Submitted To:

System Wide Electric Energy Efficiency Potential Study – Volume I

Submitted By:

MARCH 12, 2010

Contents

Volume I

SECTION 1 EXECUTIVE SUMMARY 1-1

1.1 OVERVIEW 1-1
1.2 CALCULATION METHODOLOGY 1-2
1.3 TRI-STATE BASELINE 1-3
1.4 RESULTS 1-4
1.4.1 Energy Efficiency Potential Assessment 1-4
1.4.2 Economics 1-11
1.4.3 Savings Potential by Region and End-Use 1-12
1.5 DSM PROGRAM RECOMMENDATIONS 1-14
1.5.1 Short Term Portfolio Strategy Recommendations 1-15
1.5.2 Longer-Term Portfolio Strategy Recommendations 1-17

SECTION 2 METHODOLOGY 2-1

2.1 OVERVIEW OF METHODOLOGY 2-1
2.2 LOAD PROFILE ANALYSIS 2-2
2.2.1 Conduct Primary Market Research 2-2
2.2.2 Conduct Secondary Research 2-3
2.2.3 Data Analysis and Calibration 2-4
2.3 ENERGY EFFICIENCY POTENTIAL ASSESSMENT 2-4
2.3.1 Measure Development 2-4
2.3.2 Energy Efficiency Potential Assessment Modeling 2-5
2.3.2.1 Develop Baseline Forecast 2-5
2.4 MARKET PENETRATION RATES 2-8
2.5 SEGMENTATION OF REGIONAL TERRITORIES 2-9

SECTION 3 END-USE AND LOAD PROFILE STUDY 3-1

3.1 OVERVIEW 3-1
3.2 RESIDENTIAL END-USE AND LOAD PROFILES 3-3
3.2.1 End – Use Saturations 3-4
3.2.2 Results by End-Use 3-5
3.3 COMMERCIAL END-USE AND LOAD PROFILES 3-7
3.3.1 Results by Sub-Sector 3-7
3.3.2 Results by End-Use 3-9
3.4 INDUSTRIAL END-USE AND LOAD PROFILES 3-11
3.4.1 Results by Sub-Sector 3-11
3.4.2 Results by End-Use 3-13
3.5 IRRIGATION END-USE AND LOAD PROFILES 3-14
3.5.1 Energy Consumption 3-15
3.6 OTHER KEY FINDINGS FROM MEMBER INTERVIEWS 3-17
3.6.1 Measure Baseline Information 3-17
3.6.2 Market Penetration Rates (Current) 3-17
3.6.3 Market Penetration Rates (Forecasted) 3-17

SECTION 4 RESIDENTIAL POTENTIAL 4-1

4.1 OVERVIEW 4-1
4.2 RESIDENTIAL POTENTIAL MODELING 4-1
4.2.1 Measure Overview 4-1

4.2.2 Market Inputs ... 4-2
4.2.3 Measure Screening Results ... 4-3
4.3 RESIDENTIAL POTENTIAL RESULTS ... 4-4
4.3.1 Savings Potential Overview ... 4-5
4.3.2 Savings Potential by Region and End-Use ... 4-8
4.4 CONCLUSIONS AND RECOMMENDATIONS ... 4-15

SECTION 5 COMMERCIAL POTENTIAL ... 5-1

5.1 OVERVIEW ... 5-1
5.2 COMMERCIAL POTENTIAL MODELING ... 5-1
5.2.1 Measure Overview ... 5-1
5.2.2 Market Inputs ... 5-2
5.2.3 Measure Screening Results ... 5-3
5.3 COMMERCIAL POTENTIAL RESULTS ... 5-5
5.3.1 Savings Potential Overview ... 5-5
5.3.2 Savings Potential by Region and End-Use ... 5-8
5.4 CONCLUSIONS AND RECOMMENDATIONS ... 5-14

SECTION 6 INDUSTRIAL POTENTIAL ... 6-1

6.1 OVERVIEW ... 6-1
6.2 INDUSTRIAL POTENTIAL MODELING ... 6-1
6.2.1 Calculation Overview ... 6-1
6.2.2 Market Inputs ... 6-2
6.2.3 Measure Screening Results ... 6-2
6.3 INDUSTRIAL POTENTIAL RESULTS ... 6-3
6.3.1 Savings Potential Overview ... 6-3
6.3.2 Savings Potential by Region and End-Use ... 6-6
6.4 CONCLUSIONS AND RECOMMENDATIONS ... 6-9

SECTION 7 IRRIGATION POTENTIAL ... 7-1

7.1 OVERVIEW ... 7-1
7.2 IRRIGATION POTENTIAL MODELING ... 7-1
7.2.1 Measure Overview ... 7-1
7.2.2 Market Inputs ... 7-1
7.2.3 Measure Screening Results ... 7-3
7.3 IRRIGATION POTENTIAL RESULTS ... 7-3
7.3.1 Technical, Economic, Achievable, and Program Potential ... 7-3
7.3.2 Savings Potential by Region and End-Use ... 7-7

SECTION 8 SUPPLY CURVE ANALYSIS ... 8-1

8.1 OVERVIEW ... 8-1
8.2 ECONOMIC SCENARIOS AND INPUTS ... 8-1
8.3 RESULTS ... 8-1
8.3.1 Residential Potential ... 8-2
8.3.2 Commercial Potential ... 8-4
8.3.3 Industrial Potential ... 8-5
8.3.4 Irrigation Potential ... 8-6
8.4 RECOMMENDATIONS ... 8-6

SECTION 9 DEMAND RESPONSE ... 9-1

9.1 SUMMARY OF DEMAND RESPONSE POTENTIAL ... 9-1

9.2 DEMAND RESPONSE POTENTIAL MODEL 9-1
9.3 RESOURCE POTENTIAL 9-3
9.3.1 Summary 9-3
9.3.2 Residential DLC 9-5
9.3.3 Irrigation Load Reduction 9-6
9.3.4 Callable Tariff 9-7
9.3.5 Demand Bidding 9-7
9.3.6 Aggregators 9-8

SECTION 10 DSM PROGRAM IMPLEMENTATION RECOMMENDATIONS 10-1

10.1 INTRODUCTION AND BACKGROUND 10-1
10.1.1 New Market Risks and Opportunities 10-2
10.2 PORTFOLIO SUMMARY 10-3
10.2.1 Portfolio Strategy Recommendations 10-4
10.2.2 Sector Level Program Recommendations 10-6

Tables and Figures

Tables

Table 1.1 Tri-State 2008 Electricity Sales by Sector and Region 1-4
Table 1.2 Summary of Achievable Potential Savings and Percent of Forecasted Sales 1-5
Table 1.3 System Wide DSM Economics, 2015 1-11
Table 2.1 Tri-State Cooperative Regional Groups 2-9
Table 3.1 Tri-State 2008 Electricity Sales by Sector and Region 3-3
Table 3.2 Tri-State End-Use Saturations per Region 3-4
Table 3.3 Commercial Energy Consumption by Sub-Sector and Region 3-8
Table 3.4 Industrial Sub-Sectors by Region 3-13
Table 3.5 Annual Irrigation Operating Hours and Lift 3-17
Table 4.1 Summary of Potential Savings and Percent of Forecasted Sales 4-5
Table 4.2 Residential DSM Economics, 2015 4-8
Table 4.3 Regional Energy Savings by Measure Category, Moderate Scenario, 2015 4-13
Table 4.4 Residential DSM Economics by Region, Moderate Scenario, 2015 4-14
Table 4.5 Levelized Cost by Measure Category[1] 4-15
Table 5.1 Summary of Potential Savings and Percent of Forecasted Sales 5-6
Table 5.2 Commercial DSM Economics, 2015 5-8
Table 5.3 Regional Energy Savings by Measure Category, Moderate Scenario, 2015 5-12
Table 5.4 Commercial DSM Economics by Region, Moderate Scenario, 2015 5-13
Table 5.5 Cost Effectiveness by Measure Category, Moderate Scenario 5-13
Table 6.1 Industrial Savings Percentages by End-Use 6-3
Table 6.2 Summary of Potential Savings and Percent of Forecasted Sales 6-4
Table 6.3 Industrial DSM Economics, 2015 6-6
Table 6.4 Industrial DSM Economics by Region, Moderate Scenario, 2015 6-8
Table 6.5 Cost Effectiveness by End-Use, Moderate Scenario 6-9
Table 7.1 Irrigation Measure Baseline for Worn or Leaking Equipment 7-1
Table 7.2 Summary of Potential Savings and Percent of Forecasted Sales 7-4
Table 7.3 Irrigation DSM Economics, 2015 7-6
Table 7.4 Irrigation DSM Economics by Region, Moderate Scenario, 2015 7-8
Table 8.1 Summary of Residential Potential and Percent of Forecasted Sales, 2015 8-3
Table 8.2 Summary of Commercial Potential and Percent of Forecasted Sales, 2015 8-4
Table 8.3 Summary of Industrial Potential and Percent of Forecasted Sales, 2015 8-5
Table 8.4 Summary of Irrigation Potential and Percent of Forecasted Sales, 2015 8-6
Table 9.1 Technical and Market Potential (MW in 2020) 9-3
Table 9.2 Program Cost Assumptions 9-3
Table 9.3 Levelized Costs and Market Potential (MW in 2020) 9-4

Figures

Figure 1.1 Tri-State 2008 Electricity Sales by Sector 1-3
Figure 1.2 Potential Annual Energy Savings 1-6
Figure 1.3 Potential Annual Energy Savings as a Percentage of Annual Sales 1-6

Figure 1.4 Sales Forecast with Cumulative DSM Potential Removed 1-7
Figure 1.5 2015 Potential Annual Energy Savings per Sector 1-8
Figure 1.6 Potential Annual Energy Savings per Sector 1-8
Figure 1.7 Potential Annual Demand Savings 1-9
Figure 1.8 Forecasted Potential Peak Impacts from DSM Programs 1-10
Figure 1.9 2015 Peak Impacts from DSM Programs 1-11
Figure 1.10 2015 Regional Energy Savings Shares 1-12
Figure 1.11 2015 Potential Energy Saving Shares by End-Use 1-13
Figure 1.12 Potential Energy Savings by End-Use and Sector 1-14
Figure 2.1 DSM Potential Calculation Process 2-1
Figure 2.2 Energy Efficiency Measure Application Process 2-10
Figure 3.1 Tri-State 2008 Electricity Sales by Sector 3-2
Figure 3.2 Tri-State 2008 Electricity Sales by Region 3-3
Figure 3.3 Residential Sector Energy Consumption per End-Use 3-6
Figure 3.4 Average Residential Energy Consumption by End-Use and Region 3-7
Figure 3.5 Commercial Energy Consumption by Sub-Sector 3-8
Figure 3.6 Commercial Energy Consumption by End-Use 3-10
Figure 3.7 Commercial Energy Consumption by Sub-sector and End-Use 3-11
Figure 3.8 Industrial Energy Consumption by Sub-Sector 3-12
Figure 3.9 Industrial Energy Consumption by End-Use 3-13
Figure 3.10 Irrigation Sales by Region 3-14
Figure 4.1 Residential Annual Energy Savings 4-6
Figure 4.2 Residential Annual Demand Savings 4-6
Figure 4.3 Residential Sales Forecast with Cumulative DSM Potential Removed 4-7
Figure 4.4 Energy Savings by Regional Grouping, 2015 4-9
Figure 4.5 Energy Savings by Primary End-Use, 2015 4-10
Figure 4.6 Energy Savings by Primary End-Use, 2020 4-10
Figure 4.7 Heating Energy Savings, 2015 4-11
Figure 4.8 Cooling Energy Savings, 2015 4-11
Figure 4.9 Lighting Energy Savings, 2015 4-12
Figure 4.10 Appliance Energy Savings, 2015 4-12
Figure 5.1 Commercial Annual Energy Savings 5-6
Figure 5.2 Commercial Annual Demand Savings 5-7
Figure 5.3 Commercial Sales Forecast with Cumulative DSM Potential Removed 5-7
Figure 5.4 Energy Savings by Regional Grouping, 2015 5-9
Figure 5.5 Energy Savings by Primary End-Use, 2015 5-10
Figure 5.6 Lighting Energy Savings, 2015 5-11
Figure 5.7 Cooling Energy Savings, 2015 5-11
Figure 5.8 Plug Load Energy Savings, 2015 5-11
Figure 6.1 Industrial Annual Energy Savings 6-4
Figure 6.2 Industrial Annual Demand Savings 6-5
Figure 6.3 Industrial Sales Forecast with Cumulative DSM Potential Removed 6-5
Figure 6.4 Energy Savings by Regional Grouping, 2015 6-7
Figure 6.5 Energy Savings by Primary End-Use, 2015 6-8
Figure 7.1 Irrigation Annual Energy Savings 7-5

Figure 7.2 Irrigation Annual Demand Savings 7-5
Figure 7.3 Irrigation Sales Forecast with Cumulative DSM Potential Removed 7-6
Figure 7.4 Energy Savings by Regional Grouping, 2015 7-7
Figure 8.1 Overall Supply Curve, Moderate Scenario 8-2
Figure 9.1 Tri-State Demand Response Supply Curve 9-5

1.1 OVERVIEW

Tri-State Generation and Transmission Association Inc. (Tri-State) has retained Nexant, Inc (Nexant) and their subcontractor The Cadmus Group (Cadmus), to identify and characterize cost-effective electric energy efficiency measures throughout Tri-State's system wide electric supply territory and to quantify the amount of electric energy savings achievable through energy efficiency programs. The goals of this study are:

- Establish attainable fifteen (15) year energy savings goals through comparison of the costs and savings of energy-efficient measures relative to standard equipment and practices.
- Develop understanding of, and respect for, implementation barriers at both the distribution cooperative level and Tri-State generation and transmission level.
- Identify energy efficiency measures and funding levels that can provide actionable results by developing or expanding new programs appropriate to Tri-State's service territory.
- Provide recommendations for developing an approach for future delivery of energy efficiency and demand response to Tri-State's system.
- Quantify the potential energy efficiency resource for systems planning.

It is important for the reader of this document to understand that the values and figures presented are intended to provide target ranges of achievable energy efficiency savings for Tri-State and their member cooperatives. However, this study does not provide precise goals for energy efficiency savings, nor does it provide a specific road map on how to acquire these energy efficiency targets. These targets are intended to provide Tri-State an understanding of energy efficiency as a resource, add clarity to new program development priorities, and establish goals for current energy efficiency programs.

This study acknowledges the implementation barriers that Tri-State has with its member cooperatives and how this might ultimately reduce the achievable energy savings; however, it also anticipated that over time, some of these barriers will be overcome. Since Tri-State does not have holistic control over how these energy efficiency programs are presented and scheduled to the ultimate customer, the acquisition schedule of these energy efficiency resources will likely vary from those results presented in this study, thus adding to the uncertainty already implicit in an energy efficiency potential study. If more precise energy efficiency targets are desired, the Nexant team recommends a more detailed design for each unique efficiency program, including an understanding of how each cooperative may market and incent the program, assessment of in-house technical expertise, development of trade ally networks, and a market characteristic study.

1.2 CALCULATION METHODOLOGY

The Demand Side Management (DSM) resource for energy efficiency programs can be characterized by the technical potential, economic potential, and achievable potential. The technical potential describes the savings available if all baseline equipment stock was replaced with the most efficient applicable measure. The economic potential is a calculation of savings when all measures that are cost-effective are installed. Market penetration rates are then developed from market research and evaluation data gathered through the implementation of representative DSM programs. Applying these market penetration rates to the economic potential yields the calculation of achievable potential which represents the savings that Tri-State could expect to achieve from energy efficiency programs.

Nexant conducted the evaluation of energy efficiency potential using a bottom-up modeling approach following a general three (3) step process. The core steps employed to develop a model of Tri-State's end-use energy consumption and its potential DSM resource are described below.

- **Step 1: Characterize Tri-State consumption.** Nexant first created a baseline energy consumption model of each primary sector. Nexant interviewed a sampling of member cooperatives and utilized resources available through Tri-State, past projects, and other studies to define the sector energy consumption by sub-sectors and end-uses. Tri-State's system was divided into eight (8) geographical regions based on sector diversity and climate to provide a more thorough analytical approach.
- **Step 2: Define applicable measures.** The breakdown of energy consumption by end-use allowed Nexant to identify suitable measures for each sector. For each measure the savings, cost, and lifetime were assembled and used to evaluate the measure for cost-effectiveness. Measures that did not pass this screening were excluded from the calculation of the economic and achievable potential.
- **Step 3: Calculate Achievable Potential.** Selected measures were applied to the Tri-State baseline and the achievable potential was calculated through the application of market penetration rates. Nexant drew from its large breadth of experience in the field of DSM forecasting and program implementation to develop accurate and consistent market penetration rate curves.

The evaluation of Demand Response (DR) potential is calculated following similar steps, with a few notable variations. First, Tri-State's peak load is characterized according to member cooperative and not by sector or end use. Next, rather than evaluate the saving potential for measures, technical load impact rates for the DR program are estimated. Technical load impact is the percent reduction in load resulting from the program. Finally, to calculate achievable potential, program participation rates and event participation rates are applied to determine actual load reduction during a summer peak period.

1.3 TRI-STATE BASELINE

Tri-State Generation and Transmission is a wholesale electric provider owned by the forty-four rural electric cooperatives that it serves. Tri-State generates and transports electricity to its member systems throughout a 250,000 square-mile service territory in Colorado, Nebraska, New Mexico and Wyoming and serves more than 1.4 million consumers.

Tri-State's 2008 electricity sales to member cooperatives were found to be 14,061GWh. By summarizing the electrical cooperatives' reported monthly RUS Form 7 data, it was determined that electricity sales to end-use customer were 13,293GWh, with the resultant member cooperative losses accounting for approximately 5.5% difference in sales. Tri-State's annual profile has a distinct summer peak, with the 2008 peak occurring on August 1st at 5:00pm at 2,506 MW. However, Tri-State's daily load profile was found to be generally flat. This is generally attributed to large summer irrigation and high-load factor industries.

One early key finding in the member cooperative interviews was the scarcity of traditional commercial loads, since approximately 50% of the member cooperatives do not serve the city and town customers within their service territories. It was determined that municipal electric utilities are common for many rural towns with western Nebraska, eastern Colorado and most of Wyoming. Another early important finding was a notable large industrial sector predominately focused around the oil, gas and mining industries.

Figure 1.1 summarizes the final segmentation of end-use sectors.

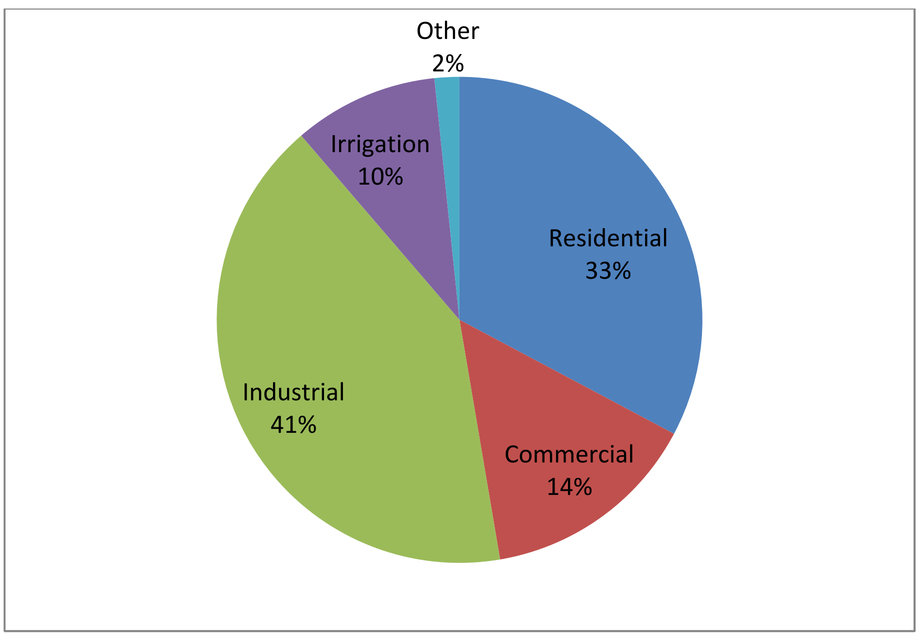

Figure 1.1 Tri-State 2008 Electricity Sales by Sector

It is notable in the 2008 electricity sales sectors the significant contribution of the industrial sector at 41%. For other electric utilities that serve metropolitan communities this fraction is usually closer to 20%. Conversely, the commercial sector fraction, at 14%, is lower than other electric utilities that serve metropolitan communities, which typically have a fraction closer to 40 to 50%. Electricity sales noted as "other" sector categories include, public street lighting, public authority, and electricity re-sales. Since these end-uses have energy efficiency, they are allocated into one of the other four applicable end-use sectors.

Table 1.1 provides further segregation of the 2008 electricity sector sales fraction for each regional territory.

Table 1.1 Tri-State 2008 Electricity Sales by Sector and Region

Sector	Eastern Colorado (ECO)	Wyoming (WY)	Southern New Mexico (SNM)	Northern New Mexico (NNM)	Nebraska (NE)	Western Colorado (WCO)	Mountain Colorado (MCO)	Front Range Colorado (FRCO)	Total
Residential	19.2%	23.4%	41.5%	27.7%	27.7%	32.7%	27.1%	46.5%	33%
Commercial	7.3%	3.4%	23.6%	14.8%	4.2%	18.6%	17.3%	18.7%	14%
Industrial	27.8%	64.0%	24.5%	52.8%	21.0%	44.4%	53.4%	30.8%	41%
Irrigation	43.8%	8.2%	10.2%	2.6%	46.1%	3.9%	0.1%	1.0%	10%
Other	1.8%	1.0%	0.3%	2.2%	0.9%	0.2%	2.2%	3.1%	2%
Total Energy (GWh)	**1,332**	**1,653**	**767**	**1,953**	**637**	**2,757**	**899**	**3,295**	**13,293**

The northern New Mexico, mountain Colorado and Wyoming regions were found to have significant industrial loads. Eastern Colorado and Nebraska have significant fractions of their overall electricity sales in the irrigation sector. Northern New Mexico and Front Range Colorado find most of their sales from the residential sector and both have the largest commercial sectors.

1.4 RESULTS

1.4.1 Energy Efficiency Potential Assessment

The following sections present Nexant's findings of technical, economic, and achievable savings potential, along with the associated economic outputs.

Savings Potential

Nexant first evaluated the overall technical potential savings. It was found that the theoretical technical potential in 2010 is expected to be 330 GWh, growing to annual savings of 376 GWh in 2015. These figures represent 2.4% and 2.5% of the total forecasted sales in each year respectively. Cumulative energy savings in 2015 could reach 2,125 GWh and account for 14.2% of the total forecasted electricity sales. Theoretical annual peak demand reductions are 71.2 MW in 2010 and 81.9 MW by 2015.

Measures that did not pass the Total Resource Cost (TRC) test were removed and the total savings were recalculated to determine economic potential. Total economic saving potential in 2010 is calculated as 238 GWh and grows to 271 GWh by 2015. These figures represent 1.7% and 1.8% of the total forecasted sales in each year respectively. Cumulative energy savings in

2015 could reach 1,525 GWh and account for 10.2% of the forecasted retail sales. Theoretical annual peak demand reductions are 45.5 MW in 2010 and grow to 51.7 MW by 2015.

Finally, Nexant evaluated the barriers to market acceptance of Tri-State's DSM programs and calculated the achievable savings potential. The theoretically achievable potential savings were calculated using four different levels of marketing and incentives. Table 1.2 summarizes the savings potential for each scenario.

Table 1.2 Summary of Achievable Potential Savings and Percent of Forecasted Sales

Load Type	Ach. – Low		Ach. – Moderate		Ach. – Aggressive		Ach. – Maximum	
Energy Savings (GWh)								
2010	29.1	0.2%	34.6	0.3%	47.7	0.4%	49.5	0.4%
2015	94.7	0.6%	114.5	0.8%	155.8	1.0%	168.7	1.1%
Cumulative, 2015	398	2.7%	481	3.2%	582	3.9%	707	4.7%
Cumulative, 2025	1,312	7.3%	1,606	8.9%	1,969	10.9%	2,412	13.4%
Demand Savings (MW)								
2010	5.5	0.2%	6.6	0.2%	7.8	0.3%	9.4	0.3%
2015	18.2	0.6%	22.0	0.7%	26.7	0.9%	32.4	1.0%
Cumulative, 2015	81.9	2.6%	92.3	3.0%	111.8	3.6 %	135.6	4.3%
Cumulative, 2025	267.0	7.2%	309.5	8.3%	379.0	10.2%	464.2	12.5%

Tri-State's annual forecast and the methodology described in Section 2 were used to calculate the savings potential through 2025. The annual energy savings as a calculated value and as a percentage of forecasted overall electricity sales for each potential scenario are shown in Figure 1.2 and Figure 1.3 respectively.

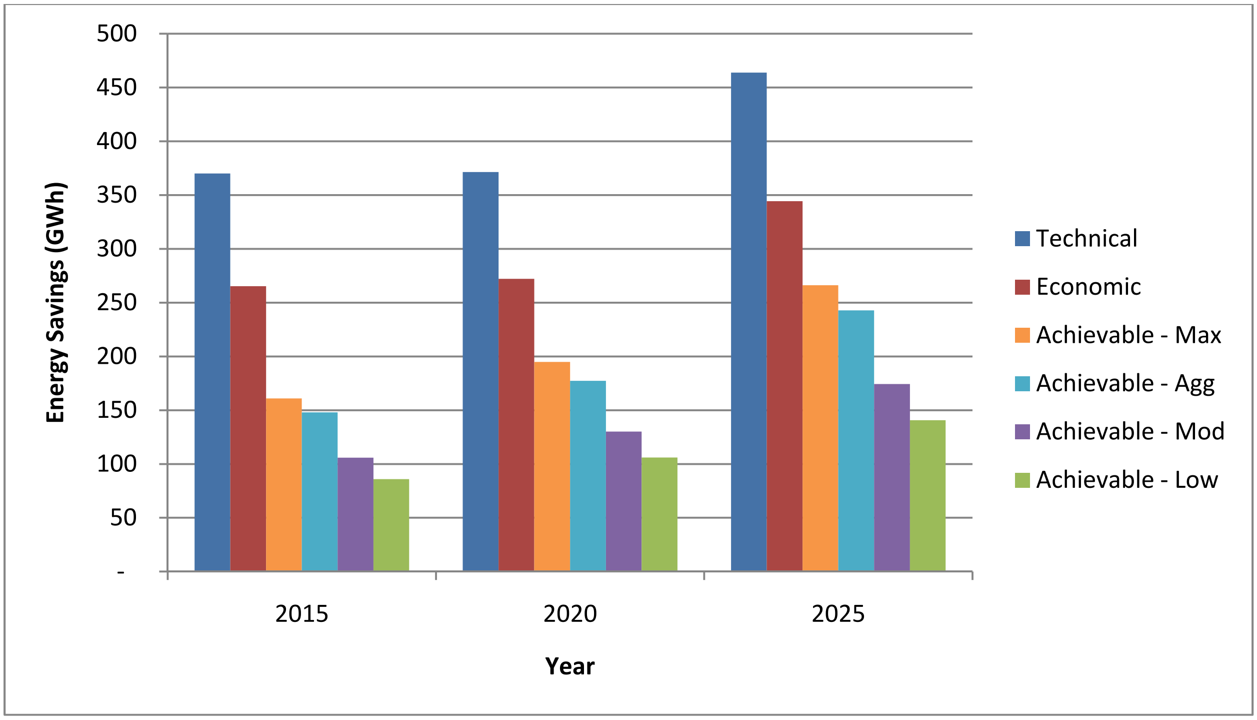

Figure 1.2 Potential Annual Energy Savings

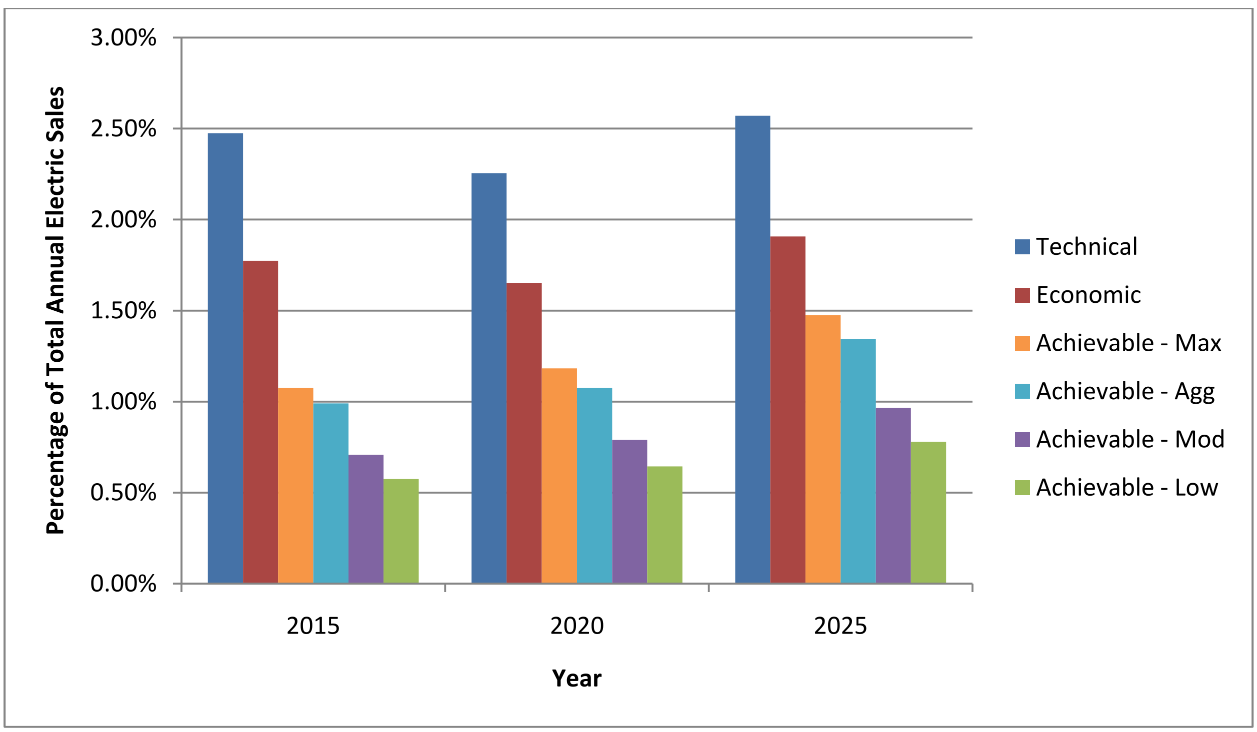

Figure 1.3 Potential Annual Energy Savings as a Percentage of Annual Sales

As shown in the figures above, the theoretically achievable savings ramp up quickly as Tri-State develops and launches new programs. The DSM programs reach maturity in roughly five years at which point savings growth is anticipated to proceed at a slower rate. In the year 2025, the achievable maximum evaluation level, where 100% of the incremental cost of the energy efficiency measure is incented, is 74.5% of the economic potential.

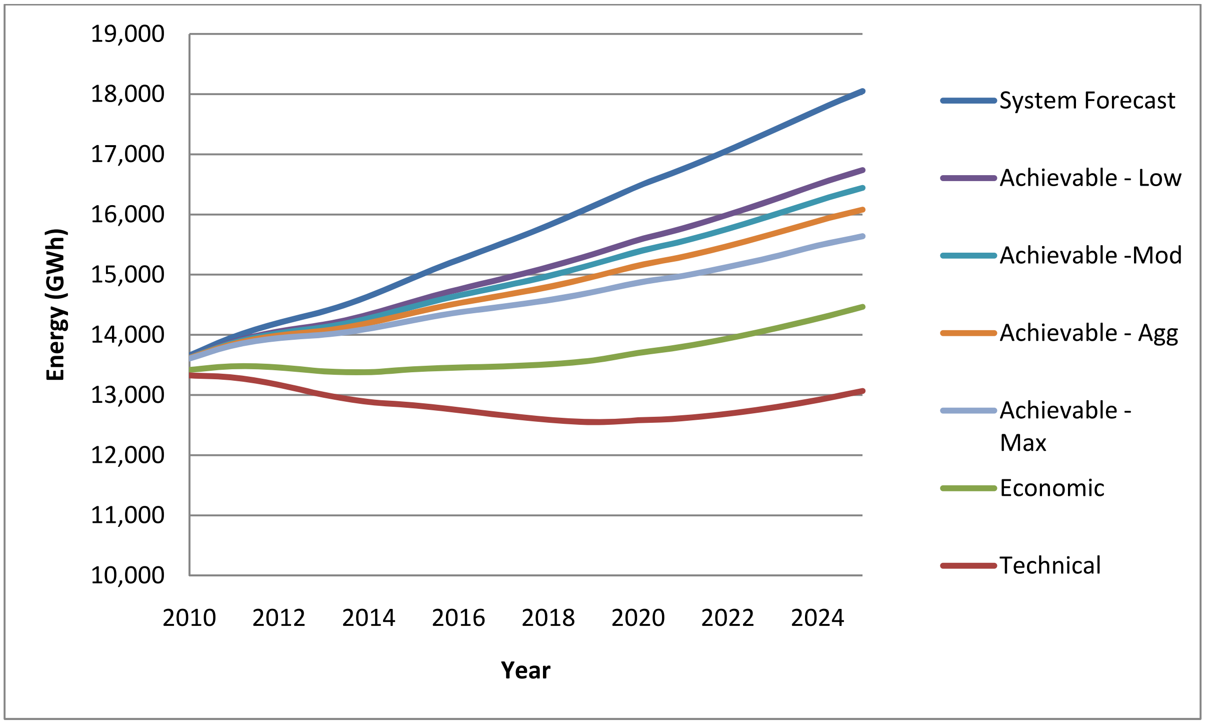

Figure 1.4 Sales Forecast with Cumulative DSM Potential Removed

Figure 1.4, above, shows the baseline sales forecast, along with the same forecast with cumulative DSM potential removed. It should be noted that the cumulative energy savings are defined as the total savings available to Tri-State in any given year due to the previous years' DSM expenditures. The energy efficiency measures installed each year will provide Tri-State with energy savings for the entire life of the measure. However, when the measure life has expired, the energy savings are no longer counted toward the cumulative savings. For this reason, cumulative energy savings in 2025 is not equal to the sum of the annual energy savings from all previous years.

Annual energy savings are shown in Figure 1.5 segmented on a sector basis in 2015 and forecasts through 2025 in Figure 1.6.

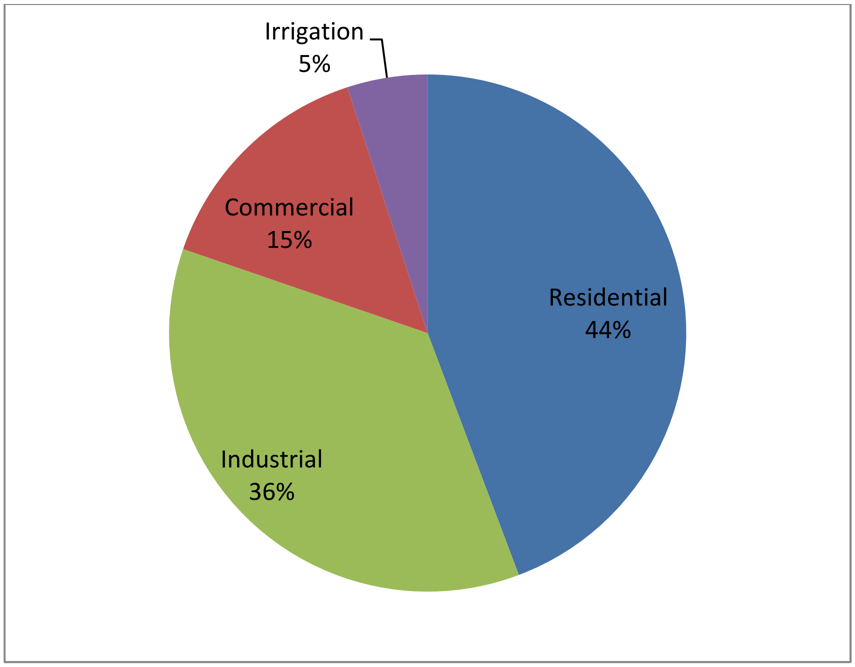

Figure 1.5 2015 Potential Annual Energy Savings per Sector

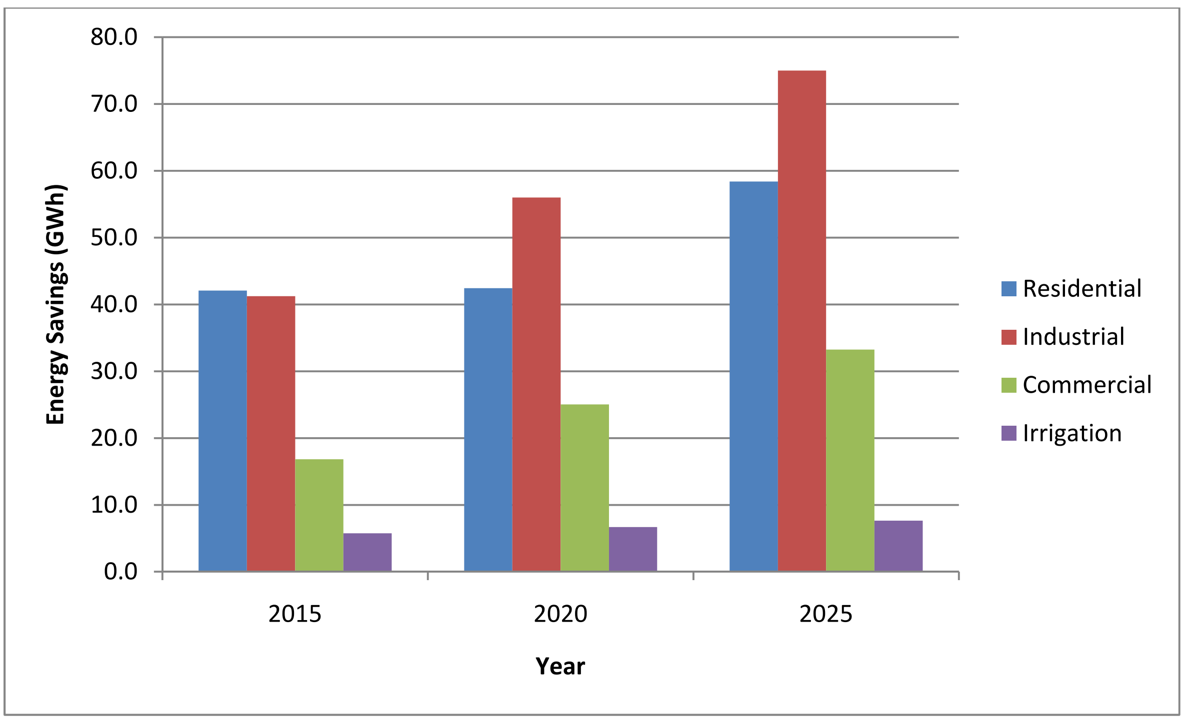

Figure 1.6 Potential Annual Energy Savings per Sector

Peak Impacts

Avoided system peak impacts for the energy efficiency measures are also evaluated. The annual demand savings for each potential scenario are shown in Figure 1.7.

