Colorado DSM Market Potential Assessment

Volume I – Main Report

Final Report to

XCEL ENERGY
DENVER, COLORADO

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VOLUME I

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E EXECUTIVE SUMMARY

This study assesses the electric energy-efficiency potential for the residential, commercial, and industrial sectors in the Xcel Energy Colorado service territory. The study was commissioned by Xcel Energy, which was directed by the Colorado Public Utilities Commission to conduct a market potential assessment as part of their Comprehensive Settlement Agreement. The goal of this study was to determine levels of energy efficiency available, costs associated with such measures, and whether the measures are cost effective in Colorado. While this study provides energy-efficiency potential estimates for a 10-year period, the main focus of this report is on the first 8 years, 2006-2013, which are the years covered in the Comprehensive Settlement Agreement.

E.1 SCOPE AND APPROACH

In the study, three types of energy-efficiency potential are estimated:

- **Technical potential,** defined as the *complete* penetration of all measures analyzed in applications where they were deemed *technically*
- **Economic potential,** defined as the *technical potential* of those energy-efficiency measures that are cost-effective when compared to supply-side alternatives
- **Achievable program potential,** the amount of savings that would occur in response to specific program funding and measure incentive levels.

In addition, naturally occurring energy-efficiency impacts are estimated. These are savings that result from normal market forces. Achievable program potential reflects savings that are projected beyond those that would occur naturally in the absence of any market intervention.

The method used for estimating potential is a “bottom-up” approach in which energy efficiency costs and savings are assessed at the customer segment and energy-efficiency measure level. For cost-effective measures [based on the total resource cost (TRC) test], program savings potential is estimated as a function of measure economics, rebate levels, and program marketing and education efforts. The modeling approach was implemented using KEMA’s DSM ASSYST™ model. This model allows for efficient integration of large quantities of measure, building, and economic data in the determination of energy efficiency potential.

For this study, three different energy-efficiency funding scenarios were constructed. The first scenario assumes 33 percent of incremental measure costs are paid out in customer incentives. This scenario also utilizes base levels of program marketing and administrative expenditures. The second scenario allows for incentives covering 50 percent of incremental measure costs. Program marketing and administration budgets also increase. The final scenario allows for incentives covering 75 percent of incremental measure costs, along with another increase in program marketing and administration budgets. Program energy and peak demand savings, as well as program cost effectiveness, are assessed under these three funding scenarios.

Under the first case analyzed (Base Case 1), measure-specific incentive levels are capped such that customer payback periods do not fall below one year. In addition, natural gas benefits are not considered in the economic analysis for measures that can save both electricity and natural gas (such as ceiling insulation and duct sealing). These constraints were placed on the analysis to reflect general Xcel Energy program policies and the fact that Xcel Energy is not authorized to offer natural gas demand-side management (DSM) programs in its Colorado service territory.

Under a second case (Base Case 2), the incentive-cap constraint was removed, and natural gas benefits were considered in the economic and program potential analyses. (Additional sensitivity analyses that separately address removing incentive caps and include natural gas benefits are presented in Section 4 of this report.)

E.2 RESULTS

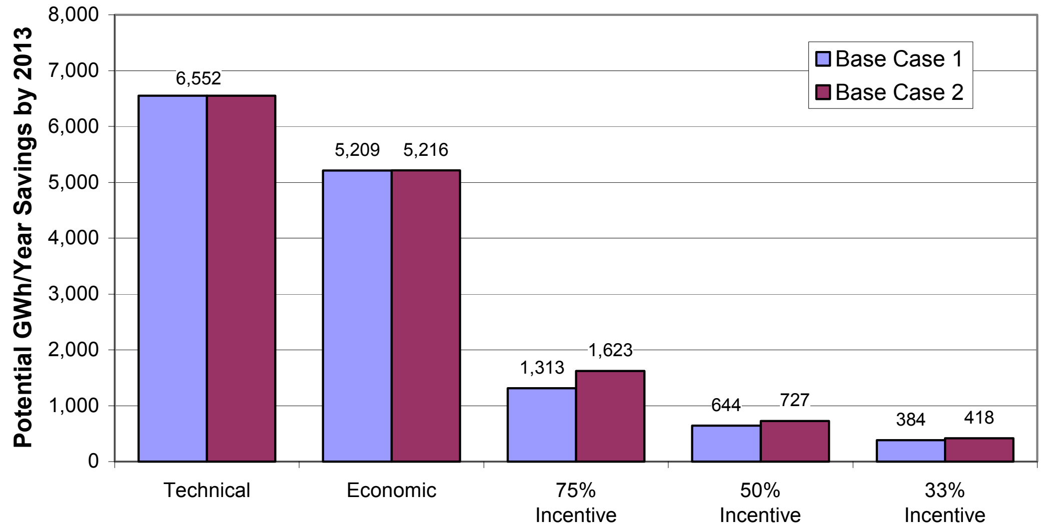
Aggregate results are presented first for the two Base Case analyses. Next, sector-specific results are reviewed.

E.2.1 Aggregate Results

Estimates of energy savings potential are presented in Figure E-1. Technical potential is estimated at 6,552 GWh per year for both Base Case 1 and Base Case 2, since both cases utilized the same measure list. Much of this potential is estimated to be economically viable. Economic potential estimates of 5,209 GWh for Base Case 1 increase slightly to 5,216 GWh for Base Case 2 as several additional residential measures were determined to be cost effective when natural gas benefits are considered. Under Base Case 1 assumptions, net[1] achievable program potentials range from 1,313 GWh per year in the 75-percent incentive scenario to 644 GWh per year for the 50-percent incentive scenario to 384 GWh per year for the 33-percent-incentive scenario. These achievable potentials increase under Base Case 2 to: 1,623 GWh under the 75-percent incentive scenario, 727 GWh under the 50-percent incentive scenario, and 418 under the 33-percent incentive scenario.

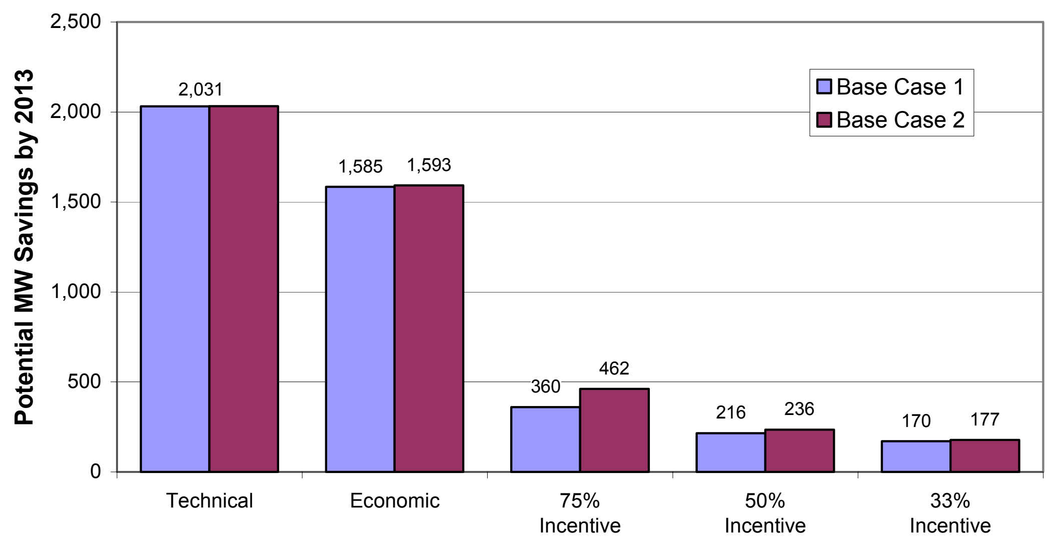
[1] *Net* refers to savings beyond those estimated to be naturally occurring; that is, from customer adoptions that would occur in the absence of any programs or standards.

Figure E-1
Estimated Energy Saving Potential, 2006-2013



Peak demand savings potential estimates are provided in Figure E-2. Technical potential is estimated at 2,031 MW, and economic potential is estimated at 1,585 MW for Base Case 1 and 1,593 MW for Base Case 2. Under Base Case 1 assumptions, net achievable program potential ranges from a high of 360 MW in the 75-percent incentive case down to 170 MW in the 33-percent incentive case. Achievable potentials increase in Base Case 2 to: 462 MW for 75-percent incentives, 236 MW for 50-percent incentives, and 177 MW for 33-percent incentives.

Figure E-2
Estimated Peak Demand Saving Potential, 2006-2013, Base Case



Figures E-3 and E-4 show estimates of achievable potential savings estimates over time. As shown in Figure E-3 for Base Case 1, by 2013 cumulative net energy savings are projected to be 384 GWh under the 33-percent incentive scenario, increasing to 1,313 GWh under the 75-percent incentive scenario. For Base Case 2, energy savings potential increases over Base Case 1 potential in all three incentive scenarios, but the difference is most pronounced in the 75-percent incentive scenario. Figure E-4 depicts projected net peak demand savings by 2013 for Base Case 1 of 170 MW under 33-percent incentives, increasing to 360 MW under 75-percent incentives. Similar to energy, Base Case 2 results show increases in all scenarios but are most pronounced in the 75-percent incentive scenario. Cumulative potentials taper off over time as some measures begin reaching high saturation levels.

Figure E-3
Achievable Energy Savings: All Sectors

Base Case 1 **Base Case 2**

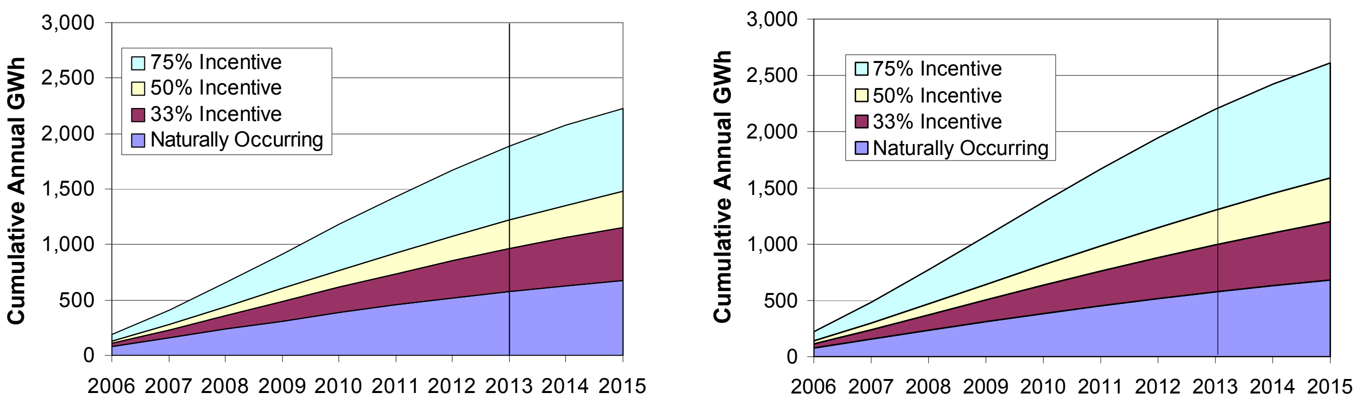


Figure E-4
Achievable Peak-Demand Savings: All Sectors, Base Case

Base Case 1 **Base Case 2**

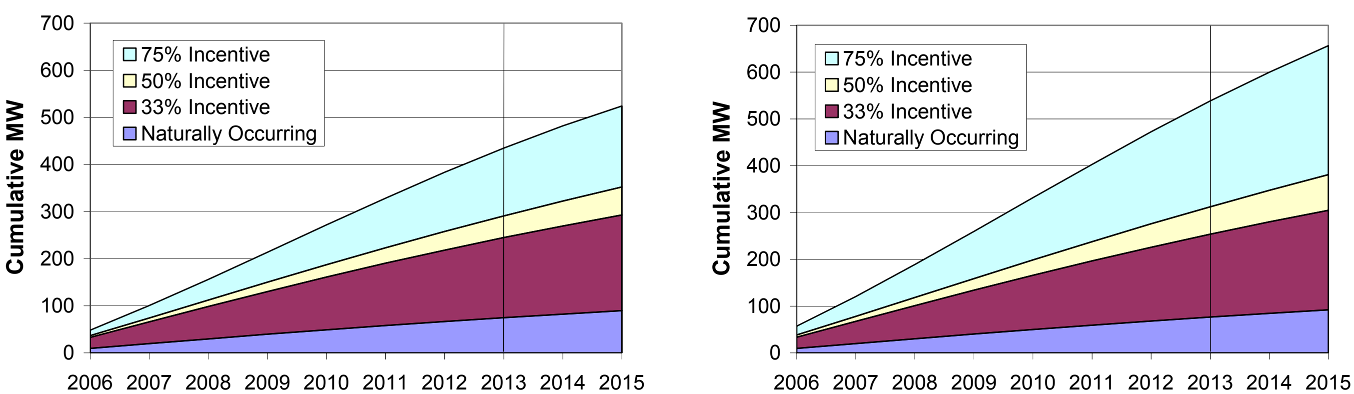
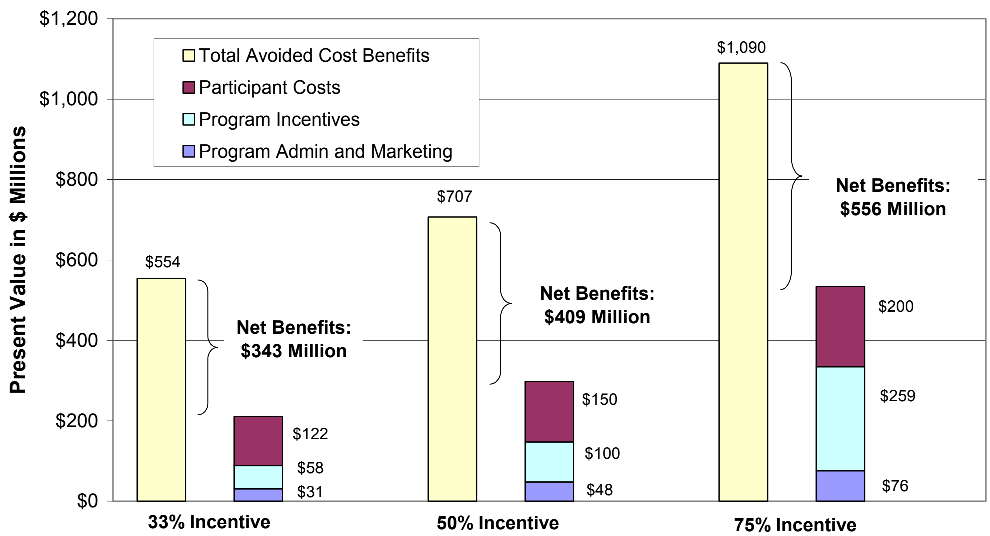


Figure E-5 depicts costs and benefits under each program-funding scenario from 2006 to 2013 for Base Case 1. The present value of program costs (including administration, marketing, and incentives) is $88 million under the 33-percent incentive scenario, $147 million under the 50-percent incentive scenario, and $334 million under the 75-percent incentive scenario. The present value of total avoided-cost benefits is $554 million under 33-percent incentives, $707 million under 50-percent incentives, and $1,090 million under 75-percent incentives. The present value of *net* avoided-cost benefits, i.e., the difference between total avoided-cost benefits and total costs (which include participant costs in addition to program costs), is $343 million under 33-percent incentives, $409 million under 50-percent incentives, and $556 million under 75-percent incentives.

Figure E-5
Benefits and Costs of Energy Efficiency Savings—2006–2013* - Base Case 1

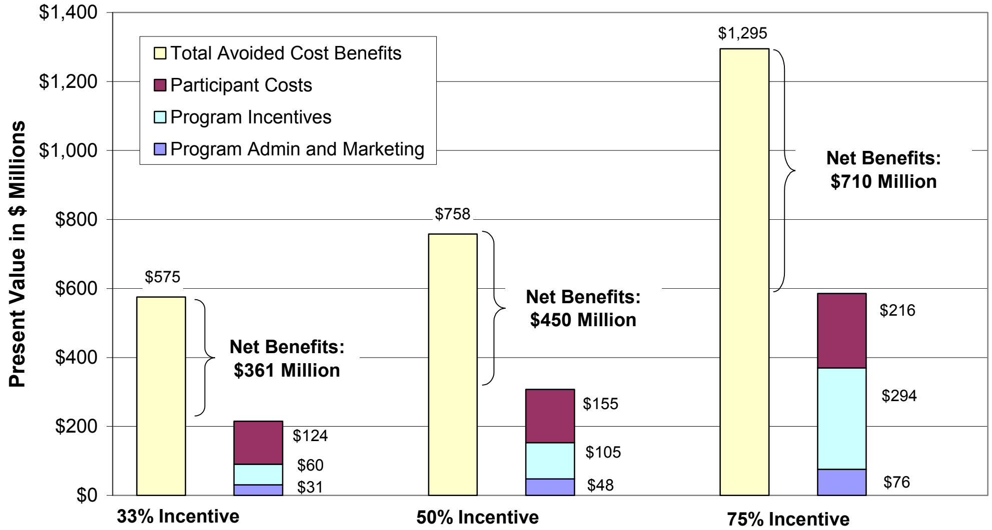


* Present value of benefits and costs over normalized 20-year measure lives; nominal discount rate is 7.4 percent, inflation rate is 2.4 percent.

Figure E-6 shows the same sets of results for Base Case 2. In this second case, the present value of program costs increase to: $90 million under 33-percent incentives, $153 million under 50-percent incentives, and $370 million under 75-percent incentives. The difference in program costs between Base Case 1 and Base Case 2 is most pronounced in the 75-percent incentive scenario because the incentive constraint in Base Case 1 is most pronounced in this scenario. Under Base Case 2, estimated net program benefits increase from $361 million in the 33-percent incentive scenario to $450 million in the 50-percent incentive scenario, to $710 million in the 75-percent incentive scenario.

For both Base Cases, all three of the program funding scenarios are cost-effective based on the TRC test, which is the test used in this study to determine program cost-effectiveness. The TRC benefit-cost ratios are 2.6 for the 33-percent incentive scenario, 2.4 for the 50-percent incentive scenario, and 2.1 for the 75-percent incentive scenario. These ratios did not vary across Base Cases. These TRC ratios indicate that program cost-effectiveness declines somewhat with increasing program effort, reflecting penetration of more measures with lower cost-effectiveness levels. Key results of our efficiency scenario forecasts from 2006 to 2013 are summarized in Table E-1.

Figure E-6
Benefits and Costs of Energy Efficiency Savings—2006–2013* - Base Case 2



* Present value of benefits and costs over normalized 20-year measure lives; nominal discount rate is 7.4 percent, inflation rate is 2.4 percent.

Table E-1
Summary of Achievable Potential Results—2006–2013

Result	Base Case 1			Base Case 2		
	33% Incentive	50% Incentive	75% Incentive	33% Incentive	50% Incentive	75% Incentive
Gross Energy Savings - GWh	639	899	1,568	674	983	1,879
Gross Peak Demand Savings - MW	206	252	396	215	273	500
Net Energy Savings - GWh	384	644	1,313	418	727	1,623
Net Peak Demand Savings - MW	170	216	360	177	236	462
Program Costs - Real, $ million						
Administration	$14	$27	$50	$14	$27	$50
Marketing	$30	$37	$45	$30	$37	$45
Incentives	$84	$135	$330	$86	$142	$372
Total	$128	$199	$425	$130	$206	$467
PV Avoided Costs ($ mil.)	$554	$707	$1,090	$575	$758	$1,295
PV Annual Program Costs ($ mil.)	$88	$147	$334	$90	$153	$370
PV Participant Costs ($ mil.)	$122	$150	$200	$124	$155	$216
TRC Ratio	2.6	2.4	2.1	2.6	2.4	2.1

PV (present value) of benefits and costs is calculated over a 20-year normalized measure life for 2006–2013 program years, nominal discount rate = 7.4 percent, inflation rate = 2.4 percent; GWh and MW savings are cumulative through 2013.

E.2.2 Results by Sector

Cumulative net achievable potential estimates by customer class for the period 2006–2013 are presented in Figures E-7 and E-8. These figures show results for each funding scenario. Achievable energy savings are highest for the commercial sector for both Base Case 1 and Base Case 2, while peak demand savings are split fairly evenly between the residential and commercial sectors in Base Case 1 and highest for residential in Base Case 2. By 2013, about 110 MW of residential peak demand savings are attributable to the Xcel Energy Saver's Switch Program, which is a demand response program that cycles residential central air conditioning units to reduce peak demand.

Figure E-7
Net Achievable Energy Savings (2013) by Sector—GWh/Year

Base Case 1 **Base Case 2**

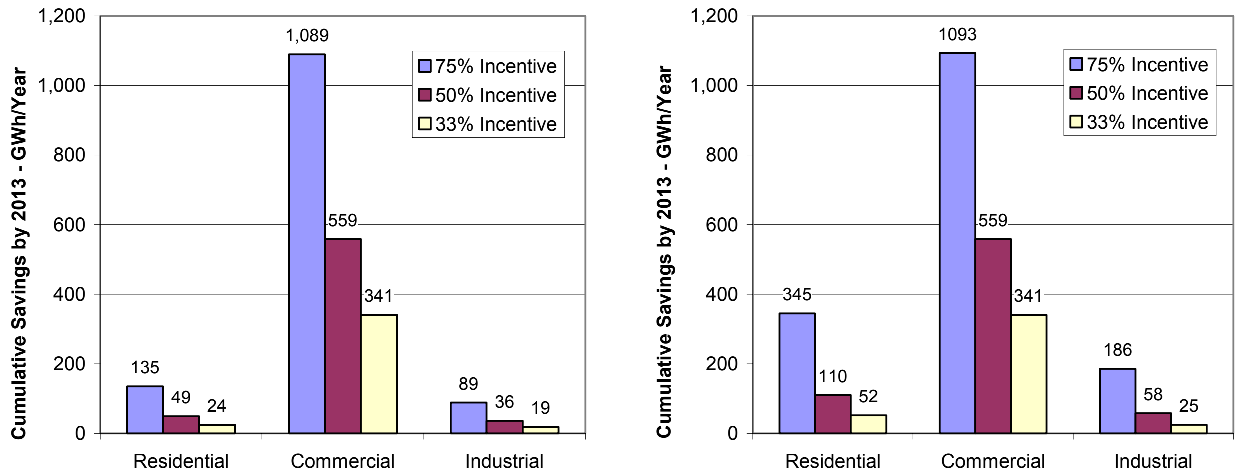
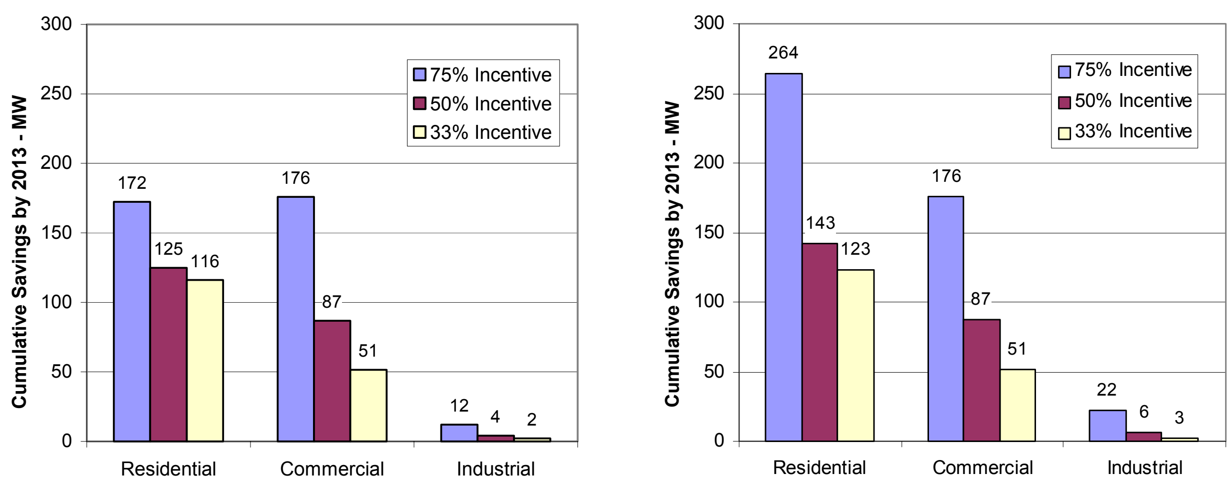


Figure E-8
Net Achievable Peak Demand Savings (2013) by Sector—MW

Base Case 1 **Base Case 2**



Residential Sector

Figure E-9 shows the residential end use distribution of energy savings potential for the 50-percent incentive program scenario. For Base Case 1, heating and lighting contribute most to the energy savings potential, mainly due to ceiling insulation and CFL measures. (Note that we were not able to isolate current ceiling insulation levels for electric space heating customers and therefore utilized insulation levels for all residential customers. This generalization may overstate achievable heating savings if electrically heated homes are better insulated.) Refrigeration, which is mainly the result of a refrigerator recycling measure, provides the next largest share of savings, followed by furnace-air conditioner fans, and cooling. For Base Case 2, lighting accounts for much of the energy savings. This result reflects the effects of uncapping CFL incentives, which were held at under 10 percent in Base Case 1. Space cooling shares also increase in Base Case 2 as building shell measures are more viable when natural gas impacts are included.

Figure E-9
Base Residential Net Energy Savings Potential End Use Shares (2013) – 50% Incentives

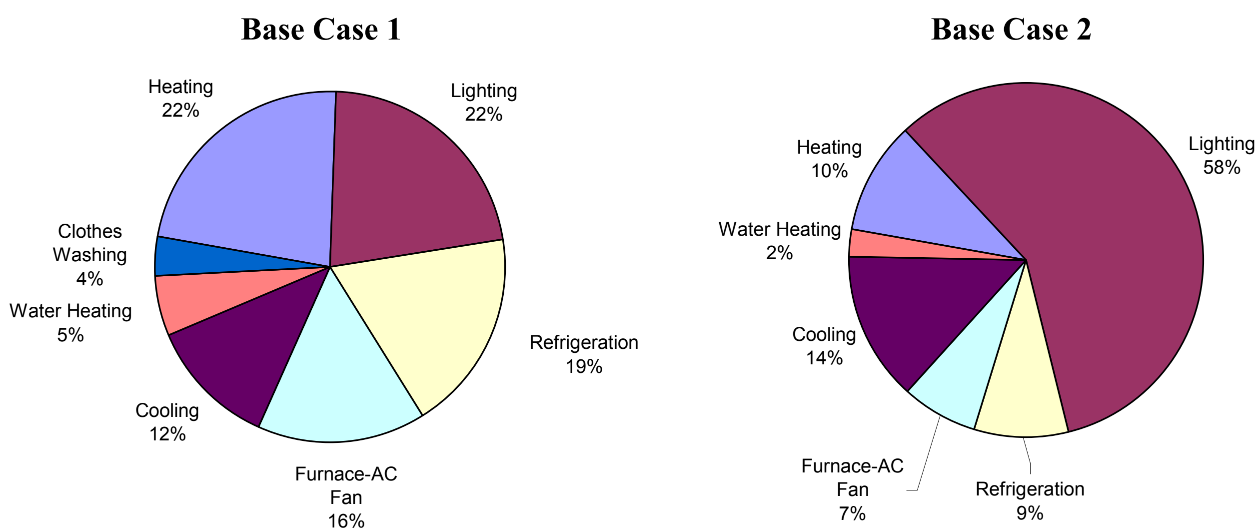
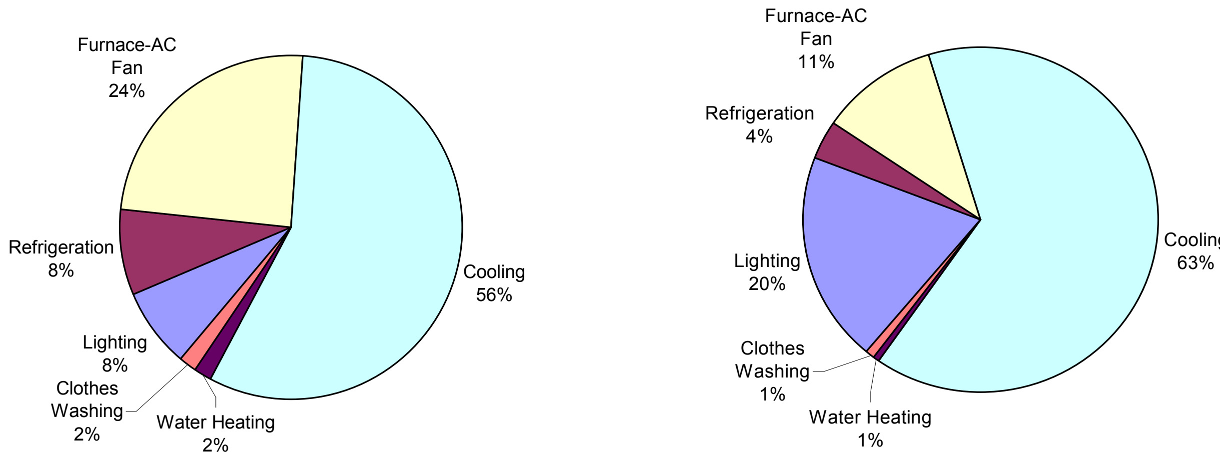


Figure E-10 shows the residential end use distribution of peak demand savings potential for the 50-percent incentive program scenario. Peak demand results exclude the effects of Xcel Energy's Saver's Switch Program, which accounts for about 96 percent of the impacts in the 50-percent scenario and 71 percent of the impacts in the 75-percent incentives scenario. Cooling accounts for the largest share under both Base Case 1 and Base Case 2. Lighting shows an increased share under Base Case 2 assumptions. Other end uses decline in share between Base Case 1 and Base Case 2, as their impacts remain fairly constant while cooling and lighting impacts increase.

