the metering study held in the summer of 2010, or they were determined through engineering review.

Table 22. Technology Consumption Values

Input	Value	Source
Tier 1, Grand Junction Evaporative Cooler Energy	693 kWh	Metering study (See Chapter 10)
Tier 1, Denver Evaporative Cooler Energy	576 kWh	Metering study (See Chapter 10)
Tier 1 Evaporative Cooler Demand	0.55 kW	Metering study (See Chapter 10)
Tier 2, Grand Junction Evaporative Cooler Energy	1,173 kWh	Metering study (See Chapter 10)
Tier 2, Denver Evaporative Cooler Energy	976 kWh	Metering study (See Chapter 10)
Tier 2, Evaporative Cooler Demand	0.94 kW	Metering study (See Chapter 10)
Room AC, Grand Junction Energy	1,607 kWh	Technical Assumptions Chapter 10
Room AC, Denver Energy	1,135 kWh	Technical Assumptions Chapter 10
Room AC Demand	1.84 kW	Technical Assumptions Chapter 10

Table 23 and Table 24 show the calculation method used to determine gross savings with the values listed in Table 22. Each row represents the savings value for each participant in each tier and location. The energy and demand savings values are calculated at the customer meter, and not the generator.

Table 23. Energy Savings Calculations for One Unit (Values at Meter)

Tier	Location	Baseline	Participants	Baseline kWh	Verified kWh	Savings kWh
1	Grand Junction	1 RAC	310	1,607	693	914
1	Denver	1 RAC	1,400	1,135	576	559
2	Grand Junction	2 RACs	242	3,214	1173	2,041
2	Denver	2 RACs	718	2,270	976	1,294

Table 24. Demand Savings Calculations for One Unit (Values at Customer)

Tier	Location	Baseline	Participants	Baseline kW	Verified kW	Savings kW
1	Grand Junction	1 RAC	310	1.84	0.55	1.3
1	Denver	1 RAC	1,400	1.84	0.55	1.3
2	Grand Junction	2 RACs	242	3.68	0.94	2.7
2	Denver	2 RACs	718	3.68	0.94	2.7

The overall gross savings on the customer side are 2,488,970 kWh and 4,836 kW. However, because Xcel Energy determines savings at the generator, it is necessary to account for an estimated 7.14% line loss. This application yields a total gross savings of 2,680,347 kWh and 5,208 kW, as shown in Table 25.

Table 25. Gross Energy and Demand Savings at the Customer and Generator

Value	Customer	Generator
Energy	2,488,970 kWh	2,680,347 kWh
Demand	4,836 kW	5,208 kW

Ex-Post to Ex-Ante Gross Savings Ratios

We calculated gross ratios by determining the quotient of the verified to the reported savings values. Table 26 shows the input values and gross ratios for the Program. We applied these gross ratios to calculate the net savings, outlined in the following chapter. The energy gross ratio of 1.36 means that the evaluation found an additional 36% of gross energy savings annually. Similarly, the demand gross ratio of 1.88 means that demand savings are actually 88% greater than the reported gross demand savings.

Table 26. Gross Ratios for Evaporative Cooling Rebate Program

Value	Reported Gross	Verified Gross	Gross Ratio
Energy	1,969,959 kWh	2,680,347 kWh	1.36
Demand	2,771 kW	5,208 kW	1.88

8. Net-To-Gross and Program Net Savings

This chapter provides the methodology, analysis, and findings we performed for determining freeridership and spillover in 2009 for the Xcel Energy Evaporative Cooling Rebate Program. We then applied these net-to-gross (NTG) findings to the gross savings from the previous chapter to derive the net savings for the Program.

Freeridership

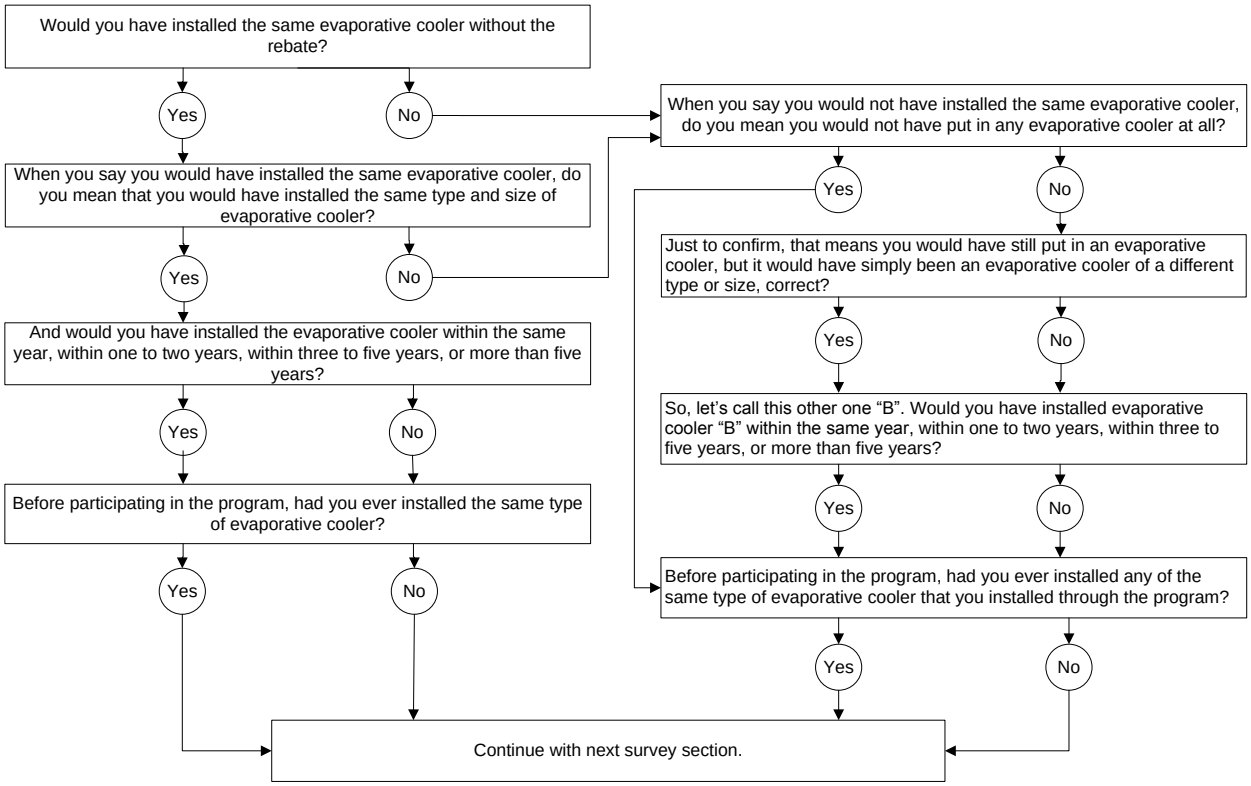
Methodology

We determined freeridership, the percent of savings that would have occurred in the absence of the Program, by conducting telephone surveys with 339 Program participants. During this survey, several questions were asked to determine the level of influence the Xcel Energy Evaporative Cooling Rebate Program had on a participant's purchasing decision. The questions used to determine freeridership are a modified version of the California Self-Report NTG approach (California SRP), found in Appendix D. Although Cadmus started development of the Program survey with the California SRP, we adapted the battery of questions to accommodate specifics of Xcel Energy's Program and customer base.

One issue in the California SRP is the use of repeated questions, which create consistency checks and allow greater confidence in responses, provided the respondent's answers are consistent. Cadmus has observed that customers are often frustrated by repeated questions, as they perceive that the interviewer has not listened carefully to their earlier answers. In our experience, while redundancy can increase confidence that respondents understood the question fully, it does not necessarily change the overall freeridership findings. Consequently, out of respect for Xcel Energy customers, Cadmus and Xcel Energy worked together to create a streamlined approach, identifying the most critical questions and eliminating unnecessary redundancy. Furthermore, only a handful of the California SRP questions were actually used to calculate freeridership. All the freerider questions from the California SRP were used in our survey with two exceptions: in one case we asked an equivalent question worded to capture more Program-specific information, and in another case we adjusted the order so the questions would flow smoothly while still providing a consistency check within the freeridership battery as a whole.

The freeridership questions, listed in Figure 27 included skip patterns in the survey designed to ensure that each participant was asked only the follow-up questions necessary depending on their given responses, omitting questions that were not used for freeridership calculations. The full list of questions with skip patterns used for the freeridership analysis is presented in Appendix D.

Figure 27. Freeridership Questions Asked of Participants



This battery of freeridership questions was completed by 315 of the 339 participants surveyed, representing 194 participants at the Tier 1 level and 121 at the Tier 2 level. A scoring algorithm was applied to each of the participant responses to derive a freeridership score.[7] This scoring algorithm can be found in the form of a matrix in Appendix D.

Results

The freeridership analysis results, presented in Table 27, yielded an overall Program freeridership score of 47%, with Tier 1 at 50% freeridership and Tier 2 at 43% freeridership. An overall freeridership score of 47% signifies that just under half of the Program participants would have purchased the same evaporative cooler without the rebate provided by Xcel Energy. It is more rigorous to separate Tier 1 and 2 and apply those rates to the population, so these separate values are used in the final impact net savings evaluation.

[7] Although freeridership questions were also asked in the trade ally surveys, those responses are treated as qualitative data only, since only responses from participants who have received an incentive through the Program are used to calculate freeridership and NTG. In the future, when there are builders installing Tier 3 evaporative coolers and receiving the $1000 incentive, these participating builders will be included in the NTG analysis.

Table 27. Freeridership Percentages by Tier and Overall

Tier	Count	Freeridership Score
1	194	50%
2	121	43%
Total	**315**	**47%**

To further the analysis, we investigated a possible correlation between freeridership and participants who previously owned an evaporative cooler as opposed to those customers new to the technology. It was determined that freeridership for participants who had owned an evaporative cooler before was higher (53%) than freeridership for first time buyers (35%). This finding, presented in Table 28, shows that there is a measurable difference in freeridership for this Program based on previous knowledge and adoption of the technology. Previous owners of evaporative coolers accounted for 70% of our surveyed sample.

Table 28. Freeridership Percentages by Previous Ownership of EC

Previous Ownership of EC	Freeridership Score	Count	% of Total Surveys
Previous Owner	53%	221	70%
First Time Buyer	35%	94	30%
Total Sample	**47%**	**315**	**100%**

Results such as those shown in Table 28, can inform future Program planning. For example, if a program goal is to transform the cooling equipment market to adoption of evaporative coolers, this data would support a higher incentive for first time buyers. However, a scenario like this must take into consideration replacements after equipment failure as opposed to a retrofit, because if an existing evaporative cooler fails, the consumer can be considered to have the same likelihood as a first time buyer to instead choose a central air conditioner or room air conditioner.

Spillover

Spillover, defined as the additional savings generated by Program participants as a result of their participation in the Program but not otherwise captured by Program records, was analyzed in a qualitative manner to reflect the Program's influence on the actions of participants to install additional energy-efficient measures. A single participant can install one or many additional measures, which are all taken into consideration when calculating spillover.

