Xcel Energy New Mexico DSM Potential Study 2021

Prepared for:

Xcel Energy

Xcel Energy New Mexico

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Table of Contents

List of Tables

List of Figures

Introduction and Background

Xcel Energy retained Guidehouse to develop an estimate of the potential for energy efficiency for the company's New Mexico service territory over a nine-year time horizon from 2021 to 2030. This study focused on energy efficiency potential only. Guidehouse conducted primary research to collect New Mexico-specific customer and measure data to inform the modeling inputs and modeled the technical, economic, and achievable potential for energy efficiency using its proprietary DSMSim™ model. Guidehouse calculated gross achievable energy efficiency potential for two scenarios, including a Maximum Achievable scenario (i.e., the reflection of the savings possible through unconstrained budgets, greatly heightened program activity and incentives) and a Reference scenario (i.e., the reflection of the primary and secondary data collected on the market for energy efficient technologies in Xcel Energy's New Mexico service territory).

The study data and analysis will inform Xcel Energy in the development of future DSM Plans. Throughout this study, Guidehouse sought regular input and feedback from both internal and external stakeholders, who provided important market knowledge and industry expertise for producing a robust final study. Table 1 summarizes the various elements of the project scope.

Table 1 Summary of Project Scope

Forms of Energy	Electricity
Type of Potential	Energy Efficiency Technical, Economic, Achievable
Sectors	Residential, Commercial, and Industrial (C&I)
Climate	Single Weather Zone
Time Horizon	2021-2030 (9 years)

Report Organization

The report is organized as follows:

- Section 1 provides an overview of **Customer Characterization** developed and used in the study. This section provides the breakdown of customers by sector and segment.
- Section 2 provides an overview of the **Primary Research** conducted for collecting customer and measure data that were used as inputs in the model.
- Section 3 discusses the **Energy Efficiency Measure Characterization**, including key parameters.
- Section 4 presents the **Energy Efficiency Technical Potential Forecast** for energy efficiency measures, including a summary of results by sector and end use.
- Section 5 provides the **Energy Efficiency Economic Potential Results** for energy efficiency measures, including a summary of results by sector and end use.
- Section 6 presents the **Energy Efficiency Achievable Potential Results by Scenario (Max Achievable and Reference)** for energy efficiency measures, including a summary

of results by sector, end use, customer segment, and measure, as well as cost effectiveness test results.

The report also includes the following six appendices and three attachments:

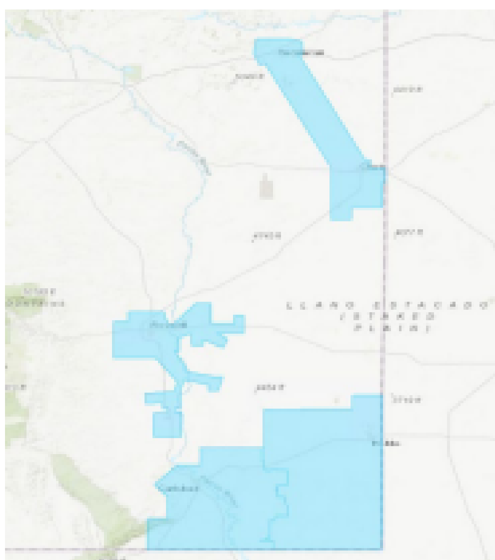
- Appendix A. Customer Characterization
- Appendix B. Primary Research
- Appendix C. Energy Efficiency Measure Characterization
- Appendix D. Energy Efficiency Technical Potential
- Appendix E. Energy Efficiency Economic Potential
- Appendix F. Energy Efficiency Achievable Potential
- Attachment A Measure Inputs
- Attachment B Results FiguresAndTables_Max Achievable
- Attachment C Results FiguresAndTables_Reference Scenario

Note: The attachments are provided at the end of the report in a separate section.

1. Customer Characterization

This section documents Guidehouse's characterization of Xcel Energy's residential and commercial and industrial (C&I) customers in the New Mexico territory (see Figure 1-1). As part of this work, Guidehouse proposed a customer segmentation scheme based on building type, income level (for residential customers), and industry (for C&I customers). Appendix A, "Customer Breakout by City" includes a detailed customer breakout by city and sector (residential and commercial).

Figure 1-1. Xcel Energy's New Mexico Territory



Source: Ventyx Energy Velocity Suite

1.1 Base Case Forecast

Guidehouse developed a base case forecast of electric sales over the study period in Xcel Energy's New Mexico service territory. The team's approach included the segmentation of sales by housing or building type and income.

In general, Guidehouse used Xcel Energy-specific data wherever possible and supplemented that data with other sources, such as Energy Information Administration (EIA) data. This approach resulted in the use of primary data collection to supplement the available secondary data as required. Appendix A, "Secondary Sources for Customer Characterization," provides the secondary sources used during the base year forecast.

1.2 Base Case Forecast Approaches and Sources

To estimate the demand side management (DSM) potential within Xcel Energy's New Mexico territory, Guidehouse requested sales and customer forecasts without the impact of DSM programs from Xcel Energy. Guidehouse then developed projections of housing and commercial building stocks, based on Xcel Energy's long-term sales forecasts and other information, such as EIA data.

Guidehouse modeled the DSM potential based on these resulting stocks and the changing proportion of new and existing buildings. In each sector, new construction savings opportunities were modeled as a function of forecasted new building stock and energy sales.

Proper segmentation reflects the minimum number of customer groups able to capture the heterogeneity in customer energy usage patterns that is meaningful for the study's goals. Guidehouse worked with Xcel Energy to determine this segmentation based on current energy efficiency measures, planned future offerings, and data available to categorize customers. We also confirmed that savings, cost, and adoption of energy efficiency measures are likely to be similar within each segment.

Guidehouse divided customers into segments with similar patterns of energy use and efficiency opportunities. Table 1-1 shows the segmentation used for this study:

- Guidehouse divided residential customers into five segments, based on the type of structure and income level (single family, multifamily, single family low income, and multifamily low income, manufactured homes). Appendix A, "Residential Customer Characterization," includes more information about the residential customers.
- The team divided the commercial sector into 11 segments and divided the industrial sector into two segments, including agriculture and manufacturing. Appendix A, "Commercial & Industrial Customer Characterization," includes more information about the C&I customers.

Table 1-1. Customer Segments by Sector

Single Family Office Agriculture

Multifamily Retail Manufacturing Single Family - Low Income Restaurant

Multifamily - Low Income Grocery

Manufactured Homes Warehouse

School

College

Health

Other

Lodging

Mining/Oil & Gas Extraction

1.3 Base Year Calibration

This section discusses some of the trends Guidehouse observed in Xcel Energy's sales and customer forecast, as well as the impacts these trends may have on the Potential Study results. The electric sales forecast Xcel Energy provided reflects a spike in electric sales growth from

2021-2024 for C&I customers with a slower rate of growth from 2025-2030. In the residential sector, Xcel Energy is projecting a 0% growth in sales through 2024 and a 1% growth from

2025-2030. Guidehouse assumes the growth in sales is correlated with new construction in the territory, so the potential from new construction efficiency measures is also correlated with the sales growth projections.

2. Primary Research

This section outlines the approach and results of Guidehouse's primary data collection activities, which provided quality inputs into the potential model to enhance the accuracy of the technical, economic, and achievable potential. Guidehouse focused primary data collection on three areas: equipment density, efficient equipment saturation, and customer willingness to pay for efficient equipment.

2.1 Primary Data Collection Approach

Energy efficiency potential follows a power law: a small number of end uses and segments typically deliver the majority of energy efficiency savings. To maximize the impact of primary data collection, Guidehouse focused primary research activities by oversampling the customer segments and end uses shown in Table B-1 in Appendix B, "Approach to Primary Data Collection,". Guidehouse used a robust sampling approach to produce results at a confidence and precision level of 90/10 at the sector and high priority end use level, while also targeting a confidence and maximum precision of 90/20 for each stratum in the residential sector and 90/30 for each building type and priority end use combination in the C&I sector. Appendix B, "Sampling Approach" provides A detailed explanation of our sampling progress to develop the sample target.

In addition to collecting data for all segments and end uses, Guidehouse focused on characterizing the density, saturation, and customer willingness to pay for specific measures within the priority customer segment/end use combinations for primary research (see Table 1-1). Our data collection method for these characteristics was a virtual audit administered through a Qualtrics[1] web surveying platform. This virtual audit guided respondents through how to provide information on selected end uses, including quantity, type, and in some cases photos of equipment nameplates or other helpful images. The virtual audits included general questions on building characteristics to validate segmentation and fill in any gaps in segment-level parameters. Guidehouse collected data on customer willingness to pay for energy efficient equipment according to Guidehouse's standard practices for informing discrete choice logit and simple payback period modeling.

The survey design collected density data for all the prioritized end uses, but in an effort to reduce the time burden on survey respondents, it limited detailed questions about saturation, characterization, and willingness to pay to the priority segment/end use combinations Table 2-1 identified, plus one to three additional end uses randomly selected for each respondent. The following table illustrates the approach for each segment. All surveys included general building characteristics (e.g., building square footage, age, etc.) regardless of the selected end uses.

[1] Qualtrics, “Experience Design and Experience Improvement,” https://www.qualtrics.com/.

Space

Table 2-1. Survey Topics by Segment and End Use

Water

Compressed

Fans,
Blowers,

Residential:

Cooling and
Heating
Hot
Air
Motors, Drives and
Pumps
Process Cooling

Single Family and
Multifamily
Residential:
◎ ◎ □ □ □ □ □ □ □ □

Manufactured ◎ □ □ □ □ □ □ □ □ □ Commercial:

Office ◎ □ □ □ □ □ □ □ □ □ Commercial:

Retail ◎ □ □ □ □ □ □ □ □ □

Commercial: Manufacturing and Mining/Oil & Gas Extraction

C&I: All Other

□ □ □ □ □ □ □ □ □ ◎ □

Segments □ □ □ □ □ □ □ □ □ □ □

◎ **Priority end use:** All respondents received saturation, characterization, and willingness to pay questions about this end use. □ **Included end use:** Respondents received basic questions on equipment count on all included end uses, as well as detailed questions on randomly selected end uses present at respondent's building. To keep surveys to a reasonable length, the number of randomly selected end uses varied based on the number of measures included within the end use.

□ **Excluded end use:** Respondents in this segment did not receive any questions about this end use.

2.2 Residential and C&I Data Collection Summary

Through the data collection process, Guidehouse achieved 93% and 61% completes for the residential and commercial sectors, respectively. Guidehouse recognized the low response rates for the residential and commercial surveys response rates (9.9% and 4.2%, respectively), which were likely due to two primary factors: screened out contacts and the COVID-19 pandemic. The residential survey achieved a total of 337 completes and 315 partial completes. The commercial survey received a total of 85 completes and 129 partial completes. Table 2-2 includes the response summary of the residential and commercial surveys. A detailed description of the methodology, customer communication and response summary can be found in Appendix B, Residential Data Collection and Commercial & Industrial Customer Characterization sections.

Table 2-2. Residential and Commercial Response Rate Summary

		Screen Outs	Partial Completes Partial	Completes (Density) Total	Completes Completes (Including All	Partial completes) Response	Total Rate	Percent of Target Achieved
Residential	700	51	145	170	337	652	9.9%	93%
C&I	350	79	111	18	85	214	4.2%	61%

3. Energy Efficiency Measure Characterization

Guidehouse characterized 88 energy efficiency measures across Xcel Energy New Mexico's residential and C&I sectors. The team prioritized measures for inclusion based on their likelihood to have high savings in Xcel Energy New Mexico's territories and their current market availability and cost-effectiveness. Xcel Energy New Mexico's engineering team reviewed the list in detail and provided feedback that was incorporated to finalize the measure list for this study. Guidehouse made this list available for review by stakeholders on November 9, 2021.

3.1 Energy Efficiency Measure List

Guidehouse and Xcel Energy New Mexico developed a thorough list of energy efficiency measures for this study. Guidehouse created the list based on measures in the New Mexico Technical Reference Manual (TRM), existing Xcel Energy programs, other North American TRMs and utility programs, and emerging technologies. For the purposes of this study, Guidehouse defines emerging technologies as known or existing technologies that have a reasonable chance of customer adoption in the frame of the study, and that are experiencing rapidly changing costs or efficiencies though economies of scale or R&D. Guidehouse did not include a generic future emerging technologies measure that would attempt to capture potential savings from technologies not ready for the market. This list was reviewed by Xcel Energy's program team as well as external stakeholders. We considered input from stakeholders and determined that the suggestions for new measures or adjustments to existing measures were already included in the measure list or were not feasible to analyze within the scope of this study. Guidehouse worked with Xcel Energy New Mexico to finalize the measure list and confirm it contained technologies viable for future DSM program planning activities.

Table A-2 and Table A-3 in Appendix A, "Residential Customer Characterization" provide the baseline and efficient description of all measures included in this study. This list does not include all the applicable segments for each measure. It should be assumed that each measure was characterized for all segments unless the measure itself has a niche application. For example, occupancy sensors for common areas were limited to multifamily residential segments.

3.2 Energy Efficiency Measure Characterization Key Parameters

The measure characterization effort included defining more than 50 individual parameters for each measure included in this study. These parameters include measure-specific parameters such as energy savings, cost, and measure life. It also included market-specific parameters such as measure saturation, density, suitability and more. Table A-4 in Appendix A defines 14 key parameters and how these items impact technical and economic potential savings estimates. Where appropriate, Guidehouse used primary data collected via remote audits of Xcel Energy's New Mexico customers to inform the measure parameters.

3.3 Energy Efficiency Measure Characterization Approaches and Sources

This section provides approaches and sources for the main measure characterization variables. Table 3-1 includes sources of data accessed for measure characterization and is sorted by hierarchical data preference. The New Mexico TRM and Xcel Energy New Mexico program data were the primary sources for savings and cost. Equipment density and efficient saturation

values were informed by the primary data collection conducted by Guidehouse and by Xcel Energy New Mexico's previous surveys. Where primary data was not available, baseline studies from other territories were used as supplements. Appendix C, "Key Parameter Approach and Sources," details the approach and sources used for characterizing energy savings, incremental cost, density, and saturation values.

Table 3-1. Sources for Measure Characterization Inputs

	• 2020 Lighting Measure Update to the New Mexico Technical Resource Manual (TRM)

	• New Mexico Technical Reference Manual for the Calculation of Energy Efficiency Savings April 17, 2019
Measure Costs, Measure Life, Energy Savings	• Guidehouse measure database and previous potential studies • US DOE Appliance Standards and Rulemakings supporting documents • Primary research conducted as a part of this study (see Appendix B, "Primary Research")
Fuel Type Multipliers, Density, Baseline Initial Saturation • Xcel Energy New Mexico Technical Assumptions File • Xcel Energy New Mexico Program data • Engineering analyses • Other TRMs • 2019 Xcel Energy Colorado DSM Potential Study	• Xcel Energy (New Mexico)-Home Energy Use Study 2018 • Xcel Energy (New Mexico)-Home Energy Use Study 2020 • US EIA Residential Energy Consumption Survey (RECS) • US EIA Commercial Building Energy Consumption Survey (CBECS) • US EIA Manufacturing Energy Consumption Survey • US Census American Community Survey • US Census Annual Economic Survey • Guidehouse baseline studies from other jurisdictions

4. Energy Efficiency Technical Potential

This study defines technical potential as the total energy savings available, assuming that all installed measures being considered can immediately be replaced with the efficient measure or technology—wherever technically feasible—regardless of the cost, market acceptance, or whether a measure has failed and must be replaced.