Figure E-10
Base Residential Net Peak Savings Potential End Use Shares (2013) – 50% Incentives

Base Case 1 **Base Case 2**



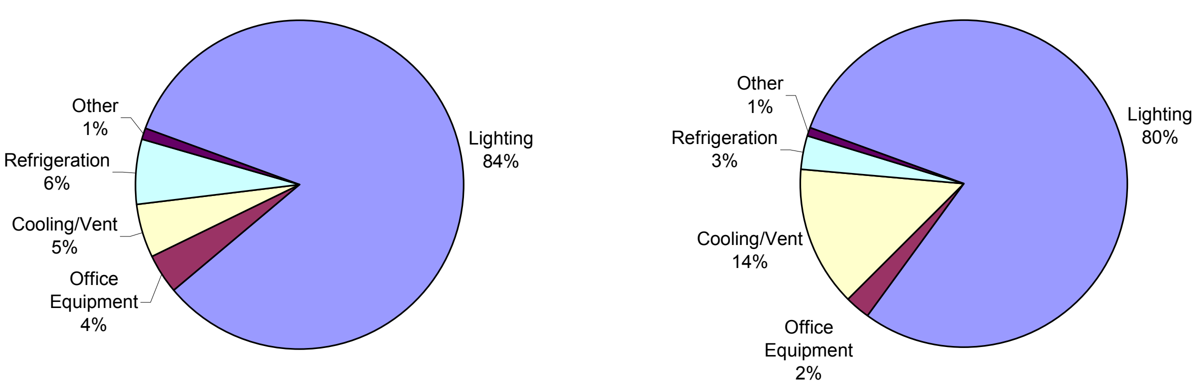
Note: end use results exclude impacts of the Saver's Switch Program.

Commercial Sector

Figure E-11 shows the commercial end use distribution of energy and peak demand savings for the Base Case 1 50-percent incentive program scenario. Only Base Case 1 results are shown because Base Case 1 and Base Case 2 results are similar. Lighting contributes most to both the energy and peak demand savings potential, followed by heating, ventilation, and air conditioning (HVAC) and refrigeration measures. As one would expect, HVAC contributes a higher share to peak demand versus energy. While office equipment measures are shown to be a contributor to net savings, no incentives are provided for measures affecting this end use. Rather, results show effects of program marketing and education efforts to make customers more aware of the benefits of implementing equipment power management capabilities.

Figure E-11
Commercial Savings Potential – End Use Shares (2013) – 50% Incentives

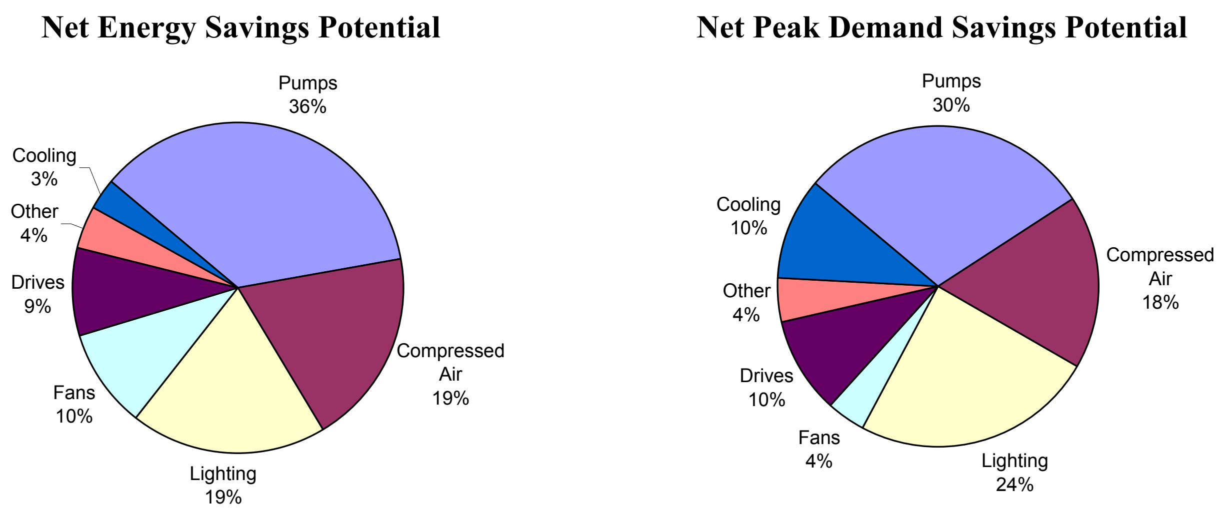
Net Energy Savings Potential **Net Peak Demand Savings Potential**



Industrial Sector

Figure E-12 shows the industrial end use distribution of energy and peak demand savings for the Base Case 50-percent incentive program scenario. Only Base Case 1 results are shown because Base Case 1 and Base Case 2 results are similar. Pumping system measures contribute most to both the energy and peak demand savings potential, followed by lighting and compressed air measures. For peak demand, end use shares for pumping and compressed air decline because some of the pumping and compressed air measures involve off-peak savings from better system management.

Figure E-12
Industrial Savings Potential – End Use Shares (2013) – 50% Incentives



E.3 RECOMMENDATIONS FOR FUTURE STUDY

While this study made significant inroads into understanding DSM potential in the Xcel Energy Colorado service territory, we believe this is just a starting point. Over the next several years, Xcel Energy will be expanding its programs in Colorado and will be gaining a better understanding of Colorado customer response to program marketing/education activities and financial incentive offerings. We believe it will be useful to revisit DSM potential in Colorado in several years in order to incorporate feedback gained from running programs into improved estimates of DSM potential.

1 INTRODUCTION

1.1 OVERVIEW

As part of the Comprehensive Settlement Agreement approved by the Colorado Public Utilities Commission in Dockets 04A-214E, 04A-215E, and 04A-216E, Xcel Energy was directed to conduct a Market Potential Assessment in Colorado.

The goal of the project, per the Settlement Agreement, was:

> "To conduct a market study to determine levels of efficiency available for various customer classes, the costs associated with such measures and whether such levels of DSM are cost-effective and available in Colorado."

KEMA Inc., with assistance from Quantum Consulting, was retained to conduct this demand-side management (DSM) market potential study, and the project commenced in June 2005. The study provides estimates of potential electricity and peak demand savings from DSM measures in Xcel Energy's Colorado service territory.

The scope of this study includes new and existing residential and nonresidential buildings, as well as industrial process savings. The focus of the study was on the 8-year, 2006–2013 period covered by the Comprehensive Settlement Agreement, but the study was extended to a 10-year period to allow for provision of results into Xcel Energy's resource planning activities. Given the near- to mid-term focus, the study was restricted to DSM measures that are presently commercially available.

Data for the study come from a number of different sources, including primary data collected for this project, secondary sources that include internal Xcel Energy studies and data, as well as a variety of information from third parties. The primary data collection effort involved 300 residential on-site surveys, 152 commercial on-site surveys, and 193 vendor telephone surveys.

1.2 STUDY APPROACH

This study involved identification and development of baseline end-use and measure data and development of estimates of future energy efficiency impacts under varying levels of program effort. Residential on-site surveys, commercial on-site surveys, and vendor telephone surveys were utilized, in conjunction with information from secondary sources, to aid in development of the baseline and measure data.

The baseline characterization allowed us to identify the types and approximate sizes of the various market segments that are the most likely sources of DSM potential in Xcel Energy's Colorado service territory. These characteristics then served as inputs to a modeling process that incorporated Xcel Energy energy cost parameters and specific energy-efficiency measure characteristics (such as costs, savings, and existing penetration estimates) to provide more detailed potential estimates.

To aid in the analysis, we utilized the KEMA DSM ASSYST™ model. This model provides a thorough, clear, and transparent documentation database, as well as an extremely efficient data processing system for estimating technical, economic, and achievable potential. We estimated technical, economic, and achievable program potential for the residential, commercial, and industrial sectors, with a focus on energy-efficiency impacts over the next 8 years.

1.3 Layout of the Report

Section 2 discusses the methodology and concepts used to develop the technical and economic potential estimates. Section 3 provides baseline results developed for the study. Section 4 discusses the results of the DSM potential analysis by sector and over time.

The report contains the following appendices:

- Appendix A: Detailed Methodology and Model Description—Further detail of what was discussed in Section 2.
- Appendix B: Measure Descriptions—Describes the measures included in the study.
- Appendix C: Economic Inputs—Provides avoided cost, electric rate, discount rate, and inflation rate assumptions used for the study.
- Appendix D: Building and TOU Factor Inputs—Shows the base household counts, square footage estimates for commercial building types, and base energy use by industrial segment. This appendix also includes time-of-use factors by sector and end-use.
- Appendix E: Measure Inputs—Lists the measures included in the model with the costs, estimated savings, applicability, and estimated current saturation factors.
- Appendix F: Non-Additive Measure Level Results—Shows energy-efficiency potential for each measure independent of any other measure.
- Appendix G: Supply Curve Data—Shows the data behind the energy supply curves provided in Section 4 of the report.
- Appendix H: Achievable Program Potential—Provides the forecasts for the achievable potential scenarios.

2 METHODS AND SCENARIOS

This section provides a brief overview of the concepts, methods, and scenarios used to conduct this study. Additional methodological details are provided in Appendix A.

2.1 CHARACTERIZING THE ENERGY-EFFICIENCY RESOURCE

Energy efficiency has been characterized for some time now as an alternative to energy supply options, such as conventional power plants that produce electricity from fossil or nuclear fuels. In the early 1980s, researchers developed and popularized the use of a conservation supply curve paradigm to characterize the potential costs and benefits of energy conservation and efficiency. Under this framework, technologies or practices that reduced energy use through efficiency were characterized as “liberating ‘supply’ for other energy demands” and could therefore be thought of as a resource and plotted on an energy supply curve. The energy-efficiency resource paradigm argued simply that the more energy efficiency or “nega-watts” produced, the fewer new plants would be needed to meet end users’ power demands.

2.1.1 Defining Energy-Efficiency Potential

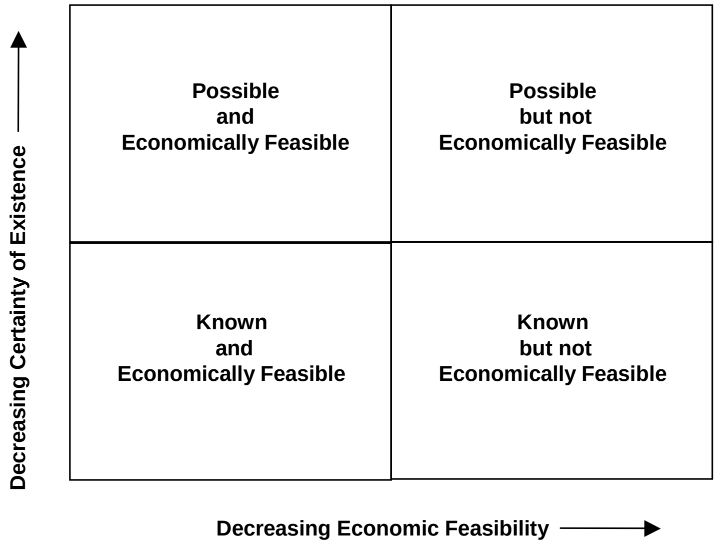
Energy-efficiency potential studies were popular throughout the utility industry from the late 1980s through the mid-1990s. This period coincided with the advent of what was called least-cost or integrated resource planning (IRP). Energy-efficiency potential studies became one of the primary means of characterizing the resource availability and value of energy efficiency within the overall resource planning process.

Like any resource, there are a number of ways in which the energy-efficiency resource can be estimated and characterized. Definitions of energy-efficiency potential are similar to definitions of potential developed for finite fossil fuel resources, like coal, oil, and natural gas. For example, fossil fuel resources are typically characterized along two primary dimensions: the degree of geological certainty with which resources may be found and the likelihood that extraction of the resource will be economic. This relationship is shown conceptually in Figure 2-1.

Somewhat analogously, this energy-efficiency potential study defines several different *types* of energy efficiency *potential*, namely, technical, economic, achievable program, and naturally occurring. These potentials are shown conceptually in Figure 2-2 and described below.

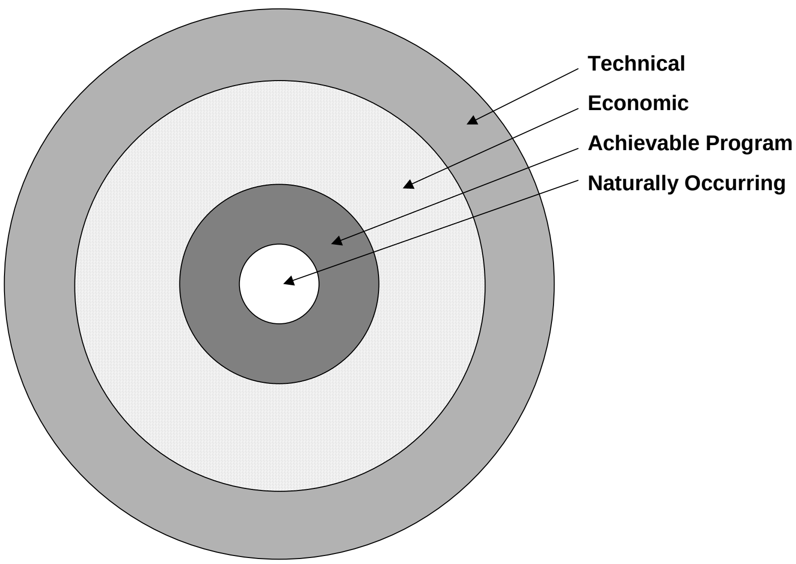
- **Technical potential** is defined in this study as the *complete* penetration of all measures analyzed in applications where they were deemed *technically* feasible from an *engineering* perspective.
- **Economic potential** refers to the *technical potential* of those energy conservation measures that are cost effective when compared to supply-side alternatives.

Figure 2-1
Conceptual Framework for Estimates of Fossil Fuel Resources



- **Achievable program potential** refers to the amount of savings that would occur in response to specific program funding and measure incentive levels. Savings associated with program potential are savings that are projected beyond those that would occur naturally in the absence of any market intervention.
- **Naturally occurring potential** refers to the amount of savings estimated to occur as a result of normal market forces; that is, in the absence of any utility or governmental intervention.

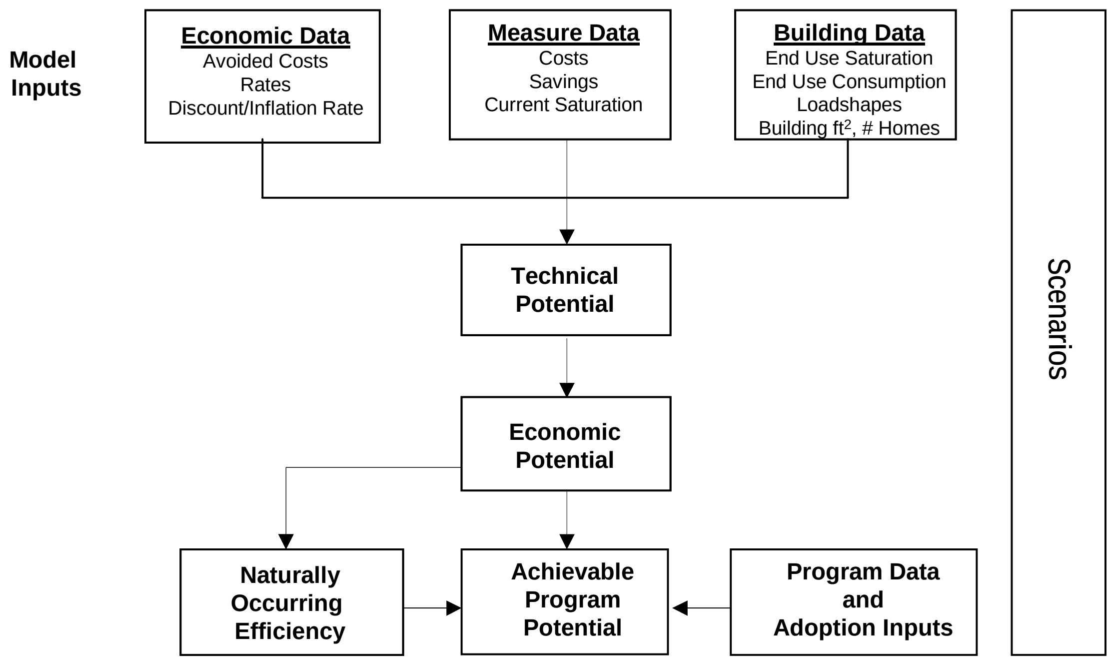
Figure 2-2
Conceptual Relationship Among Energy-Efficiency Potential Definitions



2.2 Summary of Analytical Steps Used in this Study

The crux of this study involves carrying out a number of basic analytical steps to produce estimates of the energy-efficiency potentials introduced above. The basic analytical steps for this study are shown in relation to one another in Figure 2-3. The bulk of the analytical process for this study was carried out in a model developed by KEMA for conducting energy-efficiency potential studies. Details on the steps employed and analyses conducted are described in Appendix A. The model used, DSM ASSYST™, is a Microsoft Excel®-based model that integrates technology-specific engineering and customer behavior data with utility market saturation data, load shapes, rate projections, and marginal costs into an easily updated data management system.

Figure 2-3
Conceptual Overview of Study Process



The key steps implemented in this study are:

Step 1: Develop Initial Input Data

- Develop a list of energy-efficiency measure opportunities to include in scope. In this step, an initial draft measure list was developed and circulated internally within Xcel Energy and to an external advisory group. The final measure list was developed after incorporating comments.
- Gather and develop technical data (costs and savings) on efficient measure opportunities. Data on measures was gathered from a variety of sources. Measure descriptions are provided in Appendix B, and detail on measure inputs is provided in Appendix E.

- Gather, analyze, and develop information on building characteristics, including total square footage or total number of households, electricity consumption and intensity by end use, end-use consumption load patterns by time of day and year (i.e., load shapes), market shares of key electric consuming equipment, and market shares of energy-efficiency technologies and practices. Section 3 of this report describes the baseline data developed for this study.

  To aid in development of baseline data for the project, three primary data collection efforts were undertaken. These efforts were: an on-site survey of 300 residential homes, an on-site survey of 152 commercial establishments, and telephone surveys of 193 builders and equipment vendors and other trade allies in the Xcel Energy Colorado service territory. These telephone surveys included discussions with:

  - AC distributors, contractors, and designers
  - Lighting distributors, contractors, and designers
  - Residential builders
  - Industrial motor and compressed air vendors.

- Collect data on economic parameters: avoided costs, electricity rates, discount rates, and inflation rate. These inputs are provided in Appendix C of this report.

Step 2: Estimate Technical Potential and Develop Supply Curves

- Match and integrate data on efficient measures to data on existing building characteristics to produce estimates of technical potential and energy-efficiency supply curves.

Step 3: Estimate Economic Potential

- Match and integrate measure and building data with economic assumptions to produce indicators of costs from different viewpoints (e.g., societal and consumer).
- Estimate total economic potential.

Step 4: Estimate Achievable Program and Naturally Occurring Potentials

- Screen initial measures for inclusion in the program analysis. This screening may take into account factors such as cost effectiveness, potential market size, non-energy benefits, market barriers, and potentially adverse effects associated with a measure. For this study measures were screened using the total resource cost test, while considering only electric avoided-cost benefits.
- Gather and develop estimates of program costs (e.g., for administration and marketing) and historic program savings.
- Develop estimates of customer adoption of energy-efficiency measures as a function of the economic attractiveness of the measures, barriers to their adoption, and the effects of program intervention.
- Estimate achievable program and naturally occurring potentials.

Step 5: Scenario Analyses

- Recalculate potentials under alternate program scenarios.

2.3 Scenario Analysis

Scenario analysis is a tool commonly used to structure the uncertainty and examine the robustness of projected outcomes to changes in key underlying assumptions. This section describes the alternative scenarios under which demand-side management (DSM) potential is estimated in this study. We developed these scenarios of DSM potential for two key reasons:

1. Our estimates of potential depend on future adoptions of energy-efficiency measures that are a function of data inputs and assumptions that are themselves forecasts. For example, our projections depend on estimates of measure availability, measure cost, measure savings, measure saturation levels, retail rates, and avoided costs. Each of the inputs to our analysis is subject to some degree of uncertainty.
2. The ultimate achievable energy-efficiency potential depends, by definition, on policy choices, including the level of resources and strategies used to increase measure adoption.

The cost components of program funding that vary under each scenario include:

Marketing and Education Expenditures

- Customers must be aware of efficiency measures and associated benefits in order to adopt those measures. In our analysis, program marketing expenditures are converted to increases in awareness. Thus, under higher levels of marketing expenditures, higher levels of awareness are achieved.

Incentives and Direct Implementation Expenditures

- The higher the percentage of measure costs paid by the program, the higher the participants' benefit-cost ratios and, consequently, the number of measure adoptions.

Administration Expenditures

- Purely administrative costs, though necessary and important to the program process, do not directly lead to adoptions; however, they have been included in the program funding because they are an input to program benefit-cost tests.

For the study, two primary sets of analyses were developed. Under the first case analyzed (Base Case 1), measure-specific incentive levels are capped such that customer payback periods do not fall below one year. In addition, natural gas benefits are not considered in the economic analysis for measures that can save both electricity and natural gas (such as ceiling insulation and duct sealing). These constraints were placed on the analysis to reflect general Xcel Energy program policies and the fact that Xcel Energy is not authorized to offer natural gas DSM programs in its Colorado service territory.

Under a second case (Base Case 2), the incentive-cap constraint was removed, and natural gas benefits were considered in the economic and program potential analyses. (Additional sensitivity analyses that separately address removing incentive caps and including natural gas benefits are presented in Section 4 of this report.)

For each analysis, three program-funding scenarios were considered: a 33-percent incentive scenario, a 50-percent incentive scenario, and a 75-percent incentive scenario. These scenarios are discussed below.

Thirty-three-percent Incentive Scenario

In the 33-percent incentive scenario, base incentive levels are set to 33 percent of incremental measure costs. Marketing/customer education and program administration budgets are set at modest amounts, roughly corresponding to minimum program support levels.

In all scenarios, a number of measures were modeled without financial incentives. These include commercial screw-in compact fluorescent lamps (CFLs) and industrial operations and maintenance (O&M) measures. Because these measures are very cost effective, it was deemed that provision of an incentive would primarily benefit free riders.

In addition under Base Case 1 assumptions, incentive levels for all other measures were capped (if necessary), such that the incentive would not drive the customer payback period below one year. This Xcel Energy policy was also included to minimize free ridership on the most cost effective measures.

Appendix H provides the incentive levels utilized for each measure included in the achievable program potential analysis.

Fifty-percent Incentive Scenario

In this scenario, incentives were increased to cover 50-percent of incremental measure costs, except for the measures that had constrained incentives as discussed above. Marketing/education and program administration budgets were also increased for this scenario.

Seventy-five-percent Incentive Scenario

In this scenario, incentives were increased to cover 75-percent of incremental measure costs, with the exception of constrained measures. Marketing/education and program administration budgets were increased again for this scenario.

Summary of Scenarios

Table 2-1 shows average spending for each of the scenarios for the 2006–2013 forecast period for the Base Case 1 analysis, which does not include natural gas benefits and limits incentive levels such that customer payback periods are one year or longer. Table 2-2 shows average spending for the Base Case 2 analysis in which natural gas benefits are included and incentives are not capped.

Table 2-1
Scenario Average Spending During 2006–2013 Forecast Period ($1000s)
Base Case 1

Funding Level	Market Segment	Cost Components: Admin	Marketing	Incentives	Total	% Incremental Measure Cost Paid*
33% Incentives	Residential Existing	$133	$150	$365	$648	33%
	Residential New Construction	$96	$65	$54	$215	33%
	Residential Saver's Switch	$382	$1,370	$5,898	$7,650	-
	Commercial Existing	$615	$1,533	$3,668	$5,817	33%
	Commercial New Construction	$473	$511	$343	$1,327	33%
	Industrial	$75	$75	$145	$295	33%
	Total	$1,774	$3,705	$10,473	$15,951	
50% Incentives	Residential Existing	$281	$300	$979	$1,560	50%
	Residential New Construction	$148	$90	$153	$392	50%
	Residential Saver's Switch	$382	$1,370	$5,898	$7,650	-
	Commercial Existing	$1,437	$1,643	$8,588	$11,667	50%
	Commercial New Construction	$991	$1,022	$879	$2,892	50%
	Industrial	$158	$150	$390	$698	50%
	Total	$3,397	$4,576	$16,886	$24,859	
75% Incentives	Residential Existing	$617	$601	$4,085	$5,303	75%
	Residential New Construction	$240	$135	$1,003	$1,378	75%
	Residential Saver's Switch	$382	$1,370	$5,898	$7,650	-
	Commercial Existing	$3,145	$1,792	$25,877	$30,814	75%
	Commercial New Construction	$1,561	$1,533	$2,611	$5,705	75%
	Industrial	$331	$200	$1,754	$2,285	75%
	Total	$6,276	$5,632	$41,227	$53,134	

* Note: incentive levels were capped, if necessary, to maintain customer payback periods of one year or more. Saver's Switch incentives were set at $25.