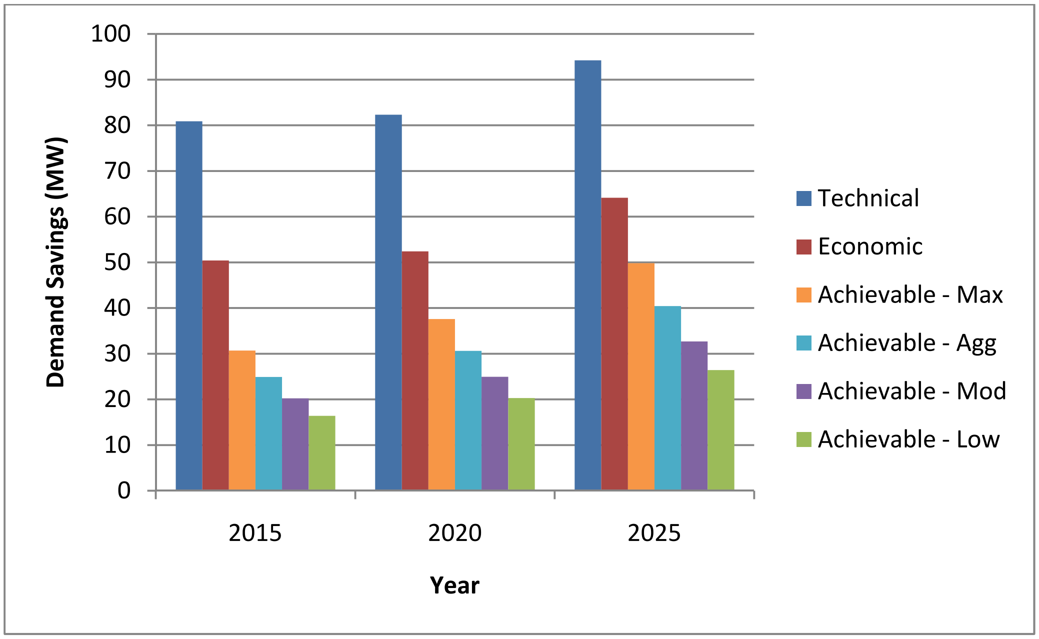

Figure 1.7 Potential Annual Demand Savings

In order to evaluate a complete portfolio of DSM programs, demand response peak reduction potential was identified. Demand response programs are designed to help reduce peak demand during system emergencies or times of extreme market prices, promote improved system reliability, and, in some cases, may lead to the deferment of investments in delivery and generation infrastructure. The programs evaluated include:

1. *Residential Direct Load Control* (DLC) programs allow the local utility to remotely turn off or cycle certain residential end-uses such as central air conditioning and electric water heating.
2. *Irrigation Load Reduction* programs typically follow one of two designs. The more traditional scheduled program allows farmers to choose the days of the week during which their pumps will be shut off. The direct load control option allows the local utility to turn off pumps during system events.
3. *Callable Tariff* programs provide the customer with a fixed monthly incentive in return for reducing load by a contractually set amount when requested by the local utility. As opposed to a DLC program, in this case the customer is responsible for turning off the load, generally with penalties for non-compliance or the option to buy their way through an event.
4. *Demand Bidding* programs are similar to callable tariff programs, except that customers are not contractually obligated to participate. Incentives are paid on an event-by-event basis based on market prices published ahead of time by the local utility and the amount of load reduced.

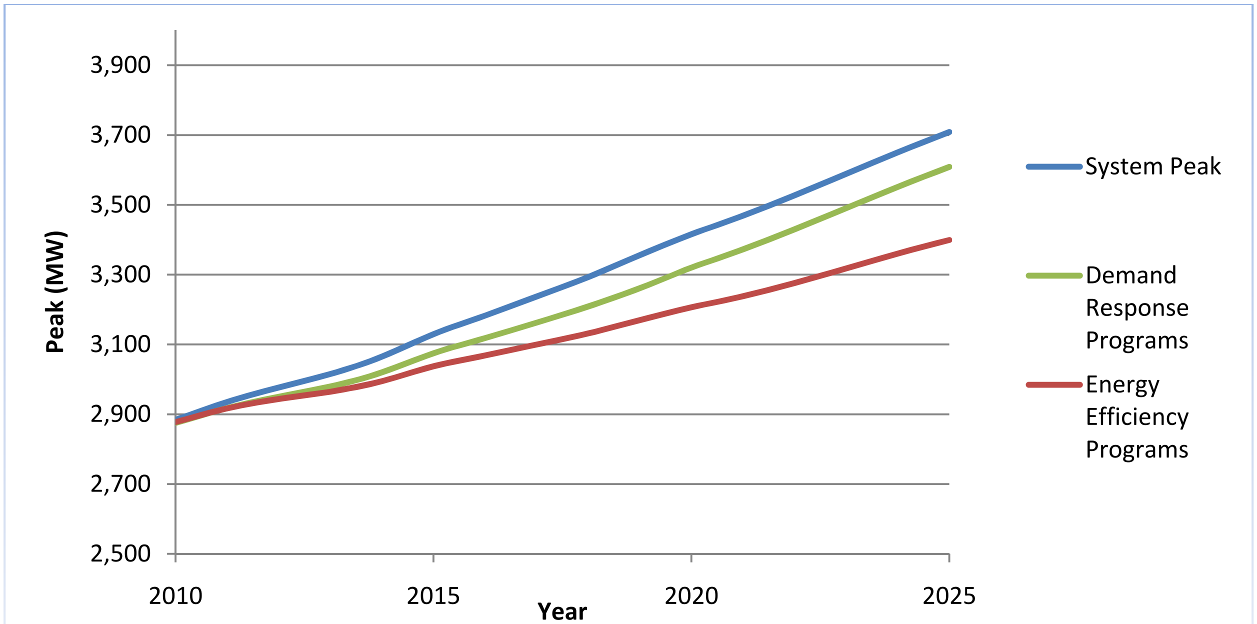

Figure 1.8 Forecasted Potential Peak Impacts from DSM Programs

Figure 1.8 indicates the forecasted Tri-State system peak with potential peak impacts from DSM programs removed, including energy efficiency and demand response programs. The energy efficiency peak impacts are significantly larger than those due to demand response because installed efficiency measures provide peak reductions for many years after their installation, while demand response impacts must be initiated each year, and are therefore not added cumulatively. It also should be noted that the impacts from each program are not combined and the potential peak impacts from both programs are not additive. Since it is probable that some customers would participate in both programs, the impacts from the demand response programs would be reduced due to more efficient equipment than assumed in these projections. Figure 1.9 shows the gross impacts of each DSM program in 2015.

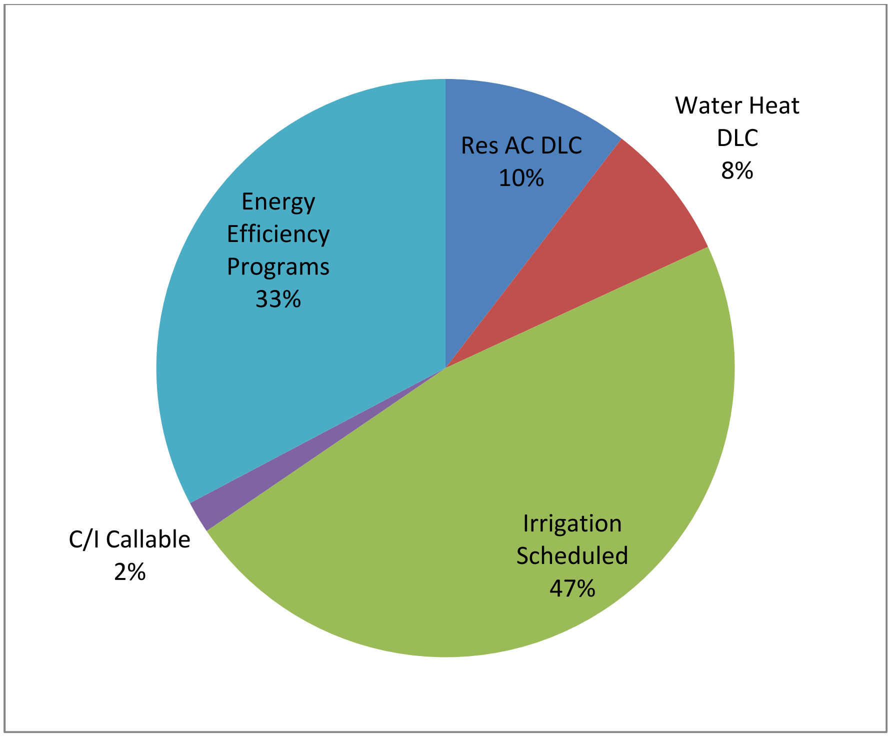

Figure 1.9 2015 Peak Impacts from DSM Programs

1.4.2 Economics

Nexant calculated the expected costs and benefits for each regional group and measure category. The anticipated economics for each incentive level have been aggregated and are presented for 2015 in Table 1.3.

Table 1.3 System Wide DSM Economics, 2015

Metric	Ach. – Low	Ach. – Mod	Ach. – Agg	Ach. – Max
Customer Costs[1]	$21.46	$25.93	$31.46	$38.21
Incentives[1]	$7.67	$16.62	$28.64	$44.08
Admin Costs[1]	$14.95	$16.29	$18.80	$21.80
Avoided Costs[1]	$78.67	$95.28	$115.71	$140.80
Levelized Utility Cost ($/kWh)[2]	$0.041	$0.050	$0.059	$0.067
TRC B/C Ratio	2.2	2.3	2.3	2.3

[1] Millions of dollars

[2] Levelized cost is calculated over the entire life of the program (2010-2025)

It is critical to point out that the incentives paid and administrative costs noted in the above tables are borne by both Tri-State Generation and Transmission and the member cooperative. Segmentation of these costs will need to be discussed between Tri-State and each member cooperative as each relationship will be unique. <u>Economic tables listed in this report hereafter will always aggregate incentives paid and administration costs in this fashion.</u>

1.4.3 Savings Potential by Region and End-Use

To provide increased resolution, Nexant's models were built to calculate savings potential on a regional and end-use level. The following sections show the various outputs for each regional grouping and by end use.

Savings Potential by Region

Figure 1.10 shows the distribution of 2015 energy savings by regional grouping for a moderate incentive scenario. The share of energy savings by region does not vary significantly for the different achievable scenarios.

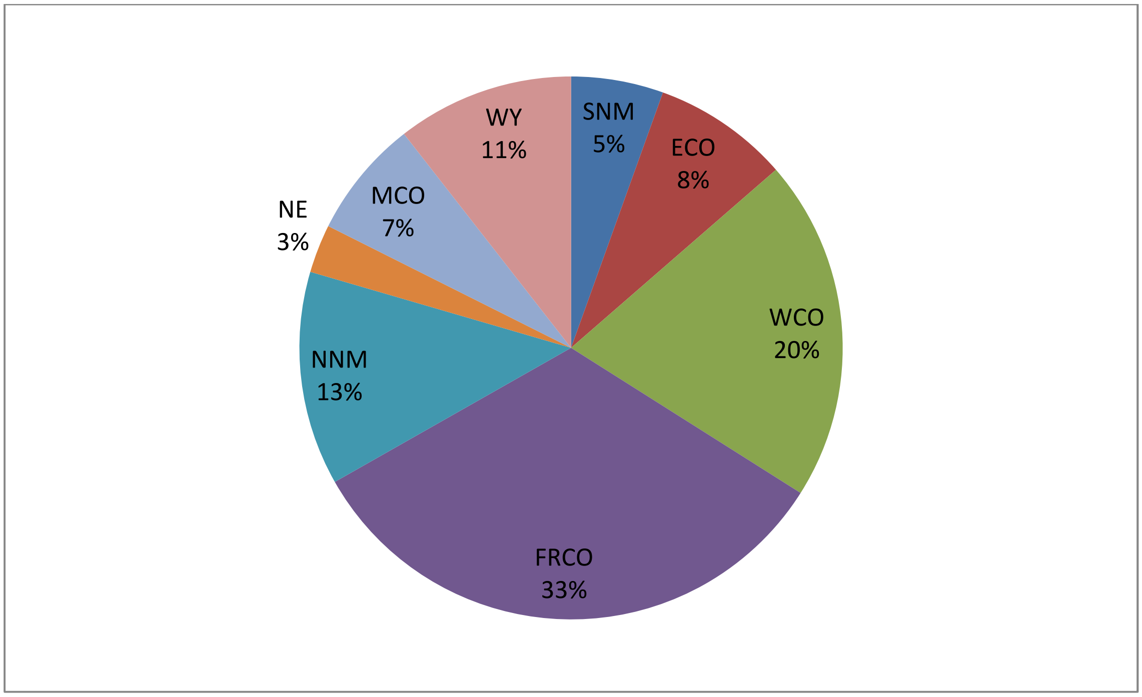

Figure 1.10 2015 Regional Energy Savings Shares

Many inputs influence the regional shares of energy savings such as varying market penetration rates, differences in energy consumption, and climate, however, the greatest determining factor is baseline energy usage. Not surprisingly, the greatest amount of savings can be achieved in the areas with the largest energy usage. The shares of energy savings track very closely to the shares of baseline energy usage.

Savings Potential by End-Use

The total energy savings were aggregated by end-use across all of the sectors. Figure 1.11 shows the share of energy savings attributable to each end-use for a moderate incentive scenario in 2015. These shares do not change significantly with time or varying incentive scenarios.

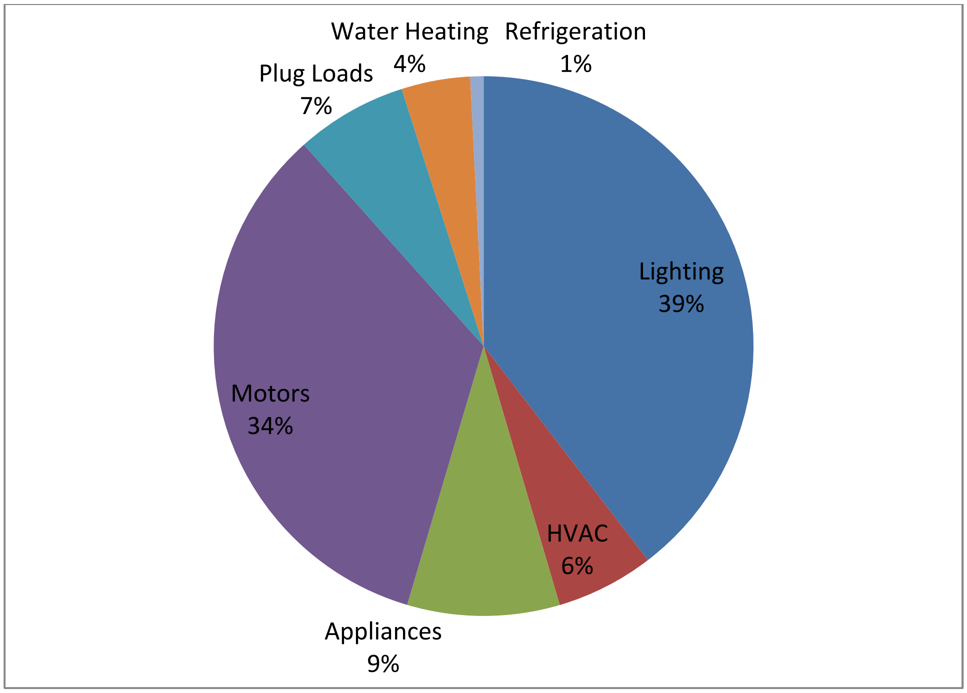

Figure 1.11 2015 Potential Energy Saving Shares by End-Use

Lighting constitutes the largest portion of energy savings potential followed by energy savings in motors. This is due to a number of factors. First, lighting constitutes the second largest share of baseline energy consumption, leading to a large potential for savings. Next, lighting measures can achieve significant savings percentages, ranging up to 75% for various combinations of equipment and controls. Finally, the market acceptance and implementation rates for lighting measures are generally higher than other measures due to their ease of installation and relative low costs.

Motors are responsible for the next largest portion of energy savings in large part due to the fact that they are the largest end-use. Appliances and plug loads are responsible for the next largest portion of energy savings. Both of these categories have large selections of cost-effective measures. Finally, HVAC and water heating provide 5% and 4% of annual savings, respectively, limited mainly by their energy usage share and lower market acceptance rates.

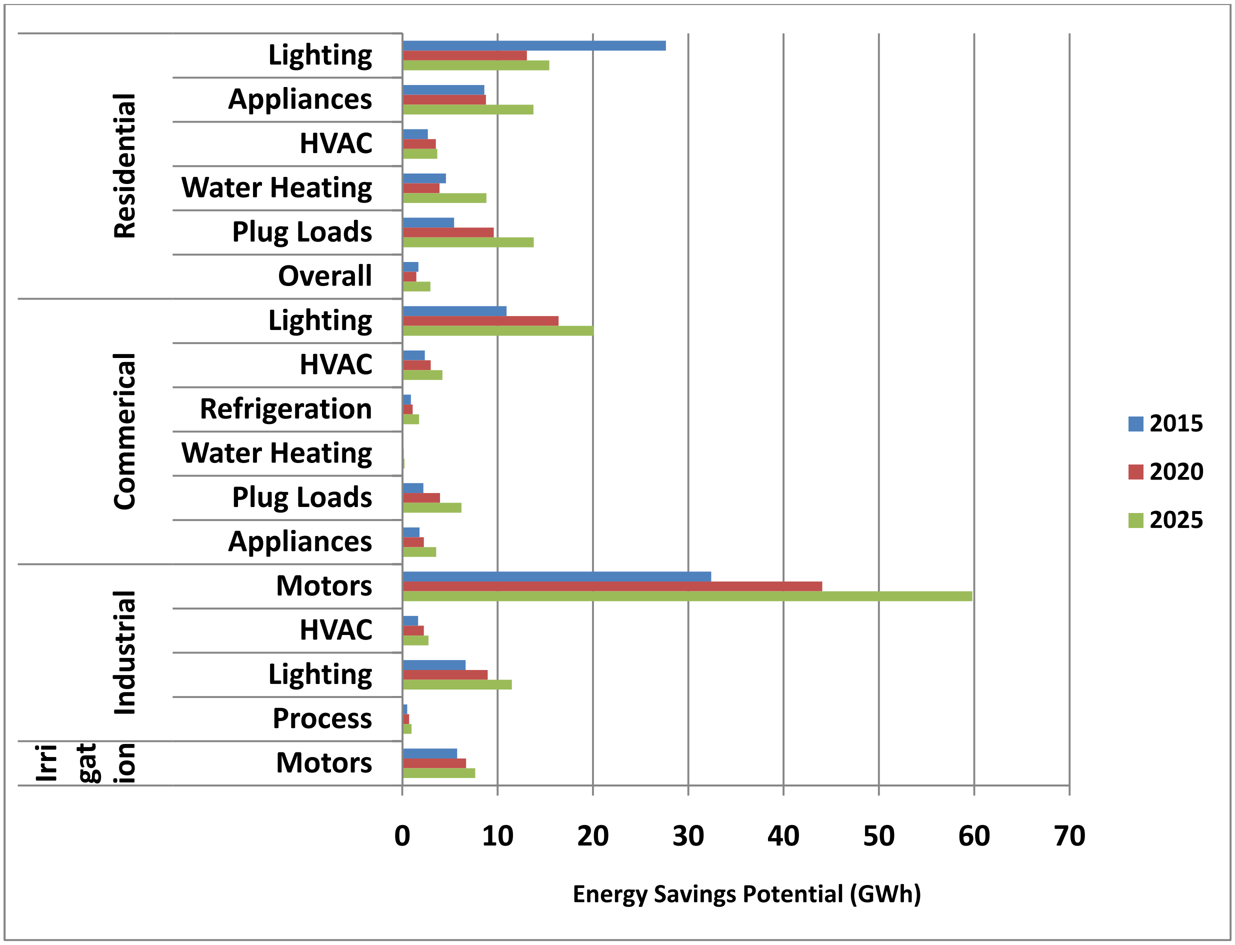

Figure 1.12 Potential Energy Savings by End-Use and Sector

Figure 1.12 indicates potential energy savings by sector, end-use and year. This figure provides constructive feedback on which programs should receive Tri-State's attention and particular sectors to target. Finally, it is worth noting in this figure the anticipated diminishing impact of residential compact fluorescent lamps (CFLs) due to Energy Independence and Security Act (EISA) requirements.

1.5 DSM PROGRAM RECOMMENDATIONS

Tri-State has been offering its utility members an Energy Efficiency Credits (EEC) program since 1985. During this time, Tri-State estimates this program has reduced demand by approximately 75 MW and electric use by 80,000 MWh. The program encourages and rewards energy-efficient purchases and practices at both the member and end-user levels, while lowering the associated cost of service. All Tri-State utility members are eligible to participate, and they may tailor the program to meet their own needs and those of their end-use customers. In addition, utility members may leverage Tri-State rebates by offering additional incentives on measures of interest.

With Tri-State's current approach, members may choose to mix and match measures from the EEC list to best meet the needs of their service territories and end-use customers via a cafeteria-style offering. Participation in the EEC program is voluntary, allowing members to participate to the level and degree best suiting their delivery capacity and operational practices. These measures and the current delivery mechanism offer a strong foundation on which the EEC program can be expanded and enhanced. The Nexant-Cadmus team recommends Tri-State supplement its cafeteria-style offerings with additional delivery approaches that cater to varying end-use customer needs, target untapped market segments and facilitate more complex technologies and projects. These additional approaches will allow Tri-State to achieve energy savings in hard-to-reach customer segments, but will require additional expertise and time to develop.

1.5.1 Short Term Portfolio Strategy Recommendations

The following recommendations can be implemented simply and at relative low costs and could be implemented over the next one to three years. They are listed in order of priority.

Expand EEC Programs

Tri-State should consider the expansion of current EEC programs to include measures included in this study. Some of these program measures can be quickly added to Tri-State's menu of programs through the implementation of pilot programs, such as commercial lighting. However, other programs will require more extensive development, such as an industrial custom efficiency program.

Increase Collaboration

Tri-State already collaborates with the following agencies:

- Wyoming Business Council—Wyoming
- The Governor's Energy Office—Colorado
- Nebraska Energy Office—Nebraska
- Energy Conservation and Management Division—New Mexico

We recommend Tri-State expand its efforts to explore collaborative programs with state agencies to: leverage each organization's resources and strengths; cooperate on complementary opportunities, such as Recovery Act-funded projects; and/or explore centralized administration for the EEC program by state.

Enhance Marketing

Effective marketing is a critical, foundational component to the EEC program's success. In addition to current efforts, it is recommended that Tri-State:

- Develop co-branded marketing templates, similar to existing Touchstone® marketing collateral, available for use by all members and to increase buy-in and participation among utilities.

- Develop and administer a customer focused, Web-based portal, which would serve as a communications tool for members and provide a range of support resources, such as marketing collateral, program rules, application templates, and so on.
- Hire additional customer outreach managers to conduct one-on-one marketing directly to utility members. These individuals' roles would include explaining programs, helping members understand the benefits and requirements associated with participation, enrolling members, helping to identify potential end-use customer targets for specific programs, etc.
- Conduct "upstream" marketing and outreach to equipment installers, contractors, and other trade allies as well as to retailers. Employ customer outreach managers to contact individual trade allies and industry associations, distribute marketing materials (point of purchase, brochures, etc.) to big box stores, hardware stores and other retail locations where customers purchase applicable high efficiency products.

Explore Alternative Delivery Mechanisms

Tri-State should consider alternative delivery mechanisms for its program offerings to reach new markets and pursue deeper energy savings per end user. An overview of alternative delivery mechanisms follows below.

Third-Party Programs. Because a third-party delivery mechanism can effectively target hard-to-reach customer segments or markets, this approach could help generate savings from market segments that do not typically participate in Tri-State's EEC Program. For example, the Bonneville Power Administration's Energy Smart Grocer Program is successfully generating energy savings through lighting and refrigeration measures among the hard-to-reach grocery and food service segment. Another program example could include refrigerator recycling. This approach would entail Tri-State implementing the program on behalf of participating members using a competitively selected third-party contractor to manage, administer, and deliver the program turnkey. Benefits of a turnkey program include reduced member burdens and streamlined administration. Third-party programs also may offer economies-of-scale cost savings, and provide Tri-State greater access to end users and control over marketing, delivery, and installation of energy-efficiency measures. Challenges to this approach include limited member control over the program and, in rural service areas, logistical barriers can increase program costs. The turnkey approach would require Tri-State to develop clear program objectives, work scope, and an RFP for the most suitable implementer. Tri-State should consider this use of pilot programs to assess the success and implementation barriers for the third-part program delivery mechanisms.

Upstream Incentives/Market Transformation Approach. Upstream incentive programs and market transformation activities seek to lower end-user costs and/or influence manufacturer, dealer, or retailer behaviors regarding specific energy-efficient technologies; they may also fund research, development, and demonstration of emerging technologies and program concepts to transform the market. The ENERGY STAR® Change-The-World, Start with ENERGY STAR® campaign serves as an example of a successful upstream program; this program negotiates incentives at the manufacturer and retailer levels and offers cooperative marketing on high-efficiency consumer products. Upstream incentives/market transformation approaches can provide Tri-State with greater control over measure deployment, and reduce barriers for member and end-user participation. Upstream incentive/market transformation initiatives can often be led effectively by regional market participants, such as nonprofit organizations or third-party contractors.

1.5.2 Longer-Term Portfolio Strategy Recommendations

Over the next two to five years, Tri-State should consider supplementing its portfolio with operational changes and infrastructure enhancements to increase administrative and delivery efficiency and support member participation in its programs. This may require more significant investment, long-term analysis and development processes, or present greater logistical challenges. Tri-State also may have to issue RFPs for outside analytical expertise and/or development support. Specific long-term recommendations include:

Program Tracking System

An Energy Efficiency Management and Tracking System is designed to facilitate accurate measurement, verification and benchmarking of program results through timely reporting as well as streamlined program management and accounting. Such a system is particularly well suited to facilitating more complex projects and multiple programs, and would help Tri-State optimize management of its EEC programs and reduce related costs. The system should be Web-based and accessible by multiple members to increase accuracy and participation by all utility customers.

Deemed Calculator

We recommend Tri-State develop a "deemed calculator" to facilitate custom projects/measures. Essentially, a deemed calculator is a simplified, modular modeling tool that allows member utilities to offer a more complex energy-efficiency project approach to their nonresidential customers. Such tools are particularly well suited to complex commercial or small industrial lighting or HVAC projects, where a large variation in measure applications, baseline conditions, and other factors make savings calculations difficult and per unit rebates inappropriate. The calculator should facilitate project screening (e.g., cost-effectiveness calculation) and measure-level or project-level calculation of energy savings and incentives. The calculator also should be Web-based, accessible by multiple members, and able to track and report results to Tri-State.

2.1 OVERVIEW OF METHODOLOGY

The general process used by Nexant in the Energy Efficiency Potential Study is shown in Figure 2.1 and described in detail below.

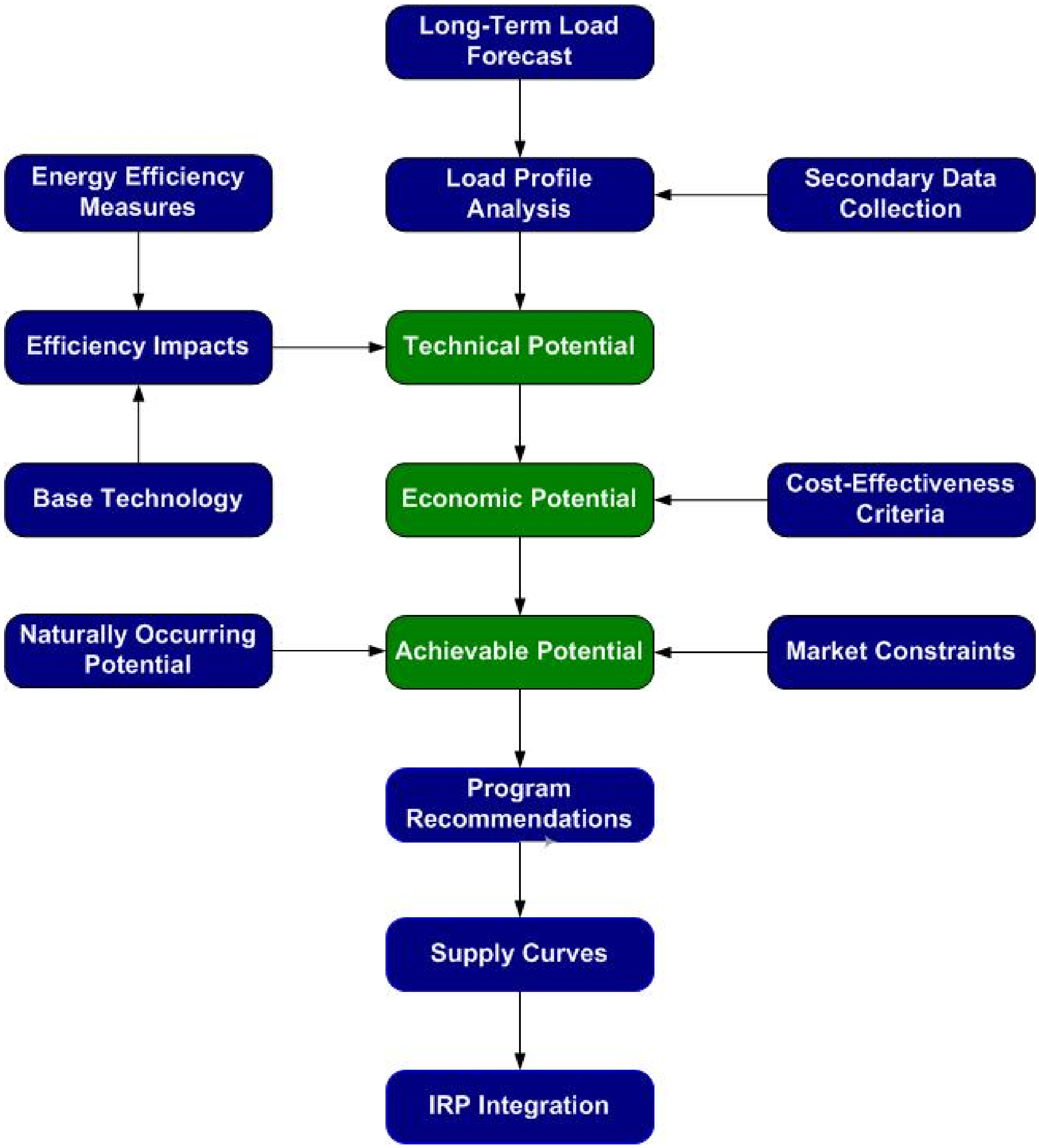

Figure 2.1 DSM Potential Calculation Process

2.2 LOAD PROFILE ANALYSIS

The production of an accurate assessment of achievable savings potential requires a thorough characterization of the energy usage and equipment saturation of the regional customer base. Our approach addressed the requirement of any energy efficiency potential study to compile a large and complex database of information on utility loads and sales forecasts, market data (fuel shares, energy system saturations, structural characteristics), end-uses (energy use intensities and load shapes), and measure characteristics (technologies, costs, life, savings). We utilized a combination of primary and secondary research to compile data which calibrated historical system consumption. Primary research included review of Tri-State's 2007 residential end-use survey, analysis of known commercial/industrial businesses types, distribution cooperative interviews, and trade ally surveys in Tri-State's service territory. Secondary research included desk review of available secondary sources and was utilized to supplement and validate the primary research. Finally, end-use loads were summed from a bottom-up level to calibrate to 2008 Tri-State sales. An overview of the steps involved in this process is outlined below. The findings of the end-use and load profile study are presented in Section 3.

2.2.1 Conduct Primary Market Research

Primary research included review of Tri-State's 2007 residential end-use survey, analysis of known commercial/industrial businesses types, distribution cooperative interviews, and trade ally surveys in Tri-State's service territory. On-site premise surveys were considered, but ultimately this method was not utilized due to the tremendous quantity of on-site surveys in order to gain the appropriate precision necessary. The following paragraphs summarize the major steps in primary market research.

2007 Tri-State Residential End-Use Survey

In 2007, Tri-State distributed a mail-in residential end-use survey requesting information on consumers' residence structure and energy consuming equipment type, age, fuel type, end-uses and behavior. Data collected for ninety-eight (98%) of the cooperatives provided a minimum confidence level of 90% with 10% precision for each survey subject.

Nonresidential customer analysis

Tri-State has access to Rural Utilities Service (RUS) Form 345 for each of the 44 cooperatives. This form contains North American Industry Classification System (NAICS) data that provides business type data on large customers (greater than 250KW). Business type information on nonresidential energy sales less than 250KW was not available. Secondary research was necessary to estimate segmentation of business types for customers less than 250KW.

Member Cooperative Interviews

The Nexant Team found significant value to conducting interviews with a sample of Tri-State's electric cooperative members. The purpose of the interviews was to discuss any particular aspects of Tri-State's regional member customer base that are unique, such as:

- Variations in customer base (e.g., rural versus township)
- Regionalized equipment implementation and saturations

- Localized amendments to building standards and codes
- Unique industries and their energy end-use

In addition, the meetings were an opportunity to gather other information from the electric cooperatives such as identifying trade allies for phone surveys, discussing which DSM programs the cooperatives already have in place, and any barriers they believe currently exist in regards to energy efficiency programs within their customer base.

A sample of thirteen cooperatives was selected to be representative of the overall customer region based on load distribution, total sales, climatic characteristics and participation in current Demand Side Management (DSM) programs. The following table shows the distribution cooperatives interviewed:

Table 2.2 Member Cooperatives Selected for Interviews

Empire Elec. Assoc.	Kit Carson Elec. Coop.
Morgan Cnty Rural Elec.	Poudre Valley Rural Elec.
San Miguel Power Assoc.	Springer Elec. Coop.
United Power	Midwest Elec. Coop
High Plains Power	San Isabel Elec. Assoc
Northwest Rural Public	Wheatland Rural Elec.
Sierra Elec. Coop.	

Survey of Trade-Allies

Interviews with contractors, dealers, distributors, and other trade allies provided a cost-effective research approach, as business activity tends to be concentrated among relatively few market actors (i.e., fewer interviews can provide detailed insight into market activity). These interviews were also leveraged to assess market shares and estimates of market saturation for multiple sectors during a single interview.

2.2.2 Conduct Secondary Research

The Nexant Team conducted secondary data research to help supplement the findings from the primary data sources. The data collection and mining effort included a search of available secondary sources such as ENERGY STAR Retailer Partner Data, Trade Associations, and Load Shape Libraries.

The Team also utilized other studies to help fill in remaining gaps. Examples include the Residential Energy Consumption Study (RECS, with household characteristics data tables), the Commercial Buildings Energy Consumption Study (CBECS), PacifiCorp Energy Efficiency Potential studies for Utah and Wyoming, 2003 Xcel Colorado Energy Potential Study, and the American Architectural Manufacturers Association and Window & Door Manufacturers Association 2005 U.S. Industry Market Study of Fenestration Products, among other studies.

2.2.3 Data Analysis and Calibration

The results of both the end-use fuel source and load profile analyses were evaluated within a framework of historical system load and consumption data with an emphasis on 2008 sales. This comparison was carefully evaluated to observe any existing discrepancies or incongruities and the data was calibrated to account for these differences. Data calibration used applied statistical methods to reconcile adjusted end-use load shapes with historical records, such that the consumption-weighted product of billing data, end-use shapes, and end-use saturation data were consistent with aggregate system consumption data and weather-normalized system loads.

2.3 ENERGY EFFICIENCY POTENTIAL ASSESSMENT

To ensure a comprehensive analysis of energy end uses and potentially achievable savings, Nexant's analysis began with a "bottom up" approach that examined measure-specific impacts and cost data.

2.3.1 Measure Development

An accurate assessment of energy efficiency potential required complete and reliable measure-level data. All measures appropriate for Tri-State's service territory were considered and reliable data on costs, savings, lifetime, and applicability were collected. This effort had two main components as described in the following sections.

Energy Efficiency Measure List

An initial list of measures was compiled based on the Nexant Team's experience and thorough review of Tri-State's current energy efficiency programs. Consideration was also given to measures that show promise for future viability but have not yet gained a foothold in the market.

Energy Efficient Measure Costs and Savings

Upon finalization of the energy efficiency measure list, data on energy savings, costs, lifetime, and applicability was collected to determine potential measure impacts. This work was performed through a four-step process.

Step 1: Define market classes

The first step in determining energy efficiency measure impacts involved defining appropriate sectors, market segments, vintages, and end-uses as follows:

- Customer Sectors: Residential, commercial, irrigation, and industrial (including agricultural)
- Market Segments:
    - Residential
    - Commercial: Typically based on major Commercial Buildings Energy Consumption Study (CBECS) business types.
    - Industrial: All major industrial segments in Tri-State service territory using NAICS classification from Form 345 information.
- Vintages: existing (early retirement), turnover (replacement at burnout), new

- End-Uses: lighting, HVAC, refrigeration, cooking, freezer, dryer, water heating, plug loads, process (industrial), irrigation pumping

Step 2: Develop base case impacts and costs

For each of the energy efficiency measures on the final list, base case equipment and practices were determined. All base case assumptions and data were informed by the energy end use and load profile study, as well as local and federal codes and standards, when deemed appropriate.

Step 3: Develop energy efficiency measure impacts and costs

For each measure, energy savings were estimated both as a percentage of base equipment usage and in absolute (kWh) savings. Each energy efficient measure had costs researched in the context of Tri-State's electric supply territory, which in turn were used to determine per-unit incremental cost. Costs were collected from RSMeans or calls to local contractors, when appropriate.

2.3.2 Energy Efficiency Potential Assessment Modeling

Drawing on the previous data compilation, organization, and market analysis tasks, the estimation of market potentials was conceptually a straightforward exercise.

2.3.2.1 Develop Baseline Forecast

The baseline forecast was created by combining all of the inputs compiled in the end-use profile and Tri-State's 15 year forecast to obtain average consumption estimates by customer segment, construction vintage, and end use, and summed up to the sector level. The disaggregated forecast data provided the foundation. For example, in the residential sector, the general equation for the DSM baseline forecast was:[1]

Eq. 1: $$Forecast_{BL} = \sum_{i,j,t} HH_{i,t} \times EUS_{i,j,t} \times UEC_{i,j,t}$$

Where:
$HH_{i,t}$ = the number of households of type i in year t
$EUS_{i,j,t}$ = the saturation of end use type j in household type i in year t
$UEC_{i,j,t}$ = the unit energy consumption of end use j in household type i in year t

[1] Nonresidential sectors follow an analogous methodology based on facility type, end use type, floor space shares, and end use intensity.

Each disaggregated end-use energy consumption and saturation value changes across the study horizon to account for the known impacts of codes and standards. Tri-State forecasting software tool utilizes underlying data from the Energy Information Agency (EIA) Statistically Adjusted End-Uses (SAE) to account for these forecasted energy impacts. Consequently, identified energy saving potentials already account for the impacts of codes and standards within the study horizon.

Role of Naturally Occurring Conservation:

Naturally occurring conservation exists through government intervention, improved manufacturing efficiencies, building energy codes, and increased energy efficient implementation through early fore-runners, who will implement measures without incentives. Government regulation can significantly increase naturally occurring potential through tax incentives, stimulus funding or stricter manufacturing standards. These forces cause certain sector end-use energy consumption values to improve across the baseline forecast and are built into Tri-State's forecast. Throughout this report savings potential is reported at the program potential, excluding naturally occurring potential. When Nexant calculated program costs and cost-effectiveness, the naturally occurring potential was added back in, as Tri-State will be responsible for incentives for free-riders.

Step 2. Estimate Technical Potential

Once the baseline forecast was complete, the measure-level inputs were used to estimate technical potential over the planning horizon. This was accomplished by creating an alternate forecast, where consumption is reduced by the installation of all technically feasible measures. For technical potential, which represents substitution of all technically feasible measures at the end use level (and following the residential example above), the general equation was:

Eq. 2: $$Forecast_{TP} = \sum_{i,j,t} HH_{i,t} \times EUS_{i,j,t} \times UEC_{i,j',t}$$

Where:

- $HH_{i,t}$ = the number of households of type *i* in year *t*
- $EUS_{i,j,t}$ = the saturation of end use type *j* in household type *i* in year *t*
- $UEC_{i,j',t}$ = the unit energy consumption of end use *j′* (the most efficient end use technology configuration) in household type *i* in year *t*

The technical potential for DSM was simply the difference between Equation 1 and Equation 2. Special consideration was required in determining UECi,j′,t to incorporate the interactive effects of appliance and envelope measures. Because measures anticipated to be installed in the absence of utility intervention are included in the baseline forecast (and, thus, the technical potential forecast), savings due to already naturally occurring conservation were excluded from the technical potential estimates.

