Knowledge to Shape Your Future

Electric | Gas | Water
information collection, analysis and application

Assessment of the Feasible and Achievable Levels of Electricity Savings from Investor Owned Utilities in Texas: 2009-2018

Final

Submitted to:

Theresa Gross
Project Manager
Public Utility Commission of Texas
Public Utility Commission
1801 North Congress Ave.
Austin, Texas 78701

Submitted by:

Itron, Inc.
1111 Broadway, Suite 1800
Oakland, CA 94607
(510) 844-2800

December 23, 2008

Table of Contents

_ES_ Executive Summary ES-1

ES.1 Technical and Economic Potential in Texas ES-2
ES.2 Achievable Potential and the Feasibility and Attainability of the Savings Goals ES-4
ES.2.1 Feasibility of Reaching the Proposed Peak Savings Goals ES-5
ES.2.2 Ramp Up Constraints to Meet the 2010 Goal ES-9
ES.2.3 Assessment of Feasibility of Achieving Proposed 2015 Savings Goals ES-10
ES.2.4 Inclusion or Exclusion of High Voltage Customers from Program Participation .. ES-11
ES.2.5 Inclusion or Exclusion of Energy and Peak Saving from CFL Bulbs ES-12
ES.2.6 Consideration of an Alternative Goal Metric ES-12
ES.3 Findings on Naturally Occurring Energy Efficiency Investments and Savings in Texas ES-15
ES.4 Cost and Benefits of Funding Efficiency Programs to Achieve the Proposed Savings Goals ES-15
ES.5 Barriers to the Achievement of the New Savings Goals ES-18
ES.6 Recommended Policies to Achieve the Higher Energy and Peak Savings Goals in Deregulated and Regulated Electricity Markets ES-19
ES.7 Uncertainties in the Forecasts of Achievable Energy and Demand Savings ES-20
ES.8 Summary ES-20

_1_ Introduction 1-1

1.1 Scope of the Potential Analysis 1-1
1.2 Background on Research Reports Produced by Itron During the Course of This Study 1-3
1.3 Organization of the Report 1-4

_2_ Energy Efficiency Assessment Methodology 2-1

2.1 Characterizing the Energy Efficiency Resource 2-1
2.1.1 Defining Energy-Efficiency Potential 2-1
2.2 Overview of Energy Efficiency Forecasting Method 2-3
2.3 Estimation of Technical Potential and Development of Energy Efficiency Supply Curves 2-6
2.3.1 Core Equation 2-6
2.3.2 Use of Supply Curves 2-8
2.4 Estimation of Economic Potential 2-10
2.4.1 Cost-Effectiveness Tests 2-10
2.4.2 Use of the Total Resource Cost to Estimate Economic Potential 2-12
2.5 Estimation of Maximum Achievable Program and Naturally-Occurring Potentials 2-14
2.5.1 Adoption Method Overview 2-15

3 Data Development and Economic Inputs 3-1

3.1 Development of Baseline Building and Energy Data 3-1
3.1.1 Residential Sector Data Development 3-1
3.1.2 Commercial Sector Data Development 3-7
3.1.3 Industrial Sector Data Development 3-12
3.2 Electricity Rate Forecasts 3-23
3.3 Avoided Cost Forecasts 3-23
3.4 Forecasts of Energy and Peak Demand for All Nine Texas Utility Service Areas 3-27
3.5 Approaches Used to Construct Electricity Forecasts 3-27
3.6 Summary of Forecast Sources 3-29
3.7 Final Electricity and Demand Forecasts 3-29

4 Key Results from Data Collection Activities in Texas 4-1

4.1 Overview of Methodology 4-1
4.2 Summary of Commercial End-User Survey Results 4-2
4.2.1 Market Share of Cooling, Space Heating, and Water Heating Systems in Commercial Buildings in Texas 4-2
4.2.2 Customer Knowledge and Awareness of Energy Efficiency Measures and Programs . 4-10
4.2.3 Types of Cooling, Heating and Lighting System Retrofits in the Last Three Years 4-13
4.3 Results of the Trade Ally Surveys 4-19
4.3.1 Trade Ally Final Sample 4-19
4.3.2 Lighting Trade Ally Survey Results 4-20
4.3.3 HVAC Trade Ally Survey Results Summary 4-29

5 Findings From Interviews with Texas Stakeholders 5-1

5.1 Key Finding from Interviews with Utility Program Administrators 5-1
5.2 Key Finding from Interviews with Environmental and Customer Advocates 5-6
5.3 Key Finding from Interviews with Retail Energy Service Providers 5-10
5.4 Key Findings from Interviews with Municipal Utilities and the State Energy Office 5-13
5.4.1 Municipal Utilities 5-13
5.4.2 State Energy Office (SECO) 5-13

6 Estimates of the Technical and Economic Potential to Save Electricity 6-1

6.1 Overall Technical and Economic Potential Savings at the System Level 6-1
6.1.1 Technical and Economic Potential by Sector Across the Distribution Utilities 6-7
6.2 Energy Efficiency Supply Curves 6-13

7 Achievable Program Savings Forecasts and Assessment of Potential to Change Current Savings Goals 7-1

7.1 Overview-Results of Achievable Scenario Analysis 7-1
7.1.1 Descriptions of the Scenarios 7-2
7.1.2 Base and High Achievable Savings Forecasts at the Statewide and Utility Level 7-2
7.1.3 Achievable Savings Forecasts at the Sector Level 7-6
7.1.4 Measure Level Composition of Forecast by Sector- Residential, Commercial and Industrial 7-17
7.1.5 Program Costs and Rate Impact of Alternative Scenarios 7-20

7.1.6 Bill Impacts for the Base and High Incentive Scenarios 7-23
7.1.7 Overall Costs and Benefits of Expanding the Energy Efficiency Programs in Texas 7-24
7.2 Discussion of Uncertainties 7-24
7.2.1 General Discussion of Uncertainty in Efficiency Forecast Estimates 7-25
7.2.2 Specific Key Areas of Uncertainty for this Study 7-26
7.3 Assessment of Potential Changes to Energy Savings Goals as Proposed in Recent Legislation 7-28
7.3.1 Estimated Peak Savings Goals 7-28
7.3.2 Estimated Energy Savings Goals 7-29
7.4 Reasons for the Differences in Meeting the Proposed Savings Goals 7-35
7.4.1 Potential Challenges in Ramping Up Program Savings to Meet the Near Term Savings Goal in 2010 7-36
7.4.2 Assessment of the Feasibility of Meeting the Proposed Savings Goals for 2015 7-38
7.4.3 Recommended Changes to Achieve the Higher Energy and Peak Savings Goals 7-43

8 **Responses to Technical and Policy Questions Posed by the Texas Legislature 8-1**

8.1 Responses to Proposed Questions Posed by the Legislature with Respect to the Economic and Achievable Levels of Energy Savings and How These Compare to the Proposed Savings Goals for the Years 2010 and 2015 8-1
8.2 Itron's Response to Policy Questions Posed by the Texas legislature 8-6
8.2.1 Assessment of the Best Source of Funding for Energy Efficiency Programs 8-8

9 **Key Sources 9-1**

Appendix A: Energy Efficiency Measure Descriptions A-1

A.1 Residential Measures A-1
A.1.1 HVAC A-1
A.1.2 Space Heating A-2
A.1.3 Building Envelope A-2
A.1.4 Lighting A-3
A.1.5 Water Heat A-4
A.1.6 Appliances A-5
A.1.7 General Measures that Effect Energy Use at the Household level A-6
A.2 Commercial Measures A-7
A.2.1 Lighting A-7
A.2.2 Space Cooling A-9
A.2.3 Ventilation A-12
A.2.4 Refrigeration A-13
A.2.5 Office Equipment A-14
A.3 Industrial Measures A-15
A.3.1 Cross-Cutting Electricity Efficiency Measures A-15
A 3.1 Sector-Specific Efficiency Measures (Electricity) A-20

Appendix B: Documentation of SitePro Residential Runs B-1

Appendix C: Summary of Telephone Survey Approach C-1

C.1 Summary of Survey Objectives, Sample Design and Weighted Results C-1

C.1.1 Trade Ally Survey Research Objectives C-1
C.1.2 Nonresidential Survey Research Objectives C-1
C.1.3 Nonresidential Sample Design C-2
C.1.4 Trade Allies Sample Design C-5
C.2 Preliminary Results Nonresidential End-User Survey C-7
C.2.1 Nonresidential End-User Survey Weights C-7
C.2.2 Nonresidential End-User Final Survey Disposition C-8

Appendix D: List of Interim Deliverables D-1

Appendix E: Comparison of Target Energy Savings Goals to Achievable Savings Forecasts using Two Alternative Conversion Methods E-1

Appendix F: Results from Commercial End Use Surveys F-1

Appendix G: Detailed Achievable Savings Forecasts By Utility Service Areas and Energy Efficiency Supply Curves G-1

Appendix H: Energy Efficiency Potential Model - Input Data H-1

Appendix I: Non-Additive Technical Potential – Measure Level Results I-1

List of Figures

Figure 1-1: Texas Electricity Service Territories* 1-2
Figure 2-1: Conceptual Framework for Estimates of Fossil Fuel Resources 2-2
Figure 2-2: Conceptual Relationship Among Energy-Efficiency Potential Definitions 2-3
Figure 2-3: Simplified Conceptual Overview of Modeling Process 2-4
Figure 2-4: Example of Technical Potential Calculation—Peak Period Commercial Perimeter Zone Dimming (Generic Data for Example Purposes Only) 2-7
Figure 2-5: Primary Measure Implementation Curves Used in Adoption Model 2-20
Figure 2-6: Illustration of Effect of Incentives on Adoption Level as Characterized in Implementation Curves 2-21
Figure 3-1: Residential Consumption in Texas by End Use (All Utilities 2007) 3-3
Figure 3-2: Energy Consumption for Studied Industry Segments 3-16
Figure 3-3: Distribution of Industrial Energy Consumption by End Use 3-18
Figure 3-4: Historical Average System Electricity Prices in Texas 3-24
Figure 3-5: Forecasts of High and Low of Avoided Electricity Costs in Texas (in nominal $) 3-25
Figure 3-6: Average Annual Energy Growth Rates for ERCOT Utilities 3-28
Figure 4-1: Cooling System Technology Saturation 4-3
Figure 4-2: Heating System Technology Saturation 4-3
Figure 4-3: Cooling and Heating System Operation 4-4
Figure 4-4: Presence of Cooling and Heating System Controls 4-5
Figure 4-5: Cooling System Maintenance Practices 4-6
Figure 4-6: Water Heating System Technology Saturation 4-6
Figure 4-7: Space and Water Heating System Fuel Type Saturation 4-7
Figure 4-8: Lighting System Technology Saturation 4-8
Figure 4-9: Linear Fluorescent Detail 4-9
Figure 4-10: Saturation of Other Types of Equipment 4-10
Figure 4-11: Knowledge of Systems and Satisfaction with Information Sources (1 to 10 Scales, where 10 is very Satisfied/Knowledgeable) 4-11
Figure 4-12: Awareness of Programs Sponsored by the Distribution Utility Designed to Encourage the Installation of Efficient Equipment 4-12
Figure 4-13: High and Standard Efficiency Retrofit Rate, Past Three Years 4-13
Figure 4-14: Cooling System Retrofit Technology Distribution 4-14
Figure 4-15: Heating System Retrofit Technology Distribution 4-15
Figure 4-16: Water Heating System Retrofit Technology Distribution 4-16
Figure 4-17: Lighting System Retrofit Technology Distribution 4-17
Figure 4-18: Linear Fluorescent System Retrofit Detail – Technology Distribution 4-18
Figure 4-19: Main Reasons for Retrofit Activity by End Use 4-19

Figure 4-20: Sales Trends, Linear Fluorescent Technologies 4-20
Figure 4-21: Sales Trends, Compact Fluorescent Lighting 4-21
Figure 4-22: Sales Trends, Electronic Ballasts 4-22
Figure 4-23: Sales Trends, Specialized Lighting 4-23
Figure 4-24: Sales Trends, Lighting Controls 4-24
Figure 4-25: New Construction and Retrofit, Linear Fluorescent Technology Distribution.. 4-25
Figure 4-26: New Construction and Retrofit, Electronic Ballast Technology Distribution 4-26
Figure 4-27: New Construction, Presence of Controls and Control Technology Distribution 4-27
Figure 4-28: Percent of Down Light and Sconce Installations That Are Compact Fluorescent (CFL) 4-28
Figure 4-29: High Bay Lighting Technology Distribution 4-29
Figure 4-30: Residential Central Air Conditioners Less Than 5 Tons, SEER Distribution 4-30
Figure 4-31: Commercial Air-Cooled Air Conditioner, Capacity Distribution 4-31
Figure 4-32: Commercial Air-Cooled AC Less than 5 Tons, SEER Distribution 4-32
Figure 4-33: Commercial Air-Cooled Air Conditioners Greater than 5 Tons, EER Distribution 4-33
Figure 4-34: Energy Efficiency Promotion by Contractors and Distributors 4-34
Figure 4-35: Reasons for Frequency of Promoting Energy Efficiency in Air Conditioning Units 4-35
Figure 4-36: Energy Efficient Air Conditioner Options 4-36
Figure 4-37: Maintenance Typically Performed Under Commercial Air Conditioning Service Agreements 4-37
Figure 4-38: Residential Air Conditioning Maintenance Practices 4-38
Figure 4-39: Residential Air Conditioning Sizing and Sizing Practices 4-39
Figure 6-1: Technical Potential to Reduce Energy Use by Utility Service Area 6-4
Figure 6-2: Economic Potential to Reduce Energy Use by Utility Service Area 6-5
Figure 6-3: Technical Potential to Reduce Peak Demand by Utility Service Area 6-6
Figure 6-4: Economic Potential to Reduce Peak Demand by Utility 6-7
Figure 6-5: Composition of Economic Potential Energy Savings in the Residential Sector by Major Measure (%) 6-9
Figure 6-6: Composition of Economic Potential Energy Savings in the Commercial Sector by Major Measure (%) 6-11
Figure 6-7: Composition of Economic Potential Energy Savings in the Industrial Sector by Major Measure (%) 6-13
Figure 6-8: Residential Energy Supply Curve for All Measures 6-14
Figure 6-9: Commercial Energy Supply Curve for All Measures 6-15
Figure 6-10: Industrial Energy Supply Curve 6-16

Figure 7-1: Cumulative Annual Achievable Savings: Naturally Occurring, Base and High Program Funding Scenarios-- Statewide with Low Avoided Costs 7-3
Figure 7-2: Cumulative Annual Peak Demand Savings MW, Statewide --Low Avoided Costs 7-4
Figure 7-3: Cumulative Annual GWh Savings, Statewide - High Avoided Costs 7-5
Figure 7-4: Cumulative Annual MW, Statewide - High Avoided Cost Case 7-6
Figure 7-5: Forecasts of Achievable Energy Savings for Residential, Commercial, and Residential Sectors: Base and High Incentives Case - Low Avoided Cost (AV)................ 7-7
Figure 7-6: Forecasts of Achievable Energy Savings for Residential, Commercial and Industrial Sectors: Base and High Incentive Cases – High Avoided Cost 7-8
Figure 7-7: Achievable Energy Savings by End Use in the Residential Sector - No CFL Case - Low Avoided Costs 7-9
Figure 7-8: Achievable Energy Savings by End Use in the Residential Sector - with CFL Case - Low Avoided Costs 7-10
Figure 7-9: Projected Achievable Energy Savings for the Commercial Sector: Base Achievable Case - Low Avoided Costs 7-11
Figure 7-10: Projected Achievable Energy Savings for the Commercial Sector: High Achievable Case - Low Avoided Costs 7-12
Figure 7-11: Projected Savings by Measure Type - Industrial Base Case - Low Avoided Costs... 7-13
Figure 7-12: Projected Energy Savings by Measure Type - Industrial High Achievable Case - Low Avoided Costs 7-14
Figure 7-13: Statewide Measure Savings by Type of Potential – Residential Low Avoided Cost 7-18
Figure 7-14: Statewide Measure Savings by Type of Potential – Commercial Low Avoided Cost Scenario 7-19
Figure 7-15: Statewide Measure Savings by Type of Potential – Industrial Low Avoided Cost 7-20
Figure 7-16: Annual Program Funding - Base and High Achievable Case - Low Avoided Costs... 7-21
Figure 7-17: Annual Program Funding - Base and High Achievable Case – High Avoided Costs... 7-22
Figure 7-18: Projected Total Costs and Benefits of the Four Achievable Savings Forecasts: Total Benefits Compared to Program and Participant Costs 7-24
Figure 7-19: Comparison of Peak Savings Targets to Achievable Forecasts- Base and High Large Texas Investor-Owned Utilities.. 7-33
Figure 7-20: Comparison of Peak Demand Savings Targets to Achievable Base and High Savings Forecasts- for the Small Texas Investor-Owned Utilities 7-35

Figure 8-1: Estimates of Technical, Economic, Achievable and Naturally Occurring Energy Savings from 2008 to 2017 8-2
Figure 8-2: Estimates of Technical, Economic, Achievable and Naturally Occurring Peak Demand Savings from 2008 to 2017 8-3
Figure 8-3: Statewide Achievable Industrial Sector Savings with and without High Voltage Industrial Customers Base funding –Low Avoided Cost case........ 8-4
Figure 8-4: Estimates of Achievable Savings for the Base and High Case relative to the forecast of naturally occurring savings 8-10

List of Tables

Table 2-1: Sample Technical Potential Supply Curve Calculation for Commercial Lighting (Note: Data is illustrative only) 2-9
Table 2-2: Summary of Benefits and Costs of Common Benefit-Cost Tests 2-11
Table 2-3: Sample Use of Supply Curve Framework to Estimate Economic Potential (Note: Data is illustrative only) 2-14
Table 2-4: Summary Description of Market Barriers from Eto, Prahl, and Schlegel (1997) .. 2-22
Table 3-1: KWh and KW per Household 3-2
Table 3-2: Saturation of Heating and Cooling Efficiency Measures 3-4
Table 3-3: Saturation of Non Weather Sensitive Energy Efficiency Measures 3-5
Table 3-4: Estimates of Heating and Cooling Savings for Residential Shell Measures 3-7
Table 3-5: Statewide Average Cooling EUIs by Building Type (EIA 2005) 3-8
Table 3-6: Adjustment Factors by Utility and Building Type 3-9
Table 3-7: Final Cooling EUIs by Utility and Building Type 3-9
Table 3-8: Energy Savings as a Percentage of Baseline Lighting Usage for College Buildings 3-11
Table 3-9: Energy Savings as a Percentage of Baseline Cooling Usage for College Buildings 3-12
Table 3-10: Mapping of NAICS Code to SIC Code 3-14
Table 3-11: Summary of Industrial Energy Use by Utility and Industrial Segment 3-15
Table 3-12: Energy Consumptions by Industry Segment and End Use - MWh per Year ... 3-17
Table 3-13: Peak Demand by Industry Segment and End Use - MW 3-19
Table 3-14: Peak Demand by Industry Segment and Utility – MW* 3-20
Table 3-15: Estimates of Industrial Energy Usage by Utility and Excluding High Voltage Customers Currently Barred from Participating in Efficiency Programs 3-21
Table 3-16: Key Industrial Measures 3-22
Table 3-17: Average Electricity Prices for the ERCOT Utilities in Texas by Sector 3-23
Table 3-18: Forecast of Nominal Avoided Energy and Capacity Cost; Low and High Case . 3-26
Table 3-19: Average System Electricity Prices in Texas 3-27
Table 3-20: Summary of Forecast Approaches 3-29
Table 3-21: Total MWh in 2008, 2012, and 2017 by Utility 3-30
Table 3-22: Total MW in 2008, 2012, and 2017 by Utility 3-30
Table 4-1: Final Distribution of Trade Ally Surveys by Business Size, Market Segment, and Market Actor 4-19

Table 6-1: Summary of Technical and Economic Potential Energy Savings at the System Level for All Nine Texas Utilities 6-2
Table 6-2: Technical and Economic Potential to Reduce Peak Demand at the System Level for All Nine Utilities 6-3
Table 6-3: Technical and Economic Potential Estimates to Save Electricity and Peak Demand in the Residential Sector 6-8
Table 6-4: Technical and Economic Potential Estimates for Energy and Peak Savings in the Commercial Sector.. 6-10
Table 6-5: Technical Potential Estimates for Energy and Peak Savings in the Industrial Sector 6-12
Table 7-1: Scenario Description 7-2
Table 7-2: Industrial Energy Use for High Voltage (HV) and Non High Voltage Industrial Customers in 2007 7-15
Table 7-3: 2015 Peak Savings Targets with and without High Voltage Customers............ 7-16
Table 7-4: Estimated Potential Revenues Impacts and Bill Savings from Efficiency Programs for a Typical Residential Customer 7-23
Table 7-5: Peak Savings Goals Compared to Base and High Achievable Savings Forecasts (Annual, not Cumulative MW per Year).. 7-29
Table 7-6: Comparisons of Savings Targets using Alternative Methods to Estimate Savings Goals in 2010 and 2015 7-31
Table 7-7: Energy Savings Goals Compared to Base and High Achievable Savings Forecasts (units are MWh per Year in each year, not cumulative)... 7-32
Table 7-8: Historical Program Savings Experience Compared to Proposed Energy Savings Goals in 2010 7-37
Table 7-9: Historical Program Peak Savings Compared to 2010 Peak Savings Goals 7-38
Table 7-10: Ramp Up Growth Rates Required to Reach the 2015 Energy Savings Targets.. 7-39
Table 7-11: Ramp Up Rates Required to Reach the 2015 Peak Savings Targets............... 7-39
Table 7-12: Texas Utility Program Performance: Annual Savings As a Fraction of Annual Sales 7-41
Table 7-13: Effect of Establishing Alternative Savings Metric for 2010 and 2015 by Utility Area, While Retaining Equivalent Statewide Targets 7-42
Table 7-14: Effect of Establishing Alternative Savings Metric for 2010 and 2015 with Reduced 2015 Statewide Total 7-43

ES

Executive Summary

This study presents the results of research undertaken by Itron to estimate energy efficiency potential in Texas and to respond to the Texas Legislature's questions regarding energy efficiency goals and policies. The analysis was funded by the Public Utility Commission of Texas (PUCT) to estimate the technical, economic, and achievable energy efficiency potential for the state of Texas and for the larger investor owned Texas utilities. Itron was also tasked with using the estimates of achievable potential to assess the reasonableness of the newly set energy saving goals for 2010 and 2015. Given the findings from the analysis, Itron was asked to recommend any policy changes necessary to increase the level of energy savings being achieved in Texas.

The study gathered and analyzed utility, ERCOT, and market data on energy and peak consumption, utility-reported program savings, baseline equipment characteristics, energy efficiency measure costs and savings, and the market penetration of energy efficiency measures. The study also included interviews with stakeholders in the Texas energy services market. Using the primary data collected in Texas and previous experience estimating and evaluating energy efficiency program impacts, Itron analyzed the remaining technical, economic, and achievable energy efficiency savings potential in Texas and for individual utilities. Based on this analysis, Itron concludes that most of the investor-owned electric utilities (IOU) can achieve the goals proposed by the Legislature for 2015, as long as certain restrictions to the IOUs' current ability to expand and market their existing and expanded future energy efficiency programs are removed or mitigated. However, some utilities will face substantially greater difficulty than others in meeting the legislature's preliminary energy savings goals due to the development of goals based on a percentage of incremental load growth rather than goals based on other metrics—for example, total system demand or electricity consumption. Itron's analysis also suggests that the Legislature may want to consider delaying adoption of the initial proposed energy and peak savings goals from 2010 to 2012 to allow utilities sufficient time to ramp up their programs, better enabling them to achieve the new energy and peak demand savings goals.

In the following summary, we present the results of the quantitative analysis and then provide answers to the qualitative questions raised by the legislature.

ES.1 Technical and Economic Potential in Texas

Itron's analysis of the potential to save electricity in Texas found that there is a significant amount of untapped technical and economic potential to reduce electricity use in the IOU service areas.[1] Technical potential is the maximum technically feasible applicable energy savings potential. Economic potential is the maximum cost-effective technical potential, where economic cost-effectiveness is defined from the utility perspective; efficiency costs and impacts are compared to alternative supply-side investment costs. Note, however, that technical and economic potential estimates are theoretical constructs that do not take into account consumer economics and preferences or the timing of equipment turnover and availability. Factors impacting customer economics and preferences, product availability, and program effectiveness are addressed while estimating of *achievable* potential. Figure ES-1 shows the estimated technical and economic potential to reduce usage compared to the baseline sales and peak demand at the statewide level. The economic potential to reduce peak demand is roughly 23% of the baseline peak demand in 2007.

Figure ES-1: Baseline Peak Demand and Technical and Economic Potential Savings Estimates - Statewide - All Nine Investor-Owned Utilities

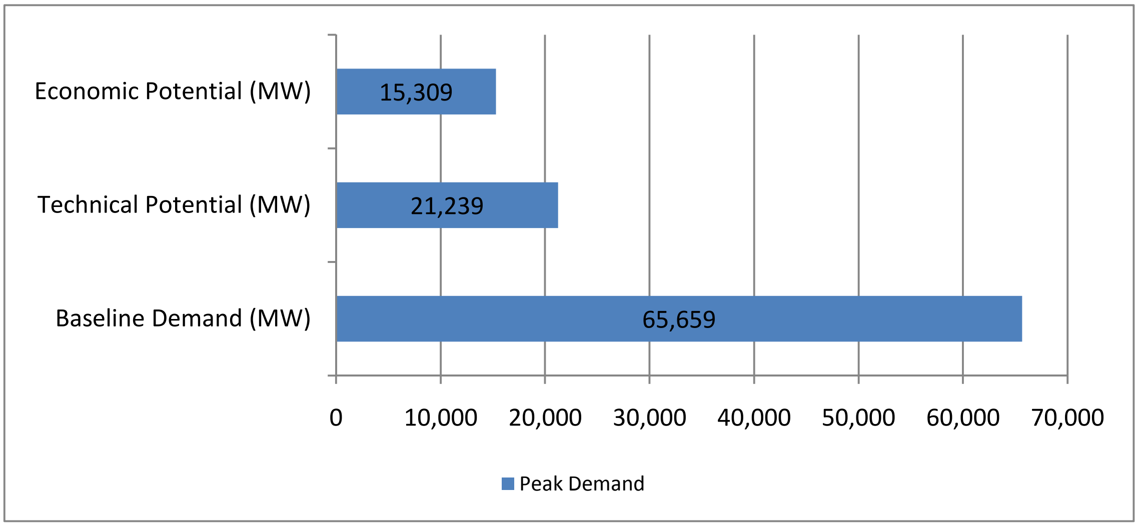


Figure ES-2 compares the estimated technical and economic energy savings potential compared to baseline (2007) energy sales for the nine investor-owned utilities. The

---

[1] This analysis does not include the potential savings for the Sharyland and Cap Rock electric utilities which were not part of this study.

economic potential to reduce energy use is roughly 18% of 2007 baseline electricity sales for the nine utilities in this study.

Figure ES-2: Baseline Electricity Sales and Technical and Economic Potential Savings Estimates- Statewide - All Nine Investor-Owned Utilities

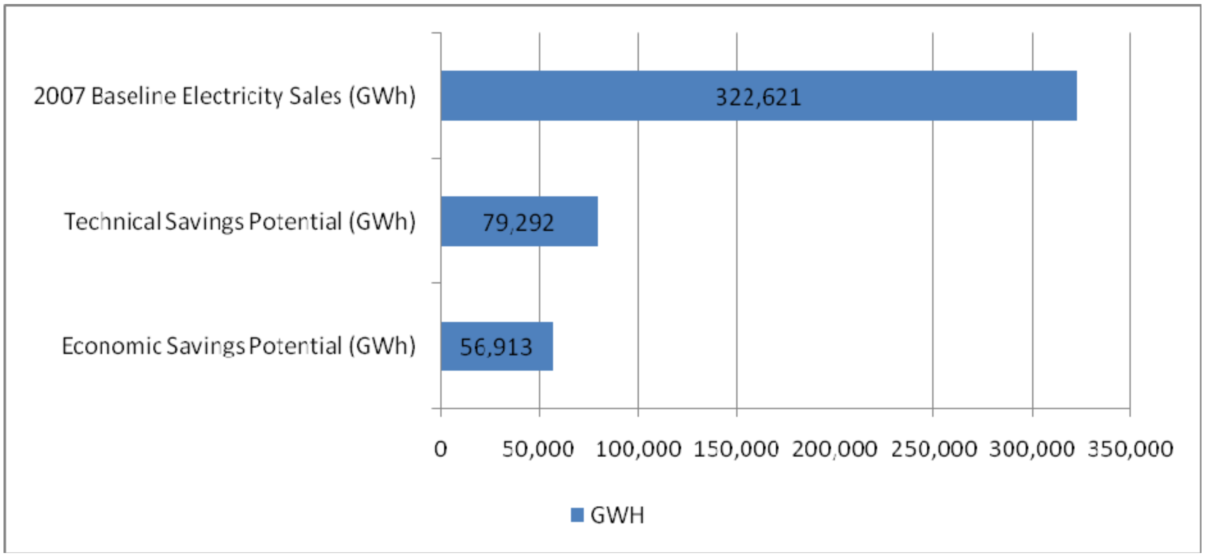


Table ES-1 shows how the level and percent technical and economic potential relative to baseline demand varies by utility service area. The projected level of economic savings as a fraction of peak demand in 2007 varies from a low of 14% for Texas New Mexico Power (TNMP) to a high of 25% for CenterPoint. Most of the variation in savings percentage is driven by the potential to reduce air conditioning in utilities with relatively high cooling loads. Similar information on the range of economic and technical savings compared to baseline energy sales is available in the main body of this report.

Table ES-1: Technical and Economic Potential Compared to Baseline Peak Demand in 2007 by Utility

Utility	Sector	Baseline Demand (MW)	Technical Potential (MW)	Economic Potential (MW)	Technical Demand Savings as Percent of Baseline	Economic Demand Savings as Percent of Baseline
AEP Central	All Sectors	4,802	1,742	1,261	36 %	26 %
AEP North	All Sectors	1,002	362	225	36 %	22 %
AEP SWEPCO	All Sectors	2,146	524	394	24 %	18 %
CenterPoint	All Sectors	20,141	6,775	5,092	34 %	25 %
El Paso	All Sectors	1,599	379	320	24 %	20 %
Entergy	All Sectors	4,249	1,311	957	31 %	23 %
Oncor	All Sectors	27,619	8,774	6,259	32 %	23 %
TNMP	All Sectors	1,847	606	254	33 %	14 %
Xcel	All Sectors	2,298	766	547	33 %	24 %
Statewide	All Sectors	65,703	21,239	15,309	32 %	23 %

ES.2 Achievable Potential and the Feasibility and Attainability of the Savings Goals

Itron provided a High and Base (low) forecast of achievable savings, based on estimated customer adoption rates under a range of incentive and marketing levels, and under two utility avoided cost and retail rate scenarios (thus, four scenarios). The Base forecast assumes incentive levels similar to recent levels (roughly 33% of incremental measure costs) but utilities are allowed to expand their program offerings and market them more directly to customers after 2009. The High forecast incorporated increased marketing efforts and incentive levels, increasing the Base incentive level to roughly 67% of the incremental costs. The High forecast resulted in significant increases in the estimated number of customers willing to purchase more efficient products. Different assumptions about avoided costs and program incentive level were used to produce the four scenarios of achievable savings. The four scenarios are described in Table ES-2.

Table ES-2: Scenario Descriptions

Scenario Name	Avoided Cost Forecast	Incentive Level as a Fraction of Incremental Measure Cost
Base Case- Low Avoided Cost	Avoided cost increases at rate of inflation = 2% per year	33%
Base Case- High Avoided Cost	Avoided cost increase at 5% per year (last five year trend)	33%
High Case- Low Avoided Cost	Avoided cost increase at rate of inflation 2% per year	67%
High Case- High Avoided Cost	Avoided cost increase at 5% per year (last five year trend)	67%-

In all cases, the measures included in the forecasts of achievable savings were restricted to those measures that pass the total resource cost test. In this benefit-cost test, the present value of the net benefits of the energy and peak savings from the programs must exceed the value of the sum of the program cost and the incremental costs to program participants of purchasing and installing the efficiency measures. The results of these forecasts are discussed in the next section.

ES.2.1 Feasibility of Reaching the Proposed Peak Savings Goals

Figures ES-3 and ES-4 compare the High and Base estimates of achievable potential for all nine IOUs relative to the proposed 2010 and 2015 peak savings goals.[2] The comparison of energy savings targets to achievable forecasts is presented in Section 7.3.2. In the figures below, if the Base and the High achievable savings forecasts (shown as green and red bars) are higher than the target savings levels bars (in blue), then the utility should be able to achieve the new savings goal at current incentive levels by expanding the number of measures included in its programs and increasing the total amount of incentives available throughout the year. If the target savings bar (in blue) is between the Base (red) and the High savings forecast (green), the utility will need to both increase savings through some

---

[2] The achievable potential forecasts discussed in this section exclude the potential savings from high voltage customers currently not allowed to participate in utility efficiency programs. The effect of excluding the consumption from these customers in the baseline system forecasts, and the additional energy and peak savings goals that could be achieved from these customers is discussed in a later section. In addition the achievable savings forecasts presented in the Executive summary do not include the potential savings from screw in CFLs as directed by the PUCT study management team.

combination of increases in efficiency measures included in the higher incentive levels, and expanding the total amount of incentives available. Finally if the savings target is within plus or minus 15% of the High achievable savings forecast, it likely will be a significant challenge but not impossible to meet the savings goals.

For example, the estimated peak savings target for Oncor in 2010 is 78 MW, the High achievable forecast is 71 MW, and the Base achievable savings forecast is 60 MW. Oncor reported peak savings of 65 MW from its 2007 programs. Given these results, Itron believes that the 2010 savings goal is achievable since the goal is within 15% of the High incentive case and achieving the goal would only require a 20% increase in peak savings over three years.

Figure ES-3 focuses on a comparison of the peak demand savings targets with achievable forecasts for the four larger investor-owned utilities: Oncor, CenterPoint, Entergy, and AEP Central. This analysis shows that it will be harder for all of these larger utilities to meet the 2010 saving goals relative to the 2015 savings goals. This is due to ramp up constraints caused by the limited time available between a proposed change in the 2010 peak goals that might be adopted in mid 2009 or 2010 and the effective date of the new savings goal on December 31, 2010. For AEP Central and Entergy, both the Base and High achievable forecasts exceed the 2010 goals by a significant amount, indicating the goal is very likely to be achievable. For Oncor, the target savings goal of 78 MW in 2010 is 10% higher than the high saving forecast of 71 MW in 2010, but the 2015 savings target is 16 % lower than the high achievable savings forecast for the same year. For CenterPoint, the 2010 peak savings goal of 77 MW is 30% higher than the High achievable savings forecast (60 MW), but the 2015 peak savings target is 21% lower than the comparable High savings forecast in 2015. These comparisons suggest that it will be more difficult in the short run to meet the 2010 goals, but that all of the larger utilities should be able to meet the 2015 savings goals through more comprehensive portfolios of programs, effective program designs, and higher funding levels. Strategies for dealing with the problems identified here for the 2010 peak savings goals are discussed later after a review of the forecasts for the smaller utilities.

Figure ES-3: Comparison of Peak Savings Targets to Achievable Forecasts - Base and High Large Texas Investor-Owned Utilities

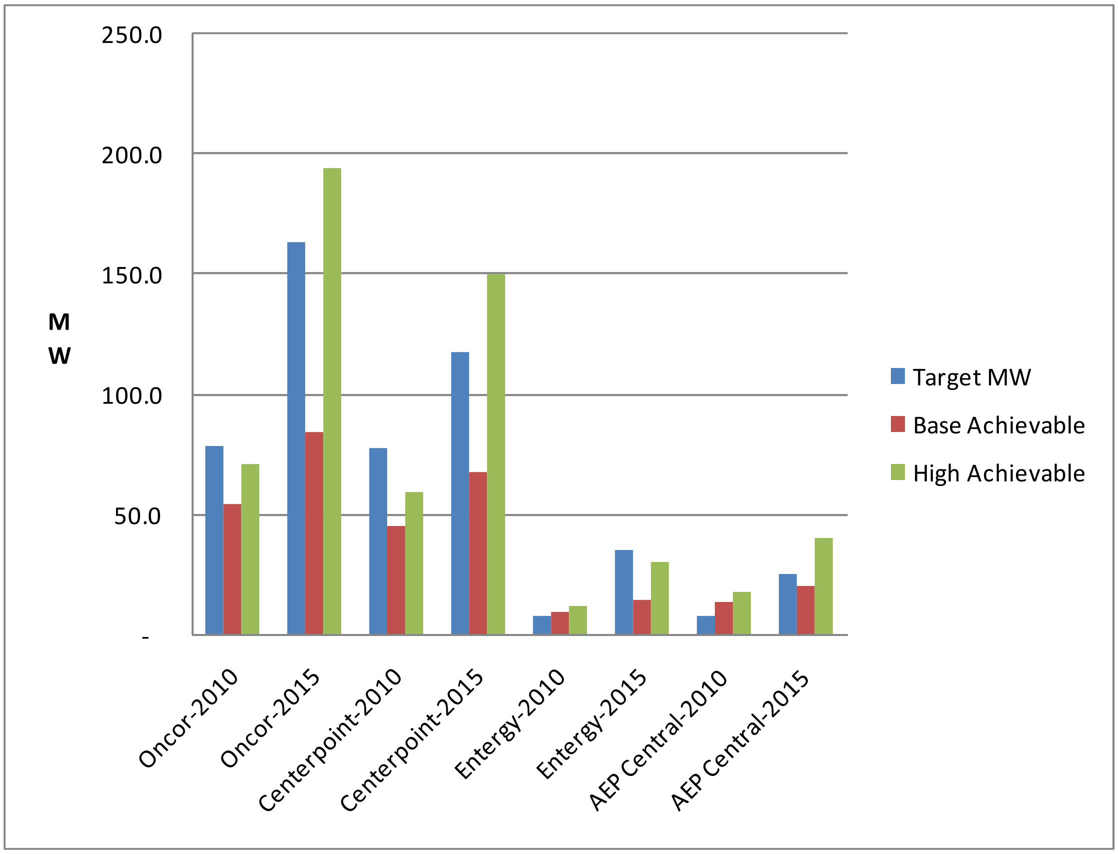
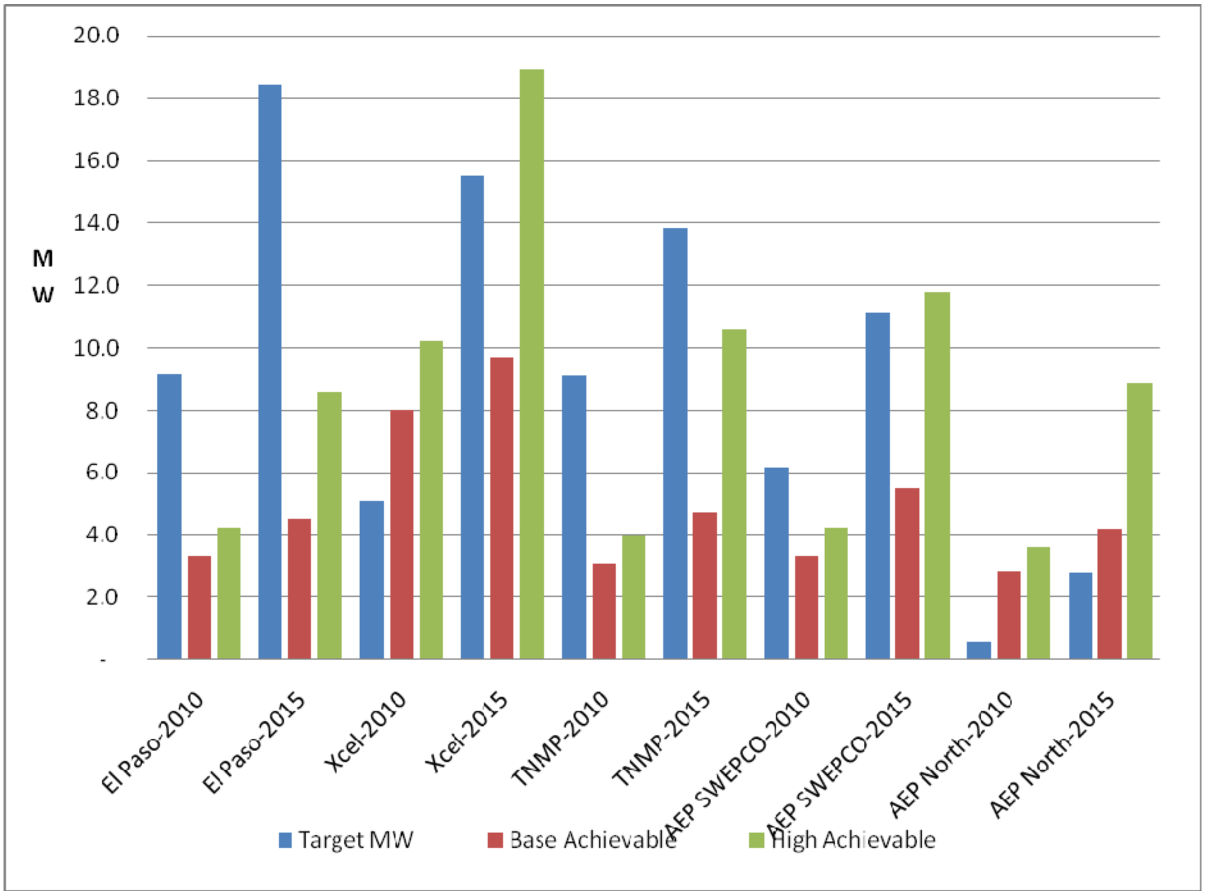


Figure ES-4 provides the same comparisons of target goals to achievable savings forecasts for the smaller utilities. This figure shows it will be more difficult for three of the five smaller utilities to reach the proposed savings goals in 2010 and very difficult for two of the smaller utilities, TNMP and El Paso Electric, in both 2010 and 2015.

Figure ES-4: Comparison of Peak Savings Targets to Achievable Base and High Savings Forecasts for the Small Texas Investor-Owned Utilities



The figure shows that the estimates of achievable potential indicate that El Paso Electric and TNMP will have a difficult challenge to reach the 2010 and 2015 goals when compared to Xcel, AEP SWEPCO, or AEP North. The latter three utilities should have an easier time reaching their 2015 goals since the forecasts of high achievable savings are higher than the savings target. The comparison also shows it will be more difficult for SWEPCO to meet its 2010 goal than its 2015 goal. This is because the High achievable forecast is lower than the savings target in 2010 and higher than the peak savings target in 2015.

For El Paso and TNMP, the proposed savings targets exceed both the High and Base forecast of achievable savings for both 2010 and 2015. For example, the proposed savings target of 9.2 MW for El Paso in 2010 (equivalent to 30% of the forecasted incremental growth) is roughly double the projected achievable potential of 3.4 MW in the Base case and 4.3 MW in the High incentives scenario. The distance between the goals and achievable potential is even larger for El Paso. In 2015, the peak savings goal for El Paso is 18.5 MW, four times the forecast savings in the Base achievable forecast and 115% higher than the High achievable forecast. The substantial difference between the proposed target goals and the estimated achievable savings potential for the smaller utilities is due, in part, to the use of a savings metric that sets goals based on historical incremental growth rates rather than the overall level of sales and peak demand in the area. This metric makes it more difficult for smaller utilities with relatively high projected rates of peak growth (for example, El Paso) to meet their targeted peak savings goals. In addition, the current program administrative cost limit of 10% of all costs has limited the level of staff devoted to program development and marketing in these utilities, which may have contributed to lower levels of initial savings relative to their baseline sales and peak demand.

In summary, Itron’s analysis demonstrates it will be easier for some of the larger utilities to achieve the proposed increase in peak and energy savings goals than the smaller utilities for two main reasons.

- The programs operated by the nine investor-owned utilities are currently operating at very different levels of program performance when measured by the savings achieved relative to their baseline load. For example, some of the larger utilities have programs that are currently achieving close to 30% of incremental growth, while some of the smaller utilities’ program reported annual savings are less than 5% of incremental growth.

- The methods used in Texas to calculate the peak and energy savings goals produce smaller savings goals relative to base usage for larger utilities with lower baseline forecasts of growth (e.g., Oncor) and relatively higher savings goals for smaller utilities with higher forecasts of peak growth (e.g., El Paso Electric). Approaches to mitigate these disparities by changing the savings metrics from a percentage of incremental growth to a percentage of total peak demand are presented in the main report. Itron’s analysis shows that most, if not all utilities, have a better chance of meeting the savings goals if the saving metrics were changed from a percentage of incremental growth to a percentage of total peak demand. The analysis shows that, under this alternative approach, the goals should be set at 0.3% of peak demand in 2010 and 0.6% of peak demand in 2015. The average program performance using this metric for the current statewide programs was 0.18% of peak demand in 2007, equivalent to 138 MW of peak savings.

ES.2.2 Ramp Up Constraints to Meet the 2010 Goal

The likely effective date of any change to the current peak demand and energy saving goals would be early in 2010, leaving utilities less than 12 months to ramp up savings from current savings levels to the new savings goal proposed for December 31, 2010.[3] Itron's analysis and experience suggests that it will take some of the utilities at least two years from the 2010 start date to rapidly ramp up from their current program savings levels to the savings levels required by the new 2010 goals. Thus, Itron suggests postponing the effective date of the new "30% of incremental growth" standards to December 31, 2011 or 2012. The later date may be necessary if the utilities do not start to ramp up their program savings until the PUCT has actually adopted a new rule in early 2010. Alternatively, the savings metric could be reformulated as a requirement to achieve peak savings equivalent to 0.30% of current peak demand. Setting the savings goal as a percentage of peak demand will level the playing field and may mitigate the need for a ramp up adjustment or delay in effective date in the goals to 2011 or 2012.