Table 2-2
Scenario Average Spending During 2006–2013 Forecast Period ($1000s)
Base Case 2

Funding Level	Market Segment	Cost Components				% Incremental Measure Cost Paid*
		Admin	Marketing	Incentives	Total	
33% Incentives	Residential Existing	$136	$150	$546	$833	33%
	Residential New Construction	$103	$65	$115	$284	33%
	Residential Saver's Switch	$382	$1,370	$5,898	$7,650	-
	Commercial Existing	$615	$1,533	$3,668	$5,817	33%
	Commercial New Construction	$473	$511	$343	$1,327	33%
	Industrial	$74	$75	$183	$332	33%
	Total	$1,783	$3,705	$10,753	$16,242	
50% Incentives	Residential Existing	$287	$300	$1,453	$2,040	50%
	Residential New Construction	$157	$90	$351	$598	50%
	Residential Saver's Switch	$382	$1,370	$5,898	$7,650	-
	Commercial Existing	$1,437	$1,643	$8,588	$11,667	50%
	Commercial New Construction	$991	$1,022	$879	$2,892	50%
	Industrial	$155	$150	$548	$854	50%
	Total	$3,409	$4,576	$17,716	$25,702	
75% Incentives	Residential Existing	$610	$601	$7,314	$8,524	75%
	Residential New Construction	$225	$135	$1,783	$2,143	75%
	Residential Saver's Switch	$382	$1,370	$5,898	$7,650	-
	Commercial Existing	$3,143	$1,792	$25,926	$30,860	75%
	Commercial New Construction	$1,561	$1,533	$2,611	$5,705	75%
	Industrial	$310	$200	$2,950	$3,460	75%
	Total	$6,231	$5,632	$46,481	$58,343	

* Note: incentive levels were capped, if necessary, to maintain customer payback periods of one year or more. Saver's Switch incentives were set at $25.

3 BASELINE RESULTS

3.1 OVERVIEW

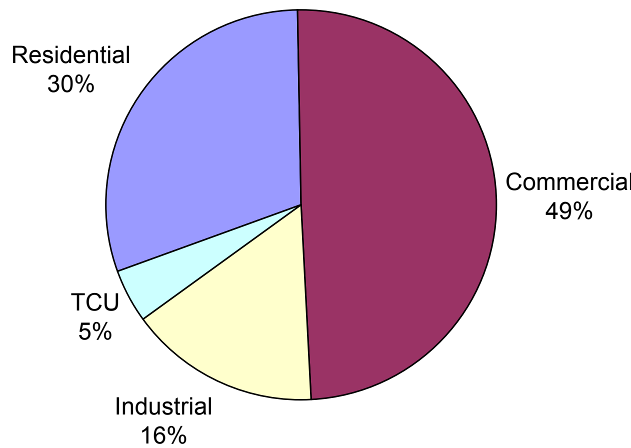
Estimating the potential for energy-efficiency improvements requires a comparison of the energy impacts of standard-efficiency technologies with those of alternative high-efficiency equipment. This, in turn, dictates a relatively detailed understanding of the energy characteristics of the marketplace. Baseline data that were required for each studied market segment included:

- Total count of energy-consuming units (floor space of commercial buildings, number of residential dwellings, and the base kWh-consumption of industrial facilities)
- Annual energy consumption for each end use studied (both in terms of total consumption in GWh and normalized for intensity on a per-unit basis, e.g., kWh/ft^2)
- End-use load shapes (that describe the amount of energy used or power demand over certain times of the day and days of the year)
- The saturation of electric end uses (for example, the fraction of total commercial floor space with electric air conditioning)
- The market share of each base equipment type [for example, the fraction of total commercial floor space served by 4-foot fluorescent lighting fixtures (CFLs)]
- Market share for each energy-efficiency measure in scope (for example, the fraction of total commercial floor space already served by CFLs).

Data for the baseline analysis comes from a number of sources, including Xcel Energy internal studies and analyses, U.S. Department of Energy studies, on-site and telephone surveys conducted as part of this project, and other secondary sources. Baseline data sources vary by sector and are described further below.

Figure 3-1 shows the overall breakdown of energy and peak demand by sector for the Xcel Energy Colorado service territory. Commercial accounts for the largest share of energy usage, followed the residential, industrial, and TCU (transportation, communications, and utilities) sectors.

Figure 3-1
Energy Usage Breakdown – Xcel Energy Colorado Service Territory



3.2 Residential

For the residential sector, customer counts were provided by Xcel Energy. Dwellings were split into single-family and multi-family components using data from the Xcel Energy Residential Usage Study (2004) and 300 residential on-site surveys that were conducted as part of this study.

End-use saturations were developed from the Residential Usage. UECs (Unit Energy Consumption in kWh per home per year) were developed from Residential Usage Study and Xcel Energy forecast analyses. These data were adjusted for single-family and multi-family levels using the U.S. DOE Residential Energy Consumption Survey (RECS) data for the Mountain Region.

Load shape data from Xcel Energy and KEMA end-use databases were utilized to allocate annual energy usage to Xcel Energy time-of-use (TOU) periods. Peak period usage, developed on a sector-specific and end-use basis, was calibrated to equal the Xcel Energy summer peak.

Table 3-1 summarizes the residential baseline energy consumption results developed for the study. Overall end-use consumption for energy and peak demand are shown in Figures 3-2 and 3-3. Overall, plug loads and lighting are the largest end uses in terms of energy consumption, followed by refrigeration, central air conditioning (CAC), and clothes drying. CAC is the largest end use in terms of peak demand.

Table 3-1
Residential End-use Saturation and Unit Consumption

End Use	Multifamily		Single Family	
	Saturation	kWh/unit	Saturation	kWh/unit
Central Air Conditioning (CAC)	47%	1,747	41%	1,837
Room Air Conditioning (RAC)	9%	873	4%	919
Evaporative Cooler	12%	349	17%	367
Space heat	12%	5,900	7%	9,500
Furnace/AC Fan	64%	720	76%	900
Refrigerator	110%	696	129%	910
Freezer	17%	418	51%	510
Water heat	12%	1,815	6%	2,560
Dishwasher	81%	464	86%	613
Clothes dryer	61%	820	81%	1,068
Lighting	100%	1,025	100%	1,550
Plug loads	100%	708	100%	1,583

Figure 3-2
Residential Energy Usage by End Use

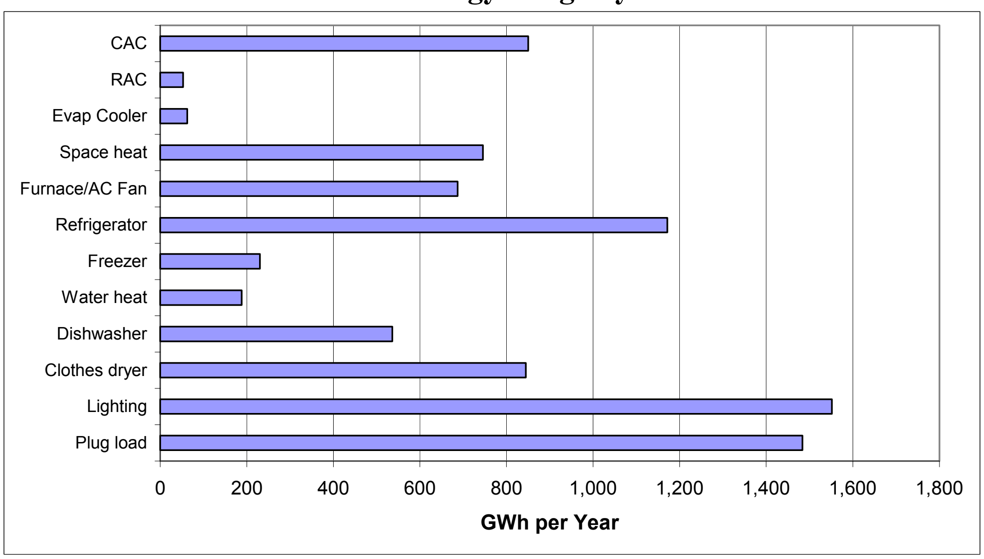
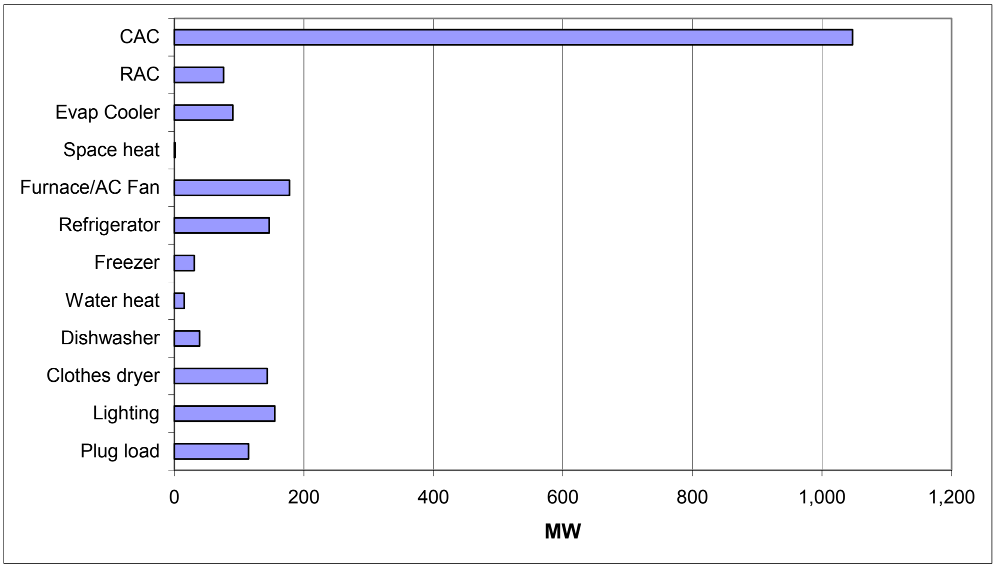


Figure 3-3
Residential Peak Demand by End Use



Data from 300 residential on-site surveys were used to develop an understanding of efficiency levels in the Xcel Energy Colorado service territory. Information from telephone surveys of 15 builders in the service territory was also used to provide an understanding of current practices. Following are some of the key results of these data collection activities.[1]

Figure 3-4 shows the distribution of ceiling insulation levels in homes with air conditioning. The figure also shows feasibility levels for adding additional insulation. As this figure indicates, the majority of homes have ceiling insulation levels in the R-19 range. About 20 percent of the homes have ceiling insulation levels that are below R-19. Adding ceiling insulation would be feasible in about 45 percent of these homes. Ceiling insulation levels are greater than R-19 in about 25 percent of the homes. To address the varying insulation levels in existing homes in the energy-efficiency potential analysis, we looked at three retrofit ceiling insulation measures: increasing insulation from R-0 to R-38, increasing insulation from R-11 to R-38, and increasing insulation from R-19 to R-38.

As Figure 3-5 shows, the majority of new homes have ceiling insulation levels between R-25 and R-38. Over 70 percent of builders report installing insulation in this range, and about 40 percent of builders report installing ceiling insulation with R-values of R-38 or better, at least in some homes.

[1] The surveyed residential builders account for about 7,000 homes per year. Around 90 percent of these homes are single-family detached homes. About 30 percent of the homes are priced under $250,000 and another 60 percent of the homes are priced in the $250,000-$500,000 range.

Figure 3-4
Ceiling Insulation in Single-Family Homes with Air Conditioning

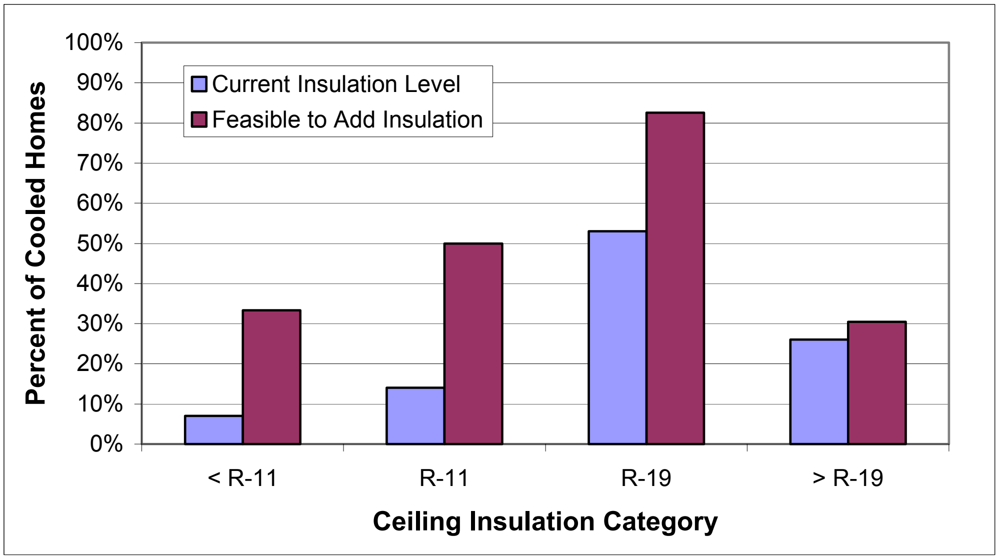
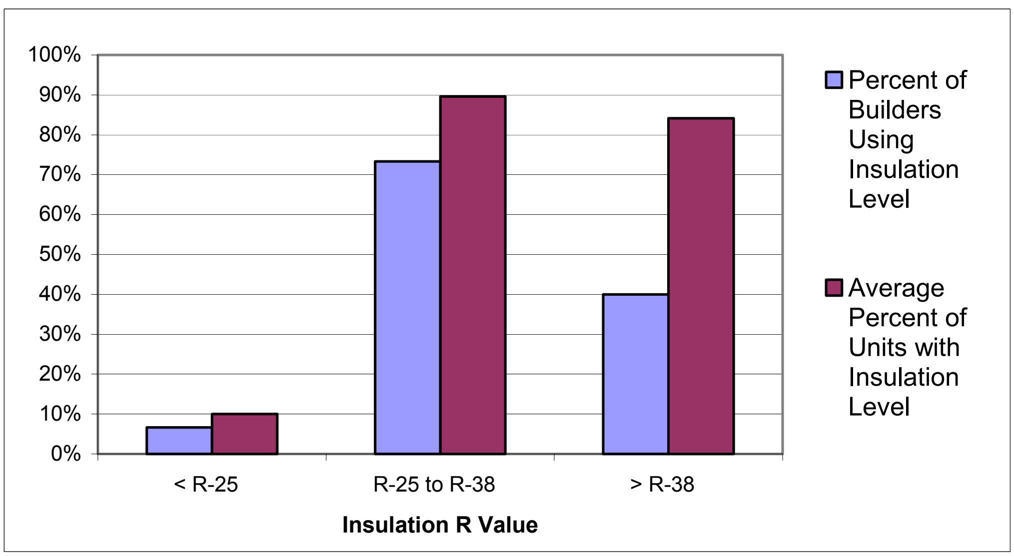


Figure 3-5
Ceiling Insulation in New Homes



About 72 percent of homes have wall insulation levels of R-11 or better, and about 30 percent of homes have wall insulation levels greater than R-15 (Figure 3-6). As Figure 3-7 shows, builders are generally installing wall insulation levels of R-15 or greater. Denser insulation materials and some use of exterior foam sheathing are being utilized. While local building codes are pushing the expanded use of 2-by-6 wall studs, builders have been more inclined to install higher efficiency HVAC equipment instead of increasing wall thickness.

Figure 3-6
Wall Insulation Levels in Existing Homes

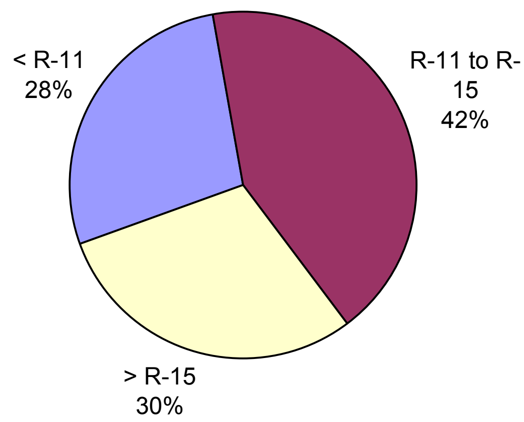


Figure 3-7
Wall Insulation in New Homes

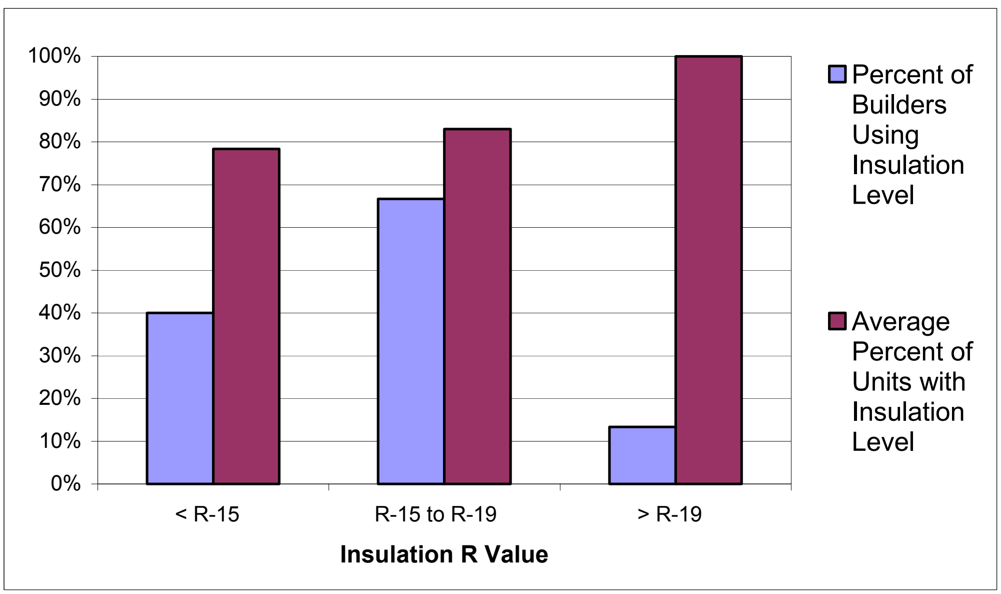
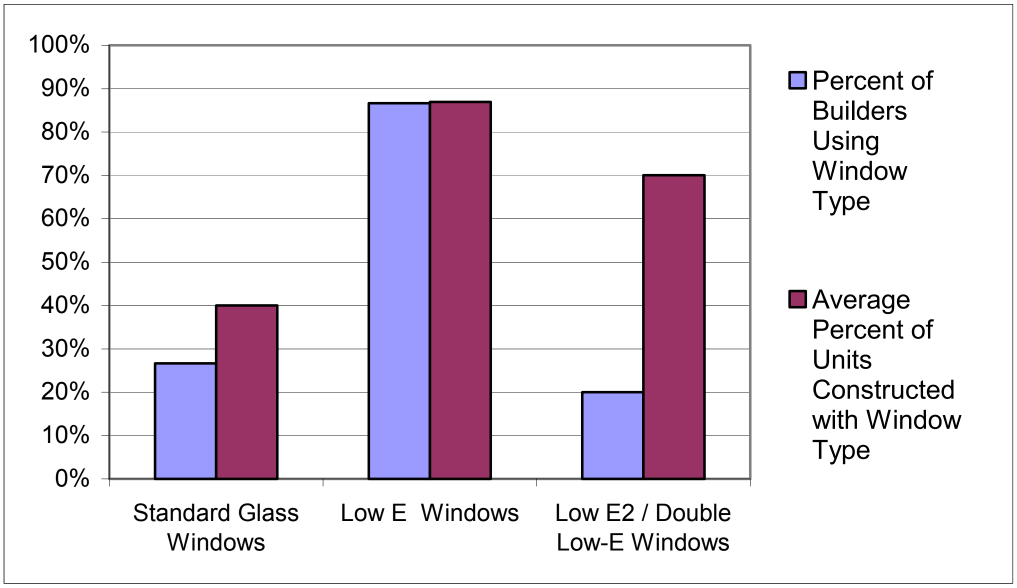


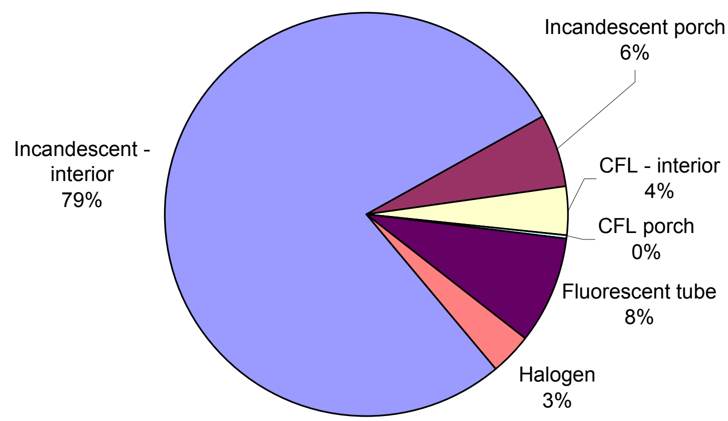
Figure 3-8 shows the distribution of window types for homes being constructed in the Xcel Energy Colorado service territory. The standard window product is a double-paned, low-E window with frames that include a thermal barrier. These are installed in about 90 percent of new homes built. A minority of builders (15 percent), who build only "green" homes, use double low-E (or low E-squared) windows in all the homes they build.

Figure 3-8
Windows in New Homes



CFL saturation across Xcel Energy's service territory is 4 percent of sockets. Incandescent bulbs fill the largest fraction of sockets – at 85 percent saturation. Fluorescent tubes (8 percent) and halogens (3 percent) make up the remaining 11 percent. Figure 3-9 shows this distribution of lamp types.

Figure 3-9
Distribution of Lamp Types in Colorado Homes



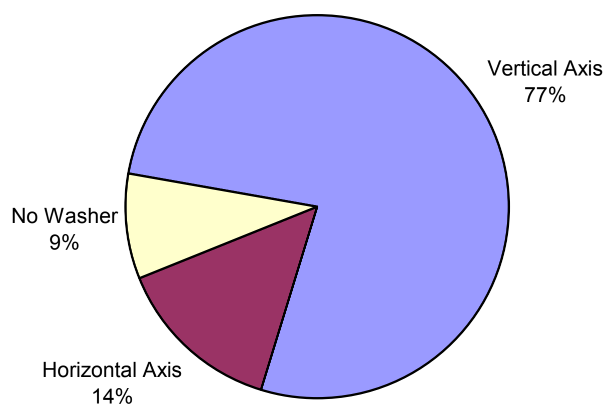
Across all homes in the Colorado service territory, there are an average of 1.8 CFLs per home. Across the 34 percent of homes have CFLs, there are 5.4 CFLs per home. Few CFLs are installed in exterior fixtures, most likely due to the inability of most CFL models to withstand extreme temperatures. Table 3-2 shows the average number of each lamp type across all homes, homes with no CFLs, and homes with CFLs. On average, it was found that about 16 sockets per home could be retrofitted with CFLs. This represents just under 50 percent of the incandescent bulbs currently installed in homes.

Table 3-2
Residential Lamp Counts per Home

	Average Number of Bulbs per Household		
Bulb Type	**All homes**	**No CFLs**	**CFLs**
Incandescent - interior	34.9	34.3	37.9
Incandescent porch	2.6	2.6	2.7
CFL - interior	1.6	0.0	5.0
CFL porch	0.2	0.1	0.4
Fluorescent tube	4.0	3.6	5.0
Halogen	1.6	1.4	2.1
Total	44.9	42.0	53.0

As Figure 3-10 shows, horizontal axis clothes washers were found in about 15 percent of homes. This represents about 15 percent of all clothes washers. Also, about 53 percent of all clothes dryers were found to have an energy-saving moisture sensor.

Figure 3-10
Clothes Washer Types in Residences



3.3 Commercial

The primary sources of commercial data for the Xcel Energy Colorado service area were the U.S. DOE Commercial Building Energy Consumption Survey (CBECS) and Xcel Energy billed consumption data.

CBECS data for the Mountain Region were used to develop end-use saturation and EUI (Energy Utilization Indices in kWh per square foot) data as well as whole-building EUI estimates.

For the commercial sector, no estimates of consuming units (square feet of commercial space by building type) were available for the Xcel Energy Colorado territory. Square footage estimates were developed for each key building type by dividing Xcel Energy energy consumption (kWh) by whole-building EUIs (kWh per square foot).

Load shape data from Xcel Energy were utilized to allocate annual energy usage to Xcel Energy time-of-use (TOU) periods. Peak period usage, developed on a sector-specific and end-use basis, was calibrated to equal the Xcel Energy summer peak.

Table 3-3 summarizes the commercial baseline energy consumption results developed for the study.

Figure 3-11 shows commercial energy consumption and peak demand by building type. The office and miscellaneous building types account for the largest shares of both energy and peak demand usage.

Figure 3-12 shows commercial energy consumption and peak demand by end use. Lighting contributes most to energy consumption at about 5,000 GWh per year, followed by office equipment and cooling at less than 2,000 GWh per year each. For peak demand, cooling contributes the largest share at about 1,100 MW, followed by indoor lighting at about 800 MW.