Step 3. Estimate Economic Potential

The next task, creating an alternative forecast of "economic" DSM potential (i.e., considering the most efficient measures that pass an economic screening test, specifically the Total Resource

Cost (TRC) as defined by the California Standard Practice Manual), was conducted similarly. Again following the residential example, the general equation was:

$$\text{Eq. 3:} \quad Forecast_{EP} = \sum_{i,j,t} HH_{i,t} \times EUS_{i,j,t} \times UEC_{i,j'',t}$$

Where: $HH_{i,t}$ = the number of households of type i in year t

$EUS_{i,j,t}$ = the saturation of end use type j in household type i in year t

$UEC_{i,j'',t}$ = the unit energy consumption of end use j'' (the most efficient end use technology configuration *that is also economic*) in household type i in year t

Similar to the calculation of technical potential, the economic potential for DSM was the difference between Equation 1 and Equation 3. And again, special consideration was required in determining UECi,j″,t to incorporate the interactive effects of appliance and envelope measures.

Utility-specific data on avoided costs, line losses, discount rates, etc., collected during the kick-off meeting, were incorporated to perform a full cost-benefit analysis (TRC) for every sector, customer segment, vintage, end use, and measure combination. The calculations are complicated by the fact that Tri-State serves as the wholesale electric provider to its member cooperative distribution systems. There has not been much tracking of program development, implementation and administrative costs and benefits between the wholesale and retail entities. As a result the costs and benefits used in this study reflect the combination of Tri-State's and its members' costs and benefits. Tri-State's unique disaggregated structure with its distribution cooperatives was to be accounted for within these benefits that are offset by measure implementation and program costs.

The cost component of the analysis consisted of incremental measure costs and utility program costs. The incremental costs are the incremental material and labor expenses associated with installation of the energy efficiency measures and ongoing operation and maintenance costs, where applicable. Utility costs are the expenses associated with development, deployment, and operation of the program, and fall into the following categories:

- **Planning and design.** Expenses associated with program development, design of new programs, or making modifications to existing programs.
- **Program administration.** Costs associated with program support functions, such as ongoing operation, administration, trade ally management, and reporting.
- **Advertising and promotion.** Program-specific marketing, education, training, and demonstrations aiming to promote the program.
- **Monitoring and evaluation.** Expenses associated with program evaluation, measurement, and verification.

Step 4: Estimate Achievable Potential

Finally, the assessment of realistically achievable energy efficiency potential required estimating, among other parameters, the rate at which cost-effective measures can be adopted over time. Because program implementation scenarios have a direct influence over such market penetration rates, Nexant incorporated individually developed sets of market penetration curves corresponding to implementation scenarios. These scenarios were correlated to differing levels of urgency in program implementation, tolerance for rate impacts, macroeconomic conditions, and other situations.

The following are important components to determination of achievable potential:

1. ***Benchmarking.*** The amount of savings expected to be achievable through DSM programs will be informed by the experience of utilities across the region and nation.

2. ***Customers' willingness to participate.*** The likelihood that customers will participate in energy efficiency programs is a function of several factors, most notably incentive level. The Nexant Team has performed several studies to attempt to estimate customers' expected behavior at different incentive levels through surveys and secondary research.

3. ***Uncertainty.*** Planning requirements often necessitate a point-estimate of potential, however, this is not an accurate reflection of the reality of DSM programs. Attention will be paid to Tri-State's disaggregated relationship with its distribution cooperatives. We prefer to think of achievable potential as a range, or probability distribution, where the point-estimate is the most likely outcome. This distribution defines the lower and upper bounds of expected savings, as well as the most likely value.

Achievable potential energy efficiency and demand reductions were evaluated based on four incentives scenarios of 25%, 50%, 75% and 100% of the incremental costs of efficiency measures.

2.4 MARKET PENETRATION RATES

An important step in assessing achievable potential was to evaluate the expected market penetration rates for each scenario. Market penetration rates were evaluated for each end-use sector, each installation scenario (early retirement, turnover, and new building stock) and for each savings potential scenario.

For the technical and economic potential calculation, market penetration for turnover and new equipment was assumed to be 100% by definition. The market penetration of early retirement equipment was much lower, but still followed an aggressive phase-in of efficient equipment.

The achievable potential scenarios used market penetration curves with steep ramp up curves. The market penetration rates were developed with the expectation that the programs would reach mature levels in five to seven years. As with the technical and economic scenarios, the market penetration rates for early retirement scenarios are significantly reduced from the turnover and new equipment installation cases. Consideration was given to Tri-State's existing programs; consequently, the early penetration rates are higher for the residential and irrigation sectors as compared to the commercial and industrial sectors.

For the achievable potential scenarios Nexant adjusted the penetration rates by end-use to accommodate variations in customers' willingness and ability to adopt certain types of measures.

For example, lighting, appliances, and plug loads were adjusted to a high level, as these measures are typically easier to market, install, and understand by the customer. On the other hand, commercial HVAC, refrigeration, and cooking measures had slightly reduced acceptance rates due to their complexity and relatively difficult installation.

Market penetration rates were also adjusted based on variations in regional characteristics. This adjustment reflects the ability of each regional grouping to effectively implement DSM programs. Factors that influence this adjustment include:

- Presence of large urban centers versus rural customer distribution
- Presence and maturity of existing DSM programs and trade ally networks
- Benefits to co-op based on load-shape considerations
- Co-ops' perceived support of DSM programs.

2.5 SEGMENTATION OF REGIONAL TERRITORIES

To understand Tri-State's large geographic service territory, strong consideration was given to segment the end-use load profile analysis and energy efficiency potential study by utilizing regional groupings. The electric energy savings potential assessment was segregated into eight (8) regions based on perceived differences between the co-ops. Segregating the co-ops by region, instead of producing one set of potential values for all of Tri-State's territory had several advantages:

- Energy efficiency measures more accurately match building code for calculation of baseline potential. For example, envelope construction requirements are different depending on climate zone.
- Capture higher resolution level of equipment end-use saturation and energy intensity. For instance, DX cooling in the residential sector has a higher saturation and energy intensity in southern New Mexico as compared to northern Wyoming.
- Accommodation of regional cost variances for participant energy efficiency implementation or utility avoided costs.
- Barriers to achievable potential will be less aggregated; consequently, overall system-wide achievable potential is estimated more accurate.

After evaluation of climatic impacts, sector segmentation and end-uses, Table 2.1 summarizes the regional electric cooperative groups.

Table 2.1 Tri-State Cooperative Regional Groups

Eastern Colorado	Front Range Colorado	Mountain Colorado	Western Colorado
Highline	Mountain View	Gunn County	Delta-Mont
K.C.	Poudre Valley	Mountain Parks	Empire
Morgan County	San Isabel	White River	La Plata
Southeast	United		San Luis Valley
Y-W			San Miguel
			Sangre De Cristo

Nebraska	Southern New Mexico	Northern New Mexico	Wyoming
Chimney Rock	Central NM	Cont. Divide	Big Horn
Midwest	Columbus	Jemez Mtns	Carbon
Northwest	Otero County	Kit Carson	Garland
Panhandle	Sierra	Mor San Miguel	High Plains
Roosevelt	Socorro	North. Rio Arriba	High West
Wheat Belt		Southwestern	Niobrara
		Springer	Wheatland
			Wyrulec

Unique energy savings measure characteristics were established for each of three applicable climatic regions, IECC climate zones 4, 5 and 6. Finally each region's baseline forecast was applied against the applicable measure characteristics to calculate the energy savings potential. Refer to Figure 2.2 for representation of process.

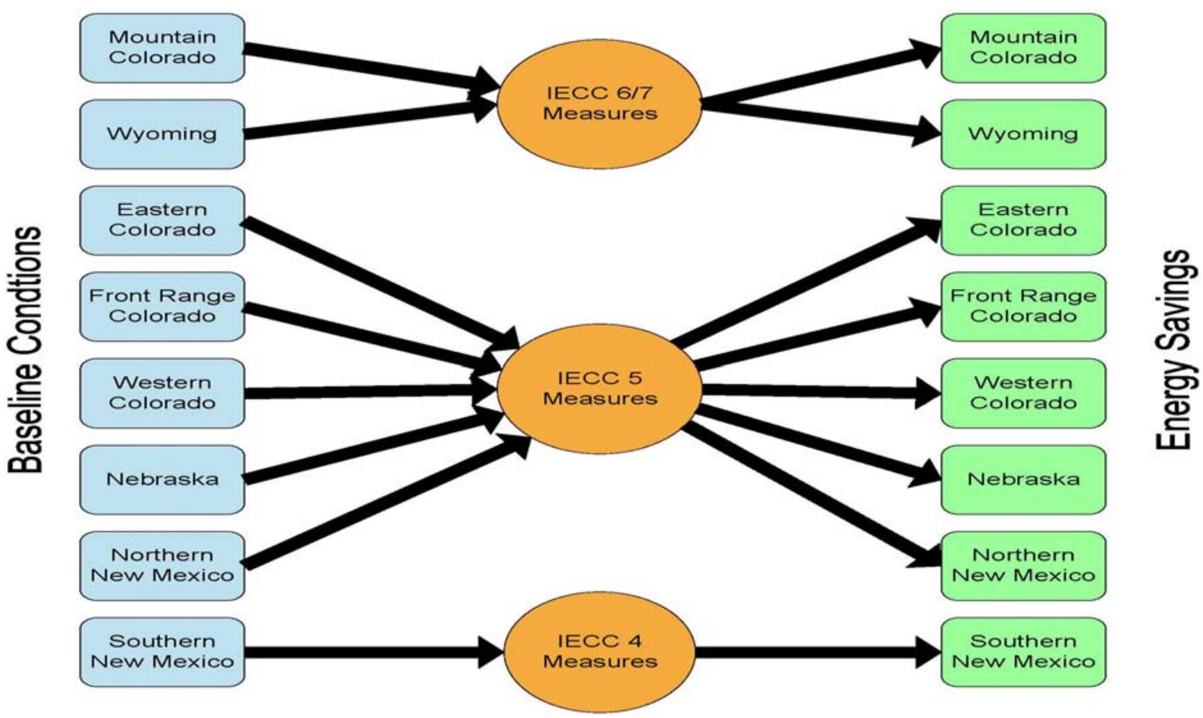

Figure 2.2 Energy Efficiency Measure Application Process

3.1 OVERVIEW

The analysis of theoretically achievable savings potential requires an accurate characterization of the baseline energy usage and customers. Nexant conducted an end-use and load profile study to describe Tri-State's energy usage by sector, region, and end-use. This section provides the results of this study.

Tri-State's 2008 electricity sales to member cooperatives were found to be 14,061GWh. By summarizing the electrical cooperatives' reported monthly RUS Form 7 data, it was determined the electricity sales to end-use customer were 13,293GWh, with the resultant member cooperative losses accounting for approximately 5.5% difference in sales. Tri-State's annual profile has a distinct summer peak, with the 2008 peak occurring on August 1st at 5:00pm at 2,506 MW. However, Tri-State's daily load profile was found to be generally flat. This is generally attributed to large summer irrigation and high-load factor industries.

One early key finding in the member cooperative interviews was the scarcity of traditional commercial loads, since approximately 50% of the member cooperatives do not serve the city and town customers within their service territories. It was determined that municipal electric utilities are common for many rural towns within western Nebraska, eastern Colorado and most of Wyoming. Another early important finding was a large industrial load, predominately focused around the oil, gas and mining industries.

Monthly RUS Form 7 data was utilized to segment aggregate sales into distinct end-use sectors, residential, commercial, industrial, irrigation and other sector categories. However, the Nexant team only had business types for large commercial/industrial customers over 250KW. An early analysis step was to segment the small commercial/industrial customers into distinct commercial and industrial sectors. This segregation relied heavily on information gained from the member interviews and available secondary data. Assumptions used in this segmentation analysis were checked in the load calibration analysis of the end-use profile. Figure 3.1 below summarizes the final segmentation of end-use sectors.

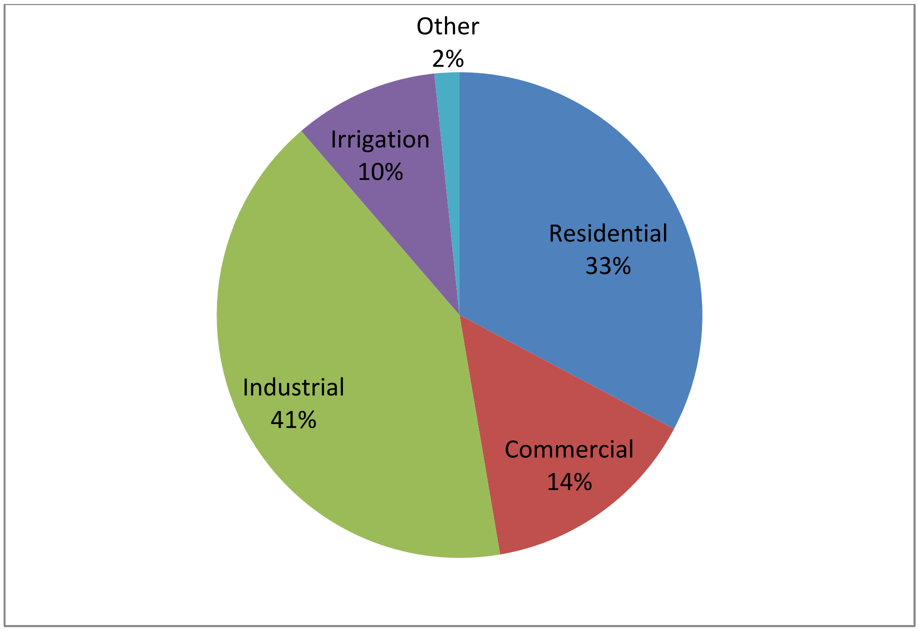

Figure 3.1 Tri-State 2008 Electricity Sales by Sector

It is notable in the 2008 electricity sales sectors the significant contribution of the industrial sector at 41%. For other electric utilities that serve metropolitan communities this fraction is usually closer to 20%. Conversely, the commercial sector fraction, at 14%, is lower than other electric utilities that serve metropolitan communities, which typically have a fraction closer to 40 to 50%. Electricity sales noted as “other” sector categories include, public street lighting, public authority, and electricity re-sales. Since these end-uses have energy efficiency, they are allocated into one of the other four applicable end-use sectors.

Figure 3.2 provides a summary of 2008 electricity sales by each regional territory.

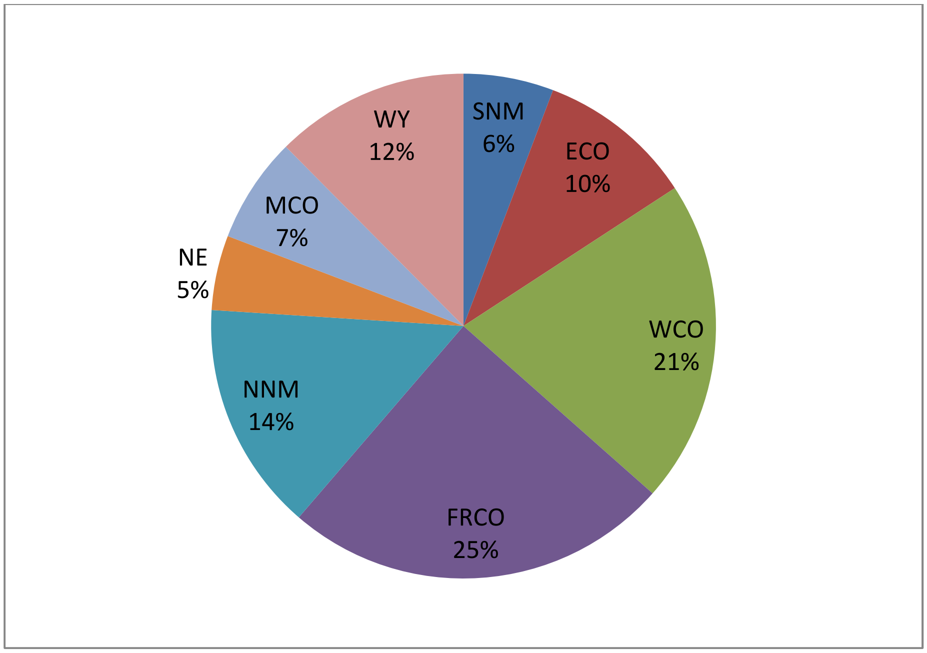

Figure 3.2 Tri-State 2008 Electricity Sales by Region

Table 3.1provides further segregation of the 2008 electricity sector sales fraction for each regional territory.

Table 3.1 Tri-State 2008 Electricity Sales by Sector and Region

Sector	SNM	ECO	WCO	FRCO	NNM	NE	MCO	WY	Total
Residential	41.5%	19.2%	32.7%	46.5%	27.7%	27.7%	27.1%	23.4%	33%
Commercial	23.6%	7.3%	18.6%	18.7%	14.8%	4.2%	17.3%	3.4%	14%
Industrial	24.5%	27.8%	44.4%	30.8%	52.8%	21.0%	53.4%	64.0%	41%
Irrigation	10.2%	43.8%	3.9%	1.0%	2.6%	46.1%	0.1%	8.2%	10%
Other	0.3%	1.8%	0.2%	3.1%	2.2%	0.9%	2.2%	1.0%	2%
Total Energy (GWh)	**767**	**1,332**	**2,757**	**3,295**	**1,953**	**637**	**899**	**1,653**	**13,293**

The northern New Mexico, mountain Colorado and Wyoming regions were found to have significant industrial loads. Eastern Colorado and Nebraska have significant fractions of their overall electricity sales in the irrigation sector. Northern New Mexico and Front Range Colorado find most of their sales from the residential sector and both have the largest commercial sectors.

3.2 RESIDENTIAL END-USE AND LOAD PROFILES

The residential sector is responsible for 4,335 GWh of electric consumption, includes approximately 465,000 unique residential dwellings and accounts for 33% of Tri-State's total electricity sales. Average per dwelling energy usage was in line with an annual consumption of 9,057 kWh per home. While characteristics of residential dwellings are relatively homogeneous throughout Tri-State's territory, there are notable variations in average home size, average annual energy consumption, and equipment saturations throughout the regions in this study.

Based on the limited information available to segment single-family, multi-family, and/or manufactured homes energy use or equipment saturations, it was determined that the existing residential sector should be analyzed in its entirety with no sub-sectors analysis.

In order to properly analyze end-use energy consumption impacts within the residential premise, Nexant established the following end-uses for evaluation, which will also be the basis of the energy efficiency potential study:

- Lighting – Interior
- Lighting – Exterior
- Space Cooling – Room Air Conditioning
- Space Cooling – Evaporative Cooling
- Space Cooling – Central Air Conditioning
- Space Cooling – Heat Pump
- Space Heating – Central Heating
- Space Heating – HVAC Auxiliary
- Appliance – Electric Cooking
- Appliance – Washing Machine
- Appliance – Electric Dryer
- Appliance – Dish Washer
- Appliance – Electric Water Heating
- Appliance – Refrigerator
- Appliance – Second Refrigerator
- Appliance – Freezer
- Plug Load – Exterior Plug Loads
- Plug Load – Plug Loads

3.2.1 End – Use Saturations

Nexant utilized the 2007 Tri-State residential end-use survey to compile end-use saturations and average residential premise square footage as found below in Table 3.2.

Table 3.2 Tri-State End-Use Saturations per Region

End-Use	ECO	FRCO	WCO	MCO	NE	NNM	SNM	WY
Central Heating	20.5%	18.5%	17.7%	26.5%	30.2%	11.1%	12.5%	23.1%
HVAC Aux	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Room AC	21.6%	9.9%	9.2%	2.9%	28.0%	11.5%	13.7%	20.7%
Evap Cooler	12.5%	10.4%	17.7%	1.7%	3.0%	15.6%	33.4%	12.5%
Central Air	36.2%	42.3%	8.5%	1.5%	38.7%	6.4%	16.9%	17.7%
Heat Pump	3.5%	3.3%	1.4%	0.4%	9.8%	0.5%	2.0%	1.4%
Interior Lighting	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Exterior Lighting	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Electric Cooking	56.8%	71.1%	59.8%	67.9%	69.6%	33.7%	36.7%	65.6%
Washer	81.9%	90.7%	87.3%	79.8%	85.2%	73.3%	79.3%	83.1%
Electric Dryer	75.7%	81.8%	73.5%	67.4%	81.8%	58.1%	65.4%	79.5%
Dish Washer	61.4%	81.7%	72.5%	71.5%	64.0%	40.9%	50.3%	62.2%
Electric Water Heater	31.7%	25.7%	33.1%	41.5%	52.4%	24.9%	26.8%	46.6%

End-Use	ECO	FRCO	WCO	MCO	NE	NNM	SNM	WY
Refrigerator	84.1%	93.8%	91.6%	90.4%	88.1%	89.8%	87.1%	87.4%
Second Refrig	34.5%	33.7%	23.2%	20.2%	39.0%	17.2%	23.1%	33.3%
Freezer	69.7%	60.8%	56.7%	42.0%	72.3%	44.9%	52.5%	71.4%
Exterior Plug Loads	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Plug Loads	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average Home Size	1,500	1,798	1,295	1,373	1,428	1,158	1,162	1,435

The saturations of 'plug loads' and 'lighting' are both 100% by definition. Therefore, the contribution of these end uses to the overall energy usage is driven by the unit energy consumption (UEC), as determined by the prevalence of certain equipment within the end use category.

One notable finding is the lower appliance saturations and smaller premise square footage for the New Mexico region residences. One surprising finding was lower than expected saturation of refrigerant space cooling (e.g. central or room AC) in the New Mexico regions. In fact, the Nebraska region has the largest saturation of refrigerant space cooling, likely due to higher ambient humidity. One expected finding was the higher prevalence of electric space and water heating in the colder climates of mountain Colorado, Nebraska and Wyoming due to the lack of available natural gas in the rural environment.

3.2.2 Results by End-Use

The Nexant team next calculated the Unit Energy Consumption (UEC) for each end-use studied. These UECs were calculated or modeled based on the findings of the end-use survey data. These UECs were initially calculated irrespective of the end-use saturation or fuel share, meaning that the UEC represents the total consumption of an end-use in a home where it is present. The computer simulation program REM Design was used to determine UECs for weather dependant end-uses including central ACs, central heating, HVAC auxiliary, heat pumps, room ACs, and room heating. Where possible, Nexant used data from the surveys to serve as inputs to this analysis. Non-weather dependent end-use UEC values were identified by representative trade association data and adjusted for market survey characteristics specific each region's territory.

Finally UECs and saturations were combined, summed and calibrated to 2008 electricity sales figures for each region. The overall residential energy consumption by end-use is shown in Figure 3.3. Figure 3.4 presents the UECs with applied saturations for each end use and for each region.

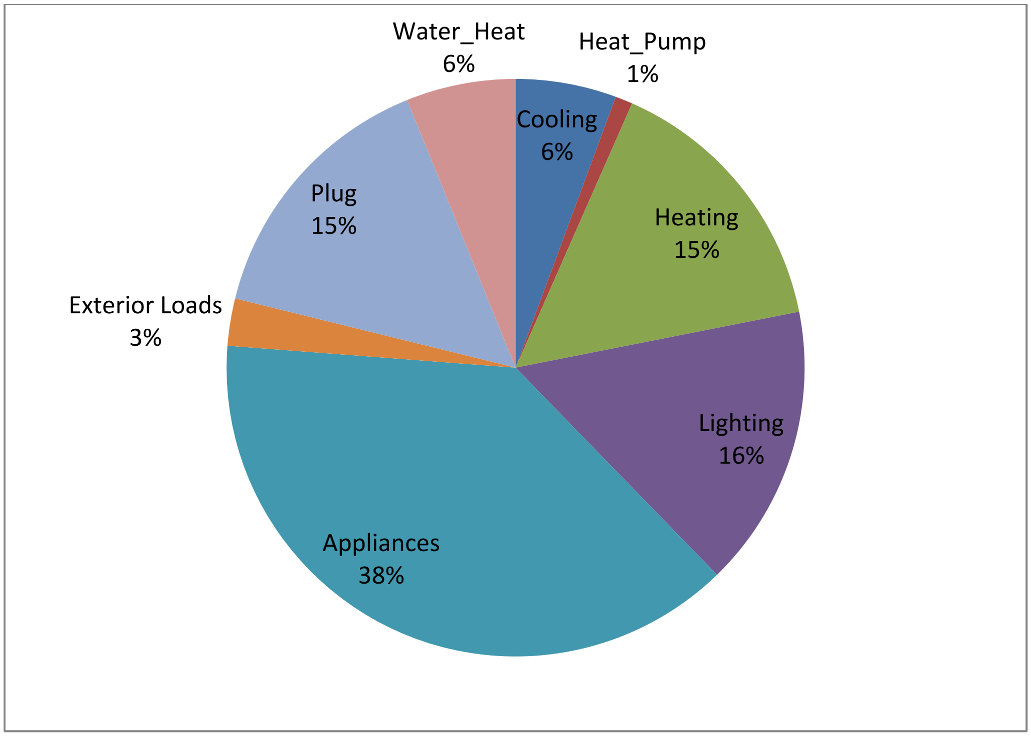

Figure 3.3 Residential Sector Energy Consumption per End-Use

Contributing over forty percent of the total electricity consumption, fixed-in-place appliances use the largest portion of electricity in the residential sector. This is attributable to the fact that this category contains a large number of appliances, many with frequent or continuous usage (refrigerators) or high energy intensity (dishwashers, clothes washers). Lighting and plugs loads are the next largest end use categories.

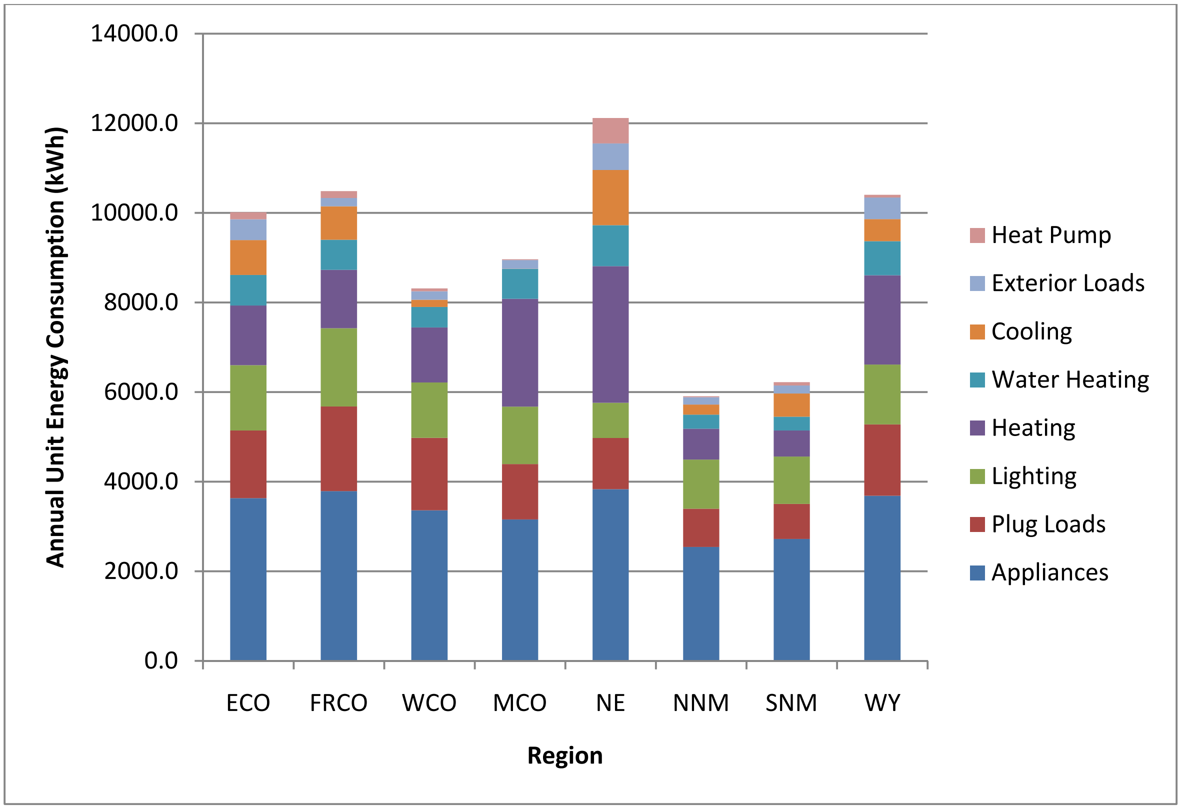

Figure 3.4 Average Residential Energy Consumption by End-Use and Region

The lower than average energy consumption per residence in New Mexico is shown to be attributable to reduced appliance saturations and limited refrigerant cooling, as well as lower lighting and plug load UECs. Conversely, Nebraska and Wyoming have the highest average energy consumption per residence due to increased saturations of electric space heat, water heating, refrigerant cooling, and plug loads.

3.3 COMMERCIAL END-USE AND LOAD PROFILES

The commercial sector is responsible for 1,936 GWh of electric consumption, which accounts for 14% of Tri-State's total electricity sales. In general, the commercial sector covers a large spectrum of customers, usually smaller in size, with 71% having a peak demand less than 250 kW.

3.3.1 Results by Sub-Sector

Since the Nexant team only had business types for large commercial/industrial customers over 250KW, an analysis step was to segment the remainder of customers into distinct commercial business types. This analysis methodology heavily relied on information gained from the member interviews and available secondary data. Assumptions used in this segmentation analysis were checked in the load calibration analysis of the end-use profile. The following commercial business types were utilized for commercial sub-sectors:

- Education
- Grocery
- Government
- Health
- Lodging
- Miscellaneous
- Retail
- Office
- Restaurant
- Warehouse

The overall commercial energy consumption by sub-sector is shown in Figure 3.5.

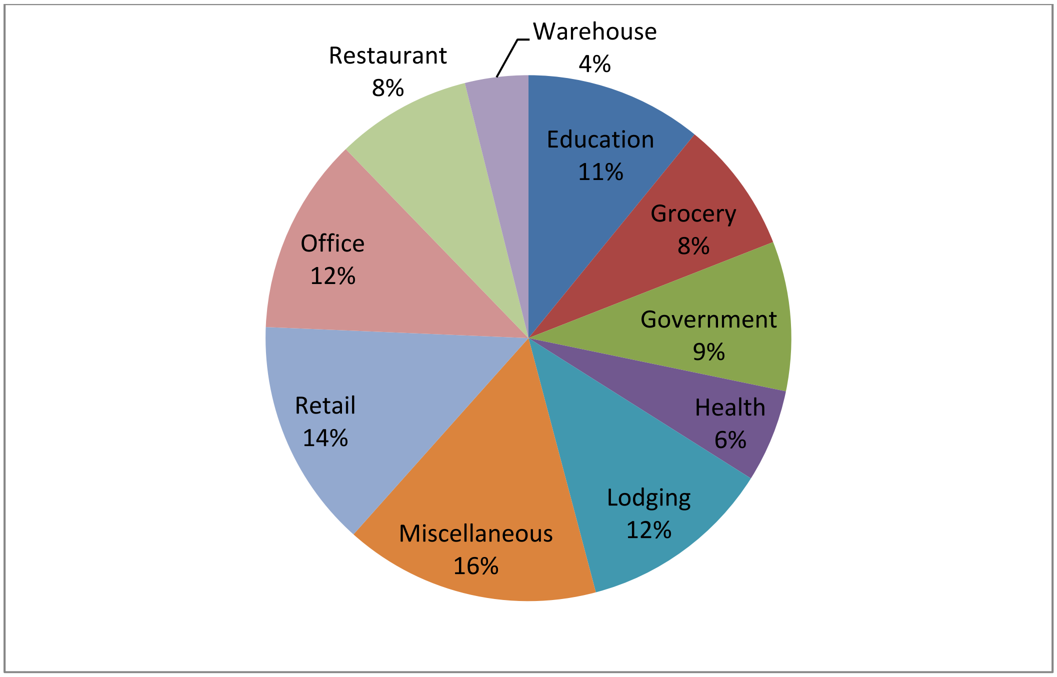

Figure 3.5 Commercial Energy Consumption by Sub-Sector

The largest commercial sub-sector is the miscellaneous sector, which includes facilities such as places of worship and assembly, casinos without hotels, service business types, ski areas and recreation centers. Table 3.3 provides higher resolution of the commercial business types for each region with 2008 commercial electricity sales.

Table 3.3 Commercial Energy Consumption by Sub-Sector and Region

Sub-Sector	ECO	WY	SNM	NNM	NE	WCO	MCO	FRCO
Education	10.6%	6.4%	18.1%	10.3%	11.0%	10.1%	8.0%	11.1%
Grocery	7.4%	4.8%	6.5%	7.3%	6.4%	9.0%	8.9%	8.8%
Government	2.5%	3.0%	17.9%	4.3%	7.8%	4.8%	2.0%	16.1%
Health	4.9%	3.2%	3.6%	9.1%	4.2%	7.9%	4.0%	4.0%
Lodging	9.8%	6.4%	17.5%	15.5%	8.5%	13.6%	18.4%	7.1%
Miscellaneous	20.6%	47.6%	8.2%	21.5%	24.0%	13.0%	17.9%	12.0%
Retail	14.7%	9.6%	11.2%	12.4%	12.7%	15.0%	12.0%	15.8%

Sub-Sector	ECO	WY	SNM	NNM	NE	WCO	MCO	FRCO
Office	9.8%	9.6%	9.3%	9.9%	8.5%	11.6%	12.9%	14.8%
Restaurant	9.8%	6.4%	5.1%	6.5%	8.5%	11.4%	12.0%	6.8%
Warehouse	9.8%	3.2%	2.6%	3.3%	8.5%	3.8%	4.0%	3.4%
Total Energy (GWh)	**120.3**	**71.1**	**181.1**	**326.5**	**31.9**	**515.6**	**174.4**	**707.0**

The Front Range and Western Colorado regions and Northern New Mexico region have the largest commercial sectors due in large part to the fact that it is not as common to have municipal electric utilities in these areas. Consequently, their sub-sector energy consumption composition is generally more balanced than the other regions, where one or two large premises can shift the fractions disproportionately.

3.3.2 Results by End-Use

In order to properly analyze end-use energy consumption impacts within the commercial sector, Nexant established the following end-uses for evaluation, which will also be the basis of the energy efficiency potential study:

- Lighting
- Cooling
- Space Heating
- Motors
- HVAC Auxiliary
- Plug Load
- Refrigeration
- Cooking
- Water Heating

The Nexant team next identified the appropriate energy usage intensity (EUI), or end-use energy consumption per square foot, for each end use studied. These EUIs were calculated based on other applicable regional commercial end-use studies, such as those found in Wyoming, Montana, Utah, Colorado, New Mexico and Iowa. Figure 3.6 summarizes the energy consumption for each end-use.

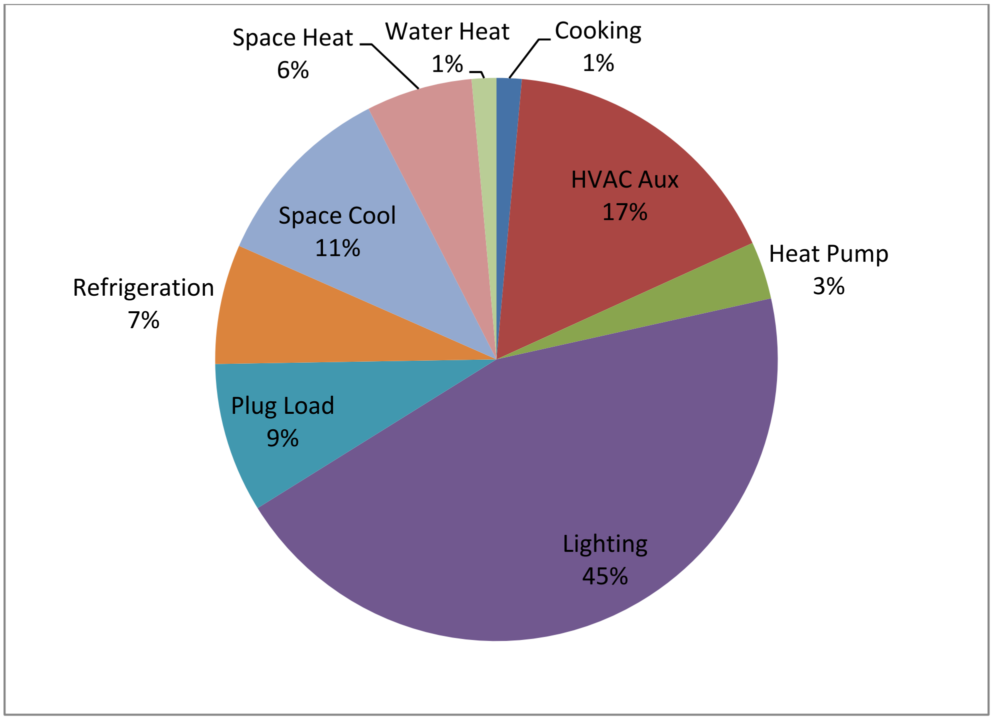

Figure 3.6 Commercial Energy Consumption by End-Use

Lighting makes up forty-five percent of the total electricity consumption, which is attributable to the fact that this end-use is common in all sub-sectors and does not have any seasonal operation. Lighting is followed by HVAC Auxiliary which included fans, pumps, motors and electronics used to move or control HVAC air and water systems. Figure 3.7 provides higher resolution of end-use energy consumption in each sub-sector.

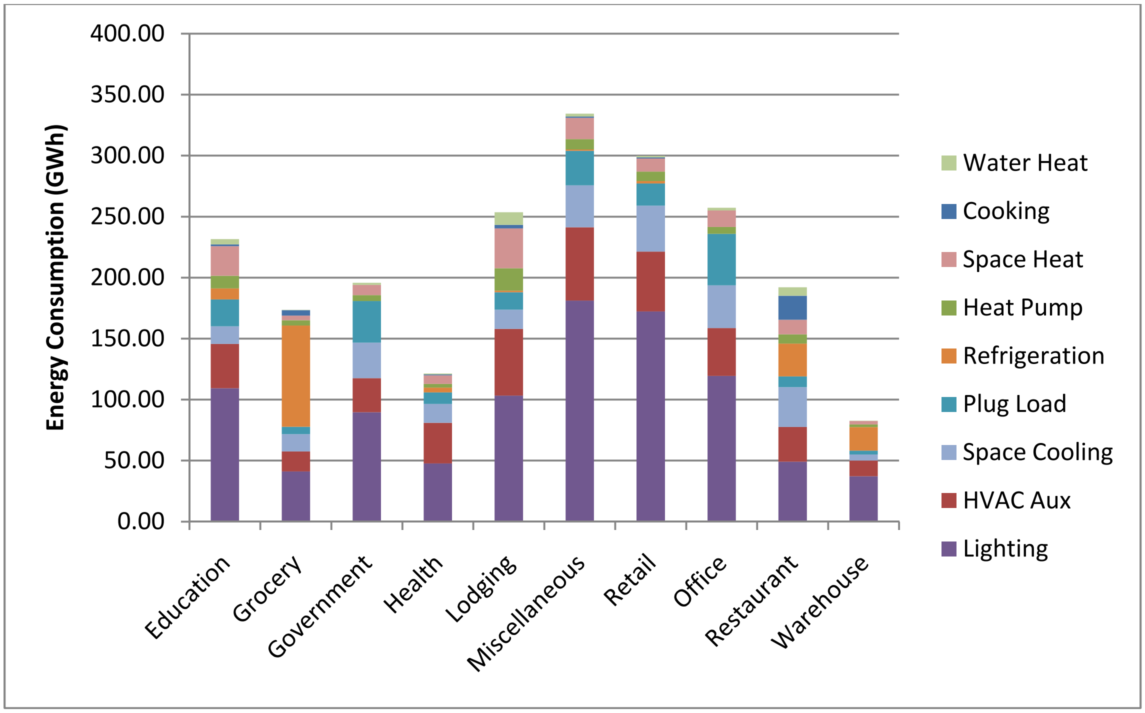

Figure 3.7 Commercial Energy Consumption by Sub-sector and End-Use

Figure 3.7 illustrates energy consumption by sub-sector and highlights the significant impacts each end-use has on the energy consumption. For instance, the refrigeration end-use comprises a significant share of the energy consumption in the grocery, restaurant and warehouse sub-sectors.