Itron recommends postponing adoption of the proposed 2010 savings goal equivalent to 30% of incremental peak demand growth to January 1, 2012 because of two factors:

- The aforementioned program ramp up problem due to the time lag between this report and legislative and PUCT actions, and
- Most of the smaller IOUs will be hard pressed to meet the 30% goal by 2010 given their current program savings levels and the lower levels of program personnel and marketing infrastructure described previously.

ES.2.3 Assessment of Feasibility of Achieving Proposed 2015 Savings Goals

Review of the previous figures suggests the potential to achieve additional peak savings is larger than the estimated savings targets for three of the four larger utilities in 2015. Adoption of the proposed 2015 savings goal (equivalent to 50% of incremental growth) may not be achievable for three of the five smaller utilities due to lower levels of current savings performance in 2007 and their higher forecasts of peak growth between now and then. There are also two policy decisions that will affect the relative level of difficulty for each utility in reaching the 2015 goals.

- Will the current policy of excluding high voltage commercial and industrial customers from participation in energy efficiency programs be continued?
- Should screw-in, compact fluorescent lamps (CFLs) be promoted by utility-funded efficiency programs or should efforts to increase the sales of screw-in CFLs be left entirely to the private market?

---

[3] This assumes any new savings goals will be adopted by the legislature by mid 2009 and the PUCT will need at least 6 months after July of 2009 to adopt a rule with the legislature's new savings goal by January 1, 2010.

We review the impact of each decision on the savings goal calculations below.

ES.2.4 Inclusion or Exclusion of High Voltage Customers from Program Participation

Table ES-3 shows the differences in projected peak savings targets for 2015 for each of the utilities as a result of removing the high voltage customers. The estimated effects on the savings goals are small because much of the high voltage load is in the industrial sector, which has a lower growth forecast than the residential and commercial sectors with a likely comparable energy efficiency forecast. For most utilities, the result of excluding high voltage customers is to reduce the peak savings goals by less than 6% and the average difference statewide is only 7%.

Table ES-3: 2015 Peak Savings Targets With and Without High Voltage Customers

Utility	MW Savings Target in 2015 with HV Customers	MW Saving Target in 2015 w/o HV Customers	Percentage Difference
AEP Central	25.1	24.7	1.8%
AEP North	2.8	2.8	0.0%
AEP SWEPCO	12.2	11.1	9.1%
CenterPoint	134.3	117.9	12.2%
El Paso	18.9	18.4	2.6%
Entergy	37.8	35.4	6.4%
Oncor	174.3	163.7	6.1%
TNMP	14.6	13.8	5.4%
Xcel	15.5	15.5	0.0%
Statewide	435.6	403.3	7.4%

Itron concludes that including or excluding high voltage customers is not likely to affect the size of the peak savings and energy savings goals in 2015 significantly. However, excluding these customers will likely result in a lower overall level of energy and peak savings being achieved in Texas. Itron estimates that programs in 2015 could achieve roughly 790 GWh of savings from high voltage nonresidential customers in the Base scenario and 2,400 GWh under the High incentive achievable forecast. These incremental savings from High voltage customers compare to the total nonresidential estimated achievable potential of 10,330 GWh and 329 MW in the High incentives scenario and 7,292 GWh and 203 MW in the Base case. The proportional increase in additional savings to be captured from high voltage customers

(11% for the Base case and 23% for the High incentive case) is higher than the 7.4% estimated reduction in the peak savings goals when they are excluded from the goal establishment. Thus, excluding high voltage customers from program participation will make it more difficult for utilities to meet the 2015 peak and energy savings goals.

ES.2.5 Inclusion or Exclusion of Energy and Peak Saving from CFL Bulbs

Programs to promote the sales of screw-in CFLs have been run by utilities across the United States for over 15 years. However, program and market forces have combined recently (since roughly 2001) to produce significant increases in CFL adoptions in the United States. Even so, there is significant remaining energy savings potential associated with further increases in CFL market penetration. A key strategic question for Texas policy makers and program administrators is whether to provide incentives and information for the purchase of CFLs, information only, or whether to rely solely on the private market to promote these products.

Removing CFLs from the achievable forecasts leads to an overall drop in the estimated achievable potential savings ranging from 15% (in the high avoided cost and High incentives case) to 26% (in the low avoided cost, Base incentives case). The corresponding loss in peak savings potential caused by the removal of CFLs is lower than the energy savings effect, between 6% and 11%. This is because CFLs have a lower incidence of usage during peak demand hours.

During the review of the draft results of this study, the Texas utility program managers indicated that they are likely to discontinue the promotion of CFLs in their programs by the end of 2010. (Note that a pilot CFL program is being implemented currently.) They believe that, given current CFL prices, availability, and market trends, the private market for CFLs is likely to be sufficiently robust in 2011 to achieve high levels of market penetration in the residential and commercial markets. In addition, the federal government may adopt new lighting standards by 2012 that effectively ban low-efficacy incandescent lighting and require that higher efficiency general service lamps be purchased by all customers. For these reasons, the PUCT study management team directed Itron to exclude the potential savings from screw-in CFL in the study's final forecasts of achievable energy and peak savings. However, it was agreed that information should be provided separately on the remaining CFL achievable potential. This information is provided in the full report.

ES.2.6 Consideration of an Alternative Goal Metric

Another strategy for dealing with the ramp up constraints and challenges faced by small utilities and utilities with higher than average growth is to change the metric to be based on savings relative to absolute sales or peak demand rather than a fraction of the projected incremental peak growth. Table ES-4 shows the net effect of switching the metrics from 30% and 50% of incremental growth in peak growth to 0.30% of base peak demand in 2010 and 0.5% of peak demand in 2015, respectively. The result is that peak savings goals decrease for some utilities, increase for others, and stay relatively neutral for the remaining utilities. The overall statewide savings resulting from this metric would decline by 19%. However, using this alternative metric would reduce the ramp up difficulties associated with meeting the 2015 peak savings goals significantly for the smaller utilities and for CenterPoint. For the four utilities with increases in target savings goals as a result of using the alternative metric, the level of alternative savings goals are still relatively close in 2010 to their 2007 accomplishments. Using this metric produces lower peak savings goals for five of the nine utilities, including the utilities with the most significant challenges in meeting the goals—El Paso Electric and Texas New Mexico Power. Overall, Itron believes that the alternative metric is fairer and increases the likelihood of goal attainment for the utilities in aggregate.

Additional discussion of the pros and cons of a new metric are presented in the main report.

Table ES-4: Effect of Establishing Alternative Savings Metric for 2010 and 2015 with Reduced 2015 Statewide Total

Utility	Reported Savings	Saving Goals for 2010		2010 Difference	Saving Goals for 2015		2015 Difference
	2007 Savings MW	30% of Incremental Growth MW	0.3% of Total Base MW	Base MW Goal vs. Incremental MW (%)	50% of Incremental Growth MW	0.5% of Total Base MW	Base MW Goal vs. Incremental MW (%)
Oncor	65	78.1	69.0	-13%	163.7	122.7	-33%
CenterPoint	39	77.2	52.3	-48%	117.9	96.5	-22%
AEP-SWEPCO	2	6.2	5.4	-15%	11.1	9.5	-17%
AEP-Central	9	7.7	15.4	50%	24.7	27.1	9%
AEP-North	1	0.6	2.6	78%	2.8	4.5	38%
Entergy	5	7.8	10.1	23%	35.4	18.6	-90%
SPS-Xcel	4	5	6	10%	16	10	-53%
El Paso Electric	1	9.2	3.6	-153%	18.4	7.0	-164%
TNMP	2	9.1	4.5	-103%	13.8	7.0	-98%
Statewide	128	201.0	168.6	-19%	403.3	303.0	-33%
🟦	MW goals resulting from new metric set at 0.3 or 0.5% of peak demand.						
	Savings calculations exclude potential savings from high voltage customers and from CFLs.						

Table ES-5 shows the net effect of changing the alternative metrics from 30% and 50% of incremental growth in peak demand to slightly higher fractions of total peak demand in order to achieve equivalent savings compared to the current incremental growth method. The table shows that it would be necessary to increase the savings fraction from 0.30% to 0.358% of total peak demand in 2010 and from 0.50% of peak demand to 0.664% of total peak demand in 2015 to yield equivalent savings. The resulting savings goals tend to be higher for the larger utilities and lower for the smaller utilities with higher rates of forecasted peak growth. CenterPoint, a large utility, is an exception to this observation because it has a higher rate of peak growth than the other utilities in this study; thus, the switch to a base peak demand savings metric results in lower peak savings goals in both 2010 and 2015 relative to the current method.

Table ES-5: Effect of Establishing Alternative Savings Metric for 2010 and 2015 by Utility Area, While Retaining Equivalent Statewide Targets

Utility	**Reported Savings**	**Saving Goals for 2010**		**2010 Difference**	**Saving Goals for 2015**		**2015 Difference**
	2007 Savings MW	30% of Incremental Growth MW	0.36% of Total Base MW	Base MW Goal vs. Incremental MW (%)	50% of Incremental Growth MW	0.66% of Total Base MW	Base MW Goal vs. Incremental MW (%)
Oncor	65	78.1	82.3	5%	163.7	163.0	0%
CenterPoint	39	77.2	62.4	-24%	117.9	128.1	8%
AEP-SWEPCO	2	6.2	6.4	4%	11.1	12.6	12%
AEP-Central	9	7.7	18.3	58%	24.7	35.9	31%
AEP-North	1	0.6	3.2	81%	2.8	6.0	54%
Entergy	5	7.8	12.1	36%	35.4	24.7	-43%
SPS-Xcel	4	5	7	25%	16	13.5	-15%
El Paso Electric	1	9.2	4.3	-112%	18.4	9.2	-99%
TNMP	2	9.1	5.4	-70%	13.8	9.2	-49%
Statewide	128	201.0	201.2	0%	403.3	402.4	0%
🟦	MW goals resulting from new savings metric set at 0.35 or 0.7% of peak demand						
	Savings calculations exclude potential savings from high voltage customers and from CFLs						

ES.3 Findings on Naturally Occurring Energy Efficiency Investments and Savings in Texas

The study found that there is a significant level of naturally occurring efficiency investment in Texas based on the efficiency measure cost and savings data collected and analyzed in this project. For example, roughly half of the sales of fluorescent lighting systems in Texas are currently energy efficient. On an aggregate basis, estimates predict that roughly 53% of the energy savings identified as achievable in the Base savings forecast and 33% of the savings in High savings forecast are likely to occur in the absence of efficiency programs. The net effect of increasing the level of program activity over the next decade is to accelerate the rate of energy savings captured beyond the natural market rate by a factor of two to five or more, depending on the market and relative payback economics for each specific efficiency measure.

ES.4 Cost and Benefits of Funding Efficiency Programs to Achieve the Proposed Savings Goals

Setting higher savings goals will require utilities to increase program funding, which by definition will lead to some, albeit modest, rate impacts in the short run. The increased program activity, however, will produce highly positive net total resource benefits. Itron's analysis shows that modestly higher rates will be more than offset by lower energy bills for the average customer in the longer run.

Table ES-6 shows the impact of potential revenue impacts (from the utility perspective) and bill savings (from the customer's perspective) for a typical residential household. Potential revenue impacts are calculated as the lost revenues (at full retail price) minus avoided cost benefits plus program costs divided by total residential sales times a typical residential usage of 833 kWh/month (10,000 kWh/year). Average bill savings are derived by dividing the annual savings in the residential sector by total residential sales and multiplying back by the same 833 kWh/month. As shown, average bill savings are higher than potential rate impacts in all cases. Note that comparison of these values is not a cost-effectiveness metric. Cost-effectiveness is shown from the total resource cost perspective in Figure ES-5.

The potential average rate impacts associated with the Base and High incentive cases ranges from 0.01 cents/kWh to 0.04 cents per kWh. The estimated rate impact depends on the avoided cost forecast (because these values affect the present value of savings achieved by programs) and the assumed level of program funding (the Base or the High incentive cases). The high avoided cost forecast and High incentive case produces the highest estimate of rate impact at 0.04 cents/kWh. Conversely, the low avoided cost case and lower funding levels associated with the Base incentive levels yield the smaller average rate impact of 0.01 cents per kWh. The low avoided cost and High incentive case yields an average rate impact of 0.033 cents per kWh, while the high avoided cost and Base incentive case yields 0.014 cents per kWh.

Table ES-6: Estimated Potential Revenues Impacts and Bill Savings from Efficiency Programs for a Typical Residential Customer

	Average Annual Potential Revenue Impacts*	**Average Annual Bill Savings**
Scenario Definition	**$/Household-Month****	**$/Household-Month****
Base Incentive- Low Retail Rate	$0.09	$0.18
Base Incentive- High Retail Rate	$0.12	$0.25
High Incentive- Low Retail Rate	$0.27	$0.48
High Incentive- High Retail Rate	$0.36	$0.62

*Revenue reduction from reduced sales (at retail rate of $0.12/kWh reduced) minus avoided cost benefits (at ~$0.08 per kWh saved) plus program costs.

**For a typical household with annual consumption of 10,000 kWh/Year.
Typical equivalent monthly bill would be roughly $100/month at $0.12/kWh.

Table ES-7 provides some perspective on the annual program funding levels that are forecast as being necessary to meet the different achievable savings forecasts or targets in 2015. This table shows the estimated annual funding needed to support the savings forecast for the High incentive case, Base incentive case, and the interpolated estimated cost to just meet the 2015 peak savings goal equivalent to 50% of the incremental peak growth over the previous five years. These funding levels should be compared to the annual program spending levels of $84 million in 2004 and $52 million in 2007 for all nine investor-owned utilities.

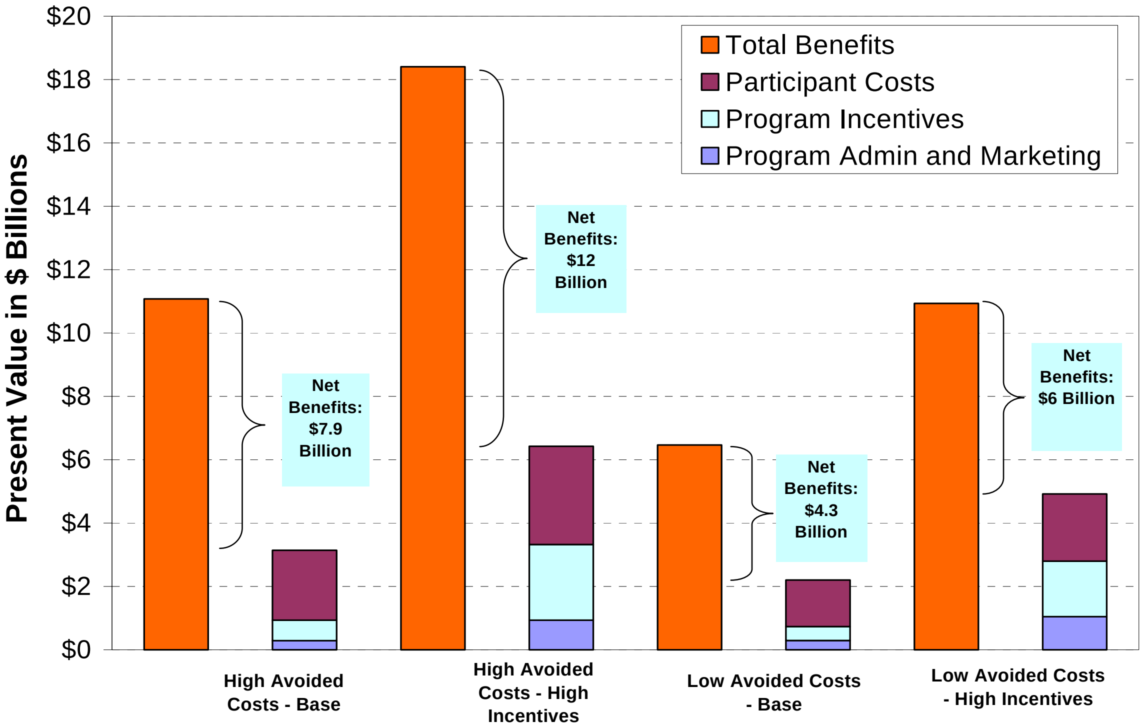
This table suggests a significant increase in statewide peak savings is possible by the year 2015. For perspective, the total peak savings reported by the Texas utilities for 2007 was 138 MW, suggesting that peak savings in 2015 could increase by 80% in the Base incentive case (248 MW) or up to 290% in the high incentive case (541 MW). The program cost per MW acquired is slightly higher in the High incentive case than in the Base incentive case. This is because using higher incentives and marketing in the high incentives case actually results in a more effective program design that reaches not only more customers, but increases the level of net savings acquired by the utility programs.

Table ES-7: Comparison of Annual Funding and Peaks Savings Levels: Base, High Incentive Case, and Savings Targets Met Case

Scenario Description	Estimated Annual Funding in 2015	Estimated Annual MW Savings
High Incentive Case	$ 426 million	541
Savings Target Met	$ 356 million	436
Base Incentive Case	$ 200 million	248

Figure ES-5 shows the estimated program costs with the present value of the energy and peak savings projected from the programs under four different achievable savings scenarios. The benefit-cost ratio exceeds 2.0 for all scenarios and net benefits to the citizens of Texas range from $4.2 billion to $11.9 billion.

Figure ES-5: Projected Total Costs and Benefits of the Four Achievable Savings Forecasts: Total Benefits Compared to Program and Participant Costs



Actual cost and benefits values linked to each of these bars are presented in the main report and the appendices.

At the statewide level, efficiency programs run by the IOUs will need to increase the level of DSM savings achieved by roughly a factor of three to reach the 2015 savings goals. Program administrators report that requesting the necessary program funding needed to reach these savings goals will likely lead to utility management resistance. Management is concerned that additional program energy savings causes lost revenues and reduced profits that may not be fully recoverable under current regulatory policy. Itron's experience suggests that once energy efficiency programs exceed 0.3% of annual revenues, administrators usually begin to resist program expansion unless they are offered significant shareholder incentives or some form of decoupling. The Texas Legislature and PUCT may need to consider or develop alternative mechanisms or policies to ensure that successful utility energy efficiency programs that reduce electricity sales do not automatically result in reduced earnings per share or net earnings to the utility. Possible policies include expanded opportunities to earn profits for successful efficiency programs through shareholder performance payments, some form of decoupling transmission and distribution revenues from kWh sales, or other mechanisms.[4]

ES.5 Barriers to the Achievement of the New Savings Goals

Itron's analysis identified several barriers to increasing electricity savings from current energy efficiency programs that need to be addressed in order to give each utility a reasonable chance of meeting the proposed energy and peak savings goals.

- **Low Levels of General Market Awareness.** Itron surveys of commercial customers found a low level of general awareness of energy efficiency opportunities and utility programs.
- **Limited Program Portfolios Constrained by Personnel Limits.** The current practice of limiting program administrative cost to 10% of total program costs has reduced the ability of program managers to develop efficient program designs, market their programs, evaluate their program's impacts, and keep track of changes in the market.
- **Limited Access to Energy Service Professionals in Rural Areas.** An inability of programs to reach low density rural areas is in part due to a lack of local contractor infrastructure and the knowledge needed to design and install efficient systems.
- **Limited Incentive Program Designs.** The current practice of providing program incentives to third parties or energy service companies only is likely to reduce the level of potential savings available to programs that may want to use different incentive strategies and market channels.

---

[4] See, for example, National Action Plan for Energy Efficiency (2007). Aligning Utility Incentives with Investment in Energy Efficiency. Prepared by Val R. Jensen, ICF International. <www.epa.gov/eeactionplan>

- **Inability to Directly Market Programs to Customers.** Stakeholders reported that the inability to market programs directly to TDU customers has limited both the scope and usefulness of these programs. There appear to be institutional barriers to forming alliances with Retail Energy Service Providers to jointly market energy efficiency programs and provide customers with feedback via smart meters.

Suggestions for reducing these barriers are discussed below.

ES.6 Recommended Policies to Achieve the Higher Energy and Peak Savings Goals in Deregulated and Regulated Electricity Markets

The following changes in regulatory policy are recommended to maximize the chances that utility program administrators will be able to meet the savings goals recommended in this document.

- Replace the 10% administrative cost limit with a requirement that utilities demonstrate their overall program portfolio was cost-effective using the program administrator cost test and total resource cost test. Alternatively, the limit could be set at 10-20% of total resource costs (i.e., as a percentage of program plus participant costs) or kept as is while amending the definition of administrative costs to exclude marketing, information (including customer audits), and training costs, which typically are counted as program delivery costs in most jurisdictions.

- Allow utilities to market their programs directly to their customers in addition to providing indirect marketing messages through energy service companies. This change is needed because the surveys of commercial customers in this project showed that awareness of the existence of energy efficiency programs was relatively low in Texas compared to the levels achieved in other states. Increased awareness of programs and associated energy efficiency benefits usually leads to increases in the number of customers willing to purchase and install energy efficiency measures.

- Limit incentive payments provided by utility programs to a maximum of 100% of incremental measure costs but with an average share of incremental costs that is significantly lower, for example, 50%, to ensure that end users co-pay for their efficiency installations (increasing the likelihood that the measure will be maintained, properly utilized, and fully valued).

- Consider establishing a stronger statewide marketing organization to increase general awareness of energy efficiency products and access to energy efficiency service suppliers. This organization could be hired to work directly for all of the investor-owned utilities, work directly for the PUCT at a statewide level, or work under the direction of the State Energy Conservation office.

- Consider encouraging even closer cooperation between utility new construction programs and the SECO to jointly pilot test and demonstrate new designs and technologies in new buildings that will then be incorporated into future codes five to ten years later.
- Consider increasing the rewards available to utility program administrators for successful utility energy efficiency programs.
- Consider establishing special funding for programs designed to achieve greater savings for rural areas with low levels of awareness and a scarcity of energy service companies providing efficiency products and services.

ES.7 Uncertainties in the Forecasts of Achievable Energy and Demand Savings

Uncertainties in the achievable savings forecast and inability to account for unforeseen changes in market structure (such as changes in building codes) suggest there is a strong need to periodically review and potentially adjust the savings goals. The most significant uncertainties in the savings forecasts in this report include the following: assumptions about current saturation rates for some efficiency measures where no Texas specific data was available, incremental costs and savings of some measures, and customer adoption rates with and without incentives (this is the greatest source of uncertainty). To deal with these uncertainties, Itron recommends the energy and peak savings goals be periodically reviewed and potentially adjusted every three to five years. The issue of whether this periodic review should be the responsibility of the PUCT or the legislature should be addressed in the legislation.

ES.8 Summary

The analysis of remaining energy and peak savings potential in Texas provided answers to four key questions posed by the legislature.

1. Are the Proposed Increases in Peak and Energy Savings goals for 2010 and 2015 reasonable and attainable?
2. Do the estimated monetary benefits from setting higher energy and peak demand savings goals exceed the costs of developing expanded programs to achieve them?
3. Do the estimated monetary benefits of allowing high voltage industrial and commercial customers to participate in (and pay for) energy efficiency programs exceed the estimated costs?

4. Does it make sense to fund and authorize a concerted effort to increase the level of awareness and knowledge of energy efficiency products in the Texas market?

Answers to each question are presented below.

1. The proposed savings goals for 2010 and 2015 are reasonable and attainable for the majority of utility service areas, particularly if some adjustments are made to the 2010 goal to account for ramp up constraints. For example, a one-year delay in the 2010 savings goal may be warranted to ensure all utilities have a good chance at meeting the goal. Alternatively, changes to the current method used to calculate the peak and energy savings goal would help to level the playing field for the smaller utilities that will have a more difficult challenge in meeting goals. This is because the current goals are based on incremental peak growth rather than base peak demand.
2. The net benefits of expanding energy efficiency programs run by investor-owned utilities to achieve the higher levels of savings identified in this report range from $ 4 billion to $ 12 billion over the next twenty years.
3. The incremental costs of making high voltage customers eligible for the programs are less than the incremental value of capturing an additional 800 GWh to 2,400 GWh per year of annual energy savings from these customers by 2015.
4. A concerted effort to raise general awareness and provide more specific targeted marketing will increase the level of energy and dollar savings in Texas.

Itron recognizes that different stakeholders may come to different policy conclusions given the results of this study. As a result, Itron provides the necessary data and analysis in the main body of this report and the detailed appendices to allow thorough review of the data, assumptions, models, and analyses. Stakeholders can use this information to formulate their own conclusions on the goals and policies ultimately adopted in Texas. Of course, Itron's primary objective is to provide the data and analysis that legislators in Texas and policy makers at the PUCT can use to come to their own conclusions on each question and adopt savings goals consistent with these decisions.

1

Introduction

This report provides estimates of the technical, economic, and achievable potential to save electricity for the nine investor owned distribution utilities that currently run energy efficiency programs overseen by the Texas Public Utility Commission (PUCT). This study was initiated by the PUCT in response to a legislature request to assess the feasibility of increasing the current energy savings goals that each investor owned utility is required to meet on an annual basis. The forecasts of achievable potential in this report provide the foundation for assessing the likelihood that the Texas utilities could achieve the higher energy savings goals proposed by the legislature in a cost-effective manner. Specifically the study provides answers to the question of whether each of the Texas utilities can feasibly achieve energy savings equivalent to 30% of each utilities projected annual growth in peak demand by the end of 2010 and 50% of the annual growth in demand by 2015. The study also provides recommendations on strategies and policies to increase the level of energy efficiency and energy cost savings for all Texas customers.

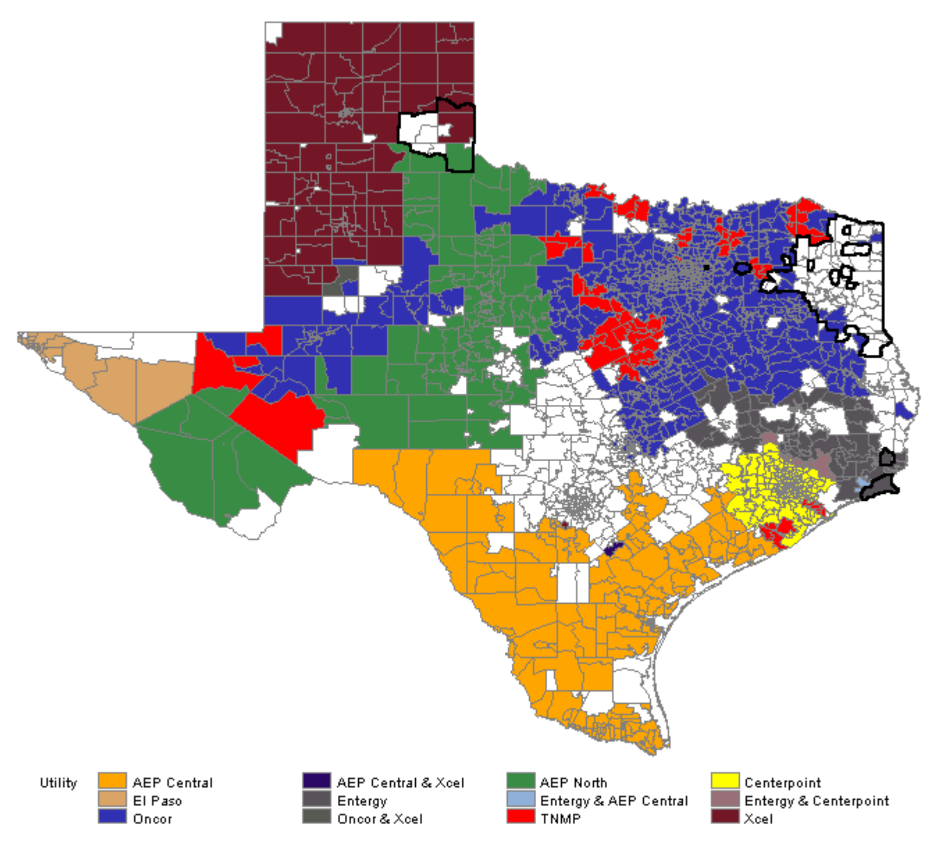
1.1 Scope of the Potential Analysis

This report provides detailed estimates of the technical, economic and achievable savings potential to save electricity in the residential, commercial, and industrial sectors for the following Utility Service areas in Texas.

- Texas Central (AEP)
- Texas North (AEP)
- Southwest Electric Power (SWEPCO)
- CenterPoint (Houston)
- El Paso Electric
- Entergy
- Oncor (formerly Texas Utilities)
- Southwest Public Service (Xcel)
- Texas New Mexico Power

Figure 1-1 shows how these service territories are distributed down to the level of Zip codes over the State of Texas. Note that more than one electric utility often provides service in the same Zip code area, making it necessary to work closely with each utility to correctly match customer addresses with their utility service provider.

Figure 1-1: Texas Electricity Service Territories*



*The SWEPCO territory is defined by the black outlines in the upper east of the state and the lower eastern part of the panhandle.

This study utilized a wide variety of data sources to develop estimates of the energy and peak savings and incremental costs of commercially available energy efficiency measures in the Texas market place. It does not include an assessment of the potential peak demand savings or energy impacts of demand response programs or technologies. It also does not include the potential energy savings from emerging technologies such as LED's or advanced energy management systems expected to be available during the rollout of advanced metering infrastructure. It does not include an assessment of the potential savings from new building and appliance standards that may be adopted over the next decade. The study does incorporate the latest State and Federal appliance codes and building standards as baseline energy use from which to assess savings from the energy efficiency measures in the study.

All of the aforementioned constraints on the scope of the project work to reduce the magnitude of the estimated economic and achievable potential that can be achieved by utility programs in the Texas market place. To qualify for inclusion in the forecast of achievable savings, each efficiency measure or technology system must also have a benefit cost ratio greater than 1 based on our forecasts of avoided costs and retail rates and the estimated incremental costs of the more efficient measures. Sensitivity analyses have been developed to produce high and low estimates of achievable energy and peak savings by utility. Itron believes the achievable savings results (presented in Section 7) are conservative and likely to be achieved as long as some of our policy recommendations are considered and adopted. A complete list of the energy efficiency measures analyzed in this study is provided in Appendix A.

1.2 Background on Research Reports Produced by Itron During the Course of This Study

The Texas Public Utility Commission selected Itron Inc., with assistance from KEMA Inc., to conduct the electric energy efficiency potential study, and the project commenced in the summer of 2008. The key tasks and deliverables completed to date include:

- Development of a list of commercially available energy efficiency technologies.
- Development of baseline estimate of electricity use and peak demand by sector and end use in 2007 and forecasts of electricity and peak demand for each of the participating utilities over the next ten years.
- Review and assessment of the trends in reported energy and peak savings from the energy efficiency programs operated by the Texas Distribution Utilities (TDUs) from 2001 to 2007.
- Completion of primary data collection efforts in the commercial sector and among lighting and HVAC trade allies doing business in Texas.
- Development of estimates of Technical and Economic potential savings for each service area at the sector and end use level.
- Development of Achievable Peak and Energy Savings Scenarios.

In addition to this final report, several interim deliverables covering various elements of the topics above were prepared. These deliverables are listed in Appendix D and are available under separate cover.

This report presents the final step in this analysis process. It contains forecasts of achievable energy and peak savings scenarios for the state of Texas and by utility area using multiple levels of incentives that might be offered by utility programs and a range of plausible trends in avoided costs and retail rates. The preliminary estimates of achievable potential were reviewed by the in-scope utilities in early November. In this report, Itron has responded to suggested comments from utility and PUCT reviewers and developed a final set of recommendations to the Legislature's questions related to energy and peak demand savings goals and policies to increase the level of energy efficiency investment in Texas.

1.3 Organization of the Report

The remainder of this report includes the following sections:

- Section 2 – Methodology
- Section 3 – Data Development and Economic Inputs
- Section 4 – Key Results from Telephone Surveys of Commercial Building Owners
- Section 5 – Key Results from Interviews with Texas Stakeholders
- Section 6 – Technical and Economic Potential Analysis
- Section 7 – Achievable Savings Analysis
- Section 8 – Policy Analysis in Response to Legislative Questions

Appendices A through E, under this cover, contain a variety of supporting documentation (see Table of Contents). Additional documentation on the detailed data inputs used to estimate the potential for each service area, along with complete study results, is provided in the electronic appendices.

2

Energy Efficiency Assessment Methodology

In this section, we provide an overview of the concepts, methods, and scenarios used to develop the baseline and energy efficiency estimates for this study.

2.1 Characterizing the Energy Efficiency Resource

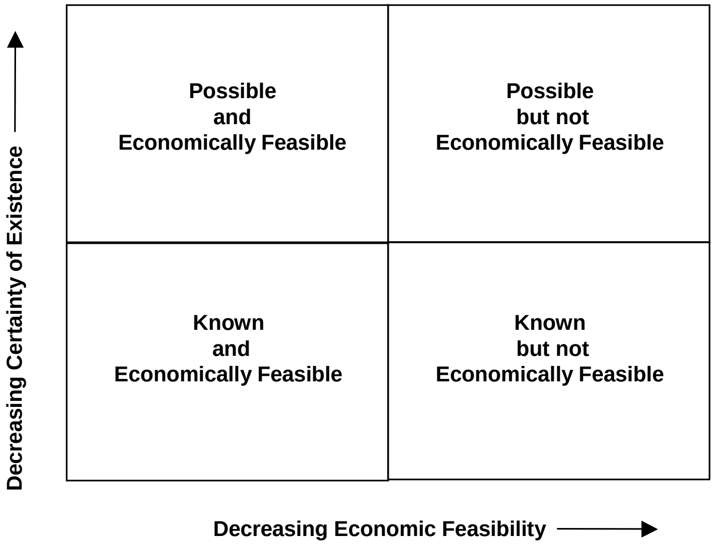
Energy efficiency has been characterized for some time now as an alternative to energy supply options such as conventional power plants that produce electricity from fossil or nuclear fuels. In the early 1980s, researchers developed and popularized the use of conservation supply curves to characterize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

2.1.1 Defining Energy-Efficiency Potential

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

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

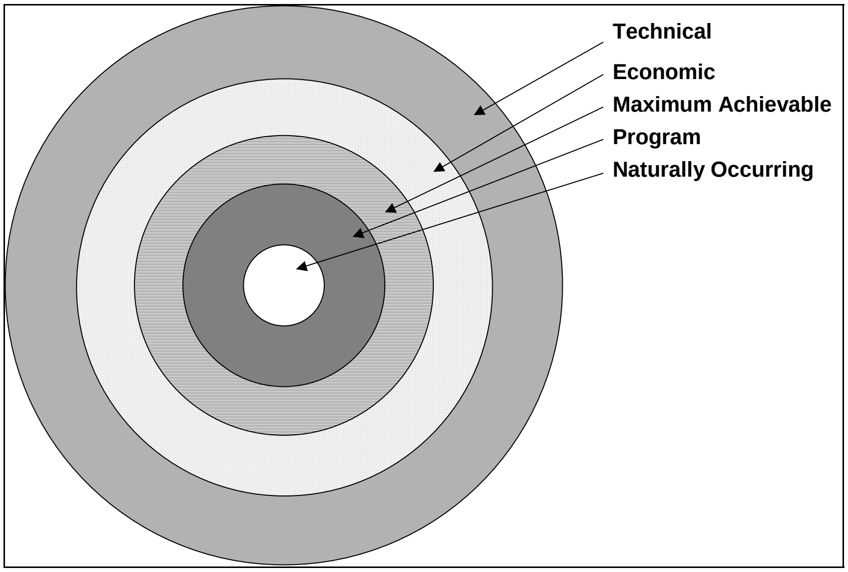
Figure 2-1: Conceptual Framework for Estimates of Fossil Fuel Resources



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

Technical potential is defined in this study as the complete penetration of all measures analyzed in applications where they were deemed technically feasible from an engineering perspective. **Economic potential** refers to the technical potential of those energy conservation measures that are cost-effective when compared to supply-side alternatives. **Maximum achievable potential** is defined as the amount of economic potential that could be achieved over time under the most aggressive program scenario possible. **Achievable program potential** refers to the amount of savings that would occur in response to specific program funding and measure incentive levels. Savings associated with program potential are savings that are projected beyond those that would occur naturally in the absence of any market intervention. **Naturally occurring potential** refers to the amount of savings estimated to occur as a result of normal market forces, that is, in the absence of any utility or governmental intervention.

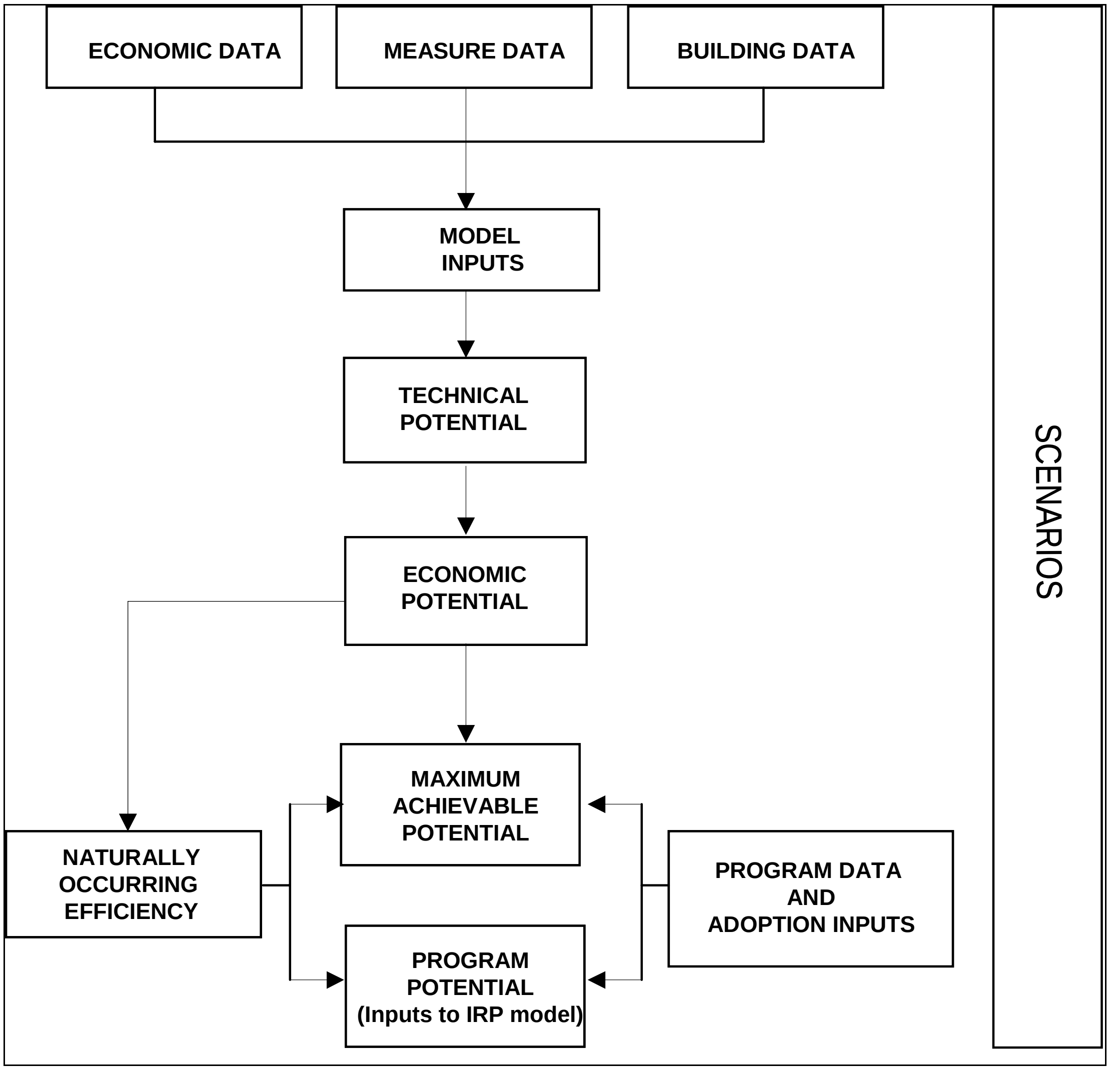
Figure 2-2: Conceptual Relationship Among Energy-Efficiency Potential Definitions



2.2 Overview of Energy Efficiency Forecasting Method

The crux of any forecasting process involves carrying out a number of systematic analytical steps that are necessary to produce accurate estimates of energy efficiency (EE) effects on system load. A simplified overview of these basic analytical steps used in this study is shown in Figure 2-3.

Figure 2-3: Simplified Conceptual Overview of Modeling Process



The approach to developing an energy efficiency forecast used for this study involves a five-step process. The steps include:

Step 1: Develop Initial Input Data

- Develop list of energy efficiency measure opportunities to include.
- Gather and develop technical data (costs and savings) on efficient measure opportunities.
- Gather, analyze, and develop information on building characteristics, including total square footage and number of households, electricity consumption and intensity by end use, end-use consumption load patterns by time of day and year (i.e., load

shapes), market shares of key electric consuming equipment, and market shares of energy efficiency technologies and practices.

- Gather economic input data such as current and forecasted retail electric prices and current and forecasted costs of electricity generation, along with estimates of other potential benefits of reducing supply, such as the value of reducing environmental impacts associated with electricity production.

Step 2: Estimate Technical Potential and Develop Supply Curves

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

Step 3: Estimate Economic Potential

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

The final step, estimate achievable potential, will be completed after the initial technical and economic results presented in this report are reviewed and improved based on comments from the Texas PUC staff and participating Texas utilities.

Step 4: Estimate Achievable Program and Naturally Occurring Potentials

- Gather and develop estimates of program costs (e.g., for administration and marketing) and historic program savings.
- Develop estimates of customer adoption of energy efficiency measures as a function of the economic attractiveness of the measures, barriers to their adoption, and the effects of program intervention.
- Estimate a high and low range of achievable program savings, and naturally occurring potentials; calibrate achievable and naturally occurring potential to recent program and market data.

Section 3 below provides additional discussion of data development and the modeling approaches for technical, economic, and achievable forecasts. The analysis was carried out using KEMA’s DSM ASSYST™ (Demand-Side Management Technology Assessment System).

2.3 Estimation of Technical Potential and Development of Energy Efficiency Supply Curves

Technical potential refers to the amount of energy savings or peak demand reduction that would occur with the complete penetration of all measures analyzed in applications where they were deemed technically feasible from an engineering perspective. Total technical potential is developed from estimates of the technical potential of individual measures as they are applied to discrete market segments (commercial building types, residential dwelling types, etc.).

2.3.1 Core Equation

The core equation used to calculate the energy technical potential for each individual efficiency measure, by market segment, is shown below (using a commercial example):[5]

$$\boxed{\textbf{Technical Potential of Efficient Measure} = \textbf{Total Square Feet} \times \textbf{Base Case Equipment EUI (kWh/ft}^{2}\textbf{)} \times \textbf{Applicability Factor} \times \textbf{Not Complete Factor} \times \textbf{Feasibility Factor} \times \textbf{Savings Factor}}$$

where:

- **Square feet** is the total floor space for all buildings in the market segment. For the residential analysis, the **number of dwelling units** is substituted for square feet.
- **Base-case equipment EUI** is the annual energy used per square foot by each base-case technology in each market segment. This is the consumption of the energy-using equipment that the efficient technology replaces or affects. For example, if the efficient measure were a CFL, the base EUI would be the annual kWh per square foot of an equivalent incandescent lamp. For the residential analysis, annual unit energy consumption (UECs), energy used per dwelling, are substituted for EUIs.
- **Applicability factor** is the fraction of the floor space (or dwelling units) that is applicable for the efficient technology in a given market segment, for the example above, the percentage of floor space that could be lit by CFL bulbs.

---

[5] Note that stock turnover is not accounted for in our estimates of technical and economic potential, stock turnover *is accounted for* in our estimates of achievable potential. Our definition of technical potential assumes instantaneous replacement of standard-efficiency with high-efficiency measures.

- **Not complete factor** is the fraction of applicable floor space (or dwelling units) that has not yet been converted to the efficient measure (i.e., 1 minus the fraction of floor space that already has the energy efficiency measure installed).
- **Feasibility factor** is the fraction of the applicable floor space (or dwelling units) that is technically feasible for conversion to the efficient technology from an engineering perspective.
- **Savings factor** is the reduction in energy consumption resulting from application of the efficient technology.

Technical potential for peak demand reduction is calculated analogously substituting kW for kWh per household or square foot of commercial floor space.

An example of the core equation is shown in Figure 2-4 for the case of a perimeter-based, daylight dimming system.

Figure 2-4: Example of Technical Potential Calculation—Peak Period Commercial Perimeter Zone Dimming (Generic Data for Example Purposes Only)

Technical Potential of Efficient Measure	=	Total Square Feet	×	Base Case Equipment EUI (kWh/ft^2)	×	Applicability Factor	×	Not Complete Factor	×	Feasibility Factor	×	Savings Factor
20.13 MW		214 million		1.5		0.8		0.98		0.2		0.4

Technical potential is calculated in two steps. In the first step, all measures are treated independently; that is, the savings of each measure are not adjusted for overlap between competing or interactive measures. By treating measures independently, their relative cost-effectiveness is analyzed without making assumptions about the order or combinations in which they might be implemented in customer buildings. However, the total technical potential across measures cannot be estimated by summing the individual measure potentials directly. The cumulative savings cannot be estimated by adding the savings from the individual savings estimates because some savings would be double counted. For example, the savings from a measure that reduces heat gain into a building, such as window film, are partially dependent on other measures that affect the efficiency of the system being used to cool the building, such as a high-efficiency chiller - the more efficient the chiller, the less energy saved from the application of the window film.

2.3.2 Use of Supply Curves

In the second step, cumulative technical potential is estimated using an energy-efficiency supply curve approach. This method eliminates the double-counting problem. A supply curve typically consists of two axes—one that captures the cost per unit of saving a resource or mitigating an impact (e.g., \$/kWh saved or \$/ton of carbon avoided) and the other that shows the amount of savings or mitigation that could be achieved at each level of cost. The curve is typically built up across individual measures that are applied to specific base-case practices or technologies by market segment. Savings or mitigation measures are sorted on a least-cost basis, and total savings or impacts mitigated are calculated incrementally with respect to measures that precede them. Supply curves typically, but not always, end up reflecting diminishing returns, i.e., costs increase rapidly and savings decrease significantly at the end of the curve.