4.1 Approach to Estimating Technical Potential

Guidehouse used its DSMSim™ model to estimate the technical potential for demand side resources in Xcel Energy's New Mexico service territory. DSMSim™ is a bottom-up technology diffusion and stock-tracking model implemented using a system dynamics framework.[2]

Guidehouse assumes that the baseline for the technical potential of a given measure, in a given year, is the baseline applicable in that year after adjusting for codes and standards changes. The calculation of technical potential in this study differs depending on the assumed measure replacement type. Technical potential is calculated on a per-measure basis and includes estimates of savings per unit, measure density (e.g., quantity of measures per home), and total building stock in the service territory. The study accounts for three replacement types, where potential from retrofit and replace-on-burnout measures are calculated differently from potential for new measures. The formulae used to calculate technical potential by replacement type are shown in Appendix D, "Approach to Technical Potential and Replacement Types."

4.1.1 Competition Groups

Guidehouse's modeling approach recognizes that some efficient technologies will compete in the calculation of potential. The study defines competition as an efficient measure competing for the same installation as another efficient measure. For instance, a consumer has the choice to install an efficient storage or tankless water heater, a heat pump water heater, or a solar thermal water heater, but not all three. These efficient technologies compete for the same installation. A detailed explanation of the calculation of potential for measures in a competition group can be found in Appendix D, "Competition Groups."

4.2 Technical Potential Results

This section provides the technical savings potential calculated through DSMSim™ by sector. The Attachment A: Measure Inputs provides the associated data.

Figure 4-1 shows the total technical savings potential split by sector for electric energy and electric demand. The allocation of technical potential among sectors is generally comparable with the allocation of forecasted sales among sectors, with commercial and residential sectors contributing the greatest electric technical potential.

Technical potential grows over time due to new stock additions to the territory. The increase in potential in the commercial sector from 2021-2026 corresponds with an increase in projected sales during that time period. The technical potential in the residential sector remains relatively

[2] Sterman, John D. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin McGraw-Hill. 2000 for detail on System Dynamics modelling. Also see http://en.wikipedia.org/wiki/System_dynamics for a high level overview.

flat during the time horizon of the study, corresponding to minimal new construction or building stock turnover and so a flat sales projection.

Comparing electric energy with electric demand, demand savings largely track energy savings for all sectors. Xcel Energy New Mexico is a summer peaking utility, with peak demand occurring in July.

Figure 4-1. Electric Energy (GWh/year) and Demand (MW) Technical Savings Potential by Sector

1,200 1,000 800
600
400
200
0

400 300 200 100 0

Commecial Industrial

Residential

Commecial Industrial

Residential

Source: Guidehouse Analysis 2021

Figure 4-2 shows the electric savings potential for all sectors as a percentage of that sector's total forecasted sales. The percentages reflect a weighted average savings among measures applicable to existing building stock and new building stock constructed during the study period. As such, the slight downward-sloping residential and commercial electric sector indicates that electric savings opportunities (on a percentage of sales basis) are larger in existing construction than new construction. This perspective shows that the residential sector has the greatest technical potential as a percentage of sales for electric savings and demand savings. The mix of measures being considered within each sector is contributing to this. Additionally, building envelope and HVAC measures are driving the high potential for energy savings, and especially demand savings, in the residential sector. Guidehouse's primary research showed that the HVAC equipment and building envelope components (windows, insulation, air leakage, etc.) in the existing residential building stock is generally inefficient and offers significant potential for savings. The residential and commercial sectors' electric savings as a percentage of sales decreases slightly over time due to the changing mix of new and existing building stock, although the technical potential grows in absolute terms.

Figure 4-2. Electric Energy and Demand Technical Savings Potential by Sector as a Percent of Sector Sales (%)

20%
80%
0%
60%
40%

Commercial
Industrial
Residential

100%
40%
Industrial
20%
Residential
80%
0%
Commercial
60%

Source: Guidehouse Analysis 2021

Appendix D, "Technical Potential Results" provides detailed results by segment and shows the top 40 measures contributing to technical potential.

5. Energy Efficiency Economic Potential

This section describes the economic savings potential, which is potential that meets a prescribed level of cost-effectiveness, available in Xcel Energy's New Mexico service territory. It explains Guidehouse's approach for calculating economic potential then presents the results for economic potential in the territory.

5.1 Approach to Estimating Economic Potential

Economic potential is a subset of technical potential, using the same assumptions regarding immediate replacement and interactive effects as in technical potential, but including only those measures that have passed the benefit-cost test chosen for measure screening (in this case, the total resource cost [TRC] test and utility cost test [UCT per Xcel Energy's guidance). The TRC and UCT ratio for each measure is calculated each year and compared against the measure-level ratio screening threshold of 1.0. A measure with a TRC or UCT ratio greater than or equal to 1.0 is a measure that provides monetary benefits greater than or equal to its costs. If a measure's TRC or UCT meets or exceeds the threshold, it is included in the economic potential.

The TRC test is a cost-benefit metric that measures the net benefits of energy efficiency measures from the combined stakeholder viewpoint of the utility (or program administrator) and the customers. The UCT is a cost-benefit metric that measures net benefits of energy efficiency from the viewpoint of the utility (or program administrator). A detailed explanation of algorithms and the approach for calculating TRC and UCT ratios is provided in Appendix E, "Economic Potential TRC and UCT"

To focus the efforts of the study on the measures most likely to contribute achievable potential, Guidehouse and Xcel Energy developed a measure list based on Xcel Energy's experience managing portfolios and Guidehouse's experience estimating potential, while considering New Mexico-specific characteristics.

5.2 Economic Potential Results

This section provides the economic potential calculated through DSMSim™ by sector. Figure 5-1 shows economic electric energy and electric demand savings potential across all sectors. On average, 51% of electric energy savings and 57% of electric demand savings potential pass the economic screening process across the study period. In the residential sector, 57% of electric energy savings pass the screening; in the commercial sector, 46% pass; and in the industrial sector, 92% pass the screening. This is due to a larger number of measures in the residential sector with high technical potential such as high efficiency HVAC measures, heat pump dryers, and building envelope measures (e.g., added attic and wall insulation) failing the cost test screen.

Figure 5-1. Electric Energy (GWh/year) and Demand (MW) Economic Potential by Sector

200 0

800

600

400

250

200

150

100 50

0

Source: Guidehouse Analysis 2021

Commercial Industrial Residential

Commercial Industrial

Residential

Bumps in select years of the economic potential occur whenever one or more measures cross the cost-effectiveness threshold in one or more customer segments. Marginally economic measures having TRC or UCT ratios slightly less than 1.0 at the beginning of the study period can become economically feasible as avoided costs—which escalate at a faster rate than equipment and operation and maintenance costs—increase throughout the study the period. This is especially evident between 2027 and 2030, when avoided capacity costs increase substantially versus previous years. For example, in the commercial sector, the bump in between 2027 and 2029 is mainly a result of high efficiency central heap pumps and rooftop units with demand controls screening for the first time, coinciding with a large jump in avoided capacity costs in 2028.

Technical and economic energy potential are similar in the industrial sector (economic potential is 92% of technical potential) because the measures included in the study are selected on the premise that they are or could become reasonably attractive to industrial customers and have some likelihood of adoption given a wide range of market environments.

Figure 5-2 shows the economic electric energy and electric demand savings potential as a percentage of sales or demand, respectively. The most noteworthy trend in economic potential as a percent of sales is that, like technical potential as a percent of sales, it is flat over time. This occurs as the growth in sales outpaces the growth of potential. There are some exceptions to this pattern, such as commercial electric energy potential, where the addition of high efficiency central heat pumps in 2028 and the addition of rooftop units with demand controls in 2029 add significantly to the economic potential.

Figure 5-2. Electric Energy and Demand Economic Potential by Sector as a Percent of Sector Consumption (%)

10%

0%

50%

40%

30%

20%

Commercial

Industrial

Residential

60%
50%
40%
30%
20%
10%
0%
70%

Commercial
Industrial
Residential

Source: Guidehouse Analysis 2021

- Appendix E, "Economic Potential Results," provides detailed results by segment and shows the top 40 measures contributing to technical potential. All the measure-level data inputs are provided as an attachment to this report (Attachment B Results FiguresAndTables_Max Achievable).

6. Energy Efficiency Achievable Potential

Guidehouse calculated gross achievable energy efficiency potential for two scenarios, including a Maximum Achievable scenario (i.e., the reflection of the savings possible through unconstrained budgets, greatly heightened program activity and incentives) and a Reference scenario (i.e., the closest reflection of the primary and secondary data collected on the market for energy efficient technologies in Xcel Energy's New Mexico service territory).Guidehouse also conducted sensitivity analysis around customer willingness to pay for an efficient technology, equipment density (i.e., quantity of a particular item in a home or building), initial saturation of efficient technologies in the market, and Xcel Energy's sales forecast, which impacts the assumptions around new construction. All sales and savings values in this report represent energy consumption or electric demand at the customer meter.

These elements help capture the variation of gross potential that reflects the range of outcomes and uncertainty inherently present in any forecast. Although the Reference scenario is reflective of past program achievement and budget, both scenarios are reasonable estimates of future energy efficiency potential under the two sets of program assumptions described above.

6.1 Approach to Estimating Achievable Potential

The adoption of energy efficiency measures can be broken down into calculation of the equilibrium market share and calculation of the dynamic approach to equilibrium market share. The equilibrium market share can be thought of as the percentage of individuals choosing to purchase a technology provided those individuals are fully aware of the technology and its relative merits (e.g., the energy- and cost-saving features of the technology). In this potential study, Guidehouse used equilibrium payback acceptance curves that were developed using primary research from fall 2020 in Xcel Energy's New Mexico service territory. For this research, customer decision makers were asked about the quantity of various end uses within their home or business to inform density and saturation estimates and whether they would be likely to make investments in energy efficiency upgrades based on a variety of project costs and expected annual energy savings. Appendix F.1.1 provides a more detailed explanation with examples of these concepts. Initial efficient saturation (which is informed by the customer survey) has a large impact on gross achievable potential and Appendix F.1.6 presents efficient saturation trends for the top saving measures in the study along with a detailed example of the interaction between efficient saturation and savings potential.

Efficient measures can either be adopted as a retrofit, replace on burnout, or new construction measure. Guidehouse models the dynamics of how customers become aware of an efficient measure and eventually choose to adopt it or not, and how the building stock changes over time two different ways depending on the type of measure being considered. This methodology and how customer incentives to purchase the efficient measure are described in Appendices F.1.2, F.1.3, and F.1.4.

For all models that simulate future product adoption, there is no future world against which one can compare simulated with actual results, so the model has to be calibrated using historic data. For this potential study, Guidehouse took a number of steps to ensure that forecast model results were reasonable by comparing historic program performance and incentive spending with the modeled forecast. Guidehouse adjusted model parameters, including assumed incentive levels and technology diffusion coefficients to obtain close agreement across a wide variety of metrics compared for the Reference Scenario. This process ensures that forecast

gross potential is grounded against real-world results considering the many factors that come into play in determining the likely adoption of energy efficient measures, including both economic and non-economic factors. Appendix F.1.5 provides modeled vs. historic savings for both the residential and commercial and industrial sectors and more details on how the model was calibrated.

Guidehouse also studied the impact of varying four data-driven, salient parameters in a sensitivity study to determine their impact on overall potential. Appendix F.1.7 presents a thorough description and the results of this study.

6.2 Achievable Potential Results

Figure 6-1 presents the overall gross achievable potential by sector for the Maximum Achievable and Reference scenarios, and Table 6-1 presents the gross potential as a percentage of overall forecasted sales, GWh savings, and portfolio budget through 2030. The Maximum Achievable scenario reflects the savings possible through unconstrained budgets, greatly heightened program activity and incentives. The Reference scenario was deemed to represent a business as usual case, whereby Xcel Energy would continue implementing their energy efficiency programs at comparable funding levels and for the most part continue to realize the energy savings that they have experienced from the past.

Figure 6-1. Total Electric Cumulative Gross Achievable Potential

250 200 150
100 50
0
Maximum Achievable Scenario

Commercial
Industrial
Residential

250 200 150
100 50
0
Reference Scenario

Commercial
Industrial
Residential

Source: Guidehouse Analysis

Table 2-1. Total Electric Cumulative Gross Achievable Potential for Maximum Achievable and Reference Scenarios

	Cumulative Savings (GWh)		
Maximum Achievable Scenario			
2021	62	0.8%	$24.4
2022	140	1.7%	$28.9
2023	218	2.5%	$30.0
2025	333	3.4%	$23.1
2030	451	4.3%	$20.6
Reference Scenario			
2021	42	0.6%	$10.3
2022	97	1.2%	$12.2
2023	151	1.7%	$12.4
2025	251	2.6%	$12.1
2030	396	3.8%	$10.6

Source: Guidehouse Analysis

Appendix F.2 details the results pertaining to the Reference scenario for electric gross achievable potential at different levels of aggregation. Results are shown by sector, customer segment, end use, and by highest-impact measures. Appendix F.2 also provides analysis of some of the factors influencing these results.

Appendix F.3 provides results for the Maximum Achievable scenario, the assumptions Guidehouse made in developing this scenario, and how it compares to the Reference scenario.

Attachment B Results FiguresAndTables_Max Achievable and Attachment C Results FiguresAndTables_Reference Scenario show the detailed results for both achievable scenarios.

Appendix A. Customer Characterization

This appendix provides a more detailed explanation of the customer characterization task.

A.1 Customer Breakout by City

Within the New Mexico service territory, Xcel Energy has just under 110,000 residential and C&I customers. Table A-1 shows the breakdown of these customers by sector and city. Nearly 80% of all customers reside in four cities (Roswell, Clovis, Hobbs, and Carlsbad) in the southeast quadrant of the state.

Table A-1. Customer Breakout by City in Xcel Energy's New Mexico Service Territory

	Total	Customers Residential	Customers % of NM Residential	Customers C&I Customers	% of NM C&I Customers
Roswell	25,111	20,296	24%	4,815	19%
Hobbs	22,742	16,913	20%	5,829	23%
Clovis	18,770	15,222	18%	3,548	14%
Carlsbad	18,685	14,376	17%	4,308	17%
Artesia	6,341	5,074	6%	1,267	5%
Portales	6,341	5,074	6%	1,267	5%
Tucumcari	3,551	2,537	3%	1,014	4%
Eunice	2,113	846	1%	1,267	5%
Jal	2,113	846	1%	1,267	5%
Loving	1,353	846	1%	507	2%
Other[3]	2,198	1,691	2%	507	2%
Total	**109,317**	**83,720**		**25,597**	

A.2 Residential Customer Characterization

Guidehouse analyzed customer contact data from Xcel Energy and validated with data from the American Community Survey (ACS) for in-territory census tracts to determine customer counts in each of the segments defined for the potential study, based on a combination of home type and income level. Residential customers are classified as low income based on the following:

- ACS household income and household size data to inform the total population of residential customers who fall below 200% of federal poverty level.
- Xcel Energy data on which customers received assistance in the past 12 months to inform the low income split between single family and multifamily customers.