3.4 INDUSTRIAL END-USE AND LOAD PROFILES

The industrial sector is the largest sector and is responsible 5,499 GWh of electric consumption, which accounts for 41% of Tri-State's total electricity sales. In general, Tri-State's industrial sector is unique since approximately 49% of the sector consumption is from the oil and gas industry and less than 20% is from manufacturing industries. Many of the industrial customers are considered to be large users, with 82% of the industrial premises having peak demand greater than 250kW.

3.4.1 Results by Sub-Sector

Since the Nexant team only had business types for large commercial/industrial customers over 250KW, an analysis step was to segment the remainder of customers into distinct industrial business types. The analysis methodology heavily relied on information gained from the member interviews and available secondary data. Assumptions used in this segmentation analysis were checked in the load calibration analysis of the end-use profile. The following industrial business types were utilized for industrial sub-sectors:

- Agriculture
- Construction
- Mining
- Liquid Mining (Oil, Gas and Carbon Dioxide)
- Manufacturing (general)
- Transportation
- Utilities
- Pipeline Transportation (Oil, Gas and Carbon Dioxide)

The manufacturing sub-sector was not broken down further due to its small size and relative homogeneity. The overall industrial energy consumption by sub-sector is shown in Figure 3.8.

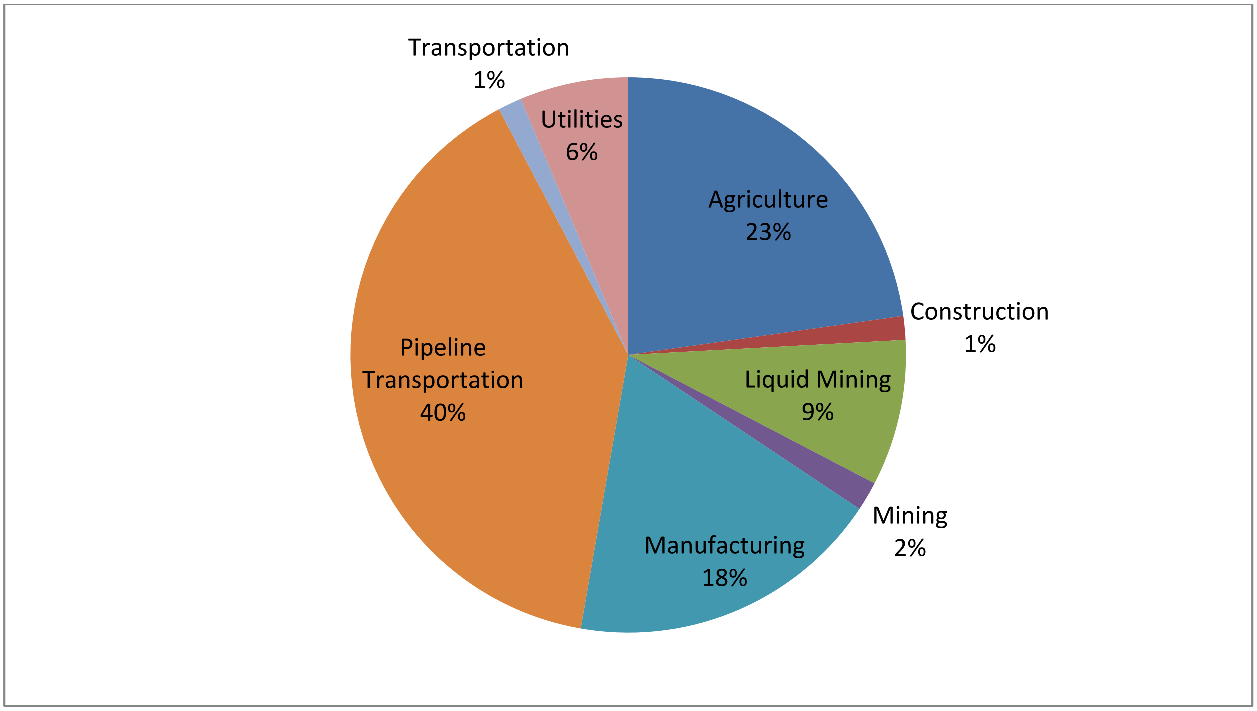

Figure 3.8 Industrial Energy Consumption by Sub-Sector

The most significant industrial sub-sector is pipeline transportation facilities for crude oil, natural gas and carbon dioxide, with 81 facilities over 250 kW within Tri-State's service territory. These facilities are usually compression and lift stations and operate with very high load factors. The second largest industrial sub-sector is agriculture, which includes non-irrigation agricultural business types, such as cattle and pig feedlots, postharvest crop activities and grain elevators. Table 3.4 summarizes industrial sub-sector energy consumption by region.

Table 3.4 Industrial Sub-Sectors by Region

Sub Sector	ECO	WY	SNM	NNM	NE	WCO	MCO	FRCO
Agriculture	22.7%	3.2%	10.4%	3.6%	22.1%	2.8%	0.0%	6.9%
Construction	1.4%	0.8%	1.9%	0.7%	2.2%	0.6%	1.1%	1.1%
Liquid Mining	8.5%	65.9%	5.8%	21.9%	13.8%	40.5%	68.1%	8.5%
Mining	1.7%	5.7%	6.1%	10.7%	2.2%	18.1%	23.2%	2.1%
Manufacturing	18.4%	3.1%	16.0%	21.0%	21.7%	5.3%	3.0%	59.7%
Pipeline Transportation	39.6%	18.5%	38.6%	36.5%	28.1%	29.8%	2.6%	12.5%
Transportation	1.4%	1.0%	1.9%	0.7%	4.8%	0.6%	0.5%	1.5%
Utilities	6.3%	1.8%	19.1%	4.8%	5.1%	2.3%	1.6%	7.7%
Total Energy Sales (GWh)	**370.9**	**1,057.6**	**188.0**	**1,030.5**	**134.1**	**1,224.7**	**480.0**	**1,013.6**

3.4.2 Results by End-Use

The Nexant team identified the appropriate energy usage fraction for each industrial end use studied. These energy end-use shares were calculated based on other applicable regional and national industrial end-use studies. Figure 3.9 summarizes the energy consumption for each end-use.

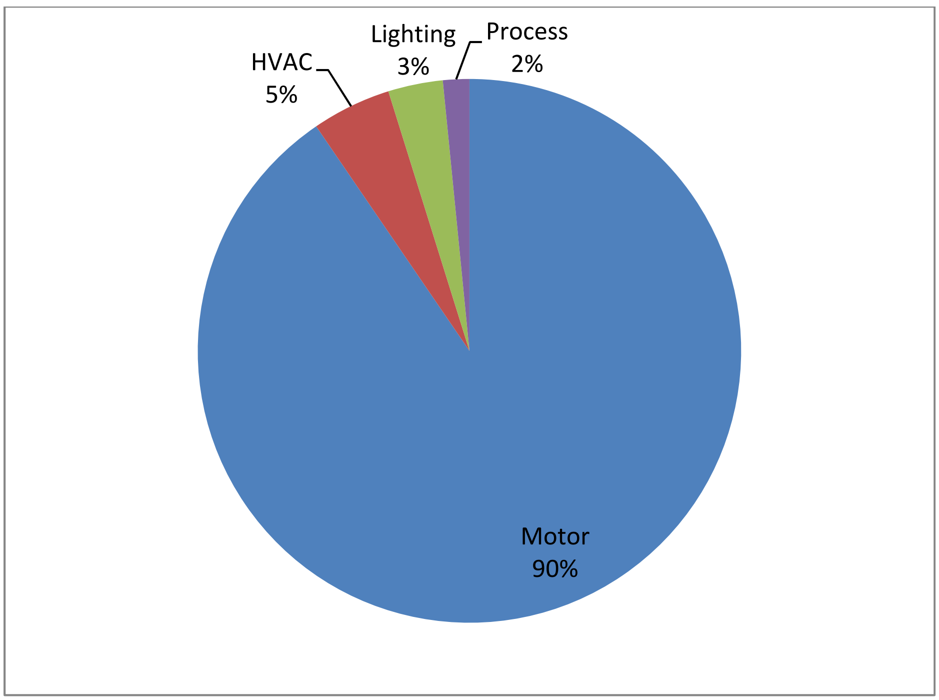

Figure 3.9 Industrial Energy Consumption by End-Use

3.5 IRRIGATION END-USE AND LOAD PROFILES

The irrigation sector is the smallest major sector and is responsible 1,283 GWh of electric consumption, which accounts for 9% of Tri-State's total electricity sales. Although irrigation is the smallest of the four sectors studied in this report, Tri-State's irrigation sector is unique because it comprises a much larger percentage of the total sales as compared to other utilities serving metropolitan communities. Additionally, since this load is seasonal and only operates from April until October, it can contribute as much as 20% of Tri-State daily load share during July and August.

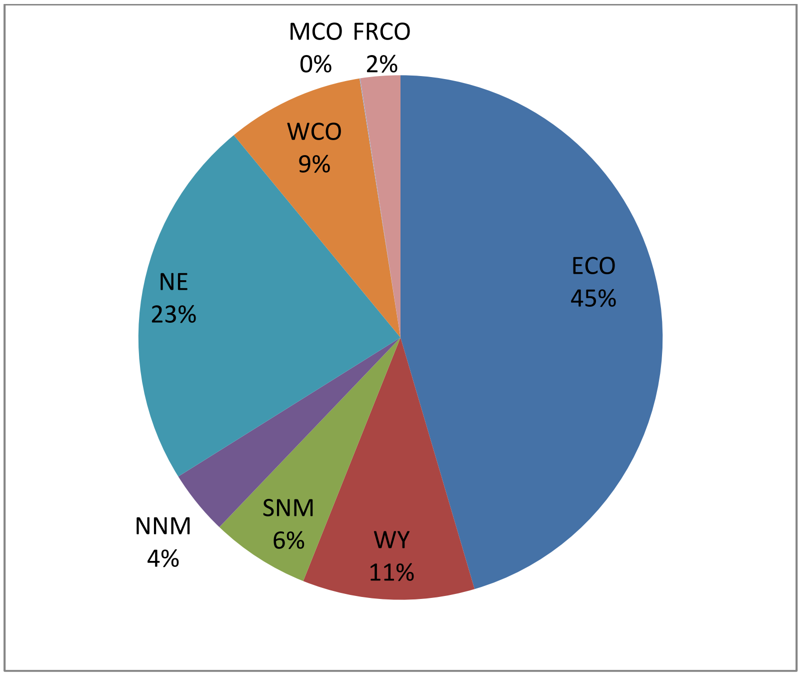

Figure 3.10 Irrigation Sales by Region

Figure 3.10 indicates the irrigation energy consumption share for each region analyzed. Eastern Colorado has the largest share of irrigation energy consumption by a wide margin and is followed by the Nebraska region. The Mountain Colorado region has a negligible market share of irrigation sales.

Irrigation energy usage is entirely attributable to electrical motors. These motors serve several different purposes, including well lift pumps, supplemental pressure boost pumps, drive motors for center pivots, and gate motors. Through Nexant's experience and research, it was determined that the major application for irrigation electricity is well lift pumps and supplemental pressure boost pumps; consequently, analyses and measures were developed for these end-uses. In order to fully understand measure saving impacts, Tri-State's 2008 sales were calibrated using the calculation methodology described in the following paragraphs.

3.5.1 Energy Consumption

Annual energy consumption was calculated using standard engineering methods as documented in Section 15 of the Soil Conservation Service (SCS) National Engineering Handbook[1], as maintained by the USDA.

Determining Total Dynamic Head

It is necessary to consider both the suction and discharge sides of the pump when determining the total dynamic head. Thus, the *tdh* equals the total dynamic suction lift plus the total dynamic discharge head, minus the suction velocity head.

Part 1 – Compute Total Dynamic Suction Lift

The suction lift consists of several components:

1) Static suction lift
2) Friction head in pipes
3) Friction head losses in strainers, valves, elbows, and other fittings
4) Velocity Head

The static suction lift was determined from analyzing irrigation well data from various agencies (more detail provided below). In practice the largest component is the static suction lift, and the friction head and velocity head are very small. Thus a small value for friction and velocity may be assumed for purposes of simplification. It was assumed that the total of components 2 thru 4 was 15 feet for calculations.

Part 2 – Compute Total Dynamic Discharge Head

The dynamic discharge head consists of the following components:

1) Static discharge head
2) Friction head in pipes
3) Friction head losses in strainers, valves, elbows, and other fittings
4) Velocity head at the end of the discharge pipe
4) The pressure required at end of line.

As above, the friction losses and velocity losses are very small, and were combined with the losses above. Because the majority of systems were assumed to be center-pivot systems, the

[1] Editor, Chapter 8 (Irrigation Pumping Plants), Section 15 (Irrigation), Soil Conservation Service National Engineering Handbook, United States Department of Agriculture.

operating pressure was assumed to be 65 psi. When multiplied by 2.31 feet, this becomes about 150 feet of head.

Determining Static Suction Lift and Gallons per Minute

As mentioned above, the largest component of the suction lift is the static suction lift. Investigation and discussion with various government agencies revealed that well databases are maintained by Water Resource Departments in every state that Tri-State operates. These databases have been maintained by decades, and generally document any and all uses of water produced from an operating well. Although the integrity of data in these datasets is somewhat problematic, it was judged that in the absence of better data from actual irrigation customers of Tri-State, it was the most reliable source. In most cases, these datasets contain well depth, well count, flow rate (gpm), and in some cases, the pump depth.

Consequently, databases were obtained from the Water Resource Boards in the states of Colorado, Nebraska, New Mexico, and Wyoming. The records were parsed and filtered based upon the end use, namely irrigation. In all cases, the county in which the well was drilled was stored, so that well metrics (counts, minimum depth, maximum depth, average depth, average gpm, etc.) could be obtained on a per-county, per state basis. Then the data was aggregated to correspond with the 8 regions as defined by this study. The county metrics were weighted, based upon the irrigated acres for that county, and then used to determine region-wide metrics. As a check, the metrics were weighted 3 ways: by irrigated acres, total acres, and well count.

Determining Annual Operating Hours

In order to estimate annual operating hours, various assumptions had to be made. It was assumed that a standard center pivot system serves 120 acres (equivalent to a ¼ mile radius), and pumps 900 gpm. This can be described by the following equation:

$$Oper.Hours = \frac{Acres \times (NIR/12) \times 43{,}560(ft^3/acre \cdot ft) \times 7.48(gal/ft^3)}{gpm \times 60(\min/hr)}$$

$$Oper.Hours = \frac{120 \times (NIR/12) \times 43{,}560(ft^3/acre \cdot ft) \times 7.48(gal/ft^3)}{900 \times 60(\min/hr)}$$

$$Oper.Hours = 60.34 \times NIR$$

Where NIR = net irrigation requirement (inches)

Thus, by determining the average annual irrigation requirements for various crops in the area of interest, the annual operating hours can be estimated. To this end, a large number of representative crops were investigated for the Tri-State territory, and the irrigation requirements were aggregated based upon the evapotranspiration (ET) requirements and normal year precipitation. In some cases, the state agencies had prepared normal-year estimates of the ET requirements for common crops such as alfalfa, corn, wheat, grass hay, dry edible beans, barley, and pasture grass. The per-crop, per-county ET requirements were averaged so as to provide weighted averages for the regions. The average operating hours and average pumping lift which are displayed in Table 3.5 for each of the regions.

Table 3.5 Annual Irrigation Operating Hours and Lift

Region	Average Annual Operating Hours	Average Lift (ft)
ECO	1,250	106
FRCO	1,200	30
MCO	1,250	1,905
WCO	1,300	510
NNM	1,400	44
SNM	1,550	57
WY	1,250	41
NE	1,200	63

3.6 OTHER KEY FINDINGS FROM MEMBER INTERVIEWS

The interviews with the cooperative members were not only a critical information source for the end-use analysis, but also provided some valuable information analysis inputs. These interviews influenced inputs such as measure baselines and market penetration rates, and were instrumental in calibrating the results for each of Tri-State's regions.

3.6.1 Measure Baseline Information

To determine appropriate baseline information, Nexant surveyed member co-ops about the existence of energy codes in each region. The following statistics were found:

- 38% of surveyed cooperatives identified their communities as having or developing energy codes more strict than baseline codes (2006 International Energy Conservation Code).
- 38% of surveyed cooperatives identified their communities as having no energy code.

3.6.2 Market Penetration Rates (Current)

Nexant questioned the co-ops about which DSM programs offered by Tri-State are subsequently offered to the customer. This data was collected to help develop and adjust market penetration rates by end-use and region. It was found that 62% of cooperatives pass through at least 95% of Tri-State's programs to customers. Additionally, the most popular Energy Efficiency Credit Programs were:

- Compact Fluorescent Lamps
- High Efficiency Electric Water Heaters
- Energy Star Refrigerators

3.6.3 Market Penetration Rates (Forecasted)

To help evaluate the barriers to DSM program adoption, Nexant asked the co-ops if they anticipated limiting program development and why. The following results were found:

- 46% of cooperatives will likely limit new program development; factors for filtering programs include:
    - Customer applicability and perceived market potential.
    - Lack of developed trade ally network.
    - Cooperative willingness based on business model.
    - Required In-house and Tri-State technical expertise.
- Energy Star brand is widely recognized.

4.1 OVERVIEW

The residential sector is responsible for 4,335 GWh of electric consumption, and accounts for 33% of Tri-State's total electricity sales. By regional co-op grouping, residential sales range from 19.2% to 46.5% of total sales. The characteristics of a residential dwelling have only slight variations throughout the regions in this study; including small but notable variations in average home size and equipment saturations. Residences have a large number of end-uses and therefore can benefit from a large number of energy efficiency measures.

Nexant evaluated a large number of potential energy efficiency measures pertaining to each of the residential end-uses, including those that are currently offered by Tri-State. These measures included mature technologies, emerging technologies, maintenance measures and behavioral modification techniques.

Nexant's calculation of achievable potential under a moderate incentive scenario resulted in savings of 23.1 GWh in 2010 which grow to 50.7 GWh in 2015 when the programs reached maturity. These values represent 0.5% and 1.0% of the total residential annual sales respectively. Nexant forecasts a total summer peak reduction of 4.1 MW in 2010, growing to 8.9 MW in 2015, based on the same incentive scenario.

4.2 RESIDENTIAL POTENTIAL MODELING

Nexant built a spreadsheet model to evaluate the potential energy savings in the residential sector, and calculate the economic outputs associated with the DSM resource. The model inputs measure data, regional baseline characteristics, and economic variables to output savings potential are specifically calibrated to the market variables pertinent to each region.

4.2.1 Measure Overview

For the residential sector Nexant evaluated approximately 170 unique energy efficiency measures. These measures were selected with consideration of DSM program design and implementation, with a comprehensive suite of measures available for each residential end-use. Sources for the measure database included current Tri-State programs, other utility DSM programs, and studies of emerging technologies.

Upon selection of appropriate efficiency measures, Nexant assembled a database of measure information including energy savings, peak demand savings, customer costs, and expected lifetimes. This information was determined for new installation, equipment turnover, and early retirement situations, in each of the three climate zones. Where deemed values were appropriate this data was adapted from existing measure databases. In many cases, where variations between climate zones or installation scenarios existed, Nexant relied on engineering calculations and models to determine appropriate data.

The end-use and load profile portion of the study characterized Tri-State's sales using a total of 18 end-use categories. The measures were bundled together based on their applicable end-use. An additional category was included for purposes of evaluating behavioral changes. Since these changes can impact all of the end-uses, the 'overall' category encompasses the UEC of all the other end-uses. The final measure categories evaluated for the residential sector included:

- Lighting – Interior
- Lighting – Exterior
- Space Cooling – Room Air Conditioning
- Space Cooling – Evaporative Cooling
- Space Cooling – Central Air Conditioning
- Space Cooling – Heat Pump
- Space Heating – Central Heating
- Space Heating – HVAC Auxiliary
- Plug Load – Cooking
- Plug Load – Washing Machine
- Plug Load – Dryer
- Plug Load – Dish Washer
- Plug Load – Water Heating
- Plug Load – Refrigerator
- Plug Load – Second Refrigerator
- Plug Loads – Freezer
- Plug Load – Exterior Loads
- Plug Load – Plug Loads
- Behavioral Feedback

For new construction and turnover installations, measure baseline was defined primarily by IECC 2006 if an efficiency or minimum requirement was specified. For the residential measures, IECC 2006 provided specifications primarily for heating, cooling and envelope (insulation) measures. In some cases, recent changes to federal code were adopted over the IECC code because the code would take precedence in all regions. Baselines for other measures were adopted from measure data bases and utility work-papers as appropriate for the member co-ops' service territories. Measure baselines for early retirement scenarios were adjusted from these new construction levels based on Nexant's knowledge of old code specifications, equipment performance degradation, and regional code compliance.

4.2.2 Market Inputs

In addition to gathering measure level data, Nexant assembled the pertinent regional data and economic inputs necessary to complete the residential modeling.

Regional Inputs

Much of the regional data was derived from the end-use and load profile study. The primary regional inputs needed were the total premise count, end-use Unit Energy Consumption (UEC) and saturation. This data was assembled from the end-use and load profile study, and uniquely calibrated to the energy sales of each regional grouping. Expected improvements and code, and other general trends were built into the UECs based on the trends found in the U.S. Energy Information Administration's forecasts. In general these trends showed a decrease in all end-use UECs with the exception of plug loads, which showed an increasing trend.

For the residential model, the energy usage was calculated using premise count, saturation and UEC. The product of all these factors is equal to the total energy usage by region and Tri-State overall.

Economic Inputs

To accurately determine the cost effectiveness of each measure and evaluate the overall economics of the DSM resource, Nexant input a number of economic variables into the residential model. First, Nexant was provided with Tri-State's avoided energy cost forecast on an hourly level as well as annual avoided capital costs to reflect reductions in system peak demand. The hourly avoided energy costs were averaged for six usage periods (on and off peak for summer, winter, and shoulder months). Load shapes for each end-use were then applied to these periods to find an average annual avoided cost value.

To accurately value avoided energy savings for Tri-State, Nexant calculated the expected losses from the customers' meters to Tri-State's generation. These losses were calculated for each climate zone, and reflected the losses from the customer to the co-op and the losses from the co-op to Tri-State. In addition to line losses, Nexant applied a discount rate of 8% to value future avoided costs.

Finally, Nexant assigned an expected program administration cost to the model. This value includes costs to Tri-State for running the DSM programs, excluding the customer incentive. This cost includes general activities such as rebate processing, trade-ally organization, and technical assistance. While Nexant was provided with aggregate administrative costs, incremental administrative costs per unit savings were unavailable. For calculation of the TRC test, Nexant assumed a value of $0.05 per first year kWh saved which reflects the typical costs of a utility in the ramping stages of DSM programs. This rate reflects the cost of processing applications and issuing rebate checks, the minimum costs needed to assessment measure cost-effectiveness. Administrative costs associated with marketing are added in independently of the TRC test, and are calculated at a slightly higher rate

4.2.3 Measure Screening Results

With the appropriate input variables in place, Nexant was able to apply the Total Resource Cost (TRC) test to each measure. Approximately 25% of the initial residential measures passed the TRC test performed for this study. It is important to note that the TRC test is very sensitive to changes in the input values. Changing the measure cost or energy savings even a small amount can in some cases mean the difference between a passing measure and a failing one. For this reason, Nexant recommends the continuing review of these measures as the program matures. A complete listing of all measures and the results of their respective TRC tests may be found in Appendix B.

There was a hand full of measures in this study that fall on the border of passing and failing. These measures include:

- Evaporative coolers
- Air source heat pump
- Central air conditioner
- Air to air heat recovery
- Attic insulation
- Basement insulation
- Wall insulation
- Duct insulation

- Energy Star DVD and VCR players
- LED lighting
- In home energy usage displays
- Duct sealing
- Window film
- Programmable thermostats

Many of the above measures did pass the TRC test with a narrow margin. Others that did not pass the TRC test for one end-use, climate zone or change case did pass for a different scenario. This is due to the differing characteristics of the baseline condition that the measures are compared to, and the differences in measure cost and load shape from one climate zone or change case to the next.

Measure Additions

At the baseline avoided cost level, Nexant found many measures that could be added to Tri-State's suite of DSM programs. Nexant identified many cost-effective lighting measures for various applications. New lighting measures included an assortment of permanently installed compact fluorescents, LEDs, and lighting controls.

Several new HVAC measures passed the TRC test including evaporative coolers and programmable thermostats. Additionally, Nexant was able to identify a few envelope measures as cost-effective; including attic and floor insulation increases and self-installed weatherization. Tri-State may benefit from expanding its water heating program to include measures such as low flow showerheads, faucet aerators, water heater setbacks and pipe and tank insulation. Drain water heat recovery passed the economic screening, although only in new construction as they require a more complex installation.

Nexant found many cost-effective plug load measures that Tri-State should consider adding to its current plug load offerings. These measures consisted of Energy Star home office equipment, Energy Star home entertainment equipment, and "smart" power strips.

Finally, in-home energy displays, and customer feedback type programs were found to save energy, be economical, and provide customers with a way to connect with and curb their energy usage. However, these measures are most effective where a demand rate pricing structure is employed because they help the customer save money.

Existing Program Modifications

Nexant evaluated the measures currently offered by Tri-State and found the residential programs are still cost-effective. Energy Star dishwashers and clothes washers are very sensitive to economic inputs as they relate to the TRC test. It is recommended that Tri-State's assumptions for cost and savings of these measures be carefully evaluated and updated as needed.

4.3 RESIDENTIAL POTENTIAL RESULTS

The potential DSM resource was evaluated using the methodologies presented in Section 2 and described in detail in the previous paragraphs. The savings potential is presented in the following sections, along with a discussion of the results and recommendations for moving forward. Nexant's complete findings may be found in Appendix A

4.3.1 Savings Potential Overview

The following sections present Nexant's overall findings of technical, economic, and achievable savings potential, along with the associated economic outputs.

Savings Potential

Nexant first evaluated the overall technical potential savings. It was found that the technical potential in 2010 is 181.2 GWh, growing to annual savings of 196.8 GWh in 2015 when the programs have matured. These figures represent 4.0% and 3.9% of the total residential forecasted sales in each year respectively. Cumulative energy savings in 2015 reach 1,143.6 GWh and account for 22.4% of the forecasted residential sales. It is expected that annual peak demand reductions reach 37.1 MW in 2010 and grow to 40.5 MW by 2015.

Measures that did not pass the TRC test were removed and the total savings were recalculated to determine economic potential. Total residential economic saving potential in 2010 is calculated as 104.6 GWh and grows to 110.7 GWh by 2015. These savings make up 2.3% and 2.2% of the total sales in each year respectively. Cumulative energy savings in 2015 reach 649.8 GWh and account for 12.7% of the forecasted residential sales. Annual peak demand reductions reach 17.9 MW in 2010 and grow to 18.8 MW by 2015.

Finally, Nexant evaluated barriers to market acceptance of Tri-State's DSM programs and calculated the achievable savings potential. The theoretically achievable potential savings were calculated using four different levels of marketing and incentive aggressiveness (25-100% of measures' incremental costs). Table 4.1 summarizes the savings potential for each scenario.

Table 4.1 Summary of Potential Savings and Percent of Forecasted Sales

Load Type	Ach. – Low		Ach. – Mod		Ach. – Agg		Ach. – Max	
Energy Savings (GWh)								
2010	19.9	0.4%	23.1	0.5%	27.0	0.6%	31.6	0.7%
2015	43.6	0.9%	50.7	1.0%	59.1	1.2%	69.2	1.4%
Cumulative, 2015	195.2	3.8%	227.5	4.5%	266.1	5.2%	312.3	6.1%
Cumulative, 2025	472.6	7.4%	559.7	8.7%	663.8	10.4%	787.5	12.3%
Demand Savings (MW)								
2010	3.6	-	4.1	-	4.7	-	5.5	-
2015	7.7	-	8.9	-	10.3	-	12.0	-
Cumulative, 2015	34.7	-	40.1	-	46.5	-	54.1	-
Cumulative, 2025	80.9	-	95.0	-	111.8	-	131.5	-

Tri-State's annual forecast and the inputs described in the sections above were used to calculate the savings potential through 2025. The annual energy savings and demand savings for each potential scenario are shown in Figure 4.1 and Figure 4.2 respectively. Figure 4.3 shows the expected energy forecast with the DSM energy savings removed.

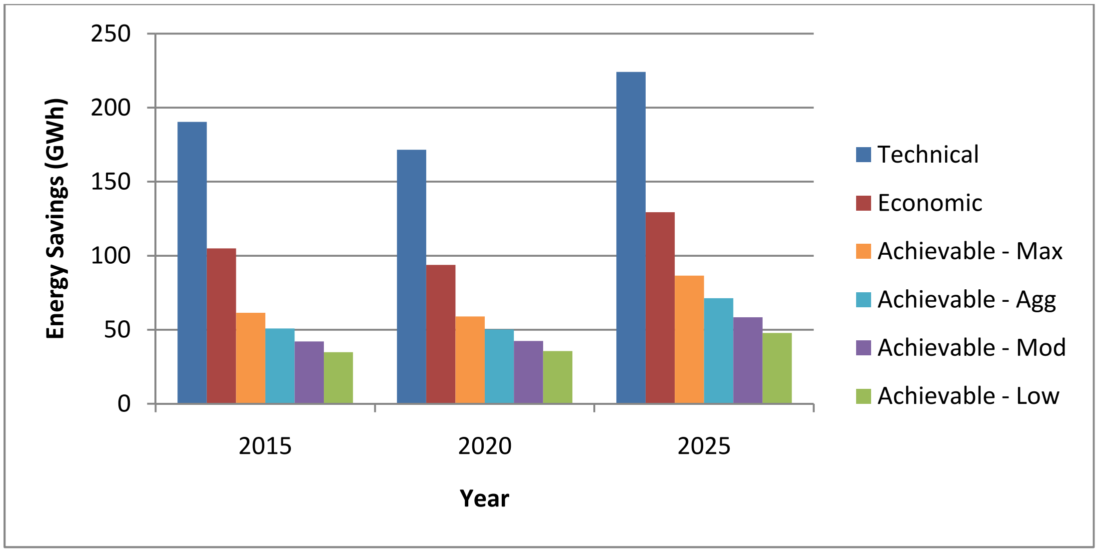

Figure 4.1 Residential Annual Energy Savings

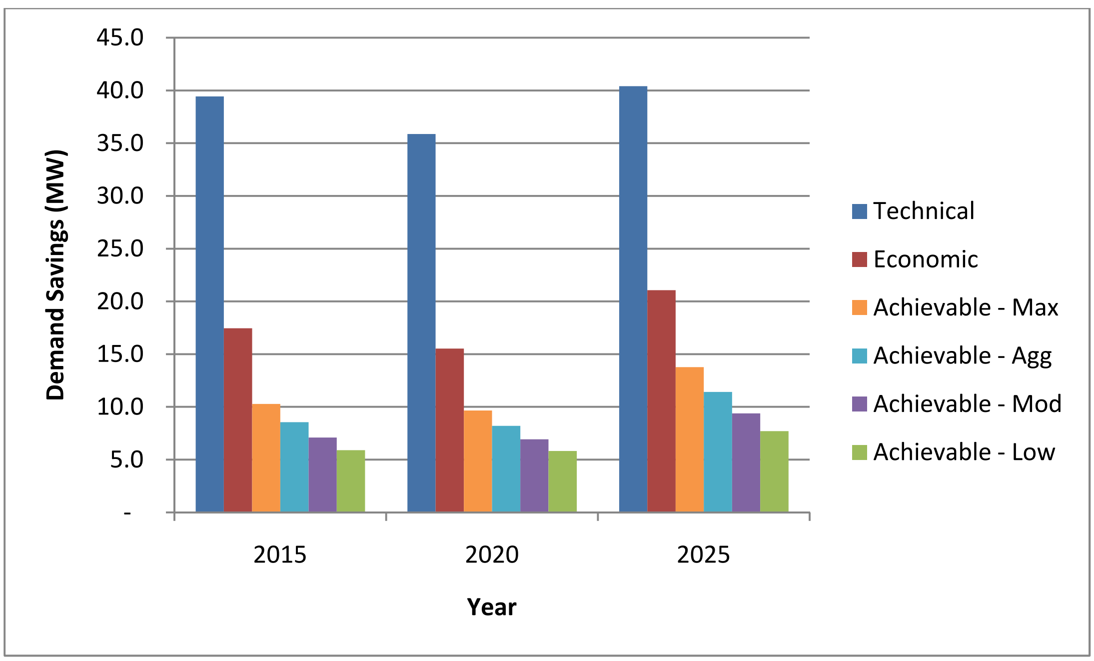

Figure 4.2 Residential Annual Demand Savings

As shown in the figures above, the theoretically achievable savings ramp up quickly as Tri-State develops and launches new programs. The DSM programs reach maturity in roughly five years at which point savings growth will begin to proceed at a slower rate.

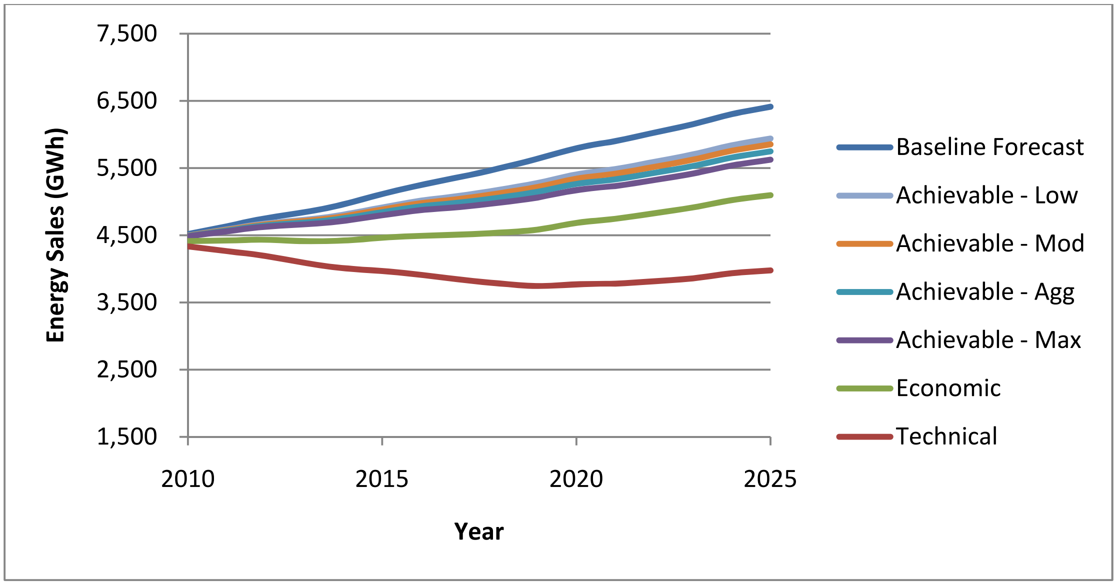

Figure 4.3 Residential Sales Forecast with Cumulative DSM Potential Removed

Figure 4.3, above, shows the baseline residential sales forecast, along with the same forecast with cumulative DSM potential removed. It should be noted that the cumulative energy savings are defined as the total savings available to Tri-State in any given year due to the previous years' DSM expenditures. The energy efficiency measures installed each year will provide Tri-State with energy savings for the entire life of the measure. However, when the measure life has expired, the energy savings are no longer counted toward the cumulative savings. For this reason, cumulative energy savings in 2025 is not equal to the sum of the annual energy savings from all previous years.

Economics

In addition to calculating total energy savings potential, Nexant used the economic inputs described in the preceding sections to calculate the economic variables and cost effectiveness of the DSM resource. Table 4.2 shows the economics for each of the achievable potential scenarios in 2015.

Table 4.2 Residential DSM Economics, 2015

Metric	Ach. – Low	Ach. – Mod	Ach. – Agg	Ach. – Max
Customer Costs[1]	$ 11.15	$ 13.08	$ 15.40	$ 18.18
Incentives[1]	$ 3.98	$ 8.31	$ 13.90	$ 20.80
Admin Costs[1]	$ 6.17	$ 6.40	$ 7.10	$ 7.93
Avoided Costs[1]	$ 33.89	$ 39.39	$ 45.93	$ 53.71
Levelized Utility Cost ($/kWh)[2]	$ 0.039	$ 0.049	$ 0.060	$ 0.070
TRC B/C Ratio	1.96	2.02	2.04	2.06

[1] Millions of dollars

[2] Levelized cost is calculated over the entire life of the program (2010-2025)

As shown above, each achievable scenario provides a cost effective DSM resource. For most scenarios the levelized cost is below Tri-State's avoided energy costs, making energy efficiency an attractive energy alternative. The levelized cost for the maximum achievable scenario begins to approach the low end of Tri-State's avoided supply costs.

4.3.2 Savings Potential by Region and End-Use

To provide increased resolution, Nexant's models were built to calculate savings potential on a regional and end-use level. The following sections show the various outputs for each regional grouping and by end use.

Savings Potential

Figure 4.4 shows the distribution of 2015 energy savings by regional grouping for a moderate incentive scenario. The share of energy savings by region does not vary significantly for the different achievable scenarios.

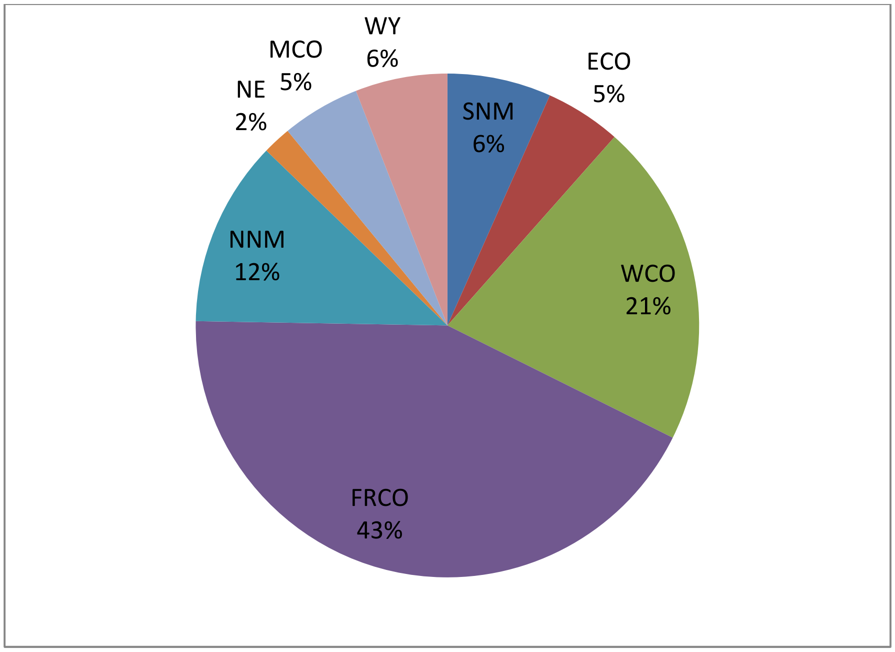

Figure 4.4 Energy Savings by Regional Grouping, 2015

Many inputs influence the regional shares of energy savings such as varying market penetration rates, differences in UECs, and climate. However, the greatest determining factor is baseline energy usage. Not surprisingly, the greatest amount of savings can be achieved in the areas with the largest energy usage.

The distribution of energy savings across the different regions is closely related to the distribution of baseline energy usage across the regions. Front Range Colorado has the largest potential energy savings because it has the largest population, largest home sizes, mature programs in place. Furthermore, this region has high equipment saturations overall, creating potential for energy savings across all end-uses. Like Front Range Colorado, Western Colorado has high equipment saturations; however, the Western Colorado population is somewhat smaller and the baseline energy forecast is smaller, caused primarily by a smaller demand for cooling, water heating and lighting usage as a result of smaller home size. Conversely, Nebraska has a low energy savings potential because the population is smaller and equipment saturations are lower. Similar to Nebraska, the remaining regions have low potential energy savings primarily due to smaller populations.

The total energy savings were aggregated by end-use across all of the sectors. Figure 4.5 shows the share of energy savings attributable to each end-use for a moderate incentive scenario in 2015. These shares do not change significantly with varying incentive scenarios; however, there is a change with time. Figure 4.6 shows the breakdown of energy usage by end-use in 2020. The primary end-uses shown in this figure are subdivided into technology types in the subsequent figures.