The cost dimension of most energy-efficiency supply curves is usually represented in dollars per unit of energy savings. Costs are usually annualized (often referred to as “levelized”) in supply curves. For example, energy efficiency supply curves usually present levelized costs per kWh or kW saved by multiplying the initial investment in an efficient technology or program by the “capital recovery rate” (CRR) as follows:

$$\text{CRR} = \frac{d}{1 - (1 + d)^{-n}}$$

where d is the real discount rate and n is the number of years over which the investment is written off (i.e., amortized).

Thus,

Levelized Cost per kWh Saved = Initial Cost x CRR/Annual Energy Savings
Levelized Cost per kW Saved = Initial Cost x CRR/Peak Demand Savings

The levelized cost per kWh and kW saved are useful because they allow simple comparison of the characteristics of energy efficiency with the characteristics of energy supply technologies. However, the levelized cost per kW or kWh saved are biased indicators of cost-effectiveness because all of the efficiency measure costs are allocated to either peak savings or annual energy savings. As a result, energy efficiency supply curves do not reflect the integrated value of both peak and energy savings. In this study, the integrated value of both peak and energy savings is captured by using the total resource cost test for each measure as described in the section on Economic Potential below.

Table 2-1 shows a simplified numeric example of a supply curve calculation for several energy efficiency measures applied to commercial lighting for a hypothetical population of buildings. It is important to note that in an energy efficiency supply curve, measures are sorted by relative cost—from least to most expensive. In addition, the energy consumption of the system being affected by the efficiency measures goes down as each measure is applied. As a result, the savings attributable to each subsequent measure decrease if the measures are interactive. For example, the occupancy sensor measure shown in Table 2-1 would save more at less cost per unit saved if it was applied to the base-case consumption before the T8 lamp and electronic ballast combination. Because the T8 electronic ballast combination is more cost-effective, however, it is applied first, reducing the energy savings potential for the occupancy sensor. Thus, in a typical energy efficiency supply curve, the base-case end-use consumption is reduced with each unit of energy efficiency that is acquired. Notice in Table 2-1 that the total end-use GWh consumption is recalculated after each measure is implemented, thus reducing the base energy available to be saved by the next measure.

Table 2-1 shows an example that would represent measures for one base-case technology in one market segment. These calculations are performed for all of the base-case technologies, market segments, and measure combinations in the scope of a study. The results are then ordered by levelized cost and the individual measure savings are summed to produce the energy efficiency potential for the entire sector.

In the next subsection, we discuss how economic potential is estimated as a subset of technical potential.

Table 2-1: Sample Technical Potential Supply Curve Calculation for Commercial Lighting (Note: Data is illustrative only)

Measure	Total End Use Consumption of Population (GWh)	Applicable, Not Complete and Feasible (1000s of ft^2)	Average kWh/ft^2 of population	Savings %	GWh Savings	Levelized Cost ($/kWh saved)
Base Case: T12 lamps w/Magnetic Ballast	425	100,000	4.3	N/A	N/A	N/A
1. T8 w. Elec. Ballast	425	100,000	4.3	21%	89	$0.04
2. Occupancy Sensors	336	40,000	3.4	10%	13	$0.11
3. Perimeter Dimming	322	10,000	3.2	45%	14	$0.25
With all measures	309		3.1	27%	116	

2.4 Estimation of Economic Potential

Economic potential is typically used to refer to as those energy efficiency measures that are cost-effective when compared to either supply-side alternatives or the price of energy. Economic potential takes into account the fact that many energy efficiency measures cost more to purchase initially than do their standard-efficiency counterparts. The incremental costs of each efficiency measure are compared to the savings delivered by the measure to produce estimates of energy savings per unit of additional cost. These estimates of energy efficiency resource costs can then be compared to estimates of other resources such as building and operating new power plants.

2.4.1 Cost-Effectiveness Tests

To estimate economic potential, it is necessary to develop a method by which it can be determined that a measure is cost-effective. In this study, we use the total resource cost (TRC) test to assess cost-effectiveness. The TRC test is a form of societal benefit-cost test. Other tests that are sometimes used in analyses of program cost-effectiveness include the utility cost, ratepayer impact measure (RIM), and participant tests. Before discussing the TRC test and how it is used in our DSM forecasts, below we present a brief introduction to the common cost-effectiveness tests:[6]

- **Total Resource Cost Test —** The TRC test measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs. The test is applicable to conservation, load management, and fuel substitution programs. For fuel-substitution programs, the test measures the net effect of the impacts from the fuel not chosen versus the impacts from the fuel that is chosen as a result of the program. TRC test results for fuel-substitution programs should be viewed as a measure of the economic efficiency implications of the total energy supply system (gas and electric). A variant on the TRC test is the societal test. The societal test differs from the TRC test in that it includes the effects of externalities (e.g. environmental, national security), excludes tax credit benefits, and uses a different (societal) discount rate.

- **Participant Test —** The participant test is the measure of the quantifiable benefits and costs to the customer due to participation in a program. Since many customers do not base their decision to participate in a program entirely on quantifiable variables, this test cannot be a complete measure of the benefits and costs of a program to a customer.

---

[6] California Standard Practice Manual, October 2001.

- **Utility (Program Administrator) Test** — The program administrator cost test measures the net costs of a demand-side management program as a resource option based on the costs incurred by the program administrator (including incentive costs) and excluding any net costs incurred by the participant. The benefits are similar to the TRC benefits.
- **Ratepayer Impact Measure Test** — The ratepayer impact measure (RIM) test measures what happens to customer bills or rates due to changes in utility revenues and operating costs caused by the program. Rates will go down if the change in revenues from the program is greater than the change in utility costs. Conversely, rates or bills will go up if revenues collected after program implementation are less than the total costs incurred by the utility in implementing the program. This test indicates the direction and magnitude of the expected change in customer bills or rate levels.

The key benefits and costs of the various cost-effectiveness tests are summarized below in Table 2-2.

Table 2-2: Summary of Benefits and Costs of Common Benefit-Cost Tests

Test	Benefits	Costs
TRC Test	▪ Generation, transmission and distribution savings ▪ Participants avoided equipment costs (fuel switching only)	▪ Generation costs ▪ Program costs paid by the administrator ▪ Participant measure costs
Participant Test	▪ Bill reductions ▪ Incentives ▪ Participants avoided equipment costs (fuel switching only)	▪ Bill increases ▪ Participant measure costs
Utility (Program Administrator) Test	▪ Generation, transmission and distribution savings	▪ Generation costs ▪ Program costs paid by the administrator ▪ Incentives
Ratepayer Impact Measure Test	▪ Generation, transmission and distribution savings ▪ Revenue gain	▪ Generation costs ▪ Revenue loss ▪ Program costs paid by the administrator ▪ Incentives

Generation, transmission and distribution savings (hereafter referred to as energy benefits) are defined as the economic value of the energy and demand savings stimulated by the interventions being assessed. These benefits are typically measured as induced changes in energy consumption and valued using some mix of avoided costs. Electricity benefits are typically valued using three types of avoided electricity costs: avoided distribution costs, avoided transmission costs, and avoided electricity generation costs (which are often characterized in terms of both energy and capacity costs).

Participant costs are comprised primarily of incremental measure costs. Incremental measure costs are essentially the costs of obtaining energy efficiency. In the case of an add-on device (say, an adjustable-speed drive or ceiling insulation), the incremental cost is simply the installed cost of the measure itself. In the case of equipment that is available in various levels of efficiency (e.g., a central air conditioner), the incremental cost is the excess of the cost of the high-efficiency unit over the cost of the base (reference) unit.

Administrative costs encompass the real resource costs of program administration, including the costs of administrative personnel, program promotions, overhead, measurement and evaluation, and shareholder incentives. In this context, administrative costs are not defined to include the costs of various incentives (e.g., customer rebates and salesperson incentives) that may be offered to encourage certain types of behavior. The exclusion of these incentive costs reflects the fact that they are essentially transfer payments. That is, from a societal perspective they involve offsetting costs (to the program administrator) and benefits (to the recipient).

2.4.2 Use of the Total Resource Cost to Estimate Economic Potential

The TRC test is used in two ways in this study. First, we develop an estimate of economic potential by calculating the TRC of individual measures and applying the methodology described below. Second, we develop estimates of whether different program scenarios are cost-effective.

Economic potential can be defined either inclusively or exclusively of the costs of programs that are designed to increase the adoption rate of energy efficiency measures. At this stage of the analysis, we define economic potential to *exclude* program costs. We do so primarily because program costs are dependent on a number of factors that vary significantly as a function of program delivery strategy. There is no single estimate of program costs that would accurately represent such costs across the wide range of program types and funding levels possible. Once an assumption is made about program costs, one must also link those assumptions to expectations about market response to the types of interventions assumed. Because of this, we believe it is more appropriate to factor program costs into our analysis of maximum achievable and program potential. Thus, our definition of economic potential is that portion of the technical potential that passes our economic screening test (using the TRC test) exclusive of program costs. Economic potential, like technical potential, is a theoretical quantity that will exceed the amount of potential we estimate to be achievable through even the most aggressive voluntary program activities.

As discussed previously, the TRC focuses on resource savings and counts benefits as utility-avoided supply costs and costs as participant costs and utility program costs. It ignores any impact on rates. It also treats financial incentives and rebates as transfer payments; i.e., the TRC is not affected by incentives. The somewhat simplified benefit and cost formulas for the TRC are presented in Equations 2-1 and 2-2 below.

$$\text{Benefits} = \sum_{t=1}^{N} \frac{\text{Avoided Costs of Supply}_{p,t}}{(1+d)^{t-1}} \qquad \text{Eqn. 2-1}$$

$$\text{Costs} = \sum_{t=1}^{N} \frac{\text{Program Cost}_{t} + \text{Participant Cost}_{t}}{(1+d)^{t-1}} \qquad \text{Eqn. 2-2}$$

where:

d = the discount rate
p = the costing period
t = time (in years)
n = 20 years

A nominal discount rate of 8.67 percent is used. We use a normalized measure life of 20 years to capture the benefit of long-lived measures. Measures with measure lives shorter than 20 years are “re-installed” in our analysis as many times as necessary to reach the normalized 20-year life of the analysis. This assumption is reasonable given that most measures are eventually replaced with more, not less, efficient alternatives.

The avoided costs of supply are calculated by multiplying measure energy savings and peak demand impacts by per-unit avoided costs by costing period. Energy savings are allocated to costing periods and peak impacts estimated using load shape factors.

As noted previously, in the *measure-level* TRC calculation used to estimate economic potential, program costs are excluded from Equation 2-2. Using the supply curve methodology discussed previously, measures are ordered by TRC (highest to lowest) and then the economic potential is calculated by summing the energy savings for all of the technologies for which the marginal TRC test is greater than 1.0. In Table 2-3, the economic potential would include the savings for measures 1 and 2, but exclude savings for measure 3 because the TRC is less than 1.0 for measure 3. The supply curve methodology, when combined with estimates of the TRC for individual measures, produces estimates of the economic potential of efficiency improvements. Again, by definition and intent, this estimate of economic potential is a theoretical quantity that will exceed the amount of potential we estimate to be achievable through program activities in the final steps of our analyses.

Table 2-3: Sample Use of Supply Curve Framework to Estimate Economic Potential (Note: Data is illustrative only)

Measure	Total End Use Consumption of Population (GWh)	Applicable, Not Complete and Feasible Sq.Feet (000s)	Average kWh/ft^2 of population	Savings %	GWh Savings	Total Resource Cost Test	Savings Included in Economic Potential?
Base Case: T12 lamps w/Magnetic Ballast	425	100,000	4.3	N/A	N/A	N/A	N/A
1. T8 w. Elec. Ballast	425	100,000	4.3	21%	89	2.5	Yes
2. Occupancy Sensors	336	40,000	3.4	10%	13	1.1	Yes
3. Perimeter Dimming	322	10,000	3.2	45%	14	0.6	No
Technical Potential w. all measures				27%	116		
Economic Potential w. measures for which TRC > 1.0				24%	102		

2.5 Estimation of Maximum Achievable Program and Naturally-Occurring Potentials

In this section we present the method we employ to estimate the fraction of the market that adopts each energy efficiency measure in the presence and absence of energy efficiency programs. We estimate achievable program savings as a function of two key variables:

- Incentive Levels- Business as usual and High
- Avoided Cost and Rate forecasts- Low and High case

Using these scenario levers we can create four basic scenarios or forecasts of achievable savings by sector (residential, commercial and industrial) and for all sectors combined for each utility area:

I. Base Case – with Low Avoided Costs and Rates
II. Base Case – with High Avoided Costs and Rates
III. High Case – with Low Avoided Costs and Rates
IV. High Case – with High Avoided Costs and Rates

Each case also includes an estimate of naturally occurring savings forecast to occur in the absence of programs.

- **The Base or Business as Usual Case** is a forecast of the amount of energy savings that could be achieved over time if utility incentives and overall funding levels remain roughly constant over the ten year period
- **The High or Expanded Case** is a forecast of the amount of energy and peak savings that would occur in response to one or more specific market interventions.
- **Naturally Occurring Case** is a forecast of the amount of energy and peak savings that is likely to occur as a result of normal market forces, that is, in the absence of any utility or governmental intervention.

The forecast of naturally occurring savings for each scenario has the effect of reducing the estimates of achievable energy savings in the base and high case from gross savings (the current reporting convention) to net savings, e.g. those savings due exclusively to program marketing and program incentives.

Forecasts of achievable program potential are the most important results of the modeling process. Estimating technical, economic, and maximum achievable potentials are necessary steps in the process from which important information can be obtained. However, the end goal of the process is to better understand how much of the remaining potential can be captured in programs, whether it would be cost-effective to increase program spending, and how program costs may be expected to change in response to measure adoption over time.

The remainder of this section describes how Itron simulates the effects of these scenario drivers (incentive levels, avoided costs and retail rates) on levels of customer awareness, product availability and ultimately adoption of energy efficiency measures

2.5.1 Adoption Method Overview

We use a method of estimating customer adoption of energy efficiency measures that applies equally to the achievable program and naturally occurring analyses. Whether as a result of natural market forces or aided by a program intervention, the rate at which measures are adopted is modeled in our method as a function of the following factors:

- The availability of the measure adoption opportunity as a function of capital equipment turnover rates and changes in building stock over time
- Customer awareness of the efficiency measure
- The cost-effectiveness or simple payback period of the efficiency measure

- Market barriers associated with the efficiency measure.

The method employed is executed in the measure penetration module of KEMA's DSM ASSYST model. Only measures that pass the measure-level TRC test are put into the penetration module for estimation of customer adoption or achievable savings.

Availability

In most cases, the model uses a stock accounting algorithm that handles capital turnover and stock decay over a period of up to 20 years. In the first step of our achievable potential method, we calculate the number of customers for whom each measure will apply. The input to this calculation is the total floor space available for the measure from the technical potential analysis, i.e., the total floor space multiplied by the applicability, not complete, and feasibility factors described previously. We call this the eligible stock. The stock algorithm keeps track of the amount of floor space available for each efficiency measure in each year based on the total eligible stock and whether the application is new construction, retrofit, or replace-on-burnout.[7]

Retrofit measures are available for implementation by the entire eligible stock. The eligible stock is reduced over time as a function of adoptions[8] and building decay.[9] Replace-on-burnout measures are available only on an annual basis, approximated as equal to the inverse of the service life.[10] The annual portion of the eligible market that does not accept the replace-on-burnout measure does not have an opportunity again until the end of the service life.

---

[7] Replace-on-burnout measures are defined as the efficiency opportunities that are available only when the base equipment turns over at the end of its service life. For example, a high-efficiency chiller measure is usually only considered at the end of the life of an existing chiller. By contrast, retrofit measures are defined to be constantly available, for example, application of a window film to existing glazing.

[8] That is, each square foot that adopts the retrofit measure is removed from the eligible stock for retrofit in the subsequent year.

[9] An input to the model is the rate of decay of the existing floor space. Floor space typically decays at a very slow rate.

[10] For example, a base-case technology with a service life of 15 years is only available for replacement to a high-efficiency alternative each year at the rate of 1/15 times the total eligible stock. For example, the fraction of the market that does not adopt the high-efficiency measure in year *t* will not be available to adopt the efficient alternative again until year *t* + 15.

New construction applications are available for implementation in the first year. Those customers that do not accept the measure are given subsequent opportunities corresponding to whether the measure is a replacement or retrofit-type measure.

Awareness

In our modeling framework, customers cannot adopt an efficient measure merely because there is stock available to install that measure. Before they can make the adoption choice, they must be aware and informed about the costs and benefits of the efficiency measure. Thus, in the second stage of the process, the model calculates the portion of the available market that is informed. An initial user-specified parameter sets the initial level of awareness for each measure. Awareness levels vary by measure as a function of the relative cost-effectiveness of the measure. More cost-effective measures have higher awareness levels than less cost-effective measures. For this study, initial awareness levels generally start around 25 percent and, in the naturally occurring scenario, increase modestly over time.

Incremental increases in awareness are estimated in the model as a function of the amount of money spent on awareness and information building and how well those information-building resources are directed to target markets. In this study, awareness levels grow under the different program scenarios to roughly 60, 80, and 100 percent under the increasing program budgets estimated for respective scenario.[11]

User-defined program characteristics determine how well information-building money is targeted. Well-targeted programs are those for which most of the money is spent informing only those customers that are in a position to implement a particular group of measures. Untargeted programs are those in which advertising cannot be well focused on the portion of the market that is available to implement particular measures. The penetration module in DSM ASSYST has a target effectiveness parameter that is used to adjust for differences in program advertising efficiency associated with alternative program types.

The model also controls for information retention. An information decay parameter in the model is used to control for the percentage of customers that will retain program information from one year to the next. Information retention is based on the characteristics of the target audience and the temporal effectiveness of the marketing techniques employed.

---

[11] See Section 4 for scenario definitions and assumed funding levels.

Adoption

The portion of the total market that is available and informed can now face the choice of whether or not to adopt a particular measure. Only those customers for whom a measure is available for implementation (stage 1) and, of those customers, only those who have been informed about the costs and benefits (cost savings) of the program/measure (stage 2), are in a position to make the implementation decision.

In the third stage of our penetration process, the model calculates the fraction of the market that adopts each efficiency measure as a function of the participant test. The participant test is a benefit-cost ratio that is generally calculated as follows:

$$\text{Benefits} = \sum_{t=1}^{N} \frac{\text{Customer Bill Savings (\$)}_t}{(1+d)^{t-1}} \qquad \text{Eqn. 2-3}$$

$$\text{Costs} = \sum_{t=1}^{N} \frac{\text{Participant Costs (\$)}_t}{(1+d)^{t-1}} \qquad \text{Eqn. 2-4}$$

where:

d = the discount rate
t = time (in years)
n = 20 years

As noted previously, we use a *normalized* measure life of 20 years in order to compare the cost-effectiveness associated with measures with different service lives. Measures with lives shorter than 20 years are “re-installed” in our analysis as many times as necessary to reach the normalized 20-year life of the analysis. For example, the costs for a measure with a 10-year lifetime would include the costs in Year 1 plus the present value of the costs of installing the measure again in Year 11. The benefits would be the present value of the 20-year stream of avoided costs reductions associated with the measure.

The bill reductions are calculated by multiplying measure energy savings and customer peak demand impacts by retail energy and demand rates.

The model uses measure implementation curves to estimate the percentage of the informed market that will accept each measure based on the participant’s benefit-cost ratio. The model provides enough flexibility so that each measure in each market segment can have a separate implementation rate curve. The functional form used for the implementation curves is:

$$y = \frac{a}{\left(1 + e^{-\ln\frac{x}{4}}\right) \times \left(1 + e^{-c\ln(bx)}\right)} \qquad \text{Eqn. 2-5}$$

where:

y = the fraction of the market that installs a measure in a given year from the pool of informed applicable customers;
x = the customer’s benefit-cost ratio for the measure;
a = the maximum annual acceptance rate for the technology;
b = the inflection point of the curve. It is generally 1 over the benefit-cost ratio that will give a value of 1/2 the maximum value; and
c = the parameter that determines the general shape (slope) of the curve.

The primary curves utilized in our model are shown in Figure 2-5. These curves produce base year program results that are calibrated to actual measure implementation results associated with major IOU commercial efficiency programs over the past several years. Different curves are used to reflect different levels of market barriers for different efficiency measures. A list of market barriers is shown in Table 2-4. It is the existence of these barriers that necessitates program interventions to increase the adoption of energy efficiency measures. For more information on market barriers see Eto, Prahl, and Schlegel (1997), Golove and Eto (1996), DeCanio (2000), and DeCanio (1998).

Note that for the moderate, high, and extremely high barrier curves, the participant benefit-cost ratios have to be very high before significant adoption occurs. This is because the participant benefit-cost ratios are based on a 15-percent discount rate. This discount rate reflects likely adoption if there were no market barriers or market failures, as reflected in the no-barriers curve in the figure. Experience has shown, however, that actual adoption behavior correlates with implicit discount rates several times those that would be expected in a perfect market.[12]

---

[12] For some, it is easier to consider adoption as a function of simple payback. However, the relationship between payback and the participant benefit-cost ratio varies depending on measure life and discount rate. For a long-lived measure of 15 years with a 15-percent discount rate, the equivalent payback at which half of the market would adopt a measure is roughly 6 months, based on the high barrier curve in Exhibit 2-5. At a 1-year payback, one-quarter of the market would adopt the measure. Adoption reaches near its maximum at a 3-month payback. The curves reflect the real-world observation that implicit discount rates can be well over 100 percent.

The model estimates adoption under both naturally occurring and program intervention situations. There are only two differences between the naturally occurring and program analyses. First, in any program intervention case in which measure incentives are provided, the participant benefit-cost ratios are adjusted based on the incentives. Thus, if an incentive that pays 50 percent of the incremental measure cost is applied in the program analysis, the participant benefit-cost ratio for that measure will double (since the costs have been halved). The effect on the amount of adoption estimated depends on where the pre- and post-incentive benefit-cost ratios fall on the curve. This effect is illustrated in Figure 2-6.

Figure 2-5: Primary Measure Implementation Curves Used in Adoption Model

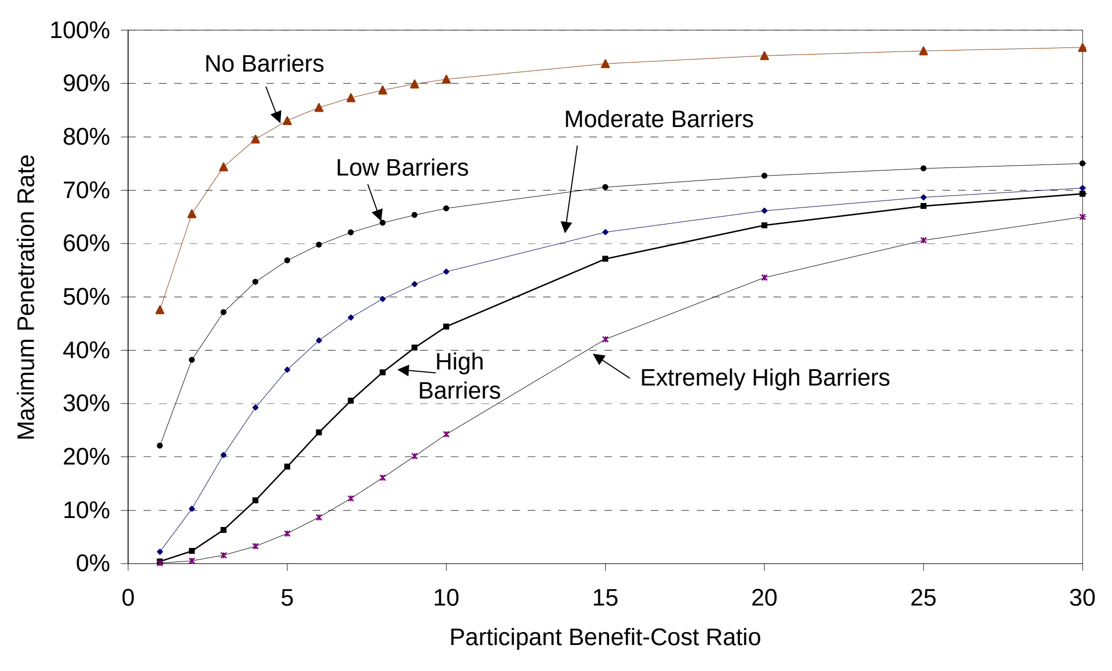


Figure 2-6: Illustration of Effect of Incentives on Adoption Level as Characterized in Implementation Curves

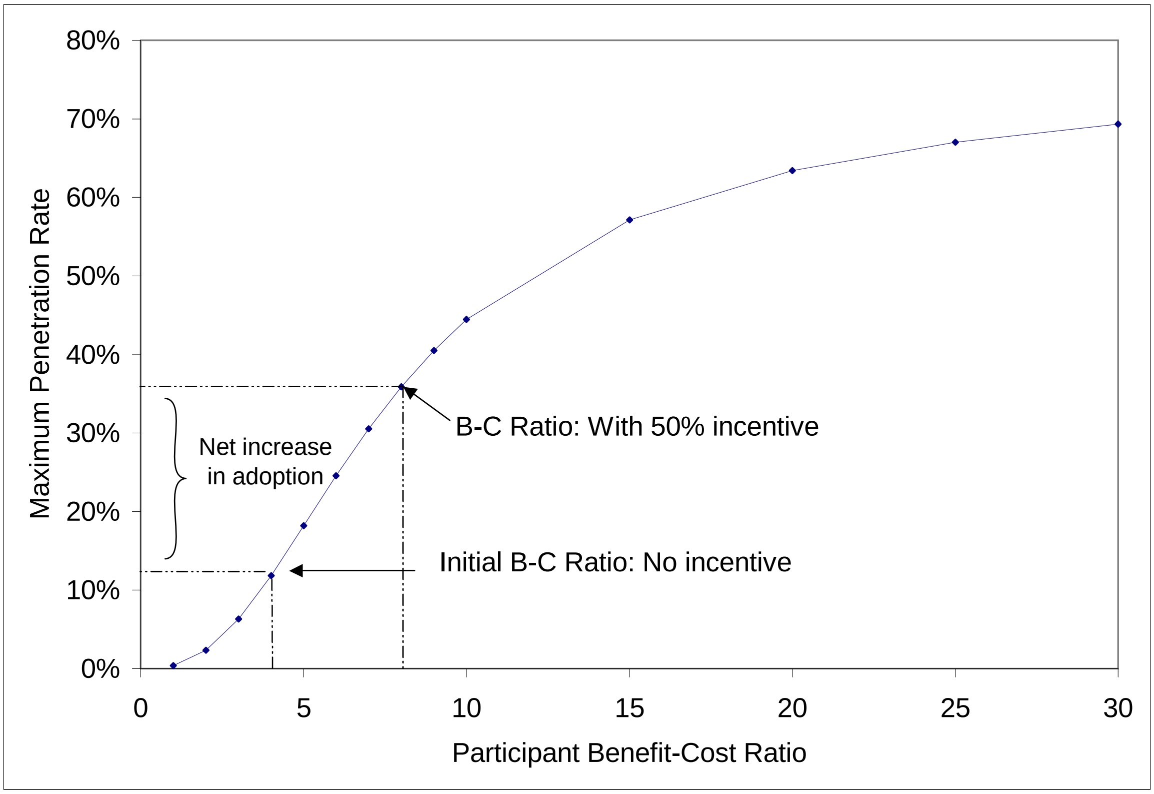


Table 2-4: Summary Description of Market Barriers from Eto, Prahl, and Schlegel (1997)

Barrier	Description
Information or Search Costs	The costs of identifying energy-efficient products or services or of learning about energy-efficient practices, including the value of time spent finding out about or locating a product or service or hiring someone else to do so.
Performance Uncertainties	The difficulties consumers face in evaluating claims about future benefits. Closely related to high search costs, in that acquiring the information needed to evaluate claims regarding future performance is rarely costless.
Asymmetric Information and Opportunism	The tendency of sellers of energy-efficient products or services to have more and better information about their offerings than do consumers, which, combined with potential incentives to mislead, can lead to sub-optimal purchasing behavior.
Hassle or Transaction Costs	The indirect costs of acquiring energy efficiency, including the time, materials and labor involved in obtaining or contracting for an energy-efficient product or service. (Distinct from search costs in that it refers to what happens once a product has been located.)
Hidden Costs	Unexpected costs associated with reliance on or operation of energy-efficient products or services - for example, extra operating and maintenance costs.
Access to Financing	The difficulties associated with the lending industry's historic inability to account for the unique features of loans for energy savings products (i.e., that future reductions in utility bills increase the borrower's ability to repay a loan) in underwriting procedures.
Bounded Rationality	The behavior of an individual during the decision-making process that either seems or actually is inconsistent with the individual's goals.
Organization Practices or Customs	Organizational behavior or systems of practice that discourage or inhibit cost-effective energy efficiency decisions, for example, procurement rules that make it difficult to act on energy efficiency decisions based on economic merit.
Misplaced or Split incentives	Cases in which the incentives of an agent charged with purchasing energy efficiency are not aligned with those of the persons who would benefit from the purchase.
Product or Service Unavailability	The failure of manufacturers, distributors or vendors to make a product or service available in a given area or market. May result from collusion, bounded rationality, or supply constraints.
Externalities	Costs that are associated with transactions, but which are not reflected in the price paid in the transaction.
Non-externality Pricing	Factors other than externalities that move prices away from marginal cost. An example arises when utility commodity prices are set using ratemaking practices based on average (rather than marginal) costs.
Inseparability of Product Features	The difficulties consumers sometimes face in acquiring desirable energy efficiency features in products without also acquiring (and paying for) additional undesired features that increase the total cost of the product beyond what the consumer is willing to pay.
Irreversibility	The difficulty of reversing a purchase decision in light of new information that may become available, which may deter the initial purchase, for example, if energy prices decline, one cannot resell insulation that has been blown into a wall.

In Section 7, Itron describes the results of the savings forecasts for the four scenarios defined earlier and analyzes what types of measures are included within each forecast of achievable savings. The final results produced are forecasts of annual streams of achievable program impacts (energy and demand by time-of-use period) and all societal and participant costs (program costs plus end-user costs). Before getting to these results, Sections 3 and 4 summarizes the data we gathered about the size of the market for energy efficiency in Texas, the sales of energy efficient products, and how this knowledge dictated changes in the final awareness and availability parameters needed to run the model for each participating utility.

3

Data Development and Economic Inputs

The key building data necessary to establish the modeling baselines for this study include the following:

- units of consumption (e.g., number of households for the residential sector, square feet of building space for the commercial sector, and kWh sales for the industrial sector)
- electric end-use saturations (e.g., the share of households owning particular types of energy-using equipment)
- end-use energy intensity (e.g., annual kWh/unit for residential appliances and annual kWh/square foot for commercial lighting and cooling)
- end-use load shapes (e.g., the distribution of end-use energy consumption across hours of the day, days of the week, and season)

The process used to gather and estimate data for each data type is explained below in separate sections for the residential, commercial and industrial sectors.

3.1 Development of Baseline Building and Energy Data

For the residential sector, Itron obtained data on electricity sales and the number of households directly from the participating utilities and ERCOT. This data was not available from utilities for commercial and industrial customers in the nonresidential sector so Itron developed a process to estimate these sales total using data from Dunn and Bradstreet and the Energy Information agency. The methods and analysis used to derive these sector totals are explained in the section below entitled commercial and industrial sector data development.

3.1.1 Residential Sector Data Development

Baseline Energy Usage per Household

Based on billing and account data, ERCOT and non ERCOT utilities provided three key data series that served as important benchmarks during the development of the residential baseline. These data include number of households (or number of residential accounts), KWh, and KW. From these data the average KWh and peak KW per household was calculated for each utility and is presented below in Table 3-1. Note: Blank cells in Table 3-1 indicate the peak data has not yet been provided or estimated.

Table 3-1: KWh and KW per Household

Utility	Accounts	GWh Sales	MW Peak	Average KWh/ Household	Average KW/ Household
AEP Central	636,396	8,445	1,848	13,270	2.9
AEP North	143,548	1,697	393	11,822	2.7
AEP SWPCO	142,375	2,117	-	14,869	-
CenterPoint	1,732,656	23,955	6,787	13,825	3.9
El Paso	239,217	1,643	-	6,870	-
Entergy	341,132	5,281	-	15,479	-
TNMP	189,210	2,530	672	13,369	3.6
Oncor	2,595,460	37,450	10,470	14,429	4.0
Xcel	218,242	2,511		11,507	-
Total	6,238,236	85,629	20,170	13,726	3.2

Texas specific Residential Energy Consumption Statistics (RECS) data collected by the EIA in 2002 was used as the starting point for end-use Unit Energy Consumptions (UEC) and equipment saturations. Equipment saturations from the RECS tables are the proportion of residential households that have the equipment specified in the year 2002. In some cases we have updated the saturations with the results from the latest 2005 Residential Appliance Survey from ERCOT. In cases where no data is available from the ERCOT RASS or the local utility we have assumed that the equipment saturations have not changed significantly overall from 2002 to 2007 in Texas.

Households

Participating utilities provided Itron with estimates of the number of households in their territory in 2007 but in most cases were unable to provide disaggregated estimates of the split between single and multifamily household in their service territory and the energy sales for each. After reviewing the available data on equipment saturations, we decided the extra effort to estimate the splits for each of the nine utilities would not yield any additional accuracy in potential estimates because estimates of equipment and measure saturation were not available for single and multifamily households at the service territory level.

Equipment and Measure Level Saturations

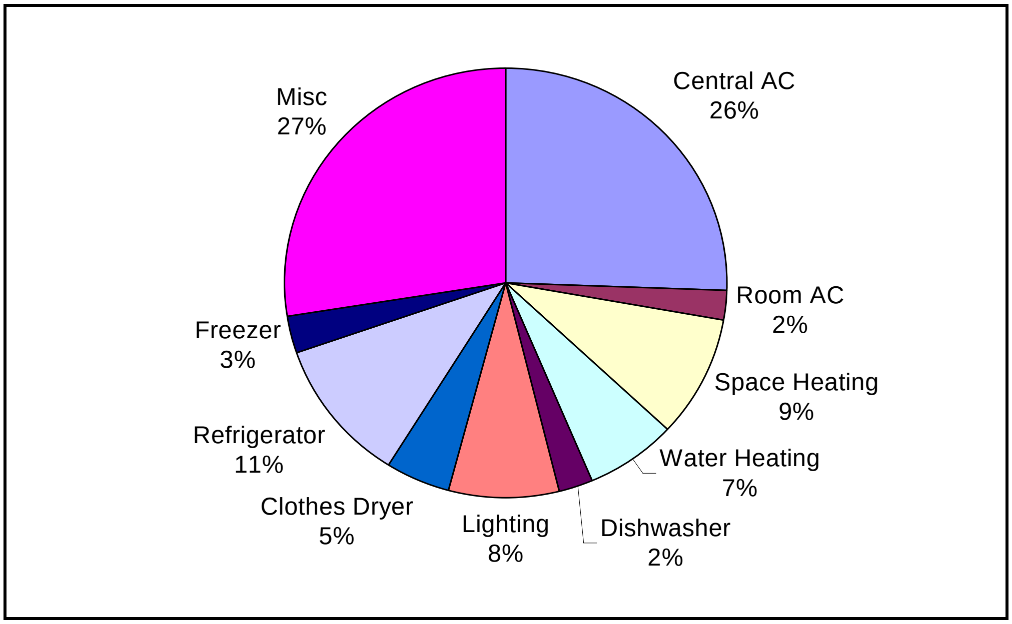
Itron used the following sources to estimate end use and measure saturations in Texas:

1. Electricity Reliability Council of Texas, (ERCOT), 2005 Residential Appliance Saturation Results
2. Lone Star Research, Residential Appliance Saturation Survey, (Prepared for El Paso Electric Company, July 1997)
3. Itron, Public Service New Mexico Electric Energy Efficiency Potential Study; Final Report (Prepared for the Public Service New Mexico, September 2006)
4. Energy Information Agency, 2005 Residential Energy Consumption Survey, Table HC15.13 Lighting Usage Indicators by Four Most Populated States, 2005
5. Entergy Residential Appliance Saturation Survey.

The process used to estimate end use saturations and unit energy consumption estimates for each of the nine Texas Utilities was documented in a previous Itron deliverable; Residential Unit Energy Consumption Estimates for Texas Investor Owned Utilities. (September 2008).

Figure 3-1 illustrates the estimated breakdown of residential consumption by end use for all of the nine utility areas combined.

Figure 3-1: Residential Consumption in Texas by End Use (All Utilities 2007)



The process used to estimate measure level saturations used data from the 2005 RECS analysis for Texas, utility specific sources and the 2005 Residential Appliance Survey performed by ERCOT. In most cases ERCOT appliance survey data was used as the default data source when better information was not available at the utility level. Information on the actual measure level saturations used (in the form of M files) was sent out to utility reviewers in mid September and revised based on their comments. A high level summary of the saturations estimated for each measure is provided in Table 3-2. These saturations come from sources at the statewide level and were used for each utility unless there was better saturation information available from the local utility.

Table 3-2: Saturation of Heating and Cooling Efficiency Measures

Measure #	Measure Description	2007 Single Family Saturation % of Applicable HH
102	15 SEER Split-System Air Conditioner	2.5%
103	17 SEER Split-System Air Conditioner	1.0%
105	Programmable Thermostat	33.0%
110	Ceiling Fans	54.1%
111	Whole House Fans	2.0%
112	Attic Venting	20.0%
113	Proper Refrigerant Charging and Air Flow	50.0%
114	Duct Repair (0.32)	50.0%
115	Window Film	20.0%
116	Default Window With Sunscreen	9.5%
117	Double Pane Clear Windows to Double Pane Low-E Windows	7.3%
118	Double Pane Clear Windows to Double Pane Low-E2 Windows	5.0%
120	Ceiling R-0 to R-19 Insulation(.29)	67.0%
121	Ceiling R-19 to R-38 Insulation (.27)	13.0%
122	Wall 2x4 R-0 to Blow-In R-13 Insulation (0.14)	46.4%
123	Reflective Roof with Radiant Barriers or insulation	5.0%
140	Base Room Air Conditioner - EER 9.0	0.0%
141	HE Room Air Conditioner - EER 11	10.0%
142	HE Room Air Conditioner - EER 12	5.0%
145	Ceiling Fans	54.1%
146	Whole House Fans	2.0%
147	Attic Venting	20.0%
148	Window Film	20.0%
150	Default Window With Sunscreen	9.5%
151	Double Pane Clear Windows to Double Pane Low-E Windows	7.3%
153	Ceiling R-0 to R-19 Insulation (.29)	70.0%
154	Ceiling R-19 to R-38 Insulation (.27)	13.0%
155	Wall 2x4 R-0 to Blow-In R-13 Insulation (0.14)	46.4%

Table 3-3 provides estimates of the saturation for key energy efficiency measures where the energy estimates are not sensitive to differences in weather across Texas.

Table 3-3: Saturation of Non Weather Sensitive Energy Efficiency Measures

Measure #	Measure Description	2007 Single Family Saturation % of Applicable HH
201	CFL (20-Watt integral ballast), .5 hr/day	9.2%
211	CFL (20-Watt integral ballast), 2.5 hr/day	9.2%
221	CFL (20-Watt integral ballast), 6.0 hr/day	9.2%
230	Base Fluorescent Fixture, 2L4'T12, 40W, 1EEMAG	0.0%
231	ROB 2L4'T8, 1EB	5.0%
232	RET 2L4'T8, 1EB	5.0%
251	Outdoor Lighting Controls	10.0%
300	Base Refrigerator (18 cf w/top-mount freezer, no through-door ice)	0.0%
301	HE Refrigerator - Energy Star version of above- 15% above standard	10.0%
351	HE Freezer	10.0%
400	Base 40 gal. Water Heating (EF=0.88)	0.0%
401	Heat Pump Water Heater (EF=2.9)	0.0%
402	HE Water Heater (EF=0.93)	5.0%
403	Solar Water Heat	1.3%
404	Tankless Water Heater	1.0%
405	Low Flow Showerhead	42.4%
406	Pipe Wrap	19.9%
407	Faucet Aerators	30.1%
408	Water Heater Blanket	30.0%
409	Energy Star CW CEE Tier 1 (MEF=1.42)	14.4%
410	Energy Star CW CEE Tier 2 (MEF=1.60)	5.0%
500	Base Clothes Dryer (EF=3.01)	0.0%
501	High Efficiency CD (EF=3.01 w/moisture sensor)	10.0%
600	Base Dishwasher (EF=0.46)	0.0%
601	Energy Star DW (EF=0.58)	30.0%
701	Two Speed Pool Pump (1.5 hp)	1.0%
702	High Efficiency One Speed Pool Pump (1.5 hp)	1.0%
810	Water Bed Base	0.0%
811	Water Bed Insulation	95.0%
821	Power Strip	50.0%
830	Base Meter	0.0%
831	In Home Display Device	0.0%
901	Heat Pump Space Heating	0.0%
902	Ceiling R-0 to R-19 Insulation (.29)	80.0%
903	Ceiling R-19 to R-38 Insulation (.27)	13.0%
904	Wall 2x4 R-0 to Blow-In R-13 Insulation (0.14)	46.4%
905	Double Pane Clear Windows to Double Pane Low-E Windows	7.3%
910	Base Heat Pump Space Heating	0.0%
912	Ceiling R-0 to R-19 Insulation (.29)	70.0%
913	Ceiling R-19 to R-38 Insulation (.27)	13.0%
914	Wall 2x4 R-0 to Blow-In R-13 Insulation (0.14)	46.4%
915	Double Pane Clear Windows to Double Pane Low-E Windows	7.3%
921	Variable Speed Furnace Fan	5.0%

Energy Savings and Incremental Measure Costs

For each of the efficiency measures on the final measure list (See Appendix A), Itron estimated energy savings as a percentage of the baseline unit energy consumption and the associated incremental measure cost data from three main sources:

1. Database for Energy Efficient Resources (DEER) developed jointly by the California Public Utilities Commission and the California Energy Commission and just updated in July of 2008. The DEER database contains average cost and energy savings data for over 250 energy efficiency measures currently available in the market.
2. Florida Solar Energy Center (FSEC) evaluation reports for incremental costs and savings for solar water heaters, radiant barriers, window films and attic barriers
3. Frontier Associates. Deemed Savings, Installation Standard and Efficiency Standards, Residential and Small Commercial Standard Offer Program and Hard to Reach Standard Offer program**,** February 2006.

In addition Itron used its own in house energy simulation model (*SitePro*) to adjust estimates of baseline cooling and heating UEC's for the nine different utility areas. Itron also used the *SitePro* model to simulate the energy savings for the six significant cooling measures that effect heating and cooling usage. The simulations were conducted using weather data for eight different weather zones. Itron developed a map to weight the climate region results into an average UEC for each utility service area. *SitePro* was also used to estimate heating and cooling savings and peak impacts of ceiling insulation, wall insulation, window measures and attic fans. *SitePro* allows analysts to develop end-use load shapes from an extensive list of building prototypes, HVAC systems, regions, and weather. This Windows program utilizes data about building configuration, equipment inventories, and operating schedules. It also allows limited modification of key parameters such as floor area, weather, and temperature schedules that can be used to customize a prototype to approximate a specific customer. *SitePro* can also be used to calibrate the simulation to a customer's actual monthly bills. Savings estimates for ceiling and whole house fans came from the latest version of DEER.

Table 3-4 summarizes the energy savings estimates observed across the different utilities and weather zones. Copies of the runs for all eight weather zones can be made available upon request.

Table 3-4: Estimates of Heating and Cooling Savings for Residential Shell Measures

Measure	% Heating Savings Range	% Cooling Savings Range
Window Film	-12% to -9%	3% to 13%
Double Pane Clear Windows to Double Pane Low-E Windows	30% to 26%	-1.5% to -1.0%
Double Pane Clear Windows to Double Pane Low-E2 Windows	18% to 16%	4.8% to 18.11%
Ceiling R-0 to R-19 insulation	63% to 54%	15% to 27%
Ceiling R-19 to R-38 insulation	13% to 11%	2% to 4%
Wall 2X4 R-0 to Blow-in R-13 Insulation	40% to 33%	0% to 12%

These energy savings estimates were derived from building simulations completed for the two weather stations that represent the extremes of the climate in Texas, Brownsville (South East) and Amarillo (Northern Texas Panhandle). See Appendix B for a description of the building characteristics and system efficiency assumptions used for these runs.

For measures affecting non-weather sensitive end uses, we drew primarily from the DEER measure savings data, with the exception of measures involving ENERGY STAR products, in which case we used savings estimates based on EPA's energy savings calculators.[13]

The final estimates of energy savings per residential measure expressed as a percentage of the baseline energy usage were previously distributed to the sponsor utilities. Itron received some useful comments and information that was used to adjust these estimates. The same excel files also contain our estimates of the estimated incremental costs of installing each measure, the technology density, (units or square footage per household) and any maintenance costs. The majority of the incremental cost information was obtained from the DEER data base although Texas utilities provided us with useful information from the Energy Star New home program on the incremental costs of more efficient homes.