There are 83,720 residential customers in Xcel Energy's New Mexico service territory, the majority of which reside in single family homes. Table A-2 provides a home type breakout of

[3] The other category includes the cities of Dexter, Hagerman, Texaco, Lake Arthur, Monument, Lovington, and Malaga.

residential single family customers and multifamily customers living in a building with two to four units, multifamily customers living in a building with greater than four units, and customers living in manufactured homes.

Table A-2. Residential Customer Count by Home Type and City

	Single Family Homes	Multifamily Customers (2-4 Units per Building)	Multifamily Customers (5+ Units per Building)	Manufactured Homes
Roswell	14,455	726	1,835	3,241
Hobbs	11,677	761	1,753	2,703
Clovis	11,055	948	991	2,474
Carlsbad	10,272	538	1,224	2,292
Artesia	3,769	171	295	806
Portales	3,426	380	267	775
Tucumcari	1,982	51	95	405
Eunice	940	43	18	190
Jal	692	4	0	132
Loving	614	30	9	124
Other	1,185	53	69	249
Total	**60,065**	**3,704**	**6,556**	**13,395**

Note that the potential study did not break multifamily into large and small bins, but rather use random sampling to weight metrics accordingly, such that multifamily measure characterization and global inputs are representative of Xcel Energy's New Mexico residential multifamily population.

Analysis of ACS data indicates that 36% of households in Xcel Energy's New Mexico territory live at or below 200% of federal poverty level and were classified as low income for the potential study. Guidehouse analyzed data provided by Xcel Energy to determine what portion of these households are single family vs. multifamily. While 72% of total residential customers are single family and 12% are multifamily, 74% of customers receiving assistance from Xcel Energy are single family vs. 26% multifamily, which suggests a larger proportion of multifamily customers (greater than half) are low income relative to single family customers. Table 4 provides the total customer counts in each of the residential customer segments.

Table A-3. Residential Sector Customer Counts

Single Family	37,673
Single Family – Low Income	22,392
Multifamily	2,471
Multifamily – Low Income	7,789
Manufactured Homes	13,395
Total	**83,720**

A.3 Commercial & Industrial Customer Characterization

C&I customers are mapped to one of 11 commercial segments or two industrial segments based on a six-digit North American Industry Classification System (NAICS) code Xcel Energy provided in the customer database.

There are 25,597 C&I customers in Xcel Energy's New Mexico service territory. Guidehouse mapped each customer to a segment based on the six-digit NAICS code listed in the customer database. Table A-4 contains number of customers, total annual consumption, and average annual consumption per customer by C&I customer segment, based on these NAICS code classifications.

Table A-4. C&I Customer Count and Annual Consumption by Segment

Customer	Quantity	Total Annual MWh Consumption	Annual MWh Consumption per Customer
Commercial – College	87	33,872	389
Commercial - Grocery	609	89,205	146
Commercial – Health	375	61,944	165
Commercial - Lodging	451	53,492	119
Commercial - Mining/Oil & Gas Extraction	4,607	2,287,347	496
Commercial – Office	8,770	1,250,561	143
Commercial – Other	3,421	62,283	18
Commercial - Restaurant	560	291,624	521
Commercial – Retail	3,663	396,625	108
Commercial – School	227	8,520	38
Commercial - Warehouse	798	*	*
Industrial - Agriculture	1,381	236,107	171
Industrial - Manufacturing	648	*	*
Total	**25,597**	**5,892,648**	**230**

*energy sales not provided to protect identity of customers

A.4 Secondary Sources for Customer Characterization

To supplement customer and measure data, and to validate assumptions developed from customer data, Guidehouse used a variety of secondary sources. To increase transparency, Guidehouse relied publicly available sources wherever possible:

- US EIA Residential Energy Consumption Survey (RECS): This survey provides consumption, energy intensity, and residential building stock data broken out by census division, end use, fuel type, and building type for residential households. The latest data available is from 2015. While the data is not geographically granular (maximum geographic specificity for summary tables is for the "Mountain South" region, which includes New Mexico, Arizona, and Nevada), detailed cross tabs were used to supplement Xcel Energy data on EUI and fuel splits especially for multifamily and low income breakouts.

- US EIA Commercial Building Energy Consumption Survey (CBECS): This survey provides consumption, energy intensity, and stock data broken out by census division, end use, and fuel type. At time of writing, the latest full data set available was from 2012, with partial 2018 data used when possible (only a portion of the 2018 dataset had been published at the time of this study). While these data are not geographically granular, detailed cross tabs were used to supplement Xcel Energy data on size of commercial buildings, number of floors, EUI, and fuel splits.

- US EIA Manufacturing Energy Consumption Survey: This survey provides much of the same data as in CBECS, but for manufacturing buildings. The latest data available is from 2014, is cross-referenced to NAICS codes, and is not geographically specific (for most tables). The team used this data to supplement Xcel Energy's commercial customer data around end use breakouts, square footage, and fuel switching and fuel type.

- US Census American Community Survey: This includes a wide variety of demographic metrics on residential households including income, household size, building type, and owner occupancy. These tables were used to supplement Xcel Energy residential customer data and forecasts, particularly around low income and multifamily.

- US Census Annual Economic Survey: These surveys are conducted each year and provide information on economic activity including counts of businesses by sector, (NAICS summary codes), number of employees, and census geographies. The latest data available is from 2018. The team used the data to supplement Xcel Energy's customer data and forecasts.

Appendix B. Primary Research

This appendix provides a more detailed explanation of the primary research task.

B.1 Approach to Primary Data Collection

Guidehouse identified the segments shown in Table B-1 through:

1. Analysis of customer count and consumption data from the segments defined in Appendix A, "Customer Characterization"
2. Energy efficiency potential in Xcel Energy's adjacent Colorado service territory
3. Rapid growth segments
4. Other existing or ongoing Guidehouse potential studies in various jurisdictions
5. Historic program performance

Table B-1. Customer Segment/End Use Combination Focus for Primary Research

Commercial – Office Lighting

Commercial – Retail Lighting

Residential – Single Family	Lighting Space Cooling Space Heating Lighting
	Space Cooling Space
Residential – Single Family Low Income	Heating

Residential – Manufactured Lighting

Industrial – Manufacturing Fans, Blowers, Motors, Drives, and Pumps Commercial –

Mining/Oil & Gas Extraction Fans, Blowers, Motors, Drives and Pumps

B.2 Sampling Approach

Each characterization of an end use, equipment type, or willingness to pay value has its own distribution and its own confidence and precision level. We made conservative estimates with our sample sizes, since we designed for the equipment, we expected to have the highest variability in saturation. The sample sizes that follow are the total number of sites for which we collected data.

To minimize customer fatigue and maximize the quality of the most important data, we asked each customer about the applicable high impact end uses for their respective segment plus one to two lower priority end uses. Our assumption was that by keeping the survey as succinct as possible, we would receive a higher level of data quality for the most important end uses . Thus,

the sample sizes for lower priority end uses were less than the total number of sites, since not every site was asked about every end use. We used the same approach for willingness to pay questions.

B.2.1 Residential Population Frame

Our residential population frame, shown in Table B-2, is segmented into residential homes, multifamily, and manufactured homes. The residential and multifamily strata are further stratified into low income and non-low income since it is likely that the income level of a customer may influence both their willingness to pay and the equipment installed in their home.

Table B-2. Residential Population Frame

Single Family	36,610
Single Family – Low Income	21,760
Multifamily	2,401
Multifamily – Low Income	7,569
Manufactured	13,017
Total	**81,357**

Source: Guidehouse analysis of Xcel Energy customer database

B.2.2 Residential Sample

Table B-3 shows our residential sample size by segment. We developed our residential sample size assuming a coefficient of variance (CV) of 0.75 and reported all relative precisions at a two tailed 90% confidence interval.

Table B-3. Residential Sample Size

Customer	Count	Coefficient of Variance (σ/μ)	Sample Size	Relative Precision
Single Family	36,610	0.75	300	7%
Single Family – Low Income	21,760	0.75	120	11%
Multifamily	2,401	0.75	80	14%
Multifamily – Low Income	7,569	0.75	80	14%
Manufactured	13,017	0.75	120	11%
Total	81,357		700	5%

Source: Guidehouse analysis of Xcel Energy customer database

For high priority segment and end use combinations, we achieved the confidence and precision outlined above. However, not every customer was asked about every end use and not every customer reported on every measure type. For some saturations, densities, and willingness to pay responses we had half or less of the sample size shown above. Because of the expectation that not all customers will respond to questions for all end uses, we designed our sample to achieve 90/10 confidence and precision for end uses with fewer responses, while exceeding that target for high priority end uses.

B.2.3 Commercial & Industrial Population Frame

Our C&I population frame, shown in Table B-4 and Table B-5, is segmented by building type/industry. The sampling unit for the C&I segment is an individual premise (i.e., defined as having a unique premise ID in Xcel Energy's customer database).

Table B-4. Commercial Population Frame

	Premise Quantity	Total Annual MWh Consumption	Annual MWh Consumption per Customer
College	38	17,915	471
Grocery	179	33,097	185
Health	315	48,545	154
Lodging	177	37,957	214
Mining/Oil & Gas Extraction	1,387	972,101	701
Office	6,026	740,189	123
Other	518	6,450	12
Restaurant	405	48,728	120
Retail	2,710	243,456	90
School	159	8,260	52
Warehouse	528	*	*
Total	**12,471**	*	*

**energy sales not provided to protect identity of customers*

Source: Guidehouse analysis of Xcel Energy customer database

Table B-5. Industrial Population Frame

	Premise Quantity	Total Annual MWh Consumption	Annual MWh Consumption per Customer
Agriculture	695	72,273	104
Manufacturing	339	*	*
Total	**1,034**	*	*

**energy sales not provided to protect identity of customers*

Source: Guidehouse analysis of Xcel Energy customer database

B.2.4 Commercial & Industrial Sample

In the C&I sector there is a wide range of consumption by facility. Since the types of equipment installed correlates with building consumption, Guidehouse chose to further stratify the sample into large, medium, and small substrata for some building types. The strata breakpoints for large, medium, and small were decided for each stratum based on the range of energy consumption within that strata, natural breakpoints in consumption, and the overall share of energy consumption of the segment compared to the service territory as a whole.

Table B-6 shows the target sample size by segment for the commercial sector without substrata and Table B-9 shows our commercial sample size including substrata. Guidehouse assumes a CV of 0.75 for all strata and our relative precision is reported at a 90% confidence interval.

Table B-6. Commercial Sample Size

Commercial Segment	Premise Count	Total Annual MWh	Consumption Coefficient of Variation (σ/μ)		Relative Precision
College	38	17,915	0.75	9	38%
Grocery	179	33,097	0.75	20	24%
Health	315	48,545	0.75	23	25%

Lodging	177	37,957	0.75	20	33%
Mining/Oil & Gas Extraction	1,387	972,101	0.75	45	14%
Office	6,026	740,189	0.75	57	14%
Other	518	6,450	0.75	20	30%
Restaurant	405	48,728	0.75	25	22%
Retail	2,710	243,456	0.75	45	20%
School	159	8,260	0.75	25	33%
Warehouse	528	*	0.75	25	28%
Total	**12,471**	*****		**317**	**8%**

**energy sales not provided to protect identity of customers*

Source: Guidehouse analysis of Xcel Energy customer database

There are relatively few commercial customers that consume a large portion of the commercial sector's energy in Xcel Energy's New Mexico territory, as Table B-7 shows. In the Mining/Oil & Gas Extraction segment, there are six customers that use one-quarter of Xcel Energy's delivered energy to the commercial sector. In the office segment, 10 customers consume 18% of Xcel Energy's delivered energy. Given the energy consumption of these customers, it was critical for Guidehouse to sample most of these customers and characterize their baseline equipment and willingness to pay.

Table B-7. Commercial Sample Size with Substrata

Segment		Commercial Premise Count	Total Annual MWh Consumption	Coefficient of Variation (σ/μ)	Sample Size	Percent of Total Energy Consumption	Relative Precision
College	Large	4	16,032	0.75	4	1%	0%
College	Small	34	1,883	0.75	5	0%	67%
Grocery	Large	11	20,331	0.75	5	1%	55%
Grocery	Small	169	12,766	0.75	15	1%	33%
Health	Large	4	25,769	0.75	3	1%	73%
Health	Small	312	22,776	0.75	20	1%	28%
Lodging	All	177	37,957	0.75	20	2%	27%
Mining/Oil & Gas Extraction	Large	6	537,286	0.75	5	25%	32%
Mining/Oil & Gas Extraction	Medium	73	350,171	0.75	20	16%	25%
Mining/Oil & Gas Extraction	Small	1,310	84,644	0.75	20	4%	29%
Office	Large	10	400,881	0.75	7	18%	32%
Office	Medium	45	138,298	0.75	20	6%	22%
Office	Small	5,982	201,011	0.75	33	9%	22%
Other	All	519	6,450	0.75	20	0%	28%
Restaurant	All	405	48,728	0.75	25	2%	25%
Retail	Large	29	104,533	0.75	10	5%	36%
Retail	Small	2,691	138,923	0.75	35	6%	21%
School	All	161	8,260	0.75	25	0%	24%
Warehouse	All	529	*	0.75	25	*	25%
Total		**12,471**	*****		**317**	**100%**	**9%**

** energy sales not provided to protect identity of customers*

Table B-8 and Table B-9 show the industrial sector segment and substrata level sample sizes, respectively. Much like in the commercial sector, there are relatively few customers that consume much of Xcel Energy's delivered energy. Five of the customers consume 88% of the sector's energy.

Table B-8. Industrial Sample Size

Segment	Industrial Premise Count	Total Annual MWh Consumption	Coefficient of Variation

			(σ/μ)	Sample Size	Relative Precision
Agriculture	695	72,273	0.75	16	18%
Manufacturing	339	*	0.75	19	2%
Total	**1,034**	*		**35**	**3%**

**energy sales not provided to protect identity of customers*

Table B-9. Industrial Sample Size with Substrata

Industrial Segment	Sub strata	Premise Count Total	Annual MWh Consumption	Coefficient of Variation (σ/μ)	Sample Size	Percent of Total Energy Consumption	Relative Precision
Agriculture	Large	4	*	0.75	1	*	0%
Agriculture	Small	694	38,711	0.75	15	7%	34%
Manufacturing	Large	4	*	0.75	4	*	0%
Manufacturing	Small	335	30,686	0.75	15	5%	33%
Total		**1,034**	**573,777**		**35**	**100%**	**3%**

**energy sales not provided to protect identity of customers*

B.3 Residential Data Collection

Guidehouse's approach for residential data collection uses an innovative virtual audit platform to cost-effectively collect data from a large sample of residential customers across segments. The primary objectives of the residential online survey included determining Xcel Energy's residential customer characteristics (e.g., home type, size, age, occupancy, and energy usage patterns), energy types used, and equipment characteristics. Guidehouse's approach in the survey was to focus on questions that residents can realistically answer, rather than asking more technical questions about efficiency levels.