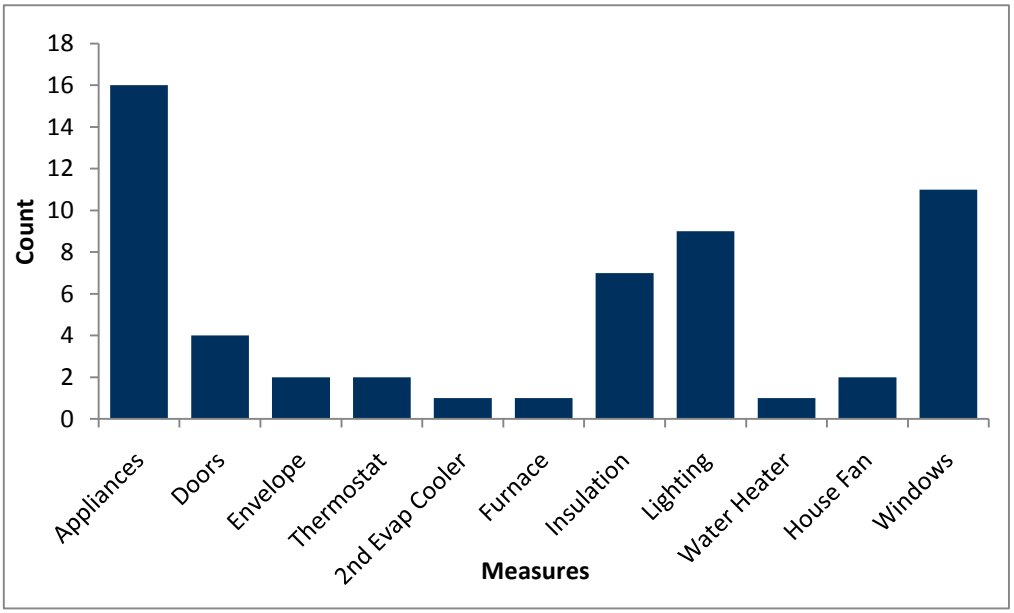
Participant Methodology and Results

Of the 339 participants surveyed, 111 responded that they had installed another energy-efficient measure since participating in the Program. Of those 111, slightly less than half (49 people) said that the Program had little or no influence on their decision to install the additional measure (a score of 0-5), 56 said the Program did influence their decision (score of 6-10), and 6 said they

don't know if the Program influenced their decision. The 56 people who said the Program influenced their decision installed a combined 70 additional measures.[8]

Of these 70 measures, 14 received other forms of rebated funds, thereby negating the spillover attribution to this Program. In the end, 56 total measures remained after the qualification screenings. Figure 28 shows the distribution of measures by type.

Figure 28. Distribution of Participant Spillover Measures (N=56)



Most measures described by respondents involved HVAC or building envelope measures that can arguably be said to relate to the function of an evaporative cooler. Lighting, appliances, and water heaters do not have that direct correlation to envelope measures. The appliances bar includes clothes washers and dryers, stoves, dishwashers, refrigerators/freezers, and microwaves.

Participant Spillover Quantification

Calculating participant spillover is not an exact quantification, due to Xcel Energy and Cadmus having little to no direct information about the technology baseline or specifications being replaced. For this reason, it was necessary to use information from several sources as a proxy for average savings values by technology. The sources include the ENERGY STAR Website appliance calculators, the Northwest 6th Power Plan, the Database for Energy Efficient Resources (DEER), and studies Cadmus conducted in the state of Iowa and for Ameren Illinois Utility.

Savings for the 56 reported measures that qualified as spillover were broken into two measure types: appliances and HVAC/building envelope. Appliances were calculated to save 1,509 kWh per year, and the HVAC/building envelope measures to save 2,135 kWh annually. This sums to a

[8] Although only 56 participants reported that the Program influenced their decision to install more energy-efficient measures, some of these participants installed more than one additional measure. The total number of measures analyzed for spillover is 70.

total of 3,644 kWh additional annual savings for the 339 participants. Because 339 out of 2,670 participants were surveyed, it is necessary to extrapolate our finding to the entire population of participants, which yields additional savings of 28,701 kWh annually. However, the gross program savings were calculated at the generator level, and not the customer level, so it is necessary to adjust the savings to account for line losses, which Xcel Energy estimates to be 7.14%. This new savings then becomes 30,907 kWh. With a total gross generator savings for the Program of 1,969,959 kWh, the amount of savings due to spillover accounts for 1.6% of the total Program total gross savings. Table 29 shows the steps of the spillover quantification.

Table 29. Participant Spillover

	Step	Value
Survey Population (339)	Appliances Savings	1,509 kWh
	HVAC/Envelope Savings	2,135 kWh
	Total Survey Savings	3,644 kWh
Total Population (2,670)	Extrapolation Multiplier	7.9
	Spillover Population Savings	28,701 kWh
	Line Loss	7.14%
	Spillover Savings at Generator	30,907 kWh
Total Program	Total Program Gross Savings at Generator	1,969,959 kWh
	Spillover Percentage	1.6%*

*With rounding, 2% is used in the NTG calculation.

Nonparticipant Spillover Methodology and Results

Nonparticipant spillover refers to actions taken by nonparticipants as a result of the Program, which may have resulted from the increased availability of efficient products and the training of participating trade allies.

Examples of spillover include:

- Consumers adopting Program measures without an incentive.
- Consumers acting upon the Programs' influence because of changes in the availability of energy-reliant equipment in the marketplace.
- Changes brought about by more efficient practices employed by architects and engineers, which ultimately force consumer behavior into desired patterns.
- Changes in the behavior of nonparticipants resulting from retailer's direct marketing or changes in stocking practices.

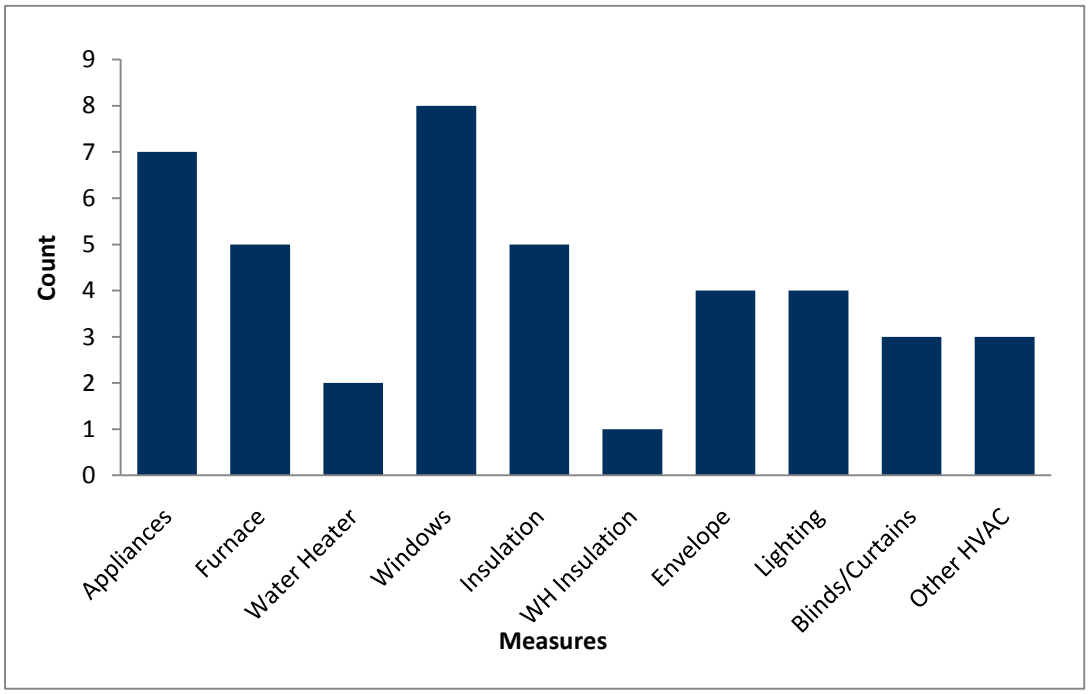
Program nonparticipants were defined as customers that made a central air conditioner purchase in the same time period as the Program evaluation year (2009). Because the purpose of the Xcel Energy Evaporative Cooling Rebate Program is to transform the market over time from central air conditioners, this definition of a nonparticipant represents the market that the Program has not yet transformed. A preponderance (80%) of the nonparticipants surveyed were participants in Xcel Energy's Central Air Conditioning Rebate Program. The remaining 20% were in a sample of Saver's Switch participants that we screened to confirm that they had installed a new air

conditioning unit in 2009. Because all of these nonparticipants are participants in another program, spillover for this group cannot be attributed to the Xcel Energy Evaporative Cooling Rebate Program.

Of the 118 nonparticipants surveyed, 52 claimed to have installed additional energy-efficient measures beyond their air conditioning unit. These 52 customers installed a total of 73 measures; however, 31 were rebated by other utility programs and were thus removed from the analysis, leaving 42 un-rebated measures. Unlike the participant survey, it was not possible to determine what effect the Evaporative Cooling Rebate Program had on the nonparticipant's decision to install the additional measures (because this population did not participate in the Program). For this reason, we were not able to adjust the spillover analysis for influence of the Program, and instead, we will report on the aggregate measures.

Figure 29 shows the 42 spillover measures by count and type installed by nonparticipants. Again, most measures relate to building envelop or HVAC, whereas lighting, appliances, water heaters, and water heater insulation do not have such a correlation to home cooling. It is important to note that these nonparticipant spillover measures were not discounted for Program influence as they were in the participants section above.

Figure 29. Distribution of Nonparticipant Spillover Measures (N=52)



Participant and Nonparticipant Results Comparison

The participant and nonparticipant spillover cannot be directly compared because they are based on different criteria. Most, if not all, nonparticipant respondents participated in other Xcel Energy programs, such as the air conditioning program, and the spillover for this group would be more appropriately attributed to those programs and not to the Evaporative Cooling Rebate Program.

Interestingly, in both the participant and nonparticipant populations, most of the additional efficient measures installed were related to the home envelope, complementing the effect of an upgraded cooling system (for both evaporative coolers and air conditioning). A purely qualitative assessment could argue that the cooling equipment programs influenced Program participants to install additional measures that *complement* the incentivized measure.

Net-To-Gross

Table 30 shows the freeridership and spillover percentages, and the resulting net-to-gross (NTG) percentages, for Tier 1 and Tier 2 units. We calculated the NTG percentage by subtracting freeridership and adding spillover from 100%. The NTG percentage for Tier 1 is 51.6% and is 58.6% for Tier 2. As outlined above, it was determined that the Program can attribute approximately 2% of gross Program savings to spillover measures, therefore adding savings to the final NTG percentage. Freeridership for Tier 1 is 50%, indicating that half of those who bought Tier 1 evaporative coolers would have bought the same unit had the Program rebate not existed. Combined with the 2% spillover, this finding indicates that 52% of Xcel Energy's claimed gross savings for Tier 1 evaporative coolers and similarly, 59% of savings for Tier 2 evaporative coolers, can be attributed to the Evaporative Cooling Rebate Program in Colorado. Thus, these NTG percentages will be applied to the adjusted gross savings determined by the 2009 evaluation of the Program.

Table 30. Freeridership, Spillover, and NTG Findings

Tier	Freeridership	Spillover	2009 Assumed NTG**	Recommended NTG
1	50%	2%	59.7%	52%
2	43%	2%	100%	59%
3*	N/A	N/A	100%	N/A

*No Tier 3 rebates were provided in 2009, thus it could not be included in our analysis.
** 2009/2010 Xcel Energy Demand-Side Management Biennial Plan; Docket No. 08A-366EG; original filing August 2008/Revised February 2009.