3.1.2 Commercial Sector Data Development

Baseline Energy Usage Per Square Foot in Each Building Type

For the purposes of this study, Itron categorizes commercial energy usage into ten specific building types; Office, Restaurant, Retail, Grocery, School, College, Hospital, Lodging, and Warehouses. Most of the utilities did not have estimates of electricity consumption for each building type so Itron developed estimates of energy usage by building type using data from Dunn and Bradstreet on the number of employees and sales associated with each building

---

[13] Available at http://www.energystar.gov.

type. A summary of these methods and the final data was provided to the Texas Utilities in an earlier deliverable entitled *Estimates of Baseline Electricity Sales by Sector and building type for each of the investor owned transmission and distribution service providers in Texas.*

Commercial Baseline Energy Usage by End Use

Electricity intensities by end use (kwh/sq foot) were not available from the nine Texas utilities. Itron estimated these energy intensities based on the latest data from the EIA 1999 for Texas adjusted for the updated 2003 estimates made available for the West South Central Census Region. The ratio of the EUIs at the building level for 2003 to the EUIs at the building level for the 1999 commercial buildings in Texas was used to increase the baseline EUI by end use for each Texas utility (an 11% increase). If no data was available from either a Texas source or the Energy Information Agency, Itron used information from the 2006 Commercial End Use survey in California.

Table 3-5 displays the resulting average cooling EUIs by building type estimated for the entire state of Texas using data from the Commercial Building Energy Use tables from the Energy Information Agency for 2005. These EUI data were then adjusted to develop utility specific cooling EUIs that varied by commercial building type. The adjustment to the cooling EUI for each utility area and building type was based on the relative differences in the estimated cooling EUI for prototypical buildings run using climate data for each of the seven different weather zones run for Texas. Adjustments at the end use level were iterated until the sum of all estimated electricity use at the building level for all ten building types was equivalent to the total sales data for the commercial sector at each utility.

Table 3-5: Statewide Average Cooling EUIs by Building Type (EIA 2005)

	College	Grocery	Health	Lodg.	Misc.	Office	Rest.	Retail	School	Ware
Average EUIs kwh/sq foot	2.35	5.95	8.42	3.44	5.79	5.99	8.22	3.99	2.17	1.06

After estimating saturations and electricity intensities for all of the end uses except cooling, Itron then used information from *SitePro* building energy simulations for the eight weather regions in Texas to estimate adjustments in the statewide EUIs for cooling by building types as described below. Table 3-6 displays the cooling load adjustment factors by utility and building type derived from our analysis of cooling EUIs.

Table 3-6: Adjustment Factors by Utility and Building Type

	College	Grocery	Health	Lodg.	Misc.	Office	Rest.	Retail	School	Ware
AEP Central	1.45	1.30	1.47	1.42	1.35	1.37	1.37	1.34	1.31	1.29
AEP North	0.82	0.90	0.80	0.82	0.87	0.83	0.86	0.88	0.89	0.89
AEP SWPCO	1.07	1.06	1.08	1.08	1.07	1.07	1.08	1.06	1.06	1.06
CenterPoint	1.22	1.14	1.22	1.19	1.17	1.17	1.15	1.16	1.15	1.15
El Paso	0.73	0.83	0.70	0.74	0.80	0.77	0.79	0.81	0.84	0.89
Entergy	1.22	1.14	1.22	1.19	1.17	1.17	1.15	1.16	1.15	1.15
Oncor	1.05	1.01	1.05	1.05	1.06	1.05	1.03	1.04	1.05	1.09
TNMP	0.88	0.91	0.87	0.89	0.90	0.90	0.91	0.91	0.92	0.92
Xcel	0.55	0.72	0.60	0.62	0.61	0.66	0.66	0.63	0.64	0.57

Table 3-7 shows the final estimates of the cooling EUIs by utility and building type derived by multiplying the average cooling EUI by building type (in Table 3-5) by the cooling load adjustment factor (in Table 3-6). These are the baseline EUI values used in the technical and economic potential analysis.

Table 3-7: Final Cooling EUIs by Utility and Building Type

	College	Grocery	Health	Lodg.	Misc.	Office	Rest.	Retail	School	Ware
AEP Central	3.39	7.72	12.39	4.89	7.81	8.20	11.27	5.34	2.84	1.37
AEP North	1.93	5.36	6.76	2.83	5.06	5.00	7.09	3.50	1.94	0.94
AEP SWPCO	2.52	6.32	9.12	3.71	6.22	6.41	8.86	4.21	2.29	1.13
CenterPoint	2.87	6.78	10.24	4.09	6.76	7.03	9.48	4.64	2.49	1.23
El Paso	1.71	4.93	5.89	2.56	4.66	4.61	6.47	3.25	1.83	0.94
Entergy	2.87	6.78	10.24	4.09	6.76	7.03	9.48	4.64	2.49	1.23
Oncor	2.47	6.00	8.81	3.60	6.11	6.27	8.43	4.16	2.28	1.16
TNMP	2.07	5.44	7.32	3.06	5.24	5.40	7.47	3.62	2.00	0.98
Xcel	1.30	4.26	5.04	2.14	3.52	3.94	5.40	2.53	1.40	0.60

Commercial Peak Calibration

After estimating all of the energy usage intensities, it is important to estimate the associated peak usage by building type and then calibrate the resulting peak usage by building types against the system total peak demand in 2007. The analysis calibration starts by applying typical commercial peak-to-energy factors by building type to the average demand levels. These peak to energy ratios were taken from previous Itron analyses in New Mexico and California. Average demand equals energy (KWh/sq ft) divided by hours. The peak-to-energy factor is multiplied times the average demand to produce the actual demand in the utility's peak hour. The cooling peak-to-energy factor is then adjusted across all building types to reconcile calculated peak demand with utility reported demand.

Commercial Equipment and Measure Saturation

Estimates of equipment and measure saturations relied on data from the commercial end user surveys, previous commercial marker research conducted by the Texas utilities, results from the Commercial Energy Use Surveys in California, and information from the Energy Information Agencies, Commercial Building Energy Consumption estimates for 2002.

Commercial Energy Savings and Incremental Cost per Measure

Estimates of energy savings per measure were not available from the Texas distribution utilities for an average customer at the end use level. Itron used estimated energy savings as a fraction of the baseline EUI based on previous work conducted for the Public Service of New Mexico and the California Energy Commission (References 9 & 10 in Section 6). Energy and peak savings estimates varied by utility area for the cooling end use but estimated savings for the water heating, office equipment and lighting UECs were held constant across utility areas even though the absolute savings will vary by utility due to difference in equipment saturations, baseline energy use, and applicability factors.

The estimated energy savings as a fraction of baseline usage for commercial lighting measures is shown in Table 3-8.

Table 3-8: Energy Savings as a Percentage of Baseline Lighting Usage for College Buildings

Segment	Measure #	Measure Description	College Building Type 1
1	110	Base Fluorescent Fixture, T12, 34W, EB	NA
1	111	Premium T8, Electronic Ballast	31.4%
1	112	Premium T8, EB, Reflector	50.0%
1	113	Occupancy Sensor	20.0%
1	114	Daylighting/Perimeter Dimming	75.0%
1	115	Lighting Control Tune-up	5.0%
1	130	Base T8, EB	NA
1	131	ROB Premium T8, 1EB	15.8%
1	133	Occupancy Sensor	20.0%
1	134	Daylighting/Perimeter Dimming	75.0%
1	135	Lighting Control Tune-up	5.0%
1	150	Base Incandescent Flood, 75W to Screw-in CFL	NA
1	151	CFL Screw-in 18W	72.0%
1	155	Base Incandescent Flood, 75W to Hardwired CFL	NA
1	156	CFL Hardwired, Modular 18W	72.0%
1	165	Base High Bay Metal Halide, 400W	NA
1	166	High Bay T5	37.4%
1	170	Base CFL	NA
1	180	Base Halogen	NA
1	220	Base Outdoor Mercury Vapor 400W Lamp	NA
1	221	High Pressure Sodium 250W Lamp	35.0%
1	222	Outdoor Lighting Controls (Photocell/Timeclock)	22.2%

A similar overview of the estimated energy savings as a fraction of baseline cooling usage is shown in Table 3-9.

Table 3-9: Energy Savings as a Percentage of Baseline Cooling Usage for College Buildings

Energy Savings Percent		
Measure #	**Measure Description**	**College Building Type 1**
300	Base Centrifugal Chiller, 0.58 kW/ton, 500 tons	NA
301	Centrifugal Chiller, 0.51 kW/ton, 500 tons	12.1%
302	Window Film (Standard)	4.0%
303	EMS - Chiller	10.0%
304	Cool Roof - Chiller	1.3%
305	Chiller Tune Up/Diagnostics	8.0%
306	VSD for Chiller Pumps and Towers	10.0%
307	EMS Optimization	5.0%
308	Economizer	0.0%
320	Base DX Packaged System, EER=10.3, 10 tons	NA
321	DX Tune Up/Advanced Diagnostics	5.0%
322	DX Packaged System, EER=10.9, 10 tons	5.5%
323	Window Film (Standard)	4.0%
324	Evaporative Pre-Cooler	0.0%
325	Programmable. Thermostat - DX	5.0%
326	Cool Roof - DX	1.3%
327	Optimize Controls - DX	5.0%
328	Economizer	0.0%
400	Base Fan Motor, 15hp, 1800rpm, 91.0%	NA
401	High Efficiency Fan Motor, 15hp, 1800rpm, 92.4%	1.5%
402	Variable Speed Drive Control	30.0%
403	Air Handler Optimization	10.0%

The numerous charts and figures used for each of the ten building types were too detailed to be presented here for each of the nine participating utilities. The remaining estimates of baseline energy usage and the percentage energy savings estimated for each efficiency measure for the remaining end uses are provided in the appendices.

3.1.3 Industrial Sector Data Development

In order to estimate energy efficiency potential for the industrial sector, several key data steps were required:

- Assignment of energy usage to the various industrial segments;
- Allocation of energy usage to end uses by industrial segment;
- Development of peak demand estimates by industrial segment and end use;
- Applying measure data developed by LBNL (Lawrence Berkeley National Laboratory) to each industry segment and end use combination.

These steps are discussed in the following sections.

Energy Usage by Industrial Segment

Since data by utility and industrial segment were not readily available for the Texas utilities, an estimation approach was required. First Dunn & Bradstreet (D&B) employment data by SIC code was developed for each utility. The D&B data was mapped to each utility service territory using ZIP code identifiers. Next, employment was aggregated from SIC code to the industrial segments utilized in the study.

The next step in the analysis was to develop energy usage per employee data using the US DOE 2002 Manufacturing Energy Consumption Survey (MECS) data. These data were available by NAICS codes which were then translated to SIC codes using standard mappings (for industry, 3-digit NAICS codes translate fairly directly to 2-digit SIC codes). Table 3-10 shows this mapping.

Energy use per employee was then multiplied by the number of employees in each service territory and industrial segment to provide first-cut estimates of energy use by utility and industrial segment. These estimates were reviewed by the utilities and adjusted as necessary. Table 3-11 shows the breakdown of industrial usage by utility and industrial segment that was developed in this analysis.

Overall, the industrial sector accounts for about 66,918 GWh on annual energy consumption. Of this amount, 84% (55,995 GWh) is covered in this potential study.

Figure 3-2 summarizes energy consumption by industry for studied industry segments. As shown, the chemicals industry is by far the largest consumer of electricity, followed by petroleum refining.

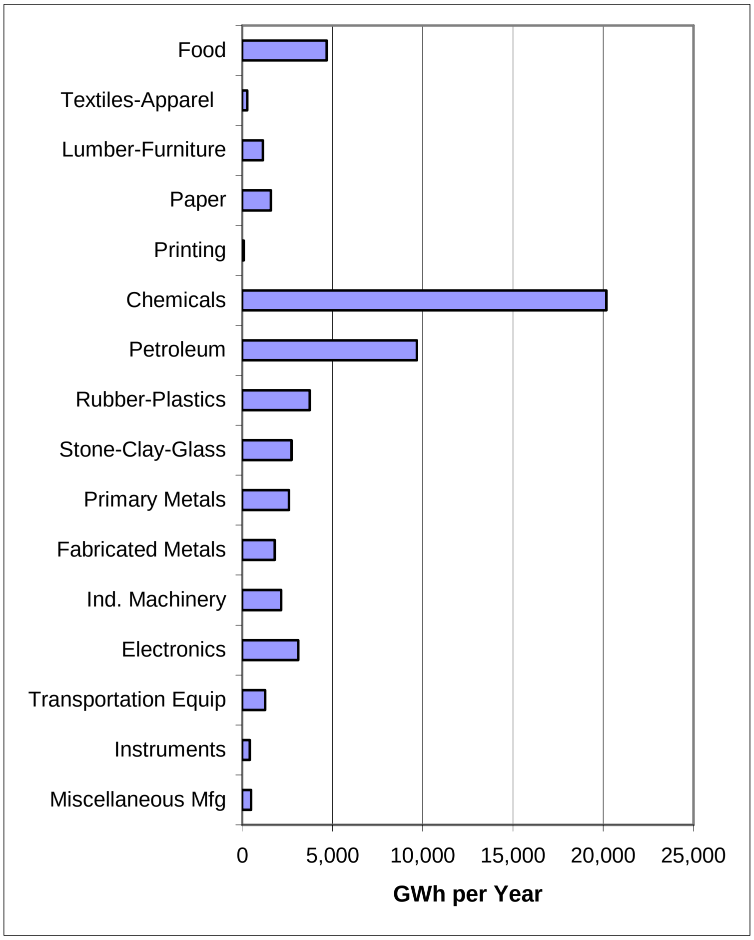
Table 3-10: Mapping of NAICS Code to SIC Code

Industrial Segment (NAICS Definition)	**NAICS**	**SIC**
Food Manufacturing	311	20
Beverage and Tobacco Product Manufacturing	312	20
Textile Mills	313	22
Textile Product Mills	314	23
Apparel Manufacturing	315	23
Leather and Allied Product Manufacturing	316	31
Wood Product Manufacturing	321	24
Paper Manufacturing	322	26
Printing and Related Support Activities	323	27
Petroleum and Coal Products Manufacturing	324	29
Chemical Manufacturing	325	28
Plastics and Rubber Products Manufacturing	326	30
Nonmetallic Mineral Product Manufacturing	327	32
Primary Metal Manufacturing	331	33
Fabricated Metal Product Manufacturing	332	34
Machinery Manufacturing	333	35
Computer and Electronic Product Manufacturing	334	36
Electrical Equipment, Appliance, and Component Manufacturing	335	36
Transportation Equipment Manufacturing	336	37
Furniture and Related Product Manufacturing	337	25
Miscellaneous Manufacturing	339	39

Table 3-11: Summary of Industrial Energy Use by Utility and Industrial Segment

	MWh										
Industry	AEP Central	AEP North	SWEPCO	CenterPoint	El Paso	Entergy	Oncor	TNMP	Xcel	Total	In Potentials
Food	204,305	86,988	271,927	1,049,649	34,172	82,199	2,687,626	70,067	193,442	4,680,374	Yes
Textiles-Apparel	11,309	3,033	5,953	472	36,779	24,696	126,539	22,148	46,536	277,465	Yes
Lumber-Furniture	7,393	4,074	177,338	0	11,975	330,095	574,058	33,157	8,704	1,146,794	Yes
Paper	88,521	281	278,244	63,272	59,784	216,266	848,057	10,318	29,384	1,594,127	Yes
Printing	5,938	854	3,577	5,756	14,519	19,885	0	20,810	11,829	83,166	Yes
Chemicals	1,796,425	26,754	189,235	14,653,485	35,046	1,140,176	1,618,380	529,890	181,243	20,170,635	Yes
Petroleum	2,318,984	414,900	507,998	3,066,280	17,134	2,047,305	625,182	541,951	141,500	9,681,234	Yes
Rubber-Plastics	43,068	19,023	14,877	689,310	108,908	163,942	2,648,638	39,525	10,291	3,737,581	Yes
Stone-Clay-Glass	44,941	45,294	21,361	16,199	77,766	220,576	2,163,526	87,062	65,400	2,742,125	Yes
Primary Metals	178,812	105	867,745	962,518	100,346	175,581	0	123,197	197,159	2,605,461	Yes
Fabricated Metals	36,568	19,913	147,410	95,209	42,147	230,228	1,155,856	53,415	15,608	1,796,354	Yes
Ind. Machinery	37,312	5,035	169,418	601,182	50,005	177,987	990,783	79,230	52,543	2,163,495	Yes
Electronics	52,155	38,825	89,401	212,920	261,743	34,532	2,346,371	42,096	37,751	3,115,794	Yes
Transportation Equip	10,518	2,476	38,971	4,316	41,826	78,345	1,057,226	38,856	3,436	1,275,968	Yes
Instruments	6,562	68,686	5,926	8,668	62,728	72,853	147,850	34,456	18,180	425,910	Yes
Miscellaneous Mfg	14,689	7,481	31,642	50,971	61,096	142,036	55,615	102,597	32,777	498,903	Yes
Subtotal	4,857,497	743,721	2,821,024	21,480,207	1,015,973	5,156,701	17,045,706	1,828,775	1,045,781	55,995,385	Yes
Agriculture	0	0	0	5,052	0	0	0	0	175,467	180,519	No
Construction	0	0	0	130,200	0	0	0	0	65,054	195,255	No
Mining/Extraction	342,503	3,279	217,976	26,165	13,376	754,323	5,406,564	99,159	1,589,204	8,452,550	No
TCU	0	0	0	2,005,392	0	0	0	0	89,328	2,094,720	No
Subtotal	342,503	3,279	217,976	2,166,809	13,376	754,323	5,406,564	99,159	1,919,054	10,923,044	No
Total Industry	5,200,000	747,000	3,039,000	23,647,017	1,029,349	5,911,023	22,452,271	1,927,934	2,964,835	66,918,429	

Figure 3-2: Energy Consumption for Studied Industry Segments



End Use Energy Consumption

The next step in the analysis was to allocate industrial energy use to the various end uses. This allocation was done by industrial segment using data from the following sources:

- The US DOE 2002 MECS was used to allocate electricity consumption to the major end uses.
- The US DOE 1998 Industrial Motors Market Assessment Study was used to allocate the machine drive end use in the various motors systems (fans, pumps, compressed air, and other drives).

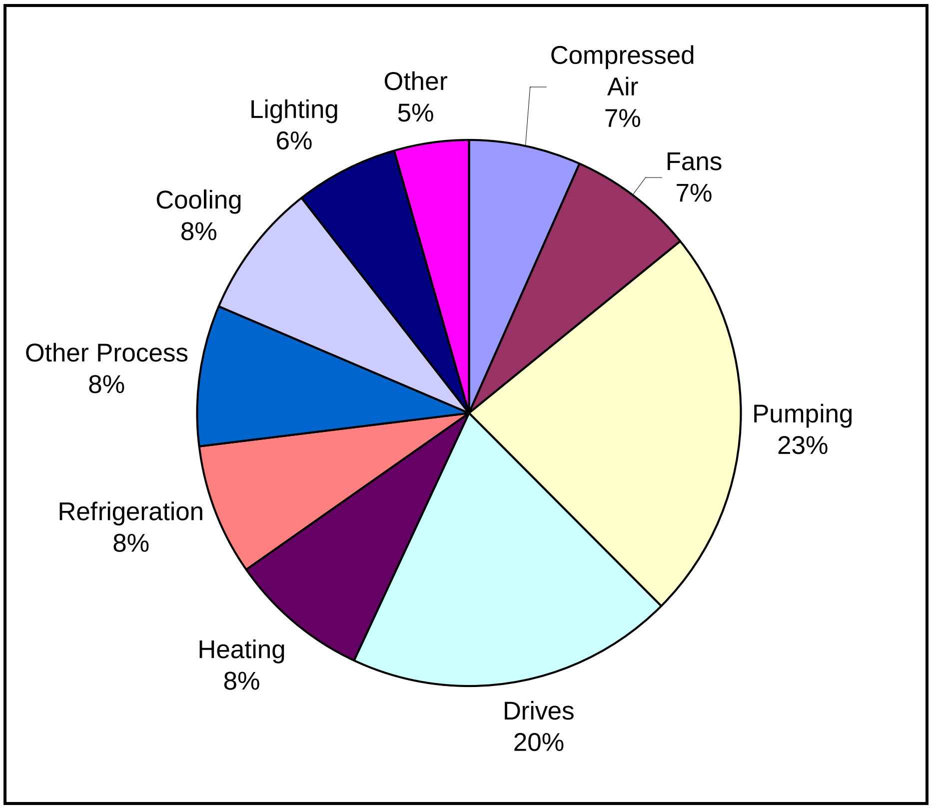
Table 3-12 shows the distribution of industrial energy use by end use. This table shows usage for the Texas as a whole. Industrial segments for each utility receive the same end use allocation.

Table 3-12: Energy Consumptions by Industry Segment and End Use - MWh per Year

Industry	Compressed Air	Fans	Pumping	Drives	Heating	Refrigeration	Other Process	Cooling	Lighting	Other	Total
Food	390,479	427,378	752,053	722,610	137,607	1,182,426	18,298	345,653	318,465	385,404	4,680,374
Textiles-Apparel	10,587	20,040	26,816	91,761	24,169	20,582	1,332	41,659	26,172	14,347	277,465
Lumber-Furniture	52,700	99,754	130,809	470,537	56,978	10,574	1,975	93,658	105,627	124,181	1,146,794
Paper	62,232	252,701	420,539	552,547	39,616	23,858	35,136	64,806	62,781	79,912	1,594,127
Printing	2,852	5,399	7,080	25,467	2,078	3,683	298	14,945	9,348	12,017	83,166
Chemicals	525,264	1,332,376	5,406,371	4,317,410	667,870	1,702,568	3,525,632	1,170,033	862,958	660,153	20,170,635
Petroleum	1,172,656	703,594	4,690,625	1,250,833	571,255	540,807	16,640	311,207	238,805	184,812	9,681,234
Rubber-Plastics	140,465	265,880	348,653	1,254,149	576,967	308,433	48,566	370,598	303,203	120,668	3,737,581
Stone-Clay-Glass	167,262	393,066	498,999	565,904	553,413	94,628	41,306	169,836	131,907	125,802	2,742,125
Primary Metals	86,173	202,508	257,084	291,553	731,608	21,325	803,980	95,636	76,612	38,981	2,605,461
Fabricated Metals	191,556	106,695	139,911	354,379	412,223	62,292	14,340	182,021	169,692	163,244	1,796,354
Ind. Machinery	337,302	122,129	160,150	429,484	160,694	70,621	31,631	398,668	296,591	156,225	2,163,495
Electronics	320,605	97,151	127,396	272,515	412,883	241,990	122,483	795,100	399,842	325,828	3,115,794
Transportation Equip	188,159	84,239	110,465	181,439	124,578	58,611	30,013	247,946	194,119	56,399	1,275,968
Instruments	39,826	18,058	23,680	57,476	47,636	24,765	10,228	105,221	78,294	20,727	425,910
Miscellaneous Mfg	49,221	18,280	23,971	89,342	43,809	36,298	2,834	97,964	71,561	65,623	498,903
Total	3,737,340	4,149,247	13,124,604	10,927,406	4,563,382	4,403,461	4,704,693	4,504,952	3,345,976	2,534,325	55,995,385

Figure 3-3 summarizes industrial end use energy consumption. As this figure shows, pumping and machine drives account for the largest shares of industrial energy consumption. Refrigeration/process cooling, fans, compressed air, and process heating account for the next largest shares of usage.

Figure 3-3: Distribution of Industrial Energy Consumption by End Use



Peak Demand Estimates

The next stage in the analysis was to develop industrial peak demand estimates by utility, industry segment, and end use. Given the limited data on industrial peak demands in Texas, secondary source data for typical industry load shapes were used to allocate end use energy consumption into peak and non-peak periods. Peak period energy was then divided by the number of peak-period hours to develop estimates of average peak demands. Peak demands for weather sensitive end uses were then adjusted upward to account for weather-driven effects on peak. Table 3-13 shows the breakdown of peak demand by industry type and end use, while Table 3-14 shows the breakdown of peak demand by industry and utility.

Table 3-13: Peak Demand by Industry Segment and End Use - MW

Industry	Compressed Air	Fans	Pumping	Drives	Heating	Refrigeration	Other Process	Cooling	Lighting	Other	Total
Food	54.2	59.3	104.4	100.3	19.1	164.2	2.5	206.9	44.2	53.5	808.7
Textiles-Apparel	1.0	1.9	2.5	8.7	2.3	1.9	0.1	24.9	2.5	1.4	47.3
Lumber-Furniture	10.1	19.2	25.2	90.6	11.0	2.0	0.4	56.1	20.3	23.9	258.8
Paper	9.0	36.4	60.6	79.6	5.7	3.4	5.1	38.8	9.0	11.5	259.2
Printing	0.2	0.3	0.4	1.6	0.1	0.2	0.0	8.9	0.6	0.7	13.2
Chemicals	40.8	103.6	420.4	335.7	51.9	132.4	274.2	700.3	67.1	51.3	2,177.9
Petroleum	181.6	108.9	726.3	193.7	88.5	83.7	2.6	186.3	37.0	28.6	1,637.1
Rubber-Plastics	35.9	68.0	89.2	320.7	147.5	78.9	12.4	221.8	77.5	30.9	1,082.8
Stone-Clay-Glass	18.5	43.5	55.2	62.6	61.2	10.5	4.6	101.7	14.6	13.9	386.1
Primary Metals	4.5	10.6	13.4	15.2	38.1	1.1	41.9	22.9	4.0	2.0	153.7
Fabricated Metals	53.6	29.9	39.2	99.2	115.4	17.4	4.0	109.0	47.5	45.7	560.8
Ind. Machinery	23.6	8.6	11.2	30.1	11.3	4.9	2.2	238.6	20.8	10.9	362.3
Electronics	14.3	4.3	5.7	12.2	18.4	10.8	5.5	475.9	17.8	14.5	579.5
Transportation Equip	11.0	4.9	6.4	10.6	7.3	3.4	1.8	123.7	11.3	3.3	183.6
Instruments	2.5	1.1	1.5	3.6	2.9	1.5	0.6	63.0	4.8	1.3	82.8
Miscellaneous Mfg	3.0	1.1	1.5	5.5	2.7	2.2	0.2	58.6	4.4	4.1	83.4
Total	463.8	501.6	1,563.0	1,369.7	583.4	518.8	358.0	2,637.4	383.5	297.6	8,677.0

Table 3-14: Peak Demand by Industry Segment and Utility – MW*

	MW									
Industry	AEP Central	AEP North	SWEPCO	CenterPoint	El Paso	Entergy	Oncor	TNMP	Xcel	Total
Food	35.3	15.0	47.0	181.4	5.9	14.2	464.4	12.1	33.4	808.7
Textiles-Apparel	1.9	0.5	1.0	0.1	6.3	4.2	21.6	3.8	7.9	47.3
Lumber-Furniture	1.7	0.9	40.0	0.0	2.7	74.5	129.5	7.5	2.0	258.8
Paper	14.4	0.0	45.2	10.3	9.7	35.2	137.9	1.7	4.8	259.2
Printing	0.9	0.1	0.6	0.9	2.3	3.1	0.0	3.3	1.9	13.2
Chemicals	194.0	2.9	20.4	1,582.2	3.8	123.1	174.7	57.2	19.6	2,177.9
Petroleum	392.1	70.2	85.9	518.5	2.9	346.2	105.7	91.6	23.9	1,637.1
Rubber-Plastics	12.5	5.5	4.3	199.7	31.6	47.5	767.3	11.5	3.0	1,082.8
Stone-Clay-Glass	6.3	6.4	3.0	2.3	10.9	31.1	304.6	12.3	9.2	386.1
Primary Metals	10.5	0.0	51.2	56.8	5.9	10.4	0.0	7.3	11.6	153.7
Fabricated Metals	11.4	6.2	46.0	29.7	13.2	71.9	360.8	16.7	4.9	560.8
Ind. Machinery	6.2	0.8	28.4	100.7	8.4	29.8	165.9	13.3	8.8	362.3
Electronics	9.7	7.2	16.6	39.6	48.7	6.4	436.4	7.8	7.0	579.5
Transportation Equip	1.5	0.4	5.6	0.6	6.0	11.3	152.1	5.6	0.5	183.6
Instruments	1.3	13.4	1.2	1.7	12.2	14.2	28.7	6.7	3.5	82.8
Miscellaneous Mfg	2.5	1.3	5.3	8.5	10.2	23.7	9.3	17.2	5.5	83.4
Subtotal	702.3	130.8	401.7	2,732.9	180.6	846.7	3,259.0	275.4	147.5	8,677.0
Agriculture	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	57.8	59.5
Construction	0.0	0.0	0.0	21.8	0.0	0.0	0.0	0.0	10.9	32.6
Mining/Extraction	39.1	0.4	24.9	3.0	1.5	86.1	617.2	11.3	181.4	964.9
TCU	0.0	0.0	0.0	156.8	0.0	0.0	0.0	0.0	7.0	163.8
Subtotal	39.1	0.4	24.9	183.2	1.5	86.1	617.2	11.3	257.1	1,220.8
Total Ind	741.4	131.2	426.6	2,916.1	182.2	932.8	3,876.2	286.7	404.6	9,897.8

While agriculture, construction, minding/extraction and TCU were included in the table, these industrial segments were not included in the potential analysis.

Baseline Industrial Usage with and without High Voltage Customers

In this study, the legislature has asked to what extent the current exclusion of customers with high voltage service will affect the level of achievable savings for each of the utilities. Given this requirement, it was important to estimate what fraction of current sales and peak load are represented by high voltage in each of the service territories. Table 3-15 shows that the decision to exclude high voltage customers may a significant effect on the potential energy savings from the industrial sector because these customers constitute over 60% of total industrial sales on a statewide basis, and consequently potential savings.

Table 3-15: Estimates of Industrial Energy Usage by Utility and Excluding High Voltage Customers Currently Barred from Participating in Efficiency Programs

Texas Utility	Total Industrial Sales MWH	Total Sale-Non HV Customers	Per Cent High Voltage customer Sales
AEP Central	5,200,000	2,566,512	50.6%
AEP North	747,000	747,000	0.0%
Entergy	5,911,023	-	100.0%
El Paso	1,029,349	254,686	75.3%
CenterPoint	23,647,017	4,030,229	83.0%
Oncor	22,452,271	12,509,493	44.3%
Xcel	2,964,835	2,960,085	0.2%
TNMP	1,927,934	896,459	53.5%
AEP SWEPCO	3,039,000	2,070,052	31.9%
Total Statewide	66,918,429	26,034,516	61.1%

Measure Data

The final data elements for the industrial sector analysis are the measure data that was developed by LBNL and the Itron/KEMA team. These data elements include the following:

- Share of end use the measure applies to/feasibility of installing it
- Potential penetration/measure saturation
- Savings percentage
- Useful life
- Measure cost

The LBNL data are used to assess the industrial process end uses. The Itron/KEMA data are used for the HVAC and lighting end uses and are set up to be as consistent with the commercial analysis as possible. Each measure is applied to end use energy consumption, and the above data are utilized to estimate energy efficiency potentials using the DSM Assyst™ model. Table 3-16 lists the key measure categories that are included in the analysis.

Table 3-16: Key Industrial Measures

Process Measures	HVAC Measures	Lighting Measures
High Efficiency Equipment	High Efficiency Chillers	Premium T8/Electronic Ballast
Controls	High Efficiency DX Units	CFLs
O&M	Controls	High Bay T5s
System Optimization	Tune-ups	Controls
Efficient Processes	Window Film	
ASDs	Cool Roofs	
Proper Sizing	Control Optimization	
Load Control		
Insulation		
Heat Recovery		

The LBNL measure data used for this study comes from a variety of sources including:

- LBNL-specific industry studies:
  - Transportation
  - Food Processing
  - Paper
  - Chemicals
  - Petroleum Refining
  - Cement
  - Pumping
  - Compressed Air
  - Motors
  - Emerging Technologies
- Various other studies researched by LBNL

The LBNL data reflect average energy savings and incremental cost data across each industry and are not Texas-specific, as state specific data required for this type of analysis do not exist to our knowledge. The specific assumptions used to estimate energy savings and incremental costs were mailed to each utility in the M files for the industrial sector. A summary of representative savings per measure is shown in Table 3-17.

3.2 Electricity Rate Forecasts

Table 3-17 shows information from the Energy Information Agency on the actual average utility rates in Texas for the year 2007 for the residential, commercial and industrial sectors. For this preliminary analysis, Itron applied a modest nominal growth rate of 2% per year to increase the base retail rate values in each sector from 2008 to 2017 for all of the utilities in the ERCOT region. Itron used utility specific retail rate forecasts, again on a nominal basis, for the four non ERCOT utilities: El Paso Electric, Southwest Electric Company (SWEPCO), Entergy, and Xcel Entergy (SPS).

Table 3-17: Average Electricity Prices for the ERCOT Utilities in Texas by Sector

Sector	Average Electricity Price 2007 cents/ kwh
Residential	12.4
Commercial	9.99
Industrial	7.80

3.3 Avoided Cost Forecasts

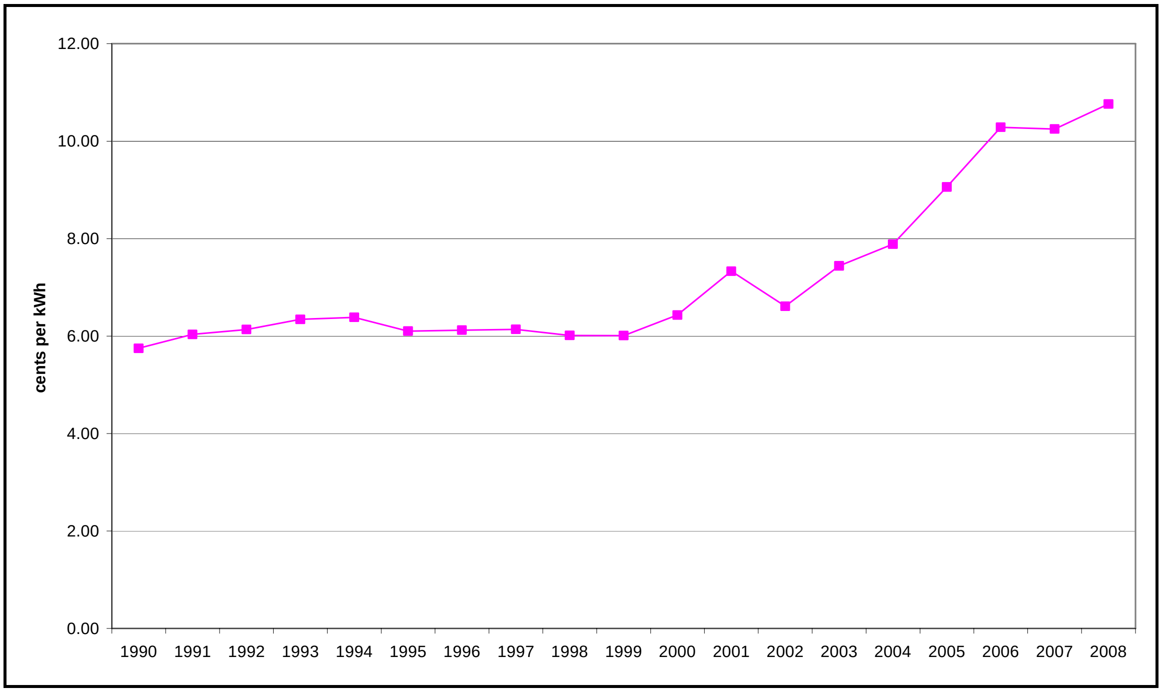
In this section we describe how Itron developed a high and low forecast of long run avoided costs for the period 2009 through 2018. This forecast is needed to assess the cost-effectiveness of potential energy savings investments over the next decade at the state level and to determine the order of loading the specific measure savings at the end use level. Measures with the highest benefit cost ratios are run first and then remaining efficiency measures are run against the reduced end use totals to ensure there is no double counting of savings effects and to account for interactions between shell and HVAC system measures.

Itron produced its own independent forecast of avoided costs for Texas because the majority of investor owned utilities no longer produce a forecast of avoided costs. In addition ERCOT, the system operator for some of these utilities, does not produce long term (10 year or more) forecasts of average or marginal costs for their control area. In the absence of available avoided cost forecasts, Itron decided to examine the long term trends in average and marginal prices for electricity in Texas over the last 18 years and use the trends to develop a high and low forecast of electricity avoided costs.

Figure 3-4 presents the trend in average nominal electricity prices for Texas over the last 18 years. Inspection of the graph shows that system average prices were relatively flat from 1990 to 1998 and then increase sharply. The average price increase in nominal terms was

3.5% per year over the 18 year period from 1990 to 2008. The rate of nominal price growth, increased sharply to 7.5% per year starting in 2002.

Figure 3-4: Historical Average System Electricity Prices in Texas



Source: United States Energy Information Agency, Table 5.6a (Published in October 2007 and updated July 2008)

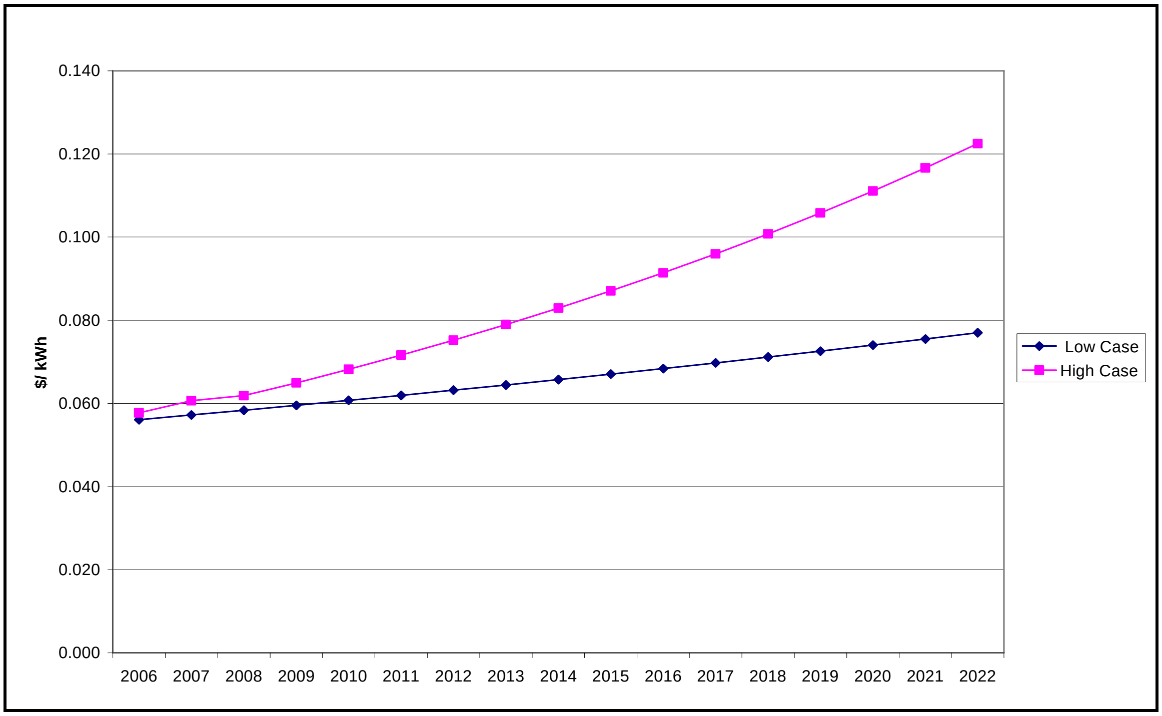
Based on these trends, Itron constructed a low and a high growth rate avoided cost forecast. The forecasts begin in 2005 with the administratively determined avoided cost of electricity at 5.5 cents/kWh and $80/kW. Both the high and low forecast of avoided costs start from this base year and grow at the different growth rates described below.

The low case is based on the assumption that the long tern trend in avoided costs will more closely resemble the price trends observed in the 1990’s in Texas. Thus avoided costs are projected to increase at 2% per year in nominal terms. This is equivalent to a flat trajectory of real prices assuming an underlying inflation rate of 2% per year. The low case is lower than the latest trends in nominal electricity prices of roughly five percent per year over the last five years. Actually achieving this lower trajectory of avoided costs will probably require significant reductions in the capital cost of key renewable technologies such as wind turbines and nuclear technologies, the development of much less expensive clean coal technologies, or a large drop in natural gas prices.

The high growth case assumes that avoided costs track the more recent rate of retail price growth rate of 5% per year nominal and 3% per year in real terms over the next decade leading to a doubling of avoided cost by 2017. This scenario is consistent with conventional wisdom that the fuel costs for electricity generation are likely to continue to rise. Fuel costs could increase due to the long term trends in oil and gas prices, likely significant growth in demand for both fuels in the developing countries of the world, and the recent short term increases in the capital costs of some renewable technologies such as photo voltaic systems. There is also the potential for fuel price increases caused by any policies adopted by the new U.S. administration to reduce the carbon content of fossil generation sources such as coal.

The projected trend in avoided energy costs for energy in the high and the low case is shown in Figure 3-5. For the purposes of simplicity we assume that the same growth rates should also be applied to the avoided costs of peak capacity. Actual avoided cost values by year are shown at the end of this section.

Figure 3-5: Forecasts of High and Low of Avoided Electricity Costs in Texas (in nominal $)



Forecast of Avoided Costs

The forecasts of annual avoided costs are shown in Table 3-18. Retail rates are shown in Table 3-19. These tables help to illustrate the impact of inflation and the translation of nominal prices into real prices. The middle column of the retail rates presents the consumer price index with a base of 1 in 2005. Because the base CPI is represented by 2005, the conversion of nominal prices to real prices leads to an increase in the relative price for the pre-2005 period. The real rate in 1990 ($.0872/kWh) is only approximately 1 cent lower than the real rate in 2008 ($0.987/kWh).

Table 3-18: Forecast of Nominal Avoided Energy and Capacity Cost; Low and High Case

	Low Case	High Case	Low Case	High Case
Year	$/kWh	$/kWh	$/kWyr	$/kWyr
2006	0.056	0.058	80	80
2007	0.057	0.061	81.60	84.00
2008	0.058	0.064	83.23	88.20
2009	0.060	0.067	84.90	92.61
2010	0.061	0.070	86.59	97.24
2011	0.062	0.074	88.33	102.10
2012	0.063	0.077	90.09	107.21
2013	0.064	0.081	91.89	112.57
2014	0.066	0.085	93.73	118.20
2015	0.067	0.090	95.61	124.11
2016	0.068	0.094	97.52	130.31
2017	0.070	0.099	99.47	136.83
2018	0.071	0.104	101.46	143.67
2019	0.073	0.109	103.49	150.85
2020	0.074	0.114	105.56	158.39
2021	0.076	0.120	107.67	166.31
2022	0.077	0.126	109.82	174.63

Low case- 2.0 % growth per year
High case- 5.0 % growth per year

Table 3-19: Average System Electricity Prices in Texas

Year	Nominal Cents/kwh	CPI Index	Real 2005 Price
1990	5.75	0.66	8.72
1991	6.03	0.70	8.65
1992	6.13	0.72	8.54
1993	6.34	0.74	8.57
1994	6.38	0.76	8.41
1995	6.10	0.78	7.82
1996	6.12	0.80	7.62
1997	6.14	0.82	7.47
1998	6.02	0.83	7.21
1999	6.01	0.85	7.05
2000	6.43	0.88	7.29
2001	7.33	0.91	8.08
2002	6.61	0.92	7.18
2003	7.44	0.94	7.90
2004	7.89	0.97	8.15
2005	9.06	1	9.06
2006	10.29	1.03	9.99
2007	10.25	1.06	9.65
2008	10.76	1.09	9.87

3.4 Forecasts of Energy and Peak Demand for All Nine Texas Utility Service Areas

In this section we describe the data and methods used to develop forecasts of electricity sales and peak demand. These forecasts are not used directly in the estimates of technical and economic potential developed in this report (as explained earlier, technical and economic potential forecasts are assumed to have no time dimension) but they are used and important in assessing the achievable levels of savings and estimating the target peak demand and energy savings targets that discussed in Section 7.

3.5 Approaches Used to Construct Electricity Forecasts

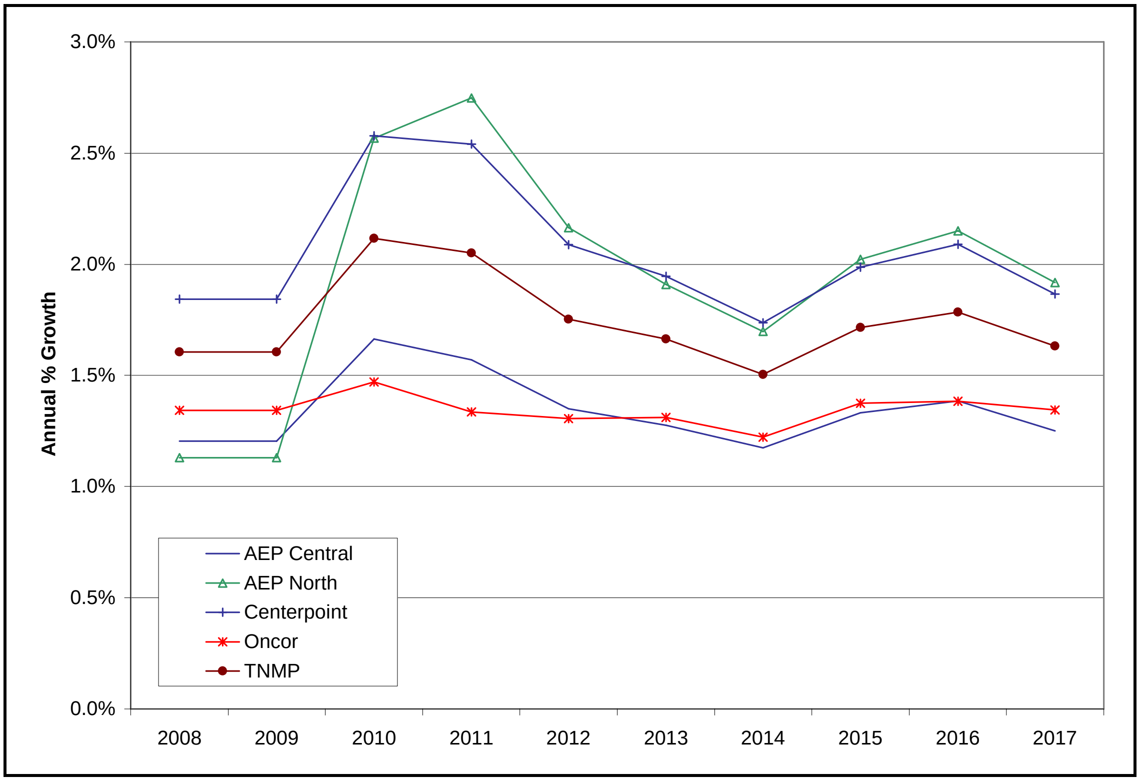
The alternative approaches used to produce the necessary sales and peak forecasts over the next ten years relied in large part on two sources of data provided by ERCOT. The first source of information consisted of historical energy and peak demand for each utility broken out by a number of different grouping variables, including weather zone and load profile. The second source of information was ERCOT's most recent forecast of energy and demand by weather zone for 2008 to 2017.