B.3.1 Methodology

For the residential market research, Guidehouse employed virtual audits through an online survey platform, Qualtrics, to estimate the saturations and densities of various end uses by customer strata, as well as customer willingness to pay for efficient equipment. These mobile friendly web-based surveys offered customers tiered incentives for varying levels of survey participation:

- **Tier 1 – Saturation Survey:** Customers responded to a web survey focused on home characteristics, willingness to pay, demographics, and the saturation of energy-using equipment. Customers who completed this survey were eligible for a $15 incentive.[4]
- **Tier 2 – Virtual Audit:** Customers with high impact measures or end uses were offered the opportunity to continue the survey (at a later time if necessary) and provide additional details, including photos of equipment nameplates, to further characterize these high impact measures. Customers who completed this survey were eligible for a $35 incentive (i.e., Tier 1 incentive plus $20).[5]

B.3.2 Residential Customer Communication

Guidehouse launched the residential survey on October 28, 2021 and distributed it in multiple waves, as Table B-10 outlines. In total, the team contacted 6,580 customers to complete the survey.

Table B-10. Residential Survey Distribution Summary

(valid emails)

Wave 1

launch)
949 10/28/2020 11/5/2020 11/14/2020 12/10/2020 1/5/2021

(soft

Wave 2 5,631 11/5/2020 11/14/2020 11/24/2020 12/10/2020 1/5/2021

[4] The incentive was increased during the survey distribution to increase the survey response rate and encourage customers to complete the survey.

[5] The incentive was increased during the survey distribution to increase the survey response rate and encourage customers to complete the survey.

(valid emails)

Total 6,580 - - - - -

After the initial distributions, Guidehouse recognized the response rate of the survey was low,[6] which was likely due to two factors: screened out contacts and the COVID-19 pandemic. In total, 51 respondents were screened out of the survey because they either owned the property but do not live there, no longer reside at the residence, have never lived at the address, or indicated the address was a commercial location. Furthermore, although the direct impact is unknown, COVID-19 could have had an impact on customers' ability to complete the survey.

To increase the response rate and confirm a sufficient number of responses were collected, Guidehouse completed the following activities:

- **Enhanced email communications**: Guidehouse met with Xcel Energy's communication team to discuss the survey invitation and reminder emails. To appeal to customers, the following enhancements were made to email communications:
  - **Simplified the subject line and mentioned the incentive first.** Guidehouse updated the subject line to read, "Earn an Amazon gift card for completing a short survey about Xcel Energy."
  - **Condensed the email body.** The initial email contained a lot of information. Xcel Energy and Guidehouse worked to reduce the information in the email and add the link to the survey earlier in the email. The intent was for customers to easily see and click on the survey link.
  - **Sent additional reminder emails.** Originally, Guidehouse intended to send an invitation email followed by two reminder emails. To encourage people to respond, Guidehouse sent four reminder emails to customers.
- **Increased the incentive**: Guidehouse increased the Tier 1 saturation survey incentive from $15 to $25. Originally, an additional $20 incentive was offered to customers who provided pictures of equipment, then the Tier 2 photo incentive was increased from $20 to $25. The maximum incentive available for completing the survey increased from $35 to $50 to encourage customers to compete the survey.

The survey closed in January 2021 and achieved a total of 337 completes and 315 partial completes. Out of 6,580 customers, 652 (partial and total completes) completed the survey with an overall response rate of 9.9%, as Table B-11 shows. The percentage of target achieved including total and partial completes was 93%. Table B-11 shows the completes by residential segment type.

[6] In early December, the overall survey response rate was 1.7%.

Table B-11. Residential Response Rate Summary

	Screen Outs	Partial Completes	Partial Completes (Density)	Total Completes	Total Completes (including all partial completes)	Response Rate	Percent of Target Achieved
700	51	145	170	337	652	9.9%	93%

A definition of each of the columns in Table B-11 is provided below:

Target – Target Sample for each sector

Screen Outs – Customers were asked screening questions in the beginning of their survey to determine their eligibility of taking the survey. For example: if a customer indicates that their address on file is incorrect then they will be screened out of the survey.

Partial Completes – Respondents that only completed a portion of the survey.

Partial Completes (Density) - Respondents that only completed a portion of the survey including density questions.

Total Completes – Respondents that completed the entire survey

Total Completes (including all partial completes) – Respondents that partially or fully completed the survey.

Response Rate – Percentage of customers that partially or fully completed the survey to the total number of customers that were contacted to take the survey.

Percent of Target Achieved – Percentage of total completes to the original sample target.

Table B-12. Stratification of Completed Residential Customer Surveys

Single Family[8]	36,610	473
Single Family – Low Income	21,760	84
Multifamily	2,401	30
Multifamily – Low Income[9]	7,569	24
Manufactured	13,017	41
Total	**81,357**	**652**

B.4 Commercial & Industrial Customer Characterization

Guidehouse's approach for C&I primary data collection mirrors the approach for residential data collection, using a virtual audit platform to collect data from a large sample representing the variety of segments contained within the C&I sectors.

B.4.1 Methodology

The primary objectives of the online survey included determining firmographics of the businesses in Xcel Energy's service territory (e.g., facility type, size, age, occupancy, usage patterns), equipment saturations, energy types used, and equipment characteristics. As with the residential survey, Guidehouse designed questions to elicit information that respondents can

[7] These values include partially completed survey and fully completed surveys.

[8] These completes included responses that were not flagged as low income or unknown. [9] These completes include responses that were flagged being low income or unknown (likely low income).

confidently provide regarding equipment types, energy sources used, and equipment age, as well as information regarding their firm and facilities.

To make sure the study collected a sufficient sample of contacts in all of the targeted segments, Guidehouse enlisted the help of market research firm Bellomy Research to conduct recruitment by phone. This approach helped reach the appropriate decision makers at C&I organizations, collected email addresses, and secured commitments to complete the survey. Customers who completed this survey were eligible for a $70 incentive or donation to a charity of Xcel Energy's choosing, as their corporate rules permit.[10]

B.4.2 C&I Customer Communication

Guidehouse launched the C&I survey on October 9, 2020 and distributed multiple waves of invitation and reminder emails coupled will phone calls from Bellomy Research, as Table B-13 and Table B-14 show. In total, 5,086 customers were contacted and 83 of these customers were identified as high priority participants that Bellomy Research also contacted.

Like the residential survey, the response rate was low, and it was difficult to collect C&I responses due to the COVID-19 pandemic. At the time, some businesses were closed, inhibiting program participants from providing measure-specific information.

To increase the response rate and confirm the collection of sufficient, reliable data, Guidehouse employed the following tactics:

- **Enhanced email communications:** To appeal to customers, Guidehouse sent additional reminder emails to customers to encourage them to complete the survey.
- **Increased the incentive:** Guidehouse increased the increased the survey incentive from $70 to $100.

Table B-13. C&I Survey Distribution Summary (Online Only)

Wave	(valid emails)					
Wave 1	533	10/9/2020	10/15/2020	12/3/2020	12/15/2020	1/5/2021
Wave 2	1,314	11/2/2020	11/5/2020	12/3/2020	12/10/2020	1/5/2021
Wave 3	3,239	12/17/2020	1/5/2021	-	-	-
Total	**5,086**	**-**	**-**	**-**	**-**	**-**

[10] The incentive was increased during the survey distribution to increase the survey response rate and encourage customers to complete the survey.

Table B-14. C&I Disposition Summary by Bellomy Research

		Communication 1	Communication 2	Communication 3	Communication 4	Communication 5
Wave 1	10	11/16/2020	11/30/2020	12/7/2020	12/10/2020	1/5/2021
Wave 2	41	11/19/2020	11/30/2020	12/7/2020	12/10/2020	1/5/2021
Wave 3	9	11/24/2020	12/3/2020	12/10/2020	1/5/2021	-
Wave 4	4	11/30/2020	12/7/2020	1/5/2021	-	-
Wave 5	19	12/7/2020	1/5/2021	-	-	-
Total	**83**	**-**	**-**	**-**	**-**	**-**

Overall, 5,086 customers were contacted and the survey received a total of 85 complete responses and 129 partial completes, which resulted in an overall response rate of 4.2%, as Table B-15 shows. Guidehouse collected a total of 214 responses[11] with usable data, out of a target number of completes of 350. Although 61% (inclusive of partial and total completes) of the target was achieved, Guidehouse supplemented some gaps in the primary data through the use of secondary resources as detailed in Section 3, “Energy Efficiency Measure Characterization.” Table B-16 shows the stratification of the commercial customer surveys by segment.

Table B-15. C&I Response Rate Summary

Target	Screen Outs	Partial Completes	Partial Completes (Density)	Total Completes	Total Completes (including all partial completes)	Response Rate	Percent of Target Achieved
350	79	111	18	85	214	4.2%	61%

A definition of each of the columns in Table B-15 is provided below:

Target – Target Sample for each sector

Screen Outs – Customers were asked screening questions in the beginning of their survey to determine their eligibility of taking the survey. For example: if a customer indicates that their address on file is incorrect then they will be screened out of the survey.

Partial Completes – Respondents that only completed a portion of the survey.

Partial Completes (Density) - Respondents that only completed a portion of the survey including density questions.

Total Completes – Respondents that completed the entire survey

Total Completes (including all partial completes) – Respondents that partially or fully completed the survey.

Response Rate – Percentage of customers that partially or fully completed the survey to the total number of customers that were contacted to take the survey.

Percent of Target Achieved – Percentage of total completes to the original sample target. [11] Responses are broken

out by C&I segment in Table B-15.

Table B-16. Stratification of Completed C&I Customer Surveys

Agriculture	9
College	1
Grocery	4
Health	7
Lodging	14
Manufacturing	12
Mining/Oil & Gas Extraction	14
Office	89
Other	4
Restaurant	11
Retail	36
School	5
Warehouse	8
Total	**214**

[12] These values include partially completed surveys and fully completed surveys.

Appendix C. Energy Efficiency Measure Characterization

This appendix provides a more detailed explanation of the energy efficiency measure characterization task.

C.1 Measure List

Table C-1. Residential End Uses and Measures

Res - Programmable Thermostat	Manual thermostat, programmable thermostat operated as a manual thermostat, or no thermostat
Res - Smart Thermostat	
Res - Ceiling Insulation	R value between 0-4 (Insulation level higher than baseline level)
Res - Wall Insulation Retrofit - Existing insulation / NEW - IECC 2009	
Res - Infiltration Reduction	Upper limit of 4.00 CFM50 per square foot of house floor area

Res - Attic Insulation R-15 attic insulation

Res - Low-emissivity coating for standard windows Standard window

Res - Central Furnace Efficient Fan Motor (ECM) - MF buildings Standard furnace motor : PSC Motor

Space Heating & Cooling

Res - High Efficiency VRF Heat Pump equipment Baseline Eff (AC)/HP unit

Res - Central Air Conditioner Tune-up No central air conditioning tune-up

Res - High Efficiency AC/HP Equipment <17 SEER Baseline Eff (AC)/HP unit

Res - Interior operable storm windows Baseline windows

Res - High Efficiency AC/HP Equipment <17 SEER Federal minimum AC

Lighting

LED lamps (general service lamps including A lamps, specialty lamps) Mixed market incandescent/CFL/halogen

Networked/connected indoor LED bulb lamps

Res - Duct Sealing Ducts with a leakage factor assumed to be 35% or less

LED indoor fixture (pin-based lamps) Incandescent/CFL bulb (market baseline wattage)

Res - Ductless Mini-Split Heat Pumps NEW/ROB: Federal Minimum / ER: Existing conditions

Linear LEDs T12/T8 fluorescents

Res - Central AC/Heat Pump Quality Installation Verification (QIV) No CAC/HP QIV

LED outdoor fixtures CFL/halogen bulbs (market baseline wattage)

Occupancy sensors (for MF common areas) No occupancy sensors

Res - Central heat pumps for space heating (replace of AC) Baseline Eff (AC)/HP unit

Space Cooling

Res - Evaporative Cooling Federal minimum: 13 SEER split system air conditioner

Res - Whole House Fans Baseline Eff AC unit

Res - Smart ceiling fans No ceiling fan

Res - Indirect -Direct Evaporative Cooler Federal minimum AC

Hot Water

Low-flow showerheads Federal minimum standard flow rate 2.5 GPM

Low-flow faucet aerators Federal standard 2.2 GPM or greater

Efficient storage and tankless water

Res - High Efficiency Air Conditioner NEW/ROB: Federal minimum / ER: Existing conditions electric storage and instantaneous water

heaters Heat pump water heaters
Solar water heaters

heaters Federal standard minimum efficiencies for

Electronics Advanced power strips Standard power strip or no power strip Smart/Wi-Fi plugs

Appliances ENERGY STAR clothes washers Non-ENERGY STAR clothes washers Heat pump clothes dryers Non-ENERGY STAR clothes dryers

Refrigeration ENERGY STAR refrigerators Non-ENERGY STAR refrigerators Whole

House Home energy reports No home energy reports

Table C-2. Commercial & Industrial End Uses and Measures

High efficiency packaged

heat pump

system IECC 2009 efficiency

Packaged terminal heat pumps Minimum federal efficiency standards for PTHP

Space
Heating & Cooling

Guest room energy management Manual heating/cooling temperature setpoint and fan on/off/auto thermostat

HVAC variable frequency drives HVAC fan or pump not controlled by variable frequency drive (VFD)

RTU with demand control RTU with standard

Space
Cooling

economizer Direct evaporative pre-cooling Air cooled condensers on DX units without evaporative pre-cooler

Ductless mini-split heat pumps Mini-split heat pump with 13-14 SEER Water source heat pumps HP with 12 SEER

DX RTU of varying sizes DX RTU unit 10-13 EER

Chillers (air cooled, centrifugal,

scroll/screw) Chiller with code-minimum efficiency Packaged terminal air

conditioners Minimum federal efficiency standards for PTAC

Room Air Conditioners Minimum federal efficiency standards for RAC

High efficiency packaged air

conditioning IECC 2009 efficiency

Custom cooling Less efficient product/systems

Custom motors Less efficient product/systems

Hot Water Low-flow faucet aerators 2.2 gpm faucet aerator

Interior LED linear fixture/retrofit kit
(includes troffers)

Linear fluorescents T12, T8, T5 Interior linear lamp (including high,
medium, low bay lamps)

Interior LED fixture – high/medium/low
bay

Interior LED lamp – PAR/BR/MR/A Mixed market CFL/incandescent/halogen bulb
Interior network connected LED fixtures code
Federal standards or local building energy

Interior network connected LED lamps Manual controls

Interior LED fixture – other (includes all

Lighting commercial applications) mix
other LED fixtures in CFL and halogen technology

LED refrigerated case lighting Linear fluorescents T12, T8, T5 case lighting LED

lighting for industrial applications Mixed market industrial lights

Exterior LED fixture Metal halide/linear fluorescents/HPS systems Exterior LED lamp

Mix of halogen, CFL, linear fluorescent, mercury vapor, and metal halide

Interior lighting controls:

occupancy/daylights sensors No controls or manual controls

Exterior lighting controls Manual control

Custom lighting Less efficient product/systems

New construction – lighting power

density Code maximum LPD

Appliances Vending machine controls No controls

Zero-energy doors Cooler or freezer glass door that is continuously heated to prevent
condensation

Refrigeration shaded pole motor Anti-sweat heater controls No
ECM motors for reach-in and walk-in controls

coolers and freezers Evaporator fan driven by

ENERGY STAR commercial

ENERGY STAR cabinet ENERGY STAR hot food holding

Cooking
dishwasher Conventional unit as defined by

Demand-controlled ventilation – commercial kitchens Commercial kitchen ventilation hoods without demand-controlled ventilation

Motors, Drives, & Pumps

Compressed Air

Process Cooling

Fans, Blowers,

Pre-rinse spray valves Federal standards or average existing conditions

No air loss drains New electronic solenoid/timed drains Air compressor optimization No optimization of compressed air Air compressor

VFDs No VFD

VFDs on industrial fans and pumps

Select More efficient Pumps Low efficient pumps Progressive Cavity Pumps Sucker road pumps

O&G O&M No operation and maintenance Dew point controls No purge control for heatless desiccant dryers

Mist eliminators New general-purpose filter

C.2 Key Parameters

Table C-3. Key Measure Characterization Parameters

Baseline Measure Existing inefficient equipment or process to be replaced. T5/T8 Fluorescent Lighting

Energy Efficiency Measure Efficient equipment, process, or project to replace the baseline. Indoor LED Linear Lamp

Measure Lifetime The lifetime in years for the base and energy efficient technologies. The base and energy efficient lifetimes only differ in instances where the two cases represent inherently different technologies, such as solar water heaters compared to a baseline of regular storage water heaters. T5/T8 Fluorescent Lighting: 10 years Indoor LED Linear Lamp: 12 years

Measure Costs The incremental cost between the assumed baseline and efficient technology using the following variables: • Base Costs: The cost of the base equipment, including both material and labor costs.