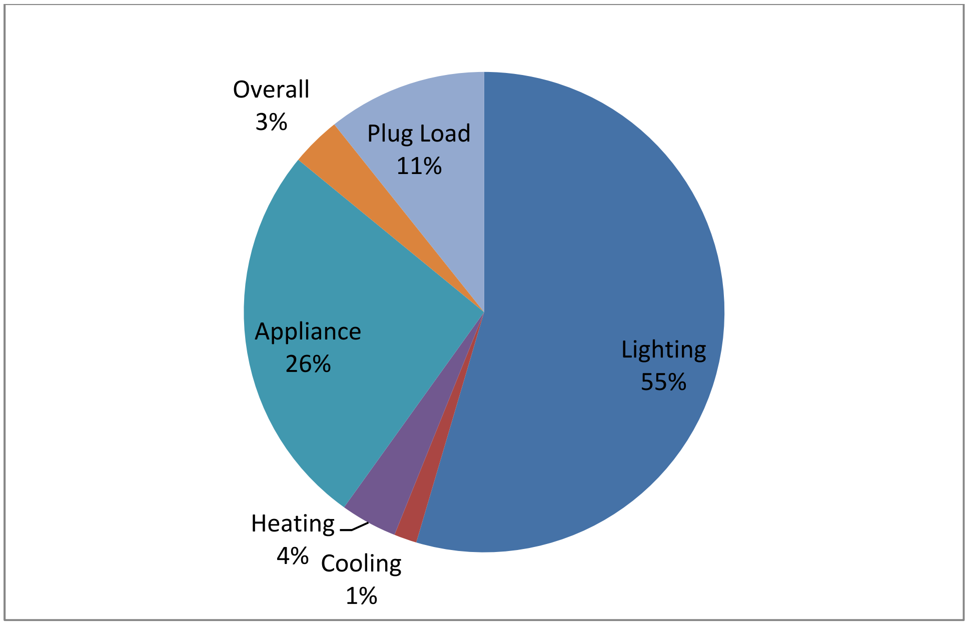

Figure 4.5 Energy Savings by Primary End-Use, 2015

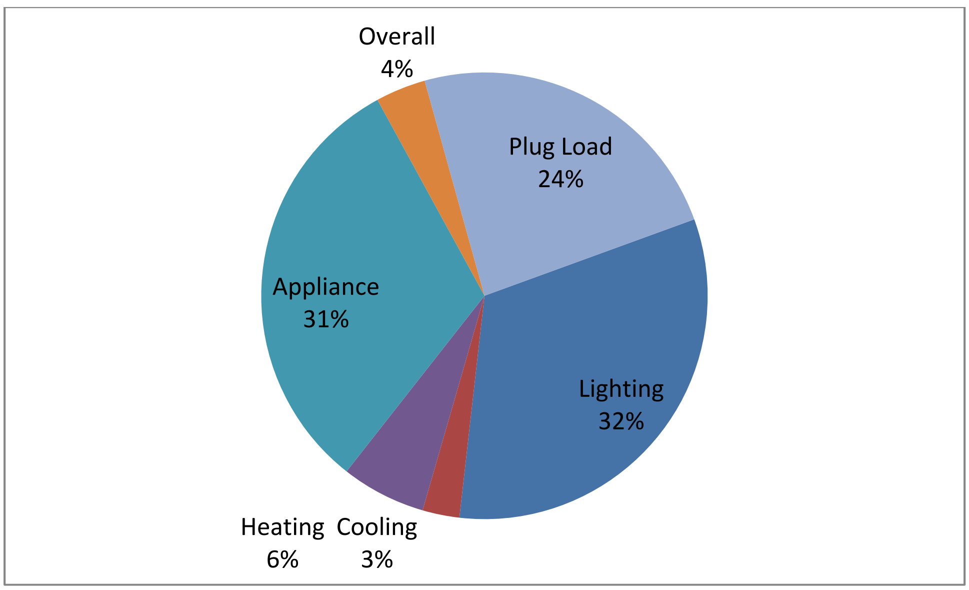

Figure 4.6 Energy Savings by Primary End-Use, 2020

As can be seen clearly in the figures above, the largest energy savings potential occur in the lighting, appliance, and plug load end-uses. Comparison of the savings shares in 2015 and 2020 shows a significant drop in lighting savings. This is due primarily to the code mandated shift away from incandescent light bulbs. While it is expected that new technologies will offer savings over CFLs, the efficiency increase will not be as significant as going from an incandescent bulb to a CFL.

Lighting is one of the largest energy consuming end-uses in a residential premise. Lighting has high market acceptance, as many of the upgrades are 'do-it-yourself' projects, and customers are willing to upgrade to high efficiency lighting. Furthermore, advancements in lighting technology have achieved immense energy savings, many high efficiency lighting technologies can be retro-fit with relative ease, and in the case of compact fluorescent lighting the technology is reasonably priced. For these reasons, lighting is cost-effective and can achieve large energy savings.

In this study, many appliances proved cost effective according the TRC test. Appliance technologies have achieved vast improvements in energy efficiency, especially when compared to the existing equipment baseline. The recycling programs are considered highly effective at removing secondary refrigerators and freezers, which are often old and inefficient. For this study, it was assumed that the recycled equipment was replaced by new, high efficiency equipment.

The plug load end-use refers to an array of Energy Star home electronics. Energy Star-rated electronics can save an average of 30% over standard equipment. Furthermore, Energy Star-rated electronics are often comparable in price to standard electronics making these measures cost effective for new and turnover conditions.

As discussed in the beginning of this section, the heating, cooling, lighting, appliance, plug load, and overall end-uses were sub-divided into technology types to provide further resolution of savings and economics. The breakdowns of energy savings within each end-use are shown in Figure 4.7 through Figure 4.10.

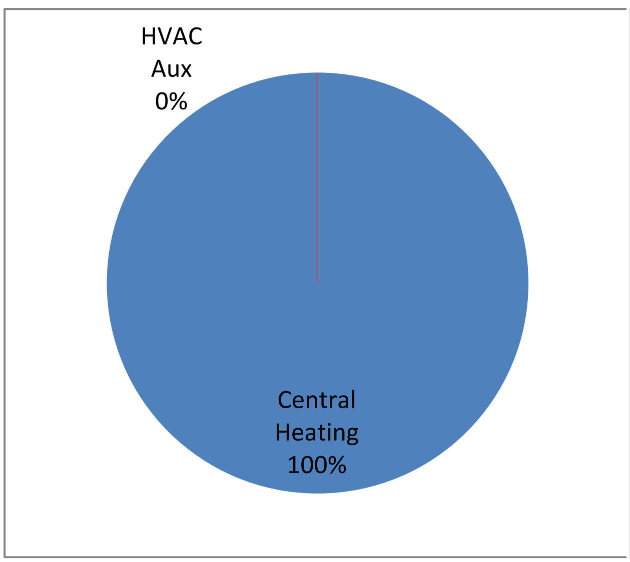

Figure 4.7 Heating Energy Savings, 2015

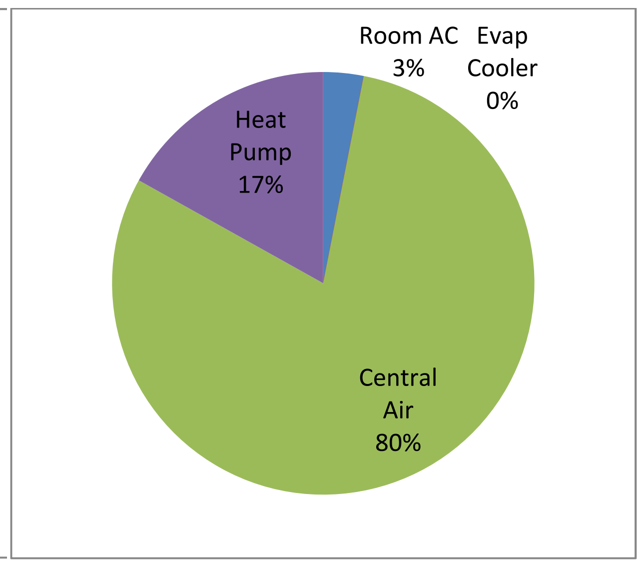

Figure 4.8 Cooling Energy Savings, 2015

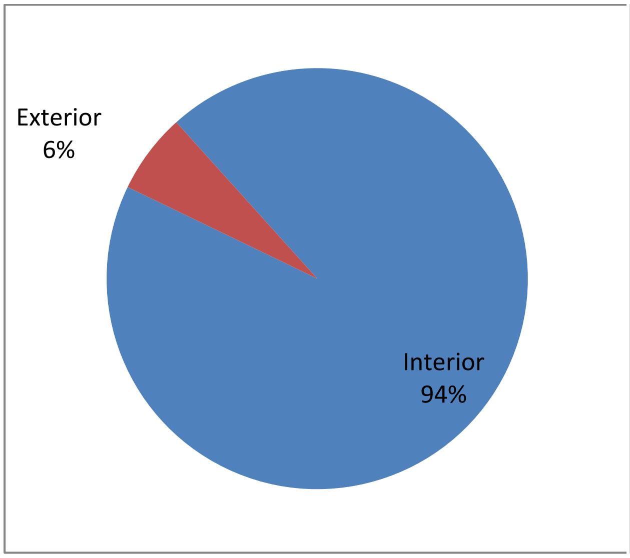

Figure 4.9 Lighting Energy Savings, 2015

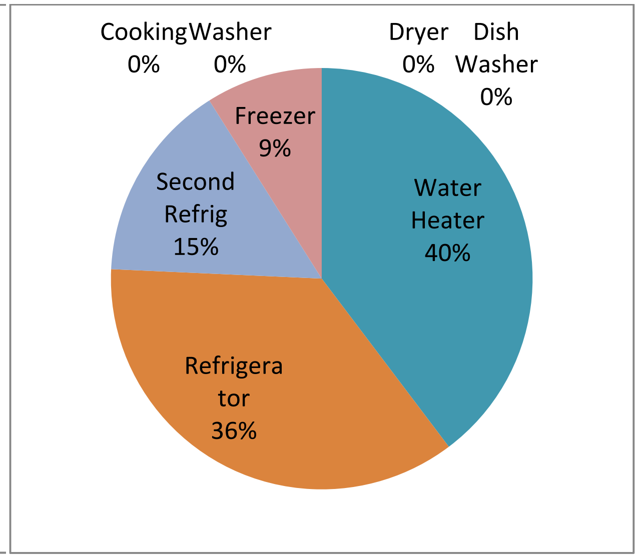

Figure 4.10 Appliance Energy Savings, 2015

The heating end-use is dominated by central heating measures, as none of the HVAC auxiliary measures examined were found to be cost-effective by the TRC test.

Cooling savings are dominated by central air measures. This is due to the large saturation of central air systems, major improvements in central air system efficiencies, and the cost-effective nature of a central air system. Heat pumps also make a contribution to energy savings; however, the saturation of heat pump systems in Tri-State's service territory is significantly lower than central air systems, and Nexant believes this trend will continue.

Lighting was divided into interior and exterior applications. Interior lighting has a much larger market share, as well as a larger array of applicable measures.

Appliances were divided into eight categories, pertaining to major appliance types. Electric water heating is the largest percentage of energy savings in this end-use. Nexant found a large number of measures to be cost-effective, including drain water heat recovery, high efficiency water heaters, low flow shower heads and faucets, tank and pipe insulation, and water heater temperature setbacks. Today, almost every residence has at least one refrigerator, providing a large opportunity for energy savings as new refrigerators can save up to 25% more energy than baseline equipment. This same benefit is shared with secondary refrigerators, which are often older, poorly maintained, and rarely used though constantly on. Energy Star freezers and freezer recycling account for 8% of the energy savings for this end-use. Similar to refrigerators, new freezers have made improvements in efficiency and can save up to 10% more energy than the baseline equipment. Washing machines and dishwashers just pass the TRC test, and their performance should be monitored throughout the life of their programs.

Plug loads are dominated by Energy Star home electronics. Energy Star home electronics can achieve up to 30% energy savings, while having costs similar to standard equipment.

The energy savings for each region are broken down by end-use in Table 4.3. This table shows a moderate incentive scenario in 2015. The energy savings shares are not expected to change significantly with difference scenarios, and with the exception of lighting, the shares should also remain fairly constant with time.

Table 4.3 Regional Energy Savings by Measure Category, Moderate Scenario, 2015

Measure Category	SNM	ECO	WCO	FRCO	NNM	NE	MCO	WY
Heating- Central Heat	1.23%	3.76%	4.42%	3.49%	2.44%	11.09%	8.31%	5.76%
Heating- HVAC Aux	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Cooling- Room AC	0.11%	0.09%	0.02%	0.03%	0.06%	0.20%	0.00%	0.10%
Cooling- Evaporative Cooler	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Cooling – Central Air	1.90%	1.76%	0.32%	1.99%	0.44%	3.27%	0.00%	0.45%
Cooling – Heat Pump	0.27%	0.36%	0.17%	0.31%	0.07%	1.49%	0.13%	0.35%
Lighting- Interior	54.57%	50.95%	51.70%	54.46%	57.08%	31.96%	49.58%	47.45%
Lighting- Exterior	4.06%	3.11%	3.37%	3.68%	3.57%	1.94%	3.04%	2.79%
Appliance- Cooking	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Appliance-Clothes Washer	1.03%	0.67%	0.92%	0.74%	0.91%	0.80%	0.81%	0.77%
Appliance- Clothes Dryer	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Appliance- Dish Washer	2.28%	1.84%	2.68%	2.29%	1.83%	2.21%	2.53%	2.02%
Appliance- Water Heater	7.32%	10.61%	8.66%	9.52%	7.37%	16.52%	11.44%	11.93%
Appliance- Refrigerator	10.98%	7.20%	9.41%	7.17%	11.37%	8.80%	8.89%	8.06%
Appliance- Second Refrigerator	4.06%	4.13%	3.35%	3.60%	3.05%	5.41%	2.78%	4.27%
Appliance- Freezer	3.13%	3.39%	2.35%	1.75%	2.51%	5.25%	2.68%	3.21%
Plug Loads- External Loads	1.64%	2.83%	1.39%	0.99%	1.49%	4.19%	1.32%	3.07%
Plug Loads- Miscellaneous	7.41%	9.29%	11.25%	9.96%	7.80%	6.89%	8.49%	9.76%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

The shares of energy savings by end-use in each region are fairly consistent. Differences between regions are due to varying measure savings, measure cost effectiveness, market penetration rates, and baseline energy usage. Overall savings shares are within a couple of percentage points between regions. The most significant variation occurs in Nebraska, where the saturation of electric water heaters is high. In Mountain Colorado, Wyoming and Nebraska the heating savings are larger due to higher heating baseline energy usage.

Economics

Nexant calculated the expected costs and benefits for each regional grouping and measure category. The anticipated economics for each region are presented for 2015 in Table 4.4.

Table 4.4 Residential DSM Economics by Region, Moderate Scenario, 2015

Metric	SNM	ECO	WCO	FRCO	NNM	NE	MCO	WY
Customer Costs ($)[1]	$893.3	$632.6	$2,702.6	$5,683.4	$1,569.1	$246.1	$630.1	$726.9
Incentives ($)[1]	$612.7	$390.5	$1,668.3	$3,508.3	$1,076.2	$217.0	$388.9	$448.7
Admin Costs ($)[1]	$461.6	$304.2	$1,294.1	$2,664.4	$822.9	$169.2	$314.8	$370.7
Avoided Costs ($)[1]	$2,783.8	$1,917.2	$8,109.1	$16,917.5	$4,691.9	$734.8	$1,958.2	$2,281.6
Levelized Utility Cost ($/kWh)[2]	$0.054	$0.047	$0.047	$0.048	$0.052	$0.070	$0.047	$0.046
TRC B/C Ratio	2.05	2.05	2.03	2.03	1.96	1.77	2.07	2.08

[1] Thousands of dollars

[2] Levelized cost is calculated over the entire life of the program (2010-2025)

As shown above, each region has the potential of achieving a DSM resource cost-effectively. Nexant also calculated the levelized cost and TRC ratio for each measure category to show which programs will provide Tri-State with the most cost effective DSM resource. The values for each category are shown in Table 4.5.

Table 4.5 Levelized Cost by Measure Category[1]

Measure Category	Levelized Cost ($/kWh)	TRC B/C Ratio, 2015
Heating- Central Heat	$0.064	1.71
Heating- HVAC Aux	N/A	N/A
Cooling- Room AC	$0.067	3.39
Cooling- Evaporative Cooler	N/A	N/A
Cooling – Central Air	$0.094	1.21
Cooling – Heat Pump	$0.049	2.38
Lighting- Interior	$0.039	2.29
Lighting- Exterior	$0.110	1.20
Appliance- Cooking	N/A	N/A
Appliance-Clothes Washer	$0.101	1.16
Appliance- Clothes Dryer	N/A	N/A
Appliance- Dish Washer	$0.075	1.24
Appliance- Water Heater	$0.040	2.93
Appliance- Refrigerator	$0.057	1.66
Appliance- Second Refrigerator	$0.059	1.56
Appliance- Freezer	$0.047	2.47
Plug Loads- External Loads	$0.043	2.17
Plug Loads- Miscellaneous	$0.044	2.19
Behavioral Feedback	$0.046	2.09

[1] Levelized cost is calculated over the entire life of the program (2010-2025)

4.4 CONCLUSIONS AND RECOMMENDATIONS

Nexant found that Tri-State has significant room to expand its residential DSM programs. Tri-State would benefit from a careful evaluation of the recommended measure additions presented in this section. The majority of the theoretically achievable savings potential was found to be due to measures currently included in Tri-State's programs. A few additional measures were found to have energy saving potential, including many plug load measures. These new measures should be carefully evaluated within the context of DSM program design and considered for inclusion in the current suite of programs.

Finally, it is recommended that Tri-State carefully evaluate and justify its current measure assumptions to ensure that all data is up-to-date and accurate. Changes in both internal and external market forces may result in variations of measure cost-effectiveness. As new DSM programs are launched, Tri-State would benefit from continuous measurement and verification and market research to keep measure data accurate, particularly for measures with current TRC ratios close to one.

5.1 OVERVIEW

The commercial sector is responsible 2,033 GWh of electric consumption, which accounts for 14% of Tri-State's total electricity sales. The commercial share of energy sales by regional co-op grouping ranges from 4% to 24% of total sales. In general, the commercial sector covers a large spectrum of customers and is characterized by a high degree of variation in electricity consumption, resulting in many potential energy efficiency measures.

At the time of this study, Tri-State was offering rebates for a handful of measures for nearly all of the commercial end-uses. In addition to these measures, Nexant evaluated a large number of additional commercial technologies applicable to all of the commercial end-uses. These measures were both well established in the market place and undergoing recent emergence.

Nexant's calculation of achievable potential under a moderate incentive scenario (50% of incremental cost) resulted in savings of 2.3 GWh in 2010, growing to annual savings of 16.8 GWh in 2015 when programs mature. These values represent 0.1% and 0.7% of the total commercial annual sales respectively. Nexant forecast a total summer peak reduction of 0.5 MW in 2010, growing to an annual reduction of 3.5 MW in 2015, based on the same incentive scenario. Meeting these potential levels will require the expansion of existing programs, as well as the adoption of new programs.

5.2 COMMERCIAL POTENTIAL MODELING

Nexant built a spreadsheet model to evaluate the potential energy savings in the commercial sector and to calculate the economic outputs associated with the DSM resource. The model incorporates measure data, regional baseline characteristics, and economic variables to output savings potential specifically calibrated to the market conditions pertinent to each region.

5.2.1 Measure Overview

In the commercial sector roughly 200 unique energy efficiency measures were selected. These measures were selected with consideration for DSM program design and implementation and provide a comprehensive suite of measures for each end-use. The measure database drew technologies from the current Tri-State programs, other utility DSM programs, and studies of emerging technologies.

Upon selection of appropriate efficiency measures, Nexant assembled a database of measure information including energy savings, peak demand savings, customer costs, and expected lifetimes. This information was determined for new installation, equipment turnover, and early retirement situations, in each of the three climate zones. Where deemed values were appropriate, this data was adapted from existing measure databases. In many cases, where variations between climate zones or installation scenarios existed, Nexant relied on engineering calculations and models to determine appropriate data.

The end-use and load profile portion of the study characterized Tri-State's sales using a total of nine end-uses. To calculate savings potential the measures were bundled together based on their applicable end-use. To provide deeper resolution into the savings potential, and account for technology differences within the end-uses, the lighting, space cooling, and plug load categories were subdivided further. Lighting was broken down into fluorescent, incandescent, high-bay, and signage applications. The space cooling end-use was divided into packaged DX systems and chiller systems. Plug load energy usage was split into office equipment and large appliances. The allocation of energy usage to each subdivision was based on historical data and reconciled against the known characteristics of Tri-State's commercial customers. The final measure categories evaluated for the commercial sector included:

- Lighting – Fluorescent
- Lighting – Incandescent
- Lighting – High-bay
- Lighting – Signage
- Cooling – Packaged DX
- Cooling – Chillers
- Space Heating
- Motors
- Plug Load – Office Equipment
- Plug Load – Large Appliances
- Refrigeration
- Cooking
- Water Heating

For new construction and turnover installations, measure baseline was defined primarily by IECC 2006 if an efficiency or minimum requirement was specified. IECC 2006 provided specifications primarily for cooling and envelope measures. In some cases, recent changes to federal code were adopted over the IECC code because they would take precedence in all regions. Motor baseline efficiencies were taken primarily from the Energy Policy Act of 1992. Baselines for other measures were adopted from measure data bases and utility work-papers as appropriate for the member co-ops' service territories. Baselines for early retirement scenarios were adjusted from these new construction levels based on Nexant's knowledge of old code specifications, equipment performance degradation, and regional code compliance.

5.2.2 Market Inputs

In addition to gathering measure level data, Nexant assembled the pertinent regional data and economic inputs necessary to complete the commercial modeling.

Regional Inputs

The primary regional inputs needed for calculation of savings potential were the total building stock and end-use EUIs. This data was assembled from the end-use and load profile study, and uniquely calibrated to the energy sales of each regional grouping. Expected improvements in code, and other general trends were built into the EUIs based on the trends found in the U.S. Energy Information Administration's forecasts. In general these trends showed a decrease in all end-use EUIs with the exception of plug loads, which showed an increasing trend.

For the commercial model, the energy usage was calculated using a blended EUI. This means that the EUI was representative of the total end-use energy usage divided by the total building floor stock. Therefore, the baseline EUIs were already de-rated by a saturation and fuel share value, and Nexant was able to set the model's saturation values to 100%.

Economic Inputs

To accurately determine the cost effectiveness of each measure and evaluate the overall economics of the DSM resource, Nexant input a number of economic variables into the commercial model. First, Nexant was provided with Tri-State's avoided energy cost forecast on an hourly level as well as annual avoided capital costs to reflect reductions in system peak demand. The hourly avoided energy costs were averaged for six usage periods (on and off peak for summer, winter, and shoulder months). Load shapes for each end-use were then applied to these periods to find an average annual avoided cost value.

To accurately value avoided energy savings for Tri-State, Nexant calculated the expected losses from the customers' meters to Tri-State's generation. These losses were calculated for each climate zone, and reflected the losses from the customer to the co-op and the losses from the co-op to Tri-State. Nexant also applied a discount rate of 8% to value future avoided costs.

Finally, Nexant assigned an expected program administration cost to the model. This value includes costs to Tri-State for running the DSM programs, excluding the customer incentive. This cost includes general activities such as rebate processing, trade-ally organization, and technical assistance. While Nexant was provided with aggregate administrative costs, incremental administrative costs per unit savings were unavailable. For calculation of the TRC test, Nexant assumed a value of $0.05 per first year kWh saved which reflects the typical costs of a utility in the ramping stages of DSM programs. This rate reflects the cost of processing applications and issuing rebate checks, the minimum costs needed to assessment measure cost-effectiveness. Administrative costs associated with marketing are added in independently of the TRC test, and are calculated at a slightly higher rate

5.2.3 Measure Screening Results

With the appropriate input variables in place, Nexant was able to apply the TRC test to each measure. Overall, it was found that a large number of measures have significant potential and may be valuable additions to Tri-State's DSM program offerings. Additionally, Nexant found that some of the measures currently offered by Tri-State did not pass the TRC test, and it may be beneficial to Tri-State to carefully evaluate their current assumptions. A complete listing of all measures and the results of their respective TRC tests may be found in Appendix B.

Measure Additions

At the current avoided cost level, Nexant found many measures that could be added to Tri-State's suite of DSM programs. Resulting in significant energy savings, many cost-effective lighting measures were identified for various applications. New lighting measures included an assortment of fluorescent, high-bay, and sign lighting retrofits. It was also found that multiple types of lighting controls were cost-effective in certain scenarios.

Many new HVAC measures passed the TRC test for both packaged DX and chiller systems. In addition to increased efficiency of the current technology, Nexant found measures such as evaporative coolers, economizers, and variable frequency drives to be cost-effective installations.

A number of control systems was also deemed to be cost effective and included in the assessment of economic and achievable potential.

Nexant found many cost-effective plug load measures that Tri-State may add to its current plug load offerings. These measures consisted of EnergyStar office equipment, computer controls, and vending machine controls.

The refrigeration measure category provided a large number of new measures in new construction, turnover, and early retirement scenarios. Refrigeration measures included equipment retrofits such as high efficiency display cases, high efficiency compressors and condensers, and ECM motors. This measure category also included a number of upgrades like anti-sweat heater controls, automatic door closers, and night covers. Finally, Nexant found a number of refrigeration lighting measures to be cost-effective including LED display case lighting.

Tri-State may benefit from expanding its water heating program to include measures such as low flow showerheads, faucet aerators, and pipe insulation. A number of more complex measures was also found to be cost-effective such as demand controlled circulating systems, water heater setbacks, and drain water heat recovery.

Finally, a small number of building envelope measures was found to be cost effective, though the majority did not pass. Additionally, the majority of cooking measures did not pass the TRC test, though high-efficiency ventilation hoods and electric steam cookers were found to be cost effective for new and turnover installations.

Existing Program Modifications

Nexant evaluated the measures currently offered by Tri-State and found some may need to be re-evaluated for cost-effectiveness. It was found that packaged DX systems with cooling capacities less than 65,000 Btu/hr were not cost effective except as new construction or turnover scenarios in climate zone four. Tri-State currently offers rebates for central air conditioners down to 36,000 Btu/hr. This discrepancy is likely due to the Energy Independence and Security Act of 2007 which recently increased the minimum efficiency of small air conditioners and heat pumps.

Nexant found LED street lighting is currently not cost effective in any installation scenario. However, this measure has recently received increased publicity and marketing, and it is expected that the customer cost will drop in the future.

EnergyStar dishwashers were not found to be cost-effective in any scenario, and high-efficiency clothes washers only passed the TRC test in very few scenarios. In the new construction and turnover scenarios the TRC ratio is very close to one and may be tipped depending on changes in market forces. It is recommended that Tri-State's assumptions for cost and savings of these measures be carefully evaluated and updated as needed.

Finally, Nexant found that premium efficiency motors are cost effective down to three horsepower in a turnover or new construction scenario. Tri-State's current program requires that motors less than 10 horsepower be aggregated to equal or exceed 10. It may be beneficial to reconsider this policy in light of Nexant's findings.

5.3 COMMERCIAL POTENTIAL RESULTS

The potential DSM resource was evaluated using the methodologies presented in Section 2 and described in detail in the previous paragraphs. The savings potential is presented in the following sections, along with the associated economics and a discussion of the results and recommendations for moving forward. Nexant's complete findings may be found in Appendix A.

5.3.1 Savings Potential Overview

The following sections present Nexant's findings of technical, economic, and achievable savings potential, along with the associated economic outputs.

Savings Potential

Nexant first evaluated the overall technical potential savings. It was found that the technical potential in 2010 will be 51.5 GWh, growing to annual savings of 56.0 GWh in 2015. These figures represent 2.5% and 2.5% of the total commercial forecasted sales in each year respectively. Cumulative energy savings in 2015 will reach 319.9 GWh and account for 14.2% of the forecasted commercial sales. It is expected that annual peak demand reductions will reach 12.6 MW in 2010 and grow to 13.6 MW by 2015.

Measures that did not pass the TRC test were removed and the total savings were recalculated to determine economic potential. Total economic saving potential in 2010 is calculated as 43.1 GWh and grows to 46.4 GWh by 2015. These savings will make up 2.1% of the total sales in both years. Cumulative energy savings in 2015 will reach 264.4 GWh and account for 11.8% of the forecasted commercial sales. It is expected that annual peak demand reductions will reach 8.9 MW in 2010 and grow to 9.6 MW by 2015.

Finally, Nexant evaluated barriers to market acceptance of Tri-State's DSM programs and calculated the achievable savings potential. The theoretically achievable potential savings were calculated using four different levels of marketing and incentive aggressiveness. Table 5.1 summarizes the savings potential for each scenario.

Table 5.1 Summary of Potential Savings and Percent of Forecasted Sales

Load Type	Ach. – Low		Ach. – Mod		Ach. – Agg		Ach. – Max	
Energy Savings (GWh)								
2010	1.8	0.1%	2.3	0.1%	2.9	0.1%	3.6	0.2%
2015	13.5	0.6%	16.8	0.7%	20.9	0.9%	26.0	1.2%
Cumulative, 2015	52.4	2.3%	65.4	2.9%	81.4	3.6%	101.4	4.5%
Cumulative, 2025	203.1	7.4%	251.5	9.1%	310.4	11.3%	381.9	13.9%
Demand Savings (MW)								
2010	0.4	-	0.5	-	0.6	-	0.8	-
2015	2.8	-	3.5	-	4.3	-	5.4	-
Cumulative, 2015	10.9	-	13.6	-	17.0	-	21.1	-
Cumulative, 2025	42.4	-	52.4	-	64.7	-	79.5	-

Tri-State's annual forecast and the inputs described in the sections above were used to calculate the savings potential through 2025. The annual energy savings and demand savings for each potential scenario are shown in Figure 5.1 and Figure 5.2 respectively. Figure 5.3 shows the expected energy forecast with the DSM energy savings removed.

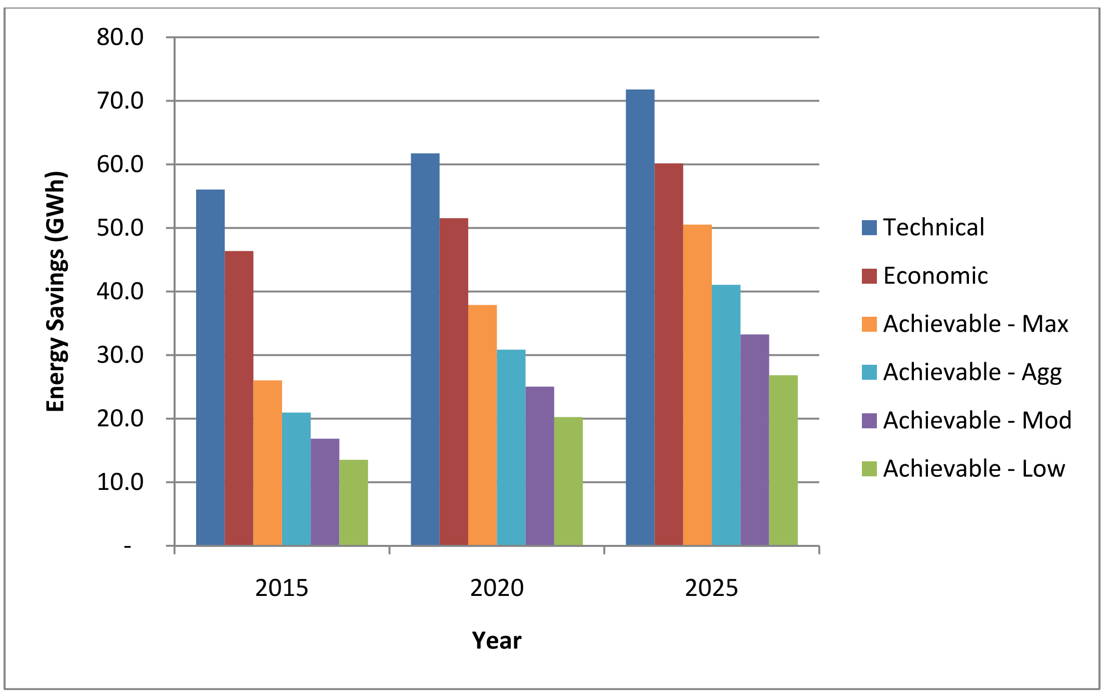

Figure 5.1 Commercial Annual Energy Savings

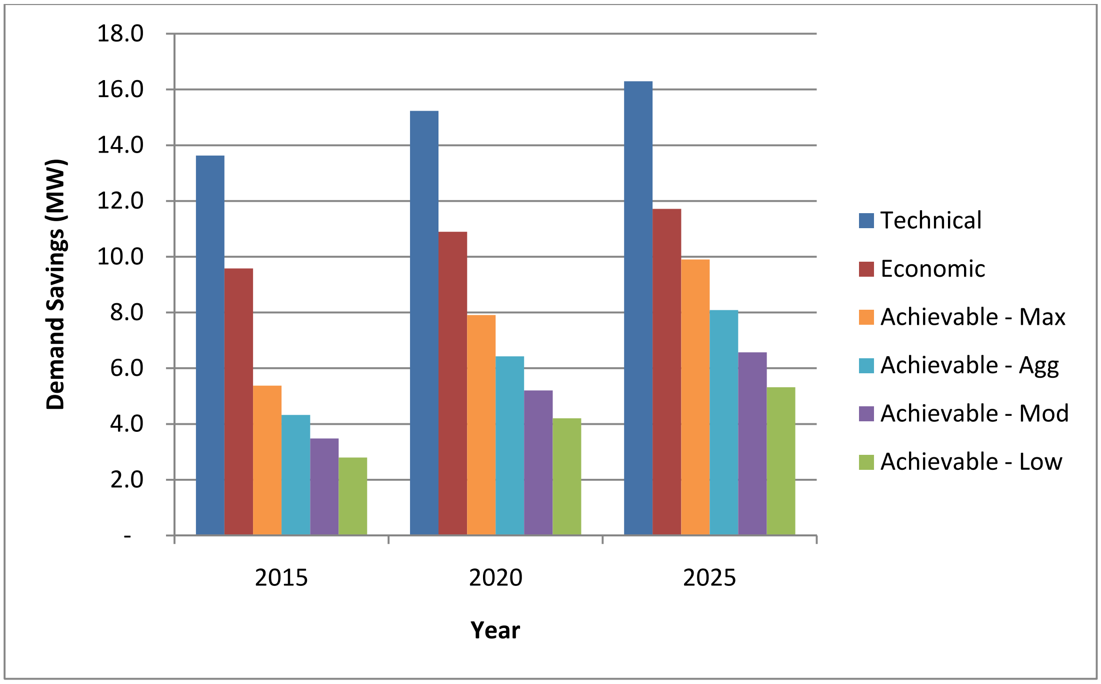

Figure 5.2 Commercial Annual Demand Savings

As shown in the figures above, the theoretically achievable savings ramp up quickly as Tri-State develops and launches new programs. The DSM programs reach maturity in roughly five years at which point savings growth will begin to proceed at a slower rate.

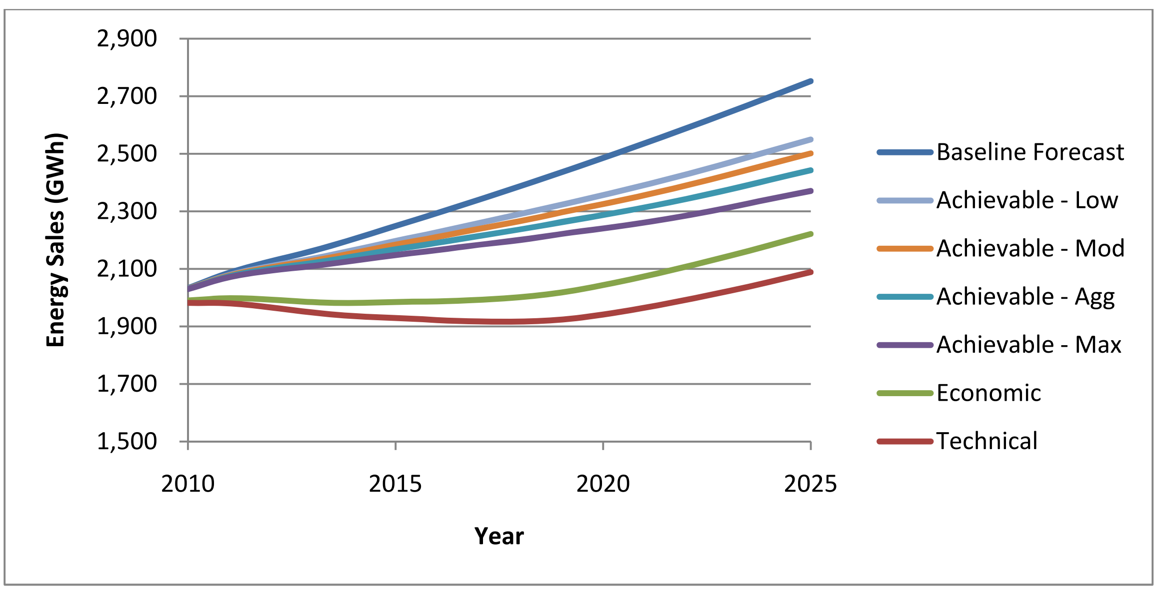

Figure 5.3 Commercial Sales Forecast with Cumulative DSM Potential Removed

Figure 5.3, above, shows the baseline commercial sales forecast, along with the same forecast with cumulative DSM potential removed. As described in Section 2 the baseline commercial forecast is taken as a portion of the combined energy from the 'Large Commercial' and 'Small Commercial' customers as defined on the RUS form 7.

It should be noted that the cumulative energy savings are defined as the total savings available to Tri-State in any given year due to the previous years' DSM expenditures. The energy efficiency measures installed each year will provide Tri-State with energy savings for the entire life of the measure. However, when the measure life has expired, the energy savings are no longer counted toward the cumulative savings. For this reason, cumulative energy savings in 2025 is not equal to the sum of the annual energy savings from all previous years.

Economics

In addition to calculating total energy savings potential, Nexant used the economic inputs described in the preceding sections to calculate the economic variables and cost effectiveness of the DSM resource. Table 5.2 shows the economics for each of the achievable potential scenarios in 2015.

Table 5.2 Commercial DSM Economics, 2015

Metric	Ach. – Low	Ach. – Mod	Ach. – Agg	Ach. – Max
Customer Costs[1]	$2.76	$3.43	$4.26	$5.28
Incentives[1]	$0.93	$2.19	$3.86	$6.05
Admin Costs[1]	$2.07	$2.44	$2.87	$3.39
Avoided Costs[1]	$10.46	$13.01	$16.18	$20.09
Levelized Utility Cost ($/kWh)[2]	$0.042	$0.052	$0.061	$0.069
TRC B/C Ratio	2.16	2.22	2.27	2.32

[1] Millions of dollars

[2] Levelized cost is calculated over the entire life of the program (2010-2025)

As shown above, each achievable scenario provides a cost effective DSM resource. For most scenarios the levelized cost is well below Tri-State's avoided energy costs, making energy efficiency an attractive energy alternative. The levelized cost for the maximum achievable scenario begins to approach the low end of Tri-State's avoided supply costs.

5.3.2 Savings Potential by Region and End-Use

To provide increased resolution, Nexant's models were built to calculate savings potential on a regional and end-use level. The following sections show the various outputs for each regional grouping and by end use.

Savings Potential

Figure 5.4 shows the distribution of 2015 energy savings by regional grouping for a moderate incentive scenario. The share of energy savings by region does not vary significantly for the different achievable scenarios.