These two sources of information from ERCOT were used in the following manner. The historical sales were used to estimate the share of each utility's residential and nonresidential sales associated with each weather zone. These shares were combined with growth rates by weather zone from the ERCOT forecasts to develop series of average residential and nonresidential growth rates for energy and demand for each utility. These growth rates were then applied to the base year (2007) energy and demand control totals to generate the forecasts for each TDU.

Given the use of these forecasts in developing the targets for energy efficiency, there are two issues with the approach used to develop the forecasts using the approach described above. The first is whether is results in meaningful differences among the forecasts by service area within ERCOT. The second is whether it accurately captures the sector-specific variation in growth.

With respect to the first issue, while the actual forecasts vary too much in magnitude to compare with one another, the average growth rates associated with each of the ERCOT utilities in Figure 3-6 show clear differences, particularly in the earlier years of the forecast horizon.

Figure 3-6: Average Annual Energy Growth Rates for ERCOT Utilities



The second issue, however, is more of a concern, as it results in forecasts for the industrial sector with growth rates identical to that of commercial. Based on the forecasts for those utilities that did provide industrial forecasts, in addition to a great deal of past experience, industrial growth rates of that magnitude are not tenable. In the absence of actual sector-specific data, the forecasts for the industrial sector were set to a one percent annual growth rate and the difference in resulting sales were allocated proportionately to the residential and commercial sectors.

3.6 Summary of Forecast Sources

In addition to the application of the ERCOT growth rates at the system level, a number of other approaches were used to estimate the final forecasts of energy and demand by sector, depending on the nature of the data available. Utility data sources were used where possible. A summary of these approaches is presented in Table 3-20.

Table 3-20: Summary of Forecast Approaches

Forecast	Approach	Utilities
Energy	Forecasts used with no modification	AEP Central, AEP North, SWEPCO, Entergy
	Shares by sector in base year applied to aggregate forecasted values	Xcel, El Paso
	ERCOT growth rates applied to base year	CenterPoint, Oncor, TNMP
Demand	Shares by sector in base year applied to aggregate forecasted values	El Paso
	Base year relationship between energy and demand applied to energy forecast by sector	Xcel, AEP Central, AEP North, SWEPCO, Entergy
	ERCOT growth rates applied to base year	CenterPoint, Oncor, TNMP

The final forecasts developed using these various methods are presented in an accompanying Excel spreadsheet. There are two key questions to consider in reviewing these numbers. First, do the forecasts represent growth rates that are reasonably consistent with utility expectations for the growth in different customer sectors? Second, is the relationship between energy and peak demand representative of known trends in the service territory? If there is evidence of an increasing load factor, for example, these cases may need to be identified so that the forecasts can be adjusted to account for them.

3.7 Final Electricity and Demand Forecasts

Summaries of the energy and demand forecasts for each participating utility are presented in Table 3-21 and Table 3-22 below. These forecasts have been adjusted to account for the likely impacts of a slowdown in business activity for the next two years. Forecasts of energy sales and peak demand were reduced by 1% for the years 2009, 2009 and 2010 to account for the potential impacts of the of the economic downturn which began in October of 2007, three months after the initial sales forecasts were developed by Itron.

Table 3-21: Total MWh in 2008, 2012, and 2017 by Utility

Utility	2008	2012	2017	Annual Growth Rate
AEP Central	22,285,890	23,301,000	24,570,000	1.1%
AEP North	4,122,360	4,278,000	4,391,000	0.7%
AEP-SWEPCO	7,307,190	7,706,000	8,230,000	1.1%
CenterPoint	76,578,182	84,330,566	92,766,635	2.1%
El Paso	5,498,658	6,298,998	7,118,271	2.9%
Entergy	16,965,671	18,543,945	20,075,104	2.6%
Oncor	105,490,439	112,243,675	119,879,662	1.3%
TNMP	6,659,933	7,228,664	7,850,212	1.7%
Xcel	8,567,769	8,832,181	9,481,370	1.2%

Table 3-22: Total MW in 2008, 2012, and 2017 by Utility

Utility	2008	2012	2017	Annual Growth Rate
AEP Central	3,966	4,154	4,381	1.1%
AEP North	858	891	915	0.7%
SWEPCO	1,749	1,850	1,958	1.2%
CenterPoint	15,793	17,263	18,377	1.3%
El Paso	1,125	1,290	1,459	2.6%
Entergy	3,200	3,526	3,876	2.0%
Oncor	22,148	23,533	25,200	1.4%
TNMP	1,427	1,549	1,685	1.8%
Xcel	1,892	1,953	2,097	1.2%

4

Key Results from Data Collection Activities in Texas

4.1 Overview of Methodology

This section describes the data collection activities conducted by Itron in Texas to gather more information on the existing building stock, the potential for efficiency measures to reduce their energy use and the potential for Texas utility program administrators to increase the level of energy and peak savings captured by their existing programs. Itron gathered data from five primary sources:

1. Commercial building owners
2. Lighting and HVAC contractors and distributors
3. Utility Program Administrators
4. Environmental and Consumer Advocates
5. Retail Energy Service Providers.

Telephone surveys conducted by Itron's survey center personnel were used to gather data from the first two groups while a battery of more informal and qualitative questions were used to gather information from the latter three groups. The methodology used to develop the survey designs, pull the sample and weight the results is presented in Appendix C. The Trade Ally surveys were used to gather data on trends in sales and installation practices for contractors and distributors in the lighting and HVAC systems business. The commercial survey was used to gather information on baseline shares and saturations of efficient and standard lighting, HVAC, refrigeration and other systems that use electricity in the commercial sector. The in depth interviews were designed to gather information from a variety of stakeholders on the status of the current programs, how different groups felt about the success of the current programs and their ideas about potential barriers to expanding the savings from the efficiency programs.

The next section highlights the key findings from these surveys and the results from the in depth interviews of the Utility Program Administrators, Environmental and Consumer Advocates and the Retail Energy Service Providers in Texas.

4.2 Summary of Commercial End-User Survey Results

This section provides a high level summary of the commercial end-user survey results. More detailed tables of all the responses to the survey in tabular form, including building-type specific results are presented in Appendix F.

The nonresidential survey results are presented in the following order:

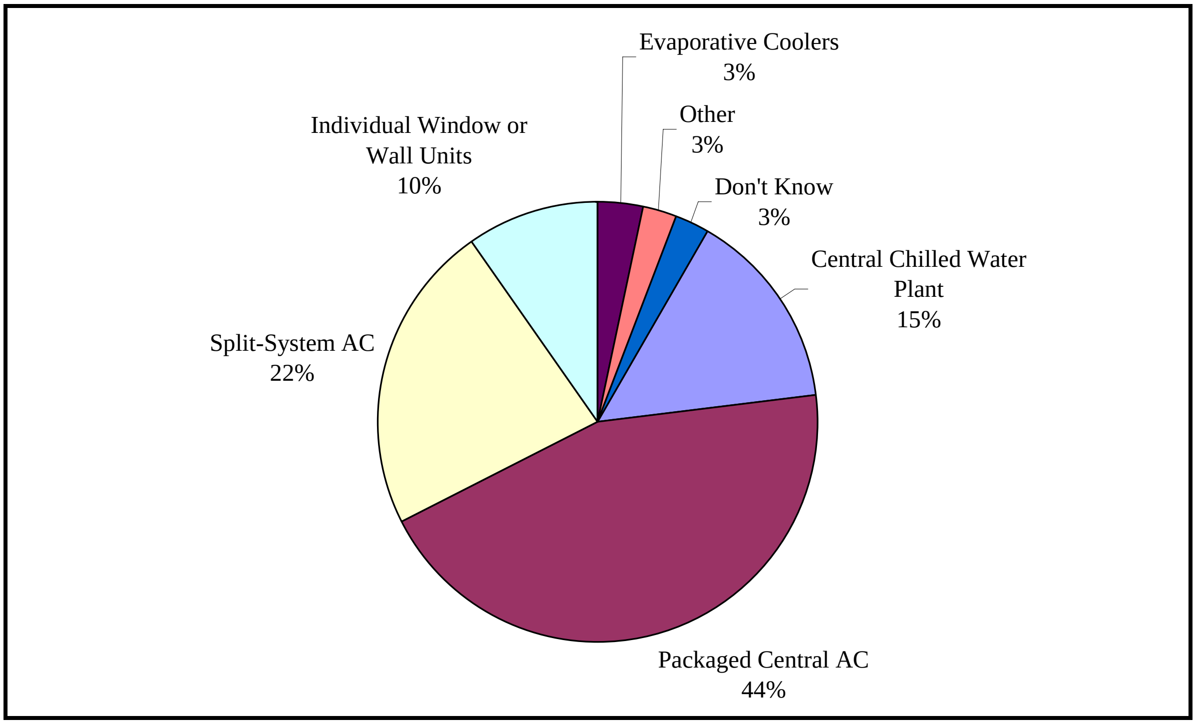
- Information on the share and types of heating, cooling and water heating systems installed in the existing building stock by building type, how they are operated and maintained and the fuels used to support each system.
- Information on the share and types of lighting systems in the commercial building stock, estimated market sales of efficient lamp and ballast systems, market share of different types of linear fluorescent lamps and the use of systems to control lighting usage over a typical 24 hour cycle.
- Information on the presence of other types of energy using systems that represent significant opportunities to save energy in other end uses, such as refrigerated vending machines.
- Data on customer reported levels of awareness of energy efficiency opportunities, efficiency program offerings and types of energy efficiency retrofit conducted in the last three years.

4.2.1 Market Share of Cooling, Space Heating, and Water Heating Systems in Commercial Buildings in Texas

Respondents were asked to report the type of cooling system present at their facility. Figure 4-1 presents the implied relative saturation of cooling systems in Texas. Packaged central AC systems are the most common, at 44% and split systems account for another 22%.

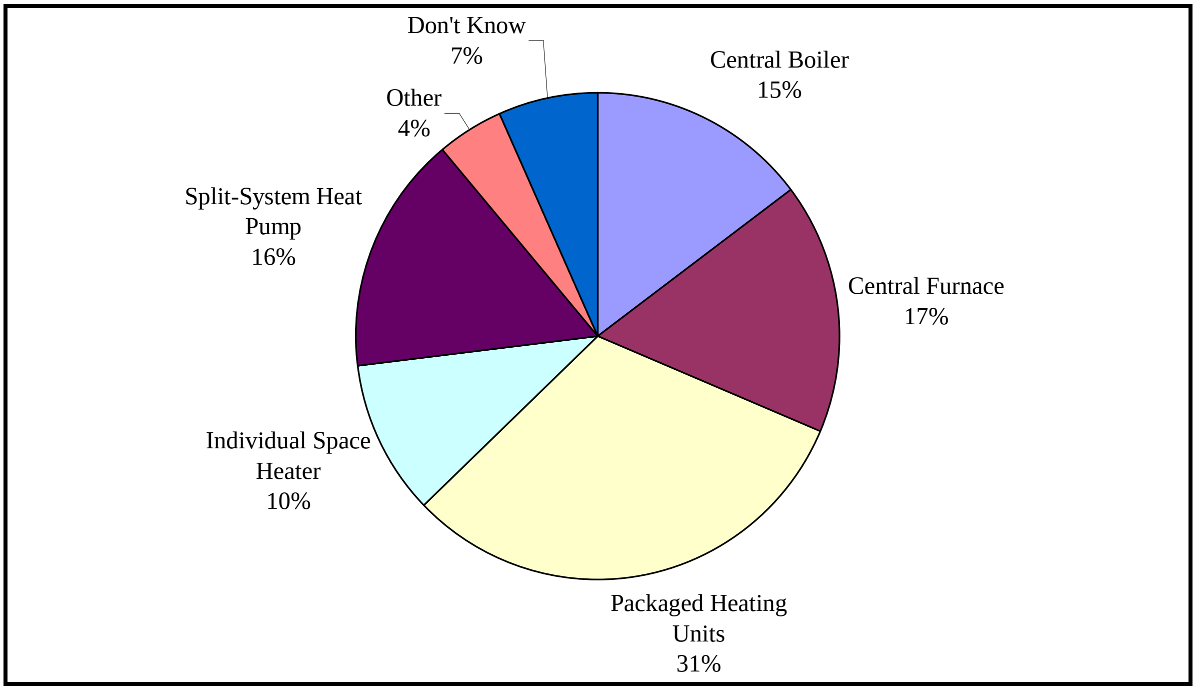
Heating system saturations are presented below in Figure 4-2. The heating system technology distribution is also led by packaged systems with 31% of all heating systems, followed by a group of technologies that are fairly evenly divided;, central furnace (17%), central boiler (16%), and split system heat pumps (15%), followed by space heaters (10%).

Figure 4-1: Cooling System Technology Saturation



The data presented in the figure represent the responses of 440 surveys.

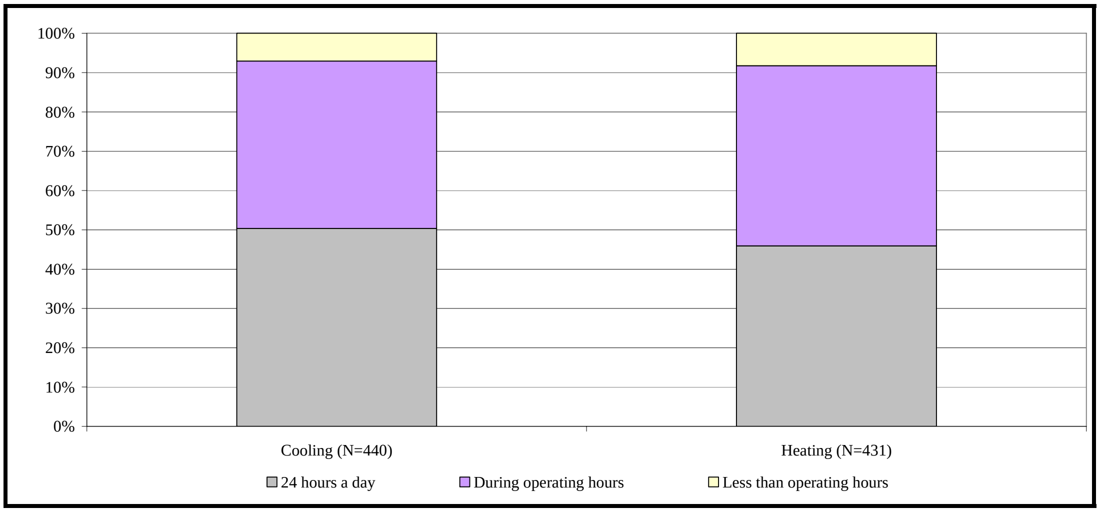
Figure 4-2: Heating System Technology Saturation



The data presented in the figure represent the responses of 431 surveys.

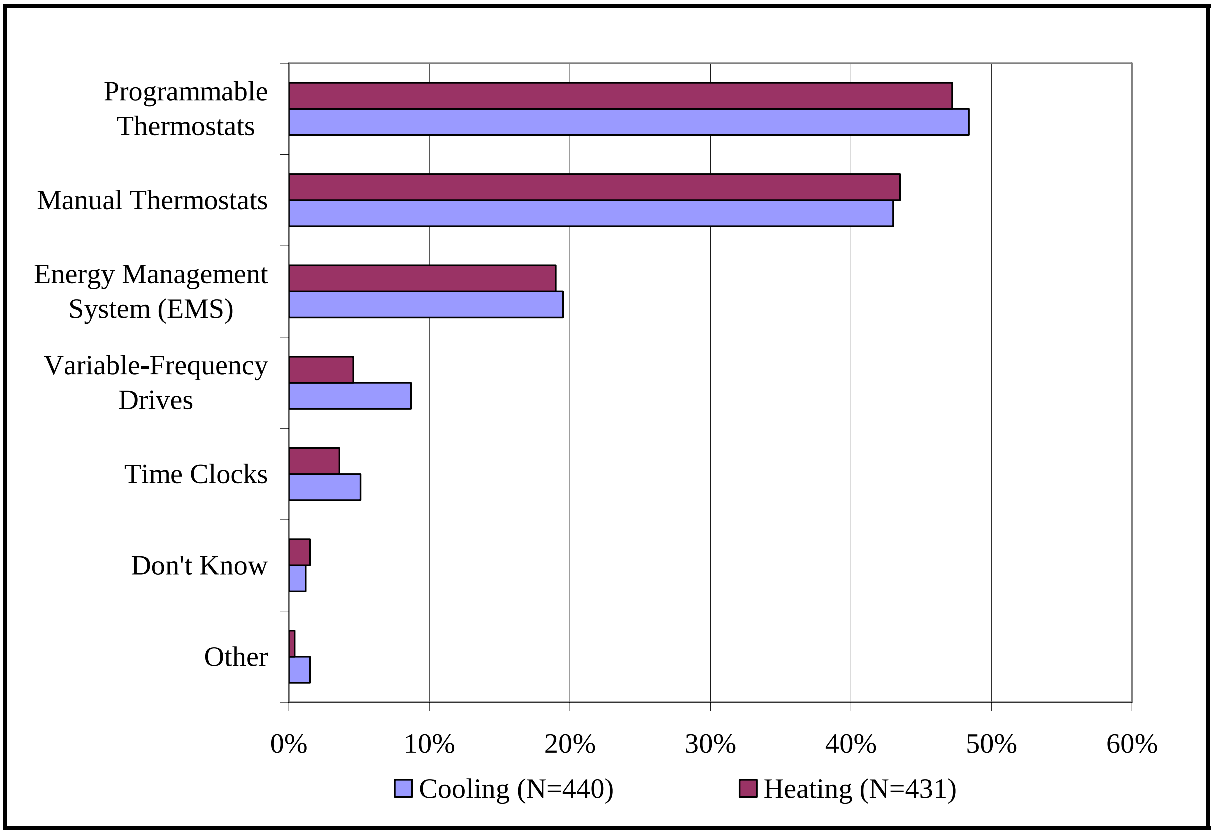
A summary of respondents' self-reported hours of operation for cooling and heating systems is presented below in Figure 4-3. Respondents indicate that nearly half of the nonresidential market use their heating and cooling systems 24 hours a day. Less than 10 percent of respondents run their heating and cooling systems for fewer hours than they operate their business.

Figure 4-3: Cooling and Heating System Operation



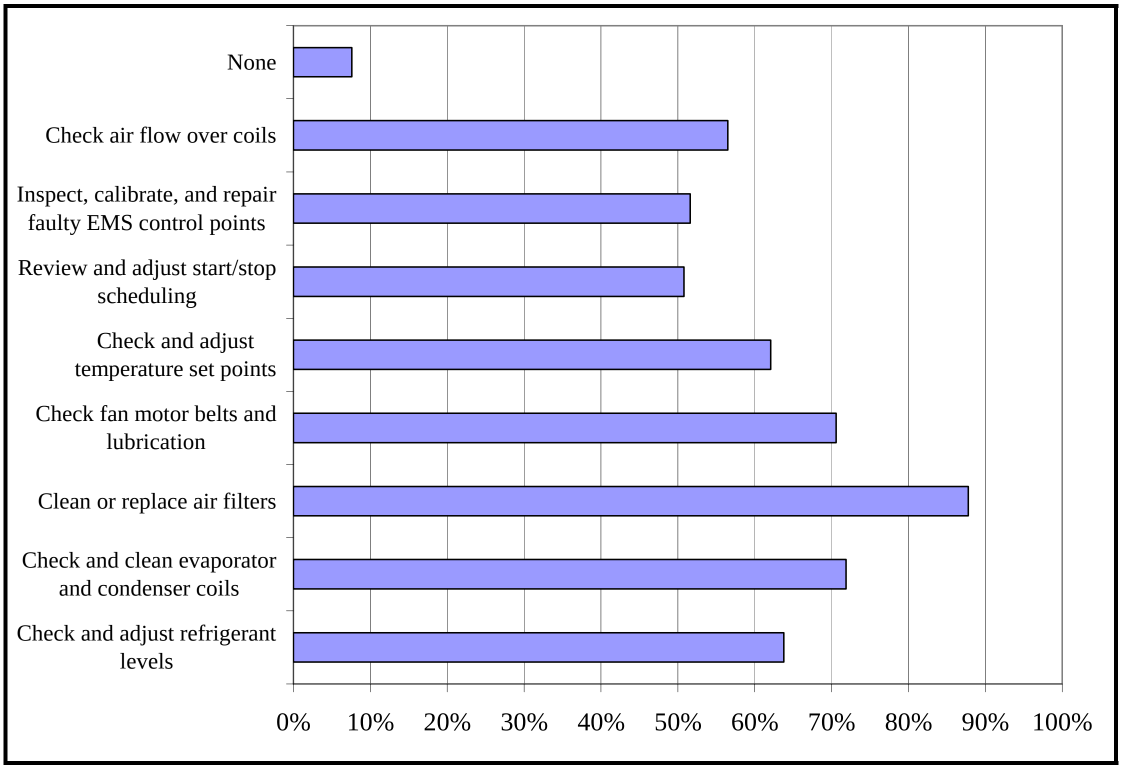
The relative market saturation of various cooling and heating system controls is summarized in Figure 4-4 below. Programmable thermostats are the most common control, at a little less than half the market capacity. Manual thermostats also continue to be quite common, at a little more than 40 percent. EMS is present at less than 20 percent of the market capacity.

Figure 4-4: Presence of Cooling and Heating System Controls



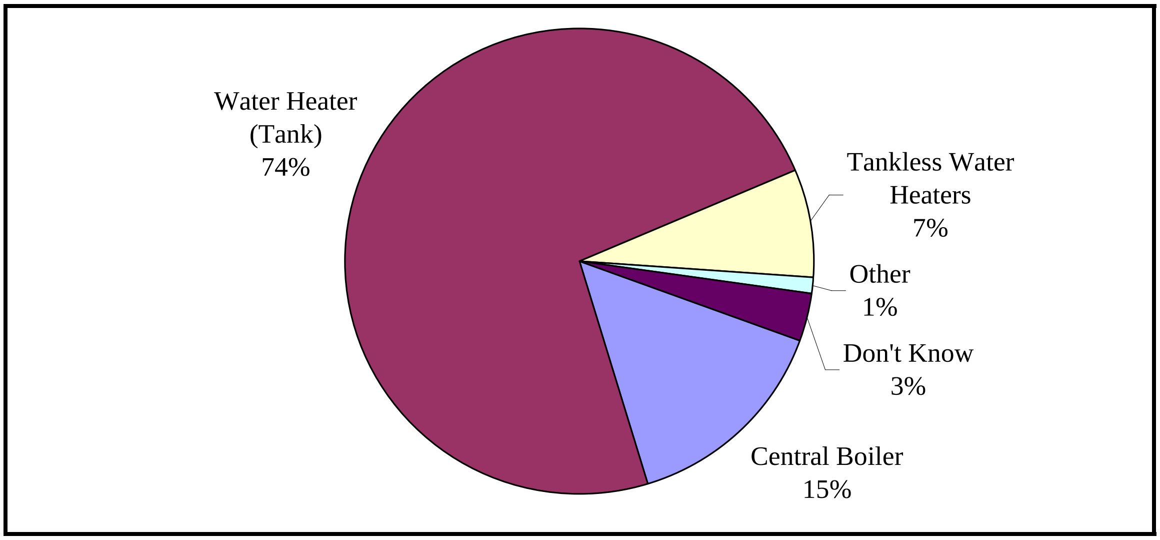
Respondents listed the types of maintenance regularly performed on the cooling systems in their facilities. Figure 4-5 below summarizes the data. This data suggests that over 40% of the market does not routinely perform the maintenance needed to maintain system performance and minimize energy usage at their facilities. This may be a marketing or program opportunity.

Figure 4-5: Cooling System Maintenance Practices



The relative market shares of different types of water heating systems are shown in Figure 4-6 below. Water heater tanks dominate the market, at nearly 75 percent of the market.

Figure 4-6: Water Heating System Technology Saturation



The data in the above figure represent the responses from 425 businesses.

The relative share of various fuel types for space and water-heating systems are presented below in Figure 4-7. Not surprisingly, natural gas and electricity are the most common fuel types – and they split the market for both space and water heating roughly 50/50.

Figure 4-7: Space and Water Heating System Fuel Type Saturation

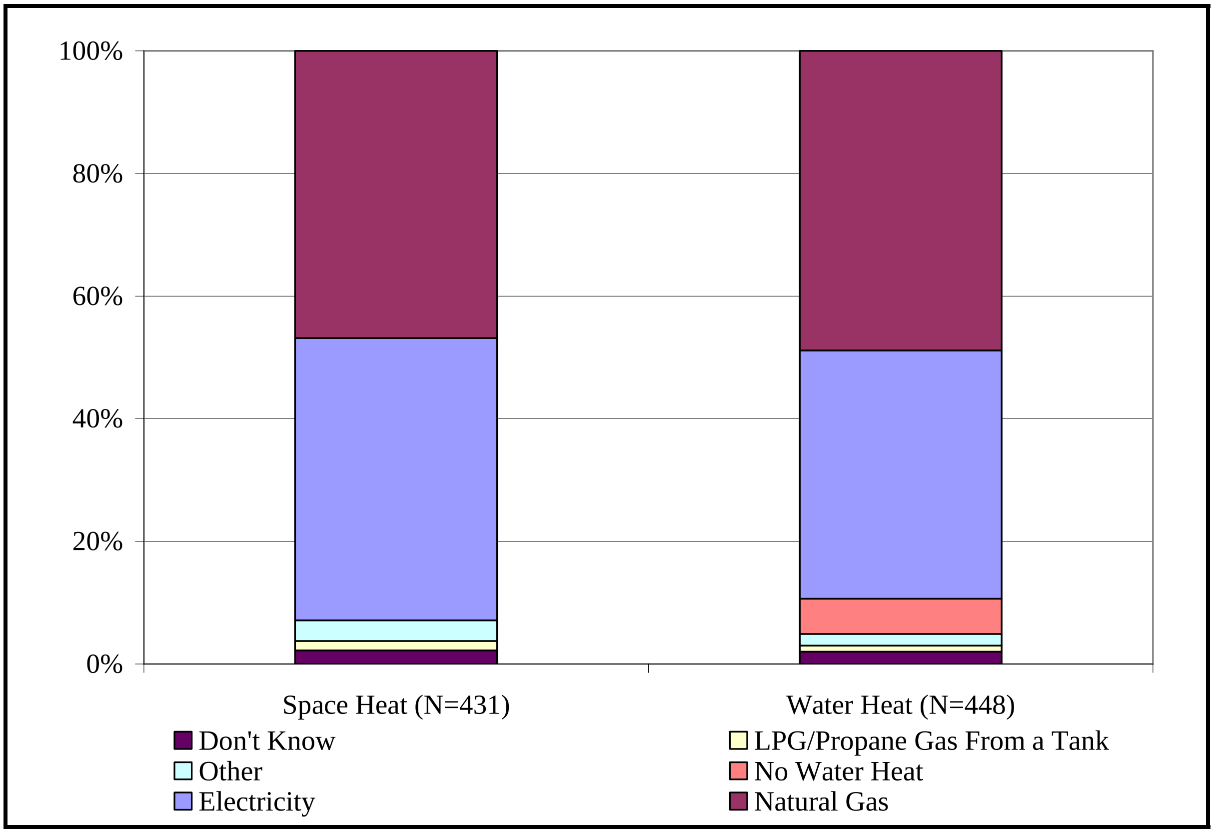
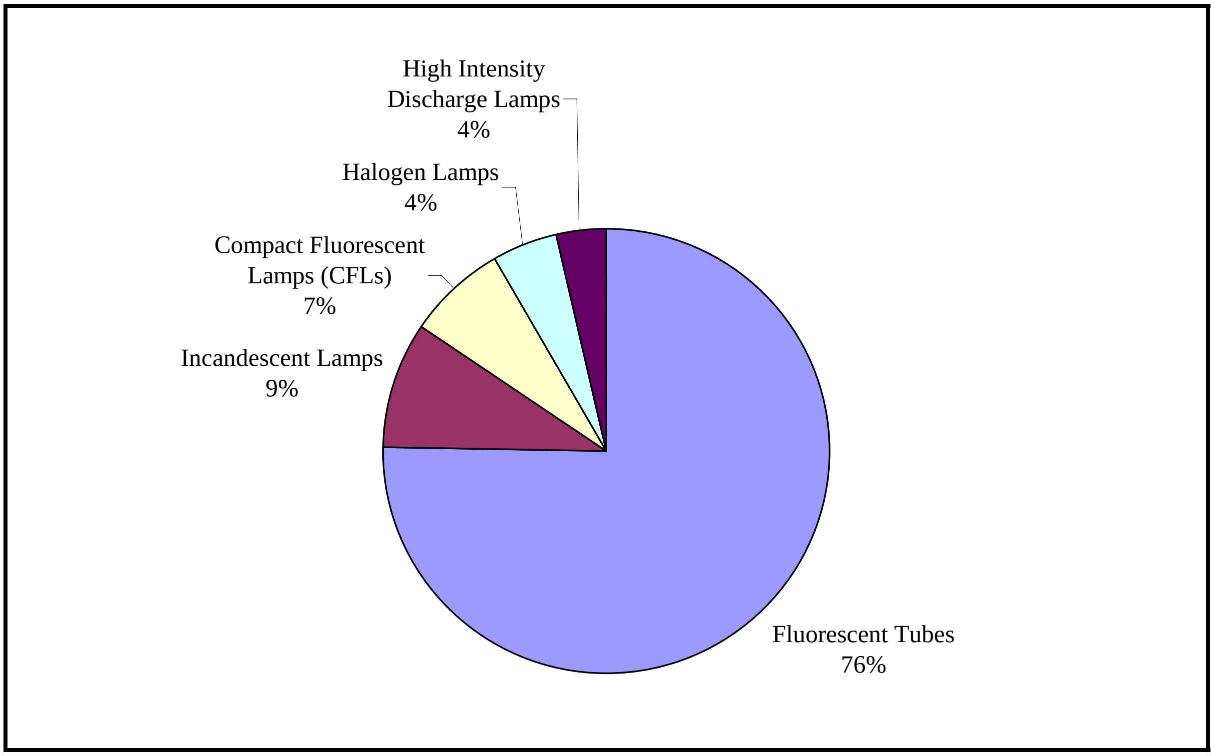


Figure 4-8 below summarizes the lighting system saturation results found in the nonresidential end-user survey. Fluorescent tubes account for the greatest share of lighting, at 76%. CFLs currently make up 7% of current nonresidential lighting lamps but incandescent still have a slight edge with a 9% market share. This data suggests CFLs have captured nearly 50% of the market without any significant promotion at the program level.

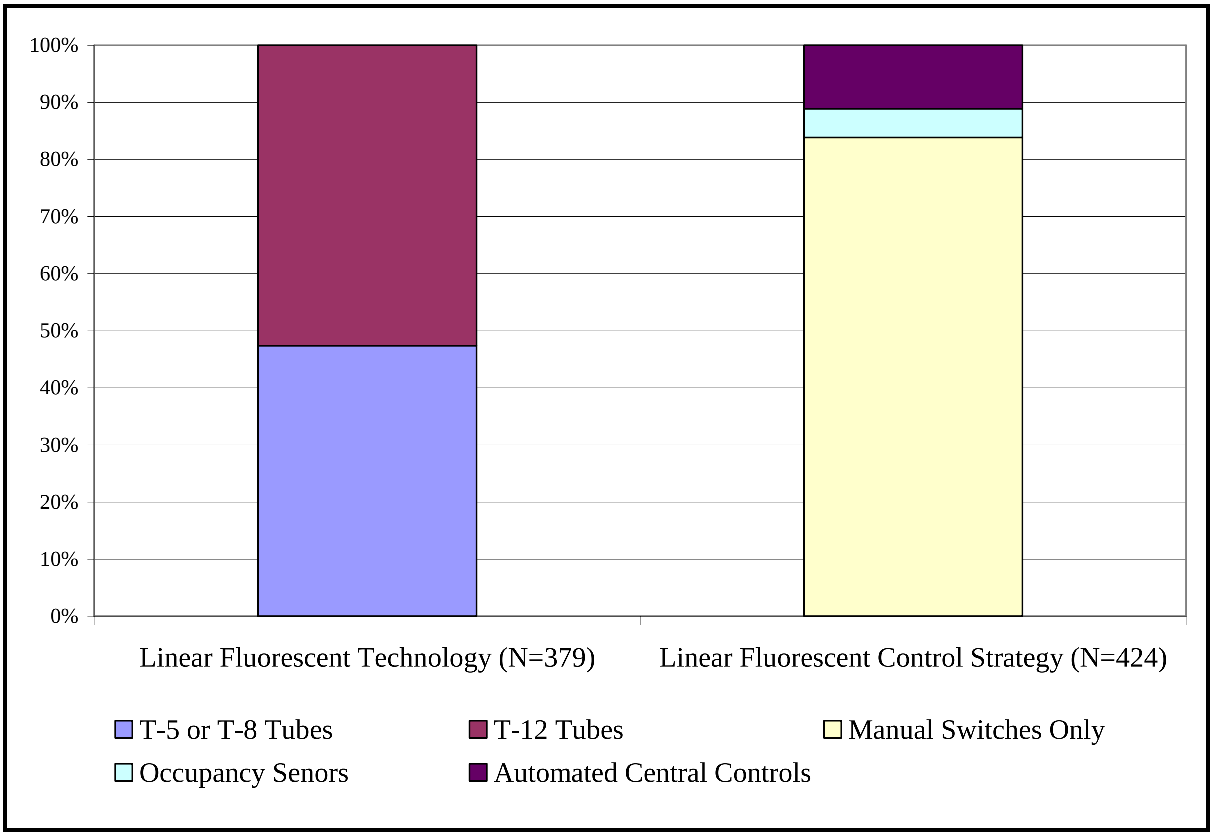
Figure 4-8: Lighting System Technology Saturation



The data in the figure represent the responses of 422 businesses.

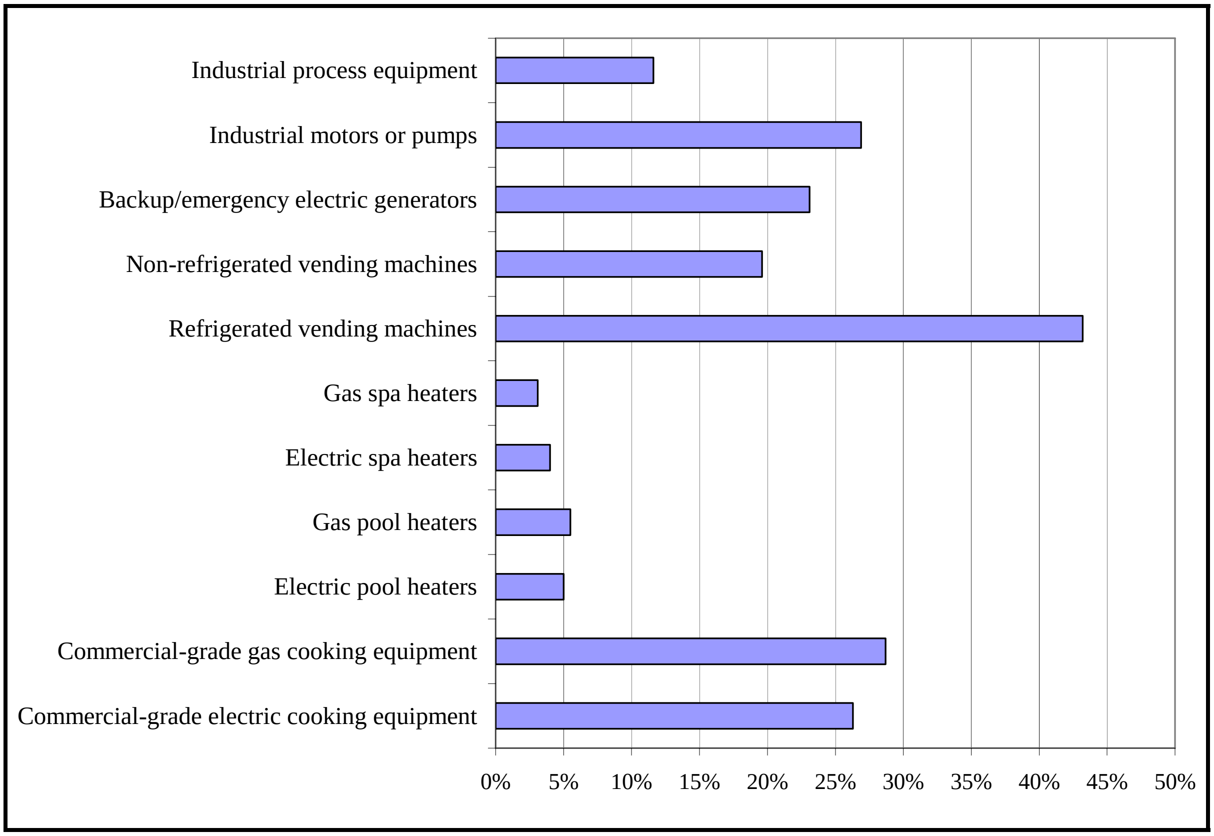
Figure 4-9, below provides a more detailed breakdown of linear fluorescents technology. The Figure shows the relative shares of various linear fluorescent technologies, as well as the controls present on the linear fluorescent systems. T-12's account for a little over half of all linear fluorescent systems, and only about 15 percent have a control system. This data was an important input to the Naturally Occurring and the Achievable potential models because it shows that close to 50% of the market has installed more efficient lighting systems in a market in which only 10% of the retrofit market is currently being reached by utility programs.

Figure 4-9: Linear Fluorescent Detail



Saturations of various other types of more specialized equipment are summarized in Figure 4-10 below. Refrigerated vending machines are the most common measure among the other equipment types of measures for which saturation data was collect. Commercial grade cooking equipment is also quite common, at about one-quarter of the market. Industrial motors, pumps and processing equipment are also present in about 25 percent of the market. Each of these systems presents opportunities to market more efficient systems to customer building owners.

Figure 4-10: Saturation of Other Types of Equipment



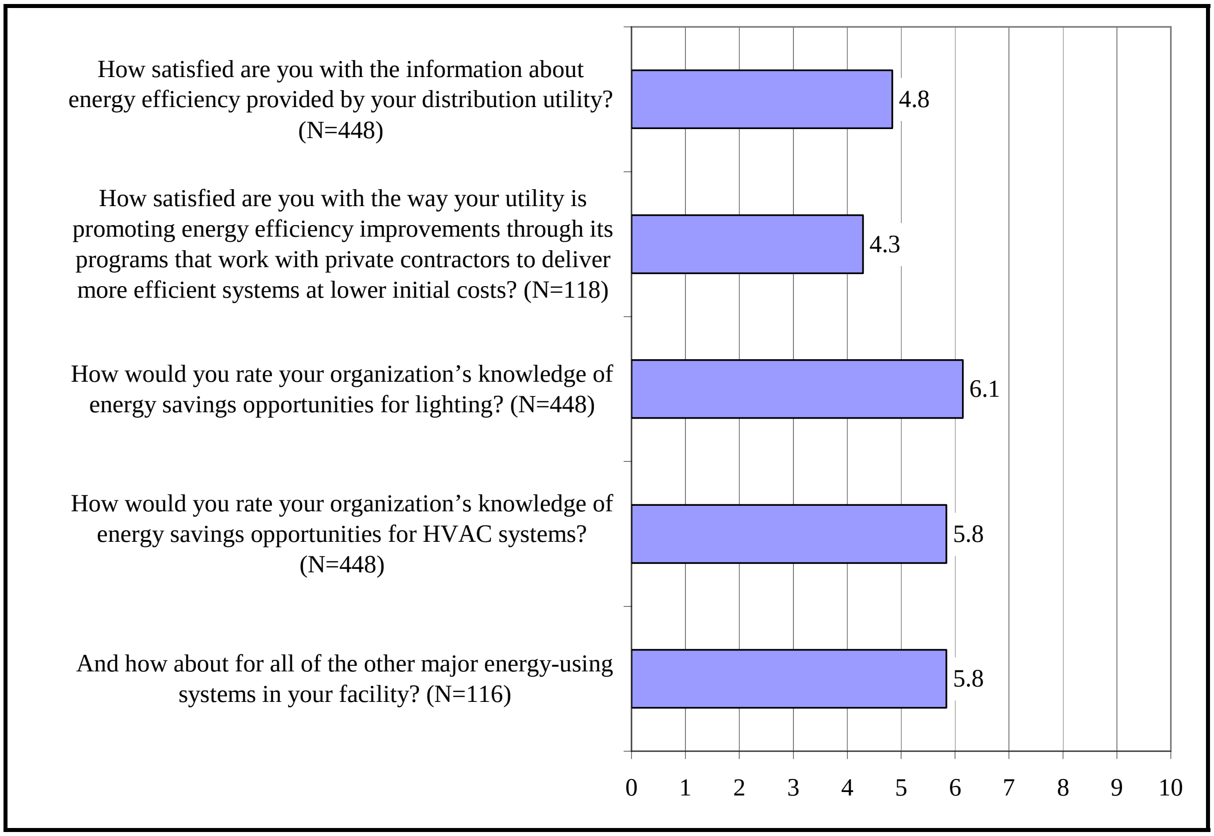
The data in the above figure represent the responses from 448 businesses.

4.2.2 Customer Knowledge and Awareness of Energy Efficiency Measures and Programs

Customers were asked to rate their knowledge of energy efficiency opportunities for their cooling, heating and “other” systems. Respondents rated their knowledge on a scale of 1 to 10, where 1 is not knowledgeable at all and 10 is very knowledgeable. Customers were only moderately confident in their level of energy efficiency knowledge, with an average rating of approximately 6 for all systems. The knowledge survey results are presented in Figure 4-11.

Customers also rated their satisfaction with sources of energy efficiency information and programs. A 1 to 10 scale was used, where 1 was completely dissatisfied and 10 was extremely satisfied. Respondents report relatively low levels of satisfaction with these services offered by their distribution utility, with average rating less than 5.

Figure 4-11: Knowledge of Systems and Satisfaction with Information Sources (1 to 10 Scales, where 10 is very Satisfied/Knowledgeable)



Awareness of energy efficiency programs in the nonresidential population is fairly low, at about 23 percent. Sixteen percent report both being aware and having participated in such a program. Awareness results are displayed below in Figure 4-12. Again this is an important input to Itron's forecast of achievable savings because it shows that the combined effects of private marketing from ESCOS participating in utility programs have only reached from 20 to 30% of the market.