Table 3-3
Commercial Baseline Consumption Summary

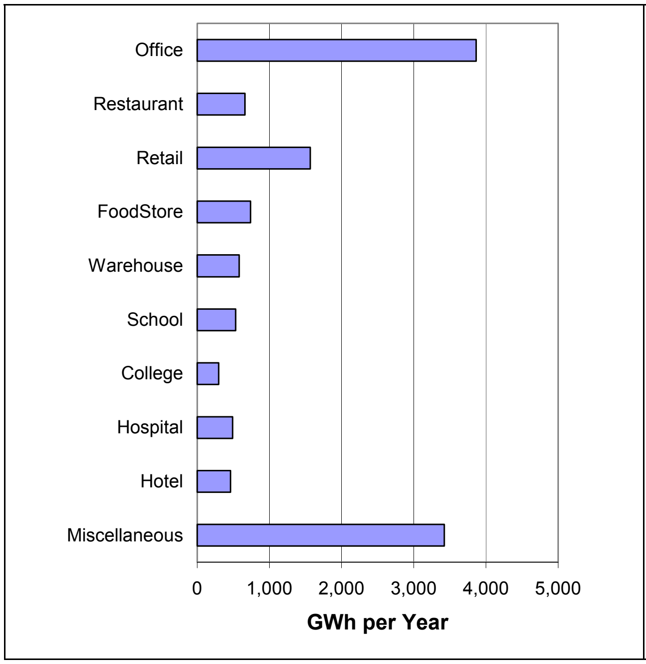
Saturation	Office	Restaurant	Retail	Food Store	Warehouse	School	College	Health	Lodging	Miscellaneous
Cooking	0.01	0.41	0.02	0.32	0.00	0.14	0.14	0.35	0.06	0.07
Cooling	0.99	0.81	0.62	0.99	0.75	0.49	0.49	0.66	0.82	0.77
Heating	0.53	0.39	0.05	0.34	0.69	0.41	0.41	0.29	0.80	0.32
Indoor Lighting	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00
Outdoor Lighting	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00
Miscellaneous	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00
Office Equipment	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00
Refrigeration	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00
Ventilation	1.00	1.00	1.00	0.98	0.76	0.67	0.67	1.00	0.86	0.94
Water Heating	0.48	0.01	0.30	0.35	0.67	0.21	0.21	0.07	0.33	0.30

EUI = kWh per Sqft	Office	Restaurant	Retail	Food Store	Warehouse	School	College	Health	Lodging	Miscellaneous
Cooking	2.2	1.9	1.1	0.6	0.0	1.3	1.3	0.2	3.1	1.2
Cooling	2.8	4.3	1.5	1.9	0.9	2.5	2.5	2.3	3.0	2.4
Heating	1.5	3.0	1.1	1.6	0.2	1.6	1.6	1.3	1.9	1.5
Indoor Lighting	7.1	4.3	5.2	6.5	2.8	4.3	5.2	8.5	6.9	5.4
Outdoor Lighting	1.0	1.9	1.0	0.9	0.3	1.2	0.3	0.3	1.0	1.5
Miscellaneous	1.2	3.1	0.4	1.2	0.8	0.3	0.3	2.6	1.5	0.9
Office Equipment	5.1	0.4	0.7	0.3	1.8	0.6	0.6	2.8	1.6	1.2
Refrigeration	0.1	7.4	0.2	21.4	0.4	0.4	0.4	0.8	0.8	0.4
Ventilation	1.8	2.0	0.6	0.7	0.2	1.0	1.0	1.5	0.6	1.1
Water Heating	0.3	1.4	0.2	1.5	0.1	1.8	1.8	1.8	2.6	0.4
Total EUI	20.1	24.7	9.1	34.2	6.0	9.9	9.9	18.4	17.3	13.0

	Office	Restaurant	Retail	Food Store	Warehouse	School	College	Health	Lodging	Miscellaneous	Total
Square Footage Estimate (1000s)	192,013	26,893	171,738	21,592	95,404	53,950	28,977	26,556	26,711	263,168	907,000

Figure 3-11
Commercial Electricity Usage by Building Type

Energy



Peak Demand

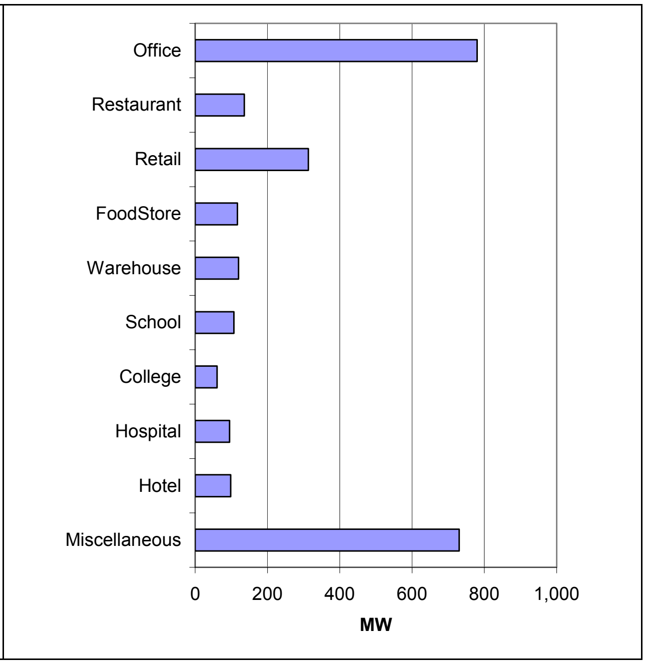
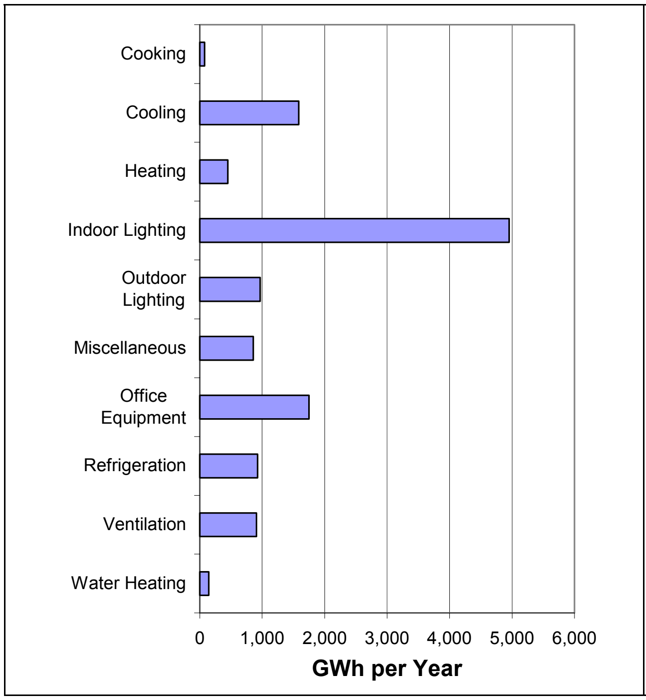
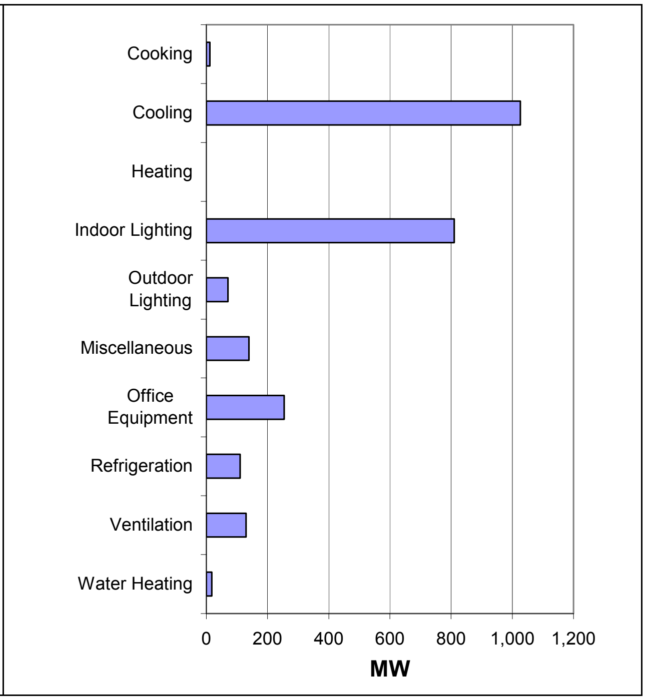


Figure 3-12
Commercial Electricity Usage by End Use

Energy



Peak Demand



Data from 152 commercial on-site surveys were used to develop an understanding of efficiency levels in the Xcel Energy Colorado service territory. While these surveys covered most energy using aspects of the commercial buildings, the primary focus was on the lighting and cooling end uses.

The distribution of commercial indoor lighting technologies is shown in Figure 3-13. The largest lighting component is 1-to-4-foot fluorescent fixtures with one or two lamps. These are mainly two-lamp, 4-foot fixtures. One-to-4-foot fixtures with over two lamps is the next largest component. These are mainly four-lamp, 4-foot fixtures. Fluorescent tube fixtures that are greater than 4 feet long are generally 8-foot fixtures, and these account for lighting in about 11 percent of the commercial floor space. Altogether, fluorescent tubes account for about 71 percent of the commercial lighting. Small wattage, point source fixtures (such as incandescents and CFLs) account for about 20 percent of commercial lighting, and larger wattage, point source fixtures (such has HIDs) account for about 7 percent of commercial lighting.

Figure 3-13
Commercial Indoor Lighting Technologies

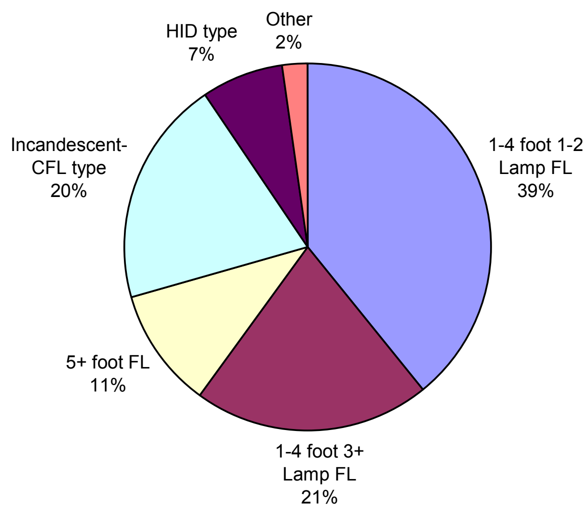


Figure 3-14 shows the breakdown of lighting efficiency types in commercial fluorescent fixtures. About 50 percent of this lighting utilizes the more efficient T8 lamps. This includes 6 percent of the fixtures that utilize premium T8 lighting that increases energy savings over standard T8 lighting by 15 percent or more (when paired with low-output electronic ballasts).

Figure 3-14
Lighting Efficiency in Commercial Fluorescent Fixtures

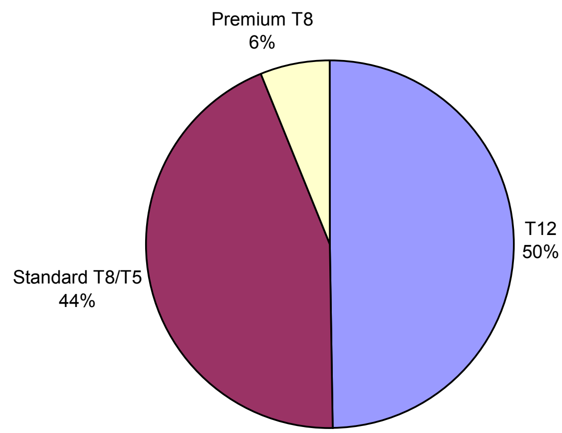
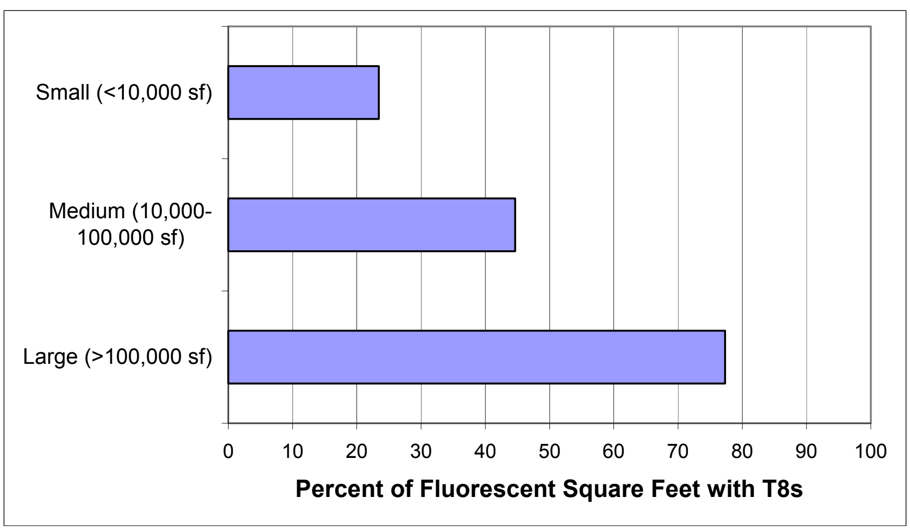


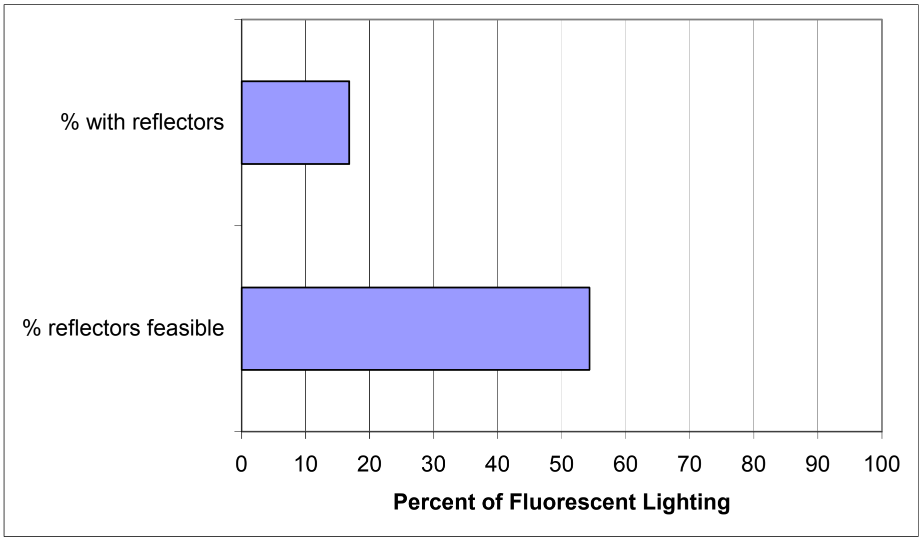
Figure 3-15 shows the saturation of T8 lighting (as a percentage of all fluorescent tube lighting) by building size. As this figure indicates, most larger buildings have converted to the T8 technology. Hence, most of the remaining potential for T8 conversions involves small and medium-sized customers, who are generally harder to reach with energy-efficiency programs.

Figure 3-15
T8 Saturations by Building Size



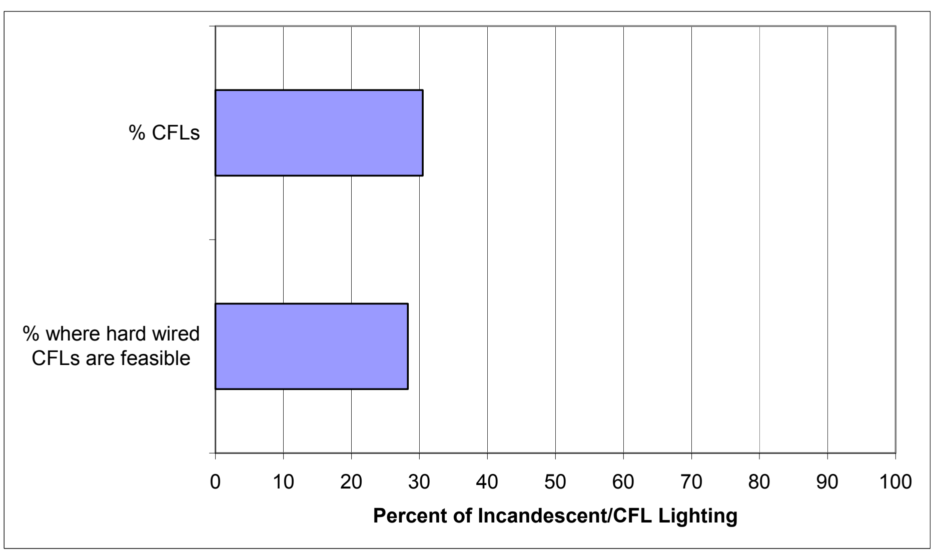
Installation of reflectors, combined with delamping, is often a cost-effective opportunity in commercial buildings. As Figure 3-16 shows, about 15 percent of the fluorescent lighting already has reflectors. Based on surveyor judgment, after review of current installations and current lighting levels in commercial buildings, it appears that installation of reflectors and associated delamping may be feasible in over 50 percent of the remaining fluorescent lighting applications.

Figure 3-16
Delamping Opportunities in Commercial Fluorescent Lighting



CFLs are often a cost-effective alternative to incandescent lighting technologies. As Figure 3-17 shows, about 30 percent of applicable commercial floor space has converted to CFLs. These are usually the screw-in variety that could revert back to incandescent bulbs as lamps burn out. It appears that the more permanent hard-wired CFLs would be feasible in about 30 percent of all small wattage, point source lighting applications.

Figure 3-17
CFL Saturation and Feasibility



The distribution of commercial cooling technologies is shown in Figure 3-18. Direct expansion, or DX, cooling accounts for the majority of commercial cooling on Colorado. Chillers account for the next biggest cooling share. Evaporative cooling is used in about 10 percent of commercial floor space.

Figure 3-18
Distribution of Commercial Cooling Technologies

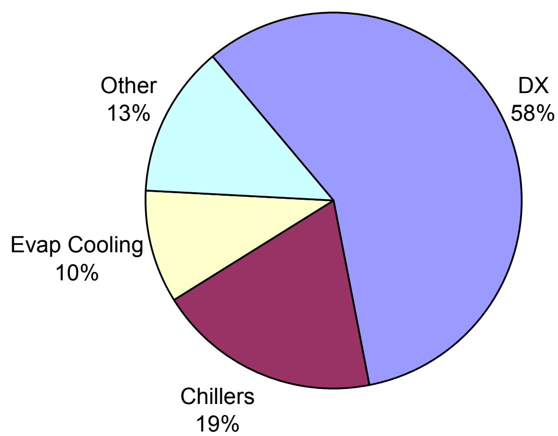
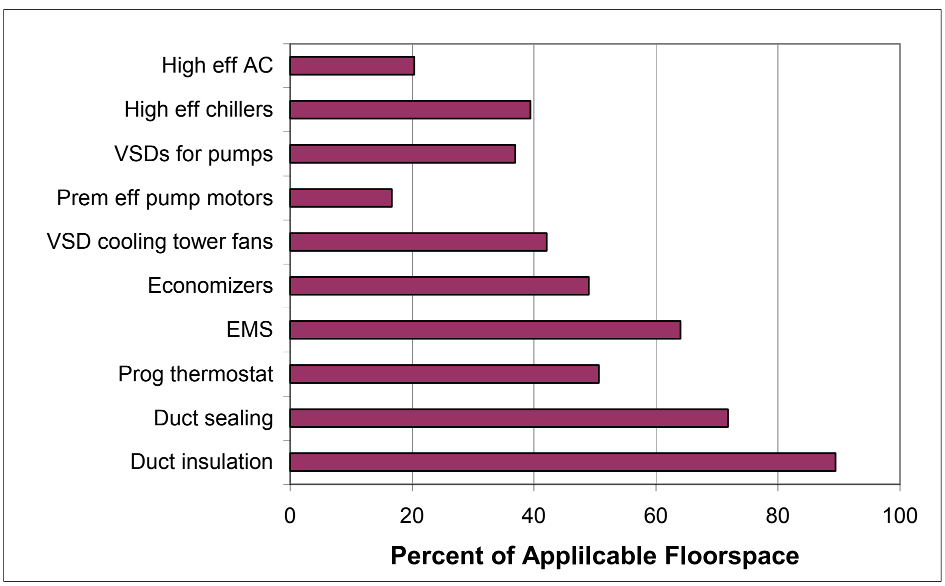


Figure 3-19 shows saturations of a number of typical commercial cooling energy-efficiency measures. For the most part, saturations are in the mid-ranges. In addition, over 90 percent of surveyed customers reported having regular maintenance on their cooling system.

Figure 3-19
Saturation of Commercial Cooling Measures



3.4 INDUSTRIAL

Data on the industrial sector consisted of Xcel Energy billing data and end-use consumption data at the national level developed as part of the U.S. DOE Manufacturing Energy Consumption Survey (MECS). The motors end use was further disaggregated using national level data developed by KEMA as part of a U.S. Motors Assessment Study conducted for DOE in 1998. Given the relatively small size of the Xcel Energy industrial sector relative to the residential and commercial sectors, it was determined that aggregate national level data were sufficient for the CPS industrial baseline work. Similar to the residential and commercial sectors, industrial peak demand estimates were calibrated to ensure that they were consistent with Xcel Energy system peak demand.

Figure 3-20 summarizes industrial energy consumption and peak demand by industry type. The primary metals industry accounts for the largest single share of energy usage. Food, primary metals, industrial machinery, and instruments all account for significant shares of industrial peak demand.

Figure 3-20
Industrial Electricity Usage by Industry Type

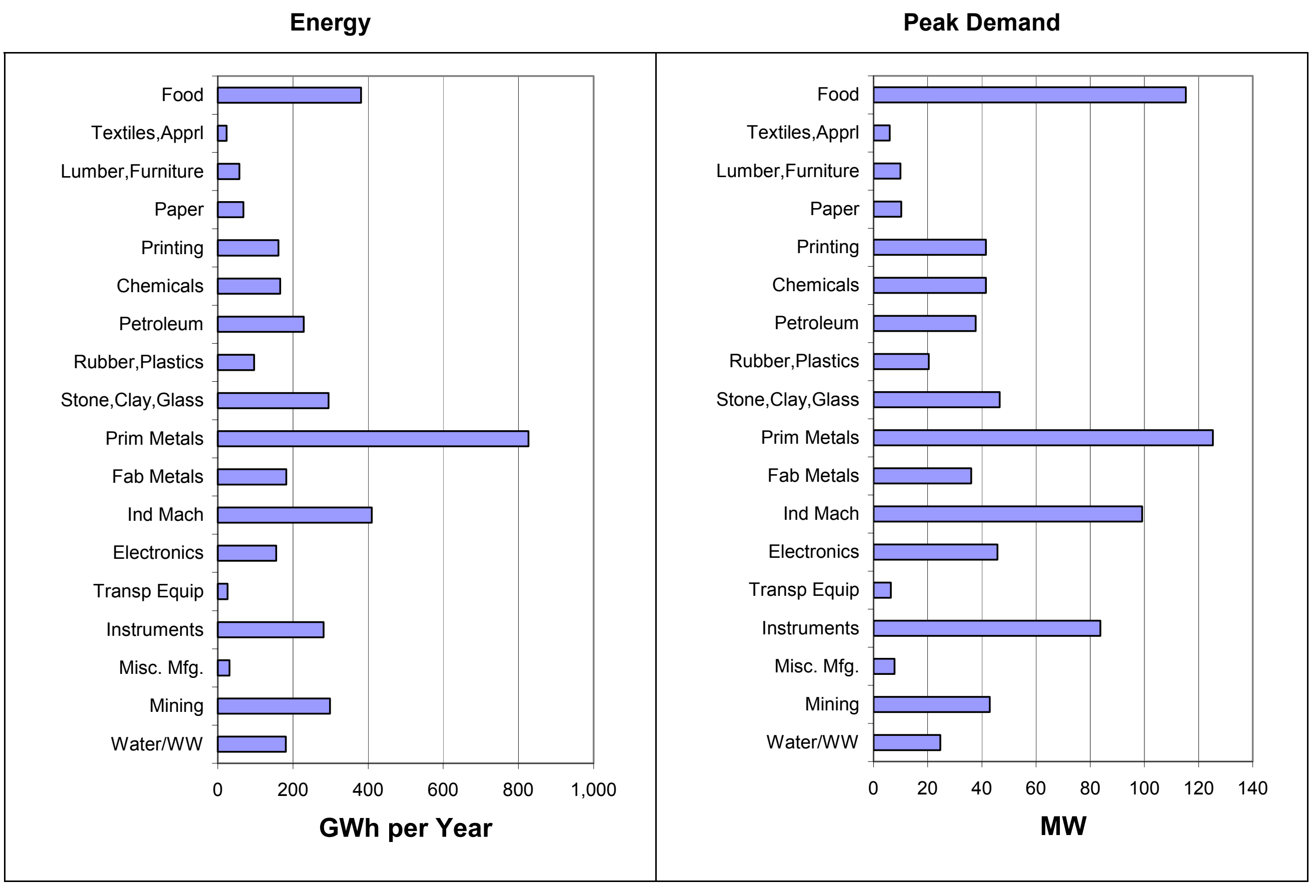
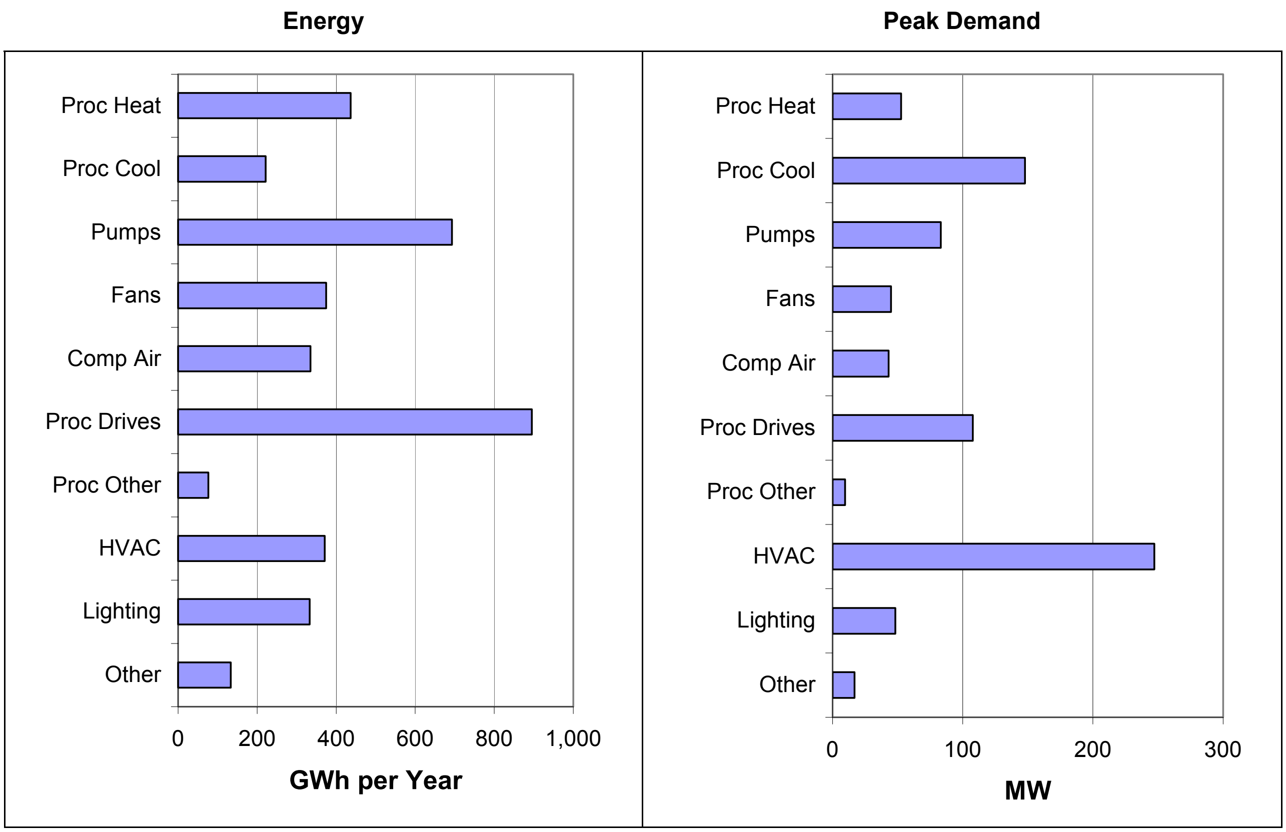


Figure 3-21 shows energy consumption and peak demand estimates by industrial end use. Process drives accounts for the largest single share of energy consumption, followed by pumping systems and process heating. HVAC and process cooling contribute most to peak demand.

Figure 3-21
Industrial Electricity Usage by End Use



4 DSM POTENTIAL RESULTS

In this section, we present estimates of DSM potential. First, we present technical and economic potential results for all measures considered in the study. Next, we present estimates of achievable program potential under different program funding scenarios for Base Case 1 in which natural gas benefits are not considered and incentives are capped to limit customer payback periods to one year or more. We then show sensitivity analyses that address key modeling assumptions: the constraint of incentive levels to limit customer payback periods to one year or more and the exclusion of natural gas benefits in the cost-effectiveness screening of residential shell measures. Finally, we show Base Case 2 results. In Base Case 2, we combine the effects of removing the incentive constraint and including natural gas benefits.

4.1 TECHNICAL AND ECONOMIC POTENTIAL

Estimates of overall energy efficiency *technical* and *economic* potential are discussed in section 4.1.1. More detail on these potentials is presented in section 4.1.2. Energy-efficiency supply curves are shown in section 4.1.3.

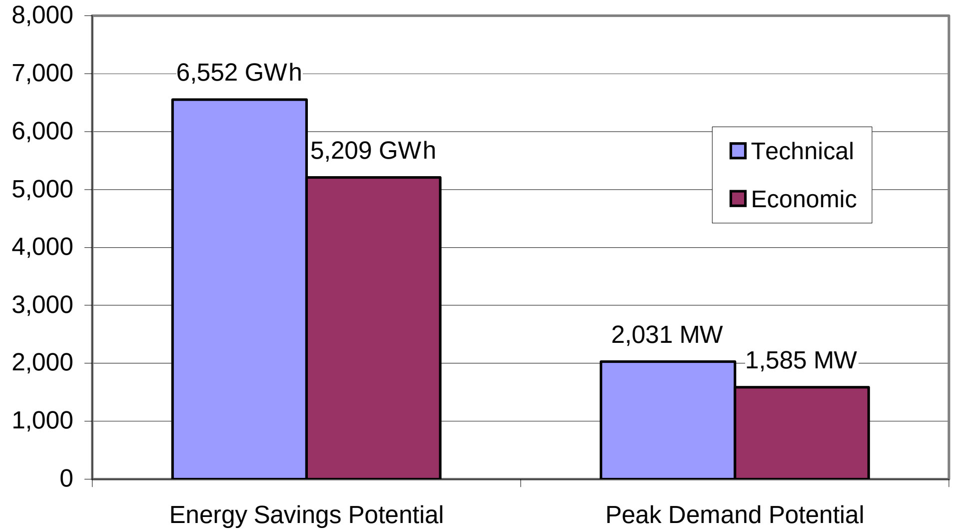
4.1.1 Overall Technical and Economic Potential

Figure 1-1 presents our overall estimates of total technical and economic potential for electrical energy and peak-demand savings for the Xcel Energy Colorado service territory. *Technical potential* represents the sum of all savings from all of the measures deemed applicable and technically feasible. *Economic potential* is based on efficiency measures that are cost-effective based on the total resource cost (TRC) test—a benefit-cost test that compares the value of avoided energy production and power plant construction to the costs of energy-efficiency measures and program activities necessary to deliver them. The values of both energy savings and peak-demand reductions are incorporated in the TRC test.