• Energy Efficient Costs: The cost of the energy efficient equipment, including both material and labor costs.

Retrofit measure costs will include the full material cost of the efficiency measure and associated labor rates for removal of existing equipment and installation of the efficient technology. Dual baseline measures consider both the initial retrofit measure cost and savings, and that of the portion of measure life once a new code or standard is projected to become effective. Baseline cost: $690 Efficient cost: $500

Replacement Type Identifies when in the technology or building's life an efficiency measure is introduced. Replacement type affects when in the potential study period the savings are achieved as well as the duration of savings and is discussed in greater detail in Appendix D, "Technical Potential." Retrofit (RET), replace on-burnout (ROB) and new construction (NEW)

Annual Energy Consumption The annual energy consumption for electricity in kWh and demand in kW for each baseline and energy efficiency measure. Baseline: 196 kWh/year Efficient: 163 kWh/year

Unit Basis The normalizing unit for energy, demand, cost, and density estimates. The unit used to scale the energy, demand, cost, and

Per bulb, per hp, per kWh consumption

Per home, per 1,000

Scaling Basis

reference forecast.

sector.
SF of commercial area, per segment/end use consumption etc.

Sector and End use Mapping
density estimate for each measure according to the

The team mapped each measure to the appropriate end uses, customer segments and sectors. Section 2, "Primary Research," describes the breakdown of customer segments with each

Commercial HVAC Tune-up is mapped to the Non-Res HVAC end use in the commercial sector.

Fuel Type Multiplier

The Electric Space heating + Electric

density in order to avoid double counting of savings. Appendix D, "Technical Potential," provides further explanation on competition groups.

Cooling multiplier only assigns electric space heating measures to customers that have electric heating.

Measure Density

Used to characterize the occurrence or count of a baseline or energy efficiency measure, or stock, within a residential household or within 1,000 square feet of a commercial building. This parameter was not defined for industrial measures as they scaled by consumption.

Energy Efficiency Saturation

The fraction of the residential housing stock or commercial building space that has the efficiency measure installed each year. For the industrial sector, saturations are based on energy consumption.

35 bulbs per household.

40% of all residential bulbs are LEDs so saturation of LEDs is 40%.

Technical Suitability

The percentage of the base technology that can be reasonably and practically replaced with the specified efficient technology.

Occupancy sensors have a technical applicability of less than 1.0 because they are only practical for interior lighting fixtures that do not need to be on at all times.

Competition Group
Assigns the percentage of electric/gas fuel type to measures with electric fuel type such as water heaters and space heating equipment.

Identifies measures competing to replace the same baseline

Solar water heater or a heat pump water heater can replace an inefficient storage water heater, but not both.

C.3 Key Parameter Approach and Sources

C.3.1 Energy and Demand Savings

Guidehouse took four general bottom-up approaches to analyzing residential and C&I measure energy and demand savings:

1. **TRM Standard Algorithms:** Guidehouse used the New Mexico TRM as the primary source of savings for this study. From the TRM, Guidehouse sourced deemed savings and standard algorithms for unit energy savings and demand savings calculations.

2. **Xcel Energy New Mexico Program Data:** Guidehouse used measure-specific program data from Xcel Energy New Mexico to inform energy and demand savings if savings for those measures were not present in the TRM.

3. **Engineering Analysis:** Guidehouse used appropriate engineering algorithms from other TRMs to calculate energy savings for any measures not included in Xcel Energy New Mexico programs or available TRMs. As an example, the team used algorithms from the

Illinois Statewide TRM version 9.0[13] while calculating savings for central air conditioner tune-up.

4. **Work Papers:** Published work papers based on Guidehouse's research and as provided by Xcel Energy New Mexico's engineering team were used for informing savings for emerging technology measures such as smart ceiling fans.

C.3.2 Incremental Costs

Guidehouse relied primarily on the New Mexico TRM and Xcel Energy New Mexico-provided program data for incremental cost data. Secondary sources of incremental cost data included other TRMs, potential studies, and web scraping of cost data . Incremental costs for custom measures were calculated based on Xcel Energy New Mexico's actual program data. Similar to the calculation of site-level savings, a $/kwh was calculated based on site-level data.

C.3.3 Density and Saturation

Guidehouse used a new approach to estimating density and saturation values for this study. Guidehouse primarily relied on four sources arranged in hierarchical order for developing these values for the residential sector:

- Primary research conducted as a part of this study (2020/2021)
- Xcel Energy (New Mexico)-Home Energy Use Study 2020
- Xcel Energy (New Mexico)-Home Energy Use Study 2018
- Guidehouse's other potential studies and US EIA RECS (if measure-specific data was not available in the above three sources)

Guidehouse developed a weighting for the density and saturation values based on the sample size and age of each study for each individual measure. Almost 90% of the residential measures relied on the data collected through the primary research efforts and the two Xcel Energy home energy use studies. The remaining 10% were informed by other potential studies or RECS.

For the commercial sector, Guidehouse relied on the following sources:

- Primary research conducted as a part of this study (2020/2021)
- Xcel Energy New Mexico's Lighting Saturation Study 2020
- Guidehouse's other potential studies and US EIA Commercial Building Energy Consumption Survey (CBECS

Approximately 60% of the commercial measures were calculated based on weighted average of the data from the primary data collection, the lighting saturation survey, and other potential

[13] Illinois Statewide Technical Reference Manual Version 9.0, https://www.ilsag.info/technical-reference-manual/il-trm version-9/

studies. The remaining measures relied on other potential studies and CBECS for calculating density and saturation values.

C.4 Identifying and Characterizing Emerging Technologies

For emerging technologies on the measure list such as smart ceiling fans Guidehouse reviewed relevant literature and discussions with internal and external industry experts. For each technology, the team documented the following metrics:

• Vintage and locale of the supporting data (when and where it was developed) •

Transparency and updatability of supporting data

• What analysis approach was used and whether any descriptive statistics are provided

• Cost-effectiveness of the emerging technology, as evaluated using methods described above

• Likelihood of the adoption of the emerging technology

Appendix D. Energy Efficiency Technical Potential

This appendix details the energy efficiency technical potential task. The Attachment A: Measure Inputs provides the associated data.

D.1 Approach to Technical Potential and Replacement Types

Guidehouse's modeling approach considers an energy efficient measure to be any change made to a building, piece of equipment, process, or behavior that could save energy. The savings can be defined in numerous ways, depending on which method is most appropriate for a given measure. Measures like residential water heaters are best characterized as some fixed amount of savings per water heater; savings for measures like high efficiency chillers in commercial buildings are typically characterized as savings per 1,000 sq/ft of floor space; and measures like high efficiency fans, motors and drives in the mining/oil & gas extraction segment are characterized as a percentage of segment sales. The DSMSim™ model can appropriately handle savings characterizations for all three methods. The following sections include the formulae used to calculate technical potential by replacement type.

D.1.1 New Construction Measures

The cost of implementing new construction (NEW) measures is incremental to the cost of a baseline (and less efficient) measure. However, new construction technical potential is driven by equipment installations in new building stock rather than by equipment in existing building stock.[14] New building stock is added to keep up with forecast growth in total building stock and to replace existing stock that is demolished each year. Demolished (sometimes called replacement) stock is calculated as a percentage of existing stock in each year, and this study uses a demolition rate of 0.5% per year for all building stock. New building stock (the sum of growth in building stock and replacement of demolished stock) determines the incremental annual addition to technical potential, which is then added to totals from previous years to calculate the total potential in any given year. The team used the following equations to calculate technical potential for new construction measures.

Equation D-1. Annual Incremental NEW Technical Potential (AITP)

$AITP_{YEAR}$ = New Buildings$_{YEAR}$ (e.g., buildings/year[15]) X Measure Density (e.g., widgets/building) X Savings$_{YEAR}$ (e.g., kWh/widget) X Technical Suitability (dimensionless)

Equation D-2. Total NEW Technical Potential (TTP)

����������������=2030
TTP = ∑ ����������������❘����������������
�������� =2020
����������������

������������ = � ����������������❘����������������
���������������=����������������

[14] In some cases, customer-segment-level and end use-level consumption/sales are used as proxies for building stock. These consumption/sales figures are treated like building stock in that they are subject to demolition rates and stock-tracking dynamics.

[15] Units for new building stock and measure densities may vary by measure and customer segment (e.g., 1,000 square meters of building space, number of residential homes, customer-segment consumption/sales, etc.).

D.1.2 Retrofit and Replace-on-Burnout Measures

Retrofit (RET) measures, commonly referred to as advancement or early-retirement measures, are replacements of existing equipment before the equipment fails. RET measures can also be efficient processes that are not currently in place and not required for operational purposes. For RET measures, we calculated a deferred replacement credit, which accounts for the value of deferring the replacement of baseline equipment by some number of years (lifetime of equipment minus remaining useful life of existing equipment). The deferred replacement credit is subtracted from the incremental costs of RET measures. In contrast, replace-on-burnout (ROB) measures, sometimes referred to as lost-opportunity measures, are replacements of existing equipment that have failed and must be replaced, or they are existing processes that must be renewed. Because the failure of the existing measure requires a capital investment by the customer, the cost of implementing ROB measures is always incremental to the cost of a baseline (and less efficient) measure.

Retrofit and ROB measures have a different meaning for technical potential compared with new construction measures. In any given year, we use the entire building stock for the calculation of technical potential.[16] This method does not limit the calculated technical potential to any pre assumed rate of adoption of retrofit measures and assumes that all ROB equipment is instantly eligible for replacement. Existing building stock is reduced each year by the quantity of demolished building stock in that year and does not include new building stock that is added throughout the simulation. For RET and ROB measures, annual potential is equal to total potential, offering an instantaneous view of technical potential. The team used Equation D-3 to calculate technical potential for RET and ROB measures.

Equation D-3. Annual/Total RET/ROB Technical Savings Potential

Total Technical Potential = Existing Building Stock$_{YEAR}$ (e.g., buildings[17]) X Measure Density (e.g., widgets/building) X Savings$_{YEAR}$ (e.g., kWh/widget) X Technical Suitability (dimensionless)

D.2 Competition Groups

General characteristics of competing technologies used to define competition groups in this study include the following:

- Competing efficient technologies share the same baseline technology characteristics, including baseline technology densities, costs, and consumption
- The total (baseline plus efficient) measure densities of competing efficient technologies are the same
- Installation of competing technologies is mutually exclusive (i.e., installing one precludes installation of the others for that application)
- Competing technologies share the same replacement type (RET, ROB, or NEW)

[16] In some cases, customer-segment-level and end use-level consumption/sales are used as proxies for building stock. These consumption/sales figures are treated like building stock in that they are subject to demolition rates and stock-tracking dynamics.

[17] Units for building stock and measure densities may vary by measure and customer segment (e.g., 1,000 square feet of building space, number of residential homes, customer-segment consumption/sales, etc.).

To address the overlapping nature of measures within a competition group, Guidehouse's analysis only selects one measure per competition group to include in the summation of technical potential across measures (e.g., at the end use, customer segment, sector, service territory, or total level). The measure with the largest energy savings potential in a given competition group is used for calculating total technical potential of that competition group, regardless of the customer economics or cost-effectiveness of that measure. This approach confirms the aggregated technical potential does not double-count savings. However, the model still calculates the technical potential for each individual measure outside of the summations. Although measure savings are not double counted, this approach does not consider savings interaction between measures. For example, if a high efficiency air conditioner is installed in a house with poor insulation or a leaky envelope, the potential savings for retrofitting those components after the new air conditioner is installed will be less than if they were installed first. These interactive effects are addressed when calculating achievable potential.

In practice, some measures have within-end use interactive effects that are not accounted for in technical potential, leading to the technical and economic potential to be higher than practicable. These interactive effects occur when the installation of one measure would reduce the savings for other measures after installation, despite the measures not competing directly. The whole is less than the sum of its parts. An example of this is with HVAC and insulation measures. When installed in a home without upgraded insulation, evaporative cooling would save more energy per year relative to a home with upgraded insulation. The same is true for the savings of an insulation measure in a home with a baseline air conditioner versus a home with evaporative cooling. Because the order of installation matters when assigning the discount factor to the applied savings, it does not make sense to evaluate these interactive effects when the stock can turnover instantly, as is the case for technical and economic potential. The sum of technical or economic potential over measures that interact will be overstated.

D.3 Technical Potential Results

D.3.1 Results by Customer Segment

The electric energy and electric demand technical potentials shown in Figure D-1 and Figure D-2, respectively, are broken out for each of the customer segments. Attachment A: Measure Inputs provides the associated data. These figures show that technical potential is roughly split between the residential segments and commercial segments, with single family homes and offices as the largest contributors. The growth in potential for the commercial segments is the largest contributor to the increase in technical savings potential due to the projected sales growth in those segments of the time horizon of the study. The main contributors to potential in the commercial segment are HVAC measures, with high efficiency central heat pumps, HVAC variable frequency drives, roof top units with demand control, high efficiency chillers, and packaged terminal air conditioners leading the way. Compared to studies in the region over the past few years, technical potential for lighting measures such as LEDs are lower in the portfolio for both the commercial and residential sectors. This is being driven by the rapid adoption of these technologies over the past few years, as demonstrated through Guidehouse's recent primary research showing LEDs as a high percentage of existing commercial lighting technologies.