Figure 4-12: Awareness of Programs Sponsored by the Distribution Utility Designed to Encourage the Installation of Efficient Equipment

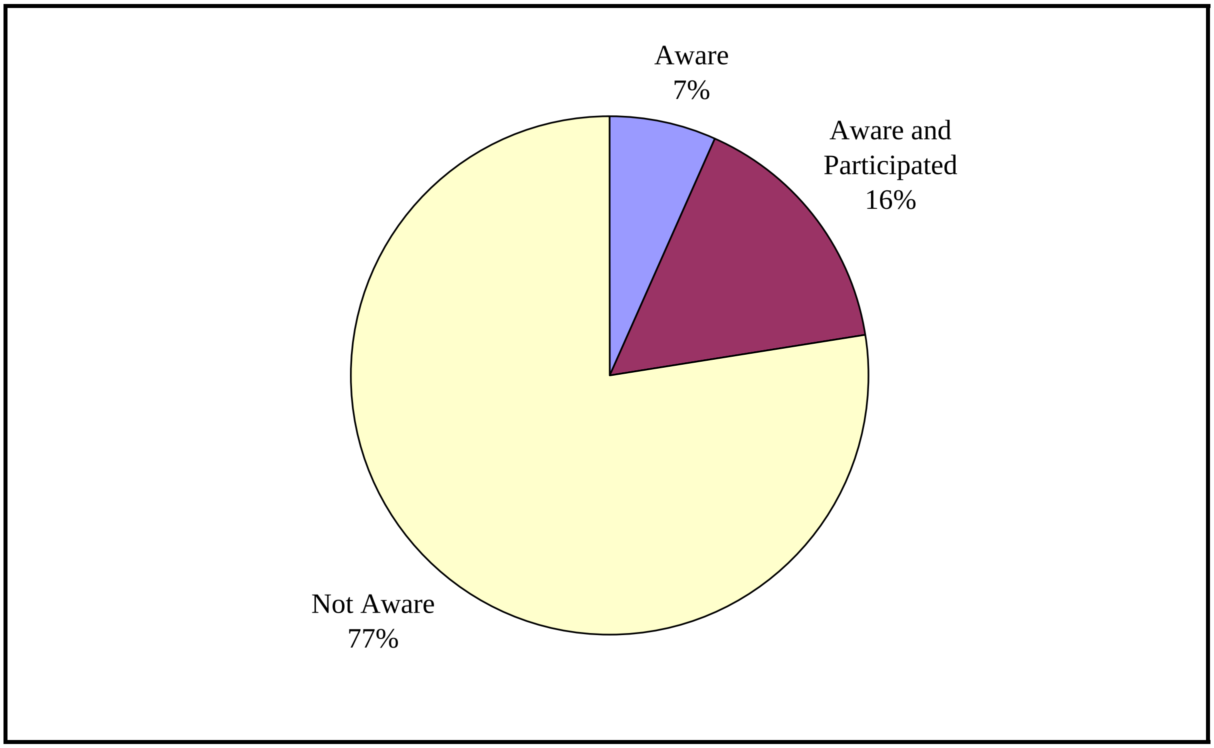
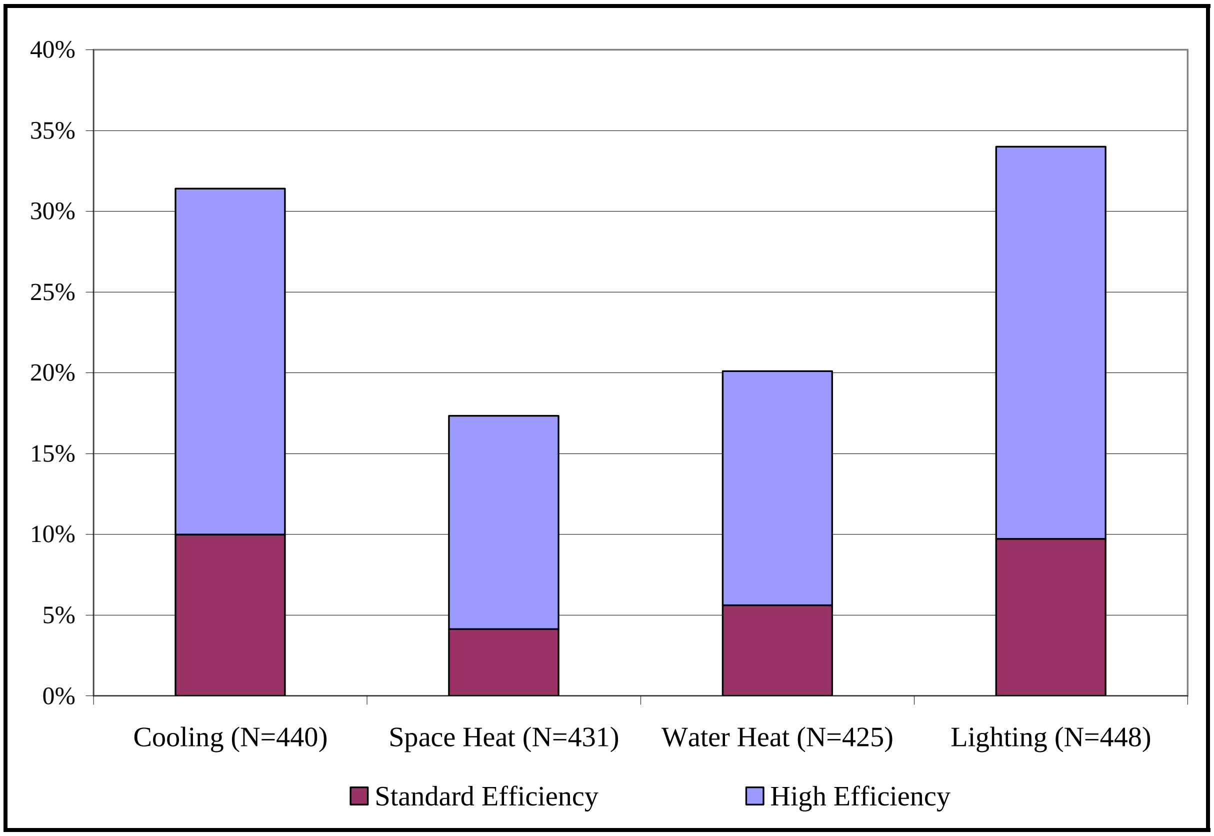


Figure 4-13 below summarizes retrofit rates over the past three years reported by survey respondents. Respondents also characterized their retrofit installations as either “high” or “standard” efficiency, and these relative shares are shown in the bars below. Not surprisingly, lighting and cooling systems have the highest retrofit rates, and all technologies report a larger share of energy efficient installations compared to standard efficiency systems.

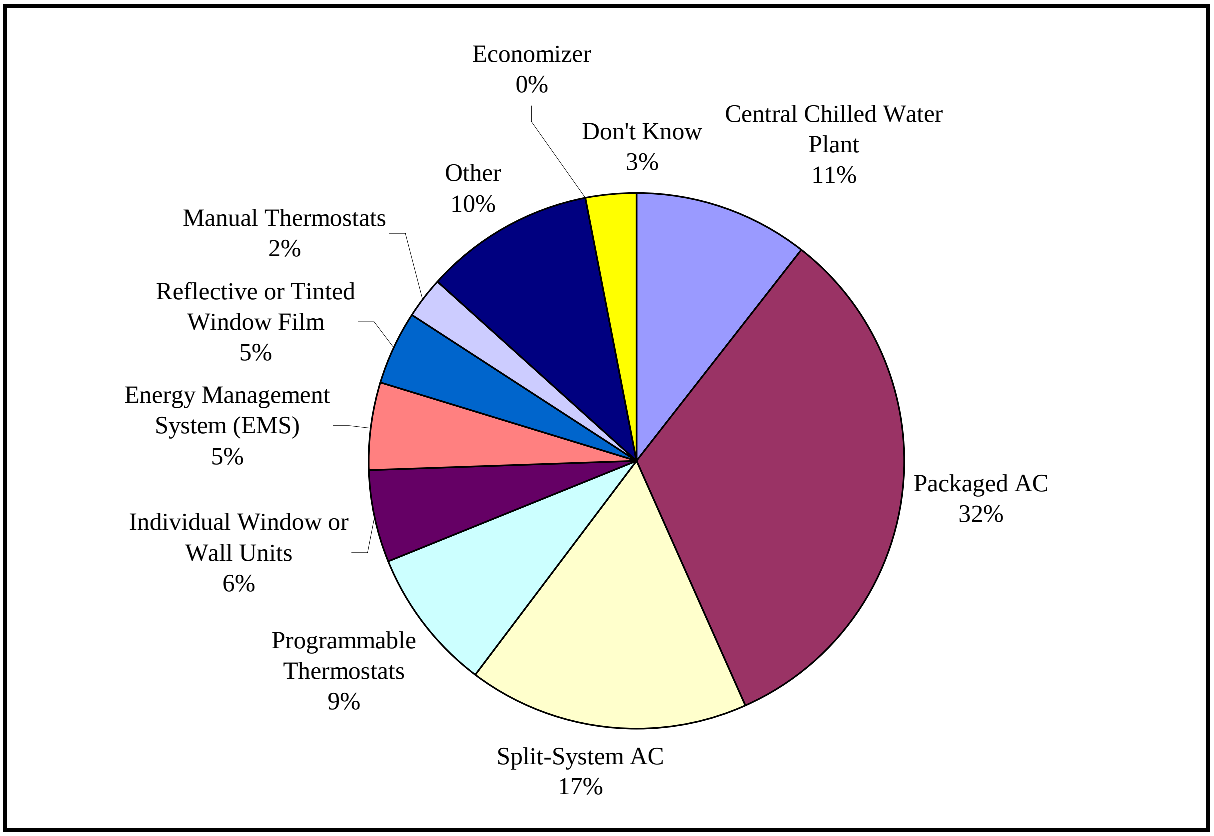
Figure 4-13: High and Standard Efficiency Retrofit Rate, Past Three Years



4.2.3 Types of Cooling, Heating and Lighting System Retrofits in the Last Three Years

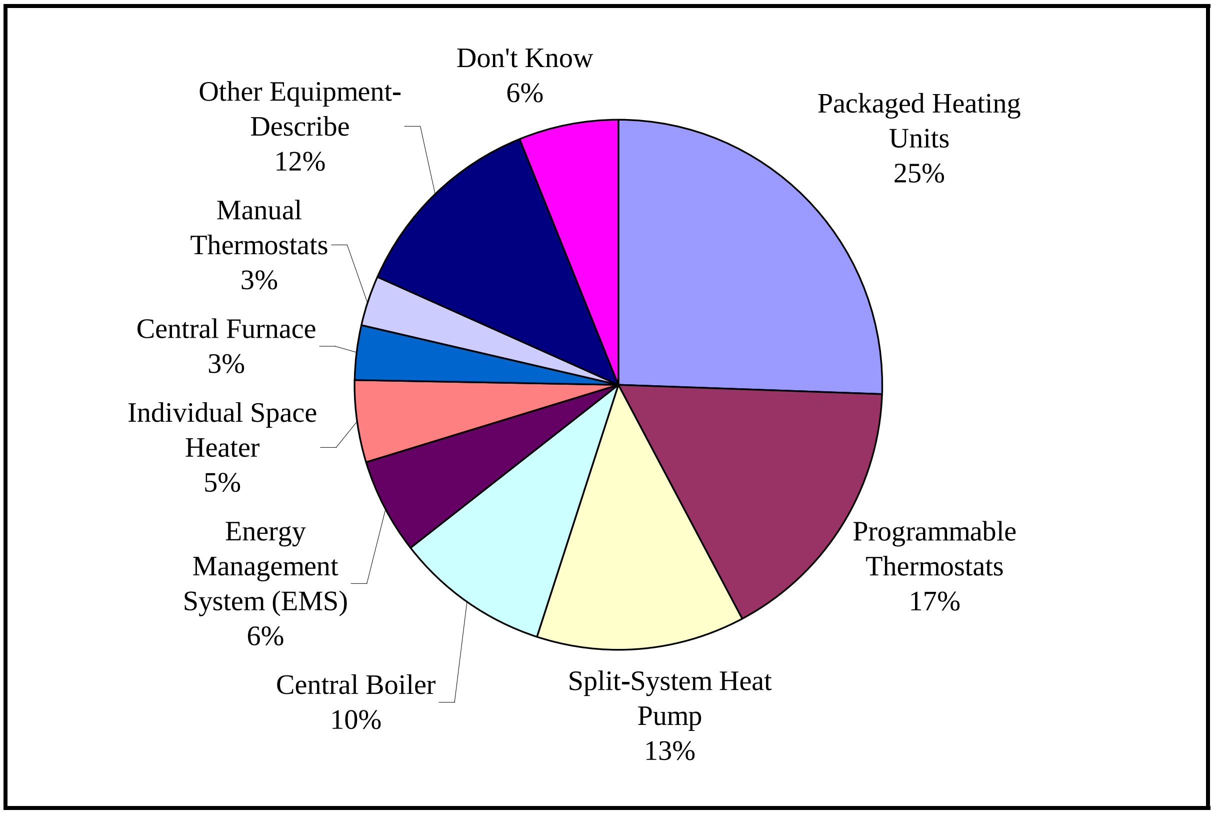
Respondents that performed a retrofit of a cooling system over the past three years were asked to report what technology they installed. Figure 4-14 below summarizes their responses. Packaged AC's are the most common system installed, at 32 percent of retrofits.

Figure 4-14: Cooling System Retrofit Technology Distribution



Respondents performing a space heating retrofit over the past three years were asked to report the installed technology. The retrofit technologies are presented in Figure 4-15. Packaged heating units were the most common type of heating system present in nonresidential buildings and they are the most common heating retrofit measure (25% of retrofits). Programmable thermostats are also common retrofit measures (17% of retrofits).

Figure 4-15: Heating System Retrofit Technology Distribution



Respondents performing a water heating retrofit over the past three years were asked to report the installed technology. The water heating retrofit measures are displayed in Figure 4-16. Tank water heaters are the most commonly type of water heater and they are the most common water heater retrofit at 64% of retrofits. Tankless water heaters represent only 7% of the current water heater saturation but are 12% of retrofit installations. These data may indicate that the future saturation of the more efficient tankless water heating measure is growing.

Figure 4-16: Water Heating System Retrofit Technology Distribution

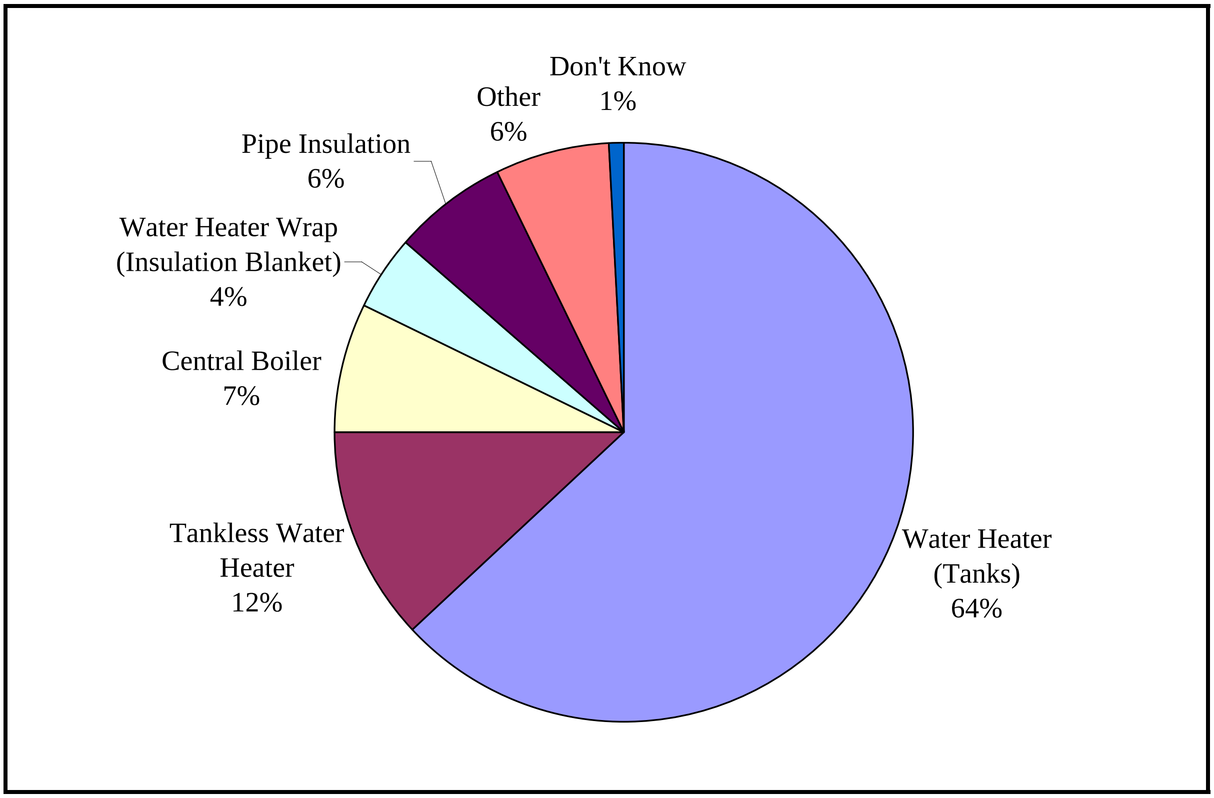
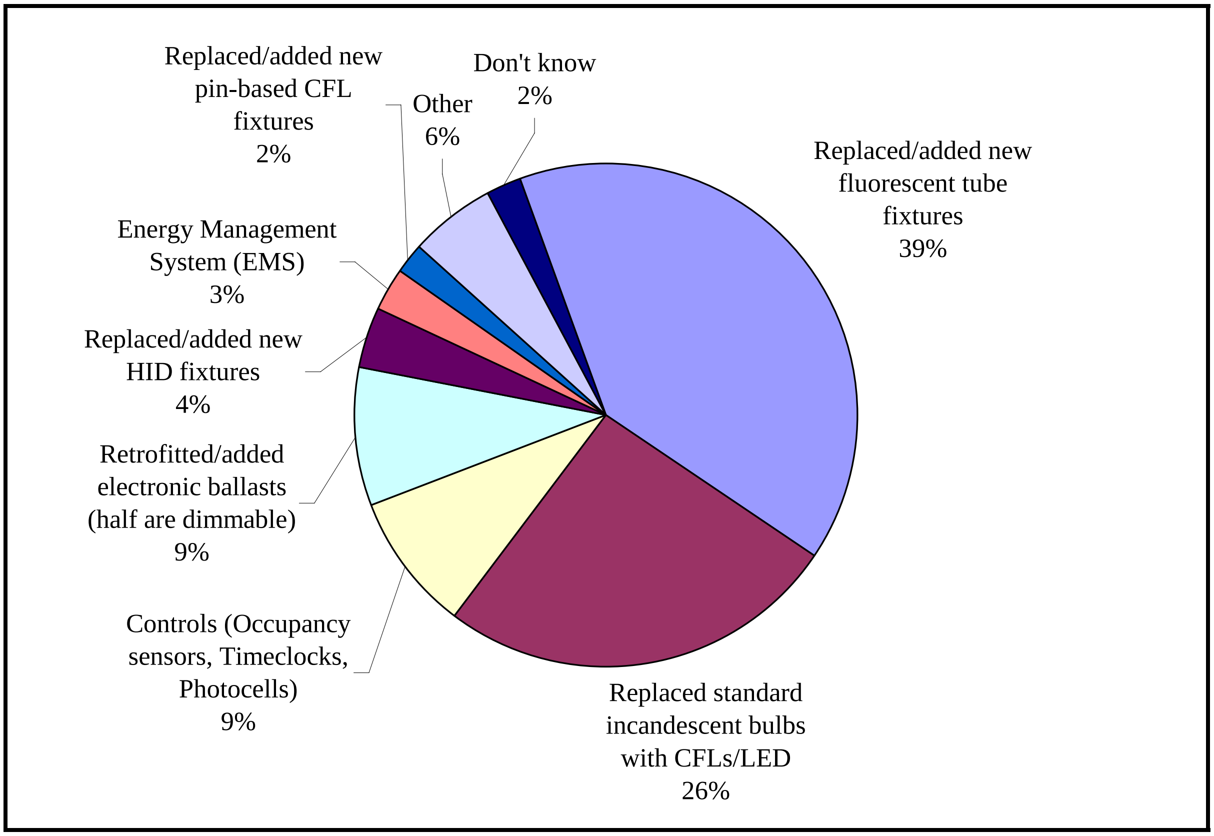


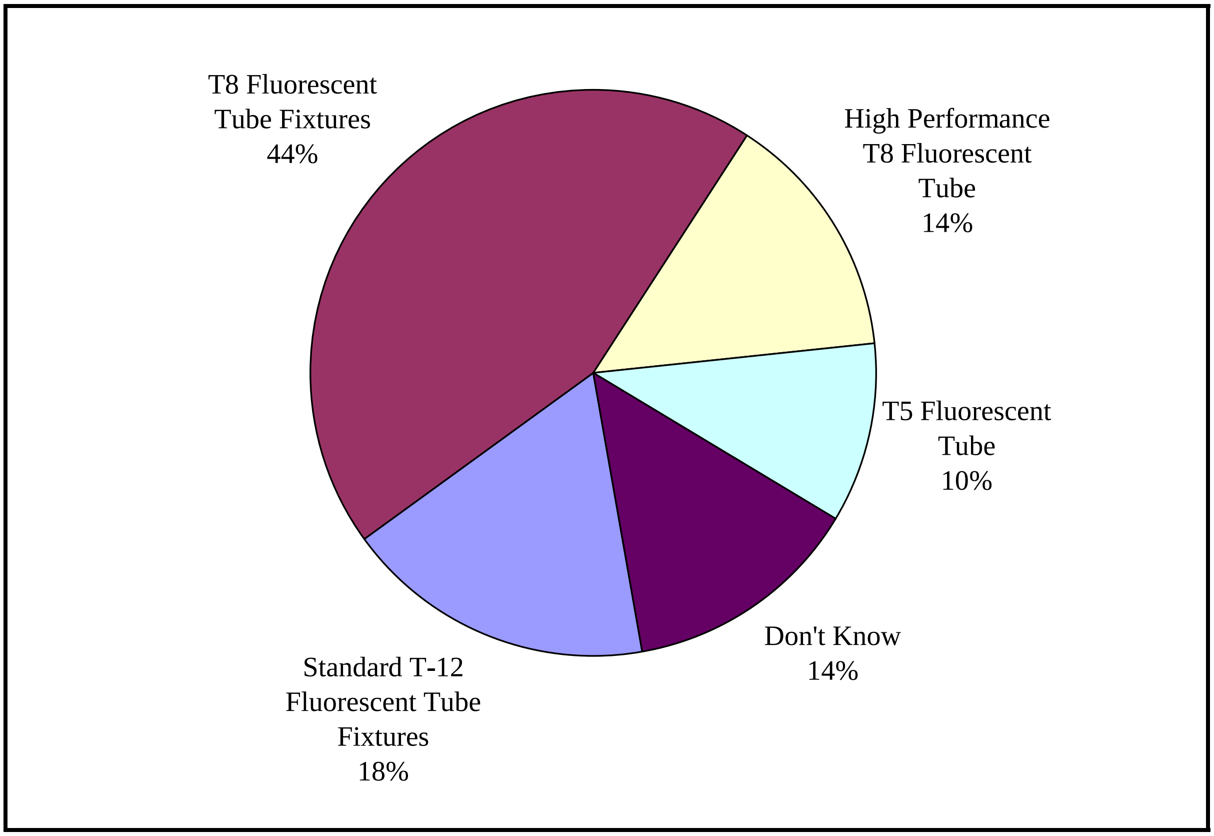
Figure 4-17 below shows the lighting system retrofit technology distribution. Not surprisingly, given the total relative saturations, the most common retrofit activity is replacement of linear fluorescent systems. However, the high rate of replacement of incandescent with CFL or LED reveals a significant interest in efficient lighting in the nonresidential population. The share of CFLs and lighting control retrofits is substantial given the relatively low levels of program awareness presented in previous figures.

Figure 4-17: Lighting System Retrofit Technology Distribution



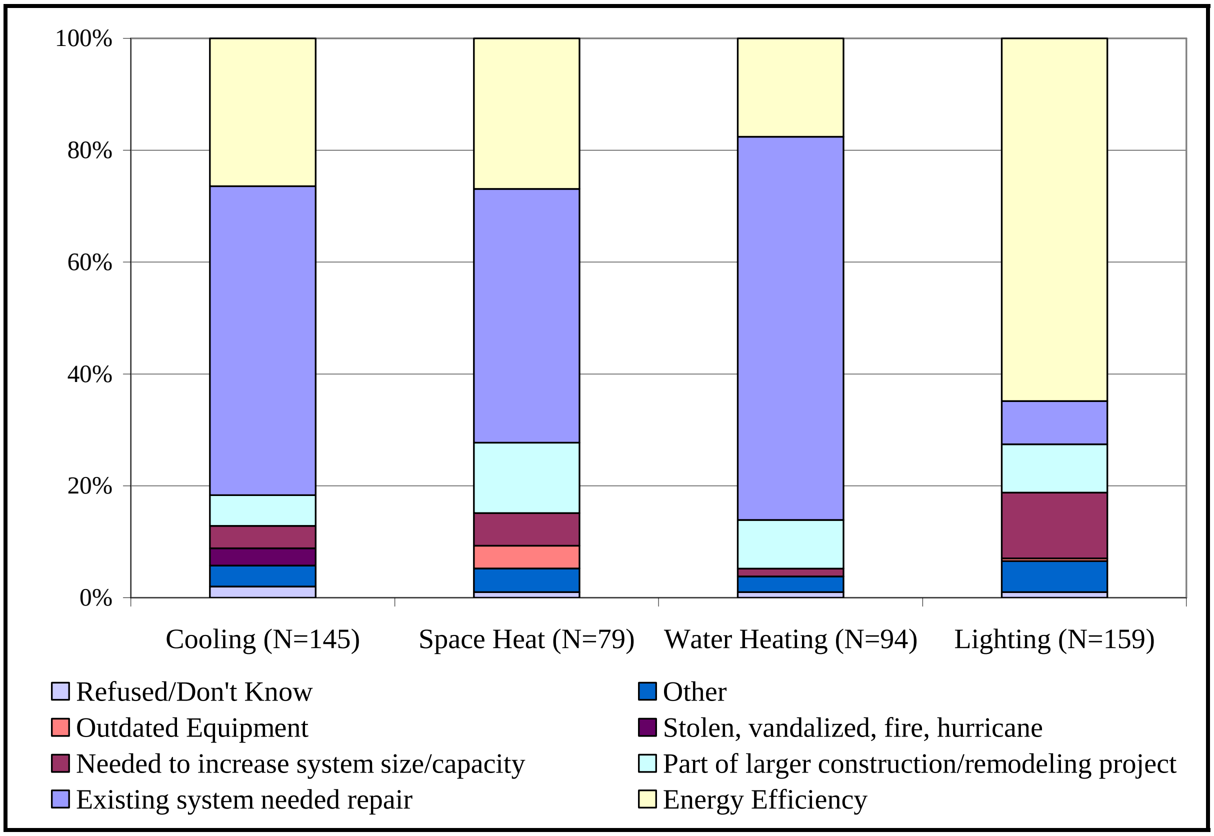
Customers reporting a retrofit of a linear fluorescent system were asked to report the type of lamps installed during the retrofit. Figure 4-18 below summarizes their response. The most common installation is T-8 tubes, at 44 percent of linear fluorescent retrofit activity. This figure shows that a high percentage (perhaps up to 25%) of the market is aware of and pursuing high performance T8s and T5s while a combined 44% of the market are pursuing T-8 or T5 lighting systems. The retrofit of T12 systems with T8s and T5s is occurring largely without significant levels of program assistance. Recall that our review of program performance showed that utility programs had reached between 1 and 2 percent of the nonresidential market over the last six years.

Figure 4-18: Linear Fluorescent System Retrofit Detail – Technology Distribution



Customers reporting a retrofit of any major system were asked to report the main reason for the retrofit. Possible responses included the old system was broken, they were expanding or remodeling their facility, etc. The responses are displayed in Figure 4-19 by retrofit end use. The results indicate that the majority of lighting system retrofits are completed based on a desire to improve the energy efficiency of the facility (and reduce energy costs) while the majority of other system types (cooling, heating and water heating) are not replaced until they break down or needed repair. This finding is consistent with Itron choice to model the replacement of lighting as a retrofit activity and the replacement of most other measures as replace on burnout applications.

Figure 4-19: Main Reasons for Retrofit Activity by End Use



4.3 Results of the Trade Ally Surveys

4.3.1 Trade Ally Final Sample

The final distribution of trade allies who provided answers to our survey by business size and market segment is presented below in Table 4-1.

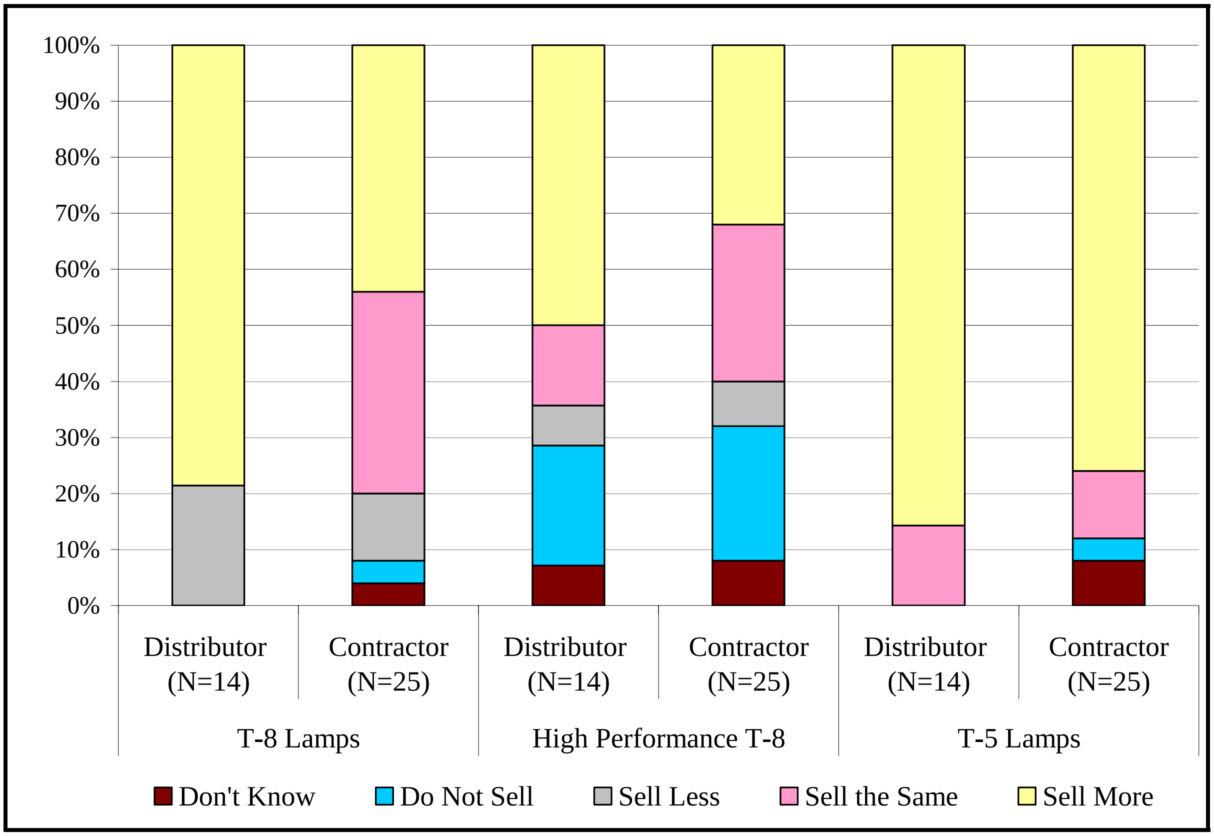
Table 4-1: Final Distribution of Trade Ally Surveys by Business Size, Market Segment, and Market Actor

	Air Conditioner		Lighting	
Size	**Distributors**	**Contractors**	**Distributors**	**Contractors**
Large	6	10	1	4
Medium	7	11	4	14
Small	2	10	4	2
Total	**15**	**31**	**9**	**20**

4.3.2 Lighting Trade Ally Survey Results

This section summarizes the results of the lighting contractor and distributor survey. Figure 4-20 summarizes the responses of lighting contractors and distributors to the question of whether they are selling more, less, or the same quantity of more efficient lighting technologies in the last three years. The Figure shows the greatest market movement has been in T-5 lamps, where approximately 76% of contractors and 86% of distributors report a recent increase in sales of efficient lighting systems.

Figure 4-20: Sales Trends, Linear Fluorescent Technologies



Trends in compact fluorescent sales are reported in Figure 4-21. About 80% of distributors report an increase in both hardwired and screw-based CFLs, while more contractors report an increase in hardwired sales (68 percent) than in sales of screw-based bulbs (44 percent).

Figure 4-21: Sales Trends, Compact Fluorescent Lighting

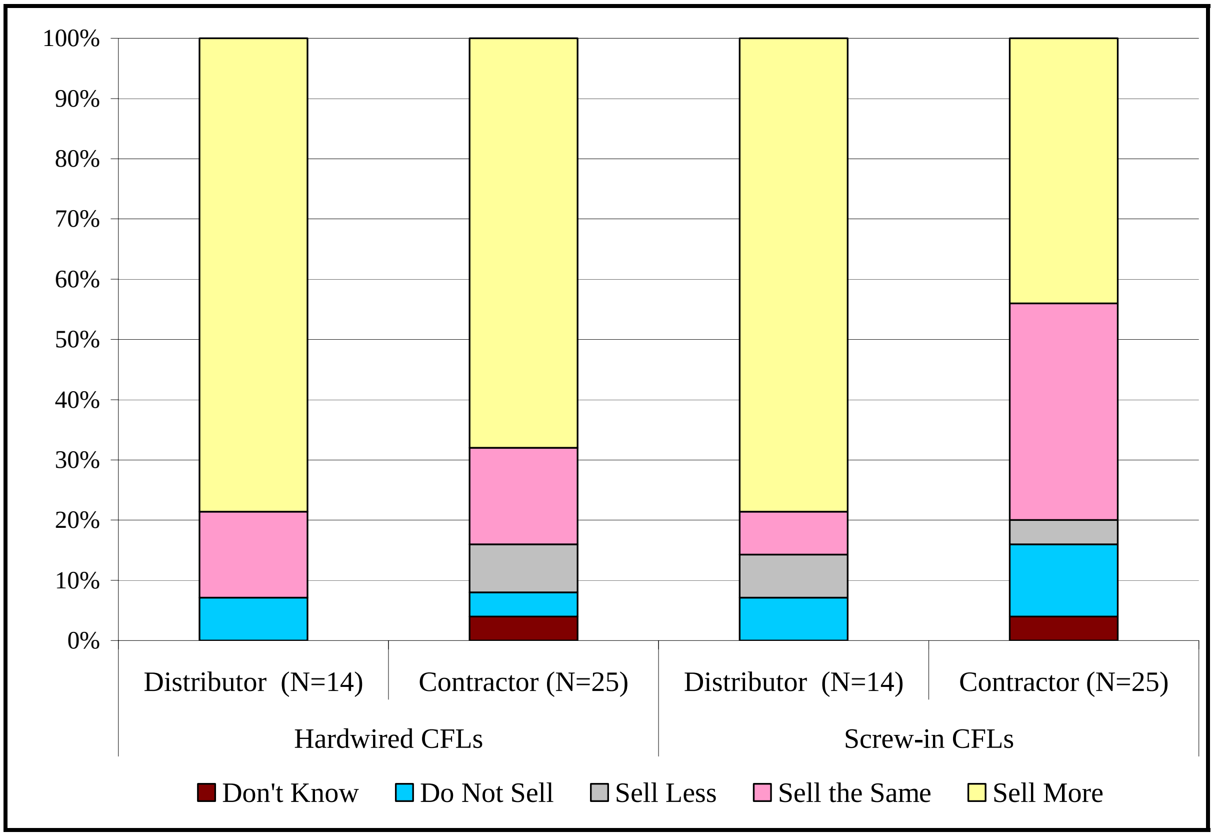
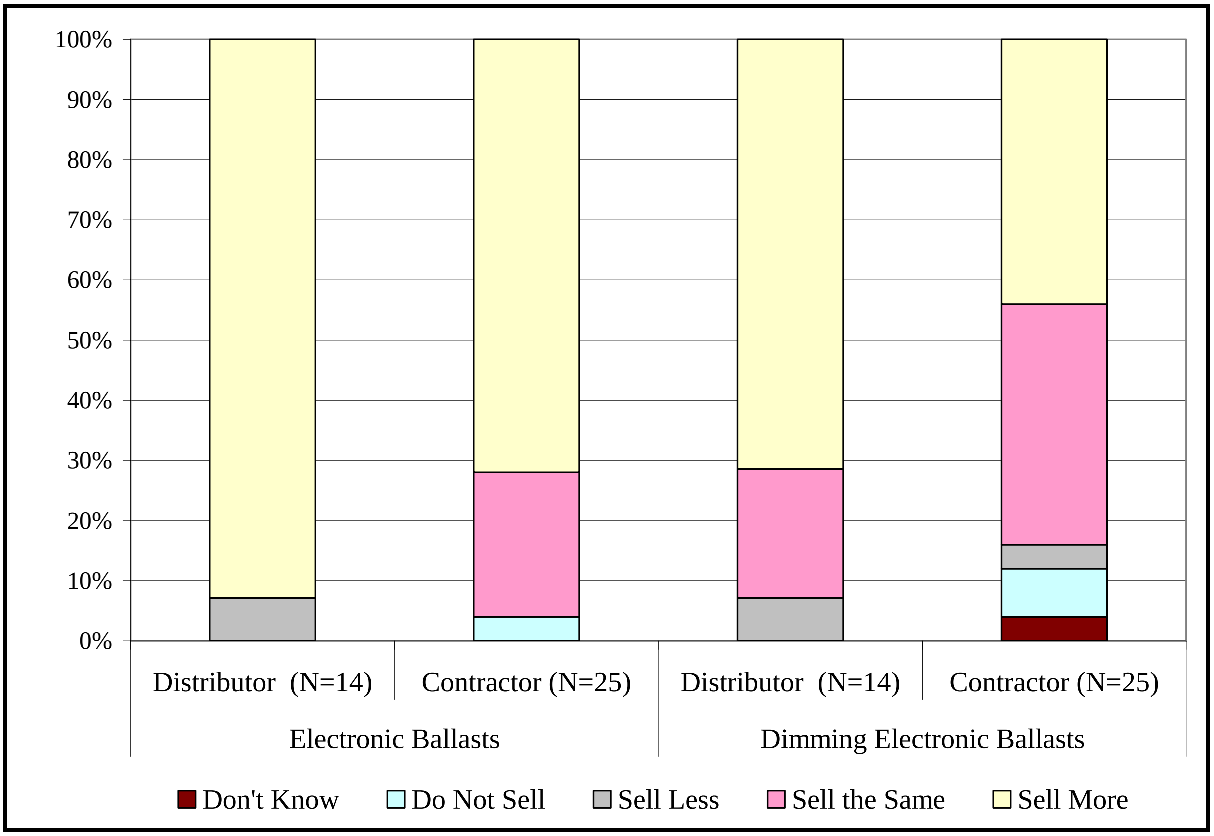


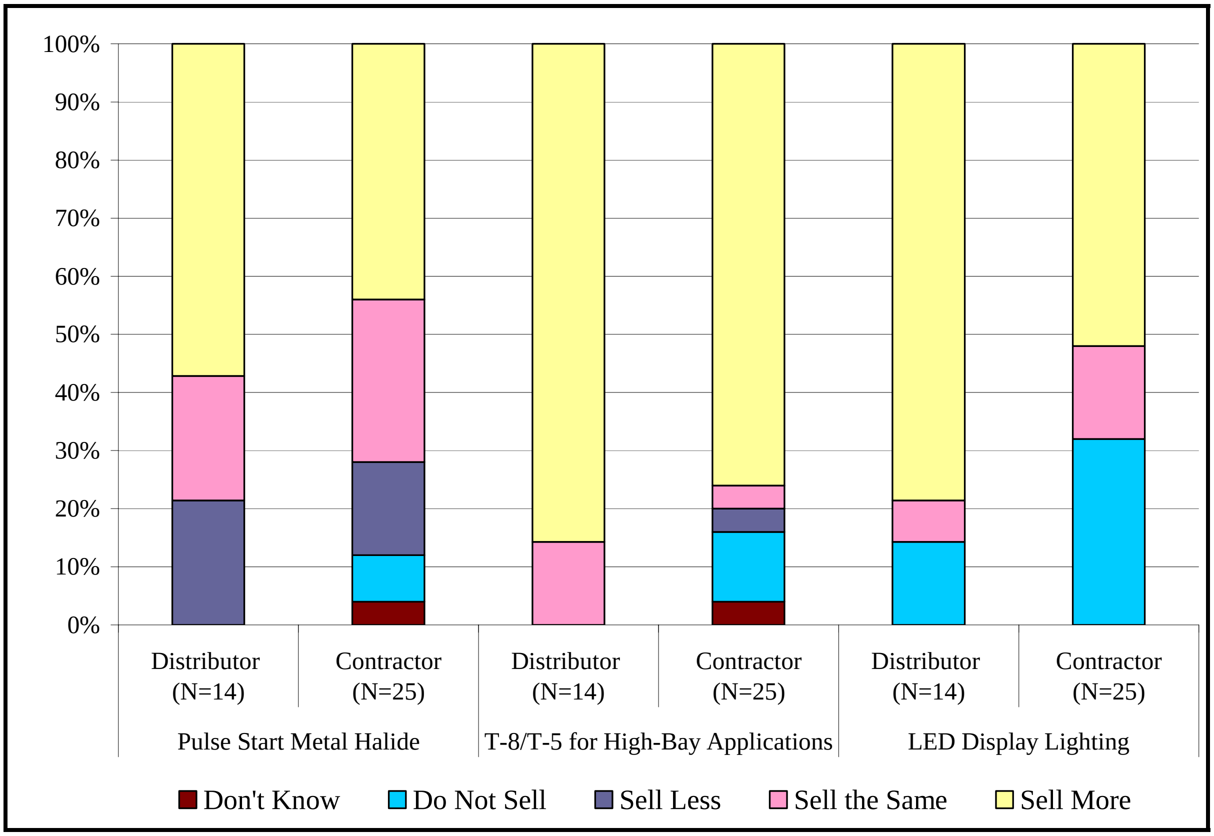
Figure 4-22 summarizes contractor and distributor reports of recent sales trends in electronic and dimmable electronic ballasts. Both contractors and distributors report growth in the market for electronic ballasts, and both report greater change in sales of electronic ballasts than dimmable electronic ballasts.

Figure 4-22: Sales Trends, Electronic Ballasts



Trends in other more specialized efficient lighting technologies are summarized in Figure 4-23. Contractors and distributor survey results indicate substantial growth in the sales of T-8/T-5 linear fluorescent lamps for high bay applications.

Figure 4-23: Sales Trends, Specialized Lighting



Contractors and distributors reports of recent sales trends in lighting control technologies is displayed in Figure 4-24. There is little movement in the market for reflectors (for de-lamping), moderate growth in day lighting controls, but more significant growth in the sales of occupancy sensors, with about 90% of both contractors and distributors reporting growth in the sales of occupancy sensors. This suggests that occupancy sensors have a strong naturally occurring adoption rate in Texas and that sensors may not require the support of program rebates to encourage high adoption rates.

Figure 4-24: Sales Trends, Lighting Controls

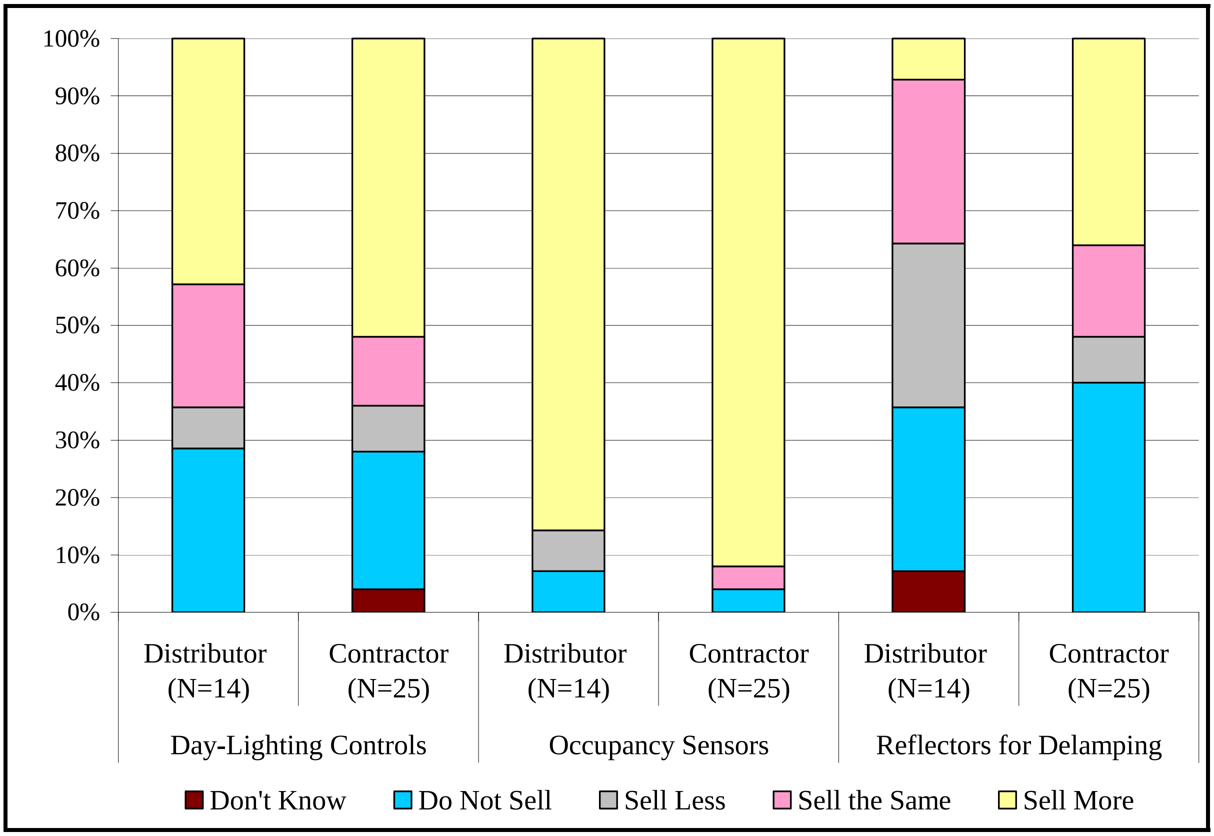


Figure 4-25 presents the relative shares of linear fluorescent technologies installed by surveyed contractors in new construction and retrofit jobs over the past year. Results indicate that T-8 technology is the most common form of linear fluorescent installed, though T-5's account for about 20% of both retrofit and new construction installations. Distributors also reported their breakdown of recent sales by type of linear fluorescent technology. The distributors' responses are illustrated in Figure 4-25 and they are generally consistent with the responses of contractors.