Although freeridership is not expected to change drastically in the near future, as pricing in the residential cooling market has remained fairly stable and the proportion of existing evaporative cooler ownership has remained fairly steady over the past few years,[9] changes to the Program design could potentially influence NTG. Survey data indicated differences in freeridership between Tier 1 and Tier 2, and also between first time buyers and repeat evaporative cooling purchasers. As Table 31 shows, the lowest freeridership exists among first time buyers of Tier 2 equipment, followed by Tier 1 first time buyers.

Table 31. Freeridership Values by Tier and Customer Type

Customer	Tier 1 Freeridership	Tier 2 Freeridership
Previous Owner	55%	49%
First Time Buyer	38%	31%

[9] Xcel Energy Colorado Home Use Study: 2008 & 2010.

Overall Program freeridership could be reduced by changing the proportion of the four types of participants outlined in Table 31. Possible Program design approaches for achieving this change include:

A. Increasing the rebate amount for first time buyers, and

B. Further incentivizing Tier 2 participation through enhanced rebate amounts or tighter participation requirements.

By changing the incentive structure to attract more first time evaporative cooler purchasers and Tier 2 purchasers, the NTG ratio could theoretically increase to 70%. This assumes that freeridership remains steady among the four groups identified above, spillover remains constant, and the change in incentive structure results in a higher proportion of Tier 2, first-time purchasers. Changes to Program design must also be considered in light of overall Program cost-effectiveness.

Net-to-Gross Benchmark Comparison

Many of the evaporative cooling rebate programs Cadmus compared for program design elements either did not have a publically reported NTG number, or a comparable NTG could not be calculated due to very small participation levels. The three programs that were comparable reported freeridership and NTG values similar to those found for Xcel Energy's Evaporative Cooling Rebate Program in 2009.

Table 32. Freeridership and NTG Benchmarking

Program	Evaluated Year	Freeridership	NTG
Xcel Energy, Colorado	2009	47%	53%
Rocky Mountain Power, Utah	2006	75% - Replacements 56% - New	25% - Replacements 44% - New
EPE, New Mexico	2009	45%	55%
PNM, New Mexico	2007-2008	46%*	NA*

* PNM did not publish official freeridership or NTG calculations, but did report the results of a freeridership survey question asking customers if they were planning to install the same equipment before they found out about the rebate. Of the responding participants, 46% said they were planning on buying the same equipment, indicating that if freeridership had been calculated for this program, it would have been close to 46%.

The Cool Cash Program in Utah reported freeridership in 2006 to be slightly higher than the finding for the 2009 Xcel Energy evaluation, with 56% freeridership for new units, 75% for replacement units, and 25% for premium units. The corresponding NTG was calculated for each category with no spillover applied, yielding 44% NTG for new units, 25% NTG for replacement units, and 75% NTG for premium units. An overall weighted NTG was not calculated for all rebated evaporative cooler units in the Cool Cash 2006 report.

El Paso Electric in New Mexico reported freeridership at 45% overall for their Evaporative Cooling Rebate Program in 2009, and did not apply any spillover when calculating the program NTG at 55%. This program differed slightly from the Xcel Energy Program in that rebates were offered to post-secondary school housing and multifamily complexes as well as to single family homes. The post-secondary school housing had 100% freeridership, the multifamily complexes

had 4.9% freeridership, and the single family homes had 39.8% freeridership. The high freeridership found for post-secondary school housing contributed to the overall freeridership value.

Another New Mexico program, offered through PNM, did not publish a freeridership or NTG measure, but did report the results of a single freeridership survey question, asking customers if they were planning to install the same equipment before they found out about the rebate. Of the responding participants, 46% said they were planning to buy the same equipment, indicating that if freeridership had been calculated, it would have yielded similar results to the findings for Xcel Energy's Program.

The NTG value assigned to evaporative coolers in DEER is currently 85%. This NTG is a default value obtained from the "New Measures not Otherwise Addressed" and "Existing Direct Installed Measures for Hard to Reach Markets" categories. Measures within these categories are assigned an estimated 85% NTG because based on a third party evaluation or actual measurement, no other value exists. SCE and PG&E did not have any evaluation results on which to base their own programs, and both reported the DEER default NTG value in their work papers from their 2006-2008 and 2009 program cycles. Utilities that have conducted third party evaporative cooling rebate program evaluations, such as Rocky Mountain Power and El Paso Electric, have resulting freeridership well above 40%, yielding a considerably lower NTG value compared to the DEER default value. Therefore, because there is no confirmed support for this value, the NTG value assigned in DEER is not recommended for the evaporative cooling measure.

Net-To-Gross Recommendations

The reported freeridership and NTG values found for Xcel Energy's Evaporative Cooling Rebate Program in 2009 are comparable to other evaporative cooling rebate programs we researched. Cadmus did not find evidence of higher NTG ratios used by any other program; however, overall Program freeridership could be reduced in the following ways:

1. By changing the incentive structure to attract more first time evaporative cooler purchasers and Tier 2 purchasers, the NTG ratio could theoretically increase to 70%. This assumes that freeridership remains steady among the four groups, spillover remains constant, and that the change in incentive structure results in a higher proportion of Tier 2, first-time purchasers. Changes to Program design must also be considered in light of overall Program cost-effectiveness. Possible Program design approaches for achieving this incentive structure change include:

   A. **Increasing the rebate amount for first time buyers.**

   B. **Further incenting Tier 2 participation through enhanced rebate amounts or tighter participation requirements.**

2. To best account for the fundamental differences between Tier 1 and Tier 2, we recommended that Xcel Energy use one 1.5-ton RAC for Tier 1 and two 1.5-ton RACs for Tier 2.

Net Savings

We determined net savings by applying NTG percentages to verified gross savings. Recall that Tier 1 and Tier 2 have different NTG percentages. Table 33 and Table 34 show the application of those NTG values to the four groups of savings values (by tier and location).

Table 33. NTG and Net Energy Savings for One Unit (At the Meter)

Tier	Location	Gross Savings kWh	NTG	Net Savings kWh
1	Grand Junction	914	51.6%	472
1	Denver	559	51.6%	288
2	Grand Junction	2,041	58.6%	1,196
2	Denver	1,294	58.6%	758

Table 34. NTG and Net Demand Savings for One Unit (At the Customer)

Tier	Location	Gross Savings kW	NTG	Net Savings kW
1	Grand Junction	1.29	51.6%	0.67
1	Denver	1.29	51.6%	0.67
2	Grand Junction	2.74	58.6%	1.61
2	Denver	2.74	58.6%	1.61

The overall net savings on the customer side are 1,383,930 kWh and 2,680 kW. Applying the 7.14% line loss value, the savings at the generator are 1,490,340 kWh and 2,886 kW. Table 35 shows the savings values at the generator compared to the original Program goals and reported savings values. The verified savings are lower than the overall Program goals; however, they are higher than the reported savings values for both energy and demand.

Table 35. Program Goals and Reported and Verified Savings

Value	Program Savings Goal	Reported Savings	Verified Savings
Energy	2,071,569 kWh	1,181,975 kWh	1,490,340 kWh
Demand	3,803 kW	2,771 kW	2,886 kW

9. Benchmarking

Cadmus conducted a benchmark study to compare design elements of the Xcel Energy Evaporative Cooling Rebate Program with other evaporative cooling rebate programs across the U.S. With input from Xcel Energy staff, Cadmus selected a total of seven comparison programs that offered rebates for evaporative cooling in both 2009 and currently in 2010. These programs were located in Colorado, Idaho, Utah, New Mexico, Nevada, and California. These states have similar arid climates to Xcel Energy's service territory in Colorado, making them all locations where evaporative cooling can be effective and practical. The key program design elements we compared were:

- Recipients of incentives,
- Incentive types and levels,
- Requirements for participating customers, and,
- Requirements for participating trade allies.

Overall, Xcel Energy's Evaporative Cooling Rebate Program is in-line with the other programs we reviewed. However, many evaporative cooling programs tend to struggle meeting participation quotas, which in one case led to discontinuing the program, while in 2009 the Xcel Energy Program had the highest participation levels compared to other programs. While Xcel Energy's rebates on evaporative cooler purchases are similar in value to other programs, Xcel Energy's Program may benefit from incentives directed to contractors and dealers. Offering incentives to business customers represent a possible area for Xcel Energy to expand the Program, as other programs have experienced success with this approach.

Detailed findings of our benchmark study are discussed below.

Recipients of incentives: Four of the seven programs compared, Black Hills Energy, El Paso Electric (EPE), Boulder City (Nevada) Municipality, and Southern California Edison (SCE), offer rebates to residential customers only. Two programs, Public Service of New Mexico (PNM) and Idaho Power, offer rebates to both residential and business customers, and Rocky Mountain Power currently offers incentives to homeowners and HVAC trade allies (incentives are offered to contractors for installing evaporative coolers in both new and existing homes).

Incentive types: As shown in Table 36, all seven comparison programs offer a cash rebate for the purchase and installation of a qualified direct or indirect evaporative cooler.[10] Units must be new and, in all but one case, permanently installed in order to qualify for a rebate. Two of the programs, EPE and Black Hills Energy, offer a rebate for a window unit as well as for permanently installed options. Rebates are offered by all seven of the programs for the purchase and installation of an evaporative cooler as either the lone cooling system or to work with an air conditioner. Boulder City offers the only program in which an evaporative cooler is intended as

[10] Direct evaporator systems intake air directly from outside, across a wet media and into the house. Indirect systems bring outside air across a wet medium and then up against a plate, and circulate inside air past the other side of the plate to achieve cooler air indoors without bringing in outdoor air directly.

supplemental to the existing central air conditioning. In this program, a participant is required to have a minimum of a 1.5-ton central air conditioner to qualify for the rebate.

Incentive levels: Incentive amounts ranged from $50 per 1,000 CFM in Boulder City's program, to $1,000 offered by Rocky Mountain Power for an indirect or direct/indirect, whole-house ducted system. Six of the seven comparison programs offer different incentive levels for various efficiency levels, with $500 being the most common rebate amount, offered by four of the seven programs compared. See Table 36 for the range of incentives offered by each program.

The smallest rebate offered, ranging from $50 to $500, was provided for the purchase and installation of a direct or direct/indirect unit,[11] with only one program, PNM, accepting a direct/indirect unit. Two programs in addition to Xcel Energy have a minimum requirement of 2,500 CFM for the lowest rebate amount, and one program has a minimum of 1,000 CFM. The Rocky Mountain Power program offered a lower rebate for a replacement cooler, and a higher rebate to homeowners who were purchasing an evaporative cooler for the first time. The only programs offering a (minimum) rebate for a window unit are EPE and Black Hills Energy. The SCE and EPE programs both offer a higher rebate for the purchase and installation of new pressure relief dampers,[12] and the Rocky Mountain Power program has a higher rebate for the first time installation of an evaporative cooler.

Five of the seven comparison programs offer even higher rebates for two stage or indirect systems. Also, similar to Xcel Energy, Rocky Mountain Power and Black Hills Energy require the installation of a whole-house, closed system to achieve the highest rebate available.

Incentive requirements: For all programs, the rebate applicant must be a rate-paying customer of the utility offering the rebate. In six of the seven comparison programs, the paperwork is the responsibility of the customer seeking the rebate, including cases where a qualified contractor was required. The exception is Idaho Power, where the installing company submits the paperwork on the customer's behalf. Idaho Power is the only program that requires a participating contractor to install the unit in order for the customer to receive the rebate. Four other programs encourage the use of a participating contractor and have a list of participating contractors available online.