Energy Savings. Technical potential is estimated at about 6,552 GWh per year and economic potential at 5,209 GWh per year by 2013 (about 21 and 16 percent of base 2013 usage, respectively).

Peak-Demand Savings. Technical potential is estimated at about 2,031 MW and economic potential at 1,585 MW by 2013 (about 31 and 24 percent of base 2013 demand, respectively).

Figure 4-1
Estimated Electric Technical and Economic Potential, 2013
Xcel Energy Colorado Service Territory



4.1.2 Technical and Economic Potential Detail

In this subsection, we explore technical and economic potential in more detail, looking at potentials by sector and by end use.

Potentials by Sector

Figures 4-2 and 4-3 show estimates of technical and economic energy and demand savings potential by sector. Figures 4-4 and 4-5 show the same potentials as a percentage of 2013 base energy and base peak demand.

The commercial sector provides the largest contribution to both technical and economic potential for energy savings, accounting for about 54 percent of these potentials.

The residential sector contributes most to the technical and economic potential for peak demand savings, accounting for about 62 percent of these potentials.

Figure 4-2
Technical and Economic Potential (2013)
Energy Savings by Sector—GWh per Year

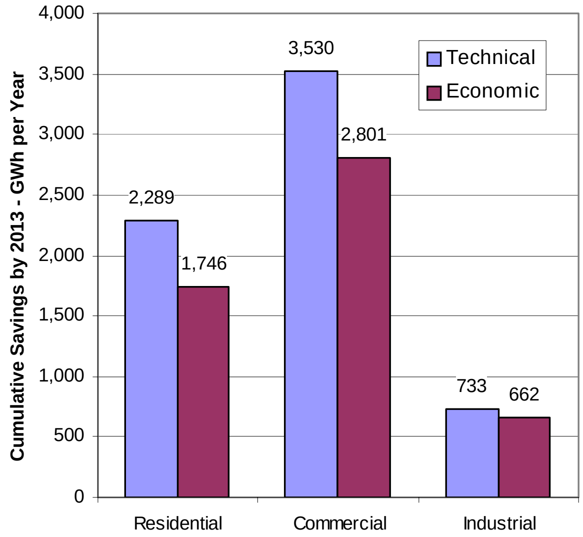
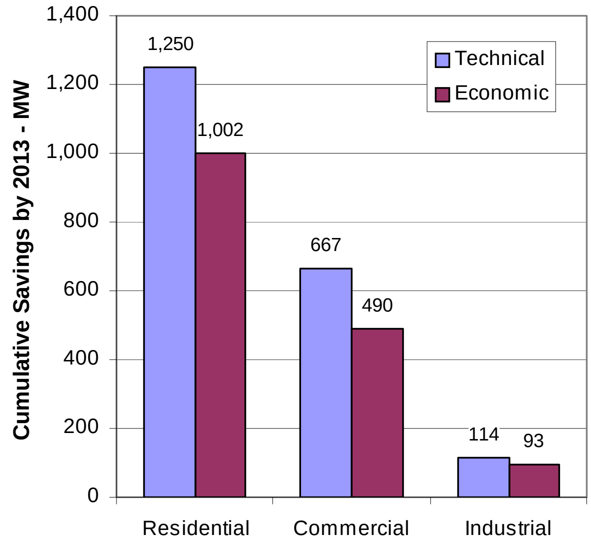


Figure 4-3
Technical and Economic Potential (2013)
Demand Savings by Sector—MW



As shown in Figure 4-4, the commercial sector has a somewhat higher savings potential in relation to base energy use than does the residential or industrial sectors. Peak savings potential relative to base demand is largest for the residential sector.

Figure 4-4
Technical and Economic Potential (2013)
Percentage of Base Energy Use

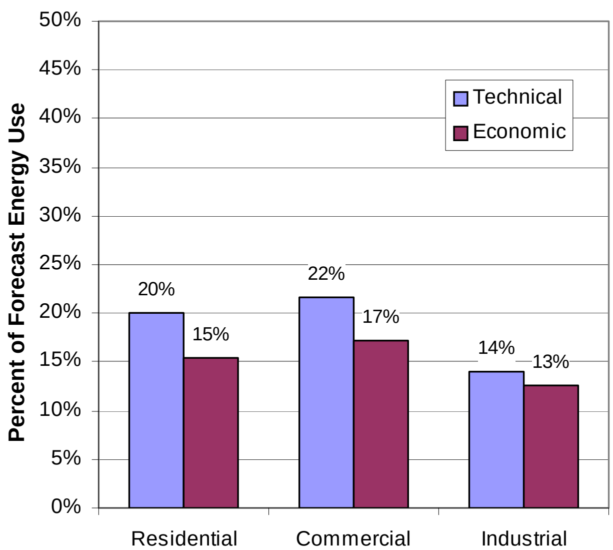
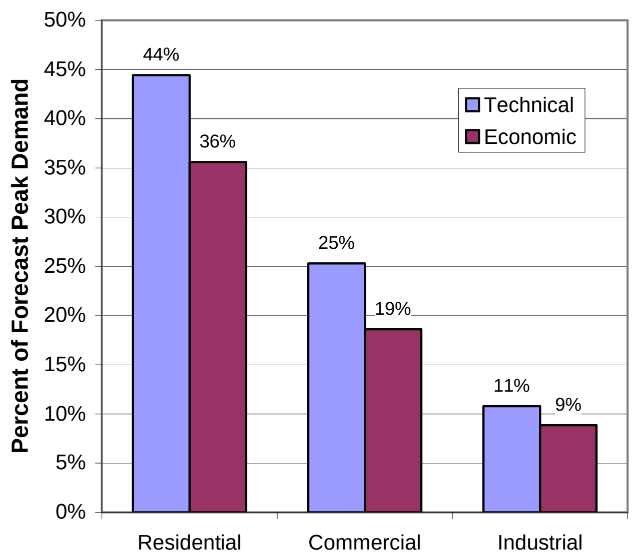


Figure 4-5
Technical and Economic Potential (2013)
Percentage of Base Peak Demand



Potentials by End Use

Figures 4-6 and 4-7 show the end-use breakdown of economic potential in the residential sector. Energy savings potential is split pretty evenly among the lighting and cooling end uses, followed by refrigeration and furnace/air conditioning (AC) fans. Cooling accounts for most of the economic peak demand savings potential, as very little lighting is used on warm summer afternoons. The key lighting measure is compact fluorescent lamps (CFLs), and the cooling measures that contribute most to economic potential are evaporative coolers and sunscreens (or similar types of window treatments).

Figure 4-6
Residential Economic Energy Savings Potential by End Use (2013)

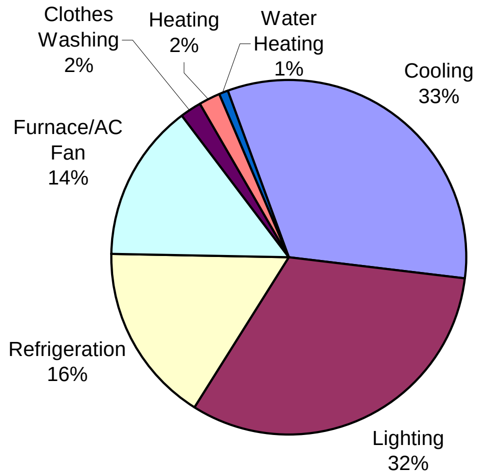
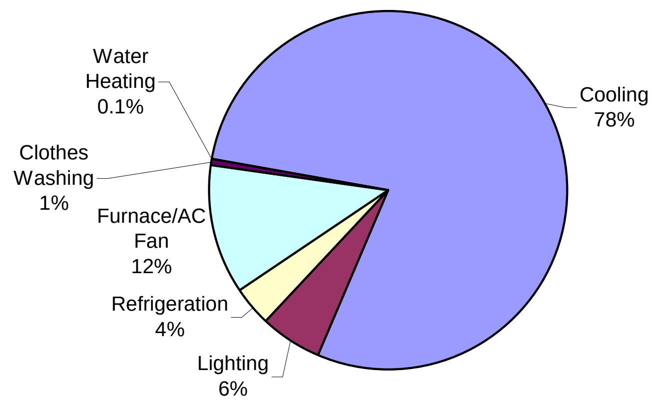


Figure 4-7
Residential Economic Demand Savings Potential by End Use (2013)



Figures 4-8 and 4-9 show the end-use breakdown of commercial economic potential. The lighting end use is the largest contributor to both energy and peak demand savings potential. CFLs and premium T8 lamps with electronic ballasts are key lighting measures. Important cooling measures include high-efficiency chillers and DX air conditioners, window film, and cool roofs. Office equipment measures mainly involve enabling of power management features in ENERGY STAR computers, printers, and copiers.

Figure 4-8
Commercial Economic Energy Savings Potential by End Use (2014)

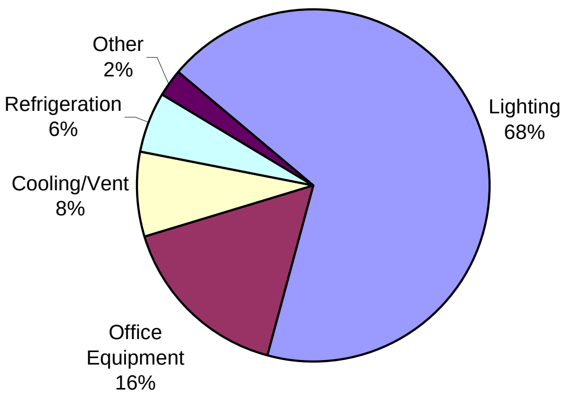
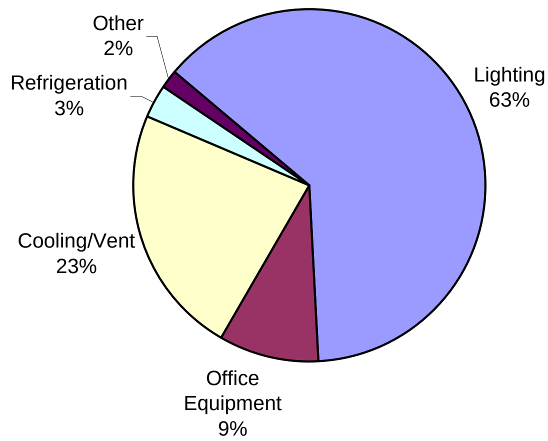


Figure 4-9
Commercial Economic Demand Savings Potential by End Use (2014)



Figures 4-10 and 4-11 show the end-use breakdown of industrial economic potential. Pumping system measures provide the largest source of economic potential, followed by compressed air systems and lighting. While cooling is a fairly small share of overall energy savings potential, it contributes about 20 percent to economic peak demand potential.

Figure 4-10
Industrial Economic Energy Savings Potential by End Use (2013)

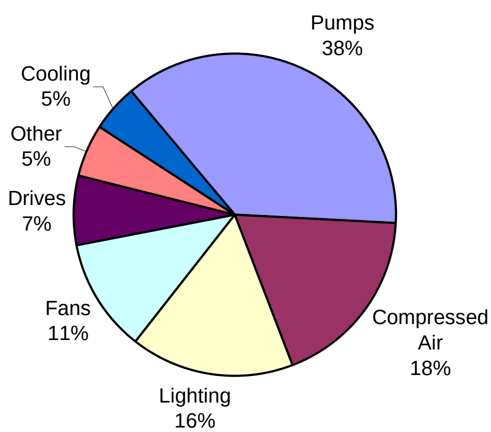
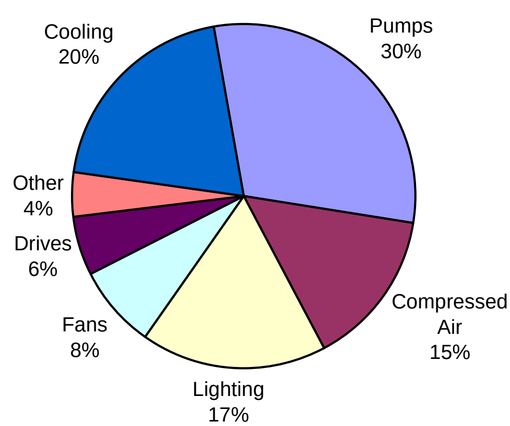


Figure 4-11
Industrial Economic Demand Savings Potential by End Use (2013)

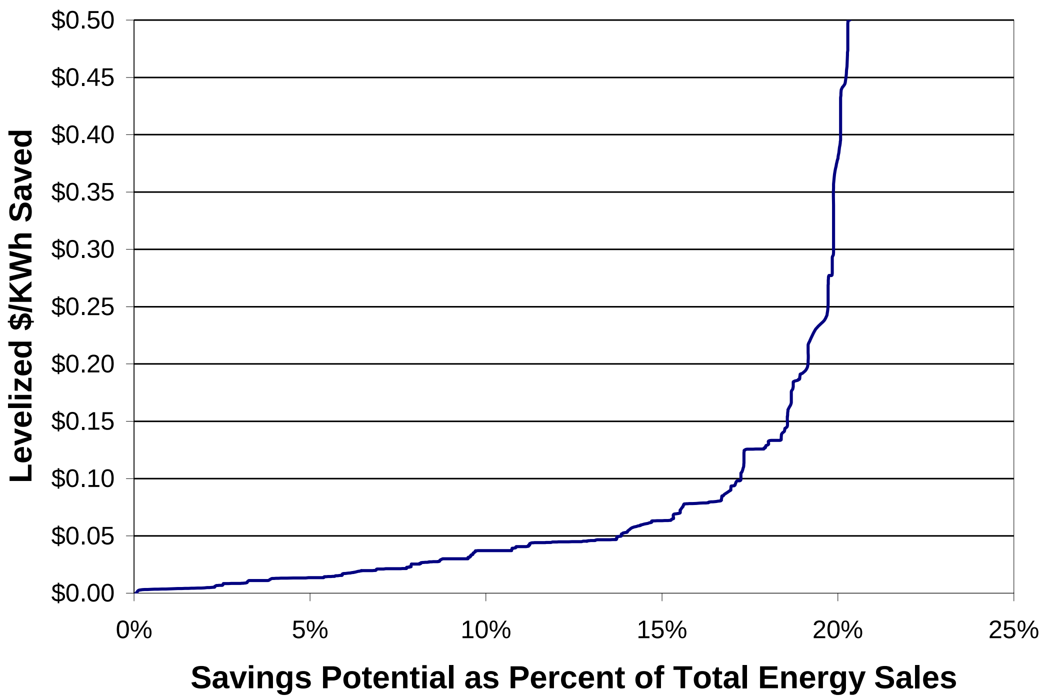


4.1.3 Energy-Efficiency Supply Curves

A common way to illustrate the amount of energy savings per dollar spent is to construct an energy-efficiency supply curve. A supply curve typically is depicted on two axes—one captures the cost per unit of saved electricity (e.g., levelized $/kWh saved) and the other shows energy savings at each level of cost. Measures are sorted on a least-cost basis, and total savings are calculated incrementally with respect to measures that precede them. The costs of the measures are levelized over the life of the savings achieved.

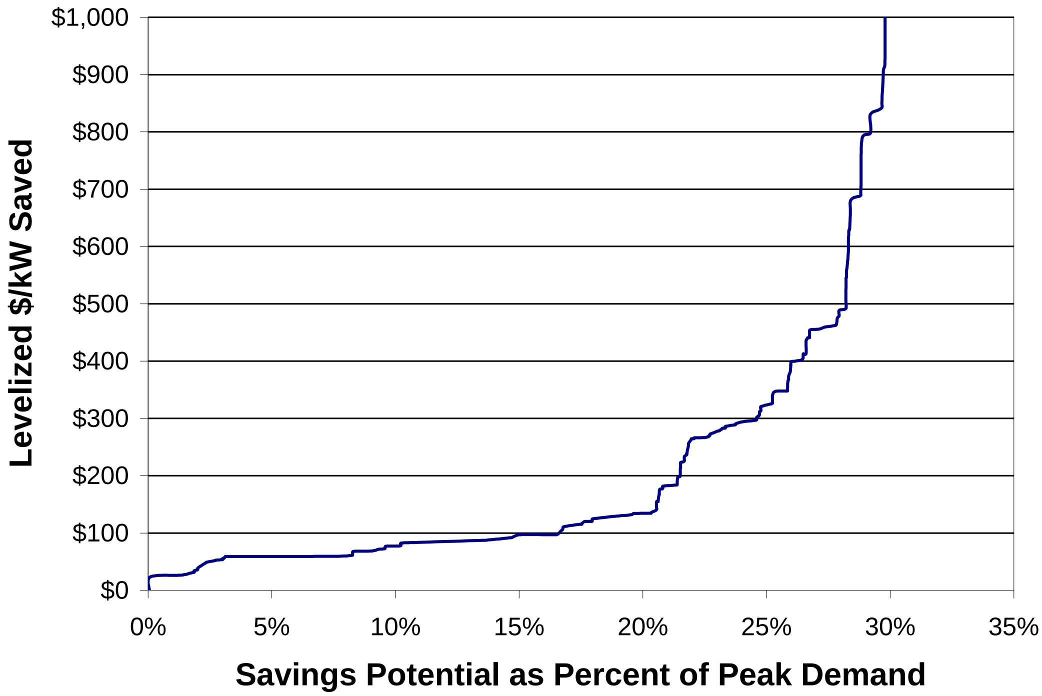
Figures 4-12 and 4-13 present the supply curves constructed for this study for energy-efficiency and peak demand efficiency, respectively. Each curve represents savings as a percentage of total energy or peak demand. These curves show that energy savings of about 14 percent are available at under $0.05 per kWh, and peak demand savings of about 16 percent are available at under $100 per MW. Savings potentials and levelized costs for the individual measures that comprise the supply curves are provided in Appendix G.

Figure 4-12
Energy Supply Curve*



*Levelized cost per kWh saved is calculated using a 7.4 percent nominal discount rate.

Figure 4-13
Peak Demand Supply Curve*



*Levelized cost per kWh saved is calculated using a 7.4 percent nominal discount rate.

4.2 Achievable (Program) Potential – Base Case 1

In contrast to technical and economic potential estimates, achievable potential estimates take into account market and other factors that affect the adoption of efficiency measures. Our method of estimating measure adoption takes into account market barriers and reflects actual consumer- and business-implicit discount rates. This section presents results for achievable potential, first at the summary level and then by sector. More detail on achievable program potential is shown in Appendix H.

Achievable potential refers to the amount of savings that would occur in response to one or more specific program interventions. *Net* savings associated with program potential are savings that are projected beyond those that would occur naturally in the absence of any market intervention. Because achievable potential depends on the type and degree of intervention applied, we developed potential estimates under alternative funding scenarios: 33-percent incentives, 50-percent incentives, and 75-percent incentives. These scenarios reflect the percent of incremental measure cost that is assumed to be paid in customer incentives. In each scenario in Base Case 1, incentive levels were capped for some measures to limit the measure payback period to one year or more. We forecasted program energy and peak-demand savings under each scenario for the 2006–2015 period, with an emphasis on the 2006–2013 period covered in Xcel Energy's Comprehensive Settlement Agreement dated December 3, 2004.

Figures 4-14 and 4-15 show our estimates of achievable potential savings and their effect on projected demand and energy consumption. As shown in Figure 4-14, by 2013 cumulative *net*[1] energy savings are projected to be 384 GWh under the 33-percent incentive scenario, 644 GWh under the 50-percent incentive scenario, and 1,313 GWh under the 75-percent incentive scenario. Figure 5-15 depicts projected net peak demand savings of 170 MW under 33-percent incentives, 216 under 50-percent incentives, and 360 MW under 75-percent incentives.

Figure 4-14
Achievable Energy Savings: All Sectors, Base Case 1

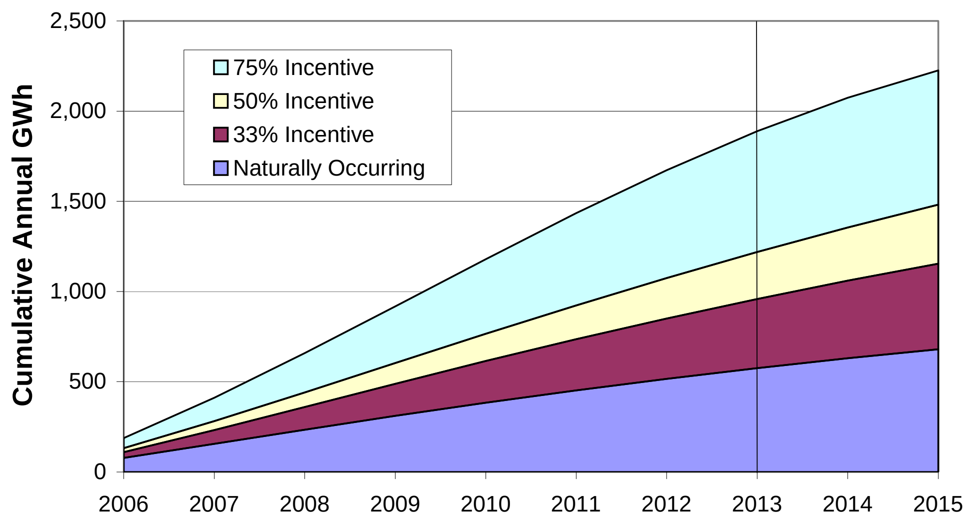
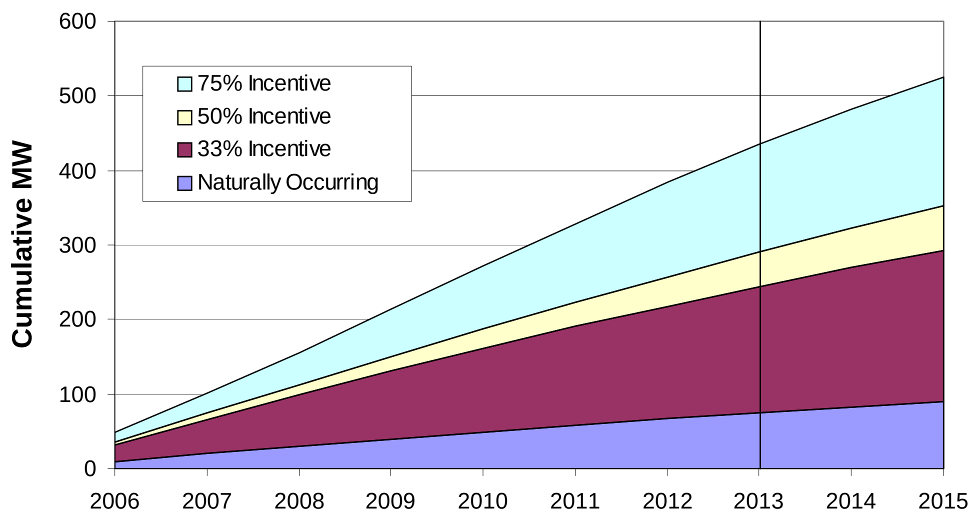


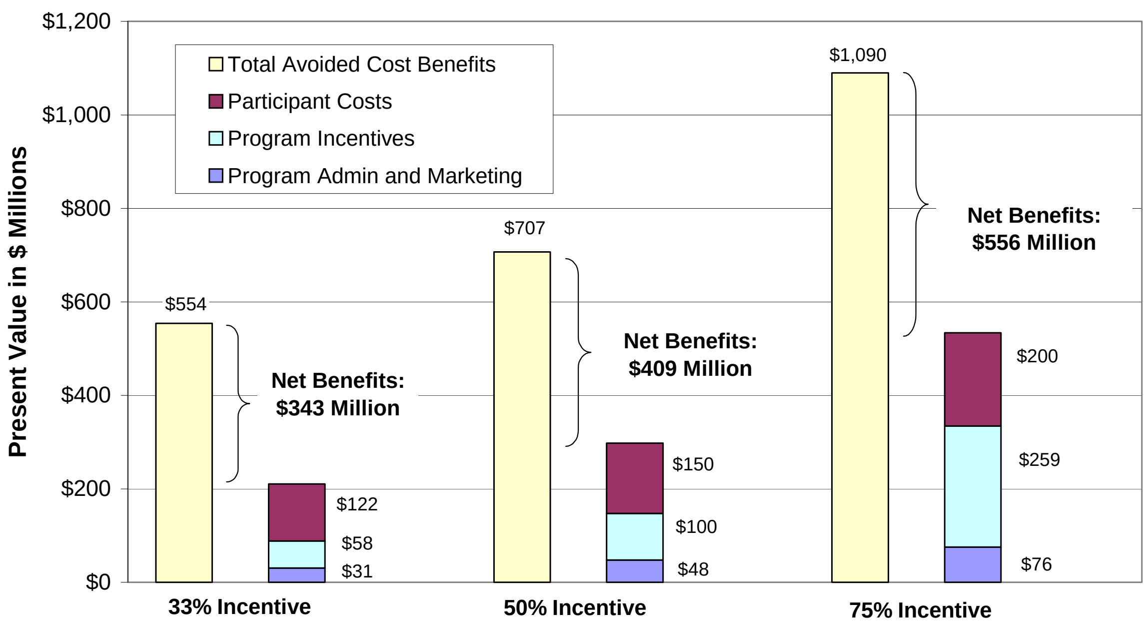
Figure 4-15
Achievable Peak-Demand Savings: All Sectors, Base Case 1



[1] Throughout this section, *net* refers to savings beyond those estimated to be naturally occurring; that is, from customer adoptions that would occur in the absence of any programs or standards.

Figure 3-15 depicts costs and benefits under each funding scenario from 2006 to 2013. The present value of program costs (including administration, marketing, and incentives) is $89 million under the 33-percent incentive scenario, $148 million under the 50-percent incentive scenario, and $335 million under the 75-percent incentive scenario. The present value of total avoided-cost benefits is $554 million under 33-percent incentives, $707 million under 50-percent incentives, and $1,090 million under 75-percent incentives. The present value of *net* avoided-cost benefits, i.e., the difference between total avoided-cost benefits and total costs (which include participant costs in addition to program costs), is $343 million under 33-percent incentives, $409 million under 50-percent incentives, and $556 million under 75-percent incentives.

Figure 4-16
Benefits and Costs of Energy Efficiency Savings—2006–2013*, Base Case 1



* Present value of benefits and costs over normalized 20-year measure lives; nominal discount rate is 7.4 percent, inflation rate is 2.4 percent.

All three of the funding scenarios are cost effective based on the TRC test, which is the test used is this study to determine program cost effectiveness. The TRC benefit-cost ratios are 2.6 for the 33-percent incentive scenario, 2.4 for the 50-percent incentive scenario, and 2.1 for the 75-percent incentive scenario. This indicates that program cost-effectiveness declines somewhat with increasing program effort, reflecting penetration of more measures with lower cost-effectiveness levels. Key results of our efficiency scenario forecasts from 2006 to 2013 are summarized in Table 4-1.

Table 4-1
Summary of Achievable Potential Results—2006–2013, Base Case 1

Result	Program Scenario		
	33% Incentive	50% Incentive	75% Incentive
Gross Energy Savings - GWh	639	899	1,568
Gross Peak Demand Savings - MW	206	252	396
Net Energy Savings - GWh	384	644	1,313
Net Peak Demand Savings - MW	170	216	360
Program Costs - Real, $ million			
Administration	$14	$27	$50
Marketing	$30	$37	$45
Incentives	$84	$135	$330
Total	$128	$199	$425
PV Avoided Costs ($ mil.)	$554	$707	$1,090
PV Annual Program Costs ($ mil.)	$88	$147	$334
PV Participant Costs ($ mil.)	$122	$150	$200
TRC Ratio	2.6	2.4	2.1

PV (present value) of benefits and costs is calculated over a 20-year normalized measure life for 2006–2013 program years, nominal discount rate = 7.4 percent, inflation rate = 2.4 percent; GWh and MW savings are cumulative through 2013.