Figure D-1. Electric Energy Technical Potential by Customer Segment (GWh/year)

Res-Manufactured

2,000 1,800 1,600 1,400 1,200

1,000 800

600

400

200

0

Res-Single Family Low Income

Res-Single Family

Res-Multi Family Low Income

Res-Multi Family

Ind-Manufacturing

Ind-Agriculture

Com-Warehouse

Com-School

Com-Retail

Com-Restaurant

Com-Other

Com-Office

Com-Mining/Oil & Gas Extraction

Com-Lodging

Com-Health

Com-Grocery

Com-College

Source: Guidehouse Analysis 2021

Figure D-2. Electric Demand Technical Potential by Customer Segment (MW)

700 600 500 400 300 200 100 0

Com-Warehouse
Com-School
Com-Retail
Com-Restaurant
Com-Other
Com-Office
Com-Mining/Oil & Gas Extraction
Com-Lodging
Com-Health
Com-Grocery
Com-College
Res-Manufactured
Res-Single Family Low Income
Res-Single Family
Res-Multi Family Low Income
Res-Multi Family
Ind-Manufacturing Ind-Agriculture

Source: Guidehouse Analysis 2021

D.3.2 Results by Measure

The measure-level savings potential Figure D-3 and Figure D-4 show is after adjustments are made due to competition groups. Attachment A: Measure Inputs provides the associated data. This is consistent with the aggregate results shown above. However, for the achievable potential scenarios, measures gain market share relative to their economic characteristics rather than their savings potential alone; measures will be included in the achievable potential forecast that are not shown in the technical and economic potential.

These figures present the top 40 measures ranked by their technical savings potential in 2030. The top measures for electric energy technical potential are led by HVAC and building envelope measures in the residential and commercial sectors. This is due to low efficient saturation of these measures and that technical and economic potential does not account for within-end use interactive effects. In the industrial sector, the top measure is VFDs on fans and pumps. In the lighting end use, the top measure is networked/connected LEDs rather than lighting retrofits,

which is due to the high penetration of efficient lighting technologies already in the building stock.

Figure D-3. Top 40 Measures for Electric Energy Technical Potential in 2030 (GWh/year)

Res - Evaporative Cooling
Com - High Efficiency Central Heat Pump System
Ind - VFDs on Industrial Fans and Pumps
Ind - Progressive Cavity Pumps
Com - HVAC Variable Frequency Drives
Com - RTU with Demand Control
Res - Duct Sealing
Res - High Efficiency VRF Heat Pump equipment
Res - Networked/ Connected - Indoor LED Lamp
Com - Chillers (air cooled, centrifugal, scoll/screw)
Com - High Efficiency Packaged Air Conditioning
Res - High Efficiency Air Conditioner
Res - Attic Insulation
Com - Packaged Terminal Heat Pumps
Com - Direct Evaporative Pre-Cooling
Com - Interior LED Linear Fixture/Retrofit Kit (includes Troffers)
Res - Central AC/Heat Pump Quality Installation Verification
(QIV)

Res - Heat Pump Water Heater
Res - ENERGY STAR Windows
Res - Whole House Fans
Res - LED Lamps (General Service Lamps including A Lamps,…
Res - Home Energy Report (Energy Feedback Residential)
Com - Interior Network Connected LED Fixtures
Com - Room Air Conditioners
Com - Custom cooling
Com - Custom motors
Com - Interior Linear Lamp (including high, medium, low bay lamps)
Com - New Construction - Lighting Power Density
Res - Infiltration Reduction
Res - Interior operable storm windows
Com - ECM motors for reach-in and walk-in coolers and freezers
Com - Interior Network Connected LED Lamps
Com - Interior Lighting Controls: occupancy/daylight sensors
Com - Interior LED Fixture - Other (includes all other LED fixtures…
Com - Exterior LED fixture
Ind - Air Compressor Optimization
Res - Low-emissivity coating for standard windows
Res - Wall Insulation
Com - Zero-Energy Doors
Res - Solar Water Heater

Source: Guidehouse Analysis 2021

Figure D-4. Top 40 Measures for Electric Demand Technical Potential in 2030 (MW)

Res - Evaporative Cooling
Com - High Efficiency Central Heat Pump System
Com - RTU with Demand Control
Res - ENERGY STAR Windows
Com - High Efficiency Packaged Air Conditioning
Res - High Efficiency Air Conditioner
Com - Packaged Terminal Heat Pumps
Com - Direct Evaporative Pre-Cooling
Com - Chillers (air cooled, centrifugal, scoll/screw)
Res - Smart Thermostat
Ind - Progressive Cavity Pumps
Com - Room Air Conditioners
Res - Central AC/Heat Pump Quality Installation Verification…
Res - Duct Sealing
Com - Interior LED Linear Fixture/Retrofit Kit (includes…
Com - HVAC Variable Frequency Drives
Res - Low-emissivity coating for standard windows
Res - Attic Insulation
Res - Networked/ Connected - Indoor LED Lamp
Com - Interior Network Connected LED Fixtures
Com - Low-flow Faucet Aerator
Ind - Air Compressor Optimization
Com - New Construction - Lighting Power Density
Com - Interior Linear Lamp (including high, medium, low…

Res - Home Energy Report (Energy Feedback Residential)
Res - LED Lamps (General Service Lamps including A…
Com - Interior LED Fixture - Other (includes all other LED…
Com - Interior Lighting Controls: occupancy/daylight sensors
Ind - VFDs on Industrial Fans and Pumps
Com - Interior Network Connected LED Lamps
Com - Custom cooling
Res - Infiltration Reduction
Res - Central Air Conditioner Tune-up
Com - DX RTU Unit of varying sizes
Com - Exterior LED fixture
Res - Heat Pump Water Heater
Com - LED Refrigerated Case Lighting
Com - Custom motors
Com - Water Source Heat Pump
Res - Wall Insulation

Source: Guidehouse Analysis 2021

Appendix E. Energy Efficiency Economic Potential

This appendix details the economic potential task.

E.1 Economic Potential TRC and UCT

The model used Equation E-1 and Equation E-2 to calculate the TRC benefit-cost ratio.

Equation E-1. Benefit-Cost Ratio for TRC

�������� = ����(����������������������������
������������ + ����&���� �������� ��������)
����(����ℎ ���� ���� �������� + ����������������
�������������)

Equation E-2. Benefit-Cost Ratio for UCT

UCT =����(����������������������������
�������������)
����(+ ���������������� �������������)

Where:

- *PV( )* is the present value calculation that discounts cost streams over time.
- *Avoided Costs* are the monetary benefits resulting from electric savings (e.g., avoided costs of infrastructure investments and avoided commodity costs due to electric energy conserved by efficient measures).
- *O&M Savings* are the non-energy benefits such as operation and maintenance cost savings.
- *Technology Cost* is the incremental equipment cost to the customer.
- *Admin Costs* are the administrative costs incurred by the utility or program administrator.
- *Incentives* are measure-level incentives that are provided to the customer for adopting the measures.

Guidehouse calculated TRC and UCT ratios for each measure based on the present value of benefits and costs (as defined above) over each measure's life. Although the equations for TRC and UCT include administrative costs, the study does not consider these costs during the measure-level economic screening process because an individual measure's cost-effectiveness on the margin is the primary focus. Guidehouse also excluded measure-level administrative costs from this analysis because those costs are largely driven by program design, which is outside of the scope of this assessment. The team included program and portfolio administrative costs, estimated from Xcel Energy's historic administrative costs, d in program and portfolio budgets to provide a more accurate picture of expected total portfolio spending. These administrative spending levels are held constant over time and across all scenarios.

Similar to technical potential, only one economic measure (meaning that its TRC/UCT ratio meets the threshold) from each competition group is included in the summation of economic potential across measures (e.g., at the end use category, customer segment, sector, service territory, or portfolio level). If a competition group is composed of more than one measure that

passes the TRC/UCT test, then the economic measure that provides the greatest savings potential is included in the summation of economic potential. This approach confirms double counting is not present in the reported economic potential, though economic potential for each individual measure is still calculated and reported outside of the summation.

E.2 Economic Potential Results

E.2.1 Results by Customer Segment

Figure E-1 and Figure E-2 depict the economic electric energy and electric demand savings potential for all customer segments. Attachment A Measure Inputs provides the corresponding measure input data. The warehouse segment sees the greatest loss from non-economic potential, while the lodging segment is the most resilient. As mentioned previously, industrial measures largely pass the economic screen. The mix of economic potential from the C&I segments does not change appreciably relative to the technical potential.

Figure E-1. Electric Energy Economic Potential by Customer Segment (GWh/year)

1,400 1,200 1,000 800

600

400

200

0

Res-Manufactured

Res-Single Family Low Income
Res-Single Family

Res-Multi Family Low Income
Res-Multi Family

Ind-Manufacturing

Ind-Agriculture

Com-Warehouse

Com-School

Com-Retail

Com-Restaurant

Com-Other

Com-Office

Com-Mining/Oil & Gas Extraction

Com-Lodging

Com-Health

Com-Grocery Com-College

Source: Guidehouse Analysis 2021

Figure E-2. Electric Demand Economic Potential by Customer Segment (MW)

500

450 400 350 300 250 200 150 100

50

0

Res-Manufactured
Com-School
Com-Retail
Com-Restaurant
Com-Other
Res-Single Family Low Income
Com-Office
Res-Single Family
Com-Mining/Oil & Gas Extraction
Res-Multi Family Low Income
Com-Lodging
Res-Multi Family
Com-Health
Ind-Manufacturing
Com-Grocery
Ind-Agriculture
Com-College
Com-Warehouse

Source: Guidehouse Analysis 2021

E.2.2 Results by Measure

Figure E-3 and Figure E-4 show the measure-level economic electric energy and electric demand savings potential prior to adjustments Guidehouse made to competition groups as detailed in the previous section. These figures highlight the economic potential from the top 40 highest-impact measures. Compared with electric energy technical potential, the fourth measure (Ind – Progressive Cavity Pumps) and the fifth measure (Com – HVAC Variable Frequency Drives) screen out as non-cost-effective. Other measures in the list move up or down depending on whether they pass economic screening in all customer segments, or if measures they were competing with are not cost-effective (e.g., residential LED lamps replace residential network/connected LEDs).

As the number one highest saving measure in both technical and economic potential, residential evaporative cooling is worth further consideration. The high savings relative to compressor based air conditioning, low efficient saturation, and lower upfront costs increase the potential and ensure that it screens the economic test. However, part of the reason for the low efficient

saturation of evaporative cooling is due to market barriers, including customer perceptions (or misperceptions), acceptance, customer awareness, and contractor awareness. Older generation units used more water, a major downside in the southwest. Because of the large education and preference gap around evaporative cooling, Achievable Potential for these measures tends to be much more limited. Please review these results in the Energy Efficiency Achievable Potential section.

Figure E-3. Top 40 Measures for Electric Energy Economic Potential in 2030 (GWh/year)

Res - Evaporative Cooling
Ind - VFDs on Industrial Fans and Pumps
Com - High Efficiency Central Heat Pump System
Res - LED Lamps (General Service Lamps including A Lamps,…
Com - RTU with Demand Control
Res - Duct Sealing
Com - Packaged Terminal Heat Pumps
Res - Central AC/Heat Pump Quality Installation Verification (QIV)
Com - Direct Evaporative Pre-Cooling
Res - ENERGY STAR Windows
Res - Home Energy Report (Energy Feedback Residential)
Res - Whole House Fans
Com - Room Air Conditioners
Com - Chillers (air cooled, centrifugal, scoll/screw)
Com - Custom cooling
Com - Custom motors
Com - Interior Linear Lamp (including high, medium, low bay lamps)
Com - New Construction - Lighting Power Density
Com - ECM motors for reach-in and walk-in coolers and freezers
Res - Infiltration Reduction
Com - Exterior LED fixture
Com - Interior Network Connected LED Fixtures
Ind - Air Compressor Optimization
Com - Interior Network Connected LED Lamps
Com - Custom Lighting
Res - Smart/Wifi Plugs
Res - Wall Insulation
Com - Exterior LED Lamp
Res - Low-flow Showerheads
Com - LED Refrigerated Case Lighting
Res - Ceiling Insulation
Com - Low-flow Faucet Aerator
Com - Interior Lighting Controls: occupancy/daylight sensors
Com - Anti-Sweat Heater Controls
Res - Ductless Mini Split Heat Pumps
Com - Water Source Heat Pump
Com - Zero-Energy Doors
Ind - LED Lighting for Industrial Applications
Com - Exterior Lighting Controls
Com - Interior LED Fixture - High/Medium/Low Bay

Source: Guidehouse Analysis 2021

Figure E-4. Top 40 Measures for Electric Demand Economic Potential in 2030 (MW)

Res - Evaporative Cooling
Com - High Efficiency Central Heat Pump System
Com - RTU with Demand Control
Res - ENERGY STAR Windows
Com - High Efficiency Packaged Air Conditioning
Res - High Efficiency Air Conditioner
Com - Packaged Terminal Heat Pumps
Com - Direct Evaporative Pre-Cooling
Com - Chillers (air cooled, centrifugal, scoll/screw)
Res - Smart Thermostat
Ind - Progressive Cavity Pumps
Com - Room Air Conditioners
Res - Central AC/Heat Pump Quality Installation Verification…
Res - Duct Sealing
Com - Interior LED Linear Fixture/Retrofit Kit (includes…
Com - HVAC Variable Frequency Drives
Res - Low-emissivity coating for standard

windows

Res - Attic Insulation

Res - Networked/ Connected - Indoor LED Lamp

Com - Interior Network Connected LED Fixtures

Com - Low-flow Faucet Aerator

Ind - Air Compressor Optimization

Com - New Construction - Lighting Power Density

Com - Interior Linear Lamp (including high, medium, low…

Res - Home Energy Report (Energy Feedback Residential)
Res - LED Lamps (General Service Lamps including A… Com - Interior LED Fixture - Other (includes all other LED… Com - Interior Lighting Controls: occupancy/daylight sensors Ind - VFDs on Industrial Fans and Pumps
Com - Interior Network Connected LED Lamps
Com - Custom cooling
Res - Infiltration Reduction
Res - Central Air Conditioner Tune-up
Com - DX RTU Unit of varying sizes
Com - Exterior LED fixture
Res - Heat Pump Water Heater
Com - LED Refrigerated Case Lighting
Com - Custom motors
Com - Water Source Heat Pump
Res - Wall Insulation

Source: Guidehouse Analysis 2021

Figure E-5 and Figure E-6 provide a supply curve of savings potential versus levelized cost of savings for all measures considered in the study. To show the most relevant measures and improve readability, these curves have been shortened to show only those measures with a levelized cost below a certain threshold—the full curve would extend beyond this to measures with more costly savings. For electric energy, the vast majority of savings occur at a levelized cost between $0.001/kWh and $0.09/kWh. The majority of electric demand savings occur at a levelized cost between $2/kW and $150/kW.

Figure E-5. Electric Energy Economic Potential LCOE Supply Curve in 2030

$0.30

$0.25

$0.20

$0.15

$0.10

$0.05

$0.00

0 50 100 150 200 250 300 350 400 450 Cumulative Potential (GWh/year)

Source: Guidehouse Analysis 2021

Figure E-6. Electric Demand Economic Potential LCOE Supply Curve in 2030

$1,000

$900

$800

$700

$600

$500

$400

$300

$200

$100

$0

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 Cumulative Potential (MW)

Source: Guidehouse Analysis 2021

Appendix F. Energy Efficiency Achievable Potential

This appendix describes Guidehouse's approach to calculating achievable energy efficiency potential and presents the results for Xcel Energy's New Mexico service territory.

F.1 Approach to Estimating Achievable Potential

This section provides a high-level summary of the approach to calculating gross achievable potential. The adoption of energy efficiency measures can be broken down into calculation of the equilibrium market share and calculation of the dynamic approach to equilibrium market share. This section also provides an overview of the sensitivity analysis and model calibration process.