Some additional program requirements include:

- A remote thermostat specifically designed for evaporative coolers that automatically controls the unit operation based on the indoor temperature, fan speed, and pump operation (SCE, EPE, Idaho Power),

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[11] A direct/indirect system senses inside and outside temperature conditions and utilizes either the direct or indirect system depending on the temperatures assigned.

[12] Pressure relief dampers (up ducts) automatically exhaust air into the attic and outdoors. They have two main benefits: security and energy efficiency. Pressure relief dampers allow the flow of evaporatively-cooled air to exit the home while windows in a home can remain closed and locked, increasing security. Also, the control systems make use of dampers which open when the home is pressurized by an evaporative cooling blower. They are typically equipped with digital thermostat controls to turn the system on and off and to vary the blower speed in order to maximize energy efficiency in light of local weather conditions, indoor temperature, and the thermostat's set point.

- Underwriters Laboratories (UL) recognized components[13] (SCE, EPE), and
- An on-site inspection by a utility representative to verify installation and product information (Boulder City Municipality).

Table 36. Customer Rebate Amounts and Requirements

Program	Incentive Recipient	Incentive	Requirements
Xcel Energy, Colorado	Homeowner	$200 – rebate or price of unit, whichever is less	- New, - Permanently installed, - Direct, indirect, or two-stage - Minimum airflow of 2,500 CFM
		$500 rebate	- New, - Minimum airflow of 2,500 CFM, - Media saturation effectiveness of 85% or higher, - Remote thermostat control, - Periodic purge water control, - Units with add-on equipment don't qualify.
	Builder	$1,000 rebate	- Builder rebate, - Minimum airflow 1,000 CFM, - Indirect or indirect/direct systems only, - Whole-house ducted system, - Closed system.
SCE, California	Homeowner	$300	- Single-stage ducted system.
		$400	- Single-stage ducted system, - With new pressure relief dampers installed.
		$500	- Two stage ducted system
		$600	- Two stage ducted system, - With new pressure relief dampers installed.
PNM, New Mexico	Homeowner	$300	- Combination unit that contains indirect and direct stages in one cooler OR - A 100% indirect evaporative cooler.
		Additional $100	- for 12-inch media
	Business Customer	$500	- Combination unit that contains indirect and direct stages in one cooler OR - A 100% indirect evaporative cooler
EPE, New Mexico	Homeowner	$300	- Single-stage ducted system, - Window unit system - mot to exceed cost of unit.
		$400	- Single stage evaporative cooling system, - With NEW pressure relief dampers installed.
		$500	- Two stage evaporative cooling system.
		$600	- Indirect or two stage evaporative cooling system, - With NEW pressure relief dampers installed.
Boulder City, Nevada	Homeowner	$50 per 1,000 CFM	- For every 1,000CFM, - First time install only, - Added to an existing air conditioning system.
Rocky Mountain	Homeowner	$100	- Replacement.
		$300	- New.

[13] UL is a recognized international resource for product safety certification and compliance.

Program	Incentive Recipient	Incentive	Requirements
Power, Utah		$500	- Premium (single inlet and direct/indirect without whole-house ducted systems).
		$1,000	- Premium (single inlet and direct/indirect with whole-house ducted systems).
	Contractor	$25	- Replacement, - New.
	Contractor	$150	- Premium (single inlet and direct/indirect without whole-house ducted systems).
	Contractor	$300	- Premium (single inlet and direct/indirect with whole-house ducted systems).
Idaho Power, Idaho	Homeowner	$150	- Minimum size equal to or greater than 2,500 CFM.
	Small to Large Commercial and Industrial Customers	$100/per ton	- Pre-cooler added to condenser standard air cooled AC unit.
		$200/per ton	- Retrofit to direct evaporative cooler replacing standard AC unit.
		$300/per ton	- Retrofit to indirect evaporative cooler replacing standard AC unit.
Black Hills Energy, Colorado	Homeowner	$200	- High efficiency evaporative cooler (window/wall) with ISR air flow rating of 2,500 CFM or greater.
		$400	- High efficiency evaporative cooler (central) with media saturation effectiveness 85% or greater.

Table 37. Benchmarking of Participation, Freeridership, and NTG

Program	Evaluated Year	Participation	Freeridership	NTG
Xcel Energy, Colorado	2009	2,362	47.3%	52.7%
Rocky Mountain Power, Utah	2006	988	75% - Replacements 56% - New	25% - Replacements 44% - New
EPE, New Mexico	2009	939	45%	55%
PNM, New Mexico	2007-2008	12	N/A*	N/A*
SCE, California**	N/A	N/A	N/A	N/A
Boulder City, Nevada**	N/A	N/A	N/A	N/A
Black Hills Energy**	N/A	N/A	N/A	N/A
Idaho Power, Idaho***	2009 Forecast	N/A	N/A	N/A

* PNM did not publish official freeridership or NTG calculations, but did report the results of a freeridership survey question asking customers if they were planning to install the same equipment before they found out about the rebate. Of the responding participants, 46% said they were planning on buying the same equipment, indicating that if freeridership had been calculated for this program, it would have been close to 46%.

** Evaluation unavailable.

*** Evaluation only reported entire program savings.

Findings

Xcel Energy's Evaporative Cooling Rebate Program is comparable to the programs we reviewed for this benchmarking study. Customer rebate amounts are all within the range of incentives offered. Xcel Energy offers one of the highest rebates—at $1,000 for a closed, whole-house ducted system (along with Rocky Mountain Power). Xcel Energy's list of requirements for

eligible equipment is comprehensive and is in-line with equipment eligibility requirements in other programs.

Xcel Energy's Program has the highest participation of any program studied, with 2,362 units installed in 2009. Cool Cash reported the next highest participation of 988 units installed in 2006, followed by EPE who reported installing 939 units in 2009. The PNM program had one of the smallest participation levels, with only two business and 10 residential customers installing in 2008. One distributer who services several states reported that evaporative cooler sales have always been higher in Colorado versus sales in New Mexico, Utah, and Arizona. He reported this is due to the dry climate and the fact that evaporative coolers were very popular in Colorado in the 1970's and 80's. According to this distributer, many Coloradoans are familiar with evaporative coolers from their childhood homes, and are therefore more comfortable replacing and purchasing this technology as adults.

Comparison programs reported similar market barriers to those found in the Xcel Energy evaluation. Noise, humidity, and maintenance were all reported as customer deterrents, but the one program design aspect discussed most was lack of trade ally participation. All comparison programs recognize that contractor and vendor participation is vital to an evaporative cooling rebate program. Another California program, offered by Pacific Gas and Electric (PG&E), which was not compared in our benchmark study, suspended their evaporative cooling rebate program in 2006 due to declining participation, no active industry support, and a lack of contractor promotion. Although records show that PG&E ran a pilot program the next year in 2007, offering training and rebates to contractors and distributors, no one who was involved with this pilot could be reached for comment and no results were publicly reported. When asked about restarting the PG&E evaporative cooling rebate program, a representative noted that "*It might even take more than one level of incentives, either contractors or distributors, along with customer rebates*" to keep participation numbers up.

Recommendations

The following recommendations are also provided in the executive summary of this report.

1. **Consider offering contractor incentives. One aspect of the Program design that needs further investigation is the possibility of offering contractor incentives for installing eligible equipment.** Currently, a dealer could earn more commission on a higher priced air conditioning unit and they would have little trouble explaining the benefits of air conditioning, given the few if any negative preconceptions. Contractors are less inclined to promote evaporative coolers because they cost less, resulting in lower commissions, and because they can be more complicated and time consuming to install. An incentive to trade allies in a sales role could help off-set both the negative financial and perceived 'hassle' factors in promoting a more efficient evaporative cooler.
2. **Consider expanding evaporative cooling rebates to business customers.** An opportunity exists to offer the Program to small to mid-size commercial and industrial customers. As seen with PNM and Idaho Power, business customers represent market potential. PNM's program has fewer business customer participants than residential participants, but it illustrates the ability to expand the program offerings that already exist for residential customers to business customers without the challenges of re-inventing

incentive amounts or program structure. Idaho's program also offers incentives to larger commercial and industrial customers as part of an energy savings package, where evaporative cooling is one component of a customized DSM program offering.

3. **Explore the implications of offering higher rebate amounts for first-time evaporative cooler purchasers.** Two comparison programs offered higher rebates for first time evaporative cooler purchasers compared to those replacing an existing unit. The program in Boulder City, Nevada, only offers a rebate to households that do not already have existing evaporative cooling, while the Cool Cash Program in Utah offers $300 to first time buyers and only $100 to those replacing an older evaporative cooling unit. This strategy may reduce freeridership, as it could boost the number of first time buyers, and they tend to report a lower freeridership when surveyed. Program resources, however, would need to be evaluated to ensure that an increase or reallocation of incentive amounts is cost effective.

10. Metering Study

The Team used a combined regression-engineering approach to estimate unit energy consumption (UEC) and peak demand for evaporative coolers, with a regression analysis conducted for meter data to estimate typical hours-of-use (HOU), and an engineering analysis conducted to estimate average unit performance.

The model regressed time series daily HOU against temperature data. To calculate HOU, the Team generated dummy variables for each five-minute reading for each unit indicating whether a unit was on; with the dummy equaling one when the unit was on and zero when it was off. These dummy variables were then averaged for each day of metering for each unit.

The purpose of a regression approach is to have the ability to extrapolate values to the unmetered portions of the year. To accomplish this, we developed a time-series weather regression model to explore the seasonality of appliance energy consumption. The following modeling considerations were used:

- The dependent variable was average daily HOU.
- The independent variable was the average daily outdoor air temperature from a National Oceanic and Atmospheric Administration weather station in the same climate zone.
- We conducted tests for significance for thermostat setting and size, but these were not found to be significant in the presence of temperature and tier.
- We tested the model using average values across all units, by weather zone, and for each individual unit. The model using average by weather zone was found to have the most robust estimates, showing no indication of biased or inefficient results.

Table 38 contains the final set of terms included in the HOU model, including their coefficients and statistical significance.

Table 38. Regression Details – Impact of Outdoor Air Temperature on HOU*

Independent Variables	Coefficient	t-Value
Intercept	-21.8	16.9
Dummy: Tier 2	2.8	12.1
Average Daily Outdoor Air Temperature (˚F)	0.4	22.5

* Dependent Variable – Average Daily Hours of Use (Adj. R^2 = 0.58)

The Team then used this model to generate an average annual HOU for each weather zone and tier. We accomplished this by combining model coefficients with TMY3 average daily temperature values for each weather zone. The results of this extrapolation for Xcel Energy's two major weather zones are shown in Table 39.

Table 39. Average Annual HOU by Region and Tier

Type	Region	
	Grand Junction	Denver
Tier 1	1,069	866
Tier 2	1,620	1,353

Figure 30 and Figure 31 show the load profiles measured in average daily HOU for each region and tier for a typical year.