4.2.1 Breakdown of Achievable Potential

Cumulative net achievable potential estimates by customer class for the period 2006–2013 are presented in Figures 4-17 and 4-18. These figures show results for each funding scenario. Under the program assumptions developed for this study, achievable energy savings are highest for the commercial sector, while peak demand savings are highest for the residential sector in the 33-percent and 50-percent incentive scenarios and are split fairly evenly between the residential and commercial sectors in the 75-percent incentive scenario.

Figure 4-17
Net Achievable Energy Savings (2013) by Sector—GWh per Year
Base Case 1

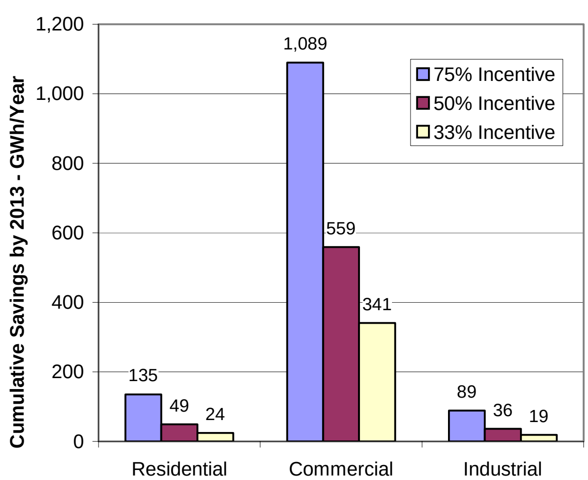
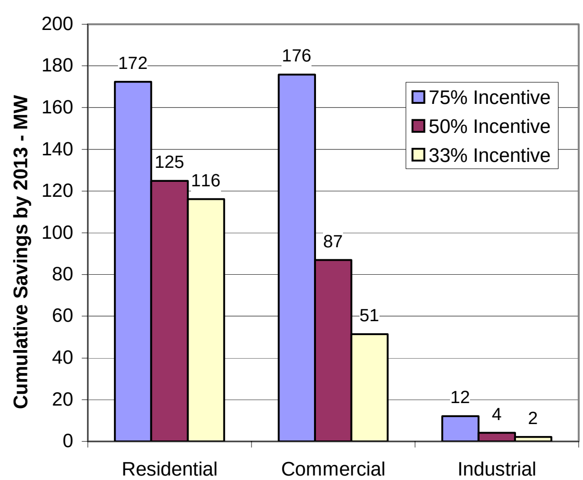


Figure 4-18
Net Achievable Peak Demand Savings (2013) by Sector—MW
Base Case 1



Residential Sector

Figures 4-19 and 4-20 show cumulative net achievable program savings by residential program scenario. By 2013, net energy savings reach 24 GWh under the 33-percent incentive scenario, 49 GWh under the 50-percent incentive scenario, and 135 GWh under the 75-percent incentive scenario. Energy savings are most sensitive to changes in incentives in the 50- to 75-percent range. For peak demand, net savings increase from 116 MW under 33-percent incentives to 125 MW under 50-percent incentives to 172 under 75-percent incentives. Peak demand impacts include effects of Xcel Energy's Saver's Switch demand response program, which did not vary by scenario and cumulate to about 110 MW by 2013. Hence, most of the peak demand impacts are reflected in the 33-percent incentive scenario, with modest increases from other energy efficiency measures in the 50- and 75-percent incentive scenarios.

Figure 4-19
Achievable Energy Savings: Residential Sector, Base Case 1

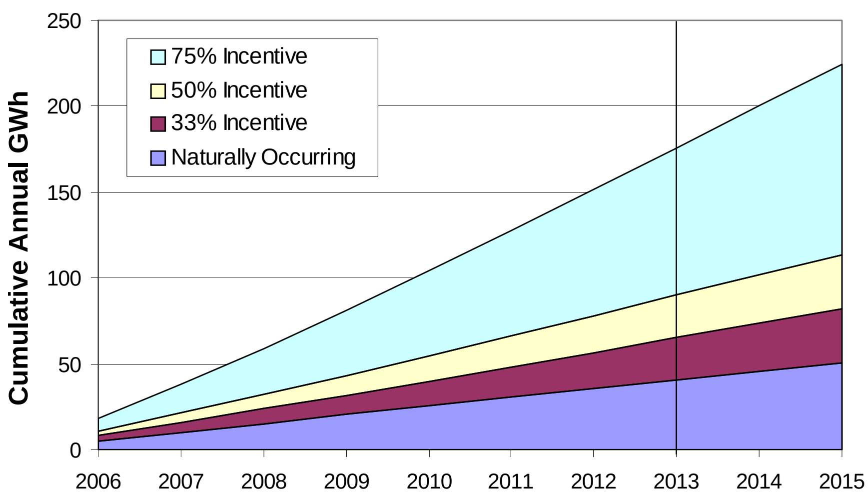
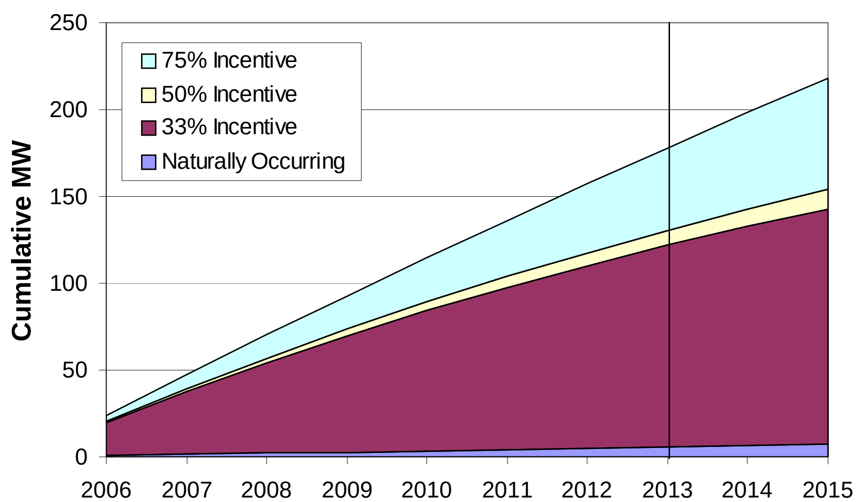


Figure 4-20
Achievable Peak Demand Savings: Residential Sector, Base Case 1



Figures 4-21 and 4-22 show the end-use distribution of energy and peak demand savings for the 50-percent incentive scenario. Heating and lighting contribute most to the energy savings potential, mainly due to ceiling insulation and CFL measures. (Note that we were not able to isolate current ceiling insulation levels for electric space heating customers and therefore utilized insulation levels for all residential customers. This generalization may overstate achievable heating savings if electrically heated homes are better insulated.) Refrigeration, which is mainly the result of a refrigerator recycling measure, provides the next largest share of savings, followed by furnace-AC fans, and cooling. Peak demand results exclude the effects of Xcel Energy's Saver's Switch Program, which accounts for about 96 percent of the impacts in the 50-percent scenario and 71 percent of the impacts in the 75-percent incentives scenario.

Figure 4-21
Residential Net Energy Savings Potential End Use Shares (2013) – 50% Incentives Base Case 1

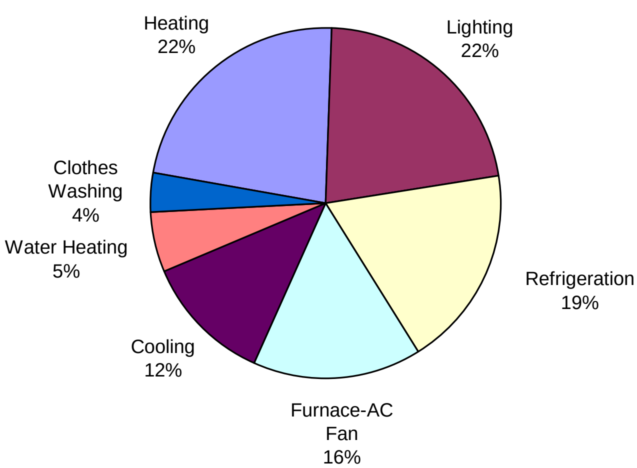
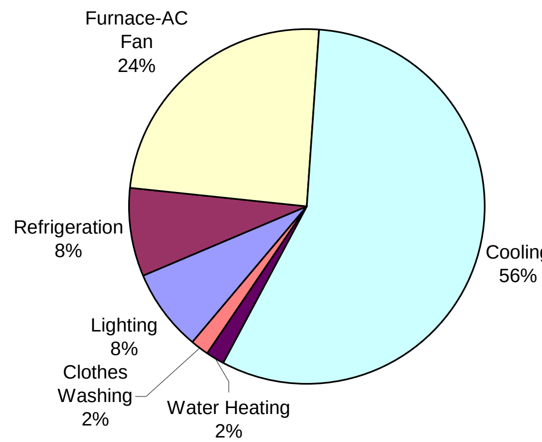


Figure 4-22
Residential Net Peak Savings Potential End Use Shares (2013) – 50% Incentives Base Case 1



Note: end use results exclude impacts of the Saver's Switch Program.

Figures 4-23 and 4-24 show end-use shares of net achievable potential across the three program scenarios. For both energy and peak demand, the lighting share of potential savings decreases and the cooling share increases as program funding increases. There are two main reasons for this result. First, incentives for the CFL measure that accounts for most of the lighting savings are capped at 9 percent of incremental measure costs to keep the customer payback period from dropping below one year. This limitation causes lighting impacts to remain relatively constant over the three incentive scenarios while impacts for other end uses are increasing. Second, cooling measures tend to be less cost effective than lighting measures; therefore, it takes higher incentives to cause increased measure adoption.

Figure 4-23
Residential Net Energy Savings Potential by End Use (2013) – Across Scenarios Base Case 1

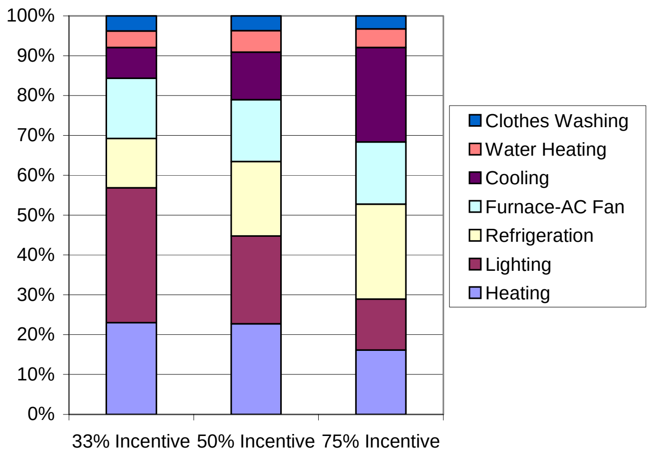
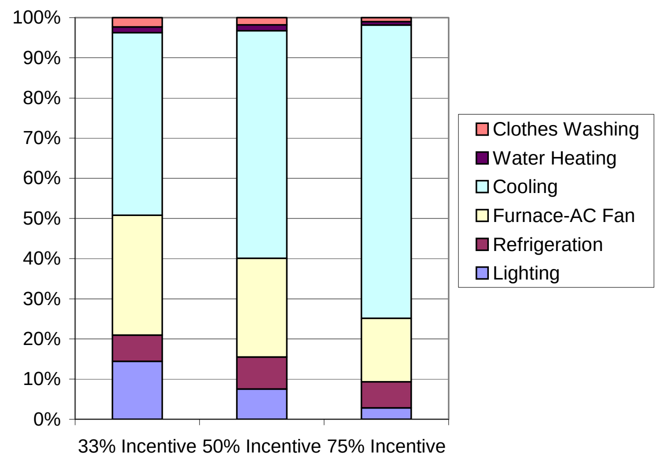


Figure 4-24
Residential Net Peak Savings Potential by End Use (2013) – Across Scenarios Base Case 1



Note: end use results exclude impacts of the Saver's Switch Program.

Table 4-2 lists the various potentials for residential measures that passed cost-effectiveness screening. This list excludes the Saver's Switch direct load control measure, which is expected to provide 110 MW of peak demand savings by 2013.

Table 4-2
Measure Specific Residential Results (Cumulative to 2013), Base Case 1

	Energy - GWh					Peak Demand - MW				
Measure	Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent	Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent
CFL - 15w	461.2	461.2	7.4	8.8	11.6	46.1	46.1	0.7	0.9	1.2
Refrigerator Recycling	283.7	283.7	3.0	9.2	32.2	35.5	35.5	0.4	1.2	4.0
Variable Speed Furnace-AC Fan	250.9	250.9	3.7	7.7	21.1	116.4	116.4	1.7	3.6	9.8
Default Window With Sunscreen	217.5	217.5	0.6	2.0	7.3	289.3	289.3	0.9	2.7	9.8
Evaporative Cooler	150.5	150.5	0.3	0.9	8.0	216.9	216.9	0.4	1.2	11.5
CFL Torchiere - 55w	53.6	53.6	0.3	0.9	3.9	5.4	5.4	0.0	0.1	0.4
ROB 2L4'T8, 1EB	43.6	43.6	0.6	1.2	1.9	4.4	4.4	0.1	0.1	0.2
Duct Sealing - from 40% AHU to 12%	41.5	38.7	0.0	0.0	0.3	59.8	55.8	0.0	0.0	0.4
Energy Star CW (MEF=1.42)	35.6	35.6	0.9	1.8	4.4	5.0	5.0	0.1	0.3	0.6
Typical Refrigerant Charge Adjustment	32.1	32.1	0.1	0.2	2.1	46.3	46.3	0.1	0.3	3.1
Window Film	31.9	31.9	0.1	0.2	0.7	38.7	38.7	0.1	0.2	0.8
New Const Cooling Package w/ Downsizing	31.3	31.3	0.2	0.7	4.9	45.0	45.0	0.3	1.0	7.1
New Constr Cooling Package	26.9	26.9	0.1	0.2	1.7	38.7	38.7	0.1	0.3	2.5
Infiltration Reduction, Heating	21.3	14.4	1.4	3.5	10.5	0.0	0.0	0.0	0.0	0.0
High Refrigerant Charge Adjustment	19.5	19.5	0.4	1.2	3.3	28.1	28.1	0.6	1.7	4.7
Evaporative Coolers	15.4	15.4	0.1	0.5	3.6	22.2	22.2	0.2	0.7	5.2
Wall Blow-in R-0 to R-13 Insulation, Heating	15.4	5.3	0.3	0.8	3.3	0.0	0.0	0.0	0.0	0.0
Ceiling R-0 to R-38 Insulation, Heating	15.3	15.3	4.0	6.9	8.0	0.0	0.0	0.0	0.0	0.0
Default Window With Sunscreen	10.0	4.1	0.0	0.0	0.1	13.4	5.5	0.0	0.0	0.1
Pipe Wrap	5.9	5.9	0.5	1.2	3.1	0.5	0.5	0.0	0.1	0.3
Low Flow Showerhead	4.5	4.5	0.4	1.0	2.2	0.4	0.4	0.0	0.1	0.2
Faucet Aerators	2.8	2.8	0.2	0.4	1.0	0.2	0.2	0.0	0.0	0.1
Window Film	1.6	0.9	0.0	0.0	0.0	1.9	1.1	0.0	0.0	0.0

Note: Measures are sorted by descending technical energy savings potential.

For the residential sector, available cost-effective energy-efficiency measures are limited. Recent energy-efficiency standards for refrigerators and central air conditioning (minimum 13 SEER) have captured into code some of the most prominent residential energy-efficiency measures. At this point, increasing efficiencies beyond the standard is not cost effective under Xcel Energy's Colorado avoided-cost forecasts.

An additional important residential measure, high-efficiency windows, is rapidly becoming standard building practice. Builders report that around 90 percent of all new-construction window installations now utilize a low-E coating with frames that include a thermal barrier. Additionally, a recent measure cost study performed in California (Summit Blue, 2005), shows no cost differentials between standard clear double-paned windows and ENERGY STAR clear double-paned windows (with u-values of 0.25 and solar heat gain coefficients of 0.35).

Given these recent market changes, residential potentials have been restricted to measures that are often associated with higher market barriers. As Table 4-2 shows, key residential measures include CFLs, evaporative coolers, refrigerator recycling, and sunscreens. Both CFLs and evaporative coolers have been associated with performance issues that lead some customers to prefer the standard-efficiency alternatives. Sunscreens have limited appeal in cold-climate areas, since they should be removed during the winter to allow sunlight to enter the dwelling. Refrigerator recycling has programmatic problems dealing with free riders, especially if sizeable cash incentives are included as part of program delivery. The refrigerator recycling measure was modeled in a somewhat conservative fashion, based on a policy decision by Xcel Energy to limit program expenditures on this measure.

There are also several other residential measures that are relatively new (variable-speed furnace-AC fans and refrigerant charge adjustments), and market acceptance is still a question mark. Other measures target electric water heating (pipe wrap, low-flow devices, and ENERGY STAR clothes washers) and electric space heating (insulation and infiltration reduction). These electric end uses are present in less than 10 percent of Colorado homes.

Commercial Sector

Figures 4-25 and 4-26 show cumulative net achievable program savings by commercial program scenario. By 2013, net energy savings reach 341 GWh under the 33-percent incentive scenario, 559 GWh under the 50-percent incentive scenario, and 1,089 GWh under the 75-percent incentive scenario. Similar to residential, energy savings are most sensitive to changes in incentives in the 50- to 75-percent range. For peak demand, net savings increase from 51 MW under 33-percent incentives to 87 MW under 50-percent incentives to 176 under 75-percent incentives. Savings increases begin to taper off in the more advanced scenarios as the T8 lighting measures begin to reach high saturation levels and increased program penetration becomes more difficult.

Figure 4-25
Achievable Energy Savings: Commercial Sector, Base Case 1

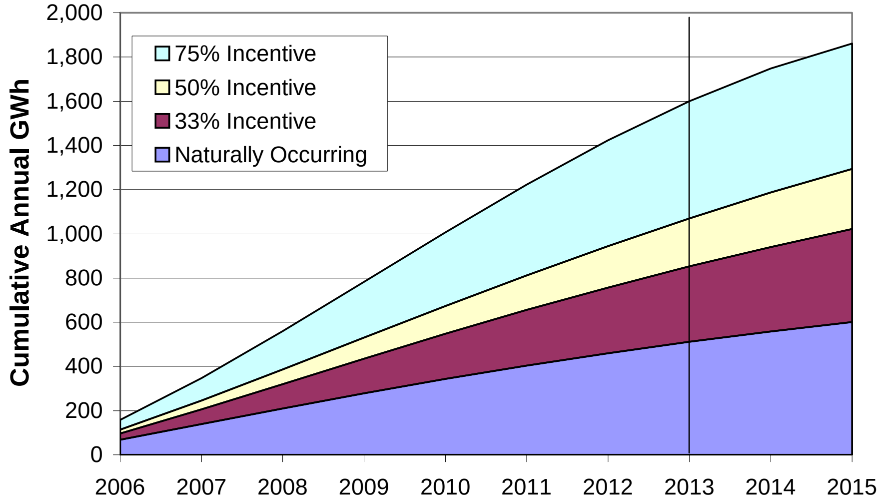
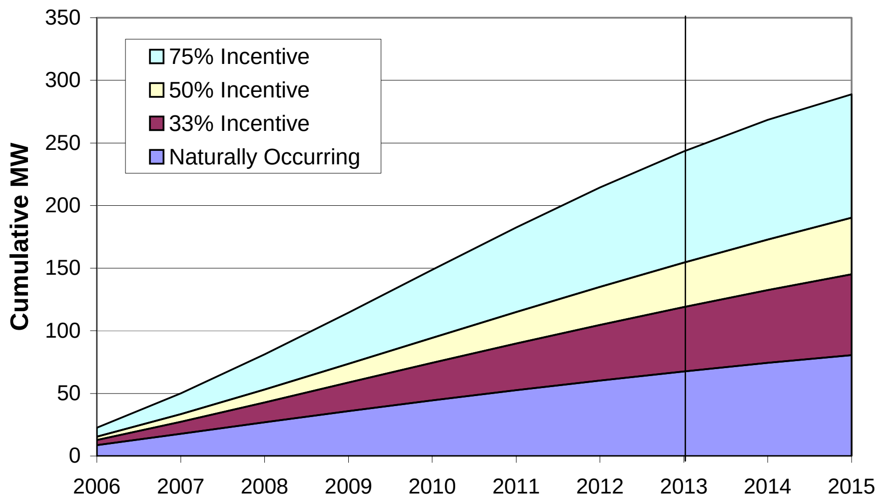


Figure 4-26
Achievable Peak Demand Savings: Commercial Sector, Base Case 1



Figures 4-27 and 4-28 show the end-use distribution of energy and peak demand savings for the 50-percent incentive scenario. Lighting contributes most to both the energy and peak demand savings potential, followed by heating, ventilation, and air conditioning (HVAC) and refrigeration measures. As one would expect, HVAC contributes a higher share to peak demand savings potential versus energy savings potential. While office equipment measures are shown to be a contributor to net savings, no incentives are provided for measures affecting this end use. Rather, results show effects of program marketing and education efforts to make customers more aware of the benefits of implementing equipment power management capabilities.

Figure 4-27
Commercial Net Energy Savings Potential End-Use Shares (2013) – 50% Incentives Base Case 1

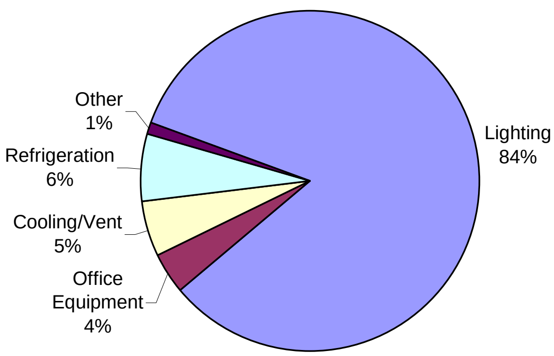
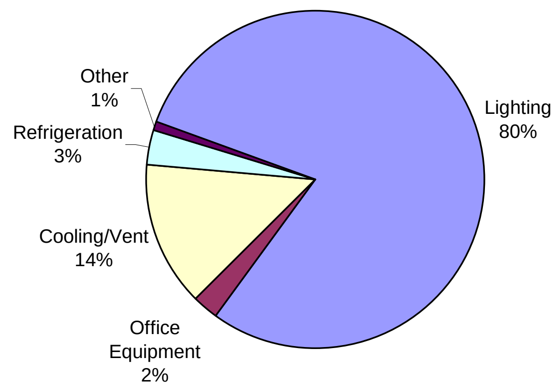


Figure 4-28
Commercial Net Peak Savings Potential End-Use Shares (2013) – 50% Incentives Base Case 1



Figures 4-29 and 4-30 show end-use shares of net achievable potential across the three program scenarios. Shares are relatively constant across scenarios. Since office equipment measures don't receive incentives, their share declines with increased program effort because other measures that receive higher incentives show increased penetration relative to the office equipment measures.

Figure 4-29
Commercial Net Energy Savings Potential by End Use (2013) – Across Scenarios Base Case 1

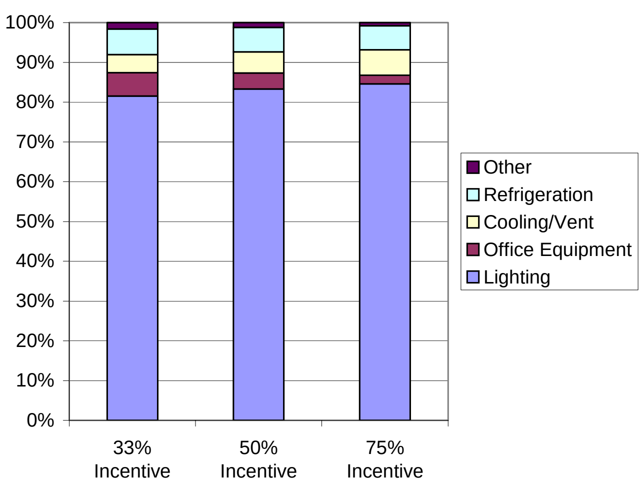


Figure 4-30
Commercial Net Peak Savings Potential by End Use (2013) – Across Scenarios Base Case 1

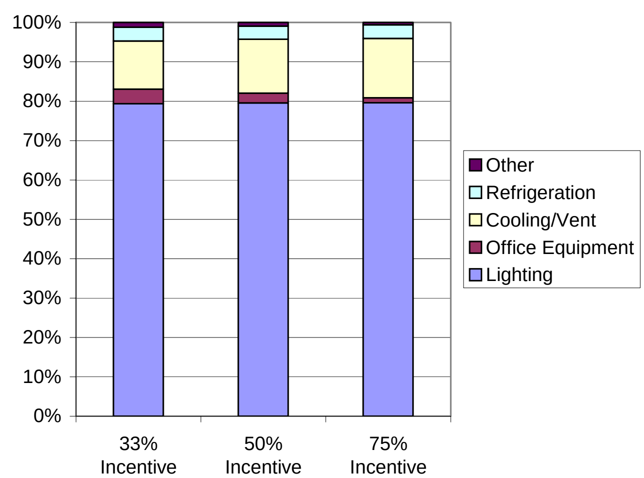


Table 4-3 lists the various potentials for commercial measures that passed cost-effectiveness screening. Lighting measures, especially the premium T8 lighting with electronic ballast, account for much of the savings potential. Limited achievable program potential for screw-in CFLs and office equipment measures reflect the fact that incentives are not being provided and that program savings are mainly from information-based efforts. Low achievable program potentials for cooling measures (efficient DX packages systems and efficient chillers) reflect the fact that these are replace-on-burnout measures that have limited opportunities due to equipment lifecycles.