F.1.1 Calculation of Equilibrium Market Share

The equilibrium market share can be thought of as the percentage of individuals that would choose to purchase a technology provided those individuals are fully aware of the technology and its relative merits (e.g., the energy- and cost-saving features of the technology). In this context – fully aware means ready and capable of making an informed purchase decision. For energy efficiency measures, a key differentiating factor between the base technology and the efficient technology is the energy and cost savings associated with the efficient technology. Of course, that additional efficiency often comes at a premium in initial cost, meaning that it can take some time for the higher efficiency to pay off. Equilibrium market share is calculated as a function of the payback time of the efficient technology relative to the inefficient technology. This approach allows Guidehouse to estimate the market share for the dozens or even hundreds of technologies that are often considered in potential studies.

In this potential study, Guidehouse used equilibrium payback acceptance curves that were developed using primary research conducted in the fall of 2020 in Xcel Energy's New Mexico service territory. Guidehouse used surveys of 652 residential, and 214 C&I customers' preference to define the payback acceptance curves at the end-use and sector level. In the surveys, customer decision makers were asked about the quantity of various end uses within their home or business to inform density and saturation estimates, and then were asked whether they would be likely to make investments in energy efficiency upgrades based on a variety of project costs and expected annual energy savings. This willingness to pay question battery is typical of discrete choice experiments and designed to elicit the customer's inherent response to different economic returns. Guidehouse conducted statistical analysis on these responses to develop a set of payback acceptance curves for each customer segment/end use combination which were used in this potential study.

Figure F-1 shows an example of a payback acceptance curve for residential HVAC measures fitted to customer responses in the New Mexico territory. In this example, even at a payback period of 0 (i.e. the cost of the efficient technology after incentives is equivalent to the cost of the baseline technology), approximately 77% of customers would choose to install the efficient technology. This indicates that there are additional considerations or barriers beyond just cost that impact whether or not a particular customer is willing to install the efficient technology.

Figure F-1. Example of Payback Acceptance Curve for Residential HVAC Measures

0.9

0.8

0.7

0.6

0.2

0.1

0

0.5

0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5 8

0.4

8.5 9 9.5 10 Payback Time in Years

0.3

Since the payback time of a technology can change over time, as technology costs or energy costs change over time, the equilibrium market share can also change over time. The equilibrium market share is recalculated for every year of the forecast to ensure the dynamics of technology adoption take this effect into consideration. As such, equilibrium market share is a bit of an oversimplification since the whole system is dynamic. Thus, the equilibrium refers to the long-run market share at each time step in the model.

F.1.2 Retrofit and New Construction Technology Adoption Approach

Retrofit technologies employ an enhanced version of the classic Bass diffusion model[18,19] to simulate the S-shaped approach to equilibrium that is observed again and again for technology adoption. Figure F-2 provides a stock/flow diagram illustrating the causal influences underlying the Bass model. In this model, market potential adopters flow to adopters by two primary mechanisms – adoption from external influences, such as marketing and advertising, and adoption from internal influences, or word-of-mouth. The fraction willing to adopt was estimated using the payback acceptance curves Figure F-2 illustrates.

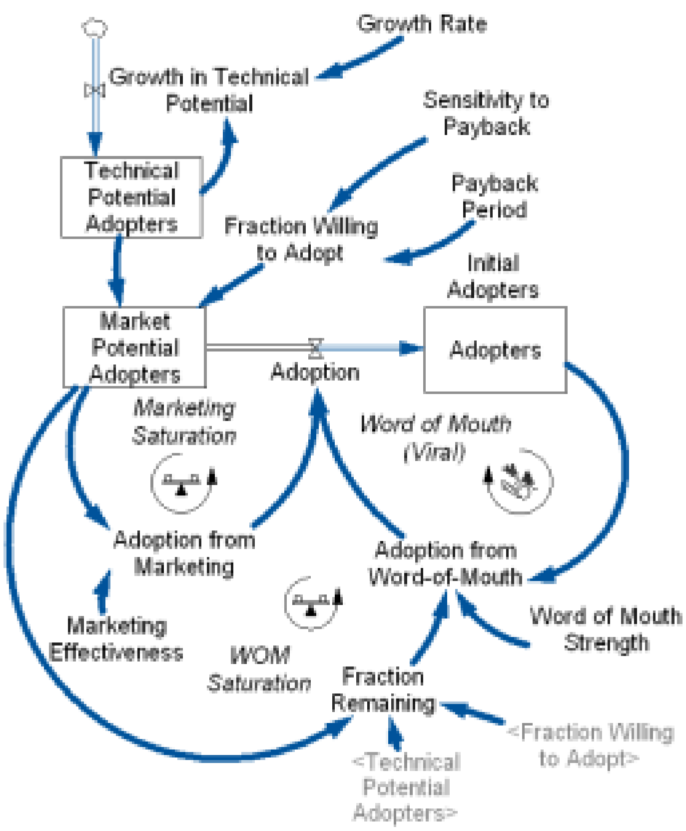
The marketing effectiveness and word-of-mouth parameters for this diffusion model were estimated drawing upon case studies where these parameters were estimated for dozens of

[18] Bass, Frank (1969). "A new product growth model for consumer durables". Management Science 15 (5): p215–227.

[19] See Sterman, John D. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin McGraw Hill. 2000. p. 332.

technologies.[20] Recognition of the positive, or self-reinforcing, feedback generated by the word of-mouth mechanism is evidenced by increasing discussion of the concepts such as social marketing as well as the term viral, which has been popularized and strengthened most recently by social networking sites such as Twitter, Facebook, and YouTube. However, the underlying positive feedback associated with this mechanism has been ever present and a part of the Bass diffusion model of product adoption since its inception in 1969.

Figure F-2. Stock/Flow Diagram of Diffusion Model for Retrofits



Source: Guidehouse

F.1.3 Replace-on-Burnout (ROB) Technology Adoption Approach

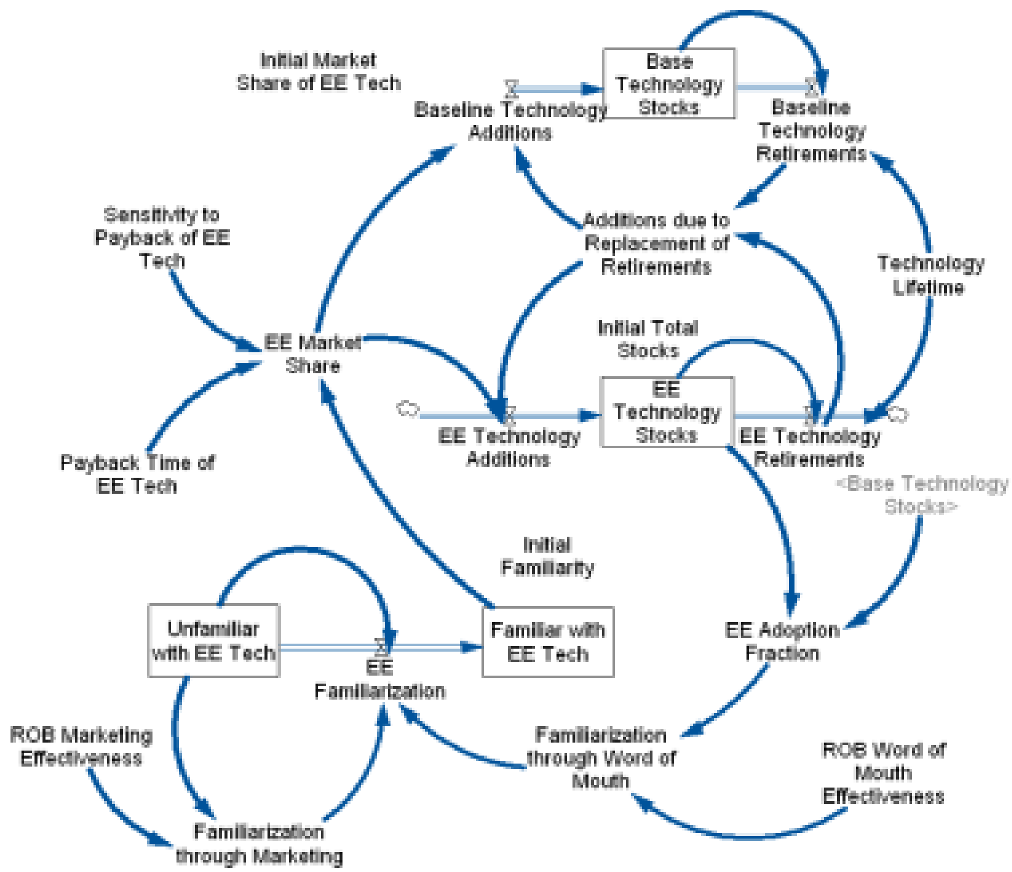
The dynamics of adoption for ROB technologies is somewhat more complicated than for NEW/RET technologies since it requires simulating the turnover of long-lived technology stocks. The DSMSim™ model tracks the stock of all technologies, both base and efficient, and explicitly

[20] See Mahajan, V., Muller, E., and Wind, Y. (2000). New Product Diffusion Models. Springer. Chapter 12 for estimation of the Bass diffusion parameters for dozens of technologies. This model uses a value of 0.10 for the word

of-mouth strength in the base case scenario. The Marketing Effectiveness parameter for the base case scenario varied between 0.019 and 0.048, depending on the sector (values were determined as part of the calibration process). These values compare reasonably with the “most likely” value of 0.021 (75th percentile value is 0.055) per Mahajan 2000.

calculates technology retirements and additions consistent with the lifetime of the technologies. Such an approach ensures that technology churn is considered in the estimation of market potential, since only a fraction of the total stock of technologies are replaced each year, which affects how quickly technologies can be replaced. A model that endogenously generates growth in the familiarity of a technology, analogous to the Bass approach described above, is overlaid on the stock tracking model to capture the dynamics associated with the diffusion of technology familiarity. Figure F-3 illustrates a simplified version of the model employed in DSMSim™.

Figure F-3. Stock/Flow Diagram of Diffusion Model for ROB Measures



Source: Guidehouse

F.1.4 Approach to Applying Customer Incentives

One of the most important drivers for estimating gross achievable potential is the approach that is taken for modeling incentives. Through various discussions with the Xcel Energy over the course of this project, Guidehouse chose the percentage of incremental cost approach for applying incentives in the model. This is where the rebate levels are set as a fixed percentage of the incremental cost of installing the efficient measure. Under this approach, the level of savings would be achieved by paying some level (say at 50% or 70%) of incremental costs. It is be possible to set the rebates at different levels, depending on the sector or end uses that are

modeled. For example, there may be policy reasons why it would make sense to set rebate levels at higher amounts for end uses that would target markets that are in the highly inefficient category.

For this potential study, Xcel Energy provided Guidehouse with historic project and incentive costs where they were available through program tracking data. Guidehouse used the actual historical values as initial values where applicable. Some values were further tuned in the model calibration process.

F.1.5 Model Calibration

Any model simulating future product adoption faces challenges with calibration, as there is no future world against which one can compare simulated with actual results. For this potential study, Guidehouse took a number of steps to ensure that forecast model results were reasonable, including:

- A comparison of 2015-2020 historic program savings values by sector and end use against Guidehouse's modeled program gross savings potential.
- Due to natural year-over-year variations in program achievement, rather than calibrating to a point estimate (i.e., tuning the model's 2020 potential to Xcel Energy's achieved 2020 savings), Guidehouse looked at the savings trend over the past 5 years of program achievement and calibrated the model to match the trend data.
- Guidehouse modeled program incentive spending by using the historic Xcel Energy program incentive spending as a percentage of program cost.

Guidehouse adjusted model parameters, including assumed incentive levels and technology diffusion coefficients, to obtain close agreement across a wide variety of metrics compared for the Reference scenario. This process ensures that forecast gross potential is grounded against real-world results considering the many factors that come into play in determining the likely adoption of energy efficiency measures, including both economic and non-economic factors.

Figure F-4 and Figure F-5 show the historic program savings from 2015-2020 by end use for the residential sector and C&I sectors, respectively, combined with the modeled gross achievable potential from 2021-2030. Xcel Energy's rapid expansion of residential customer programs in 2017—and in particular residential lighting—can be seen clearly in Figure F-4. This plus the long lifetime of LEDs has led to a rapid increase in efficient lighting saturation in residential homes over the last few years for the most common lighting categories, as Guidehouse measured in our primary data collection effort. This is discussed further in the following section.

There are several additional technologies in the potential study that were not a part of Xcel Energy's portfolio of measures in the past, so these graphs are representative of only measures that overlap between the two sets of measures. Once the calibration parameters were tuned using this overlapping set of data, Guidehouse assumed values for these calibrated parameters

were representative of measures within the same sector and end use that did not have any historic savings data.

Figure F-4. Historic and Modeled Achievable Savings for Residential Sector (representative of only measures that overlap between potential study and historic program data)

Residential HVAC
20

Residential Lighting

15

35
Historic Program Data Gross Achievable Potential Forecast

10

Residential Appliance
30

5

0

Residential Energy Feedback

Residential Envelope
25

Residential Hot Water

Source: Guidehouse Analysis

Figure F-5. Historic and Modeled Achievable Savings for C&I Sectors (representative of only measures that overlap between potential study and historic program data)

Historic Program Data Gross Achievable

Potential Forecast 60

C&I Motors and Drives

50

20

10

Commercial Cooling

0

Commercial Custom

Commercial Lighting

40

30

Source: Guidehouse Analysis

The next section on efficient technology saturation will discuss why the gross potential starts to decrease in the later years of the study period.

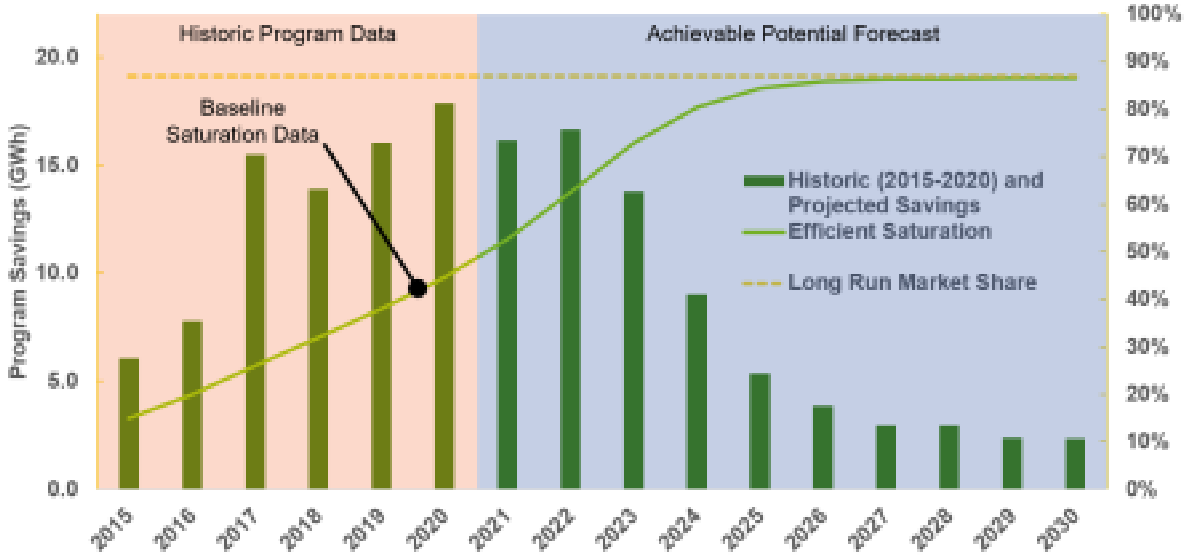
F.1.6 Efficient Equipment Saturation

As discussed in the calculation of equilibrium market share section above, the market potential of an efficient measure at any given point in the forecast is a function of four things: the percentage of customers that are aware of the efficient measure, the incremental cost of installing the efficient measure, the savings associated with the efficient measure over its baseline counterpart, and the customer's willingness to install the efficient measure based on its payback period. Once all customers are aware of a measure, unless the measure's cost decreases or savings increases, the efficient market share will not be greater than where it lands on the payback acceptance curve (e.g., Figure F-1). This is the equilibrium or long-run market share. Guidehouse calculated the current market share, or saturation of efficient

measures from the aforementioned virtual audits. As customers adopt efficient measures over time, the efficient market share begins to approach the equilibrium market share, at which point there would be no more gross achievable potential since all the customers that were willing to adopt already have. The gross achievable potential remaining for any given measure is a function of its initial efficient saturation.