Figure 30. Annual HOU - Grand Junction

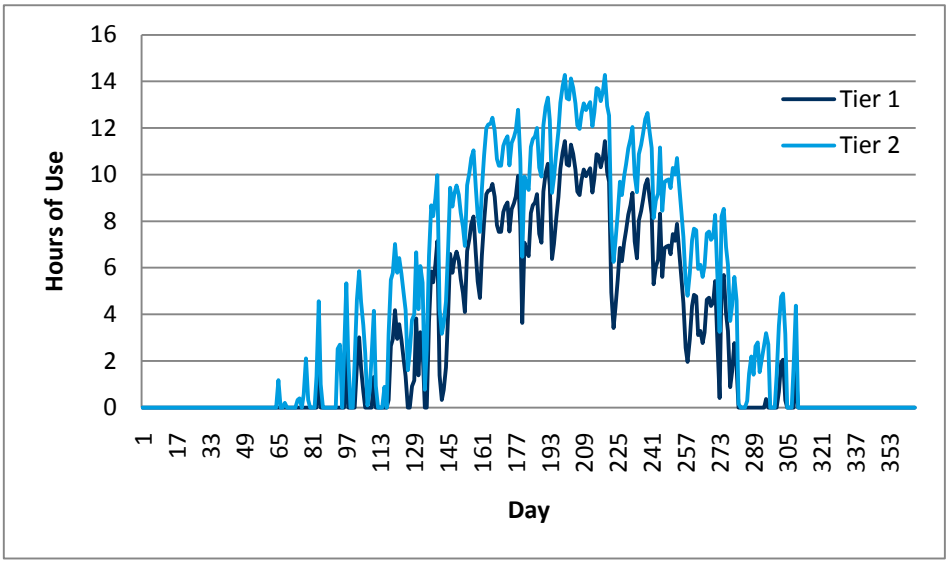
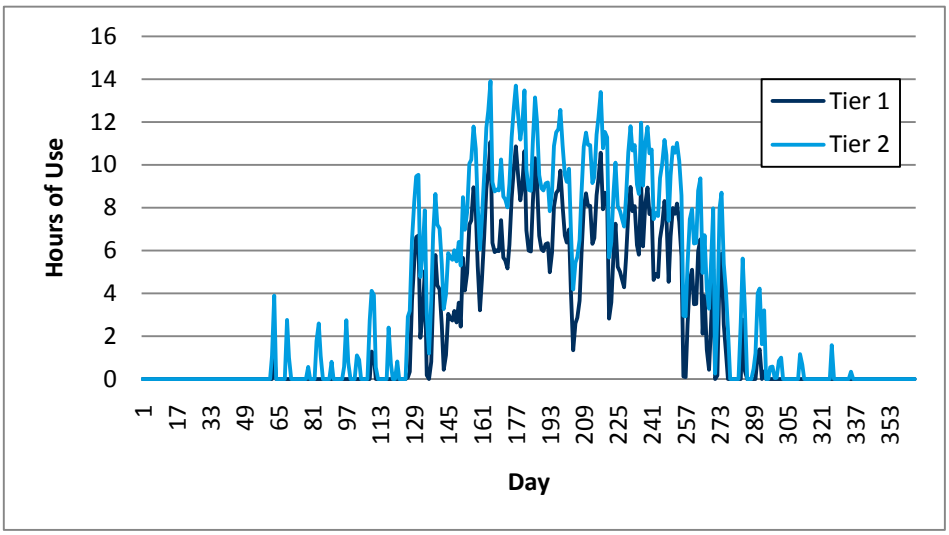


Figure 31. Annual HOU - Denver



11. Baseline and Technical Assumptions Analysis

This section provides an engineering analysis of the Evaporative Cooling Rebate Program Deemed Savings Technical Assumptions (DSTA) section of the 2009/2010 Demand Side Management Biennial Plan Filing (Filing), provided to Cadmus for verification. This section documents the Team's analysis of the methodology that Xcel Energy employed to compute the savings achieved from the Program.

Summary of Key Findings

Cadmus found examples in which Xcel Energy's technical assumptions are supported, and also where more recent studies and Cadmus' 2010 metering study could offer updated values and techniques. The tables below show the 2009 and 2010 DSTA evaluated measures, the corresponding level number (used as a reference throughout this section), and the recommended values, where applicable.

Table 40. Energy and Demand Savings

Level		Xcel Energy Deemed Savings		Cadmus Recommended Savings		Location
		kWh	kW	kWh	kW	
11.1	2009 Tier 1	1,840	2.2	1247	2.25	Denver
				1995	2.25	Grand Junction
11.2	2009 Tier 2	2,095	2.43	847	1.86	Denver
				1515	1.86	Grand Junction
11.3	2009 Tier 1 to Tier 2 Savings	362	0.24	-400	-0.38	Denver
				-480	-0.38	Grand Junction
11.4	2010 Window AC to Tier 1	735	1.74	1602	3.13	Denver
				1926	3.13	Grand Junction
11.5	2010 Window AC to Tier 2	626	1.49	1203	2.73	Denver
				1446	2.73	Grand Junction
11.6	2010 Tier 3:Whole-House HVAC to Integrated Evap	1,127	2.67	847	1.86	Denver
				1515	1.86	Grand Junction

Table 41. Variables

Variables		Xcel Energy Deemed Values			Cadmus Recommended Values	
		2009	2010			
11.7	Window AC Energy *	N/A	774	kWh	2178	kWh Denver
					2619	kWh Grand Junction
11.8	Window AC Demand*	N/A	1.84	kW	3.67	kW
11.9	Tier 1 Evap Cooler Energy (3 tons of cooling)	N/A	39	kWh	576	kWh Denver
					693	kWh Grand Junction
11.10	Tier 1 Evap Cooler Demand	N/A	0.093	kW	0.55	kW

Variables		Xcel Energy Deemed Values			Cadmus Recommended Values	
		2009	2010			
11.11	Tier 2 Evap Cooler Energy	N/A	148	kWh	976	kWh Denver
					1173	kWh Grand Junction
11.12	Tier 2 Evap Cooler Demand	N/A	0.560	kW	0.94	kW
11.11	Tier 3 Integrated Evap Cooler Energy				976	kWh Denver
					1173	kWh Grand Junction
11.12	Tier 3 Integrated Evap Cooler Demand				0.94	kW
11.13	Refrigerated Air Energy	1,358	1,358	kWh	1823	kWh Denver
					2688	kWh Grand Junction
11.14	Refrigerated Air Demand	3.22	3.22	kW	2.8	kW
11.15	Tier 1 Motor HP	1.0725	1/8	HP	0.52	HP Tier 1
11.15	Tier 2 Motor HP	1.0725	3/4	HP	1.02	HP Tier 2
11.15	Tier 3 Motor HP	N/A	NP	HP	1.02	HP Tier 3
11.16	Standard Conversion HP to kW	0.746	0.746	kW/HP	0.746	Conversion
11.17	Load Factor Tier 1	90	80	%	90	Load Factor Tier 1
11.17	Load Factor Tier 2 High	69	80	%	90	Load Factor Tier 2 High
11.17	Load Factor Tier 2 Low	N/A	10	%	N/A	Load Factor Tier 2 Low
11.17	Tier 3 Load Factor	N/A	N/A	%	N/A	%
11.18	Tier 1 Motor Efficiency	70	80	%	63	% Efficient
11.18	Tier 2 Motor Efficiency	70	80	%	73	% Efficient
11.18	Tier 3 Motor Efficiency	N/A	80	%	73	% Efficient
11.19	Effective Full Load Hours/ Operational Hours	700	N/A	Hrs	1,040	Denver Hours
					1,251	Grand Junction Hours
11.20	Coincidence Factor	90	86	%	70	% Coincidence Factor
11.21	Transmission Distribution Loss Factor	7.14	7.14	%	N/A	Loss Factor
11.22	Measure Life	10	10	yrs	15	Years

*Cadmus Window AC energy and demand savings are based off of two units.

Table 42. Incremental Cost

Base System	New System	Xcel Energy Deemed Values		Cadmus Recommended Values
		2009	2010	
Refrigerated Air	Standard Evap Cooling (Tier 1)	-$868	N/A	-$1,916
Refrigerated Air	High Efficient Evap Cooling (Tier 2)	$932	N/A	-$307
Standard Evap Cooling (Tier 1)	High Efficient Evap Cooling (Tier 2)	$1,800	$509	$1,609
Window AC	Tier 1	N/A	-$115.00	-$229
Window AC	Tier 2	N/A	$394.00	$1,380
Whole-house Conventional HVAC	Integrated Evap Cooler	N/A	$1,036.00	-$54

*Cadmus Window AC energy and demand savings based off of two units.

Table 43. Operation and Maintenance Savings

Base System	New System	Xcel Energy Deemed Savings	Cadmus Recommended Savings	
			Denver	Grand Junction
Refrigerated Air	2009 Standard Evap Cooling (Tier 1)	-$19.85	-$8.37	-$7.89
Refrigerated Air	2009 High Efficient Evap Cooling (Tier 2)	-$5.60	-$8.37	-$7.89
Standard Evap Cooling (Tier 1)	2009 High Efficient Evap Cooling (Tier 2)	$14.79	-$8.37	-$7.89
Window AC	2010 Standard Evap Cooling (Tier 1)	-$5.13	-$8.37	-$7.89
Window AC	2010 High Efficient Evap Cooling (Tier 2)	-$3.38	-$8.37	-$7.89
Refrigerated Air	2010 Integrated Evaporative Cooling	-$6.77	-$8.37	-$7.89

Recommendations

Cadmus suggests that Xcel Energy update the DSTA with the recommended values in the body of this report, also listed in Table 44 through Table 47. The recommendations below were also provided in the executive summary of this report.

1. **Consider climate as a component of savings achieved for evaporative cooling.** Currently, Xcel Energy is using a singular value for savings across all of Colorado. Greater accuracy could be achieved by using climate-specific deemed savings for both the Denver and Grand Junction areas of Xcel Energy's service territory. The Denver area is broadly interpreted as east of the Continental Divide; west of the Divide is considered Grand Junction.

2. **Update the run hours with the information obtained from this metering study.** Actual run time was collected from a sample of 70 evaporative cooling rebate recipients over the summer of 2010. We weather-normalized the data, and found that they align with the weather station data and BINMAKER data.[14]

3. **Consider using one 1.5-ton room AC for Tier 1 and two 1.5-ton room ACs for Tier 2 as the baseline for calculating energy and demand savings**. Xcel Energy changed the baseline from a 3 ton Central AC unit in 2009 to a 1.5 ton window AC unit in the 2010 DSTA. The 2009 DSTA baseline unit is a 3-ton, 13 SEER central air conditioner and the 2010 DSTA baseline unit is a 1.5-ton, 9.8 EER window air conditioner. During the Cadmus metering study, we determined that the average size home in which we observed Tier 1 units is 1,500 sq. ft, while the average size of homes with Tier 2 units was 2100 sq. ft. A 1.5-ton window AC unit can effectively cool 1000 to 1,500 sq. ft. of space in the Denver area.[15] Therefore, using one 1.5-ton room AC for Tier 1 and two 1.5-tons room ACs for Tier 2 as the baseline more accurately reflects the cooling load that evaporative cooling is replacing. This is also reflected in assumptions used for motor HP.As noted in

[14] BINMAKER is standard engineering software used for identifying weather conditions, including cooling degree days and climate by geography.

[15] http://www.consumerenergycenter.org/home/heating_cooling/window_ac.html

Table 41, item 11.15, the 2010 DSTA uses a ¾ horsepower motor size, which corresponds to the cooling output of a 3 ton AC unit.