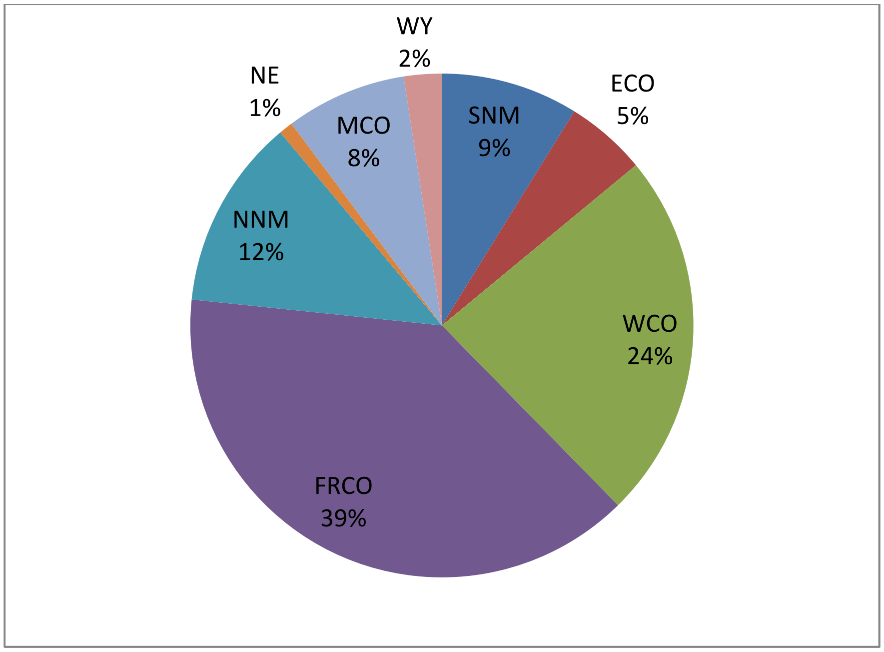

Figure 5.4 Energy Savings by Regional Grouping, 2015

Many inputs influence the regional shares of energy savings such as varying market penetration rates, differences in EUIs, and climate, however, the greatest determining factor is baseline energy usage. Not surprisingly, the greatest amount of savings can be achieved in the areas with the largest energy usage. The shares of energy savings track very closely to the shares of baseline energy usage.

The total energy savings were aggregated by end-use across all of the sectors. Figure 5.5 shows the share of energy savings attributable to each end-use for a moderate incentive scenario in 2015. These shares do not change significantly with time or varying incentive scenarios. The primary end-uses shown below are subdivided into technology types in the subsequent figures.

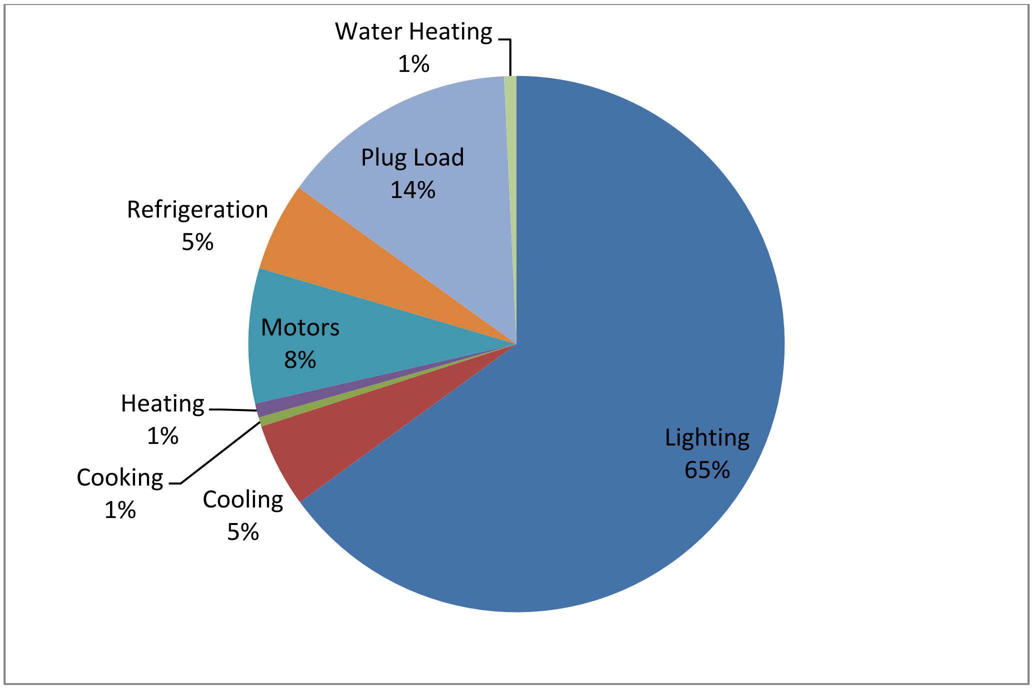

Figure 5.5 Energy Savings by Primary End-Use, 2015

Lighting constitutes the largest portion of energy savings potential by a significant margin. This is due to a number of factors. First, lighting constitutes the largest share of baseline energy consumption, leading to a greater potential for savings. Next, lighting measures can achieve significant savings percentages, ranging up to 75% for various combinations of equipment and controls. Finally, the market acceptance and implementation rates for lighting measures are generally higher than other measures due to their ease of installation and low costs.

Plug loads and motors are responsible for the next largest portion of energy savings. Both of these categories have large selections of cost-effective measures. Refrigeration and cooling both provide 5% of annual savings, limited mainly by their baseline energy usage and lower market acceptance rates. Finally cooking, heating, and water heating provide small shares of energy usage due to the small number of cost-effective measures and limited baseline energy usage.

As discussed in the beginning of this section, the lighting, cooling, and plug load end-uses were sub-divided into technology types to provide further resolution of savings and economics. The breakdowns of energy savings within each of these end-uses are shown in Figure 5.6, Figure 5.7, and Figure 5.8 respectively.

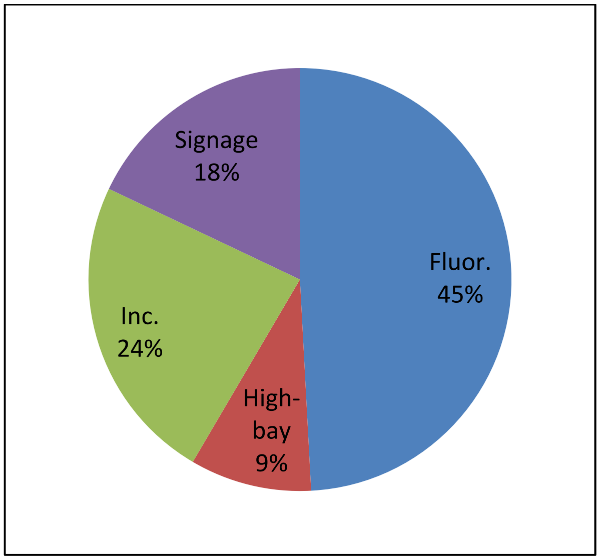

Figure 5.6 Lighting Energy Savings, 2015

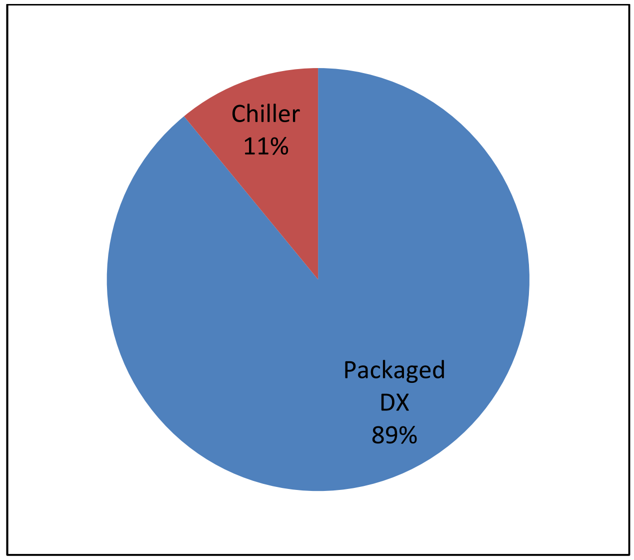

Figure 5.7 Cooling Energy Savings, 2015

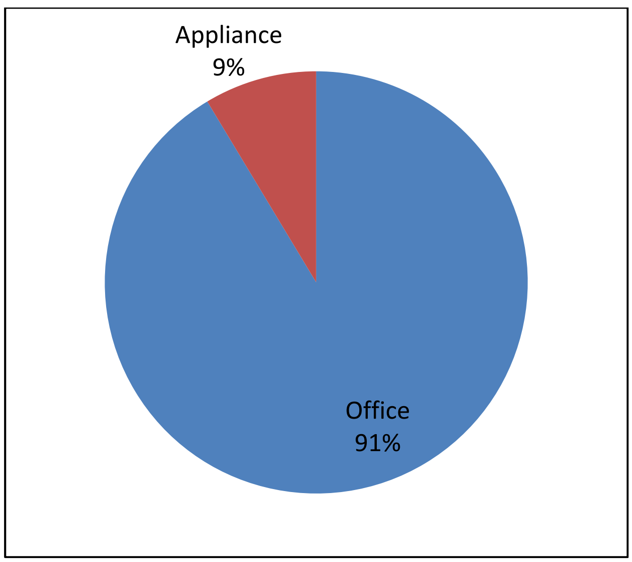

Figure 5.8 Plug Load Energy Savings, 2015

Lighting energy savings is attributable primarily to fluorescent lighting, though each technology group provides a non-trivial portion of the total energy savings. Packaged DX systems are responsible for the majority of cooling energy savings due mainly to the high saturation of DX equipment as compared to chiller systems. Finally, office equipment dominates the plug load energy savings as a result of its greater baseline energy usage.

The energy savings for each region are broken down by end-use in Table 5.3. This table shows a moderate incentive scenario in 2015. The energy savings shares are not expected to change significantly with difference scenarios, and with the exception of incandescent lighting, the shares also remain fairly constant with time.

Table 5.3 Regional Energy Savings by Measure Category, Moderate Scenario, 2015

Measure Category	SNM	ECO	WCO	FRCO	NNM	NE	MCO	WY
Lighting - Fluorescent	35.2%	28.3%	34.4%	27.9%	36.0%	28.8%	35.4%	38.1%
Lighting - Incandescent	16.7%	13.7%	16.2%	13.1%	18.1%	14.4%	17.7%	18.8%
Lighting - High-bay	6.6%	5.3%	6.5%	5.3%	6.7%	5.4%	6.6%	7.2%
Lighting - Signage	13.1%	10.2%	12.7%	10.4%	12.5%	10.1%	12.4%	13.6%
Cooling – Packaged DX	4.1%	5.9%	3.7%	5.9%	3.5%	5.9%	2.1%	1.7%
Cooling – Chillers	0.5%	0.6%	0.5%	0.7%	0.5%	0.6%	0.3%	0.2%
Space Heating	0.9%	0.6%	0.8%	0.6%	1.0%	0.7%	2.1%	1.8%
Motors	10.3%	5.5%	10.6%	5.1%	11.0%	5.6%	10.4%	9.2%
Plug Load – Office Equipment	6.2%	21.6%	5.7%	22.9%	3.9%	21.0%	5.0%	4.8%
Plug Load – Large Appliances	0.6%	2.0%	0.5%	2.2%	0.3%	1.9%	0.4%	0.4%
Refrigeration	4.8%	4.9%	6.9%	4.8%	5.5%	4.4%	4.9%	2.8%
Cooking	0.3%	0.5%	0.6%	0.4%	0.4%	0.4%	1.7%	0.8%
Water Heating	0.7%	0.9%	0.7%	0.8%	0.6%	0.9%	0.9%	0.5%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

The shares of energy savings by end-use in each region are fairly consistent. Differences between regions are due to varying measure savings, measure cost effectiveness, market penetration rates, and baseline energy usage. Overall savings shares are within a couple of percentage points between regions. The most significant variation occurs in the office equipment category which ranges from 3.9% to 22.9% of regional sales. This variation is due primarily to differences in baseline energy usage.

Economics

Nexant calculated the expected costs and benefits for each regional group and measure category. The anticipated economics for each region are presented for 2015 in Table 5.4.

Table 5.4 Commercial DSM Economics by Region, Moderate Scenario, 2015

Metric	SNM	ECO	WCO	FRCO	NNM	NE	MCO	WY
Customer Costs[1]	$326.4	$175.1	$821.0	$1,306.8	$424.9	$30.4	$267.7	$81.0
Incentives[1]	$201.4	$107.4	$535.8	$842.6	$264.0	$18.6	$165.4	$50.2
Admin Costs[1]	$209.2	$121.5	$591.8	$958.8	$291.3	$21.0	$184.5	$57.6
Avoided Costs[1]	$1,231.9	$660.2	$3,124.9	$4,938.6	$1,624.1	$114.4	$1,007.0	$313.6
Levelized Utility Cost ($/kWh)[2]	$0.052	$0.051	$0.053	$0.054	$0.050	$0.051	$0.050	$0.049
TRC B/C Ratio	2.30	2.23	2.21	2.18	2.27	2.23	2.23	2.26

1 Thousands of dollars

2 Levelized cost is calculated over the entire life of the program (2010-2025)

As shown above, each region has the potential of achieving a DSM resource cost-effectively. Nexant also calculated the levelized cost and TRC ratio for each measure category to show which programs will provide Tri-State with the most cost effective DSM resource. The values for each category are shown in Table 5.5.

Table 5.5 Cost Effectiveness by Measure Category, Moderate Scenario

Measure Category	Levelized Cost ($/kWh)[1]	TRC B/C Ratio, 2015
Lighting - Fluorescent	$0.049	2.43
Lighting - Incandescent	$0.040	3.04
Lighting - High-bay	$0.049	2.44
Lighting - Signage	$0.057	2.12
Cooling – Packaged DX	$0.076	2.28
Cooling – Chillers	$0.074	2.18
Space Heating	$0.104	1.87
Motors	$0.050	2.19
Plug Load – Office Equipment	$0.056	2.01
Plug Load – Large Appliances	$0.056	2.22
Refrigeration	$0.056	2.08
Cooking	$0.069	1.49
Water Heating	$0.061	1.81

1 Levelized cost is calculated over the entire life of the program (2010-2025)

Lighting provides the most cost-effective DSM resource, with most categories' levelized costs below $0.050 per kWh. Motors, plug loads, and refrigeration have the next lowest cost per kWh, and also provide significant savings potential. The remaining categories have varying levelized costs, reaching a maximum of $0.104 for space heating measures.

5.4 CONCLUSIONS AND RECOMMENDATIONS

Nexant found that Tri-State has significant room to expand its commercial DSM programs. Tri-State would benefit from a careful evaluation of the recommended measure additions presented in this section. The majority of the theoretically achievable savings potential was found to be due to measures not currently included in Tri-State's programs. These new measures should be carefully evaluated within the context of DSM program design and considered for inclusion in the current suite of programs.

In addition to the new measure recommendations, Tri-State should also consider proposed modifications to the existing programs. These modifications will allow Tri-State to fine-tune its DSM programs to maximize program efficacy in the most cost-effective manner.

Finally, it is recommended that Tri-State carefully evaluate and justify its current measure assumptions to ensure that all data is up-to-date and accurate. Changes in both internal and external market forces may result in variations of measure cost-effectiveness. As new DSM programs are launched, Tri-State would benefit from continuous market research to keep measure data accurate, particularly for measures with current TRC ratios close to one.

6.1 OVERVIEW

The industrial sector is responsible 5,842 GWh of electric consumption, which accounts for 41% of Tri-State's total electricity sales. The industrial share of energy sales by regional co-op grouping ranges from 21% to 64% of total sales. In general, the industrial sector is characterized by large, non-commercial uses, with pipeline transportation, agriculture, and manufacturing combining for 81% of the total sales.

At the time of this study, Tri-State was offering rebates for premium efficiency motors which were the most applicable measure for the industrial sector. More complex efficiency projects and non-prescriptive upgrades, such as process improvements, were typically handled on a case-by-case basis. In its assessment of industrial savings potential, Nexant evaluated measures for motors, HVAC equipment, lighting, and process improvements.

Nexant's calculation of achievable potential under a moderate incentive scenario (50% of incremental cost) resulted in savings of 5.9 GWh in 2010, growing to annual savings of 41.2 GWh in 2015 when programs mature. These values represent 0.1% and 0.5% of the total commercial annual sales respectively. Nexant forecast a total summer peak reduction of 1.2 MW in 2010, growing to an annual reduction of 8.2 MW in 2015, based on the same incentive scenario. Meeting these potential levels will involve increased marketing and incentives for industrial upgrades.

6.2 INDUSTRIAL POTENTIAL MODELING

Nexant built a spreadsheet model to evaluate the potential energy savings in the industrial sector and to calculate the economic outputs associated with the DSM resource. The model incorporates savings data, regional baseline characteristics, and economic variables to output savings potential specifically calibrated to the market conditions pertinent to each region.

6.2.1 Calculation Overview

The industrial model was built using a top-down calculation approach, which differs from the bottom-up approach used in the residential and commercial sectors. In the industrial sector Nexant evaluated the savings percentages for each end-use based on theoretical efficiency measures. The percentages were developed based on an assortment of industrial energy saving practices. Nexant assembled a database of typical end-use information including energy savings, peak demand savings, customer costs, and expected lifetimes. This information was determined for new installation, equipment turnover, and early retirement situations, in each of the regional groups. The measure categories evaluated for the industrial sector included:

- Motors
- HVAC
- Lighting
- Process

Although the savings data for the industrial sector was built from actual efficiency measures, the diversity of the industrial sector, variability of equipment types, and distinct facility needs prevented Nexant from assigning the potential to any specific measure. For example, it is expected that an average industrial facility can save 13% of its motor energy usage. However, it is unknown whether the energy savings will be due to motor upgrades, process improvements, controls, or scheduling.

6.2.2 Market Inputs

In addition to gathering savings data, Nexant assembled the pertinent regional data and economic inputs necessary to complete the industrial modeling.

Regional Inputs

The primary regional input needed for calculation of savings potential was simply the total industrial energy usage by end-use. This data was assembled from the end-use and load profile study, and uniquely calibrated to the energy sales of each regional grouping. The top-down methodology of the industrial sector minimized the number of inputs needed for the potential model.

Economic Inputs

To accurately determine the cost effectiveness of each measure and evaluate the overall economics of the DSM resource, Nexant input a number of economic variables into the industrial model. First, Nexant was provided with Tri-State's avoided energy cost forecast on an hourly level as well as annual avoided capital costs to reflect reductions in system peak demand. The hourly avoided energy costs were averaged for six usage periods (on and off peak for summer, winter, and shoulder months). Load shapes for each end-use were then applied to these periods to find an average annual avoided cost value.

To accurately value avoided energy savings for Tri-State, Nexant calculated the expected losses from the customers' meters to Tri-State's generation. These losses were calculated for each climate zone, and reflected the losses from the customer to the co-op and the losses from the co-op to Tri-State. Nexant also applied a discount rate of 8% to value future avoided costs.

Finally, Nexant assigned an expected program administration cost to the model. This value includes costs to Tri-State for running the DSM programs, excluding the customer incentive. This cost includes general activities such as rebate processing, trade-ally organization, and technical assistance. While Nexant was provided with aggregate administrative costs, incremental administrative costs per unit savings were unavailable. For calculation of the TRC test, Nexant assumed a value of $0.05 per first year kWh saved which reflects the typical costs of a utility in the ramping stages of DSM programs. This rate reflects the cost of processing applications and issuing rebate checks, the minimum costs needed to assessment measure cost-effectiveness. Administrative costs associated with marketing are added in independently of the TRC test, and are calculated at a slightly higher rate.

6.2.3 Measure Screening Results

As discussed above, the top-down modeling approach of the industrial sector relied on the aggregation of measure data. From an industrial DSM program design perspective, it is more effective to consider the aggregated savings data rather than the measure level data. The diversity of the industrial sector causes cost-effectiveness to vary from facility to facility, and screening out specific measures based on an average TRC value may serve to limit achievable potential. The savings percentages attributable to each end-use are shown in Table 6.1.

Table 6.1 Industrial Savings Percentages by End-Use

Scenario	Motor		HVAC		Lighting		Process	
	Technical	Economic	Technical	Economic	Technical	Economic	Technical	Economic
Existing	16.8%	16.0%	44.3%	23.7%	68.1%	49.2%	10.0%	10.0%
Turnover	13.9%	13.7%	34.9%	21.7%	61.4%	51.0%	10.0%	10.0%
New	13.9%	13.7%	34.3%	20.8%	61.4%	51.0%	10.0%	10.0%

6.3 INDUSTRIAL POTENTIAL RESULTS

The potential DSM resource was evaluated using the methodologies presented in Section 2 and described in detail in the previous paragraphs. The savings potential is presented in the following sections, along with the associated economics and a discussion of the results and recommendations for moving forward. Nexant's complete findings may be found in Appendix A.

6.3.1 Savings Potential Overview

The following sections present Nexant's findings of technical, economic, and achievable savings potential, along with the associated economic outputs.

Savings Potential

Nexant first evaluated the overall technical potential savings. It was found that the technical potential in 2010 will be 85.6 GWh, growing to annual savings of 110.1 GWh in 2015. These figures represent 1.1% and 1.3% of the total industrial forecasted sales in each year respectively. Cumulative energy savings in 2015 will reach 588.5 GWh and account for 6.9% of the forecasted industrial sales. It is expected that annual peak demand reductions will reach 18.7 MW in 2010 and grow to 24.4 MW by 2015.

The economic savings percentages were calculated and the total savings were reevaluated to determine economic potential. Total economic saving potential in 2010 is calculated as 79.7 GWh and grows to 101.4 GWh by 2015. These savings will make up 1.0% and 1.2% of the total sales in each year respectively. Cumulative energy savings in 2015 will reach 543.9 GWh and account for 6.3% of the forecasted commercial sales. Annual peak demand reductions will reach 16.1 MW in 2010 and grow to 20.3 MW by 2015.

Finally, Nexant evaluated barriers to market acceptance of Tri-State's DSM programs and calculated the achievable savings potential. The theoretically achievable potential savings were calculated using four different levels of marketing and incentive aggressiveness. Table 6.2 summarizes the savings potential for each scenario.

Table 6.2 Summary of Potential Savings and Percent of Forecasted Sales

Load Type	Ach. – Low		Ach. – Mod		Ach. – Agg		Ach. – Max	
Energy Savings (GWh)								
2010	4.7	0.1%	5.9	0.1%	7.4	0.1%	9.2	0.1%
2015	33.0	0.4%	41.2	0.5%	51.5	0.6%	64.4	0.8%
Cumulative, 2015	128.3	1.5%	160.4	1.9%	200.5	2.3%	250.7	2.9%
Cumulative, 2025	557.6	5.6%	722.0	7.0%	902.5	8.7%	1,128.2	10.9%
Demand Savings (MW)								
2010	0.9	-	1.2	-	1.5	-	1.8	-
2015	6.6	-	8.2	-	10.3	-	12.9	-
Cumulative, 2015	25.6	-	32.0	-	40.0	-	50.0	-
Cumulative, 2025	115.3	-	144.1	-	180.1	-	225.1	-

Tri-State's annual forecast and the inputs described in the sections above were used to calculate the savings potential through 2025. The annual energy savings and demand savings for each potential scenario are shown in Figure 6.1 and Figure 6.2 respectively. Figure 6.3 shows the expected energy forecast with the DSM energy savings removed.

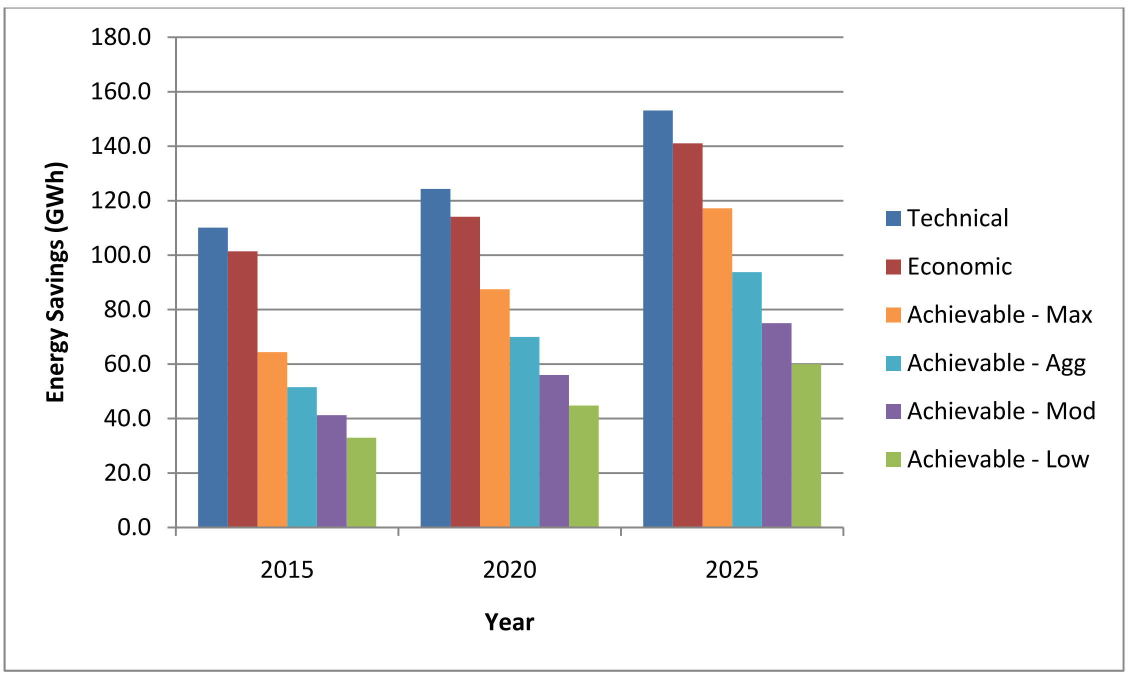

Figure 6.1 Industrial Annual Energy Savings

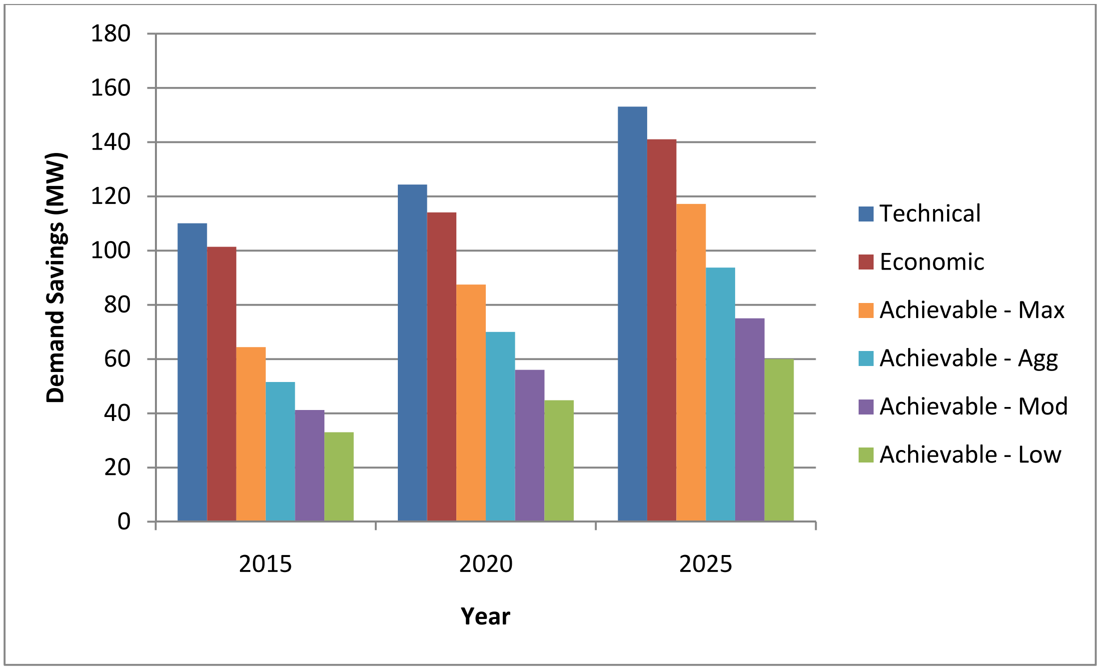

Figure 6.2 Industrial Annual Demand Savings

As shown in the figures above, the theoretically achievable savings ramp up quickly as Tri-State develops and launches new programs. However the lack of current industrial programs cause market penetration rates for the first few years to be limited by program development. The DSM programs reach maturity in roughly five years at which point savings growth will begin to proceed at a slower rate.

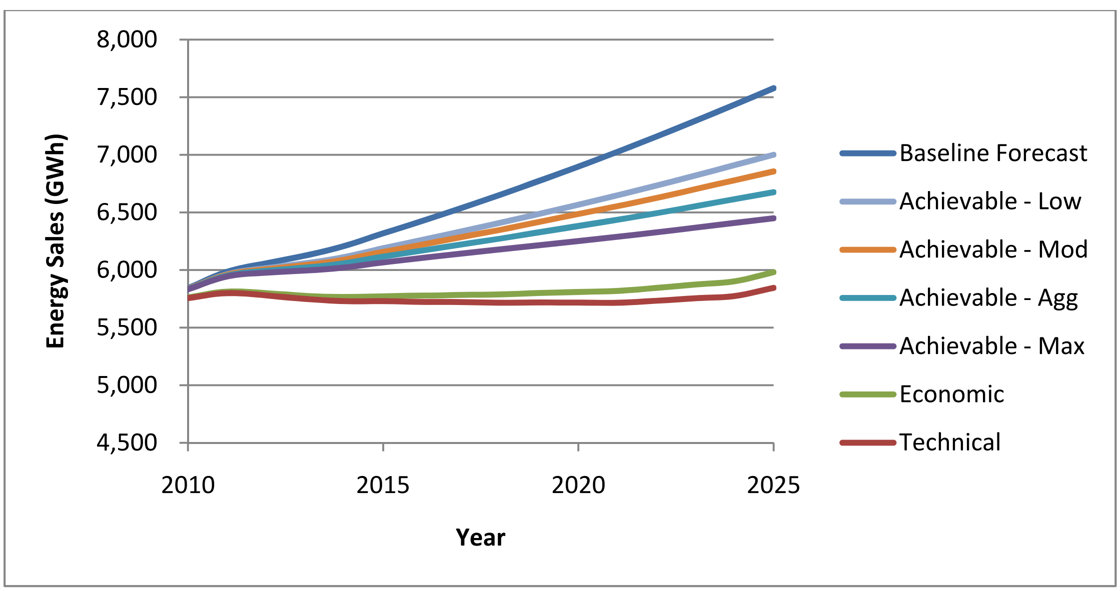

Figure 6.3 Industrial Sales Forecast with Cumulative DSM Potential Removed

Figure 6.3, above, shows the baseline industrial sales forecast, along with the same forecast with cumulative DSM potential removed. As described in Section 3 the baseline industrial forecast is taken as a portion of the combined energy from the 'Large Commercial' and 'Small Commercial' customers as defined on the RUS form 7.

It should be noted that the cumulative energy savings are defined as the total savings available to Tri-State in any given year due to the previous years' DSM expenditures. The energy efficiency measures installed each year will provide Tri-State with energy savings for the entire life of the measure. However, when the measure life has expired, the energy savings are no longer counted toward the cumulative savings. For this reason, cumulative energy savings in 2025 is not equal to the sum of the annual energy savings from all previous years.

Economics

In addition to calculating total energy savings potential, Nexant used the economic inputs described in the preceding sections to calculate the economic variables and cost effectiveness of the DSM resource. Table 6.3 shows the economics for each of the achievable potential scenarios in 2015.

Table 6.3 Industrial DSM Economics, 2015

Metric	Ach. – Low	Ach. – Mod	Ach. – Agg	Ach. – Max
Customer Costs[1]	$6.8	$8.5	$10.6	$13.2
Incentives[1]	$2.4	$5.4	$9.5	$15.1
Admin Costs[1]	$5.8	$6.5	$7.7	$9.1
Avoided Costs[1]	$30.5	$38.1	$47.6	$59.6
Levelized Utility Cost ($/kWh)[2]	$0.043	$0.049	$0.057	$0.6
TRC B/C Ratio	2.42	2.55	2.61	2.67

[1] Millions of dollars

[2] Levelized cost is calculated over the entire life of the program (2010-2025)

As shown above, each achievable scenario provides a cost effective DSM resource. For most scenarios the levelized cost is well below Tri-State's avoided energy costs, making energy efficiency an attractive energy alternative. The levelized cost for the maximum achievable scenario begins to approach the low end of Tri-State's avoided supply costs.

6.3.2 Savings Potential by Region and End-Use

To provide increased resolution, Nexant's models were built to calculate savings potential on a regional and end-use level. The following sections show the various outputs for each regional grouping and by end use.

Savings Potential

Figure 6.4 shows the distribution of 2015 energy savings by regional grouping for a moderate incentive scenario. The share of energy savings by region does not vary significantly for the different achievable scenarios.

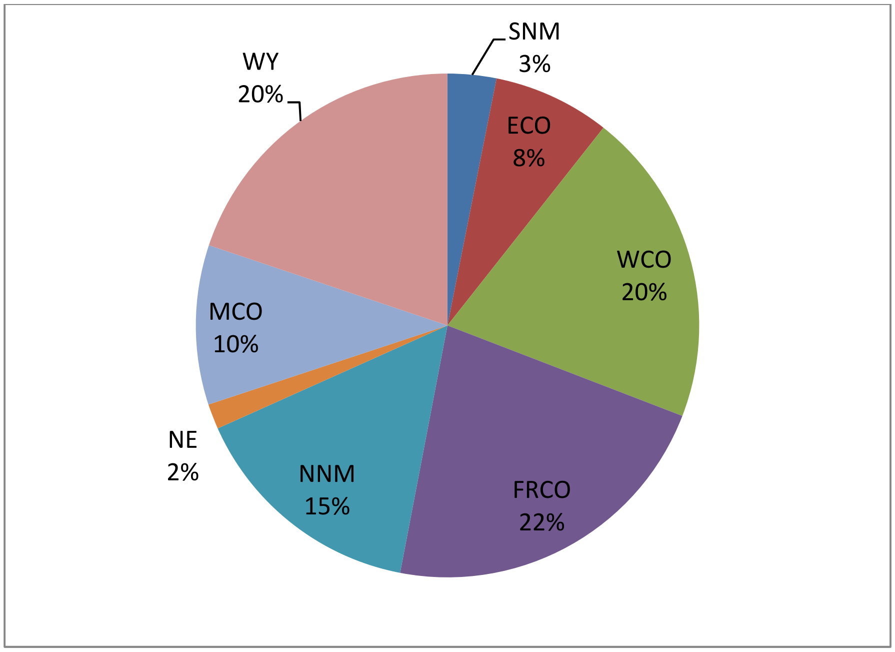

Figure 6.4 Energy Savings by Regional Grouping, 2015

Many inputs influence the regional shares of energy savings such as varying market penetration rates, differences in EUIs, and climate, however, the greatest determining factor is baseline energy usage. Not surprisingly, the greatest amount of savings can be achieved in the areas with the largest energy usage. The shares of energy savings track very closely to the shares of baseline energy usage.

The total energy savings were aggregated by end-use across all of the sectors. Figure 6.5 shows the share of energy savings attributable to each end-use for a moderate incentive scenario in 2015. These shares do not change significantly with time or varying incentive scenarios. Additionally these shares are fairly consistent by region.

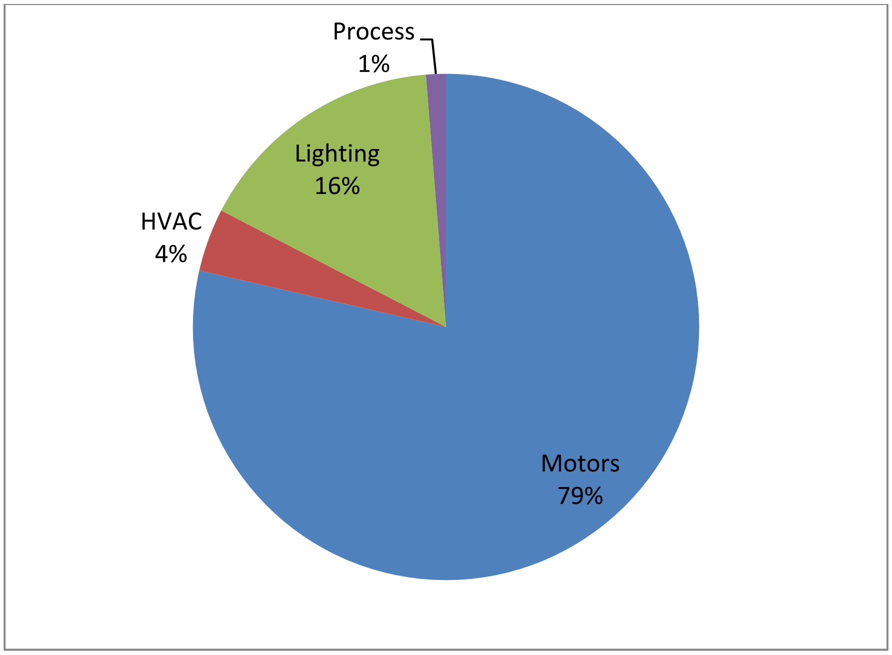

Figure 6.5 Energy Savings by Primary End-Use, 2015

As shown above, motors command the significant majority of industrial energy savings. The motor intensive energy usage by many industry types is responsible for this dramatic savings distribution. The high prevalence of pipeline transportation and agriculture amplifies the motor savings further.

Economics

Nexant calculated the expected costs and benefits for each regional group and measure category. The anticipated economics for each region are presented for 2015 in Table 6.4.

Table 6.4 Industrial DSM Economics by Region, Moderate Scenario, 2015

Metric	SNM	ECO	WCO	FRCO	NNM	NE	MCO	WY
Customer Costs[1]	$264.4	$633.6	$1,707.2	$1,872.2	$1,296.7	$137.7	$868.5	$1,677.7
Incentives[1]	$181.3	$391.1	$1,053.8	$1,155.7	$889.4	$121.4	$536.1	$1,035.6
Admin Costs[1]	$219.0	$473.4	$1,274.4	$1,397.2	$1,070.7	$146.2	$645.2	$1,251.1
Avoided Costs[1]	$1,259.5	$2,887.3	$7,715.2	$8,476.6	$5,831.5	$624.1	$3,852.6	$7,472.5
Levelized Utility Cost ($/kWh)[2]	$0.1	$0.0	$0.0	$0.0	$0.1	$0.1	$0.0	$0.0
TRC B/C Ratio	2.61	2.61	2.59	2.59	2.46	2.20	2.55	2.55

[1] Thousands of dollars

[2] Levelized cost is calculated over the entire life of the program (2010-2025)

As shown above, each region has the potential of achieving a DSM resource cost-effectively. Variations in cost-effectiveness by region are due primarily to customer make-up, market penetration, and economies of scale. Nexant also calculated the levelized cost and TRC ratio for each end-use to show which groups will provide Tri-State with the most cost effective DSM resource. The values for each category are shown in Table 6.5.

Table 6.5 Cost Effectiveness by End-Use, Moderate Scenario

Measure Category	Levelized Cost ($/kWh)[1]	TRC B/C Ratio, 2015
Motors	$0.049	2.61
HVAC	$0.058	2.59
Lighting	$0.045	2.55
Process	$0.106	1.07

[1] Levelized cost is calculated over the entire life of the program (2010-2025)

Lighting and motor upgrades provide the most cost-effective DSM resource, with low levelized costs and high TRC values. HVAC measures were also found to be highly cost-effective. Process improvements have the lowest TRC value and highest levelized cost, as improvements to process equipment is often complex and costly.

6.4 CONCLUSIONS AND RECOMMENDATIONS

Nexant found that Tri-State has significant room to expand its industrial DSM programs. Tri-State would benefit from efforts targeted at increasing participation by industrial customers. Ramping up industrial marketing efforts would allow Tri-State to work with a greater number of customers and develop reliable trade-ally networks. Development of a user-friendly ‘custom’ efficiency program would increase DSM participation and improve customers’ ability to receive rebates for cost-effective upgrades. Further recommendations for DSM program implementation are provided in Section 10.

7.1 OVERVIEW

The irrigation sector is responsible for 1,262 GWh of electric consumption, which accounts for 9% of Tri-State's total electricity sales. The irrigation share of energy sales by regional co-op grouping ranges from nearly 0% of total sales in mountain Colorado to 46% of total sales in Eastern Colorado.