Figure F-6 provides an example of this for residential LED measures. Guidehouse calculated from the survey responses that the initial saturation of LEDs (as of 2020 year-end) in the residential sector is approximately 47%. Guidehouse then calculated the equilibrium, or long run market share, for LEDs in the residential sector as approximately 87%, based on survey responses along with cost and savings assumptions. Based on this information, the market is more than halfway to the maximum gross achievable potential for this measure and starting to reach the point where acquiring each additional adopter is getting more difficult. The graph shows that the annual gross achievable potential starts declining rapidly in about 2023 as the market approaches the equilibrium market share and stabilizes in approximately 2027 when all savings are coming from new construction or replace on burnouts of existing LEDs.

Figure F-6. Residential Lighting Example of Efficient Saturation Effects on Gross Achievable Potential



Source: Guidehouse Analysis

While particularly relevant for residential LED measures due to the clear ramp up in program activity shown above, this phenomenon is present with many of the top saving measures in the study and clearly illustrates why annual gross achievable potential is declining towards the latter years of the study, as evidenced by Figure F-4 and Figure F-5 and in the next section of this report. Table F-1 shows the trend of efficient saturation over time for the top 10 measures in terms of cumulative energy savings in 2030.

Table F-1. Efficient Saturation Trend for Top 10 Measures

	Ind - VFDs on
Industrial Fans and Pumps	9% 20% 33% 47% 60% 71% 79% 84% 87% 89%
Res - Duct	
	Sealing 18% 27% 37% 47% 56% 63% 68% 71% 73% 74%
Res - LED Lamps (General Service Lamps including A Lamps, Specialty Lamps)	
Res - Evaporative Cooling	11% 11% 12% 12% 13% 14% 15% 17% 18% 19% 54%
Res - Central AC/Heat Pump Quality Installation Verification (QIV)	59% 64% 69% 74% 77% 80% 81% 82% 83%
Com - Interior Linear Lamp (including high, medium, low bay lamps)	
Res - Infiltration 45% 53% 63% 73% 80% 84% 86% 86% 86% 86%	
	62% 66% 68% 71% 72% 74% 75% 76% 78% 79%

Reduction 48% 54% 60% 66% 70% 74% 76% 77% 78% 78% Com - High

Efficiency 21% 23% 25% 27% 29% 30% 32%
Central Heat Pump System

Com -
Packaged
Terminal Heat Pumps

Com - Custom
0% 0% 0% 0% 1% 2% 2% 3% 4% 4% 16% 17% 19%

cooling 22% 25% 28% 32% 36% 40% 44% 47% 49% 51% *Source: Guidehouse Analysis*

By 2030, all but two of the technologies in Table F-1 are getting to within 5%–10% of the long run equilibrium market share. Measures with high potential tend to be ones with high unit energy savings, a gap between initial efficient saturation and the long run market share, and strong customer economics. The measures that do not see saturation reaching the long run market share are evaporative cooling and high efficiency heat pump. Evaporative cooling is in a competition group with three other cooling technologies, so it is sharing the market with other

efficient technologies. These measures also tend to be difficult to market to customers that already have central air conditioning. While the per unit potential for commercial high efficiency heat pumps is high, there are a few reasons why their adoption is slower than other measures. First, they do not pass cost effectiveness screening until halfway through the study and even then, the customer economics are not as attractive as other measures, especially for a measure with high upfront costs. Our primary data on commercial customers in New Mexico indicated a low willingness to adopt for HVAC measures with high upfront costs and a long payback period.

F.1.7 Sensitivity Analysis

As with all modeling exercises, there is a certain amount of uncertainty associated with the inputs feeding the model. Xcel Energy was interested in looking at the sensitivity of gross potential to four specific data-driven inputs: measure density, initial efficient saturation, sales forecast, and payback acceptance. Guidehouse performed a sensitivity analysis on these four parameters to determine the relative impact of each on overall gross potential. Each parameter was varied by either:

- The upper and lower bounds of the 80% confidence interval around the mean of the distribution of the data, which was calculated from survey responses (i.e., payback acceptance, density, saturation).
- A fixed percentage deemed where no distribution could be directly sampled (i.e., sales forecast).

The sensitivity analysis results in Figure F-7 show that variations in the payback acceptance, or customers' willingness to purchase an efficient technology given a certain economic return on their upfront investment, has the potential to be more influential than the other three parameters on potential future energy savings. Interestingly, since underlying customer preferences are at the root of this result, it may be one on which program administrators have little influence.

Figure F-7. Sensitivity of Gross Savings Potential to Modeling Parameters

Acceptance

-24% +18%

Sales

Density

Saturation All

Source: Guidehouse Analysis

High Potential Low Potential

Cumulative Gross achievable potential in 2030

There are many variables beyond payback period that impact why a customer may or may not decide to adopt an efficiency measure, many of which are completely out of the program administrator's ability to impact through their program and outreach. This could include perceived or real comfort impacts, political or social factors, uncertainty around adopting something perceived to be a new technology, perceptions of technology performance, and many more. Given the complexity of this issue, Guidehouse does not have justification to make an assertion that either the high or low end of the sensitivity is more likely to occur. These results are intended to explore the importance of these variables on gross achievable potential and demonstrate the usefulness of conducting primary data collection on these variables to give them a strong empirical basis.

F.2 Achievable Potential Savings – Reference Scenario

This section provides results pertaining to the reference scenario for electric gross achievable potential at different levels of aggregation. Results are shown by sector, customer segment, end use, and by highest-impact measures. The Reference Scenario was deemed to represent a business as usual case, whereby Xcel Energy would continue implementing their energy efficiency programs at comparable funding levels and for the most part continue to realize the energy savings that they have experienced from the past.

F.2.1 Results by Sector

Gross achievable potential accounts for the rate of energy efficiency acquisition. As Figure F-9 and Table F-2 show, gross achievable potential grows from 0.6 percent in 2021 to 3.8% of forecast net electric sales by 2030, or 0.42% per year on average over the potential study time horizon,[21] under the reference scenario. Figure F-10 and Table F-3 provide the comparable information for peak demand, with reductions growing from 0.5% in 2021 to 4.9% of forecast peak demand in 2030, or 0.54% per year on average over the same time horizon.

Values shown below for gross achievable potential are termed cumulative achievable potential, in that they represent the accumulation of each year's annual incremental gross achievable potential. As an example, an annual gross achievable potential of 0.42% per year, for 9 years, would result in a cumulative gross achievable potential of 3.8% of forecast sales. Economic potential, as defined in this study can be though of as a theoretical upper limit on potential if 100% of customers were willing to adopt the efficient measure regardless of payback and they chose to install the highest saving measure within a competition group (this is discussed in more detail in the Technical and Economic Potential chapters). The long run market potential considers customers' willingness to pay for an efficient measure and can be thought of as a bucket of potential from which programs can draw over time. Gross achievable potential represents the draining of that bucket, the rate of which is governed by a number of factors, including the lifetime of measures (for ROB technologies), market effectiveness, incentive levels, and customer willingness to adopt, among others. If the cumulative gross achievable

[21] The time horizon for the Potential Study is 2021-2030 (9 years).

potential ultimately reaches the economic potential, it will signify that all long run market potential in the bucket had been drawn down or harvested. Achievable electric potential reaches 3.8% of forecast sales by 2030, meaning that approximately one-quarter of economic potential has been harvested by the end of the potential study period (which represents 13.4% of sales in 2030).

While the residential sector represents a lower percentage of overall sales in the service territory, the gross potential as a percentage of sector consumption is significantly higher than the C&I sectors. This is driven largely by the fact that nearly half of the total sales in the C&I sectors are from the Mining/Oil & Gas Extraction segment, where there are significant hurdles in obtaining adoption of efficiency measures and opportunities for efficiency are more limited than in other customer segments.

Figure F-8. Total Electric Cumulative Gross Achievable Potential as a Percentage of Forecast Electric Sales

14%

10%
8%
6%
4%
2%
0%

Commercial Industrial Residential

12%

Source: Guidehouse Analysis

Table F-2. Total Electric Cumulative Gross Achievable Potential as a Percentage of Electric Sales

2021	0.6%	0.3%	0.8%	1.7%
2022	1.2%	0.6%	1.5%	3.6%
2023	1.7%	1.0%	2.2%	5.4%
2024	2.2%	1.3%	2.7%	6.9%
2025	2.6%	1.6%	3.2%	8.3%
2026	2.9%	1.8%	3.6%	9.4%
2027	3.2%	2.0%	3.8%	10.4%
2028	3.4%	2.1%	3.9%	11.3%
2029	3.6%	2.3%	4.0%	12.0%
2030	3.8%	2.4%	4.0%	12.5%

Source: Guidehouse Analysis

Figure F-9. Total Electric Cumulative Gross Achievable Potential as a Percentage of

Forecast Electric Peak Demand

16.0%

14.0%

Commercial Industrial Residential

12.0%

10.0%

8.0%

6.0%

4.0%

2.0%

0.0%

Source: Guidehouse Analysis

Table F-3. Total Electric Cumulative Gross Achievable Potential as a Percentage of Electric Peak Demand

2021	0.5%	0.2%	0.2%	1.4%
2022	1.1%	0.6%	0.3%	2.9%
2023	1.7%	0.9%	0.5%	4.6%
2024	2.2%	1.3%	0.6%	6.1%
2025	2.7%	1.7%	0.7%	7.6%
2026	3.2%	2.0%	0.8%	9.1%
2027	3.7%	2.2%	0.9%	10.5%
2028	4.2%	2.5%	1.0%	11.9%
2029	4.6%	2.7%	1.0%	13.0%
2030	4.9%	2.9%	1.0%	14.1%

Source: Guidehouse Analysis

Figure F-11 and Table F-4 shows the magnitude (in GWh/year) of electric gross achievable potential by sector. Figure F-12 and Table F-5 provide the comparable information for peak demand gross achievable potential. All savings reported in this potential study are gross, rather than net, meaning that the effect of possible free ridership is not accounted for in the reported savings.

While gross potential as a percentage of sales is highest in the residential sector, the cumulative gross potential is highest in the commercial sector which accounts for a much higher proportion of sales (73%) than the residential sector.

Figure F-10. Cumulative Electric Gross Achievable Potential by Sector (GWh/year)

250

2021 2022 2023 2024 2025 2026 2027 2028 2029 2030

Commercial Industrial Residential

200

150

100

50

0

Source: Guidehouse Analysis

Table F-4. Cumulative Electric Gross Achievable Potential by Sector (GWh/year)

2021	16	7	20
2022	40	15	42
2023	65	23	63
2024	94	31	81
2025	117	37	97
2026	137	42	111
2027	154	45	124
2028	168	47	137
2029	181	49	147
2030	191	50	155

Source: Guidehouse Analysis

Figure F-11. Cumulative Peak Demand Gross Achievable Potential by Sector (MW)

60

40

30

20

10

0

50

Commercial Industrial Residential

Source: Guidehouse Analysis

Table F-5. Cumulative Peak Demand Gross Achievable Potential by Sector (MW)

2021	2	0	4
2022	6	0	9
2023	10	1	15
2024	15	1	20
2025	19	1	24
2026	23	1	29
2027	27	1	34
2028	30	1	39
2029	34	2	44
2030	36	2	48

Source: Guidehouse Analysis

F.2.2 Results by Customer Segment

Figure F-13 shows the gross electric potential for each of the five residential customer segments from 2021-2030.

Figure F-12. Cumulative Gross Achievable Potential by Residential Customer Segment

180

160 140 120 100 80

60

40

20

0
Res-Manufactured
Res-Single Family Low Income
Res-Single Family
Res-Multi Family Low Income
Res-Multi Family

Source: Guidehouse Analysis

Residential single family, single family – low income, and manufactured homes make up the majority of potential over the course of the study. The proportion of savings from each residential segment largely mirrors the proportion of overall energy consumption. The tight correlation between savings and energy consumption is segments only having small differences in initial efficient equipment saturation between the residential segments in the surveys. Figure F-14 shows the gross electric potential for all of the C&I customer segments from 2021- 2030.

Figure F-13. Cumulative Gross Achievable Potential by Commercial Customer Segment

300
Ind-Manufacturing
Ind-Agriculture
Com-Warehouse
250 200 150 100 50

0
Com-School
Com-Retail
Com-Restaurant
Com-Other
Com-Office
Com-Mining/Oil & Gas Extraction
Com-Lodging
Com-Health
Com-Grocery
Com-College

Source: Guidehouse Analysis

Gross potential from the Office and Mining/Oil & Gas Extraction segments dominate the overall savings potential in the C&I sectors, representing 55% of the potential, even though this segment is hard to reach and includes equipment and loads not easily addressed though energy efficiency measures. Mining/Oil & Gas Extraction is slightly higher that Office, despite this segment consuming nearly double the energy as the Office segment. This is driven by the fact that there are fewer measures with energy efficiency potential available in the Mining/Oil & Gas Extractions segment compared to the Office segment. The proportion of potential from the other segments largely aligns with the proportion of their energy consumption except for the Agriculture segment, which consumes 5% of the energy but provides 14% of potential.

F.2.3 Results by End Use

Figure F-15 shows the residential sector gross potential by end-use for 2021-2030.

Figure F-14. Cumulative Gross Achievable Potential by Residential Sector End-Use

180

Whole Building

20

0

160 140 120 100 80

Lighting

Electronics

60

Space Heating and Cooling

Space Cooling

40

Hot Water

Source: Guidehouse Analysis

Lighting, space cooling, and space heating and cooling (which includes building envelope measures and heat pump measures) account for the majority of potential in the residential sector. Incremental lighting potential declines rapidly after 2023, at which point the high saturation of LEDs in the market make it difficult to obtain additional savings. Through the primary data collection, Guidehouse observed poor efficiency and older vintage stock of building HVAC equipment and envelope conditions. Combined with the high density of this equipment, this low observed saturation of efficient measures creates significant potential in these two areas through 2030.

Figure F-16 shows the gross potential savings by end use in the C&I sectors from 2021-2030.