4. **Consider updating assumptions where more current supporting data were found.** Update motor HP for both Tier 1 and Tier 2 evaporative coolers and consider accounting for pump motor energy use. Consider using 0.7 as the coincidence factor and 15 years as the expected useful life of an evaporative cooler.

11.1 2009 Tier 1 Savings

Refrigerated Air to Tier 1 Energy Savings

The 2009 DSTA defines Tier 1 energy savings (customer kWh) of refrigerated air as:

$$Energy\ Savings\ (Customer\ kWh) = Ref\ air\ energy - \left(Motor\ HP * \frac{Motor\ kW\ Constant}{Tier1Motor\ eff} * LF\ evap * EFLH\right) = 1840\ kWh$$

Section 11.13 outlines the refrigerated air energy of 1,358 kWh. The value for the motor consumption, denoted by $\left(\frac{Motor\ kW\ Constant}{Tier1Motor\ eff} * LF\ evap * EFLH\right)$ in the above equation, is not stated in the 2009 DSTA. It is not possible to save more energy (1,840 kWh) than the baseline energy usage (1,358 kWh).

We generated our recommended savings with the recommended refrigerated air energy as outlined in section 11.13, the Tier 1 motor HP listed in section 11.15, the Tier 1 motor efficiency in section 11.18, the Tier 1 load factor in section 11.17, and the EFLH in section 11.19 This yielded 1,247 kWh savings for Denver and 1,995 kWh savings for Grand Junction.

Refrigerated Air to Tier 1 Demand Savings

The 2009 DSTA defines Tier 1 demand savings as:

$$\textbf{\textit{Demand Savings (Customer kW)}} = Ref\ air\ demand - MotorHP * LF\ evap * \frac{Motor\ kW\ Constant}{Tier1Motor\ eff} = 2.2kW$$

Cadmus evaluated the above equation with the recommended refrigerated air demand in section 11.14, the motor Tier 1 HP in section 11.15, the motor efficiency in section 11.18, and the Tier 1 load factor in section 11.17. The resulting demand savings was 2.25 kW. This is within a reasonable range in comparison to the 2009 DSTA value; however, we recommend that Xcel Energy utilize the higher demand savings in both the Denver and Grand Junction areas, to maximize claimed savings.

11.2 2009 Tier 2 Savings

Refrigerated Air to Tier 2 Energy Savings

The 2009 DSTA defines Tier 2 energy savings for refrigerated air as:

$$Energy\ Savings\ (Customer\ kWh) = Ref\ air\ energy - \left(Motor\ HP * \frac{Motor\ kW\ Constant}{Tier1Motor\ eff} * LF\ evap * EFLH\right) = 1840\ kWh$$

Section 11.13 outlines the refrigerated air energy of 1,358 kWh. The value for the motor consumption, denoted by $\left(\frac{Motor\ kW\ Constant}{Tier1Motor\ eff} * LF\ evap * EFLH\right)$ in the above equation, is not stated in the 2009 DSTA. It is not possible to save more energy (2,095 kWh) than the baseline energy usage (1,358 kWh).

We generated our recommended refrigerated air to Tier 2 energy savings with the recommended refrigerated air energy in section 11.13, the Tier 2 motor HP in section 11.15, the Tier 2 motor efficiency in section 11.18, the Tier 2 load factor in section 11.17, and the EFLH in section 11.19. This recommendation yields 847 kWh savings for Denver and 1,515 kWh savings for Grand Junction.

Refrigerated Air to Tier 2 Demand Savings

The 2009 DSTA defines the Tier 2 demand savings for refrigerated air as:

$$\textbf{\textit{Demand Savings (Customer kW)}} = Ref\ air\ demand - MotorHP * LF\ evap * \frac{Motor\ kW\ Constant}{Tier1Motor\ eff} = 2.43kW$$

Cadmus evaluated the above equation with the recommended refrigerated air demand in section 11.14, the motor Tier 2 HP in section 11.15, the Tier 2 motor efficiency in section 11.18 and the Tier 2 load factor in section 11.17. The resulting recommended demand savings of 1.86 kW applies to both the Denver and Grand Junction areas.

11.3 2009 Tier 1 to Tier 2 Savings

2009 Tier 1 to Tier 2 Energy Savings

The 2009 DSTA defines the Tier 1 to Tier 2 energy savings as:

$$\begin{aligned} &Energy\ Savings\ (Customer\ kWh) \\ &\quad = \left(MotorHP * \frac{Motor\ kW\ Constant}{Tier1Motor\ eff} * Tier\ 1\ LF\ evap * EFLH\right) \\ &\quad - \left(MotorHP * \frac{Motor\ kW\ Constant}{Tier2Motor\ eff} * Tier\ 2\ LF\ evap * EFLH\right) = 362\ kWh \end{aligned}$$

Cadmus evaluated the above equation with the recommended Tier 1 motor HP in section 11.15, the Tier 1 motor efficiency in section 11.18, the Tier 1 load factor in section 11.17, the Tier 2 motor HP in section 11.15, the Tier 2 motor efficiency in section 11.18, the Tier 2 load factor in section 11.17, and the EFLH in section 11.19. The resulting recommended energy savings are -400 kWh for Denver and -480 kWh for Grand Junction.

These savings are negative because Cadmus determined from the metering study that Tier 1 and Tier 2 units run for a similar number of hours, but Tier 2 units have larger motors, requiring more kWh than Tier 1 units.

2009 Tier 1 to Tier 2 Demand Savings

The 2009 DSTA defines the Tier 1 to Tier 2 demand savings as:

$$Demand\ Savings\ (Customer\ kW) = \left(MotorHP * Tier\ 1\ LF\ evap * \frac{Motor\ kW\ Constant}{Tier1Motor\ eff}\right) - \left(Motor\ HP * Tier\ 2\ LF\ evap\ efficent * \frac{Motor\ kW\ Constant}{Tier2Motor\ eff}\right) = .24\ kW$$

Cadmus evaluated the above equation with the recommended Tier 1 motor HP in section 11.15, the Tier 1 motor efficiency in section 11.18, the Tier 1 load factor in section 11.17, the Tier 2 motor HP in section 11.15, the Tier 2 motor efficiency in section 11.18, and the Tier 2 load factor in section 11.17. The resulting recommended energy savings are -0.38 kW for both Denver and Grand Junction.

These savings are negative because Cadmus determined from the metering study that Tier 2 units have larger motors, requiring more kW than Tier 1 units.

11.4 2010 Tier 1: Window AC to Evaporative Cooling Savings

2010 Window AC to Tier 1 Energy Savings

The 2010 DSTA defines the window AC to Tier 1 energy savings as:

$$Energy\ Savings\ (Customer\ kWh) = Window\ AC\ Energy - Tier\ 1\ Evap\ Cooler\ Energy = 735\ kWh$$

Cadmus generated the recommended savings with the recommended energy consumption of two window AC units discussed in section 11.7 and the Tier 1 evaporative cooler energy found in section 11.9. The resulting recommended energy savings are 1,602 kWh for Denver and 1,926 for Grand Junction.

2010 DSTA Window AC to Tier 1 Demand Savings

The 2010 DSTA defines the window AC to Tier 1 demand savings as:

$$\textbf{\textit{Demand Savings (Customer kW)}} = Window\ AC\ Demand - Tier\ 1\ Evaporative\ Cooling\ Demand = 1.74$$

Cadmus generated the recommended savings with the values found in section 11.8 for window AC demand and the Tier 1 evaporative cooler demand found in section 11.10. The resulting recommended demand savings is 3.12 kW for both Denver and Grand Junction.

11.5 2010 Window AC to Tier 2 Energy and Demand Savings

2010 Window AC to Tier 2 Energy Savings

The 2010 DSTA defines the window AC to Tier 2 energy savings as:

$$Energy\ Savings\ (Customer\ kWh) = Window\ AC\ Energy - Tier\ 2\ Evap\ Cooler\ Energy = 626\ kWh$$

Cadmus generated the recommended savings with the recommended energy consumption of two window AC units discussed in section 11.7 and the Tier 2 evaporative cooler energy found in section 11.11. The resulting recommended energy savings are 1,203 kWh for Denver and 1,446 kWh for Grand Junction.

2010 Window AC to Tier 2 Demand Savings

The 2010 DSTA defines the window AC to Tier 2 demand savings as:

$$\textbf{Demand Savings (Customer kW)} = Window\ AC\ Demand - Tier\ 2\ Evaporative\ Cooling\ Demand = 1.49$$

Cadmus generated the recommended savings with the values found in section 11.8 for window AC demand and the Tier 2 evaporative cooler demand found in section 11.12. The resulting recommended demand savings is 2.73 kW for both Denver and Grand Junction.

11.6 2010 Tier 3: Whole-House HVAC to Integrated Evaporative Cooler

No Tier 3 evaporative cooling systems were rebated in 2009 for the Xcel Energy Program. For this reason, Cadmus was unable to meter Tier 3 units during the metering study. Therefore, our recommendations are based on best practice assumptions. For more accurate savings verification, Tier 3 units should be metered as they are rebated in the future.

2010 Whole-House HVAC to Tier 3 Energy Savings

The 2010 DSTA defines the whole-house HVAC to integrated evaporative cooler savings as:

$$Energy\ Savings\ (Customer\ kWh) = Ref\ air\ energy - \left(Motor\ HP * \frac{Motor\ kW\ Constant}{Tier1Motor\ eff} * LF\ evap * EFLH\right) = 1127\ kWh$$

The Cadmus recommended whole-house HVAC to Tier 3 energy savings were generated with the recommended refrigerated air energy in section 11.13, the Tier 3 motor HP in section 11.15, the Tier 3 motor efficiency in section 11.18, the Tier 3 load factor in section 11.17, and the EFLH in section 11.19. This recommendation yields 847 kWh savings for Denver and 1,515 kWh savings for Grand Junction.

2010 Whole-House HVAC to Tier 3 Demand Savings

The 2010 DSTA defines the Tier 3 demand savings for refrigerated air as:

$$Demand\ Savings\ (Customer\ kW = Ref\ air\ demand - MotorHP * LF\ evap * \frac{Motor\ kW\ Constant}{Tier1Motor\ eff} = 2.67kW$$

Cadmus evaluated the above equation with the recommended refrigerated air demand in section 11.14, the Tier 3 motor HP in section 11.15, the Tier 3 motor efficiency in section 11.18 and the

Tier 3 load factor in section 11.17. The resulting recommended demand savings of 1.86 kW applies to both the Denver and Grand Junction areas.

11.7 Window AC Energy

The 2010 DSTA defines the energy consumed by a window AC as:

$$Window\ AC\ kWh = Energy\ Use\ of\ 1.5\ ton\ AC = 774\ kWh$$

This value was developed by Xcel Energy using an ESPRE 2.1 model. The 2010 DSTA defines the EER as 9.8.

Using the equation[16] $kWh = OpHr * \frac{Btuh}{EER} * \frac{1kW}{1000W}$ and Xcel Energy's OpHr as discussed in section 11.19 the energy consumption of a 1.5-ton window AC unit is 767 kWh.

In order for the baseline technology cooling capacity to compare to the evaporative coolers being evaluated, Cadmus used the energy consumption for two 1.5-ton, 9.8 EER window air conditioners as the baseline.

To determine the recommended energy consumption and demand for two window AC units, Cadmus used the above equation with the assumed OpHr being 43%[17] less than the recommended OpHr for evaporative coolers from the metering study, and doubled the results to account for two window ACs.