Nexant's calculation of achievable potential under a moderate incentive scenario (50% of incremental cost) resulted in savings of 3.3 GWh in 2010 and was expected to grow to annual savings of 5.8 GWh in 2015 when the programs have matured. These values represent 0.3% and 0.5% of the total irrigation annual sales respectively. Nexant forecast a total summer peak reduction of 0.8 MW in 2010, growing to an annual reduction of 1.4 MW in 2015, based on the same incentive scenario.

7.2 IRRIGATION POTENTIAL MODELING

Nexant built a spreadsheet model to evaluate the potential energy savings in the irrigation sector and to calculate the economic outputs associated with the DSM resource. The model incorporates measure data, regional baseline characteristics, and economic variables to output savings potential specifically calibrated to the market conditions pertinent to each region.

7.2.1 Measure Overview

The universe of irrigation measures evaluated by Nexant started with The Regional Technical Forum's (RTF) list of 18 agricultural measures. The irrigation efficiency programs of other utilities, specifically the Bonneville Power Administration (BPA) and Idaho Power, were then assessed to determine consistency with the RTF list. The measures of BPA and Idaho Power are very similar to that of the RTF. BPA's list of eligible irrigation equipment is very specific to different types of equipment. Idaho Power's list appears to be a simplified list of BPA's measures, grouping similar measures together. A full list of these measures and their descriptions can be found in Appendix E.

7.2.2 Market Inputs

Each measure involves repairing or replacing worn or leaking equipment and this equipment was used as the baseline. The energy savings calculations for each measure conservatively represent the preexisting conditions. The baseline conditions for each recommended irrigation measure are summarized in Table 7.1.

Table 7.1 Irrigation Measure Baseline for Worn or Leaking Equipment

Measure	Baseline Condition
Cut and Pipe Press or Weld Repair of Leaking Wheel Lines, Hand Lines, and Portable Mainlines	Average Leak Flow Rate of 1 gpm
New Rotating or Spray Type Sprinklers or Low-Pressure Pivot Sprinkler Heads with the same flow rate or less	Pivot Flow Rate of 0.5 gpm/acre Greater with Worn Sprinklers than New Sprinklers

Measure	Baseline Condition
New Center Pivot Base Boot Gasket	Average Leak Flow Rate of 6 gpm
New Drains, Risercaps, and Gaskets for Wheel Lines, Hand Lines, Pivots or Portable Main Lines	Average Leak Flow Rate of 0.5 gpm
New Flow-Controlling Type Nozzles replacing Existing Brass or Worn-out Flow Control Nozzles of same flow rate or less	Worn Nozzle Diameter of 11/64 inches (compared to New Nozzle Diameter of 10/64 inches)
New Nozzles replacing Existing Worn-out Nozzle of same flow rate or less	Worn Nozzle Diameter of 11/64 inches (compared to New Nozzle Diameter of 5/32 inches)
New Gooseneck Elbow with Drop Tube or Boomback	Average Leak Flow Rate of 0.25 gpm
New Wheel-line hubs (on Thunderbird Wheel Lines)	Average Leak Flow Rate of 3 gpm
New Pressure Regulators	Pivot Flow Rate of 0.5 gpm/acre greater with Worn Regulators than New Regulators
Rebuilt or New Brass Impact Sprinklers	Average Leak Flow Rate of 0.5 gpm
Rebuilt or New Wheel-line Leveler	Average Leak Flow Rate of 0.25 gpm
Rebuilt or New Wheel-line Feed Hose	Average Leak Flow Rate of 1 gpm

Economic Inputs

To accurately determine the cost effectiveness of each measure and evaluate the overall economics of the DSM resource, Nexant input a number of economic variables into the industrial model. First, Nexant was provided with Tri-State’s avoided energy cost forecast on an hourly level as well as annual avoided capital costs to reflect reductions in system peak demand. The hourly avoided energy costs were averaged for six usage periods (on and off peak for summer, winter, and shoulder months). Load shapes for each end-use were then applied to these periods to find an average annual avoided cost value.

To accurately value avoided energy savings for Tri-State, Nexant calculated the expected losses from the customers’ meters to Tri-State’s generation. These losses were calculated for each climate zone, and reflected the losses from the customer to the co-op and the losses from the co-op to Tri-State. Nexant also applied a discount rate of 8% to value future avoided costs.

Finally, Nexant assigned an expected program administration cost to the model. This value includes costs to Tri-State for running the DSM programs, excluding the customer incentive. This cost includes general activities such as rebate processing, trade-ally organization, and technical assistance. While Nexant was provided with aggregate administrative costs, incremental administrative costs per unit savings were unavailable. For calculation of the TRC test, Nexant assumed a value of $0.05 per first year kWh saved which reflects the typical costs of a utility in the ramping stages of DSM programs. This rate reflects the cost of processing applications and issuing rebate checks, the minimum costs needed to assessment measure cost-effectiveness. Administrative costs associated with marketing are added in independently of the TRC test, and are calculated at a slightly higher rate.

7.2.3 Measure Screening Results

Twelve irrigation measures are recommended for a post-purchase prescriptive incentive program. The separate measures for rotating type and spray type pivot sprinkler have been combined into a single measure for all types of pivot sprinklers. The separate measures for new drains and new gaskets for wheel lines, hand lines, pivots and portable main-lines have been combined and expanded to include valve opener seals and caps. Multi-configuration nozzles sprinklers will qualify for incentives under the more general category of new pivot sprinkler heads. New drop tubes will only qualify for incentives if sold with a gooseneck elbow or boomback. Drip irrigation systems and new low pressure sprinkler nozzles are not recommended for a separate prescriptive incentive at this time based on feedback from irrigation dealers. These are better suited for a custom analysis. Recommended measures include:

- Rebuilt or new brass impact sprinklers
- Rebuilt or new wheel-line leveler
- New drains, riser caps, and gaskets for lines
- Repair of leaking wheel lines, hand lines, and portable mainlines
- New rotating or spray type sprinklers or low-pressure pivot sprinkler heads
- New flow-controlling nozzles replacing existing brass or worn out flow-controlling nozzles
- New center pivot base boot gasket
- New pressure regulators
- Rebuilt or new wheel-line feed hose
- New nozzles replacing existing worn-out nozzle
- New wheel-line hubs (on Thunderbird wheel lines)
- New gooseneck elbow with drop tube or boomback

7.3 IRRIGATION POTENTIAL RESULTS

The potential DSM resource was evaluated using the methodologies presented in Section 2 and described in detail in the previous paragraphs. The savings potential is presented in the following sections, along with the associated economics and a discussion of the results and recommendations for moving forward. Nexant's complete findings may be found in Appendix A.

7.3.1 Technical, Economic, Achievable, and Program Potential

The following sections present Nexant's findings of technical, economic, and achievable savings potential, along with the associated economic outputs.

Savings Potential

Nexant first evaluated the overall technical potential savings. It was found that the technical potential in 2010 will be 11.3 GWh, growing to annual savings of 13.5 GWh in 2015. These figures represent 0.9% and 1.1% of the total irrigation forecasted sales in each year respectively. Cumulative energy savings in 2015 reach 73.4 GWh and account for 5.8% of the forecasted irrigation sales. Annual peak demand reductions reach 2.9 MW in 2010 and grow to 3.4 MW by 2015.

Measures that did not pass the TRC test were removed and the total savings were recalculated to determine economic potential. Total economic saving potential in 2010 is calculated as 10.5 GWh and grows to 12.5 GWh by 2015. These figures represent 0.8% and 1.0% of the total irrigation forecasted sales in each year respectively. Cumulative energy savings in 2015 reach 67.8 GWh and account for 5.3% of the forecasted commercial sales. Annual peak demand reductions will reach 2.6 MW in 2010 and grow to 3.1 MW by 2015.

Finally, Nexant evaluated barriers to market acceptance of Tri-State's DSM programs and calculated the achievable savings potential. The theoretically achievable potential savings were calculated using four different levels of marketing and incentive aggressiveness. Table 7.2 summarizes the savings potential for each scenario.

Table 7.2 Summary of Potential Savings and Percent of Forecasted Sales

Load Type	Ach. – Low		Ach. – Mod		Ach. – Agg		Ach. – Max	
Energy Savings (GWh)								
2010	2.6	0.2%	3.3	0.3%	4.1	0.3%	5.1	0.4%
2015	4.6	0.4%	5.8	0.5%	7.2	0.6%	9.0	0.7%
Cumulative, 2015	21.9	1.7%	27.3	2.1%	34.2	2.7%	42.7	3.3%
Cumulative, 2025	58.8	4.5%	73.6	5.6%	91.9	7.0%	114.9	8.8%
Demand Savings (MW)								
2010	0.6	-	0.8	-	1.0	-	1.2	-
2015	1.1	-	1.4	-	1.7	-	2.2	-
Cumulative, 2015	5.3	-	6.6	-	8.3	-	10.4	-
Cumulative, 2025	14.4	-	18.0	-	22.5	-	28.1	-

Tri-State's annual forecast and the inputs described in the sections above were used to calculate the savings potential through 2025. The annual energy savings and demand savings for each potential scenario are shown in Figure 7.1 and Figure 7.2 respectively. Figure 7.3 shows the expected energy forecast with the DSM energy savings removed.

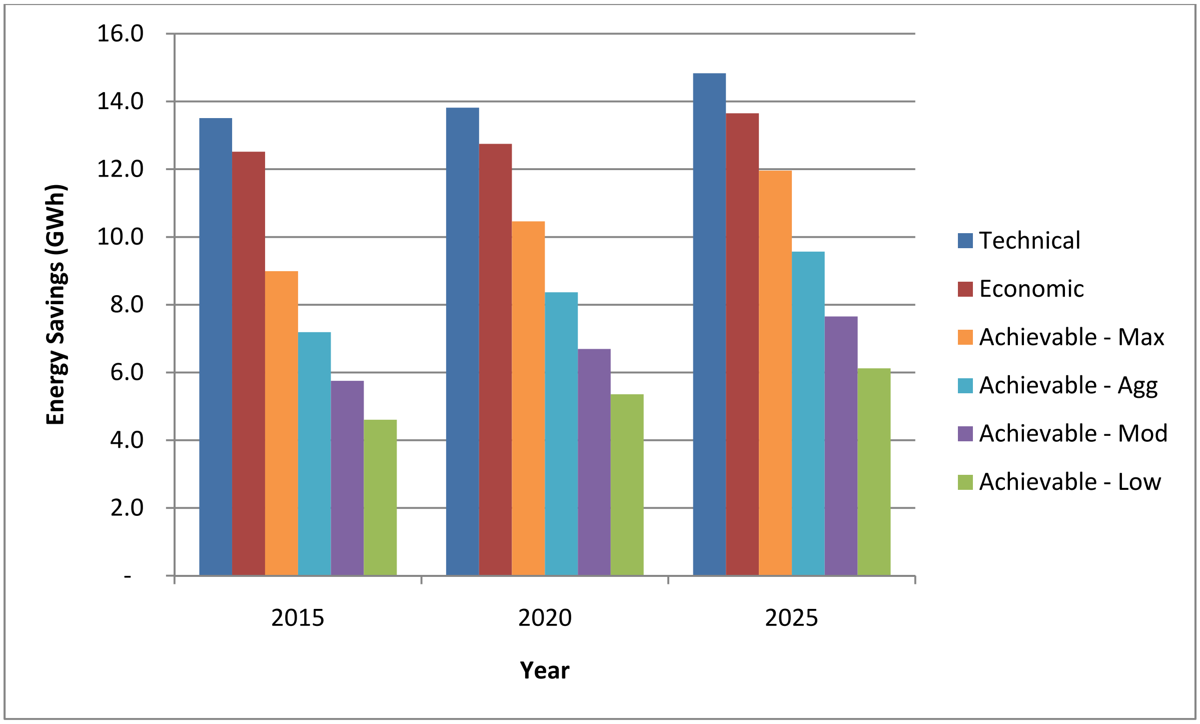

Figure 7.1 Irrigation Annual Energy Savings

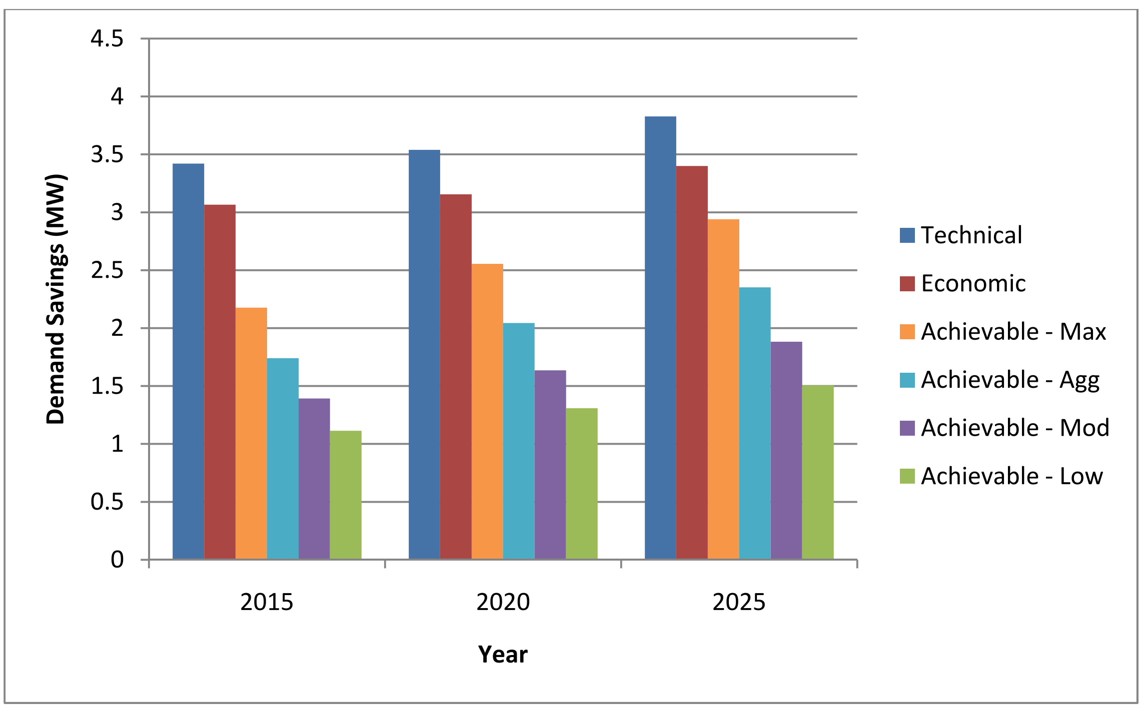

Figure 7.2 Irrigation Annual Demand Savings

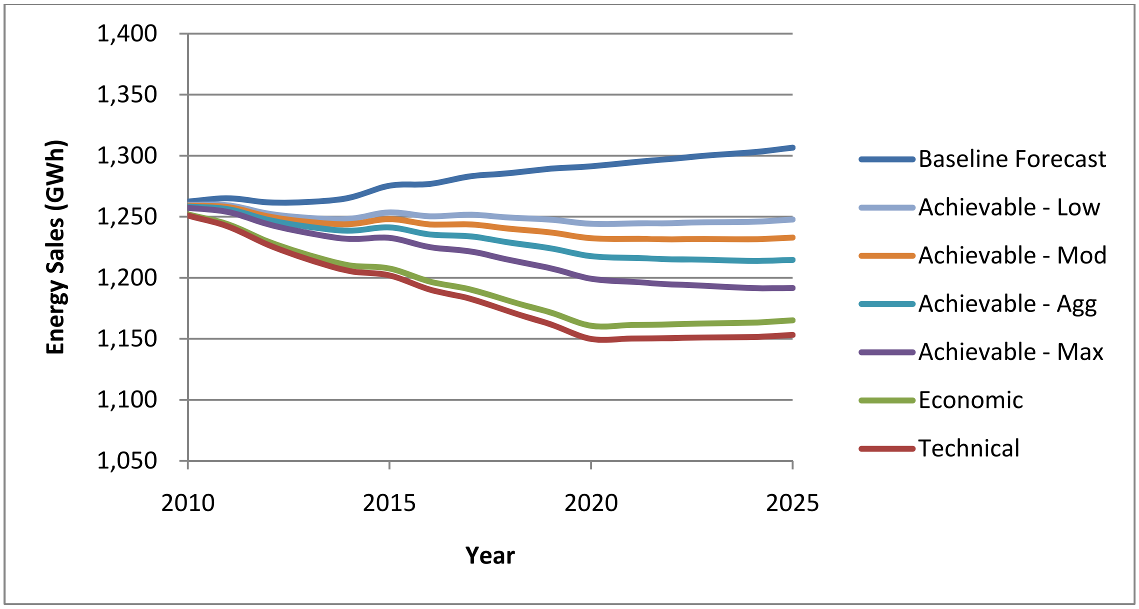

Figure 7.3 Irrigation Sales Forecast with Cumulative DSM Potential Removed

Economics

In addition to calculating total energy savings potential, Nexant used the economic inputs described in the preceding sections to calculate the economic variables and cost effectiveness of the DSM resource. Table 7.3 shows the economics for each of the achievable potential scenarios in 2015.

Table 7.3 Irrigation DSM Economics, 2015

Metric	Ach. – Low	Ach. – Mod	Ach. – Agg	Ach. – Max
Customer Costs[1]	$0.78	$0.98	$1.22	$1.53
Incentives[1]	$0.34	$0.76	$1.35	$2.14
Admin Costs[1]	$0.88	$0.98	$1.16	$1.38
Avoided Costs[1]	$3.81	$4.76	$5.95	$7.43
Levelized Utility Cost ($/kWh)[1]	$0.044	$0.050	$0.058	$0.065
TRC B/C Ratio	2.29	2.43	2.49	2.56

[1] Millions of dollars

[2] Levelized cost is calculated over the entire life of the program (2010-2025)

As shown above, each achievable scenario provides a cost effective DSM resource. For most scenarios the levelized cost is below Tri-State's avoided energy costs, making energy efficiency an attractive energy alternative. The levelized cost for the maximum achievable scenario begins to approach the low end of Tri-State's avoided supply costs.

7.3.2 Savings Potential by Region and End-Use

To provide increased resolution, Nexant's models were built to calculate savings potential on a regional and end-use level. The following sections show the various outputs for each regional grouping and by end use.

Figure 7.4 shows the distribution of 2015 energy savings by regional grouping for a moderate incentive scenario. The share of energy savings by region does not vary significantly for the different achievable scenarios.

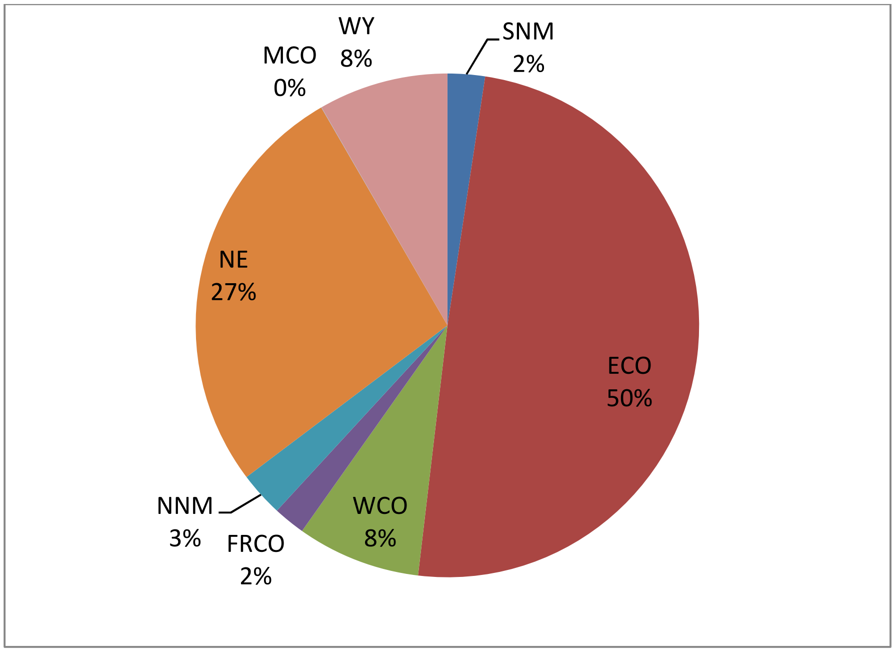

Figure 7.4 Energy Savings by Regional Grouping, 2015

The largest determining factor in the regional shares of energy use is baseline energy use; those regions that use the most energy will be able to save the most energy. Hence, as agriculturally dense regions, it is clear why Nebraska and Eastern Colorado make up the majority of irrigation savings.

Nexant calculated the expected costs and benefits for each regional group and measure category. The anticipated economics for each region are presented for 2015 in Table 7.4.

Table 7.4 Irrigation DSM Economics by Region, Moderate Scenario, 2015

Metric	SNM	ECO	WCO	FRCO	NNM	NE	MCO	WY
Customer Costs[1]	$23.5	$483.8	$77.7	$20.0	$28.0	$263.3	$0.2	$81.6
Incentives[1]	$18.1	$336.0	$53.9	$13.9	$21.6	$261.3	$0.1	$56.6
Admin Costs[1]	$23.3	$432.3	$69.4	$17.9	$27.8	$336.2	$0.2	$72.9
Avoided Costs[1]	$132.9	$2,279.4	$386.0	$99.0	$153.5	$1,276.1	$1.3	$428.4
Levelized Utility Cost ($/kWh)[2]	$0.052	$0.045	$0.045	$0.044	$0.050	$0.064	$0.045	$0.045
TRC B/C Ratio	2.84	2.49	2.63	2.61	2.75	2.13	3.28	2.77

[1] Thousands of dollars

[2] Levelized cost is calculated over the entire life of the program (2010-2025)

8.1 OVERVIEW

The energy savings potential found in this study is presented as a 'DSM resource' with the implication that energy efficiency can be used as a substitute for traditional supply side resources. With this idea in mind, Nexant used the economic outputs of this study to calculate a levelized utility cost for each measure category studied. Using a supply-side perspective, these levelized costs can be seen as the costs to Tri-State for purchasing the DSM resource associated with each end-use. A supply curve shows total resource attainable at various levelized cost values. With consideration for the sensitivity of the study results to changes in Tri-State's avoided supply costs, Nexant has developed a set supply curves for three avoided cost scenarios.

8.2 ECONOMIC SCENARIOS AND INPUTS

The models used in this study incorporated a variety of economic inputs on both the measure and utility level to calculate potential savings and the associated cost to Tri-State. One important set of variables is Tri-State's avoided costs, which are used as both model inputs and benchmark of the resultant data. As an input, the avoided costs play a large role in determining the cost-effectiveness of the energy efficiency measures. Upon completion of the modeling, the DSM levelized cost can be compared with Tri-State's avoided supply costs and used as one of the gauges in determining which DSM programs should be adopted from a supply-side perspective.

Nexant analyzed the theoretically achievable potential using three avoided cost scenarios. The first scenario is based on Tri-State's current avoided cost forecast, and was used to calculate the potential values presented in the previous sections of this report. The other scenarios were based on plus and minus 25% of the current avoided costs. These scenarios were evaluated with all other economic inputs held constant.

8.3 RESULTS

Supply curves were produced for each of the three scenarios to show the variations in total achievable DSM resource and the cost at which it can be obtained. Figure 8.1 shows the supply curves for each avoided cost scenario.

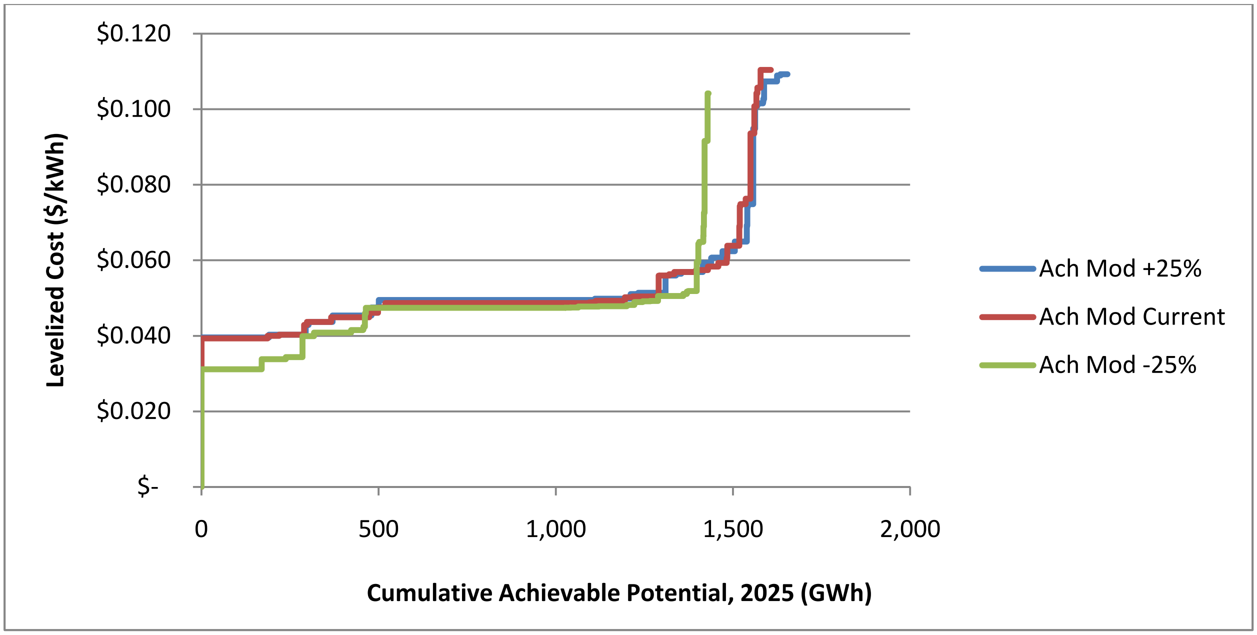

Figure 8.1 Overall Supply Curve, Moderate Scenario

The most notable feature of the curves shown above is their overall shape, with a relatively flat start, followed by a steep incline. This is typical of supply curves, as it demonstrates the increasing difficulty and cost of obtaining the DSM resource as achievable potential approaches economic potential. Each of the three curves shows that that first ~1,250 GWh of potential could be achieved for under $0.050 per kWh, but the last ~500 GWh would cost Tri-State more than double that rate.

Additionally, this figure indicates that a reduction in avoided cost would impact achievable potential much more significantly than an increase. What this suggests is that there are a number of measures that are just nearly passing the TRC test under baseline conditions, and much fewer measures with a TRC just under one. From a DSM planning and implementation perspective, this means that it is important to know which rebated measures may no longer be cost-effective with changes in avoided cost so that they can be handled appropriately.

8.3.1 Residential Potential

Table 8.1 shows the calculated residential achievable potential and percent of forecasted load under each avoided cost scenario. For a moderate incentive level, the potential energy savings range from 40.3 GWh in a low avoided cost scenario to 52.8 GWh with high avoided costs. These savings values represent a range of 0.2% of total sales. The potential demand savings range from 5.3 MW to 9.4 MW for the low and high avoided cost scenarios respectively. For both the energy and demand savings, the greatest change is seen between the baseline and low avoided costs.

Table 8.1 Summary of Residential Potential and Percent of Forecasted Sales, 2015

Scenario	Achievable Low		Achievable Mod		Achievable Agg		Achievable Max	
Energy Savings (GWh)								
-25%	35.0	0.7%	40.3	0.8%	46.6	0.9%	54.0	1.1%
Baseline	43.6	0.9%	50.7	1.0%	59.1	1.2%	69.2	1.4%
+25%	45.4	0.9%	52.8	1.0%	61.7	1.2%	72.3	1.4%
Demand Savings (MW)								
-25%	4.6	-	5.3	-	6.0	-	6.9	-
Baseline	7.7	-	8.9	-	10.3	-	12.0	-
+25%	8.1	-	9.4	-	10.9	-	12.6	-

For each avoided cost scenario, Nexant re-evaluated the TRC test for each measure, and noted where changes in cost effectiveness occurred.

Low Avoided Costs

When Nexant modeled the low avoided cost scenario, a number of measures were found to no longer be cost-effective. For the residential sector, measures were found in nearly every category that dropped out of the economic potential.

Certain air-source heat pumps and central ACs were found to be no longer beneficial. Additionally, a number of envelope measures were removed from the economic potential including various types of insulation, window film, and sunscreens. A number of duct sealing and duct insulation measures also had TRC ratios reduced below one. Programmable thermostats were also removed for certain installation cases.

A handful of plug load and appliance measures were screened out including EnergyStar clothes washers, dishwashers and high-efficiency refrigerators. EnergyStar DVD players and VCR/DVD players were removed, along with smart power strips.

Many LED lighting measures were found to be not cost-effective in nearly all installation scenarios. Among these measures were LED holiday lights, though these had a TRC B/C ratio very close to one. Drain-water heat recovery was found to no longer be cost effective, as well as certain energy feedback measures.

High Avoided Costs

For the high avoided cost scenario, a number of measures were found to be cost-effective that were not passing the TRC test under baseline avoided cost levels. As mentioned above there were fewer measures added for high avoided costs than were removed in the low avoided cost scenario.

Many of the measures added were central ACs and air-source heat pumps. Most of these measures were too expensive to be cost-effective under the baseline avoided cost conditions, such as 16 and 18 SEER units. A large number of envelope measures became cost effective, as well as duct sealing and insulation measures in certain installation cases. However, many of these measures only pass the TRC test by a slim margin.

Finally, LED holiday lighting became cost-effective for early retirement cases and in-home energy displays were added in climate zone six.

8.3.2 Commercial Potential

Table 8.2 shows the calculated commercial achievable potential and percent of forecasted load under each avoided cost scenario. For a moderate incentive level the potential energy savings range from 16.1 GWh in a low avoided cost scenario to 17.3 GWh with high avoided costs. These savings values represent a range of 0.1% of total sales. The potential demand savings range from 3.2 MW to 3.7 MW for the low and high avoided cost scenarios respectively. For both the energy and demand savings, the change between the low scenario and the baseline is roughly equivalent to the change between the baseline and the high avoided cost scenario.

Table 8.2 Summary of Commercial Potential and Percent of Forecasted Sales, 2015

Scenario	Achievable Low		Achievable Mod		Achievable Agg		Achievable Max	
Energy Savings (GWh)								
-25%	12.9	0.6%	16.1	0.7%	20.0	0.9%	24.9	1.1%
Baseline	13.5	0.6%	16.8	0.7%	20.9	0.9%	26.0	1.2%
+25%	13.9	0.6%	17.3	0.8%	21.5	1.0%	26.7	1.2%
Demand Savings (MW)								
-25%	2.6	-	3.2	-	4.0	-	5.0	-
Baseline	2.8	-	3.5	-	4.3	-	5.4	-
+25%	3.0	-	3.7	-	4.6	-	5.8	-

For each avoided cost scenario, Nexant re-evaluated the TRC test for each measure, and noted where changes in cost effectiveness occurred.

Low Avoided Costs

Nexant found a number of measures in nearly every measure category that were no longer passing the TRC test. A small number of fluorescent and HID lighting measures were found to have TRC ratios below one for certain installation cases. Additionally, hotel occupancy sensors were removed in all climate zones.

High-efficiency commercial clothes washers were removed from the economic potential, along with smart strips and 80 Plus desktop computers. Drain-water heat recovery was removed in all installation cases, and low-flow shower heads were removed in early retirement scenarios.

A handful of refrigeration measures were screened out of the economic potential including certain equipment, controls and lighting. A number of these measures still had TRC ratios very close to one including automatic door closers and efficiency evaporator fan motors.

Certain motor measures dropped out under the reduced avoided cost scenario. These measures were primarily the lower horsepower premium efficiency motors. A number of packaged DX measures were removed including both equipment and controls upgrades. Most notable packaged DX air conditioners less than 65,000 Btu/hr were removed from climate zone four.

High Avoided Costs

Nexant found that a small number lighting measures became cost-effective with increases in avoided cost. Measures included certain fluorescent and HID fixtures as well as certain controls. A limited number of refrigeration measures were also added including display cases, high-efficiency compressors, and evaporator fan controls.

Premium efficiency motors down to one horsepower were found to be cost effective under the increased avoided cost scenario, as were high-efficiency ventilation hoods for commercial kitchens. Finally, a number of HVAC measures were added including certain high-efficiency air conditioners, controls, ECM motors, and certain envelope measures.

8.3.3 Industrial Potential

The calculated industrial achievable potential is shown in Table 8.3, along with the percent of forecasted load under each avoided cost scenario. For a moderate incentive level the potential energy savings range from 39.9 GWh in a low avoided cost scenario to 41.7 GWh with high avoided costs. These savings values do not significantly change the percent of total sales. The potential demand savings range from 3.2 MW to 3.7 MW for the low and high avoided cost scenarios respectively. For both the energy and demand savings, the change between the low scenario and the baseline is roughly equivalent to the change between the baseline and the high avoided cost scenario.

Table 8.3 Summary of Industrial Potential and Percent of Forecasted Sales, 2015

Scenario	Achievable Low		Achievable Mod		Achievable Agg		Achievable Max	
Energy Savings (GWh)								
-25%	32.0	0.4%	39.9	0.5%	49.9	0.6%	62.4	0.7%
Baseline	33.0	0.4%	41.2	0.5%	51.5	0.6%	64.4	0.8%
+25%	33.4	0.4%	41.7	0.5%	52.1	0.6%	65.2	0.8%
Demand Savings (MW)								
-25%	5.3	-	6.6	-	8.3	-	10.4	-
Baseline	6.6	-	8.2	-	10.3	-	12.9	-
+25%	7.0	-	8.8	-	11.0	-	13.7	-

As discussed earlier in this report, the industrial savings potential was modeled using a top-down calculation approach. To evaluate variations in cost-effectiveness, Nexant applied savings ratios based on known sensitivities and changes in applicable commercial end-uses.

8.3.4 Irrigation Potential

The calculated irrigation achievable potential is shown in Table 8.3, along with the percent of forecasted load under each avoided cost scenario. For a moderate incentive level the potential energy savings range from 5.6 GWh in a low avoided cost scenario to 6.0 GWh with high avoided costs. These savings values represent a range of 0.1% of total sales. The potential demand savings do not vary significantly with changes in avoided cost. For both the energy savings, the change between the low scenario and the baseline is roughly equivalent to the change between the baseline and the high avoided cost scenario.

Table 8.4 Summary of Irrigation Potential and Percent of Forecasted Sales, 2015

Scenario	Achievable Low		Achievable Mod		Achievable Agg		Achievable Max	
Energy Savings (GWh)								
-25%	4.5	0.4%	5.6	0.4%	7.0	0.5%	8.7	0.7%
Baseline	4.6	0.4%	5.8	0.5%	7.2	0.6%	9.0	0.7%
+25%	4.8	0.4%	6.0	0.5%	7.5	0.6%	9.3	0.7%
Demand Savings (MW)								
-25%	1.1	-	1.4	-	1.7	-	2.1	-
Baseline	1.1	-	1.4	-	1.7	-	2.2	-
+25%	1.1	-	1.4	-	1.8	-	2.2	-

For each avoided cost scenario, Nexant re-evaluated the TRC test for each measure, and noted where changes in cost effectiveness occurred.

Low Avoided Costs

It was found that certain irrigation measures in every regional grouping dropped out of the economic potential. The measures varied by region, but many of the measures were improvements to leaky systems.

High Avoided Costs

As with the low avoided cost scenario, the high avoided cost condition resulted in changes of measure cost-effectiveness in nearly all regions. Once again, the specific measures varied by region, with most measures focusing on improving worn or broken equipment.

8.4 RECOMMENDATIONS

The results presented in this section support Nexant's recommendation that Tri-State remain informed of the variables influencing savings potential. The sensitivity of savings potential to changes in input variables is clearly shown in the tables above. Tri-State should make regular assessments of avoided costs as they relate to DSM in order to select appropriate programs and evaluate DSM targets. Additional attention should be paid the measures discussed in this section as they show particular sensitivity to adjustments in market forces.

9.1 SUMMARY OF DEMAND RESPONSE POTENTIAL

Demand response, sometimes referred to as load management, is a demand-side resource that focuses on reducing capacity needs. These programs are designed to help reduce peak demand during system emergencies or at times of extreme market prices, promote improved system reliability, and, in some cases, may lead to the deferment of investments in delivery and generation infrastructure. The programs discussed in this section offer incentives to customers to reduce loads during utility-specified events. The following demand response programs were evaluated in this study:

- *Residential Direct Load Control* (DLC) programs allow the local utility to remotely turn off or cycle certain residential end-uses. This section analyzes the potential of central air conditioning and electric water heating programs.
- *Irrigation Load Reduction* programs typically follow one of two designs. The more traditional scheduled program allows farmers to choose the days of the week during which their pumps will be shut off. The direct load control option allows the local utility to turn off pumps during system events. This section will look at the scheduled program.
- *Callable Tariff* programs provide the customer with a fixed monthly incentive in return for reducing load by a contractually set amount when requested by the local utility. As opposed to a DLC program, in this case the customer is responsible for turning off the load, generally with penalties for non-compliance or the option to buy their way through an event. These programs typically target customers with loads greater than 250 kW to achieve reasonable levelized costs per kilowatt reduced.
- *Demand Bidding* programs are similar to callable tariff programs, except that customers are not contractually obligated to participate. Incentives are paid on an event-by-event basis based on market prices published ahead of time by the local utility and the amount of load reduced. This program is also generally limited to customers with total loads greater than 250 kW.

9.2 DEMAND RESPONSE POTENTIAL MODEL

There are a few important differences between the assessment of demand response programs and other demand-side management options, such as energy efficiency. First, demand response programs require active, ongoing participation by customers. Second, unlike energy efficiency programs, demand response often shifts load from peak periods of energy use to non-peak periods, which can affect the availability of service to the customer. Finally, demand response depends on a customer's willingness to participate in individual events. This willingness to participate is a function of program design, which includes the number of events, incentive levels, the stipulation of mandatory or voluntary participation, and the existence of penalties for non-compliance. Hence, estimating demand response potential evolves in a number of steps. The final potential number is a product of the base peak demand, eligibility rates, technical load impact rates, program participation rates, and event participation rates.

In this section, assumptions for rates and cost data were gathered from demand response studies that Nexant has performed for other entities as well as from publicly available studies published on utility websites.

Peak Demand

Coincident peak demand data was available for each of the eight regions in the Tri-State system. To estimate the base peak demand for each of the programs, the peak for each customer segment (residential, irrigation, commercial, and industrial) was estimated based on their relative energy use during peak months. The peak was further subdivided by residential end use (central air conditioning, water heating, etc.) or commercial/industrial segment (education, retail, health, manufacturing, etc.).

Eligibility Rates

Eligibility rates are applied to the base peak demand to determine the peak load eligible to participate in each of the programs. For the residential DLC programs, only those customers with central air conditioners or electric water heaters are eligible to participate. Irrigation load reduction is generally limited to customers with pumping power greater than 75 horsepower. Commercial and industrial customers in the callable tariff or demand bidding programs typically need to have a peak demand of greater than 250 kW.

Technical Potential

In theory, it is possible to shed all loads during an event. However, it is neither practically feasible nor reasonable for a customer to do so. Therefore, after adjusting the base peak demand to include only eligible customers and loads, estimates must be developed that describe the load that is practically available to be curtailed. For some programs, such as the residential air conditioning program, this rate approaches 100%, as all central air conditioners can practically be shed. However, for the callable tariff or demand bidding program, a manufacturing facility generally cannot shed all of their pumps or motors, but might be able to reduce their cooling load.

Program and Event Participation: Market Potential

Program participation rates are applied to technical potential to determine the amount of load that will sign-up to participate in demand response programs. This participation rate is expressed as a percentage of eligible customers. As it takes some time for a utility to fully implement a demand response program, program participation rates are assumed to increase on a straight line to a mature participation rate over 10 years. Finally, event participation rates are applied to determine the actual amount of load that will be reduced during any one event. Event participation rates in the case of DLC programs are adjusted to account for customers who opt-out and equipment failures.

Combining technical potential with program and event participation rates provides what this section will call “market potential,” or the load that can reasonably be reduced during any one event for a certain program.