Table 4-3
Measure Specific Commercial Results (Cumulative to 2013), Base Case 1

	Energy - GWh					Peak Demand - MW				
Measure	Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent	Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent
Premium T8/EB	880.6	880.6	146.4	257.3	489.2	144.1	144.1	24.0	42.1	79.7
CFL Screw-in 18W	487.3	487.3	43.0	45.0	47.5	78.8	78.8	7.0	7.3	7.7
CFL Hardwired, Modular 18W	162.4	162.4	6.9	17.3	86.1	26.3	26.3	1.1	2.8	13.9
Occupancy Sensors	157.6	143.9	17.8	36.9	95.4	28.3	26.1	3.3	6.7	17.2
High Pressure Sodium 250W Lamp	156.8	156.8	42.2	65.8	107.8	9.4	9.4	2.5	3.9	6.5
PC Network Power Management Enabling	139.4	139.4	10.0	7.4	7.7	13.4	13.4	1.0	0.7	0.7
Lighting 15% More Efficient Design	123.2	123.2	11.1	23.3	47.1	20.2	20.2	1.8	3.8	7.8
High Bay T5	106.3	106.3	1.3	2.9	12.7	17.4	17.4	0.2	0.5	2.2
DX Packaged System, EER=10.9, 10 tons	76.3	76.3	1.5	2.6	6.0	49.4	49.4	1.0	1.7	3.8
PC Manual Power Management Enabling	74.4	74.4	2.2	5.3	5.6	7.1	7.1	0.2	0.5	0.5
Lighting 25% More Efficient Design	69.8	64.0	3.6	8.2	19.9	11.5	10.5	0.6	1.4	3.3
Monitor Power Management Enabling	65.8	65.8	7.0	7.3	7.7	6.3	6.3	0.7	0.7	0.7
Vending Misers (cooled machines only)	56.8	56.8	2.9	3.1	3.3	6.2	6.2	0.3	0.3	0.4
VSD Fan Motors	55.6	27.5	4.5	7.6	14.1	2.1	1.1	0.2	0.3	0.6
Printer Power Management Enabling	54.2	54.2	0.8	2.2	2.3	5.2	5.2	0.1	0.2	0.2
High-efficiency fan motors	42.4	42.4	3.7	7.9	24.3	5.0	5.0	0.4	0.9	2.9
Cool Roof - DX	40.6	4.3	1.3	2.1	3.0	28.1	3.0	0.9	1.4	2.1
Demand Defrost Electric	33.4	33.4	1.0	1.1	1.1	4.0	4.0	0.1	0.1	0.1
Window Film (Standard)	31.2	10.5	2.3	4.0	7.4	21.1	7.4	1.6	2.8	5.1
Economizers	31.2	11.4	0.9	2.0	6.7	6.0	1.8	0.1	0.3	1.1
Cool & Vent 30% More Efficient Design	27.0	27.0	1.2	2.9	7.6	17.3	17.3	0.8	1.9	4.9
Prog. Thermostat - DX	26.7	12.6	0.9	2.0	7.2	5.2	2.2	0.1	0.3	1.3
Centrifugal Chiller, 0.51 kW/ton, 500 tons	25.6	25.6	0.4	0.8	1.6	16.5	16.5	0.3	0.5	1.0
Efficient compressor motor	21.3	21.3	2.0	2.8	4.3	2.5	2.5	0.2	0.3	0.5
Energy Star or Better Monitor	17.6	17.6	0.0	0.0	0.0	2.6	2.6	0.0	0.0	0.0
LED Exit Sign	16.7	16.7	1.2	2.7	9.3	2.7	2.7	0.2	0.4	1.5
Outdoor Lighting Controls	16.5	16.5	1.9	2.0	2.1	0.0	0.0	0.0	0.0	0.0
Premium Efficiency Fan Motors	16.4	1.0	0.0	0.1	0.2	2.3	0.1	0.0	0.0	0.0
HVAC 10% More Efficient Design	15.0	15.0	1.2	2.6	5.6	9.6	9.6	0.8	1.7	3.6
Anti-sweat (humidistat) controls	14.4	14.4	4.6	6.6	8.8	0.9	0.9	0.3	0.4	0.5
Refrigeration 10% More Efficient Design	14.0	14.0	1.0	2.2	5.0	1.7	1.7	0.1	0.3	0.6
Optimize Controls	13.4	0.9	0.0	0.0	0.0	2.6	0.2	0.0	0.0	0.0
Copier Power Management Enabling	13.1	13.1	0.0	0.1	0.1	1.3	1.3	0.0	0.0	0.0
Strip curtains for walk-ins	11.6	11.6	3.5	4.6	5.6	1.4	1.4	0.4	0.5	0.7
Lighting Control Tuneup	11.4	11.4	2.6	4.3	4.4	0.5	0.5	0.1	0.2	0.2
Air Handler Optimization, 15 HP	10.1	7.3	0.2	0.6	3.2	0.4	0.3	0.0	0.0	0.1
Night covers for display cases	9.7	9.7	3.0	4.5	6.4	0.0	0.0	0.0	0.0	0.0
VSD for Chiller Pumps and Towers	9.0	6.6	0.8	1.5	4.4	5.8	4.1	0.5	1.0	2.8
Tankless Water Heater	8.3	5.8	1.7	2.6	4.4	1.0	0.7	0.2	0.3	0.5
Floating head pressure controls	6.9	6.9	1.5	1.8	2.0	0.0	0.0	0.0	0.0	0.0
Air Handler Optimization, 40 HP	6.7	5.7	0.2	0.5	2.7	0.3	0.2	0.0	0.0	0.1
Demand controlled circulating systems	3.5	1.7	0.3	0.4	0.4	0.4	0.2	0.0	0.1	0.1
Energy Star or Better Copier	3.3	3.3	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0
Demand Hot Gas Defrost	3.1	3.1	0.5	0.6	0.7	0.4	0.4	0.1	0.1	0.1
High Efficiency Water Heater (electric)	2.8	2.8	0.1	0.2	0.2	0.3	0.3	0.0	0.0	0.0
Hot Water Pipe Insulation	1.5	1.0	0.3	0.5	0.8	0.2	0.1	0.0	0.1	0.1

Note: Measures are sorted by descending technical energy savings potential.

Industrial Sector

Figures 4-31 and 4-32 show cumulative net achievable program savings by industrial program scenario. By 2013, net energy savings reach 19 GWh under the 33-percent incentive scenario, 36 GWh under the 50-percent incentive scenario, and 89 GWh under the 75-percent incentive scenario. For peak demand, net savings increase from 2 MW under 33-percent incentives to 4 MW under 50-percent incentives to 12 under 75-percent incentives.

Figure 4-31
Achievable Energy Savings: Industrial Sector, Base Case 1

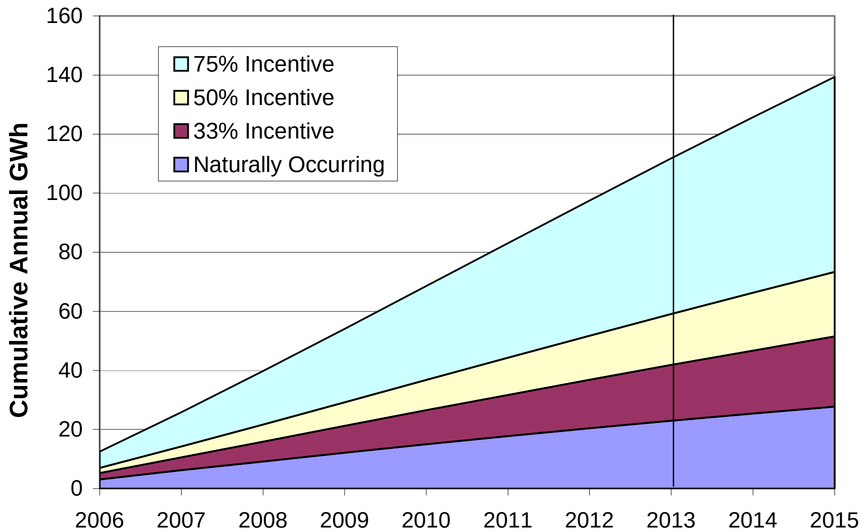
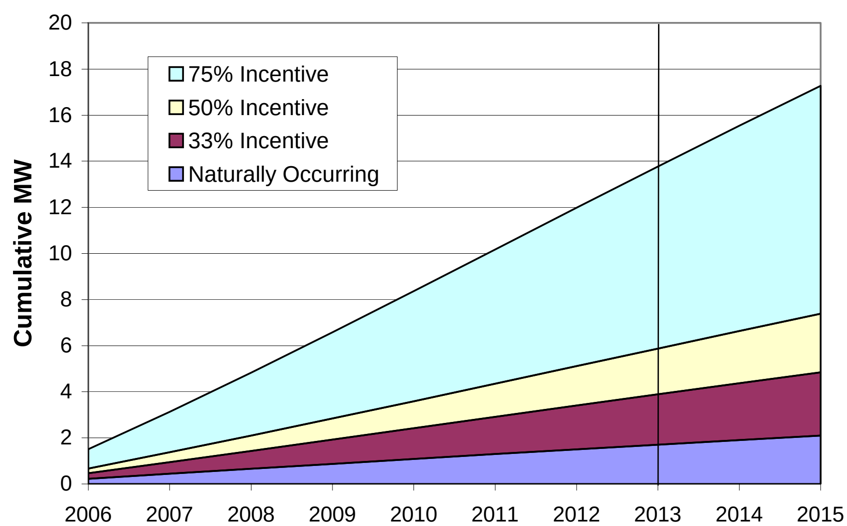


Figure 4-32
Achievable Peak Demand Savings: Industrial Sector, Base Case 1



Figures 4-33 and 4-34 show the end-use distribution of energy and peak demand savings for the 50-percent incentive scenario. Pumping system measures contribute most to both the energy and peak demand savings potential, followed by lighting and compressed air measures. The shares of lighting and cooling are higher for peak demand versus energy because a number of the pumping and compressed air measures involve off-peak savings from better system management.

Figure 4-33
Industrial Net Energy Savings Potential
End-Use Shares (2013) – 50% Incentives
Base Case 1

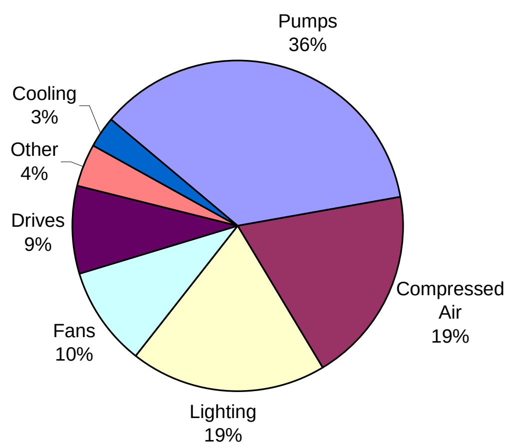
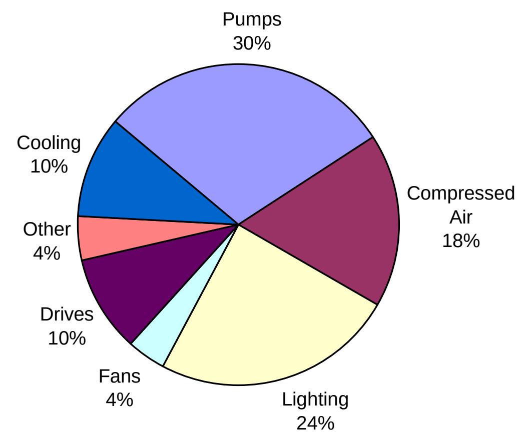


Figure 4-34
Industrial Net Peak Savings Potential
End-Use Shares (2013) – 50% Incentives
Base Case 1



Figures 4-35 and 4-36 show end-use shares of net achievable potential across the three program scenarios. The major changes in shares across scenarios involve increased lighting and decreased compressed air impacts. Several of the compressed air measures (system optimization and adjustable-speed drives) have incentive levels capped to limit customer payback period to one year, and thus compressed air impacts do not increase as rapidly as other measures in the progression to higher incentive scenarios. Other motor-driven end uses (pumps, fans, and drives) have similar constraints to a lesser degree.

Figure 4-35
Industrial Net Energy Savings Potential by End Use (2013) – Across Scenarios Base Case 1

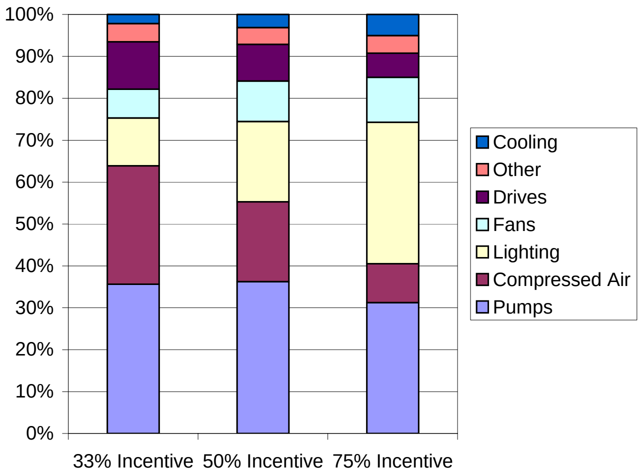


Figure 4-36
Industrial Net Peak Savings Potential by End Use (2013) – Across Scenarios Base Case 1

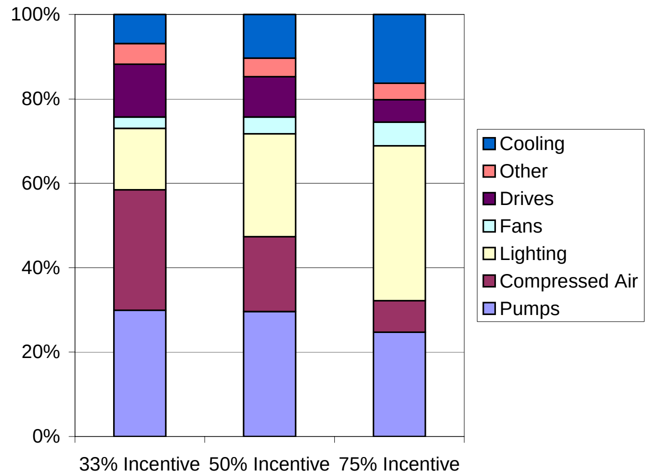


Table 4-4 lists the various potentials for industrial measures that passed cost-effectiveness screening. There are a large number of industrial measures that contribute to industrial savings potential. Limited penetration of industrial measures is, in part, due to low industrial electricity rates in Colorado that limit customer economic incentives to install measures. In addition, some of the key process measures such as installation of controls and process optimization tend to have high market barriers such as lack of customer knowledge about the measure and the need to take their plant out of operation to install measures. Rebate limits on some of the most cost-effective measures (to keep customer payback period to one year or more) also limit additional measure penetration in the higher incentive scenarios.

4.3 PROGRAM SENSITIVITY ANALYSES

Two sensitivity analyses were developed to address modeling constraints that were incorporated into the Base Case 1 analysis. In the first sensitivity analysis we remove incentive caps that constrain customer payback periods to be one year or greater. In the second sensitivity analysis we consider natural gas benefits for residential measures that affect both electricity and natural gas usage. The sensitivity analyses are discussed next.

4.3.1 Sensitivity Analysis One: Removing Incentive Constraints

In this sensitivity analysis we relax one of our modeling constraints: not allowing rebates that drop the customer payback period below one year. We compare achievable potentials for this sensitivity against those of the Base Case 1 scenario runs presented above.

Table 4-4
Measure Specific Industrial Results (Cumulative to 2013), Base Case 1

	Energy - GWh					Peak Demand - MW				
Measure	Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent	Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent
Pumps - Controls	88.72	88.72	3.16	3.54	3.79	10.80	10.80	0.38	0.43	0.46
RET 2L4' Premium T8, 1EB	80.52	80.52	1.34	4.05	23.41	11.80	11.80	0.20	0.59	3.43
Pumps - System Optimization	75.98	75.98	1.80	5.53	17.94	9.25	9.25	0.22	0.67	2.18
Compressed Air-O&M	44.43	44.43	0.02	0.04	0.06	5.78	5.78	0.00	0.01	0.01
Fans - Controls	35.33	35.33	0.10	0.31	1.83	4.29	4.29	0.01	0.04	0.22
Pumps - ASD	34.40	33.05	1.52	3.26	3.62	0.41	0.39	0.02	0.04	0.04
Compressed Air - System Optimization	32.60	32.60	4.51	4.98	5.29	4.24	4.24	0.59	0.65	0.69
Pumps - O&M	30.89	30.89	0.03	0.06	0.08	3.76	3.76	0.00	0.01	0.01
CFL Hardwired, Modular 36W	20.58	20.58	0.77	2.71	5.53	3.01	3.01	0.11	0.40	0.81
Comp Air - ASD	16.87	16.20	0.60	1.33	1.44	0.21	0.21	0.01	0.02	0.02
Fans - ASD	14.90	14.01	0.90	2.34	3.50	0.27	0.26	0.01	0.04	0.06
Compressed Air- Sizing	13.65	13.65	0.04	0.08	0.10	1.78	1.78	0.00	0.01	0.01
Fans - System Optimization	12.16	12.16	0.08	0.27	2.05	0.73	0.73	0.01	0.02	0.12
Centrifugal Chiller, 0.51 kW/ton, 500 tons	10.76	10.76	0.04	0.11	0.52	7.27	7.27	0.03	0.08	0.35
Compressed Air - Controls	8.60	8.60	0.06	0.18	0.35	1.12	1.12	0.01	0.02	0.05
Pumps - Motor practices	9.62	8.51	0.15	0.47	1.77	1.17	1.04	0.02	0.06	0.22
DX Packaged System, EER=10.9, 10 tons	7.82	7.82	0.00	0.00	0.03	5.28	5.28	0.00	0.00	0.02
Window Film	7.05	7.05	0.10	0.31	1.68	4.76	4.76	0.07	0.21	1.13
Occupancy Sensors	6.94	6.94	0.05	0.15	1.02	1.22	1.22	0.01	0.03	0.18
Energy Star transformers	5.91	5.91	0.01	0.02	0.13	0.97	0.97	0.00	0.00	0.02
Pumps - Sizing	5.56	5.56	0.00	0.00	0.02	2.52	2.52	0.00	0.00	0.01
Efficient drives - rolling	5.51	5.51	0.06	0.16	0.42	0.64	0.64	0.01	0.02	0.05
Optimization Refrigeration	5.39	5.39	0.13	0.38	2.00	0.68	0.68	0.02	0.05	0.25
Bakery - Process	5.00	5.00	0.13	0.28	0.30	0.63	0.63	0.02	0.04	0.04
Fans - Motor practices	5.20	4.75	0.12	0.35	1.65	0.82	0.76	0.02	0.05	0.22
Drives - Process Control	4.58	4.58	0.01	0.03	0.17	0.53	0.53	0.00	0.00	0.02
Heating - Process Control	4.50	4.50	0.01	0.03	0.17	0.52	0.52	0.00	0.00	0.02
Efficient electric melting	4.38	4.38	0.01	0.02	0.13	0.50	0.50	0.00	0.00	0.02
Prog. Thermostat - DX	4.32	4.32	0.26	0.71	2.24	0.88	0.88	0.05	0.14	0.46
Efficient Curing ovens	4.32	4.32	0.01	0.02	0.13	0.58	0.58	0.00	0.00	0.02
Comp Air - Motor practices	4.77	4.22	0.08	0.23	0.88	0.62	0.55	0.01	0.03	0.11
Fans- Improve components	4.00	4.00	0.06	0.14	0.15	0.49	0.49	0.01	0.02	0.02
Fans - O&M	3.96	3.96	0.00	0.01	0.01	0.48	0.48	0.00	0.00	0.00
Drives - EE motor	3.84	3.84	0.03	0.09	0.31	0.45	0.45	0.00	0.01	0.04
Drives - Optimization process (M&T)	3.73	3.73	0.98	1.07	1.12	0.51	0.51	0.13	0.14	0.15
Efficient refrigeration - operations	3.12	3.12	0.04	0.05	0.06	0.39	0.39	0.00	0.01	0.01
Efficient practices printing press	2.87	2.87	0.80	1.23	1.27	0.36	0.36	0.10	0.16	0.16
Process control	2.85	2.85	0.08	0.17	0.18	0.33	0.33	0.01	0.02	0.02
Extruders/injection Moulding-multipump	2.57	2.57	0.01	0.02	0.13	0.31	0.31	0.00	0.00	0.02
Efficient Printing press (fewer cylinders)	2.43	2.43	0.01	0.02	0.11	0.31	0.31	0.00	0.00	0.01
New transformers welding	2.43	2.43	0.02	0.06	0.18	0.33	0.33	0.00	0.01	0.02
Process optimization	1.86	1.86	0.04	0.12	0.65	0.21	0.21	0.00	0.01	0.07
O&M - Extruders/Injection Moulding	1.81	1.81	0.00	0.00	0.00	0.22	0.22	0.00	0.00	0.00
Machinery	1.69	1.69	0.01	0.04	0.13	0.23	0.23	0.00	0.01	0.02
Heating - Optimization process (M&T)	1.59	1.59	0.42	0.46	0.48	0.22	0.22	0.06	0.06	0.06
Refinery Controls - Pumps	1.32	1.32	0.09	0.23	0.54	0.16	0.16	0.01	0.03	0.06
Direct drive Extruders	1.32	1.32	0.00	0.00	0.03	0.16	0.16	0.00	0.00	0.00
Air conveying systems	1.22	1.22	0.04	0.04	0.05	0.04	0.04	0.00	0.00	0.00
Near Net Shape Casting	1.20	1.20	0.04	0.06	0.07	0.14	0.14	0.00	0.01	0.01
Drives - Scheduling	1.19	1.19	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.00
Efficient processes (welding, etc.)	1.16	1.16	0.01	0.03	0.08	0.16	0.16	0.00	0.00	0.01
Bakery - Process (Mixing) - O&M	1.02	1.02	0.00	0.00	0.00	0.13	0.13	0.00	0.00	0.00
Drives - Process Controls (batch + site)	8.10	1.01	0.00	0.01	0.04	0.94	0.12	0.00	0.00	0.00
Clean Room - Controls	0.99	0.99	0.00	0.01	0.06	0.13	0.13	0.00	0.00	0.01
Injection Moulding - Impulse Cooling	0.93	0.93	0.00	0.01	0.03	0.11	0.11	0.00	0.00	0.00
Optimize drying process	0.65	0.65	0.02	0.06	0.29	0.08	0.08	0.00	0.01	0.04
Optimization control PM	0.65	0.65	0.02	0.06	0.27	0.08	0.08	0.00	0.01	0.03
Clean Room - New Designs	0.64	0.64	0.00	0.00	0.02	0.08	0.08	0.00	0.00	0.00
Replace V-belts	0.64	0.64	0.02	0.04	0.04	0.08	0.08	0.00	0.00	0.00
Efficient drives	0.56	0.56	0.01	0.01	0.04	0.07	0.07	0.00	0.00	0.00
Other Process Controls (batch + site)	0.51	0.51	0.00	0.00	0.02	0.06	0.06	0.00	0.00	0.00
Heating - Scheduling	0.45	0.45	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00
O&M/drives spinning machines	0.39	0.39	0.00	0.00	0.00	0.05	0.05	0.00	0.00	0.00
Top-heating (glass)	0.38	0.38	0.01	0.02	0.03	0.04	0.04	0.00	0.00	0.00
Refinery Controls - Comp. Air	0.29	0.29	0.01	0.04	0.09	0.04	0.04	0.00	0.00	0.01
Refinery Controls - Fans	0.24	0.24	0.00	0.01	0.02	0.03	0.03	0.00	0.00	0.00
Gap Forming papermachine	0.22	0.22	0.01	0.01	0.01	0.03	0.03	0.00	0.00	0.00
High Consistency forming	0.21	0.21	0.01	0.01	0.01	0.03	0.03	0.00	0.00	0.00
Process Drives - ASD	0.12	0.12	0.00	0.01	0.03	0.01	0.01	0.00	0.00	0.00
Drying (UV/IR)	0.08	0.08	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00
Power recovery	0.30	0.04	0.00	0.00	0.01	0.04	0.00	0.00	0.00	0.00
Efficient machinery	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Membranes for wastewater	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Efficient desalter	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Measures are sorted by descending technical energy savings potential.

Appendix H shows the rebate percentages (of incremental measure costs) that were utilized for each program scenario. This appendix shows that rebates levels are constrained for a number of measures below the full amount allowed for in the given program scenarios. Examples of such measures include residential CFLs, commercial lighting and cooling system optimization, and a number of different industrial measures. For the Base Case 1 analysis, we model program penetration for a number of measures that do not receive incentives and are mainly promoted through marketing and customer education: commercial screw-in CFLs, commercial office equipment power management measures, and industrial operation and maintenance measures. Zero incentive levels are maintained for these measures in this sensitivity analysis.

Figures 4-37 and 4-38 compare overall achievable potential results for this sensitivity analysis against the Base Case 1 set of program scenarios. In the 75-percent incentive scenario, relaxing the incentive cap provides an increase in energy savings potential of about 21 percent, or 271 GWh. Peak demand savings potential increases by about 13 percent, or 47 MW. Changes for the other program scenarios are more modest.

Figure 4-37
Base Case 1 and No-Incentive-Cap Net Energy Savings Potential (2013)

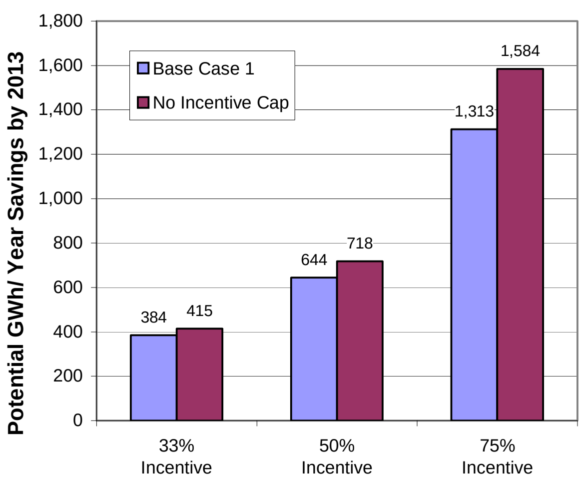
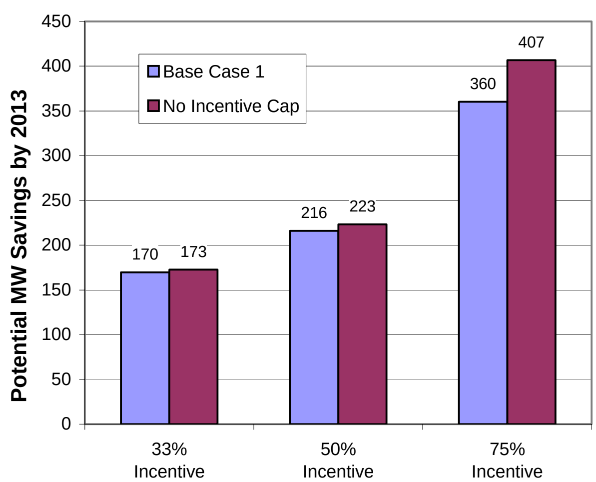


Figure 4-38
Base Case 1 and No-Incentive-Cap Net Peak Savings Potential (2013)



Base Case 1 results and no-incentive-cap results are presented by sector for the 75-percent incentive scenario in Figures 4-39 and 4-40. As shown, the residential and industrial sectors account for most of the difference. Residential potential increases by about 170 GWh and 36 MW when the incentive caps are removed. Industrial potential increases by about 97 GWh and 10 MW.

Figure 4-39
Base Case 1 and No-Incentive-Cap Net Energy Savings Potential by Sector (2013)
75% Incentive Scenario

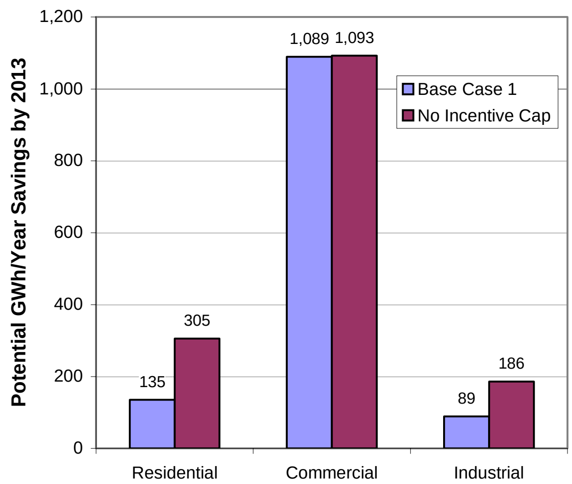
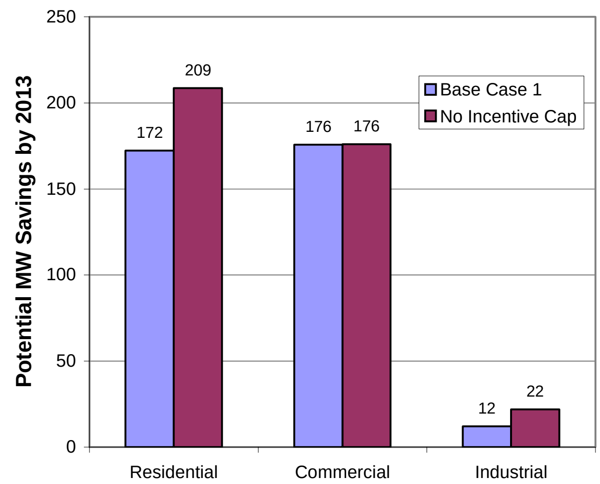


Figure 4-40
Base Case 1 and No-Incentive-Cap Net Peak Savings Potential by Sector (2013)
75% Incentive Scenario



The primary measure driving the residential increase under the no-cap sensitivity analysis is the CFL measure. Under the Base Case 1 set of achievable potential runs, CFLs were capped at a maximum 9-percent incentive. With a full incremental measure cost of $3.00 per bulb, this incentive brought the price down to $2.73. With the full 75-percent incentive, the CFL cost to customers drops to $0.75 per bulb. With this cost decrease, cumulative residential CFL potential through 2013 increases by about 115 GWh per year, from 12 GWh per year to 127 GWh per year. With Colorado's relatively low electricity rates, our penetration analysis shows limited CFL program effects with rebates of only $0.27 per bulb, but much higher adoption with rebates at $2.25 and the effective price dropping to $0.75 per bulb. Additional residential measures that show increased potential with higher uncapped incentive levels are sunscreens (plus 10 GWh per year by 2013 in the 75-percent incentive case), air conditioner refrigerant charging (plus 4 GWh per year), and refrigerator recycling (plus 31 GWh year).