The resulting energy consumption for two window ACs is 2,718 kWh in Denver and 2,619 kWh in Grand Junction.

11.8 Window AC Demand

The 2010 DSTA defines the demand of a window AC as:

$$Window\ AC\ kW = Demnad\ of\ 1.5\ ton\ AC = 1.84\ kW$$

The stated EER value is 9.8. Using the equation[18] $kW = \frac{Btuh}{EER} * \frac{1kW}{1000W}$, $kWh = \frac{Btuh}{EER} * \frac{1kW}{1000W}$the demand of a 9.8 EER window AC is 1.84 kW. This is the same value listed in the 2010 DSTA.

In order for the baseline technology cooling capacity to compare to the evaporative coolers being evaluated, Cadmus used the energy consumption for two 1.5-ton, 9.8 EER window air conditioners as the baseline.

The demand for two window ACs is 3.67 kW for both Denver and Grand Junction.

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16 2010 Mid-Atlantic Technical Reference Manual.

17 Cadmus found the assumed percentage of runtime from air conditioners to evaporative coolers in: Kinney, Larry. *New Evaporative Cooling Systems: An Emerging Solution for Homes in Hot Dry Climates with Modest Cooling Loads*. N.p.: SWEEP, n.d. Print.

18 2010 Mid-Atlantic Technical Reference Manual.

11.9 Tier 1 Evaporative Cooler Energy

The 2009 DSTA defines the energy consumption of a Tier 1 evaporative cooler as:

$$Motor\ HP * \frac{Motor\ kW\ Constant}{Tier1Motor\ eff} * LF\ evap * OpHr = 39\ kWh$$

Motor HP is discussed in section 11.15, motor efficiency is discussed in section 11.18, and the load factor is discussed in section 11.17. Cadmus was unable to find a value for operating hours (OpHr) in the 2009 DSTA. Cadmus used the other assumed values given in the 2009 DSTA, in the above equation and calculated 418 hours as the appropriate value for OpHr.

These hours appear to be extremely low for the run time of a Tier 1 evaporative cooler; 418 hours is only 60% of the 700 hours assumed in the 2009 DSTA. The recommended OpHrs from section 11.19 are 1,040 hours for Denver and 1,251 hours for Grand Junction.

When applying these larger hours of operation to the above equation, along with the recommended HP for a Tier 1 unit discussed in section 11.15 and the recommended motor efficiencies from section 11.18, the resulting energy consumption of a Tier 1 evaporative cooler is 576 kWh for Denver and 693 kWh for Grand Junction. Cadmus advises use of these values as the energy consumption for Tier 1 evaporative coolers.

11.10 Tier 1 Evaporative Cooler Demand

The 2009 DSTA defines the Tier 1 evaporative cooler demand as:

$$Motor\ HP * \frac{Motor\ kW\ Constant}{Tier1Motor\ eff} * LF\ evap = 0.093\ kW$$

Cadmus applied the DSTA values for the motor HP, motor efficiency, and load factor to the above formula and yielded the same value of 0.093 kW. However, Cadmus recommends that the suggested values for motor HP as listed in section 11.15 and the Tier 1 motor efficiency in section 11.18 be used in calculating the demand of a Tier 1 evaporative cooler. With the recommended values applied to the above formula, the resulting demand is 0.55 kW for both Denver and Grand Junction. This is the suggested Tier 1 demand value.

11.11 Tier 2 and Tier 3 Evaporative Cooler Energy

The 2009 DSTA defines the energy consumption of a Tier 2 evaporative cooler as:

$$Motor\ HP * \frac{Motor\ kW\ Constant}{Tier2Motor\ eff} * LF\ evap * OpHr\ for\ high\ and\ low\ speed\ additively = 148\ kWh$$

Motor HP is discussed in section11.15, motor efficiency is discussed in section 11.18, and the load factor is discussed in section 11.17. However, Cadmus was unable to confirm operating hours (OpHr) in the 2010 DSTA. Cadmus used the above equation and solution to solve OpHr for high and low speed additively, which yielded 265 hours. These hours appear to be extremely low for the run time of a Tier 2 evaporative cooler; 265 hours accounts for 38% of the hours assumed in the 2009 DSTA.

Applying the recommended OpHr of 1,040 hours for Denver and 1,251 hours for Grand Junction as listed in section 11.19, the resulting energy consumption of a Tier 2 evaporative cooler is 976 kWh for Denver and 1,173 kWh for Grand Junction. Inputs to these values are discussed in section 11.15 and the recommended motor efficiencies are listed in section 11.18. Cadmus advises that these values be used as the energy consumption for Tier 2 evaporative coolers.

As discussed in section 11.6 Cadmus is using the Tier 2 recommended values for Tier 3 evaporative coolers.

11.12 Tier 2 and Tier 3 Evaporative Cooler Demand

The 2009 DSTA defines the Tier 2 evaporative cooler demand as:

$$Motor\ HP * \frac{Motor\ kW\ Constant}{Tier2Motor\ eff} * LF\ evap = 0.560\ kW$$

Cadmus applied the 2009 DSTA values for the motor HP, motor efficiency, and load factor to the above formula and yielded the same value of 0.560 kW. Again, using recommended values for motor HP (section 11.15) and motor efficiency (section 11.18), the resulting demand is 0.94 kW for both Denver and Grand Junction. This is the recommended Tier 2 demand value.

As discussed in section 11.6 Cadmus is using the Tier 2 recommended values for Tier 3 evaporative coolers.

11.13 Refrigerated Air Energy

The 2009 and 2010 DSTA defines the refrigerated air energy as 1,358 kWh by using the modeled hourly energy use of a home with a 3-ton, 13 SEER standard AC unit in Denver, using an ESPRE model. According to the SWEEP article, the energy used for a 3-ton, 12.9 SEER unit in Denver is 1,935 kWh/year for a 1,800 sq. ft. residence.

Cadmus ran an Energy-10 model of a 1,700 sq. ft. home, which was found to be the average size home during the metering study, with a 3-ton, 13 SEER central air conditioning unit in Denver, Colorado. We determine that the average kWh consumed over the cooling season for Denver, based on four home-facing directional orientations, is 1,823 kWh, and is 2,688 kWh for Grand Junction, which is in line with the value mentioned in the SWEEP article and represent our recommendations for computing refrigerated air energy.

11.14 Refrigerated Air Demand

The 2009 and 2010 DSTA defines the refrigerated air demand as 3.22 kW, derived from a DOE benchmark definition article.[19] Cadmus was unable to confirm the demand value for refrigerated air in this report.

[19] Hendron, R. *Building America Research Benchmark Definition*. N.p.: NREL.

Using the DSTA refrigerated air energy of 1,358 kWh and the calculated operation hours of 418 and 265 for Tier 1 and Tier 2, respectively (listed in sections 11.9 and 11.11), the demand calculates to 3.24 kW for Tier 1 and 5.12 kW for Tier 2. Using the ANSI/AHRI Standard 210/240,[20] the demand for an air conditioner can be calculated with the equation: $Watts = \frac{Btuh}{SEER}$.

Using the above equation for a 3-ton (36,000 Btuh) 13 SEER unit, the demand is 2.8kW. Consider adjusting the baseline demand for refrigerated air using the 2.8 kW value.

11.15 Motor HP

In the 2009 DSTA, 1.0725 HP is used for both Tier 1 and Tier 2 motors. In the 2010 DSTA, the utilized motor horsepower values are 1/8 HP for Tier 1 evaporative coolers and 3/4 HP for Tier 2. It is not stated whether or not pump HP was taken into account.

Cadmus collected blower fan nameplate data during our metering study, and found that the average HP of a Tier 1 unit was 0.41, and the most common blower fan was 1/2 HP with a range of 1/8 to 1 HP. For the Tier 2 units, the average HP was .87 and the most common was 1 HP with a range from 1/3 to 1 HP. Cadmus determined through dealer Websites[21] that a reasonable blower motor size for a Tier 3 unit is 1 HP.

The horsepower of the pump motors we observed ranged from 1/70 to 1/30, with the average of 0.02 HP. [22] Cadmus recommends that this value be incorporated into the unit HP.

Cadmus recommends using 0.52 HP for Tier 1units and 1.02 HP for Tier 2 and Tier 3 units.

11.16 Motor kW Constant

The 2009 and 2010 DSTA use a conversion factor of 0.746 kW per HP. Cadmus concurs with use of this conversion factor.[23]

11.17 Load Factor

The 2009 DSTA lists the load factor (LF) for Tier 1 evaporative coolers as 0.90 and for Tier 2 evaporative coolers as 0.69. These values were recommended to Xcel Energy in a report

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[20] *2008 Standard for Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment*. ANSI/AHRI Standard 210/240 ed. N.p.: n.p., 2008. Web. 11 Nov. 2010. <http://ari.org/ARI/util/showdoc.aspx?doc=1718>.

[21] http://www.speakmancooling.com/images/files/datasheet.pdf, Page 14
http://www.swenergy.org/publications/documents/Evaporative_Cooling_Systems.pdf

[22] http://www.google.com/search?q=evap+cooler+pump+&ie=utf-8&oe=utf-8&aq=t&rls=org.mozilla:en-US:official&client=firefox-a#q=evap+cooler+pump&hl=en&client=firefox-a&hs=Tph&rls=org.mozilla:en-US:official&prmd=ivs&source=univ&tbs=shop:1&tbo=u&ei=A7rdTMfGIYGKlwer7qzMDQ&sa=X&oi=product_result_group&ct=title&resnum=1&ved=0CDEQrQQwAA&biw=1280&bih=870&fp=53894057c0dc71cc

[23] Tongue, Benson H., and Sheri D. Sheppard. *Dynamics Analysis and Design of Systems in Motion.* N.p.: John Wiley and Sons, Inc., 2005. 220. Print.

conducted by Summit Blue.[24] Cadmus confirmed the Tier 1 LF value from the Summit Blue report, but we could not confirm the Tier 2 LF.

The 2010 DSTA lists the LF for Tier 1 evaporative coolers as 0.80. For Tier 2, the 2010 DSTA lists LF as 0.8 for a cooler running on high and 0.1 for a cooler running on low. The 2010 DSTA does not identify where these LFs originated from, nor does it specify how many hours the unit is on low or high.

Throughout this review, Cadmus used the 0.9 value for Tier 1, Tier 2 and Tier 3, as a justified value from the Summit Blue report. Cadmus did not review the standard evaporative cooler LF itself, as it is based on additional system-level variables not available in the assumptions and data collected for this evaluation.

11.18 Motor Efficiency

The 2009 DSTA states the motor efficiency for a standard evaporative and high efficacy cooler as 70%. This value is stated to be derived from a report published by The Department of Energy, Energy Efficiency and Renewable Energy office (EERE). [25] Cadmus verified the validity of this value for a 3/4 HP motor.

The 2010 DSTA utilizes 80% efficiency for both Tier 1 and Tier 2 evaporative coolers. This value was stated to have also been derived from the same EERE report. Cadmus was not able to verify this value.

A discussion of these values follows in the next two subsections.

Tier 1 Motor HP Efficiency

In section 11.15, Cadmus recommends that 1/2 HP motors be used for Tier 1 evaporative coolers in determining energy and demand savings.

Using the EERE report mentioned in section 11.18, Cadmus found the efficiency for a 1/2 HP motor to be 63%.