9.3 RESOURCE POTENTIAL

9.3.1 Summary

Table 9.1 shows the technical and market potential for each program option. The majority of Tri-State's potential to reduce load during peak events comes from the irrigation sector with 65 MW, or 2.0% of peak, in 2020. Owing to the results of numerous irrigation programs implemented by Tri-State's peers, this is an assertion that Tri-State can pursue with relative confidence. The residential DLC central air conditioning and electric water heater programs are forecasted to provide 28 MW, or 0.9% of peak, in 2020. The callable tariff and demand bidding programs do not provide much in the way of peak reduction (6 MW combined in 2020). In our analysis, this is a result of low eligibility and program participation rates, especially among industrial customers who cannot, or do not want to, reduce loads unexpectedly.

Table 9.1 Technical and Market Potential (MW in 2020)

Program	Technical Potential	Market Potential	Market Potential as % of 2020 System Peak
Residential DLC	269	28	0.9%
Irrigation	373	65	2.0%
Callable Tariff	739	3	0.1%
Demand Bidding	739	3	0.1%
Total	**2,120**	**99**	**3.1%**

Resource acquisition costs fall into one of two categories. Fixed costs include program start-up, infrastructure, maintenance, administration, and data acquisition. Variable costs include hardware costs, which vary by the number of customers, and incentive costs, which can vary by number of customers or kW reduced.

Where possible, based on Nexant's previous research for demand response studies, fixed and variable costs were estimated for each program type according to comparable programs implemented by other utilities. In some cases, this was hard to accomplish because cost information is generally not reported or recorded. This analysis assumes a cost of $400,000 to start a demand response program. Marketing costs were also hard to determine, ranging from $25 to $5,000 per customer. This section assumes $25 per residential customer and $500 per commercial or industrial customer. Average hardware, communication, and incentive levels were estimated based on published values from other utilities or studies. Table 9.2 summarizes the cost assumptions for each program.

Table 9.2 Program Cost Assumptions

Variable	Residential DLC AC	Residential DLC Water Heat	Irrigation	Callable Tariff	Demand Bidding
Start-Up	$400,000	$400,000	$400,000	$400,000	$400,000
Hardware/Technology (new customer)	$175	$175	$1,000	$1,400	$1,400

Marketing (new customer)	$25	$25	$500	$500	$500
Incentive (annual)	$25	$25	$20/kW	$48/kW	$18/kW
Communication	$7	$7	$10	$0	$0
Attrition	7%	7%	5%	5%	5%
Equipment Life (yrs.)	10	10	7	20	20

In determining levelized costs for each program, annual costs were calculated over the life of the program (15 years). These costs were discounted by the cost of capital for Tri-State (8%) and summed to come up with a total program cost. Annual costs include a rate of annual attrition (generally 5%) to account for electric customer turnover and customers leaving the program. Thus, attrition requires the reinvestment of new customer program costs. Annual costs also include a general 15% cost increase (over total costs) for administration expenses.

Table 9.3 shows the expected levelized costs and potential peak reduction in 2020 for each program. Demand bidding is estimated to be the least expensive option with a levelized cost of $27/kW-year. While callable tariff programs are very similar to demand bidding programs, they are more expensive to implement because they witness lower participation as a mandatory curtailment program. Irrigation is also relatively cheap, with a cost of $44/kW-year. The two residential DLC programs have high levelized costs because of the large number of customers and the low impact per customer.

Table 9.3 Levelized Costs and Market Potential (MW in 2020)

Variable	Residential DLC AC	Residential DLC Water Heat	Irrigation	Callable Tariff	Demand Bidding
Market Potential (MW)	16	12	65	3	3
Levelized Cost	$85	$158	$44	$43	$27

The demand response supply curve in Figure 9.1 shows the cumulative market potential that can be reduced at or below the given levelized cost. Cumulative market potential is determined by adding the market potential sequentially along the horizontal axis, in the order of levelized cost. For example, the callable tariff program has 3 MW available and its cost is the second lowest. Adding this potential to the 3 MW available under demand bidding, the figure shows that a total of 6 MW of load reduction is available at levelized costs of $43/kW-year or less.

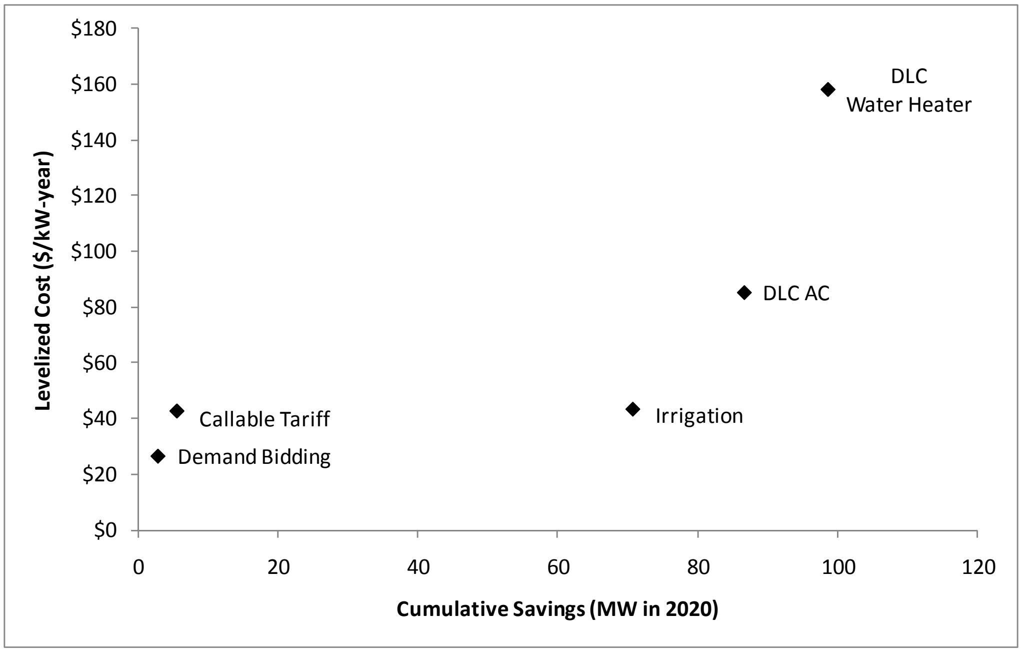

Figure 9.1 Tri-State Demand Response Supply Curve

9.3.2 Residential DLC

Direct load control programs allow the utility to remotely control certain end uses. Typically, receiver systems are installed on customer equipment (the air conditioner compressor, for example) that enable the utility to communicate with the equipment. Customers do not have to pay for the receiver or the installation costs, and are compensated for the possibility of interruption of service via monthly bill credits, whether or not an interruption occurs in any one month. When the utility foresees system reliability issues, or witnesses extremely high market prices, they may interrupt electrical service for a limited number of hours on a limited number of occasions. 35 to 40 hours of service interruption is typical for this program.

Central Air Conditioning

Residential central air conditioning direct load control is by far the most popular DLC program in the nation. A 2006 report by the FERC found that 234 service providers offered a DLC program, most of which offered air conditioning control. When calling an event, many programs employ a cycling strategy where only half of the air conditioners in a region are turned off at any one time. To account for this, and the rate of opt-outs and hardware breakdown, event participation is assumed to be 46% (combination of 50% cycling and 92% event participation). Program participation varies widely between the many service providers, ranging from 1% to over 40%. The national average participation rate is approximately 20% to 30% of eligible customers – Rocky Mountain Power, for example, has 30% participation in its Utah Cool Keeper program. This analysis adopts a conservative 20% long-run participation rate.

Technology costs can also vary widely between programs. Load reduction can be accomplished through the installation of a two-way thermostat or switches. Switches are less expensive, costing around $150 after installation, while thermostats may cost $450. This analysis assumes a switch similar to the Utah Cool Keeper program at a cost of $175.

By implementing this program, Tri-State could see 16 MW of peak reduction by 2020, or 0.5% of the system peak, at a levelized cost of approximately $85/kW-year.

Electric Water Heating

There are not many investor-owned utilities that employ water heater only DLC programs, with Hawaii Electric Company being one of the main exceptions. This is most likely due to the low saturations of electric water heaters in densely populated areas. However, some Midwestern co-ops with high electric water heater saturations have used water heater DLC programs as an effective way to reduce peak loads.

Due to the similarity between this program and the air conditioning program, cost and participation assumptions are nearly identical. The one exception is the event participation rate – electric water heaters do not need to be cycled during an event because water will retain its heat for long periods of time. Thus, we use 92% as an event participation rate. 12 MW of peak reduction, or 0.4% of peak, is forecasted for 2020 at levelized costs of $158/kW-year.

Many service providers consider combining both the central air conditioning and electric water heating programs, providing utilities the ability to control both end uses for a single customer. This will save on labor and installation costs per kW reduced because both switches can be installed at the same time. The program will have a greater market potential than the stand-alone air conditioner program, but the average levelized costs will increase because the per-unit demand reduction for water heaters is smaller than that of air conditioners. In this analysis, data was not available on the number of customers that have both central air conditioning and electric water heaters, and hence the program could not be analyzed.

9.3.3 Irrigation Load Reduction

While fully dispatchable (direct load control) irrigation programs are preferable to scheduled programs from a utility perspective, farmers are very hesitant to allow another entity to control a resource as valuable as water. Scheduled programs are relatively well received because they at least allow the farmer to plan their watering schedule ahead of time.

Idaho Power has designed their program to target only those customers with a pumping demand of greater than 75 horsepower, which focuses their economic resources for maximum demand reduction. Taking this into account, this analysis develops eligibility rates for each region in Tri-State's territory. Mountain Colorado, for example, has a 0% eligibility rate because what irrigation occurs here is typically horizontal pumping (flood irrigation) and would not require large horsepower pumps to move the water. Program participation rates for scheduled programs are generally quite high, with some reaching 30% or more of irrigation customers. Incentive levels used in this analysis are correspondingly high relative to other irrigation programs to reflect this high participation target.

65 MW of peak reduction, or 2.0% of peak, is forecasted for 2020 at levelized costs of $44/kW-year.

9.3.4 Callable Tariff

Callable tariff programs are agreements between utilities and their large commercial and industrial customers who agree to reduce load when requested by the utility. In return, customers are compensated in the form of monthly credits per kW reduced or rate discounts. Participation is typically mandatory, with penalties for non-compliance, and the amount of load reduction for each customer is set in the contract as a percentage of baseline load or a fixed amount (normally 15%-20% or 100 kW, respectively). The threshold for eligibility in this program is usually 250 kW of peak demand, which is used in this analysis, although Xcel Energy has a threshold as low as 50 kW.

Estimates of eligibility by region and segment were developed based on energy sales data provided by Tri-State on its large commercial and industrial customers. Technical load impact rates and program participation by segment were taken from the PacifiCorp study research. Event participation is assumed to be 100% because this is a mandatory participation program.

3 MW of peak reduction, or 0.1% of peak, is forecasted for 2020 at levelized costs of $43/kW-year.

9.3.5 Demand Bidding

Demand bidding is similar to callable tariff programs, except that customers have the option to participate on an event-by-event basis and incentives are not fixed over time. Customers are contacted by the utility on a day-ahead notice, or even hour-ahead notice, to bid load reduction based on market prices published by the utility. If the utility feels that it needs to call on this resource, they will contact the customer and instruct them to reduce their load according to the bid. Incentives are paid based on the amount of load reduced under baseline demand and the difference between market prices and utility rates.

The same customers in the callable tariff program are eligible for this program (greater than 250 kW demand), so technical potential is also the same. Program participation rates are generally higher for this program than for the callable tariff program because participation is voluntary and load reductions are not set by contract. One of the most difficult quantities to estimate is the amount of load that will be bid during an event. A study was performed during the 2007 PacifiCorp demand response study on the price elasticity of load reduction, the results of which found that price is not a statistically significant predictor of load reduction. Thus, this analysis uses an event participation rate (36%) based on the demand bidding program implemented by PacifiCorp. However, it must be mentioned that activity levels in this type of program are greatly influenced by the level and volatility in market electricity prices. In times of low market prices, participation in demand bidding is greatly reduced. Such has been the case in the market for the past six years, and service providers have reported that during this period demand bidding has not resulted in large peak demand impacts.

3 MW of peak reduction, or 0.1% of peak, is forecasted for 2020 at levelized costs of $27/kW-year.

9.3.6 Aggregators

Tri-State's unique relationship with its co-ops and their customers may make the use of demand aggregators a more effective way to achieve demand response potential. Demand aggregators charge a premium to deliver a megawatt target of demand reduction, but they have significant demand response marketing experience and their operations may be more streamlined than a utility-run program. They are quite active in the Texas and California electricity markets, having become an integral part of utilities' demand response portfolios. The use of aggregators could remedy Tri-State's lack of direct access to the end user of its electricity.

10.1 INTRODUCTION AND BACKGROUND

Tri-State has been offering its utility members an Energy Efficiency Credits (EEC) program since 1985. During this time, Tri-State estimates it and its utility members have reduced demand by approximately 75 MW and electric use by 80,000 MWh through the EEC program. The program encourages and rewards energy-efficient purchases and practices at both the member and end-user levels, while lowering the associated cost of service. All Tri-State utility members are eligible to participate, and they may tailor the program to meet their own needs and those of their end-use customers. In addition, utility members may leverage Tri-State rebates by offering additional incentives on measures of interest.

As discussed in previous sections of this report, Tri-State's territory covers parts of Colorado, New Mexico, Wyoming, and Nebraska. Its 44 members encompass electric cooperatives, covering a diverse range of end-user types and facilities, geographic areas, population densities, and climate conditions. Energy savings potential in Tri-State's territory is dominated by the residential sector, followed closely by the industrial sector. In general, measures represented in its EEC Program are associated with the following end-use segments:

- **Commercial**: Most heavily concentrated in Colorado and New Mexico, commercial customers include a mixture of business types. Energy-efficiency potential in the commercial sector is heavily tied to lighting, with additional potential available through HVAC systems, plug loads, and refrigeration.
- **Residential**: Distributed throughout Tri-State's service territory, residential customers are most heavily concentrated around population centers in New Mexico and Colorado. Residential energy-efficiency potential is heavily tied to appliances and lighting, with additional potential available through HVAC systems and plug loads.
- **Industrial**: Industrial customers are most heavily concentrated in Wyoming and New Mexico, with energy-efficiency potential in the industrial sector heavily tied to pipeline transportation, agriculture, and manufacturing. Within these segments, motors account for the greatest potential energy savings.
- **Irrigation**: Irrigation customers are primarily concentrated in rural Nebraska. Similarly to the industrial sector, energy-efficiency potential in the irrigation sector primarily is tied to motors. Tri-State offers a comprehensive motors initiative, available to both industrial and irrigation customers, and recently expanded this to include motors over 500 hp.

In mid-2008, Tri-State adopted a core set of program objectives and proposed several changes to better meet its members' needs. This report assumes the 2008 effort will continue, and offers recommendations for new measures and program mechanisms to contribute to the following Tri-State's EEC program objectives:

- Expand incentives to buy down the first cost of efficient electric technologies;
- Evaluate promising, efficient, new electric technologies through pilot programs; and
- Provide alternative, energy-efficient technologies that promote wise use of energy.

Some of Tri-State's past and current EEC program activities have focused on capturing lighting and motors potential as well as energy savings from residential appliances and energy efficient water heating. This report considers Tri-State's current efforts and offers short and longer-term recommendations for increasing its energy-efficiency activities to capture further savings related to these and other available end uses. Recommendations encompass a greater range of energy-efficiency measures as well as alternative approaches to delivering the programs, including operational and administrative strategies, plus marketing and outreach tactics. These recommendations are based on cost-effective and market ready technologies identified through the technical, economic, and achievable potential study.

10.1.1 New Market Risks and Opportunities

Federal recovery dollars are beginning to flow into weatherization and ENERGY STAR® programs through State governments. Tri-State will likely to be able to leverage energy savings generated through Recovery Act-funded energy-efficiency programs for low-income housing, municipal and commercial building upgrades, and energy infrastructure projects. This creates both opportunity and uncertainty:

- Directing funds toward projects that complement, but do not compete with Tri-State's programs will require coordination with delivery partners to establish priorities and clarify program roles.
- Considerable uncertainty exists regarding tracking and accounting of energy savings resulting from Recovery Act funding. Tri-State should develop tracking protocols and reporting procedures to account for Recovery Act-funded activities.

In addition to changes related to the Recovery Act, new standards for motors and lighting are being implemented. On December 19, 2007, the Energy Independence and Security Act was signed into law. The Act contains new electric-efficiency standards for motors manufactured or imported into the U.S.; its requirements, which must be met by December 19, 2010, include:

- Raising the minimum efficiency levels for 1–200 hp motors covered by EPAct 1992 to NEMA PREMIUM levels.[1]
- Setting new federal minimum standards for motors not previously covered, including: U-frame, design C, close-couple pump, footless, vertical solid shaft normal thrust, 8-pole (900 rpm), and poly-phase motors (not more than 600 volts, but other than 230 or 460).
- Creating a new federal minimum standard for NEMA design B motors of 201 to 500 hp, at NMEA energy-efficient levels.

Starting in 2011, Tri-State may reduce its motor incentives to include only motors not covered by the Energy Policy Act.

[1] This excludes fire pump motors, which remain at EPAct 1992.

Additionally, the 2009 Amendment to the Energy Policy and Conservation Act increases energy conservation standards for general service, tube-type fluorescent lamps and incandescent reflector lamps, effective in 2012. Due to the phase out of standard incandescent bulbs, it is possible that compact fluorescent lamps (CFLs) could become the market standard and, therefore, may not qualify for incentives. This change will serve to both transform the residential lighting market toward a higher-efficiency standard and eliminate a significant energy savings source for utilities across the country. Tri-State should expect to re-evaluate its CFL incentives after 2011 and begin to look to future lighting technologies. This study anticipates that a cost-effective lighting technology, either incandescent and/or LED lamps, will meet the EISA requirements from 2012 to 2020; consequently, CFL's are still anticipated to be an energy efficiency measure, with a much lower energy savings percentage.

10.2 PORTFOLIO SUMMARY

Tri-State currently offers its members incentives for a range of energy-efficiency measures, including: lighting, electric heat pumps and water heaters, air conditioners, appliances, VSDs, and motors. Incentives are provided to customers through a measure-level, deemed-savings approach, whereby Tri-State establishes and approves deemed-savings values for individual end-use measures and applications as well as a funds/co-funds incentive based on measures installed through its member programs. Tri-State also expects to continue its collaboration with its utility members on a Smart Grid initiative to determine the viability of smart grid technology through a demonstration project.[1] The initiative will address the near-term needs of utilities and other stakeholders to plan, invest in, and implement technologies facilitating the transition to smart power delivery, operation, load management, and end-use systems.

With Tri-State's current approach, members may choose to mix and match measures from the EEC list to best meet the needs of their service territories and end-use customers via a cafeteria-style offering. Participation in the EEC program is voluntary, allowing members to participate to the level and degree best suiting their delivery capacity and operational practices. These measures and the current delivery mechanism offer a strong foundation on which the EEC program can be expanded and enhanced. The Nexant-Cadmus team recommends Tri-State supplement its cafeteria-style offerings with additional delivery approaches that cater to varying end-use customer needs, target untapped market segments and facilitate more complex technologies and projects. These additional approaches will allow Tri-State to achieve energy savings in hard-to-reach customer segments, but will require additional expertise and time to develop.

Building on Tri-State's current EEC program activities, the Nexant-Cadmus team's recommendations fall into two categories:

[1] Tri-State will contribute no more than 50% of project cost capped at $50,000.

1) Portfolio strategy recommendations focus on broad, company-wide activities, designed to support Tri-State's EEC program in all sectors.
2) Sector level program recommendations are targeted to each customer sector and generally encompass more specific programs and measures.

Recommendations are categorized as either short or longer -term activities. This approach will allow Tri-State to build its capabilities and energy savings over time.

10.2.1 Portfolio Strategy Recommendations

The portfolio-level strategy recommendations outlined below represent a range of activities, requiring varying levels of investment, preparation and analysis. These strategies will help facilitate a growing energy efficiency portfolio and enhance Tri-State's ability to achieve savings in hard-to-reach customer segments and track the results.

Short Term Portfolio Strategy Recommendations

The following recommendations can be implemented simply and at relative low costs and are intended to be implemented over the next one to three years. They are listed in order of priority.

Expand EEC Programs

Tri-state should consider the expansion of current EEC programs to include measures included in this study. Some of these program measures can be quickly added to Tri-state's menu of programs through the implementation of pilot programs, such as commercial lighting. However, other programs will require more extensive development, such as an industrial custom efficiency program.

Increase Collaboration

Tri-state already collaborates with the following agencies:

- Wyoming Business Council—Wyoming
- The Governor's Energy Office—Colorado
- Nebraska Energy Office—Nebraska
- Energy Conservation and Management Division—New Mexico

We recommend Tri-State expand its efforts to explore collaborative programs with state agencies to: leverage each organization's resources and strengths; cooperate on complementary opportunities, such as Recovery Act-funded projects; and/or explore centralized administration for the EEC program by state.

Enhance Marketing

Effective marketing is a critical, foundational component to the EEC program's success. In addition to current efforts, it is recommended Tri-State:

- Develop co-branded marketing templates, similar to existing Touchstone marketing collateral, to be used by all members and to increase buy-in and participation among utilities.

- Develop and administer a customer-focused, Web-based portal, which would serve as a communications tool for members and provide a range of support resources, such as marketing collateral, program rules, application templates, and so on.
- Hire additional customer outreach managers to conduct one-on-one marketing directly to utility members. These individuals' roles would include explaining programs, helping members understand the benefits and requirements associated with participation, enrolling members, helping to identify potential end-use customer targets for specific programs, etc.
- Conduct "upstream" marketing and outreach to equipment installers, contractors, and other trade allies as well as to retailers. Employ customer outreach managers to contact individual trade allies and industry associations, distribute marketing materials (point of purchase, brochures, etc.) to big box stores, hardware stores and other retail locations where customers purchase applicable high efficiency products.

Explore alternative delivery mechanisms

Tri-State should begin to explore alternative delivery mechanisms for its program offerings to reach new markets and pursue deeper energy savings per end user. An overview of alternative delivery mechanisms follows below.

Third-Party Programs. Because a third-party delivery mechanism can effectively target hard-to-reach customer segments or markets, this approach could help generate savings from market segments that do not typically participate in Tri-State's EEC Program. For example, the Bonneville Power Administration's Energy Smart Grocer Program is successfully generating energy savings through lighting and refrigeration measures among the hard-to-reach grocery and food service segment. Another program example could include refrigerator recycling. This approach would entail Tri-State implementing the program on behalf of participating members using a competitively selected third-party contractor to manage, administer, and deliver the program turnkey. Benefits of a turnkey program include reduced member burdens and streamlined administration. Third-party programs also may offer economies-of-scale cost savings, and provide Tri-State greater access to end users and control over marketing, delivery, and installation of energy-efficiency measures. Challenges to this approach include limited member control over the program and, in rural service areas, logistical barriers can increase program costs. The turnkey approach would require Tri-State to develop clear program objectives, work scope, and an RFP for the most suitable implementer. Tri-State should consider this use of pilot programs to assess the success and implementation barriers for the third-part program delivery mechanisms.

Upstream Incentives/Market Transformation Approach. Upstream incentive programs and market transformation activities seek to lower end-user costs and/or influence manufacturer, dealer, or retailer behaviors regarding specific energy-efficient technologies; they may also fund research, development, and demonstration of emerging technologies and program concepts to transform the market. The ENERGY STAR® Change-The-World, Start with ENERGY STAR® campaign serves as an example of a successful upstream program; this program negotiates incentives at the manufacturer and retailer levels and offers cooperative marketing on high-efficiency consumer products. Upstream incentives/market transformation approaches can provide Tri-State with greater control over measure deployment, and reduce barriers for member and end-user participation. Upstream incentive/market transformation initiatives can often be led effectively by regional market participants, such as nonprofit organizations or third-party contractors.

Longer-Term Portfolio Strategy Recommendations

Over the next two to five years, Tri-State should consider supplementing its portfolio with operational changes and infrastructure enhancements to increase administrative and delivery efficiency and support member participation in its programs. This may require more significant investment, long-term analysis and development processes, or present greater logistical challenges. Tri-State also may have to issue RFPs for outside analytical expertise and/or development support. Specific long-term recommendations include:

Program Tracking System

An Energy Efficiency Management and Tracking System is designed to facilitate accurate measurement and benchmarking of program results through timely reporting as well as streamlined program management and accounting. Such a system is particularly well suited to facilitating more complex projects and multiple programs, and would help Tri-State optimize management of its EEC programs and reduce related costs. The system should be Web-based and accessible by multiple members to increase accuracy and participation by all utility customers.

Deemed Calculator

We recommend Tri-State develop a "deemed calculator" to facilitate custom projects/measures. Essentially, a deemed calculator is a simplified, modular modeling tool that allows member utilities to offer a more complex energy-efficiency project approach to their nonresidential customers. Such tools are particularly well suited to complex commercial or small industrial lighting or HVAC projects, where a large variation in measure applications, baseline conditions, and other factors make savings calculations difficult and per unit rebates inappropriate. The calculator should facilitate project screening (e.g., cost-effectiveness calculation) and measure-level or project-level calculation of energy savings and incentives. The calculator also should be Web-based, accessible by multiple members, and able to track and report results to Tri-State.

10.2.2 Sector Level Program Recommendations

Short-Term Program Recommendations

In the near term, we recommend Tri-State expand its range of energy-efficiency measures offered through the current EEC Program incentive mechanism, with new, cost-effective measures targeted to each sector's areas of greatest potential.[1] While every measure with a

[1] Short term measure recommendations are listed according to potential, with highest-potential measures listed first. Potential is based on the highest TRC for the type of measure.

benefit-to-cost ratio of 1.0 or greater offers an opportunity to capture energy savings, short-term recommendations focus on those measures that have passed the TRC test, represent a significant share of achievable potential, and are well suited to paying per-unit rebates based on expected savings across different member utilities. The sector sections below describe these measures in greater detail. Please see Appendix A of this report for a complete listing of cost effective energy efficiency measures

Residential Sector Short-Term Program Recommendations

New Measures

As shown in Section 4, cost-effective residential measures include a range of lighting, appliance, water heating, HVAC, and plug load applications. Tri-State has already implemented programs to capture end-uses with the highest savings potential—namely lighting (CFLs) and appliances (ENERGY STAR® refrigerators, freezers, clothes washers and dishwashers) – as well as electric water heaters and heat pumps. To supplement these, we recommend Tri-State add high-efficiency lighting fixtures; specialty CFLs, LED interior and exterior lighting; ENERGY STAR® electronics, such as laptop computers, cordless telephones, televisions and home audio systems. Some of these measures may be most effectively deployed through an upstream buy-down/market transformation initiative led by a regional third party.

Direct Installation

A range of lower-cost measures have been identified as cost effective and represent good potential energy savings. Such measures are typically difficult to deploy using a traditional rebate approach, because the cost of the measure, and therefore the rebate, are too small to justify the administrative burden required to process rebates at the utility level or the time required to fill out and mail in rebate forms at the consumer level. A direct installation approach helps to overcome these barriers and is also an effective way to achieve mass deployment at a low cost. Direct installation programs are most appropriately implemented by third parties. Typically such programs target lower to middle income neighborhoods, multifamily housing and other residential segments that don’t generally participate in energy efficiency programs in large numbers. CFLs have been a major target for direct installation programs in the past, however, with the advent of new lighting efficiency mandates, opportunities will diminish for acquiring savings through CFLs. However, there are several cost effective measures that Tri-State may wish to consider implementing through a direct installation approach, including: water heater pipe insulation, low flow showerheads and faucet aerators, programmable thermostats (as these are slightly more expensive, they may be implemented with a customer cost-sharing approach), simple air sealing, water heater tank wraps, and water heater setback. Additionally, in the very near term, there remains potential for CFL energy savings, particularly in low-income and multifamily housing, which could be included in a direct installation program through the end of 2011. Where direct installation measures do not correspond directly to Tri-State’s fuel supply (e.g., water heating measures in homes with gas water heat), Tri-State could negotiate sharing program costs with the corresponding gas utility to the extent possible. This concept is discussed in greater detail below.

Refrigerator/Freezer Decommissioning and Recycling

Refrigerator and freezer recycling programs are both cost effective and address a significant area of potential energy savings. Appliance recycling programs reduce energy consumption by eliminating old, inefficient appliances when new ones are purchased or eliminating a second unit that may not be needed. They also ensure that old appliances are disposed of in an environmentally responsible manner. Tri-State could facilitate such a program in one or more of the following ways:

1) Implement the program through a third party contractor. Several firms around the country specialize in appliance recycling and have established facilities for dismantling large quantities of appliances, recycling all possible components and safely disposing of the remainder.
2) Offer an incentive to member utilities that offer their own appliance recycling programs.
3) Facilitate the collection and storage of appliances through existing waste management companies. Rural areas present a unique challenge to operating an effective/efficient appliance recycling program, because appliance pick-ups may be far apart in terms of both timing and distance. Tri-State could contract with existing waste management companies in rural areas, to pick up unwanted refrigerators and freezers and store them in a central location, for periodic mass pick-ups by an appliance recycling company.

Online Audit Tool

An online audit tool helps residential customers identify energy savings opportunities in their homes. We recommend Tri-State adopts an online audit tool through its Web site and/or facilitates adoption by members on their Web sites. Numerous online audit tools, provided free of charge, are available on the market, such as the Home Energy Saver,[1] developed by Lawrence Berkley National Laboratory. Tri-State may simply wish to provide a link on its Web site to an existing, free tool, or develop a more tailored tool that links end users to specific Tri-State programs and educational information. Customers may use the online tool to increase end-user awareness of household energy, which may result in increased program participation.

Commercial Sector Short-Term Program Recommendations

New Measures

As shown in Section 5, cost-effective commercial measures include a range of lighting, refrigeration, HVAC, motors, building envelope, water heating, and plug load applications. Tri-State's EEC program currently includes rebates for motors and a standard heating and cooling measures that are most applicable to smaller commercial applications. Because the commercial sector represents only 18% of Tri-State's sales by sector, we recommend first focusing on end uses with the highest cost effectiveness and savings potential—namely lighting, and refrigeration. Initially, Tri-State should develop a rebate schedule for commercial lighting

[1] http://hes.lbl.gov/

applications, including pulse start metal halide and ceramic metal halide, high bay fixtures, occupancy sensors, standard fluorescent T8 and T5 lamps and fixtures, LED exit lights and signage, and cold cathode lamps. New refrigeration measures should include ECM case fan motors, walk-in refrigeration lighting fixtures, efficient reach-in and walk-in refrigerators, door gaskets, vertical night covers, controllers for beverage machines and other cold products refrigeration systems, evaporative cooled multiplex systems, low-temp compressors, anti-sweat controls, floating suction pressure controllers, and refrigeration line insulation. Tri-State may wish to also consider adding commercial dishwashers, programmable thermostats, and office equipment measures such as ENERGY STAR® computers, monitors, fax machines, copiers, printers and network PC power management software. We recommend Tri-State address more complex heating, cooling and hot water measures through a quasi-custom, deemed calculator program, discussed below.

Note that commercial lighting recommendations overlap with the industrial sector and may be applied to both sectors, as appropriate.

Bundle Measures into Programs for Targeted Marketing

As discussed, the measures above should be incorporated into Tri-State's EEC program, using its current delivery mechanism and infrastructure. In addition, to further support member participation and add value to its available prescriptive measure list, Tri-State should begin to aggregate discrete measures into appropriate measure bundles, helping its members better target specific end uses or customer types. These program concepts should be supported by co-branded (with members) marketing materials, available through Tri-State's member portal and technical assistance, as needed, to facilitate members' ability to offer these programs to end users. Examples of such programs include:

- A hospitality and food service program, highlighting refrigeration measures and also targeting available commercial cooking measures and lighting.
- A commercial lighting program offering incentives of a list of differing light types often employed in commercial buildings.
- A commercial office equipment program, which would bundle new plug-load measures, such as ENERGY STAR®-rated computers and monitors, network PC power management software, and so on.

Industrial Sector Short-Term Program Recommendations

New Measures

The industrial sector represents 34% of Tri-State's energy savings potential. Motors are by far, the largest end use in this sector, followed by lighting. Tri-State already has an established rebate for motors and plans to expand the program to include high efficiency motors over 500 hp. In the near term, we recommend Tri-State continue to offer incentives on motors, and also add variable speed drives. Additionally, the lighting and other measures recommended for the commercial sector should be offered as applicable to industrial customers.

Industrial sector facilities are characterized by intensive energy use and complex, a-typical systems, with limited flexibility around alternative equipment strategies. This sector is perhaps the most difficult to penetrate with traditional marketing and the least appropriate for a standardized rebate program approach. In order to increase participation in its motors efficiency incentives among industrial sector customers, we recommend Tri-State support the program with a more aggressive marketing approach, using customer outreach managers who have technical expertise in industrial processing to work directly with these customers to explain program opportunities and incentives.

Industrial Audit

The U.S. Department of Energy's (DOE) Industrial Technologies Program offers free, comprehensive building assessments for industrial facilities. Large facilities may apply for a free, three-day energy assessment from a DOE energy expert, who will use DOE software to analyze energy use and identify areas for improvement. Small- to-medium sized eligible manufacturing facilities can apply for a free onsite assessment through one of the DOE's Industrial Assessment Centers (IAC). Recommendations result in an average of roughly $55,000 in potential annual savings per manufacturer. Such a program may provide Tri-State and its members with an opportunity to offer value-added services to end users at relatively low program costs, supplementing the DOE audits by matching appropriate incentives with resulting recommendations. Tri-State should explore options to coordinate with Colorado's ICA, located at Colorado State University in Fort Collins, which conducts assessments for the Rocky Mountain region, and similar organizations in Wyoming and New Mexico, where the industrial sector represents a significant portion of Tri-State's electricity sales.

Longer-Term Program Recommendations

Residential Sector Longer-Term Program Recommendations

Residential Audit Program

Audit programs offer an opportunity to collect valuable energy-use information, install low-cost energy savings measures, educate customers on energy-efficient behaviors, and identify untapped energy-efficiency opportunities. Tri-State should develop a residential audit program to secure these savings from both direct installation measures and increased end-user awareness of other EEC program opportunities. End-user customers will benefit from personalized recommendations to increase their homes' energy efficiency and one-on-one education on energy efficient behaviors, as well as receiving additional information on utility incentives for applicable measures.

The residential audit pilot may be offered as a turnkey program, utility-sponsored program, or both. The utility-sponsored option will allow members already offering audit programs to continue using their established delivery mechanism and infrastructure resources. A turnkey option will attract new members lacking sufficient in-house resources to offer such programs, and may be best facilitated through a centralized administrator, which subcontracts with multiple local audit firms covering specific geographical areas. Offering the program as a turnkey or utility-sponsored option gives members greater flexibility in selecting delivery mechanisms best suited to their program management capacity, thus generating greater member participation. Both options should incorporate a minimum level of direct installation measures, providing instant cost-savings for end users and energy savings to make the audit cost-effective. Direct installation measures may include: faucet aerators and low flow shower heads, smart strips for high-use plug-loads, efficient lighting, and so on. Both options also should require specific minimum measurement and testing procedures and auditor certification/education levels. For end-use customers with electric heat or central air conditioning, or where members collaborate with natural gas utilities, Tri-State should offer generous incentives for insulation, air sealing, and duct sealing as actionable measures following the audit.

Because audit programs and weatherization measures typically impact both gas and electricity usage, we recommend Tri-State work with its utilities and corresponding natural gas providers to develop a cost- and savings-sharing mechanism to facilitate this program. To enable longer-term implementation of an audit program, Tri-State should now begin to work with its members and relevant natural gas providers in its territory to negotiate appropriate sharing of audit, measure, and program delivery costs in dual-fuel homes. Cost-sharing agreements are typically implemented through contractual language allocating costs, savings accrual, and roles and responsibilities associated with administrative functions, such as which entity will be responsible for a call center, scheduling, and audits, or how invoicing will be handled. For example, energy audit programs in Iowa are conducted by a single contractor, where costs and savings are shared among the gas and electric utility according to an agreed schedule based on each customer's heating and hot water fuel.

Commercial Sector Longer-Term Program Recommendations

Custom Measure Program

To facilitate adoption of more complex commercial lighting and HVAC applications, we recommend Tri-State offer a Custom Measure Program through the use of a deemed calculator tool to estimate incentives and saving, as discussed in the portfolio level recommendations above. Such a tool would reduce the analysis burden on large commercial facilities and more complex applications, where large variations of measure applications, baseline conditions, and other factors make deemed-savings measures inappropriate. As discussed, the tool should facilitate project screening (e.g., cost-effectiveness calculation) and measure-level or project-level calculation of energy savings and incentives for heating and cooling systems, complex lighting projects, and other applications as appropriate. The calculator should also be Web-based, accessible by multiple members, and able to track and report results to Tri-State.

Small Commercial Energy Audit and Direct Installation:

A turnkey small commercial audit program would allow Tri-State and its member utilities to achieve energy savings within the hard-to-reach small commercial sector. This program would generate immediate savings by deploying cost-effective, directly-installed measures, such as occupancy sensors, LED exiting lighting, vending marching controls, low-flow showerheads and faucet aerators and other appropriate measures. Similarly to the residential program, weatherization measures could be offered where warranted for customers with central air conditioning or electric heating.

Further, as with the residential audit program, Tri-State should begin now to work with its members and relevant natural gas providers in its territory to negotiate appropriate sharing of audit, measure, and program delivery costs in dual-fuel facilities. Cost-sharing agreements are typically implemented through contractual language allocating costs, savings accrual, and roles and responsibilities associated with administrative functions, such as which entity will be responsible for a call center, scheduling, and audits, or how invoicing will be handled.

Industrial Sector Longer-Term Program Recommendations

Energy Management Program

The Energy Management Program targets often elusive but valuable operations and maintenance (O&M) savings opportunities resulting from diligent tracking of building and equipment performance. The three approaches within this program complement each other: *the Energy Project Manager*, *Track and Tune Projects*, and *High-Performance Energy Management*.

- The *Energy Project Manager* supplements end-user resources with additional staff or contractors, whose primary focus is to identify and execute large energy-efficiency projects. In this component, Tri-State would fund or co-fund on-site technical expert.
- *Track and Tune Projects* focus primarily on system tune-ups as well as O&M opportunities. This may be implemented as either a third party program component or a rebate mechanism for customers and trade allies that incorporate energy performance equipment testing during routine maintenance checks and install retrofit measures to optimize system performance at the time of service.
- *High-Performance Energy Management* encourages and trains individuals at end-user companies to become energy champions that educate and instill principles of continuous improvement related to energy use.

Industrial Collaborative Partnerships

Tri-State should explore the benefits and challenges associated with entering into collaborative partnerships with relevant nonprofits and agencies to market programs to end users with similar interests. For example, Agricultural (Cooperative) Extension offices are staffed by one or more experts who provide useful, practical, and research-based information to agricultural producers, small business owners, consumers, and others in rural areas and communities. Such experts are already positioned and generally motivated to help their constituents identify energy and cost saving opportunities and provide the technical expertise needed to see projects through to installation. Industry-specific trade associations may serve a similar role supporting customers in the relevant field. Such agencies may also be able to help end users leverage Federal tax credits, Department of Agriculture/Farm Bill grants, and similar funding opportunities.

Waste Heat Recovery

The oil and gas industry is highly specialized, and traditional demand-side management programs are not well-suited to meet its needs. Twenty percent of Tri-State's industrial load is comprised of oil and gas transmission stations that utilize specialized pipeline transmission motors. Such applications typically are found in remote areas, with limited or no other fuel requirements on site. Tri-State, in partnership with its utility members, should explore program options to enable end-user oil and gas companies to recover onsite waste heat, via Combined Heat and Power (CHP) systems, and identify opportunities for supplemental uses of waste heat from oil and gas production generators, compressors (sites with thermal loads), and natural gas processing plants as well as promotion of gas-fired compression with waste heat power generation on gas pipelines instead of traditional, line-powered, central-generation, electrically-driven compressors.

Similar CHP opportunities can be found in agricultural feedlots and dairy farms, waste water treatment facilities, manufacturing facilities, hospitals, hotels and casinos, prisons, and colleges. We recommend Tri-State develop the expertise to work with its members on these types of facilities.

The Power of Experience

Corporate Headquarters

101 Second Street, 10th Floor
San Francisco, CA 94105-3672
tel: +1 415 369 1000
fax: +1 415 369 9700

www.nexant.com