Figure 4-25: New Construction and Retrofit, Linear Fluorescent Technology Distribution

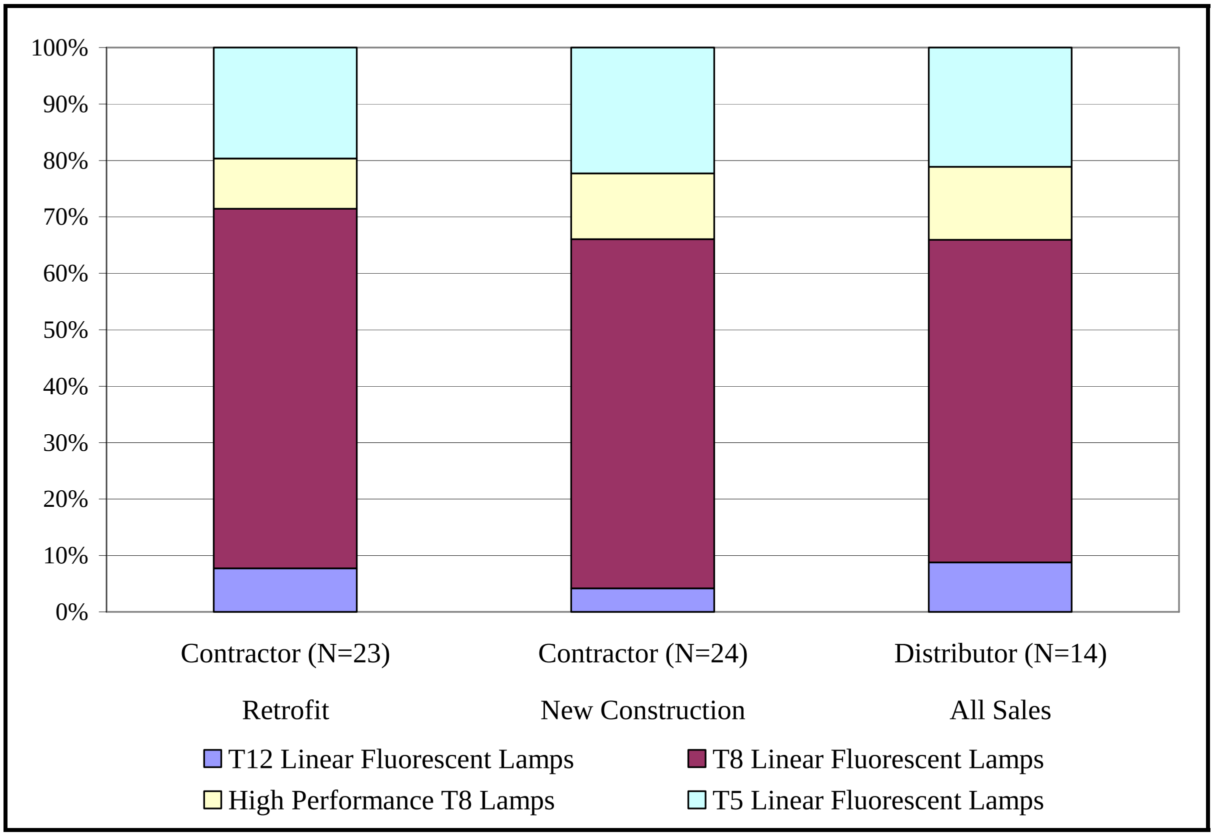
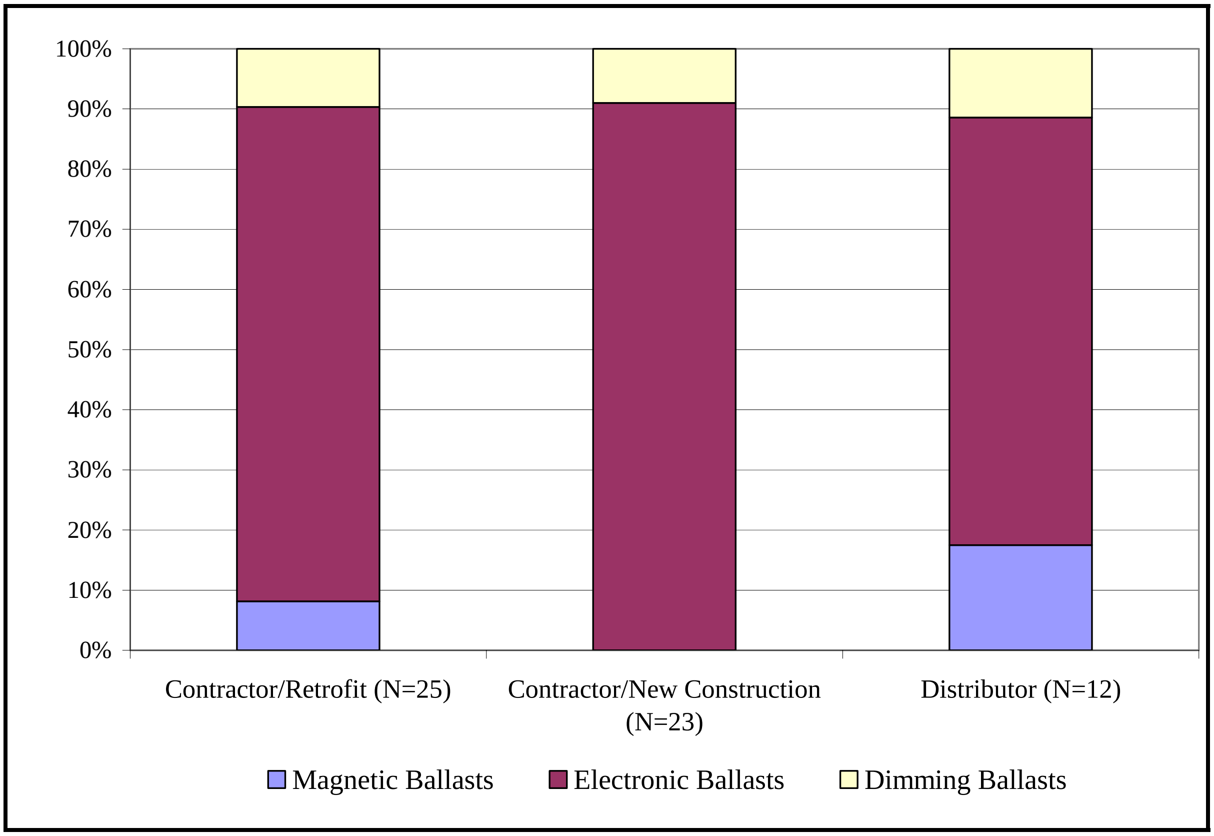


Figure 4-26 illustrates contractors and distributors reported relative shares of recent sales/installations of various ballast technologies. Contractors report that over 90% of all installations are electronic or dimmable electronic ballasts, while distributors report 18% of sales are magnetic ballasts.

Figure 4-26: New Construction and Retrofit, Electronic Ballast Technology Distribution



As shown in Figure 4-27, lighting contractors report that a little less than half of the square feet of new construction jobs are equipped with lighting controls. The most common control technology is occupancy sensors, at about 49 percent of all lighting controls. The remaining 51 percent is split between EMS (22%), time clocks (16%) and photocells/day lighting (15%).

Figure 4-27: New Construction, Presence of Controls and Control Technology Distribution

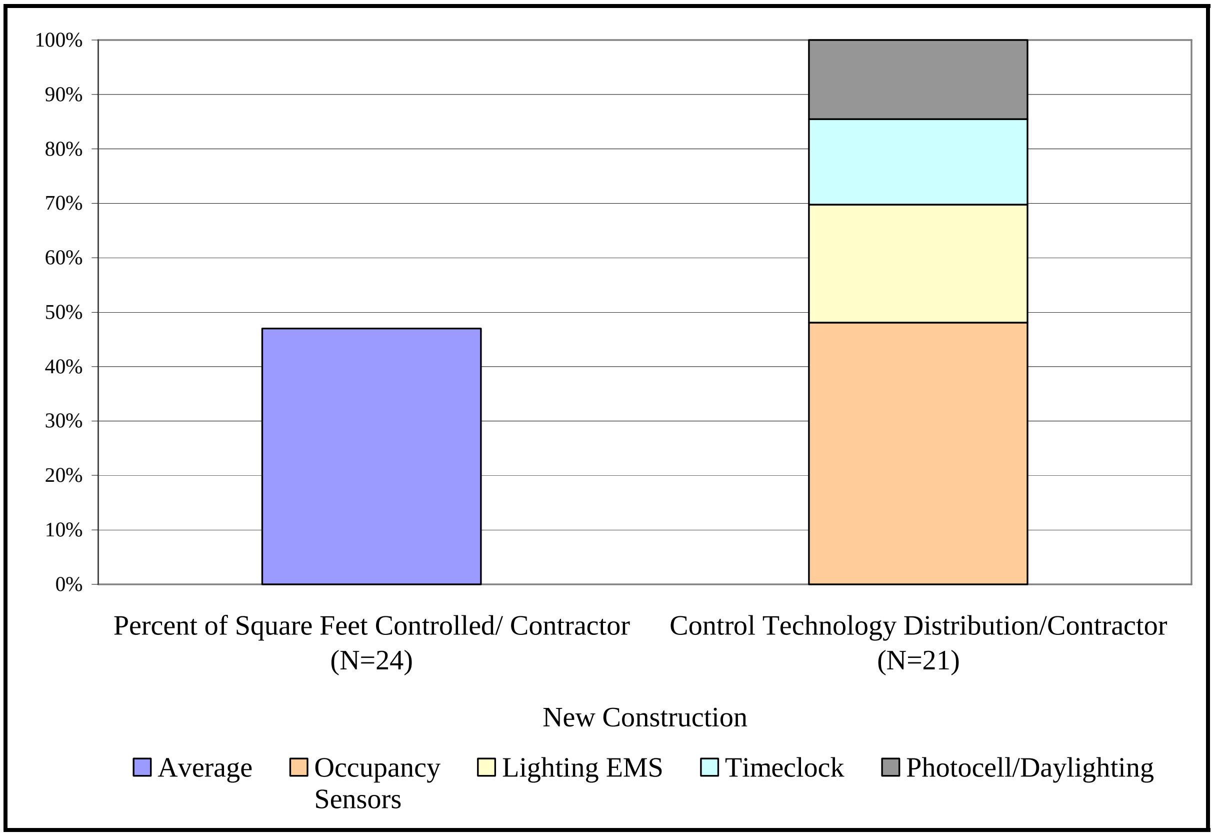
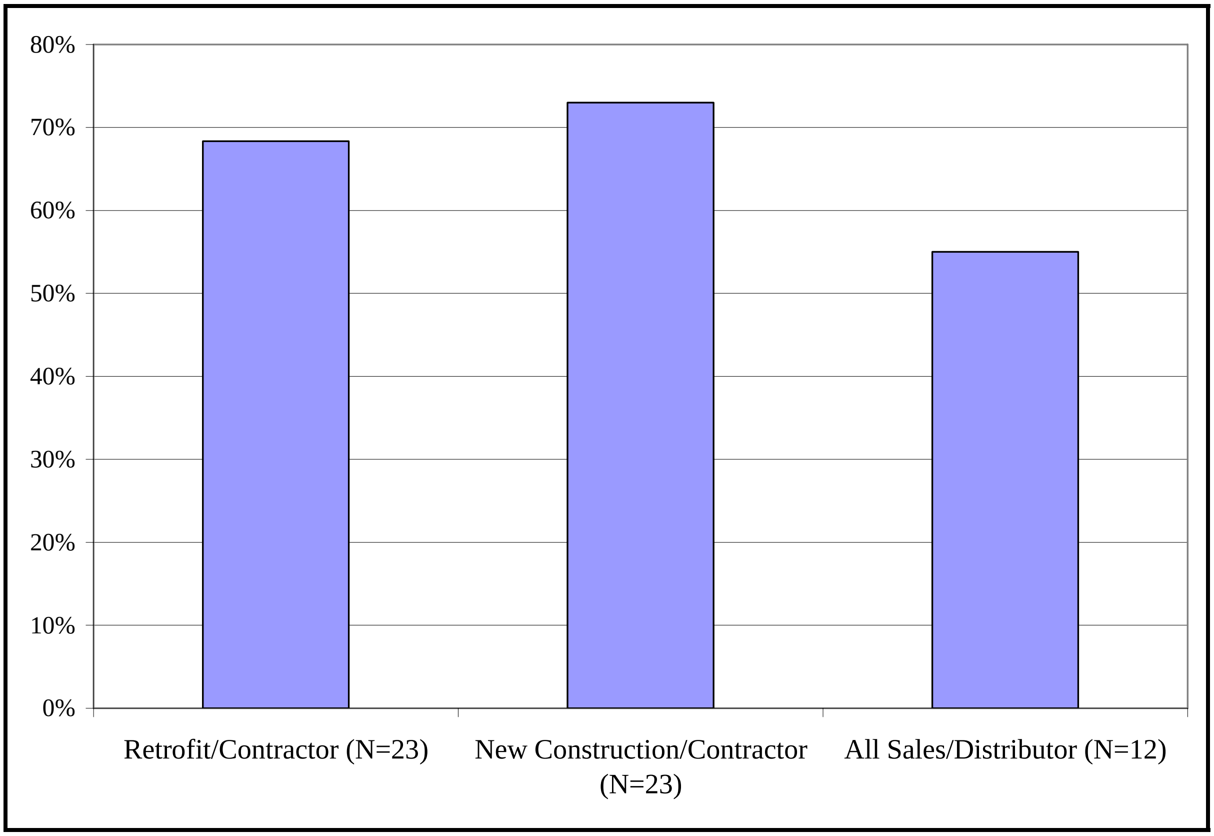


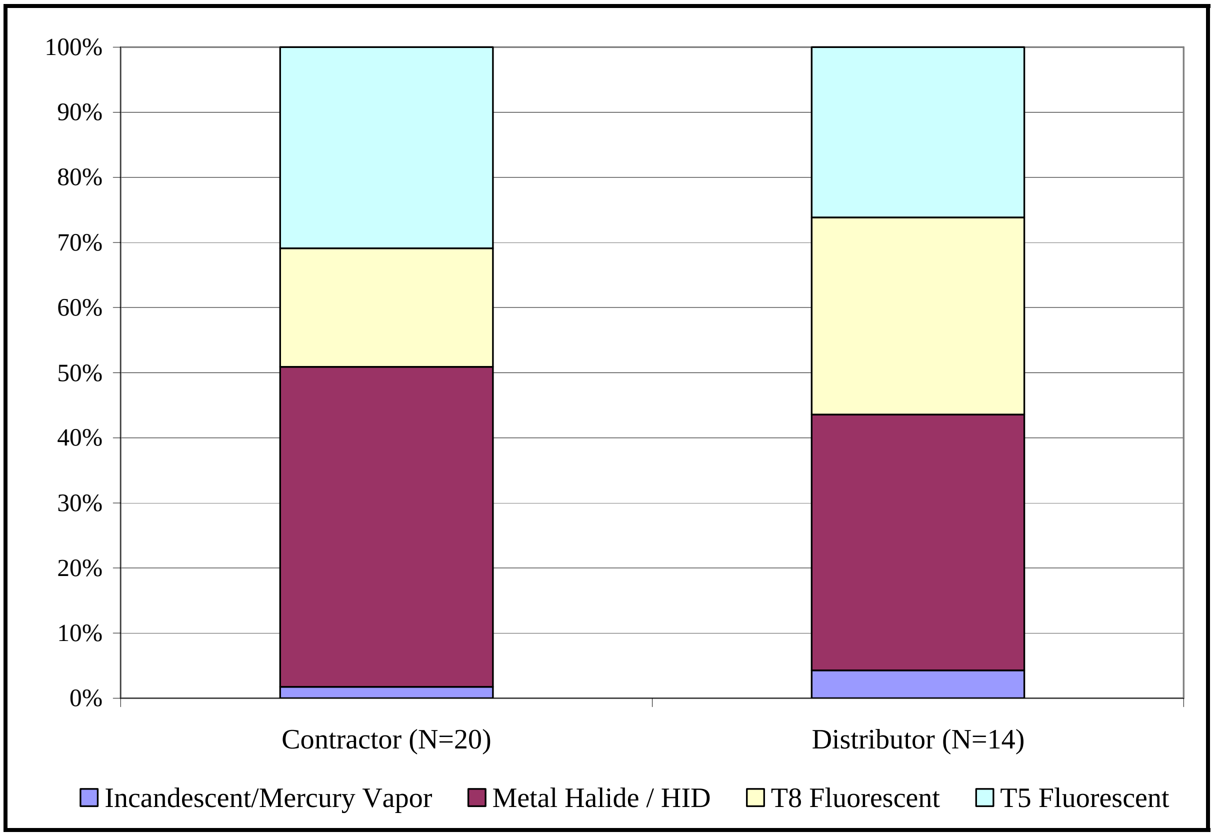
Figure 4-28 summarizes the relative share of CFL lamps utilized in down light and sconce fixture applications. Contractors report that approximately 73 percent of all down light and sconce installations in new construction use a compact fluorescent bulb technology. Contractors report that the share of down light CFLs is slightly lower in retrofit jobs at 68%. Distributors report a somewhat lower share of down lighting CFLS, at 55%.

Figure 4-28: Percent of Down Light and Sconce Installations That Are Compact Fluorescent (CFL)



As shown in Figure 4-29, installations in high bay applications are reported to be near half T-5 and T-8 fluorescent bulbs. The remaining half of high bay installations are dominated by metal halide lamps, with a very small share of incandescent/mercury vapor lamps.

Figure 4-29: High Bay Lighting Technology Distribution

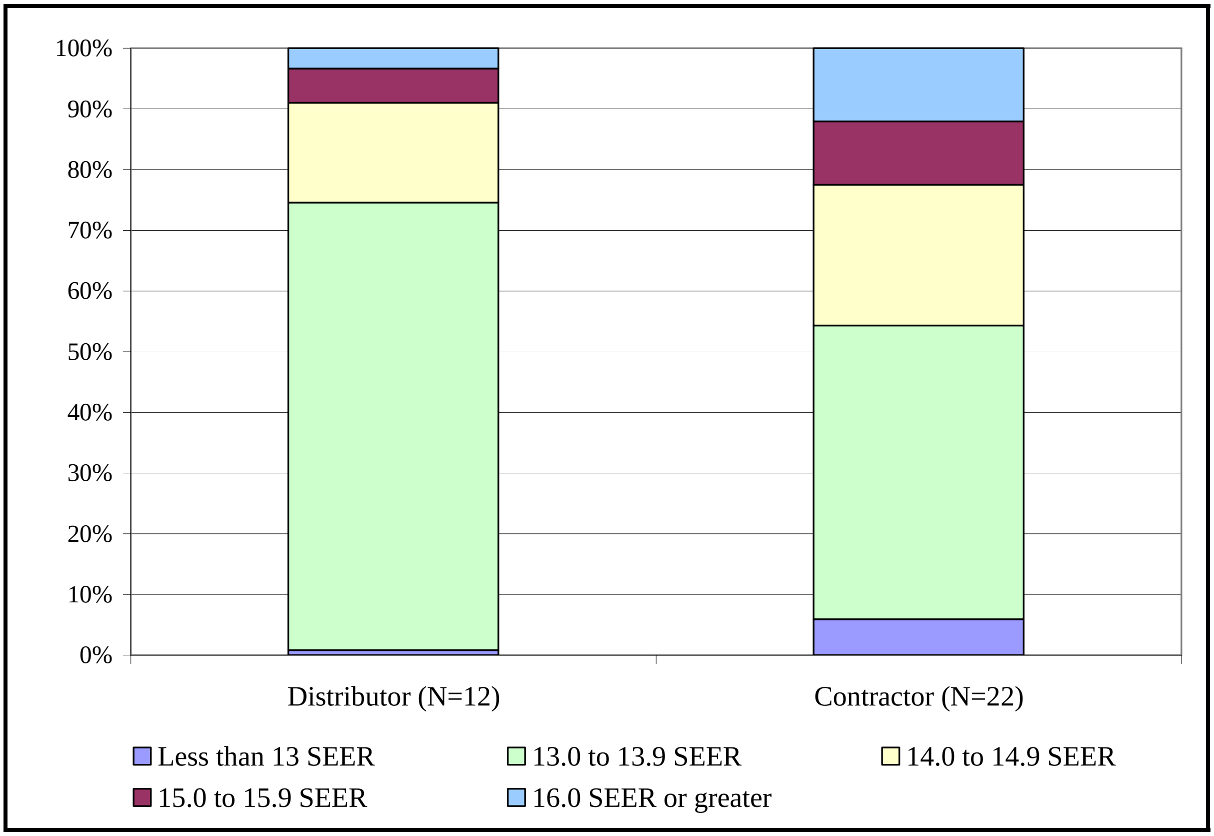


4.3.3 HVAC Trade Ally Survey Results Summary

This section summarizes the results of the HVAC contractor and distributor surveys. Key results from these surveys that are useful to calibrate the model include the reported market share by efficiency level of central air conditioner systems, the capacity of systems being installed in residential and commercial applications, and the level of promotion of high efficiency systems by contractors in the private market.

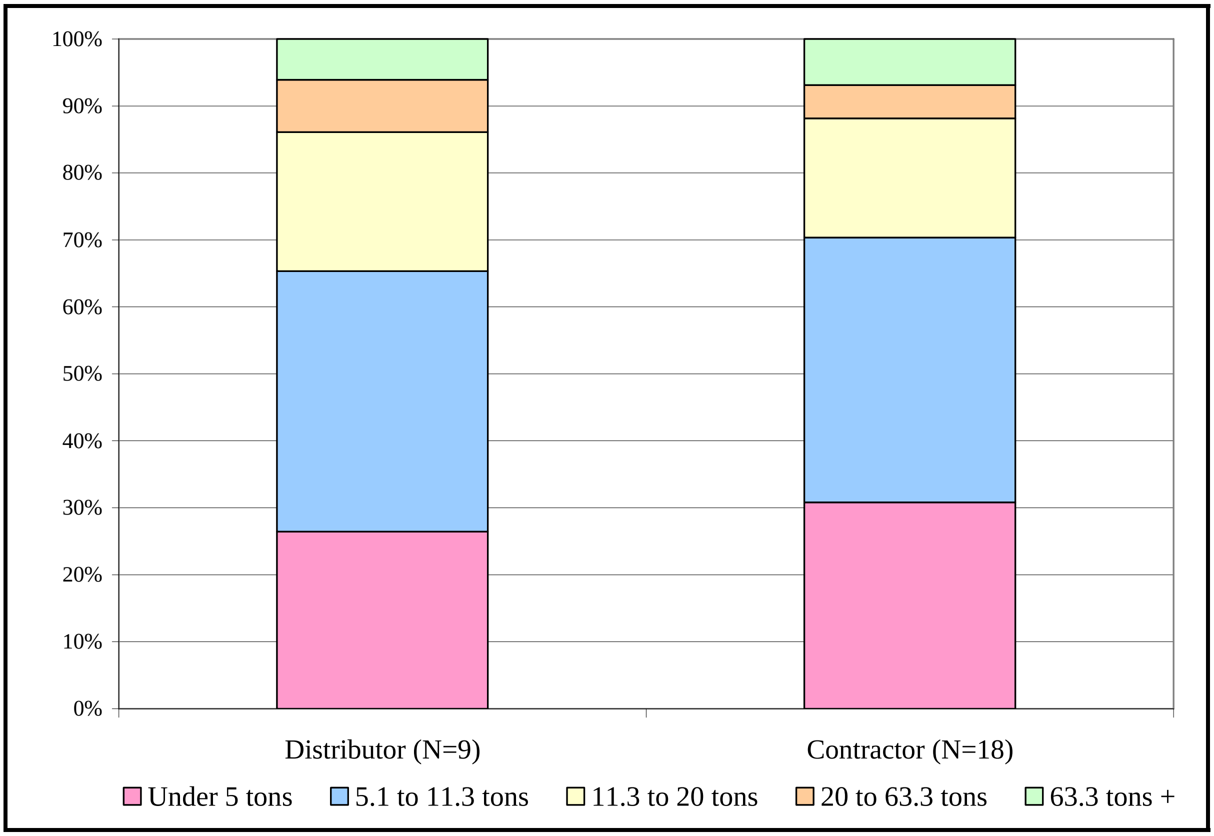
Figure 4-30 lists the contractor and distributors reported SEER distribution for recent sales of residential central AC units of less than 5 tons. Distributors report that 70% of sales are for 13 SEER AC units, and 25% of sales have a SEER rating of 14 or higher. Contractors report that 45% of AC units have a SEER rating of 14 or higher.

Figure 4-30: Residential Central Air Conditioners Less Than 5 Tons, SEER Distribution



The capacity distribution of recent air cooled air conditioning systems in the commercial sector is shown in Figure 4-31.

Figure 4-31: Commercial Air-Cooled Air Conditioner, Capacity Distribution



Contractors and distributors were asked to report the SEER distribution of recent sales of commercial air-cooled air conditioners with less than 5 tons of capacity. The commercial air cooled efficiency distributions are illustrated in Figure 4-32. As shown in Figure 4-31 above, these smaller capacity units represent 25-30% of the commercial market The SEER distribution for smaller commercial ACs is markedly less efficient than similar sized units sold to the residential sector. Both contractors and distributors report a notable portion of the commercial smaller capacity AC market is still under 13 SEER, while nearly all of the residential AC units exceed this level of efficiency.

Figure 4-32: Commercial Air-Cooled AC Less than 5 Tons, SEER Distribution

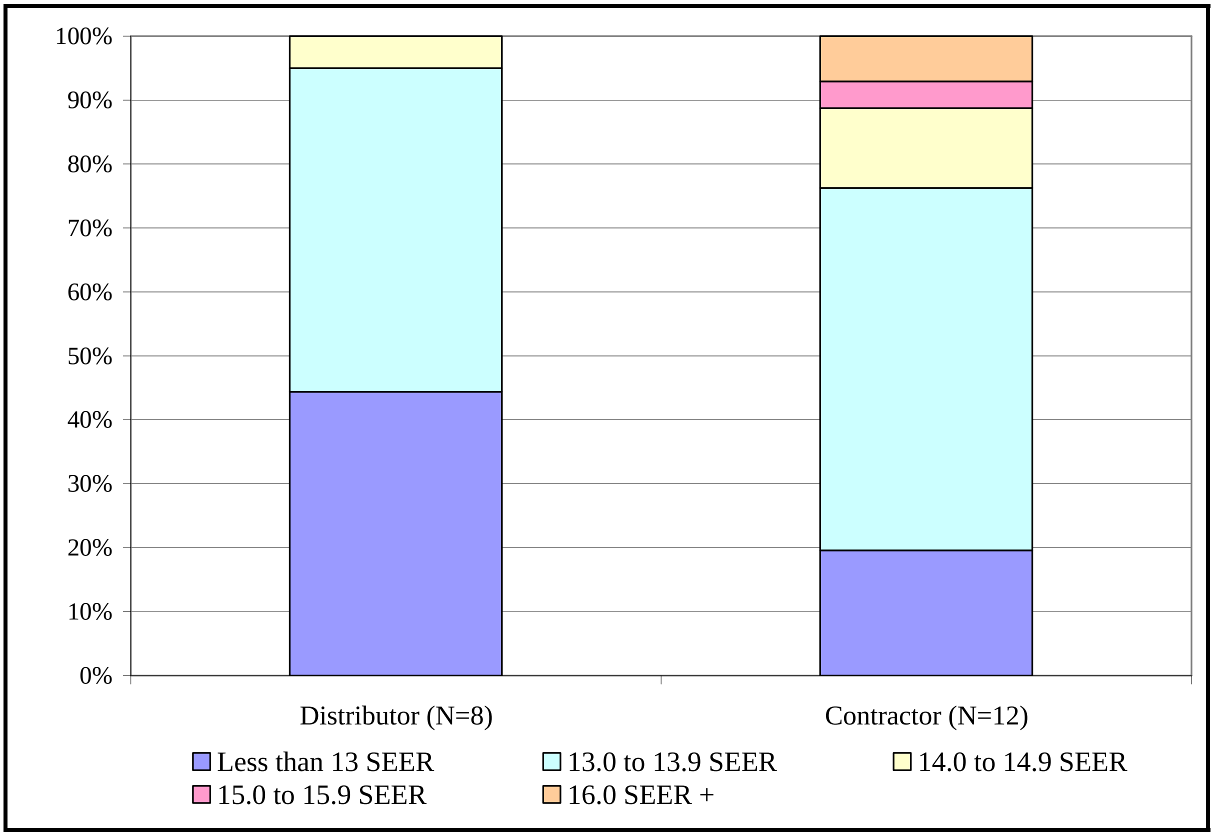
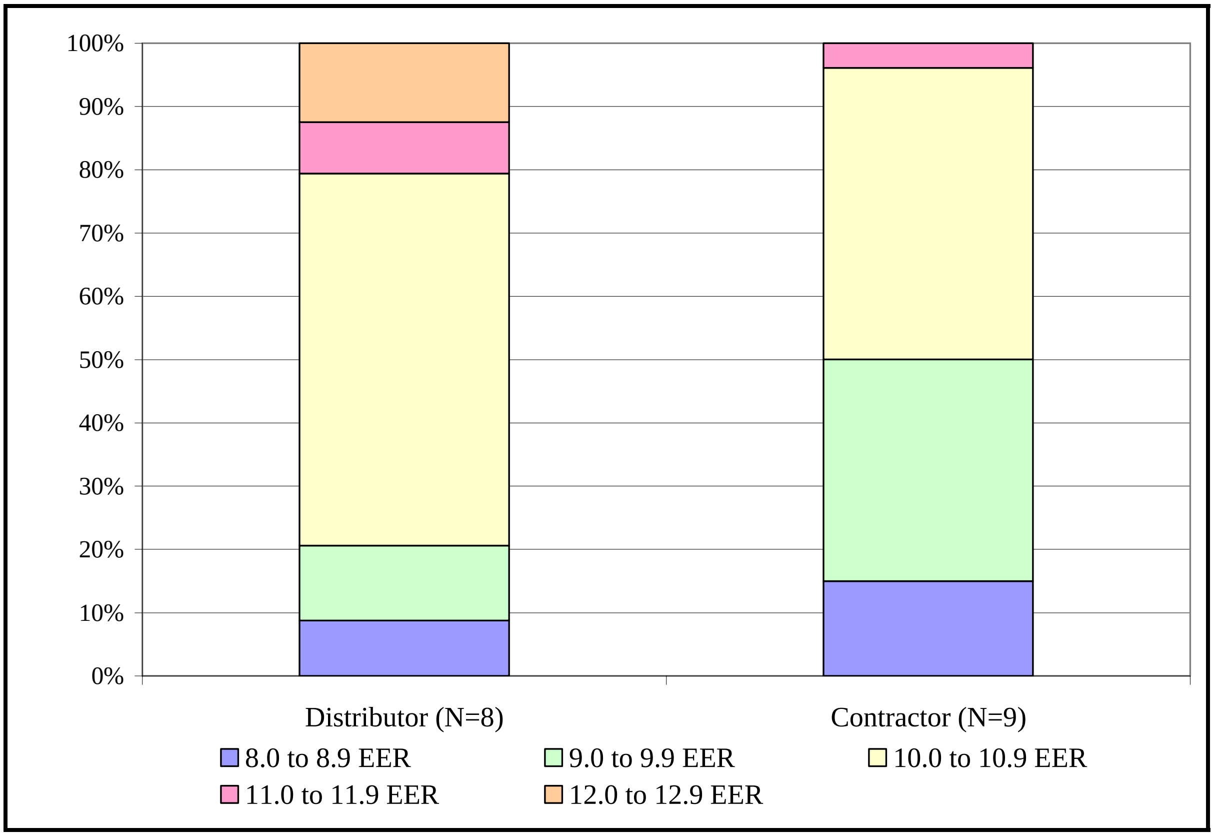


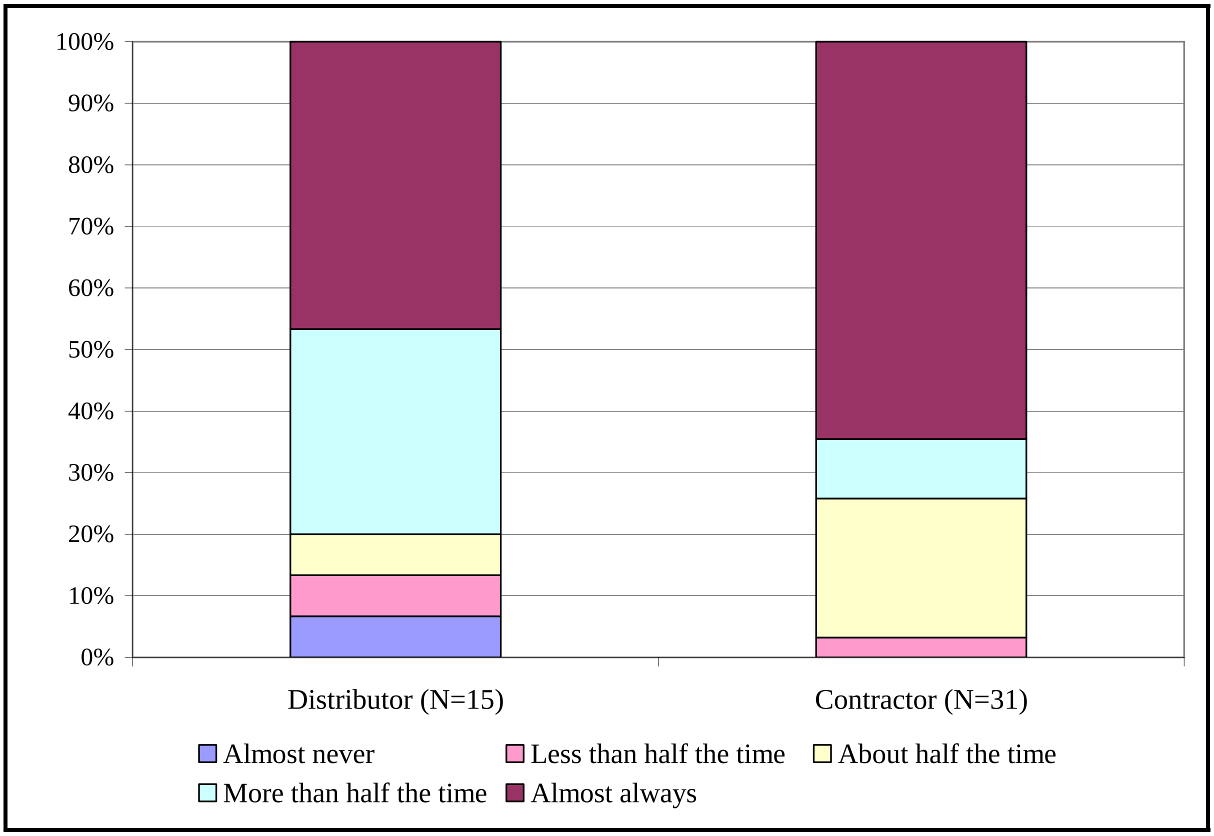
Figure 4-33 summarizes the reported EER distribution of commercial air-cooled air conditioners over 5 tons. Though contractors and distributors are not in complete agreement, both groups indicate the most prevalent option currently adopted is the 10 EER unit. Also, both contractors and distributors agree that between 70 and 80% of the market is in 9 and 10 EER units. Distributors report that 20% of air-cooled units installed have an EER of 11 or 12, while contractors report a less than 5% adoption rate for 11 and 12 EER units.

Figure 4-33: Commercial Air-Cooled Air Conditioners Greater than 5 Tons, EER Distribution



Contractors and distributors were asked how often they promote energy efficiency options to the customers. Figure 4-34 indicates contractors are somewhat more likely to "almost always" promote high efficiency options than distributors (65% versus 48%). Twelve percent of distributors and less than 5% of contractors promote efficient options less than half the time or almost never.

Figure 4-34: Energy Efficiency Promotion by Contractors and Distributors



Respondents were prompted to provide a reason for why they choose to promote, or not promote, energy efficient air conditioning equipment options. Figure 4-35 summarizes their responses. Contractors were most likely to cite energy cost savings as the reason to promote efficient equipment. Distributors had a greater variety of comments, citing greater profits for efficient equipment, in addition to environmental awareness and rebates.

Figure 4-35: Reasons for Frequency of Promoting Energy Efficiency in Air Conditioning Units

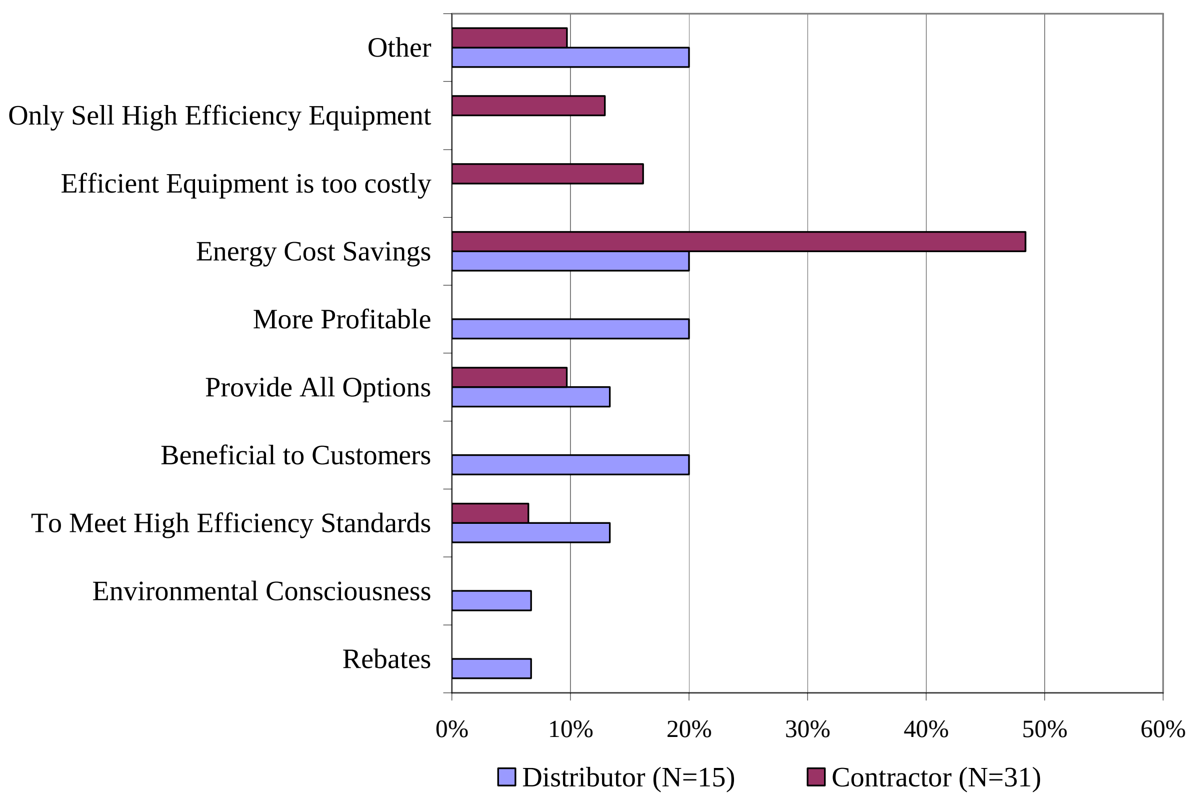


Figure 4-36 summarizes contractors' replies to questions concerning the relative frequency of various high efficiency options within commercial packaged system installations. Contractors indicate that about one-third of commercial packaged system installations include variable speed drive controls and one-third include economizers. Demand control ventilation is somewhat less common, at a little less than one-quarter.

Figure 4-36: Energy Efficient Air Conditioner Options

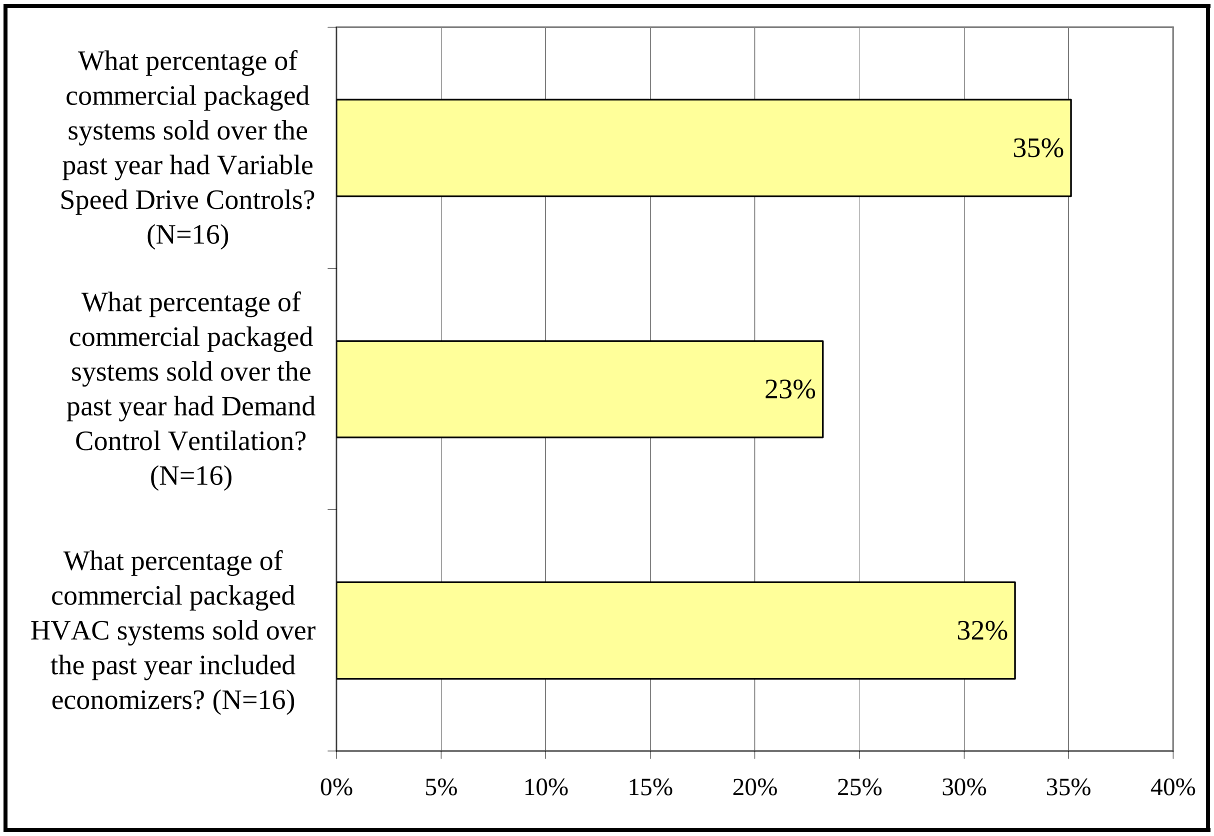
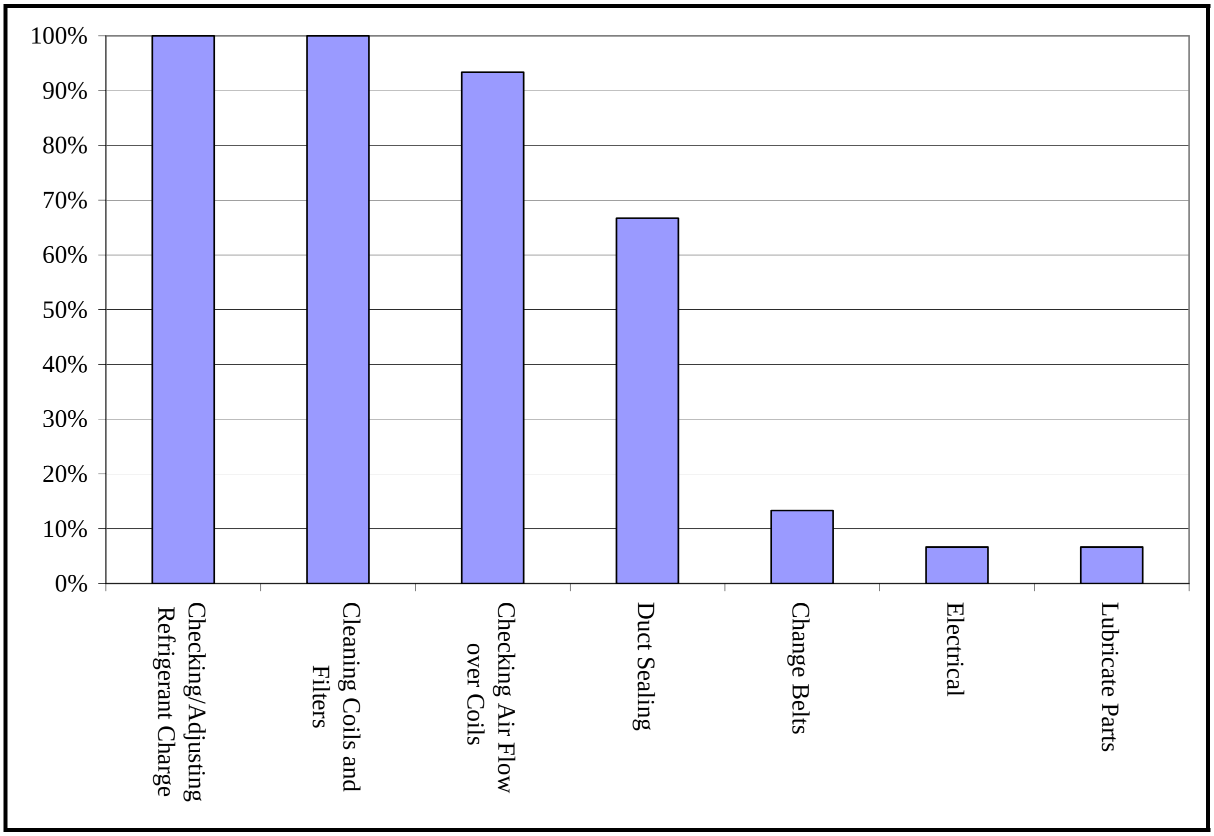


Figure 4-37 summarizes the distribution of the types of maintenance services typically offered as part of air conditioning service agreements with commercial customers. Checking and adjusting refrigerant charge, as well as cleaning coils and filters were mentioned by all contractors offering service agreements. Checking the air flow over the coils and duct sealing were also mentioned by most of the contractors.

Figure 4-37: Maintenance Typically Performed Under Commercial Air Conditioning Service Agreements



Air conditioning contractors were asked about the market for residential AC maintenance services. The contractors' responses to these questions are displayed in Figure 4-38. Contractors indicate that a little less than half of residential customers perform the required maintenance to ensure their AC system performs as rated. About half of the residential jobs performed over the past year included testing the air flow over the coils and half included testing the refrigerant charge. Duct sealing is less common with contractors reporting that less than 30% of residential jobs include some form of duct sealing. This finding is consistent with the utility reports of a relatively high share of savings from the standard offer program coming from duct sealing applications.