Tier 2 and 3 Motor HP Efficiency

In section 11.15, Cadmus recommends that 1 HP motors be used for Tier 2 evaporative coolers in determining energy and demand savings.

Using the same EERE report mentioned in section 11.18, Cadmus found that a reasonable efficiency for a 1 HP motor is 73%.

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[24] Barkett, Brent, Floyd Keneipp, Marshall Keneipp, and Mark Thornsjo. *Colorado Demand-side Management Programs Impact, Cost-effectiveness, Process and Customer Satisfaction Evaluations*. N.p.: Summit Blue Consulting LLC, 2006.

[25] "Analysis of Energy Conservation Standards for Small Electric Motors Technical Support Document." *DOE EERE*. N.p., 2006. Web. 5 Nov. 2010. <http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/small_motors_tsd.pdf>.

11.19 Effective Full Load Hours/Operating Hours

Effective full load hours (EFLH) and operating hours (OpHr) both represent the run time of evaporative coolers.

The 2009 DSTA states that 700 hours was used as the EFLHs to calculate the energy and demand savings. This value from the Summit Blue report states that the EFLH was taken from the ENERGY STAR® calculator for high-efficiency central AC units.[26] The 2010 DSTA does not contain evaporative cooler run time information.

The 2009 ASHRAE Fundamentals Handbook notes that Denver International Airport has 777 cooling degree days (CDD), and Grand Junction Walker Field has 1,200 CDD, nearly 50% more cooling hours than Denver. The Cadmus metering study shows a 21% increase in cooling hours for Grand Junction over Denver. Note that 2010 was a hotter than typical summer in Denver, but had average temperatures for Grand Junction.

Based on the review of ASHRAE and the metering study findings, Cadmus recommends that two EFLH values be used to calculate savings. Our recommended EFLH is 1,040 for Denver and 1,251 for Grand Junction.

11.20 Coincidence Factor

Coincidence factor (CF) is defined in the 2009 DSTA as the probability that the peak demand of the coolers will coincide with peak utility system demand. The value used by Xcel Energy is 0.9; this number was reported as originating from a 2006 Summit Blue report; however, Cadmus could not confirm or fine that value in the cited Summit Blue report, although the report did list the CF for central air conditioners as 0.7.[27] The reported CF in the 2010 DSTA is 0.86, but the source for this value is not cited.

Cadmus recommends using the 0.7 CF value found in the Summit Blue report.

11.21 Transmission Distribution Loss Factor

The 2009 and 2010 DSTA defines transmission distribution loss factor (TDLF) as the percent of electricity that is lost as it flows from the power plant to the customer. The value for the TDLF in both DSTAs is 7.14%.

This value was determined by Xcel Energy and is consistent with other programs using TDLF within the Filing.

11.22 Measure Life

The measure life for all tiers of evaporative coolers used in the 2009 and 2010 DSTA is 10 years. This value is reported to have come from the previously referenced SWEEP report. Cadmus was

[26] Pg. 42 of 2006 Summit Blue Report (cited previously).

[27] Ibid.

not able to confirm the quoted 10 year measure life in the referenced SWEEP report; however, another SWEEP article[28] did provide an assumed life of 15 years.

Consider using 15 years instead of 10 years as the measure life of an evaporative cooler.

Incremental Cost

The values listed in Table 44 are defined in the 2009 and 2010 DSTAs for equipment cost.

Table 44. Xcel Energy Deemed Equipment Cost

Equipment	Xcel Energy Deemed Cost	
	2009	2010
Refrigerated Air	$1,268.00	N/A
Standard Evap Cooler	$400.00	$611.00
High Efficiency Evap Cooler	$2,200.00	$1,120.00
Window AC Unit	N/A	$726.00
Integrated Evap	N/A	$9,336.00

These values were stated to come from: the ENERGY STAR® central air conditioner calculator,[29] vendor pricing found online[30], information from toolbase.org, and the California Energy Commission. Installation costs were not included for DSTA incremental cost values.

Cadmus was unable to confirm the specific values mentioned in either DSTA. The ENERGY STAR central air conditioner calculator has a value of $2,857 listed for an installed 3-ton, 13 SEER unit; this is in line with the SWEEP article. Using online retailers,[31] Cadmus found prices ranging from $493 to $761 for Tier 1 evaporative coolers, and an average retail price for a 1.5-ton window AC of $585. The SWEEP article gives a range from $1,600 to $3,500 for installed high efficacy evaporative coolers. Using the SWEEP article, Cadmus determined that a reasonable installed cost of an evaporative cooler is approximately 50% of the equipment cost. Table 45 lists the Cadmus recommended values for the installed equipment cost.

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[28] Kinney, Larry. *Evaporative Cooling Policy and Program Options: Promising Peak Shaving in a Growing Southwest*. N.p.: SWEEP, n.d. Print.

[29] http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_CAC.xls

[30] http://www.google.com/products?q=home+depot+evaporative+cooler+cost&ie=UTF-8&oe=utf-8&rls=org.mozilla:en-US:official&client=firefox-a&um=1&sa=X&oi=product_result_group&resnum=1&ct=title

[31] http://www.overstock.com/Home-Garden/Maytag-18-000BTU-Window-Air-Conditioner/3136666/product.html, http://www.coolrunninghs.com/lw1810hr.html, http://www.globalindustrial.com/p/hvac/air-conditioning/window-wall/airwell-fedders-window-air-conditioner-7?utm_source=google_pr&utm_medium=cpc&utm_campaign=Window-Wall-google_pr&infoParam.campaignId=T9F, http://www.abesofmaine.com/itemB.do?item=GBSGAM183Q1A&id=GBSGAM183Q1A&l=FROOGLE, http://www.csnstores.com/asp/superbrowse.asp?clid=984&caid=&sku=HER1122&refid=FR49-HER1122

Table 45. Recommended Cost Values

Equipment	Cadmus Recommended Cost*	Source
Refrigerated Air	$2,857	Energy Star**
Standard Evaporative Cooler	$941	Online retailers#
High Efficiency Evaporative Cooler	$2,550	SWEEP##
Window AC Unit	$1,170	Online retailers+
Integrated Evaporative	$2,533	SWEEP##

* Installed cost of units using 50% of evaporative cooler cost as installation cost. No additional installation cost included for window AC units.

** http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_CAC.xls

Homedepot.com and Lowes.com

Kinney, Larry. *Evaporative Cooling Systems: An Emerging Solution for Homes in Hot Dry Climates with Modest Cooling Loads* N.p.: SWEEP, n.d. Print.

\+ http://www.overstock.com/Home-Garden/Maytag-18-000BTU-Window-Air-Conditioner/3136666/product.html, http://www.coolrunninghs.com/lw1810hr.html, http://www.globalindustrial.com/p/hvac/air-conditioning/window-wall/airwell-fedders-window-air-conditioner-7?utm_source=google_pr&utm_medium=cpc&utm_campaign=Window-Wall-google_pr&infoParam.campaignId=T9F, http://www.abesofmaine.com/itemB.do?item=GBSGAM183Q1A&id=GBSGAM183Q1A&l=FROOGLE, http://www.csnstores.com/asp/superbrowse.asp?clid=984&caid=&sku=HER1122&refid=FR49-HER1122

The values in Table 45 were used to determine the incremental cost value recommendations found in Table 42. (CHANGE TO TABLE 45)

As no Tier 3 rebates were provided in 2009, Cadmus did not determine the cost of an integrated evaporative cooling system.

Operation and Maintenance Savings

Table 46 is a compilation of the operation and maintenance (O&M) savings from the 2009 and 2010 DSTA. These savings, derived only from water consumption of the unit, are negative, indicating additional costs to operate the units. These additional costs are associated with water consumption of the units that is not required for refrigerated air or window AC units. Savings generated by electric O&M and generation water savings are not included.

Table 46. Xcel Energy Deemed O&M Savings

Base System	New System	Xcel Energy Deemed Savings
Refrigerated Air	2009 Standard Evap Cooling (Tier 1)	-$19.85
Refrigerated Air	2009 High Efficient Evap Cooling (Tier 2)	-$5.06
Standard Evap Cooling (Tier 1)	2009 High Efficient Evap Cooling (Tier 2)	$14.79
Window AC	2010 Standard Evap Cooling (Tier 1)	-$5.13
Window AC	2010 High Efficient Evap Cooling (Tier 2)	-$3.38
Refrigerated Air	2010 Integrated Evaporative Cooling (Tier 3)	-$6.77

To determine the O&M based on unit water consumption, Cadmus used 2,685gallons for Denver and 3,596 gallons for Grand Junction. [32] The 2010 DSTA uses $3/thousand gallons of water and the manufacturer's water consumption data to generate the water O&M savings.

Cadmus found that a more accurate rate for Denver water is $3.165/thousand gallons[33] and for Grand Junction water is $2.195/ thousand gallons. [34]

Table 47 uses the current water costs with the recommended customer O&M savings.

Table 47. Recommended Customer O&M Savings

Base System	New System	Cadmus Recommended Savings	
		Denver	Grand Junction
Refrigerated Air	2009 Standard Evap Cooling (Tier 1)	-$8.37	-$7.89
Refrigerated Air	2009 High Efficient Evap Cooling (Tier 2)	-$8.37	-$7.89
Standard Evap Cooling (Tier 1)	2009 High Efficient Evap Cooling (Tier 2)	-$8.37	-$7.89
Window AC	2010 Standard Evap Cooling (Tier 1)	-$8.37	-$7.89
Window AC	2010 High Efficient Evap Cooling (Tier 2)	-$8.37	-$7.89
Refrigerated Air	2010 Integrated Evaporative Cooling (Tier 3)	-$8.37	N/A

Additional Notes

While water consumption may be a concern at the customer level remains for evaporative cooling, consideration can be given to the water used at the generation level to determine the electricity required by refrigerated air use. It is not clear from the 2009 or 2010 DSTA if or how Xcel Energy claims water savings for electricity generation.

An EPRI publication for fossil fuel generation uses an average of 1.1 gallons to produce 1 kWh.[35] Using the Cadmus recommended energy savings listed in Table 40, the water savings listed in Table 48 could be claimed.

[32] Denver value pulled directly from the following article and the Grand Junction value was interpolated from the same article: Kinney, Larry. *Evaporative Cooling Systems: An Emerging Solution for Homes in Hot Dry Climates with Modest Cooling Loads*. N.p.: SWEEP, n.d. Print.

[33] http://www.denverwater.org/BillingRates/RatesCharges/2010Rates/InsideCity/

[34] http://www.gjcity.org/citydeptwebpages/PublicWorksAndUtilities/WaterServices/WaterDistribution.htm

[35] EPRI Water and Sustainability (Volume 3), US Water Consumption for Power Production, The Last Half Century, March 2002

Table 48. Generation Water Savings

Level	Cadmus Recommended Water Savings	Location
	Gallons	
2009 Tier 1	1372	Denver
	2195	Grand Junction
2009 Tier 2	933	Denver
	1667	Grand Junction
2009 Tier 1 to Tier 2 Savings	-439	Denver
	-528	Grand Junction
2010 Window AC to Tier 1	1762	Denver
	2119	Grand Junction
2010 Window AC to Tier 2	1322	Denver
	1591	Grand Junction
2010 Tier 3:Whole-House HVAC to Integrated Evaporative Cooler	933	Denver
	1667	Grand Junction