For the industrial sector, measures that show the largest increases with uncapped incentives include adjustable-speed drives (ASDs) for pumps, fans, and compressed air motors, pumping and compressed air system optimization, and pumping system controls.

Table 4-5 summarizes the results of this uncapped incentive sensitivity analysis.

Table 4-5
Summary of Achievable Potential Results—2006–2013
No-Incentive-Cap Sensitivity Analysis

Result	Program Scenario		
	33% Incentive	50% Incentive	75% Incentive
Gross Energy Savings - GWh	669	973	1,839
Gross Peak Demand Savings - MW	209	259	443
Net Energy Savings - GWh	415	718	1,584
Net Peak Demand Savings - MW	173	223	407
Program Costs - Real, $ million			
Administration	$14	$27	$50
Marketing	$30	$37	$45
Incentives	$85	$140	$361
Total	$129	$204	$456
PV Avoided Costs ($ mil.)	$569	$744	$1,238
PV Annual Program Costs ($ mil.)	$90	$151	$361
PV Participant Costs ($ mil.)	$123	$153	$213
TRC Ratio	2.6	2.4	2.1

PV (present value) of benefits and costs is calculated over a 20-year normalized measure life for 2005–2014 program years, nominal discount rate = 7.4 percent, inflation rate = 2.4 percent; GWh and MW savings are cumulative through 2013.

4.3.2 Sensitivity Analysis Two: Inclusion of Natural Gas Benefits in the Residential Cost Effectiveness Screening

The Base Case 1 DSM potential analysis includes only electric savings benefits in determining measure cost effectiveness. There are a number of residential measures that save both electricity and natural gas. These measures include: ceiling insulation, wall insulation, and duct sealing. In this sensitivity we investigate the changes in DSM potential when we include natural gas savings benefits into our cost-effectiveness testing of the measures that affect both electricity and natural gas.

In order to integrate the effects of gas savings into the analysis, we allocated measure costs to electric and gas components based on the share of benefits they produce. For this allocation, we calculated the present value of lifecycle avoided-cost benefits for both electric and gas savings. We then calculated the electric share of benefits and applied this share to total measure costs to arrive at electric measure costs. Table 4-6 shows the electric share of avoided-cost benefits for the measures that affect both electricity and natural gas.

Next, we conducted our measure screening using the same analysis approach as for the Base Case 1 assessment, but now using lower measure costs for the measures that save on electricity and natural gas. Results of the assessment are shown in Table 4-7. This table shows basic technical potential for energy and peak demand savings and TRC ratios for the electric-only and electric-gas assessments. As the table indicates, TRC ratios increase considerably for all measures. Shaded areas in the table highlight measures that are only cost effective if the natural gas benefits are factored into the analysis.

Table 4-6
Electric Benefits Share of Measures Saving Electricity and Natural Gas

Measure	Electric Share Avoided Cost Benefits
Duct Insulation	36%
Duct Sealing - from 24% AHU to 12%	36%
Duct Sealing - from 40% AHU to 12%	36%
Ceiling R-0 to R-38 Insulation - Batts	22%
Ceiling R-11 to R-38 Insulation - Batts	17%
Ceiling R-19 to R-38 Insulation - Batts	16%
Wall Blow-in R-0 to R-13 Insulation	24%
New Construction Cooling Package	43%
NC Cooling with AC Downsizing	46%

Table 4-7
Measure Cost Effectiveness Screen with and without Gas Benefits

Segment	Measure Number	Measure	Building Type	Technical Potential GWH	Technical Potential MW	Elec Only Total Resource Cost Test (TRC)	Elec/Gas Total Resource Cost Test (TRC)
Existing	118	Ceiling R-0 to R-38 Insulation - Batts - CAC	Multifamily	2.34	2.70	1.27	5.78
Existing	148	Ceiling R-0 to R-38 Insulation - Batts - RAC	Multifamily	0.44	0.51	1.25	5.67
Existing	113	Duct Sealing - from 40% AHU to 12% - CAC	Single Family	59.47	85.70	1.69	4.70
Existing	149	Ceiling R-11 to R-38 Insulation - Batts - RAC	Multifamily	0.02	0.02	0.54	3.19
Existing	118	Ceiling R-0 to R-38 Insulation - Batts - CAC	Single Family	3.50	4.03	0.55	2.51
Existing	148	Ceiling R-0 to R-38 Insulation - Batts - RAC	Single Family	0.33	0.39	0.54	2.46
Existing	119	Ceiling R-11 to R-38 Insulation - Batts - CAC	Multifamily	0.08	0.09	0.41	2.40
Existing	113	Duct Sealing - from 40% AHU to 12% - CAC	Multifamily	7.67	11.05	0.77	2.14
Existing	150	Ceiling R-19 to R-38 Insulation - Batts - RAC	Multifamily	0.61	0.70	0.31	1.91
Existing	111	Duct Insulation - CAC	Multifamily	0.31	0.45	0.66	1.83
Existing	111	Duct Insulation - CAC	Single Family	3.35	4.82	0.60	1.68
Existing	112	Duct Sealing - from 24% AHU to 12% - CAC	Single Family	8.07	11.62	0.55	1.53
Existing	149	Ceiling R-11 to R-38 Insulation - Batts - RAC	Single Family	0.32	0.37	0.24	1.39
Existing	120	Ceiling R-19 to R-38 Insulation - Batts - CAC	Multifamily	2.11	2.43	0.20	1.27
Existing	121	Wall Blow-in R-0 to R-13 Insulation - CAC	Single Family	13.30	21.00	0.26	1.10
Existing	119	Ceiling R-11 to R-38 Insulation - Batts - CAC	Single Family	2.45	2.82	0.18	1.04
Existing	150	Ceiling R-19 to R-38 Insulation - Batts - RAC	Single Family	1.12	1.30	0.13	0.83
Existing	121	Wall Blow-in R-0 to R-13 Insulation - CAC	Multifamily	2.60	4.11	0.15	0.63
Existing	120	Ceiling R-19 to R-38 Insulation - Batts - CAC	Single Family	7.68	8.86	0.09	0.55
Existing	112	Duct Sealing - from 24% AHU to 12% - CAC	Multifamily	0.63	0.91	0.15	0.42
Existing	151	Wall Blow-in R-0 to R-13 Insulation - RAC	Single Family	0.26	0.30	0.09	0.39
Existing	151	Wall Blow-in R-0 to R-13 Insulation - RAC	Multifamily	0.17	0.20	0.05	0.23
New	136	NC Cooling Package, AC Downsizing - CAC	Multifamily	5.91	8.51	2.59	6.18
New	136	NC Cooling Package, AC Downsizing - CAC	Single Family	24.77	35.70	1.58	3.43
New	131	New Constr Cooling Package - CAC	Multifamily	5.91	8.51	1.29	2.72
New	131	New Constr Cooling Package - CAC	Single Family	21.54	31.04	1.01	2.34

The final step in the analysis was to run the expanded set of measures, together with the improved measure economics, through the achievable program analysis. Results of the sensitivity analysis, in comparison to the Base Case 1 analysis, are shown in Figures 4-41 and 4-42. As shown, when natural gas benefits are included, estimated cumulative energy savings potential through 2013 increases by 5 GWh in the 33-percent incentive case, growing to an increase of 39 GWh in the 75-percent incentive case. Peak demand potential increases by 4 MW in the 33-percent incentive case, growing to an increase of 54 MW in the 75-percent incentive case. The key measures accounting for the difference in savings potential between the Base Case 1 analysis and the gas-benefits analysis are duct sealing and residential new construction measures. (The new construction cooling package measure includes: R-38 ceiling insulation, R-19 wall insulation, improved duct sealing, SEER 14 central air conditioning, proper AC refrigerant charging, and air conditioner downsizing.)

Figure 4-41
Base Case 1 and Gas-Benefit Analysis
Net Energy Savings Potential (2013)
Residential Sector

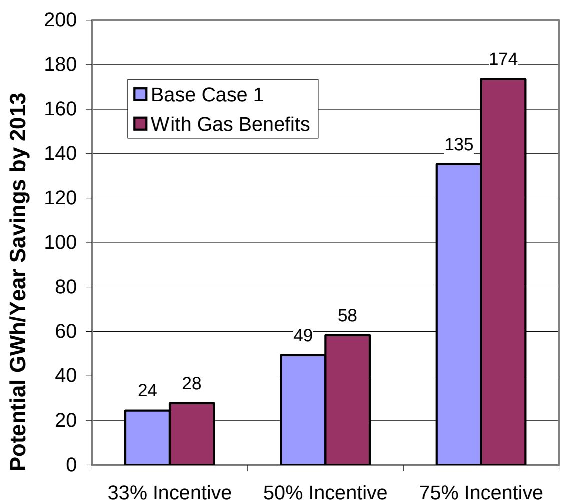
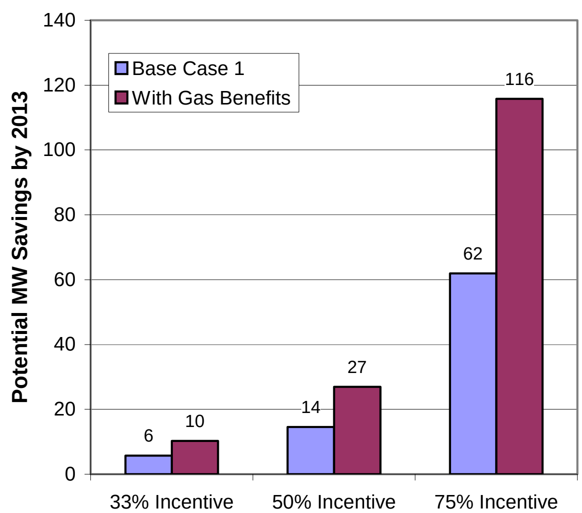


Figure 4-42
Base Case 1 and Gas-Benefit Analysis
Net Peak Savings Potential (2013)
Residential Sector



Note: results exclude Saver's Switch Impacts of 110 MW

Table 4-8 provides an overall summary of the gas-benefits sensitivity analysis.

Table 4-8
Summary of Achievable Potential Results—2006–2013
Residential Gas Benefits Sensitivity Analysis

Result	Program Scenario		
	33% Incentive	50% Incentive	75% Incentive
Gross Energy Savings - GWh	644	909	1,608
Gross Peak Demand Savings - MW	212	266	452
Net Energy Savings - GWh	388	653	1,352
Net Peak Demand Savings - MW	174	228	414
Program Costs - Real, $ million			
Administration	$14	$27	$50
Marketing	$30	$37	$45
Incentives	$84	$137	$339
Total	$128	$201	$435
PV Avoided Costs ($ mil.)	$560	$721	$1,146
PV Annual Program Costs ($ mil.)	$89	$149	$342
PV Participant Costs ($ mil.)	$123	$152	$202
TRC Ratio	2.6	2.4	2.1

PV (present value) of benefits and costs is calculated over a 20-year normalized measure life for 2005–2014 program years, nominal discount rate = 7.4 percent, inflation rate = 2.4 percent; GWh and MW savings are cumulative through 2013.

4.4 Achievable Potential – Base Case 2

For the Base Case 2 analysis we combine the effects of the two sensitivity analyses described above: (1) removing incentive constraints to allow customer payback periods for some measures fall below one year; and (2) including natural gas benefits for residential measures that have both electricity and natural gas savings.

Figures 4-43 and 4-44 compare overall achievable potential results for Base Case 2 against the Base Case 1 set of program scenarios. In the 75-percent incentive scenario, relaxing the incentive cap and addressing natural gas benefits provides an increase in energy savings potential of about 24 percent, or 310 GWh. Peak demand savings potential increases by about 28 percent, or 102 MW. Changes for the other program scenarios are not as pronounced.

Figure 4-43
Base Case 1 and Base Case 2
Net Energy Savings Potential (2013)

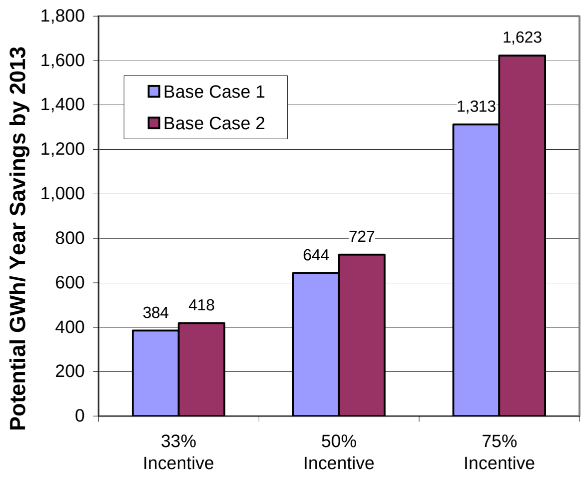
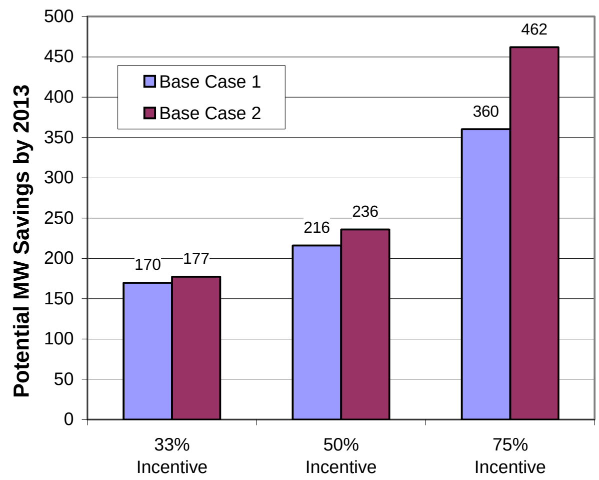


Figure 4-44
Base Case 1 and Base Case 2
Net Peak Savings Potential (2013)



Base Case 1 results and Base Case 2 results are compared by sector for the 75-percent incentive scenario in Figures 4-45 and 4-46. As shown, the residential sector accounts for the largest share of the difference, followed by the industrial sector. Residential potential increases by about 210 GWh and 92 MW when the incentive caps are removed and gas benefits are considered. Industrial potential increases by about 97 GWh and 10 MW with the removal on the incentive cap.

Figure 4-45
Base Case 1 and Base Case 2 Net Energy Savings Potential by Sector (2013)
75% Incentive Scenario

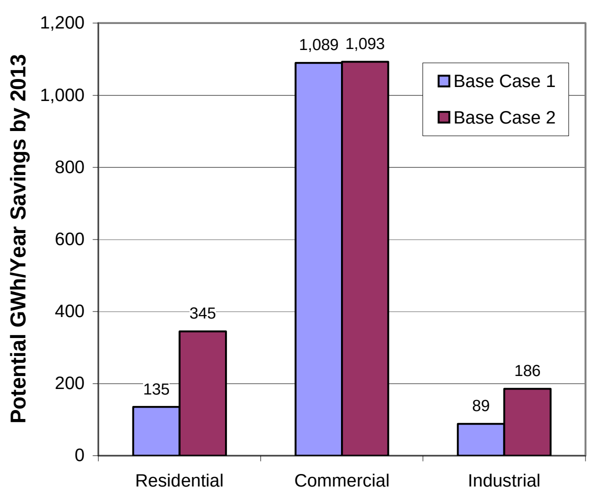
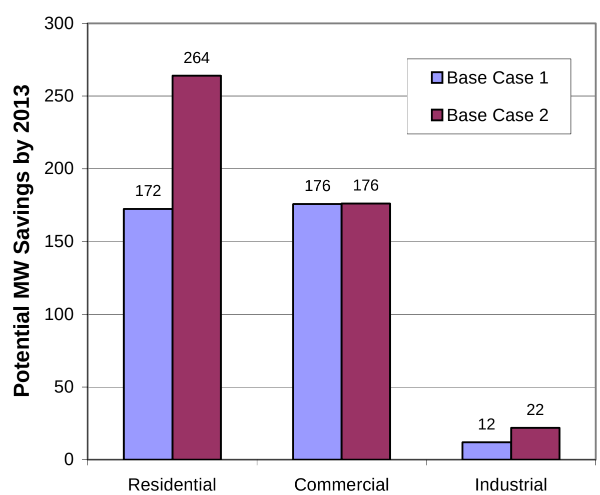


Figure 4-46
Base Case 1 and Base Case 2 Net Peak Demand Savings Potential by Sector (2013)
75% Incentive Scenario



Since the majority of the difference between Base Case 2 and Base Case 1 occurs in the residential sector, Figures 4-47 and 4-48 and Table 4-9 show additional residential results. As shown in Figures 4-47 and 4-48, when the incentive cap is removed and natural gas benefits are included, estimated cumulative energy savings potential through 2013 increases by 28 GWh in the 33-percent incentive case, growing to an increase of 210 GWh in the 75-percent incentive case. Peak demand potential increases by 7 MW in the 33-percent incentive case, growing to an increase of 92 MW in the 75-percent incentive case.

Figure 4-47
Base Case 1 and Base Case 2
Net Energy Savings Potential (2013)
Residential Sector

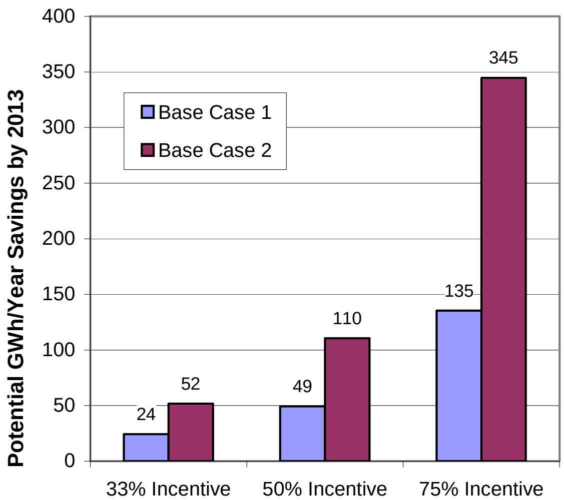
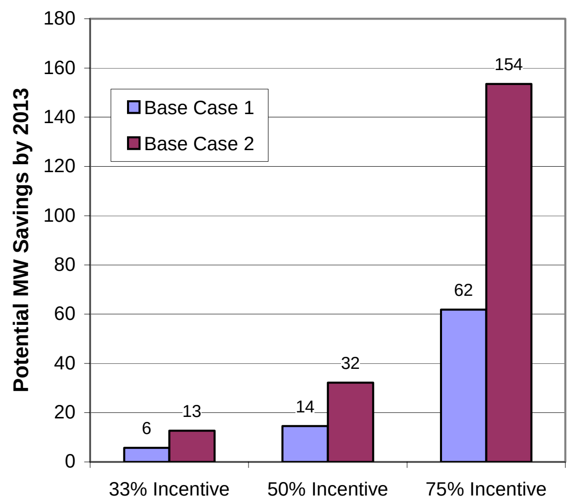


Figure 4-48
Base Case 1 and Base Case 2
Net Peak Demand Savings Potential (2013)
Residential Sector



Note: results exclude Saver's Switch Impacts of 110 MW

Table 4-9 lists the various potentials for residential measures that passed cost-effectiveness screening for this higher impact sensitivity case. This table is comparable to Table 4-2 shown above for the Base Case 1 analysis. The key measures contributing to savings potential in Base Case 2 are CFLs, refrigerator recycling, variable-speed furnace-AC fans, duct sealing, and new construction cooling measures. The CFL and refrigerator measures show higher potentials in Base Case 2 versus Base Case 1 due to removal of the incentive cap restriction, while the duct sealing and new construction cooling measures show higher potentials in Base Case 2 due to the inclusion of natural gas benefits in the analysis.

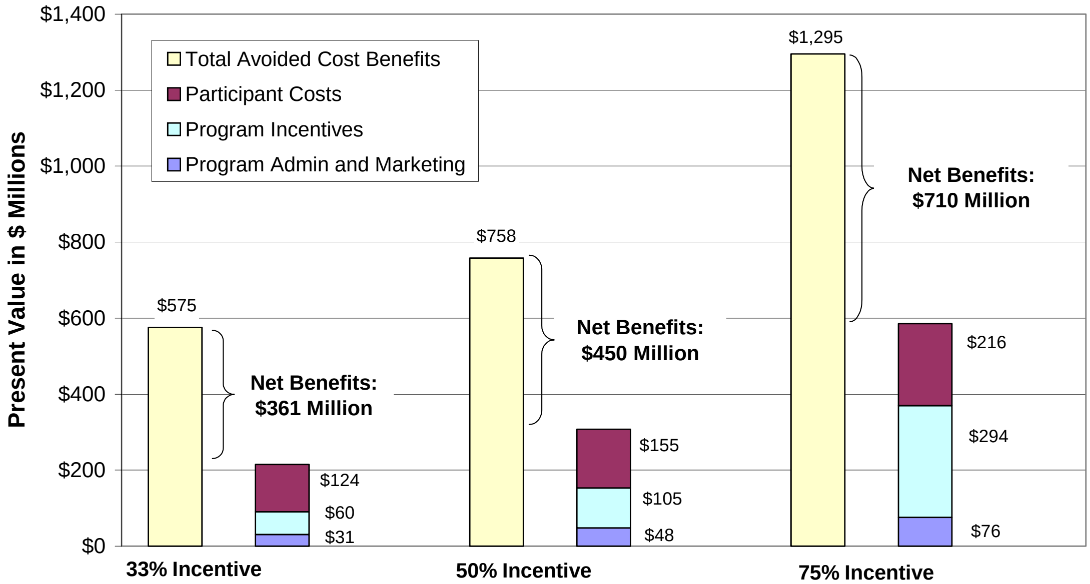
Table 4-9
Measure Specific Residential Results (Cumulative to 2013), Base Case 2

Measure	Energy - GWh Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent	Peak Demand - MW Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent
CFL - 15w	461.2	461.2	31.5	60.9	127.2	46.1	46.1	3.2	6.1	12.7
Refrigerator Recycling	283.7	283.7	3.0	9.2	63.1	35.5	35.5	0.4	1.2	7.9
Variable Speed Furnace-AC Fan	250.9	250.9	3.7	7.7	21.1	116.4	116.4	1.7	3.6	9.8
Default Window With Sunscreen	200.2	200.2	0.6	1.9	15.6	266.3	266.3	0.8	2.5	20.8
Evaporative Cooler	143.6	143.6	0.2	0.7	6.7	206.9	206.9	0.3	1.0	9.6
Duct Sealing - from 40% AHU to 12%	64.5	64.5	1.0	3.2	22.4	92.9	92.9	1.5	4.7	32.2
CFL Torchiere - 55w	53.6	53.6	0.3	0.9	5.5	5.4	5.4	0.0	0.1	0.6
ROB 2L4'T8, 1EB	43.6	43.6	0.6	1.2	3.0	4.4	4.4	0.1	0.1	0.3
Energy Star CW (MEF=1.42)	37.3	37.3	1.0	1.9	4.8	5.2	5.2	0.1	0.3	0.7
New Const Cooling Package w/ Downsizing	31.3	31.3	1.4	4.0	15.4	45.0	45.0	2.1	5.8	22.2
Window Film	29.8	29.8	0.1	0.2	1.7	36.1	36.1	0.1	0.2	2.1
Typical Refrigerant Charge Adjustment	29.4	29.4	0.1	0.2	1.6	42.4	42.4	0.1	0.2	2.2
New Constr Cooling Package	26.9	26.9	0.6	1.7	9.6	38.7	38.7	0.9	2.5	13.9
Infiltration Reduction, Heating	21.3	14.4	1.4	3.5	10.5	0.0	0.0	0.0	0.0	0.0
High Refrigerant Charge Adjustment	18.1	18.1	0.3	1.0	6.2	26.1	26.1	0.5	1.4	9.0
Wall Blow-in R-0 to R-13 Insulation - Heating	15.4	5.3	0.3	0.8	3.3	0.0	0.0	0.0	0.0	0.0
Ceiling R-0 to R-38 Insulation - Heating	15.3	15.3	4.0	6.9	10.8	0.0	0.0	0.0	0.0	0.0
Evaporative Cooler	13.0	13.0	0.1	0.3	2.3	18.8	18.8	0.1	0.4	3.4
Default Window With Sunscreen	11.5	5.7	0.0	0.0	0.2	15.2	7.6	0.0	0.0	0.3
Pipe Wrap	5.9	5.9	0.5	1.2	4.0	0.5	0.5	0.0	0.1	0.3
Ceiling R-0 to R-38 Insulation - Cooling	5.4	5.4	0.6	1.2	3.2	6.2	6.2	0.7	1.4	3.7
Low Flow Showerhead	4.5	4.5	0.4	1.0	3.4	0.4	0.4	0.0	0.1	0.3
Duct Insulation	3.2	3.2	0.0	0.1	0.4	4.6	4.6	0.0	0.1	0.6
Faucet Aerators	2.8	2.8	0.2	0.4	1.8	0.2	0.2	0.0	0.0	0.1
Window Film	1.9	1.2	0.0	0.0	0.0	2.3	1.5	0.0	0.0	0.0
Ceiling R-11 to R-38 Insulation - Cooling	1.4	0.1	0.0	0.0	0.0	1.6	0.1	0.0	0.0	0.0
Ceiling R-19 to R-38 Insulation - Cooling	1.0	0.4	0.0	0.0	0.1	1.1	0.5	0.0	0.0	0.1
Ceiling R-0 to R-38 Insulation - Cooling	0.8	0.8	0.1	0.2	0.5	0.9	0.9	0.1	0.3	0.6
Ceiling R-11 to R-38 Insulation - Cooling	0.3	0.3	0.0	0.0	0.1	0.4	0.4	0.0	0.0	0.1

Note: Measures are sorted by descending technical energy savings potential.

Figure 4-49 and Table 4-10 provide an overall summary of the Base Case 2 analysis. These exhibits are comparable to Base Case 1 Figure 4-16 and Base Case 1 Table 4-1.

Figure 4-49
Benefits and Costs of Energy Efficiency Savings—2006–2013*, Base Case 2



* Present value of benefits and costs over normalized 20-year measure lives; nominal discount rate is 7.4 percent, inflation rate is 2.4 percent.

Table 4-10
Summary of Achievable Potential Results—2006–2013, Base Case 2

Result	Program Scenario		
	33% Incentive	50% Incentive	75% Incentive
Gross Energy Savings - GWh	674	983	1,879
Gross Peak Demand Savings - MW	215	273	500
Net Energy Savings - GWh	418	727	1,623
Net Peak Demand Savings - MW	177	236	462
Program Costs - Real, $ million			
Administration	$14	$27	$50
Marketing	$30	$37	$45
Incentives	$86	$142	$372
Total	$130	$206	$467
PV Avoided Costs ($ mil.)	$575	$758	$1,295
PV Annual Program Costs ($ mil.)	$90	$153	$370
PV Participant Costs ($ mil.)	$124	$155	$216
TRC Ratio	2.6	2.4	2.1

PV (present value) of benefits and costs is calculated over a 20-year normalized measure life for 2005–2014 program years, nominal discount rate = 7.4 percent, inflation rate = 2.4 percent; GWh and MW savings are cumulative through 2013.