Figure 4-38: Residential Air Conditioning Maintenance Practices

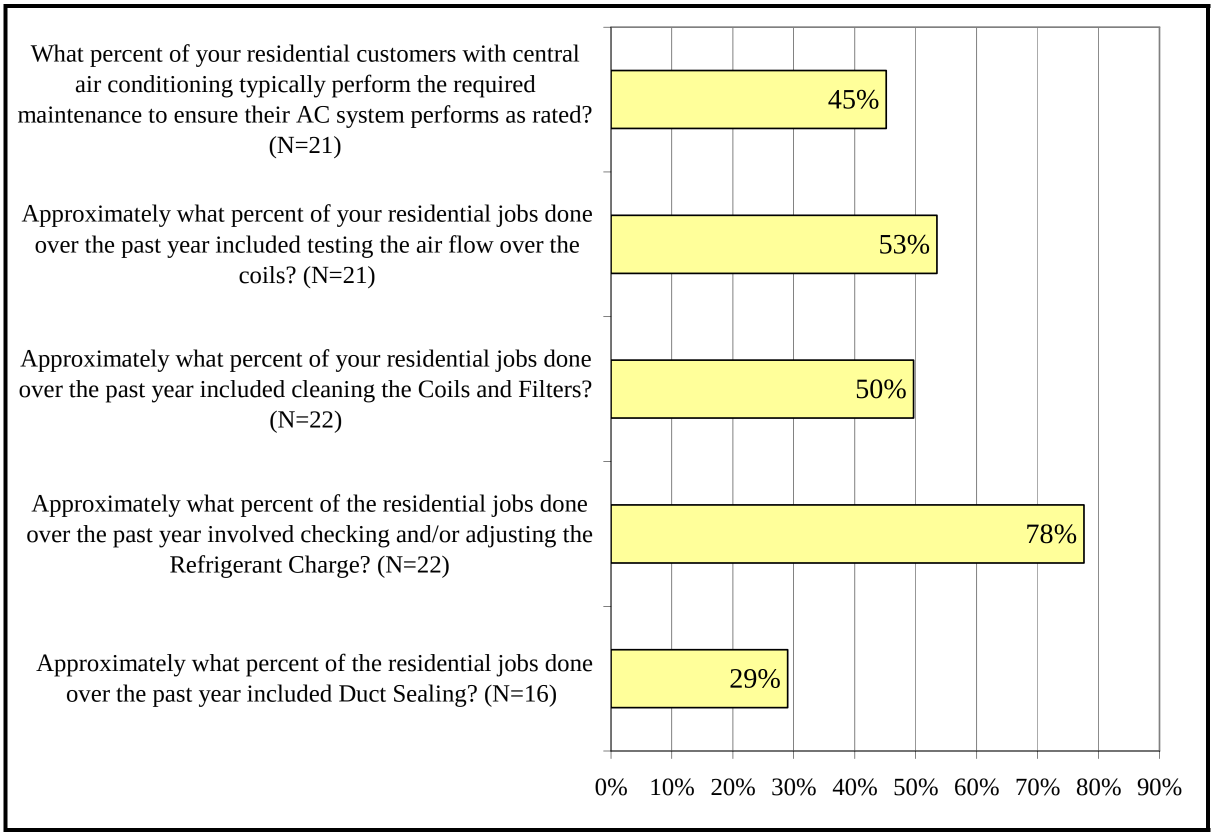
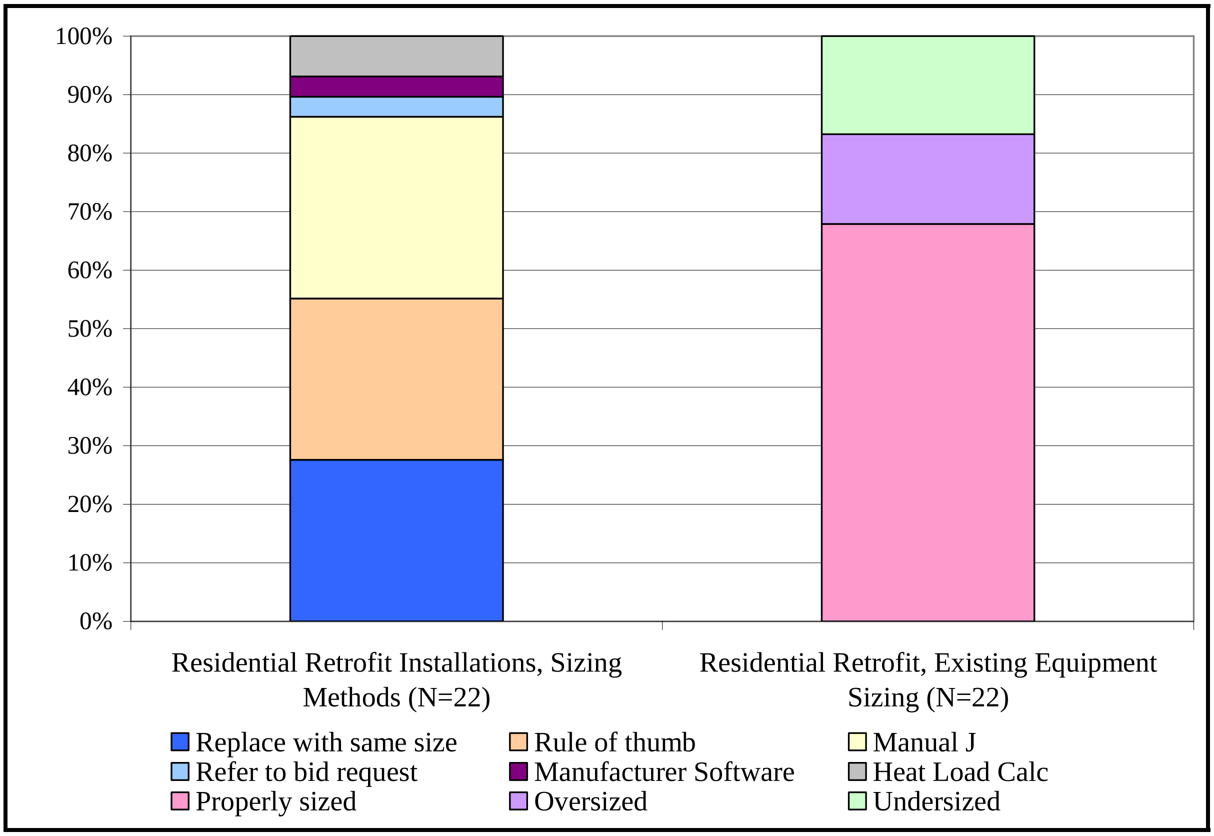


Figure 4-39 summarized contractors reported air conditioning sizing methods and their assessment of the accuracy of the sizing in the current residential market. Though contractors report that most systems are properly sized, the methods employed for sizing new units is without technical substance about 60% of the time (rule of thumb, replace with same size and refer to bid request).

Figure 4-39: Residential Air Conditioning Sizing and Sizing Practices



5

Findings From Interviews with Texas Stakeholders

5.1 Key Finding from Interviews with Utility Program Administrators

Itron interviewed 12 program administrator personnel from the Texas investor owned utilities to understand how they perceived the effectiveness of their current programs and the barriers to expanding the savings captured by their programs. Key findings from the interviews are distilled by topic area below:

Effectiveness of Current Programs

Program administrators were evenly split on the question of whether current programs are successful. Forty percent of program administrators felt that their programs were highly successful, 20% reported the programs were successful, while 40% reported that their programs had a spotty record and needed improvement..

Measures of Program Success

Program administrators were united in their view that there were two primary measures of program success:

1. Did the program achieve its annual peak saving targets?
2. Did the program spend all of the budgeted funds to secure more efficiency investments?

Other measures of success mentioned included prompt cost recovery and ensuring that program costs do not exceed the value of the energy and peak savings captured by the program. Interestingly, success indicators related to ensuring programs are cost-effective, reaching customers, or transforming markets were not reported.

Principal Strengths and Weaknesses of the Current Efficiency Programs

Program managers listed the following strengths of their programs:

1. Superior outreach to trade allies, ease of use of standard offer program materials for contractors, and long standing relationships with contractors.
2. Sound electronic tracking systems and websites.

3. Broad reach and effectiveness of market transformation programs.

Program managers list of weaknesses cluster around their perceived inability to market and improve their programs: They included:

1. PUCT prohibitions on marketing and making direct contact with their customers.
2. "Our marketing is not reaching local trades' people, and there is no practical way to communicate with our customers."
3. Overall rules for designing programs are too rigid with strict categories, more design flexibility needed.
4. No new vendors are entering the programs and it is hard to get new measures approved.

We note that some program administrators considered the current standard offer programs to be a strength while others considered them to be a major weakness. Most administrators reported that the market transformation programs offered the best opportunity to improve program reach and savings in the long run. All administrators expressed a desire to have direct contact with their customers.

Effectiveness of the Planning Process

It will be important for utilities to use their existing planning processes to develop new ideas, delivery approaches, and relationships with new vendors to develop expanded programs to meet increased savings goals. Program planning questions were asked to help explore to what extent the current planning processes are capable of bringing new participants and program ideas into a model portfolio in a short period of time.

Most program administrators report they initiate an annual planning process in the late spring and produce a final program plan by the beginning of September for the following program year. The majority develop a three to four year plan every year. Over 80% use a closed planning process with little or no opportunity for outside trade allies, customers, or vendors to provide input on program ideas until after the plans are filed with the PUCT.

Administrators report the planning process is driven by a desire to just barely meet the annual peak savings goal with the minimum amount of program funding. A minority of the administrators report they develop a funding proposal that is designed to overshoot the energy savings goal by 10 to 20% to provide for a margin of error in case some programs fail to perform as anticipated.

Administrators were evenly split about whether it made sense to use the current planning processes as a vehicle to attract new program ideas and or vendors to improve their programs. This reluctance is due in part to the fact that involving other actors in program design could drive administrative costs above the 10% cost limit discussed below.

Effect of the Program Administrative Cost Limit

All of the program administrators believe the 10% limit on program administrative costs has had either a significant or some effect on their ability to design and operate programs. None of the program administrators indicated that the cost limit had no effect on their program design or operation. Utilities in rural areas report the most significant effect of the cost restrictions. These utilities feel that the cost restrictions limits their ability to develop programs, market programs to their customers, and gather data on the effectiveness of their programs. The limit has also caused some utilities to “outsource” program administration to third party firms because any administrative work carried out by these contractors is not counted towards the administrative cost total. Some administrators believed it might be a program improvement to exclude marketing and/or evaluation and measurement expenditures from the current definition of administrative cost limits. Other administrators advocated increasing the program administrative cost limit to 12% or 15% as long as the programs continue to be cost-effective.

Finally several administrators made one common and disturbing observation (unprompted). These administrators stated that the program cost limit had made it difficult to hire and recruit new program design talent and limited their ability to discuss new program ideas with customers. The unintended consequence of the cost limits was that contractors were often relied on as the source of new programs ideas in Texas.

Market Effects of Existing Programs- Making the Market More Sustainable

Eighty percent of the administrators interviewed reported that the standard offer programs had not had any significant market effects with respect to increasing either the sales or sustainability of making energy efficiency sales over time. Increasing sales are crucial because one of the primary rationales for running standard offer programs is that the program are designed to produce significant market effects and increase the sustainability of efficiency businesses. The theory behind a standard rebate or offer level suggests that the additional incentive will help build up an infrastructure of energy service companies or energy efficiency contractors who develop the necessary sales and marketing techniques to eventually sell more efficient products or services without program assistance. The fact that the standard offer program has run for over six years without producing any noticeable market effects is a warning that either the theory is incorrect or that the program marketing is not reaching local contractors. We will see later that both explanations are probably true.

Interestingly, at least 60% of the program administrators felt that the newly approved market transformation programs were creating market effects by increasing the level of knowledge and competence of local contractors through training and rebate impacts. Most of the knowledge building comments were directed at the effects of the Energy Star new homes program. Most administrators, however, were quite candid in admitting that there had been no market research to confirm or verify that market effects could be observed as a result of the Energy Star new homes programs.

Barriers to Increasing Program Savings

Program administrators were asked if they knew of any barriers either within their companies, at the PUCT, or in the market as a whole that might hinder their ability to increase the energy savings that could be achieved by their programs over the next few years. The answers provided form a list of barriers that will need to be addressed if program savings are to be increased. They include problems related to marketing, motivation, and measurement:

- Utilities in rural areas identified significant problems in reaching customers in low density areas where there is no local contractor or trade infrastructure.
- The larger urban utilities identified problems relating to a lack of financial incentive to pursue aggressive savings given the negative effects on company revenue and the lack of any decoupling of revenues and sales in Texas. One expressed a strong opinion that some form of decoupling or increased financial incentives would be needed to motivate utilities to achieved higher savings goals.
- Finally a few utilities identified the “slow regulatory process” as being a barrier to increasing program savings. They felt there was no clear path to bring new program ideas too fruition. Even if the program was approved, the time it takes to get savings for a new measure approved or deemed is too long to be worth the effort.

Importance of Increasing Public Awareness

All of the program administrators report there is a significant need to increase public awareness of energy efficiency opportunities but only 50% of them provided some form of public awareness messages through their program. The reasons for the lack of educational messages ranged from lack of money, motivation, and expertise to develop the message to outright antagonism that the Commission had prohibited integrated utilities from communicating with their customers even though the logic behind this ban only applies to deregulated utilities. One utility summed up the belief of most administrators by saying: “Those firms who are on the hook to achieve the savings must be allowed to market the programs to their customers.” Any other solution removes the crucial link between program design and customer acceptance.

Best Ways to Increase Public Awareness

Administrators were divided on the question of whether a third party organization should be tasked with the job of increasing public awareness of efficiency opportunities. Some felt utilities should be allowed to strike up alliances with trade allies to provide energy efficiency training to contractors and trade persons at the local level while the job of reaching the mass market should be left to a statewide organization. Others felt the job of marketing to both trade allies and customers should be given back to the utilities running the programs because they are ultimately responsible for capturing the energy and peak savings. Significantly, no program administrator indicated a desire to task either the Public Utility Commission of Texas or any other public agency with the task of increasing public awareness and knowledge of energy efficiency opportunities.

Rate of Innovation in Public and Private Energy Efficiency Markets

Administrators were asked to characterize the rate of innovation in program design and new energy products and services development in Texas as either rapid, moderate, or slow. Interestingly, 60% characterize the rate of program design in the public sector as slow while 80% saw the private energy efficiency market as slow with only one vote for rapid innovation. Given the dynamic nature of energy efficiency product development in other parts of the nation, it will be useful to explore some reasons why program administrators perceive such a slow rate of innovation in the local Texas market. This question is discussed in the policy development section of this report (Section 7).

Recommendations to Increase the Effectiveness of Programs

Finally we asked administrators if they had any key recommendations on how to increase the effectiveness of their current energy efficiency programs. The interesting responses are summarized below:

1. A new set of policy rules governing efficiency programs should be developed for bundled (integrated) electric utilities who should not have to suffer under the rules that may be appropriate for de-regulated utilities (but not integrated ones).
2. The PUCT should clarify whether the energy and peak savings anticipated from the roll out of advanced metering systems with in home displays and load management controls can be counted as program savings for transmission and distribution utilities and how this may be complicated by retail providers seeking to offer or claim the same savings for themselves or their customers.
3. A related recommendation relates to load management: “Load management programs should be allowed to run outside of the standard offer framework and provide peak demand savings that count toward the annual peak savings goals.”

Itron takes no position on any of these recommendations but does note our potential analyses identified a significant potential to save energy through the deployment of in home display devices. Ownership or attribution of the savings from in home display devices is likely to be an issue in Texas. Early evaluations of these devices have found average savings ranging from 3% to 8% of annual electricity usage for home owners who purchased or volunteered for the installation of in home displays in pilot programs across North America.

5.2 Key Finding from Interviews with Environmental and Customer Advocates

Four representatives from environmental organizations in Texas and one representative from a consumer advocate organization were interviewed to gather their impressions about the strengths and weaknesses of the current energy efficiency programs. Each interview took roughly one hour and covered a range of questions sent to them in advance that were similar, but not identical, to the questions posed to program administrators. Most described themselves as both participants in the process of designing programs and supporters of programs and legislation to increase the energy and dollar savings from energy efficiency programs. Key finding from these interviews are summarized below.

Impressions of Current Efficiency Programs

- Most respondents felt the programs had been successful in reducing energy costs for participating customers and reducing the need for purchasing incremental sources of supply.
- Most respondents also criticized the current portfolio of program offering as being too reliant on a small number of contractors to install common measures and not providing a comprehensive menu of services for residential and nonresidential customers.

Strengths of the Current Programs were:

- Clear and definitive savings goals have been set for each administrator.
- A process for deeming energy savings for measures to reduce the costs of verification and measurement.
- Strong relationships have been built with some contractors to implement conservation but too many contractors have been left out of the programs.

Weaknesses of the Current Efficiency Programs were:

- No marketing is provided to the customers and very few customers are ever reached by the contractors working for utility standard offer programs.
- Tendency of contractors to “cream skim” and install only one or two measures at a home or building when many more measures would have been cost-effective.
- Customers are not sure if they actually received a reduced price for the efficiency measures. There is no requirement that contractors divulge the size or nature of the rebates they received.
- Current goals are too easy to meet and many of the reported savings claims are not verified by independent third parties.
- There is too much reliance on new construction programs (like the EPA’s Energy Star program) to meet goals. Savings from these programs are difficult to verify.
- The program spending caps authorized by the PUCT have been counterproductive. The caps often require utilities to turn off programs in the middle of the year because available funds have been spent. This leads to resentment from both customers and trade allies in the market place.

Lessons Learned from Working on Program Development Over the Last Five Years

- It is critical to improve the process of reporting and verifying program energy savings.
- Utilities do not have enough funding or time to really engage stakeholders in the process of developing new programs. Utilities routinely hand out important documents on the day of meetings and often do not have time to fully respond to comments or issues.
- There is a need to develop peak demand savings goals for demand response or load management programs. It does not make sense to have these programs’ goals included with energy efficiency goals. The two program types serve different purposes and should be evaluated separately.

Barriers to Increasing Level of Energy and Peak Savings Captured by Utility Programs

- The current regulatory processes and structure inhibits development of new program designs.
- There is a need for new programs targeted at multifamily homes. The current portfolio of programs is targeted to single family homes.

- The PUCT needs to have a proceeding that considers the various options to decouple revenues from kWh sales. Utilities cannot be expected to aggressively pursue programs that are not in the interests of their shareholder.
- There is a need to involve many more distributor and retail sales channels in the delivery of energy efficiency options. An isolated focus on contractors is not likely to be sustainable.

Organizations that Customers Find as a Credible Source of Energy Efficiency Information

Respondents were asked to rank a list of organizations that customers find credible within Texas with respect to delivering reliable information on the costs and benefits of investing in equipment to reduce their energy costs. The interviewed customer advocate groups reported the following ranking of organizations' credibility with consumers:

1. Retail Energy Providers
2. PUCT staff
3. Environmental Protection Agency
4. Municipal Utilities
5. Consumer Organizations
6. Investor owned utilities
7. Contractors

They noted that the group with the least credibility with customers was being asked to contact and market energy efficient products, a recipe for failure in their minds.

The interviewed environmental groups, with their experience in the energy efficiency field, had a completely different ranking of credible organizations, as shown below:

1. Municipal Utilities
2. Investor Owned Utilities
3. Contractors
4. PUCT staff
5. Environmental Organizations
6. Retail Energy Providers

It is interesting to note these organizations hold almost completely opposite views of the credibility of retail energy providers, contractors and investor owned utilities. It might be useful to fund a survey to determine which organizations customers actually find most credible because this knowledge will be invaluable in developing a marketing campaign to increase customer awareness of energy efficiency options and trusted providers. We suggest investor owned utilities or the PUCT consider undertaking such a study or dusting off the results from previous research performed in Texas on this topic.

Changes Needed in Current Process or Market Structure to Allow Utilities to Capture More Energy Savings

- The process needs to focus on customer and business segment needs, not the needs of the contactors currently participating in the programs.
- The focus should shift away from funding caps and towards ensuring the portfolio of programs is likely to be cost-effective.
- The planning process needs to anticipate how the market will change as result of the imminent deployment of advanced metering and in home displays.

Perspectives on the Roles of Retail Energy Providers in Delivering Energy Efficiency Services

- Both environmental organizations and customer groups favor an expansion in the role of Retail Energy Providers (REPS) to include providing efficiency services.
- REPS could have a role in determining code compliance as part of the audit services currently being offered to customers.
- REPS should also have a role in helping to benchmark electricity consumption among similar households.

Most Successful Energy Efficiency Programs in Texas and Other Recommendations to Increase Likelihood of Increased Energy Savings

- Consumer groups report that direct weatherization programs are the most successful programs because they offer a comprehensive approach and reach the highest percentage of their target market.
- Environmental groups favored the Energy Star programs as the most successful due to their potential to transform markets.
- Both consumer and environmental organizations felt that time of sale ordinances are needed statewide to ensure the necessary insulation upgrades occur when old properties change owners.
- Environmental organizations suggested that utilities be encourages to form alliances with builders to demonstrate new cutting edge renewable and energy efficient equipment in new construction applications. They believe Texas should have a successful commercial new construction program like other states' utilities.

- Finally, both groups saw a potential role for utilities to help increase the level of compliance with current building codes through training and benchmarking programs.

5.3 Key Finding from Interviews with Retail Energy Service Providers

Itron interviewed a sample of Retail Energy Service Providers (REPS) to gain their perspectives on the strength and weaknesses of utility programs as perceived by their customers and their willingness to provide or offer energy usage information or energy efficiency services to their customers. We interviewed one groups of REPS who were interested in providing energy efficiency tools and information to customers based on information provided by the Texas PUCT and another group of REPS chosen at random from the Power to Choose web site for residential customer without regard for their business model or interest in energy efficiency. As we expected, the four REPS pre identified as having an interest in energy efficiency had a number of proposals and recommendations on how to increase the level of energy efficiency investment in Texas. The randomly selected REPS were primarily interested in providing the lowest price electricity commodity to their customers without concern about energy efficiency services. The latter group reported negative opinions about the success and effectiveness of the efficiency programs run by the transmission and distribution utilities in Texas and doubts about the effectiveness of programs in general. The real issue that has not yet been resolved in the market place is which of these competing business philosophies will be successful in retaining customers.

What follows is a summary of the recommendations and observations from three REPS who are interested in expanding their role in providing energy efficiency services to Texans. The results of the other interviews with the commodity service providers are summarized after this section.

Opinions and Experience with Current Efficiency Programs

Most of the REPS interviewed felt the programs run by the Texas distribution utilities were focused on a very small segment of the residential market, primarily low income customers, and did not really provide service to middle and upper income residential households. Not surprisingly, they felt their own REP organizations could deliver higher quality efficiency services based on their ability to provide direct marketing materials on efficiency opportunities and feedback to customers on the effects of efficiency investments via advanced metering systems. These REPS clearly hoped to use a suite of program offers and tools as a means of differentiating themselves from other REP competitors who only provide cheap electricity and no services.

These REPS had participated in a limited number of energy efficiency programs run by the investor owned utilities (IOUs) but felt that the methods used to allocate funds were occasionally unfair and counterproductive. They cited the practice of having annual solicitations to attract ESCOS to participate in standard offer programs only to learn that the programs had run out of available funds within hours of the program offering. The on again off again nature of the programs had clearly irritated some contractors and REPS who believed the program offers should be available on a continuous basis provided they met strict quality and verification criteria.

The REPS believed they were in a better position than the IOU's to provide customized energy efficiency services to a variety of customer classes, particularly with the installation in the next five years of advanced metering services and in home control equipment. When asked about potential conflicts between reducing kWh sales and maximizing profits for their company, the REPS felt strongly there was no conflict because maintaining a good relationship with satisfied customers was more important than a small loss in sales at the margin. These REPS also felt strongly that their companies were in a better position to provide load management services and equipment to their customers at a lower price and better value than the IOU's.

The REP we interviewed also had very detailed plans for how they planned to expand their efforts in the energy efficiency and demand response market areas as part of the rollout of advanced metering infrastructures. They were very confident their business models would succeed as electricity prices continue to increase in Texas.

Funding for Efficiency Services Provided

A significant issue for retail providers who seek to provide efficiency services has always been the customer's willingness to pay a cost premium for these services in addition to the costs of purchasing electricity. The REPS maintained that their business model would allow them to recover the cost of providing efficiency services through the cost of electricity provided to their customers and that no government funding was needed to run programs. If government funding is needed or available to fund efficiency efforts, it should be channeled toward efforts to increase the level of both customers and supplier awareness of near term energy efficiency opportunities. All the REPS stated that an independent body could be established at a statewide level to provide this information and perhaps develop an efficiency brand that could be used by REPS and service providers to increase the sales of more efficient equipment and systems.

Recommendations for Increasing the level of Energy Efficiency Investment in Texas

The REPS provided the following recommendations to increase energy efficiency savings in Texas:

- The PUCT should consider using public funds to increase customer awareness of efficiency opportunities rather than spending the funds on programs run by the IOU's.
- Get the advanced electronic meters out to as many customers as possible, providing the platform for customers to get creative about saving energy.
- Develop appropriate settlement protocols for customers at the 15 minute level to encourage peak reduction or peak shifting.
- Shift education dollars from promoting opportunities to switch retail providers to developing marketing materials designed to convince customers to become more energy efficient using social norms and benchmarking approaches.
- There has to be more active cooperation between the State Energy Conservation Office and the IOUs and REPS. There are several organizations that have the ability to directly link with these entities. Political subdivisions can be reached with programs through aggregators – STAPP, CAPP, GAP, P3 and commercial customers can be reached through the Texas Electricity Professionals Association.
- Perhaps a special fund should be set up by the legislature for public entities to use for projects that will develop targeted savings from municipal organizations. This should be a fund for political subdivisions that supplements the incentive funds available from the IOU T & D companies.
- The PUCT should consider working with the State Energy Conservation office to put out a monthly newsletter or targeted marketing information on a consumer friendly web site that would drive customers toward efficiency providers and allow them to benchmark their homes or building energy performance against similar buildings or structures.

Findings from REPS Interested in Selling Electricity as a Commodity Only

The three commodity driven REPS who were interviewed over the phone were selected based on a random sample of current providers. All three were not interested in providing any energy efficiency services to their customers but they did not object to general messages encouraging customers to conserve. This position was based on their conviction that other private firms would provide energy efficiency services on their own if the services made economic sense. They also were not interested in cooperating with any programs fielded by IOUs, stating that these ventures were likely to add additional costs to their business without providing additional value.

5.4 Key Findings from Interviews with Municipal Utilities and the State Energy Office

5.4.1 Municipal Utilities

Two representatives from the Texas Public Power Association were interviewed to determine the level of effort devoted to energy efficiency programs in the municipal service areas. The representatives also discussed the level of cooperation and or conflict that may exist between utility programs serving customer near the border of utility service areas and they were questioned on the extent to which municipal boards have removed the boundaries to expanding energy efficiency programs in the key municipal areas in Texas. Key findings follow below:

- There is a wide range of commitment and levels of effort devoted to energy efficiency programs in the 72 municipally owned utilities in Texas. Two large municipal utilities in Austin and San Antonio have large and mature programs that rival, and in some cases exceed, the sophistication of programs run by the Texas IOUs.
- Strengths of the municipal efficiency programs include the ability to work directly with customer owners to fashion energy efficiency plans and investments that make sense.
- Weaknesses of the municipal efficiency programs include that the small size of many municipal utilities makes it difficult, if not impossible, to actually hire personnel to develop energy efficiency programs. In many cases the low population density of rural communities makes it hard to find contractors to deliver efficiency services or products.
- As a general rule, municipal utilities are not involved in the design or development of program ideas with IOUs. Their perception is that there is not much to learn from current IOU program designs and potentially a lot to lose by sharing the details of their successful program designs.
- The need to decouple revenues from electricity sales has been a thorny issue for many large municipals in other states but Texas municipal representatives report that this has not yet been a problem in Texas. They report the lack of decoupling issues is because municipal board owners are working for the best interests of their customers and are not worried about the revenue losses from successful efficiency programs. Municipal utilities are against the concept of setting savings goals and indicated they would strongly resist any attempts to establish goals in the legislature.

5.4.2 State Energy Office (SECO)

The research objective in interviewing the state energy office was to determine if there were ongoing efforts to coordinate the development of appliance and building standards with utility energy efficiency programs. The survey also gathered data on the perceived effectiveness and quality of the utility's new construction programs from the perspective of a leading state agency. In general, the State Energy Office has not been instrumental in the design or planning of utility new construction programs which promote measures likely to be included in future code updates. The SECO was willing, however, to consider becoming involved with the design process in the future if its participation would help to speed the adoption of new building codes. Key findings are summarized below:

- The mission of the state energy conservation office is to encourage investments in energy efficiency and reductions in energy use for two major market segments.
  - Public Sector- provide direct technical support and project implementation services, to schools or local governments, complementary with utility programs, results of audits lead to opportunities that are then referred to utility/or design professionals.
  - General public and private sector- provide public information and outreach, focused activities with industrial customer segments, peer exchange and best practices.
- SECO focuses on reducing two key barriers: information costs and financial hassles for customer in order to maximize energy efficiency investment.
- SECO professionals do not get involved in the design or review of utility new construction programs because they perceive that this is not part of their responsibility.
- SECO finds that the record of utility efficiency programs is mixed. Some are very good and others are non-existent.
- Perceived strengths of the IOU programs include the existence of a consistent oversight structure, and an outcome based approach using savings as the key metric.
- Perceived weaknesses of the IOU programs include the existence of a multi layered program administration, without a clear pathway for customers or for contractors to participate in programs. Uptake in programs is more sporadic for residential than nonresidential sectors. It is not easy for new contractors to gain entry to the program.
- Perceived strength of municipal programs is the clarity in program design because the administrators are closer to their customers and in some cases strong measurement and verification practices (Example Austin Energy).
- Perceived weakness of the municipal energy efficiency programs is the lack of any mechanism to decouple revenues from sales. This is a big barrier for some municipal areas that depend on electricity revenue to meet city budget needs.

- SECO has plans to aggressively update building codes and get more heavily involved in code compliance and enforcement efforts. SECO envisions utility efficiency program administrators as possible allies in this effort once the process starts.

6

Estimates of the Technical and Economic Potential to Save Electricity

In this section we present the results of the technical and economic energy efficiency potential analysis for the residential, commercial, and industrial sectors for the nine participating utilities in Texas. Achievable savings results are presented in Section 7. First, we briefly discuss the relationship between technical and economic potential and the overall forecasts of annual sales and peak demand for Electricity overall and for specific service territories. Second we compare estimates of economic potential across sectors in each of the utilities. Then we provide a snapshot of the most significant measures that contribute to the economic potential by sector and display the relative economics of all the measures analyzed by showing conservation supply curves by sector. These curves display the levelized cost of each the conservation measures analyzed during this study and allow for a simple comparison to current and future costs of electricity per kWh.

6.1 Overall Technical and Economic Potential Savings at the System Level

Table 6-1 provides the range of estimates of the technical and economic potential to save electricity for each of the nine utilities at the system level. Technical potential results range from 20% to 30% of existing electricity sales. The estimated economic potential to save electricity as a fraction of current consumption is lower than technical estimates as expected and roughly the same on a percentage basis across utility service areas; ranging from 15 % to 22% of current consumption levels. Differences across utilities are driven by differences in initial measure saturations and underlying energy usage intensities, primarily for the cooling end use where usage varies by a factor of two across the state.

Both technical and economic potential estimates assume that all of these efficiency investments could be made in one year and do not include any consideration of timing or ramp up constraints. The technical and economic estimates presented here all include the potential energy and peak savings from compact fluorescent bulbs installed in the residential and commercial sector.

Table 6-1: Summary of Technical and Economic Potential Energy Savings at the System Level for All Nine Texas Utilities

Utility	Sector	Baseline Energy (GWh)	Technical Potential (GWh)	Economic Potential (GWh)	Technical Energy Savings as Percent of Baseline	Economic Energy Savings as Percent of Baseline
AEP Central	All Sectors	26,929	8,201	5,881	31%	22%
AEP North	All Sectors	4,813	1,408	900	29%	19%
AEP SWEPCO	All Sectors	9,020	2,061	1,527	23%	17%
CenterPoint	All Sectors	101,672	24,129	18,184	24%	18%
El Paso	All Sectors	7,802	1,525	1,175	20%	15%
Entergy	All Sectors	22,002	4,835	3,580	22%	16%
Oncor	All Sectors	131,388	32,464	22,727	25%	17%
TNMP	All Sectors	8,604	2,243	1,321	26%	15%
Xcel	All Sectors	10,392	2,424	1,616	23%	16%
Statewide	All Sectors	322,621	79,292	56,913	25%	18%

Table 6-2 shows the range of technical and economic potential to reduce peak demand across the nine electric utility areas. There is more variation in the estimates of potential savings as a fraction of the total current peak demand than there was for energy savings due to differenced in climate and resulting peak demand variation across service areas. Estimates of the economic potential for peak savings range from 14% of peak demand in the Texas New Mexico Power (TNMP) area to 26% of peak demand in the AEP central service area.

Table 6-2: Technical and Economic Potential to Reduce Peak Demand at the System Level for All Nine Utilities

Utility	Sector	Baseline Demand (MW)	Technical Potential (MW)	Economic Potential (MW)	Technical Demand Savings as Percent of Baseline	Economic Demand Savings as Percent of Baseline
AEP Central	All Sectors	4,802	1,742	1,261	36.%	26.%
AEP North	All Sectors	1,002	362	225	36.%	22%
AEP SWEPCO	All Sectors	2,146	524	394	24%	18%
CenterPoint	All Sectors	20,098	6,775	5,092	34%	25.%
El Paso	All Sectors	1,599	379	320	24.%	20%
Entergy	All Sectors	4,249	1,311	957	31%	23%
Oncor	All Sectors	27,619	8,774	6,259	32%	23%
TNMP	All Sectors	1,847	606	254	33%	14%
Xcel	All Sectors	2,298	766	547	33%	24%
Statewide	All Sectors	65,659	21,239	15,309	32%	23%

Figure 6-1 provides estimates of the technical potential to reduce energy use by utility service area. This table demonstrates that the potential energy savings in the Oncor and CenterPoint service territories alone account for over 74% of the total technical potential for all nine investor owned utilities of over 79,000 GWh/year.

Figure 6-1: Technical Potential to Reduce Energy Use by Utility Service Area

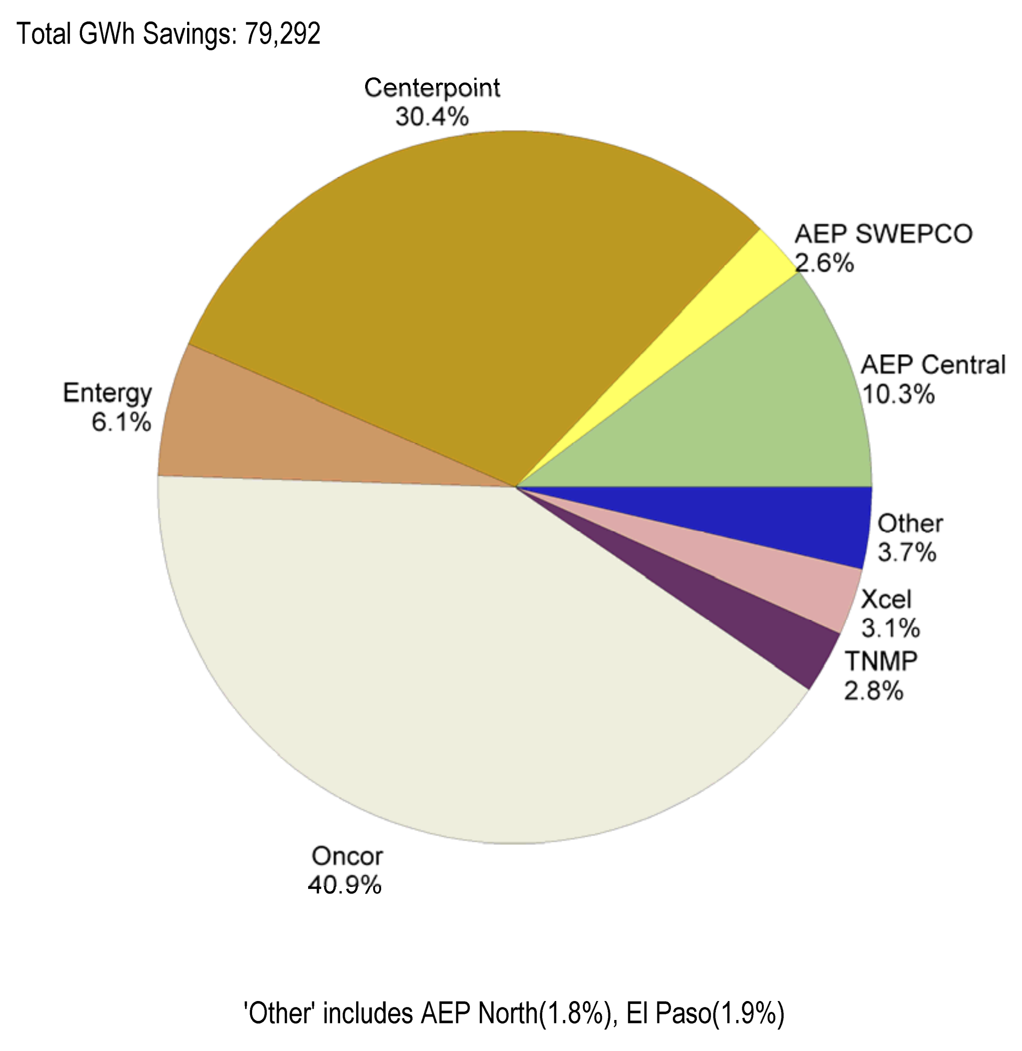


Figure 6-2 provides the same information on the total economic potential to reduce energy use of roughly 57,000 GWh/year (low avoided costs). The proportions of savings by utility areas remain roughly the same suggesting that the cost-effectiveness of measures is similar across different utility service areas.

Figure 6-2: Economic Potential to Reduce Energy Use by Utility Service Area

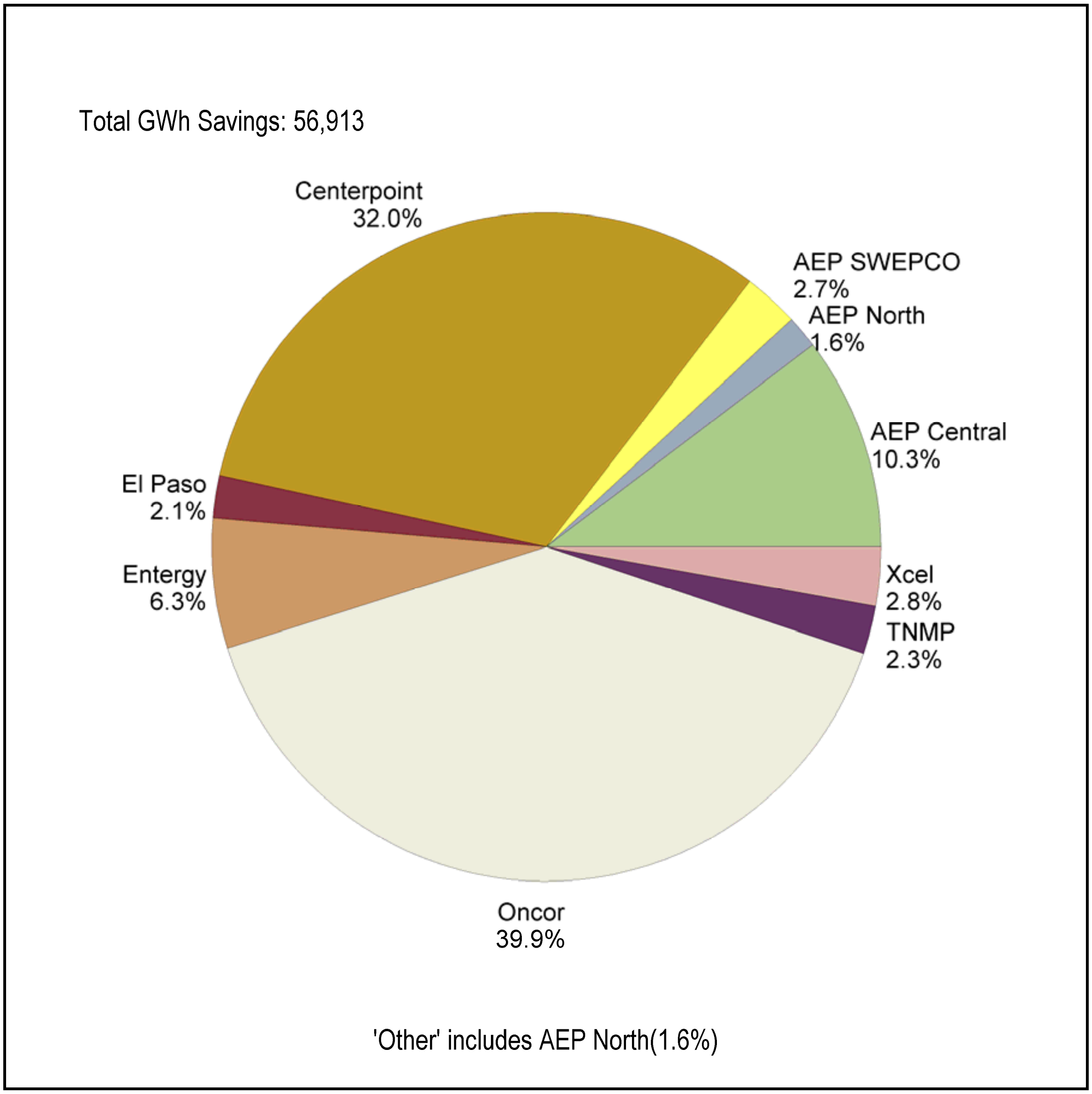


Figure 6-3 and Figure 6-4 display the technical and economic potential to reduce peak demand for each of the nine utility service areas. The percentage share of total peak savings potential represented by Oncor and CenterPoint is slightly higher than their shares of the technical and economic potential to save energy, perhaps due to the higher incidence of savings from cooling measures in these areas.

Figure 6-3: Technical Potential to Reduce Peak Demand by Utility Service Area

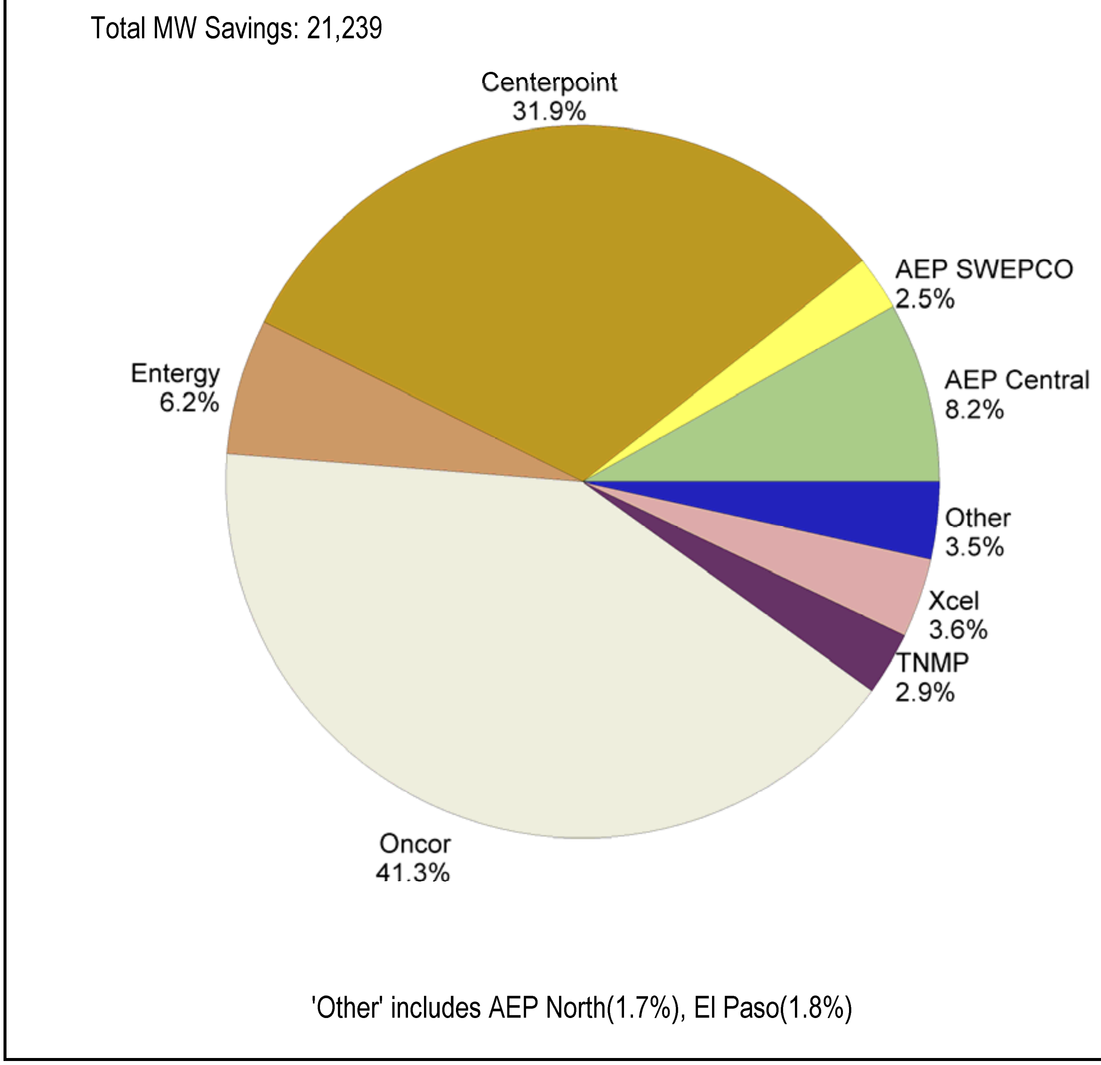
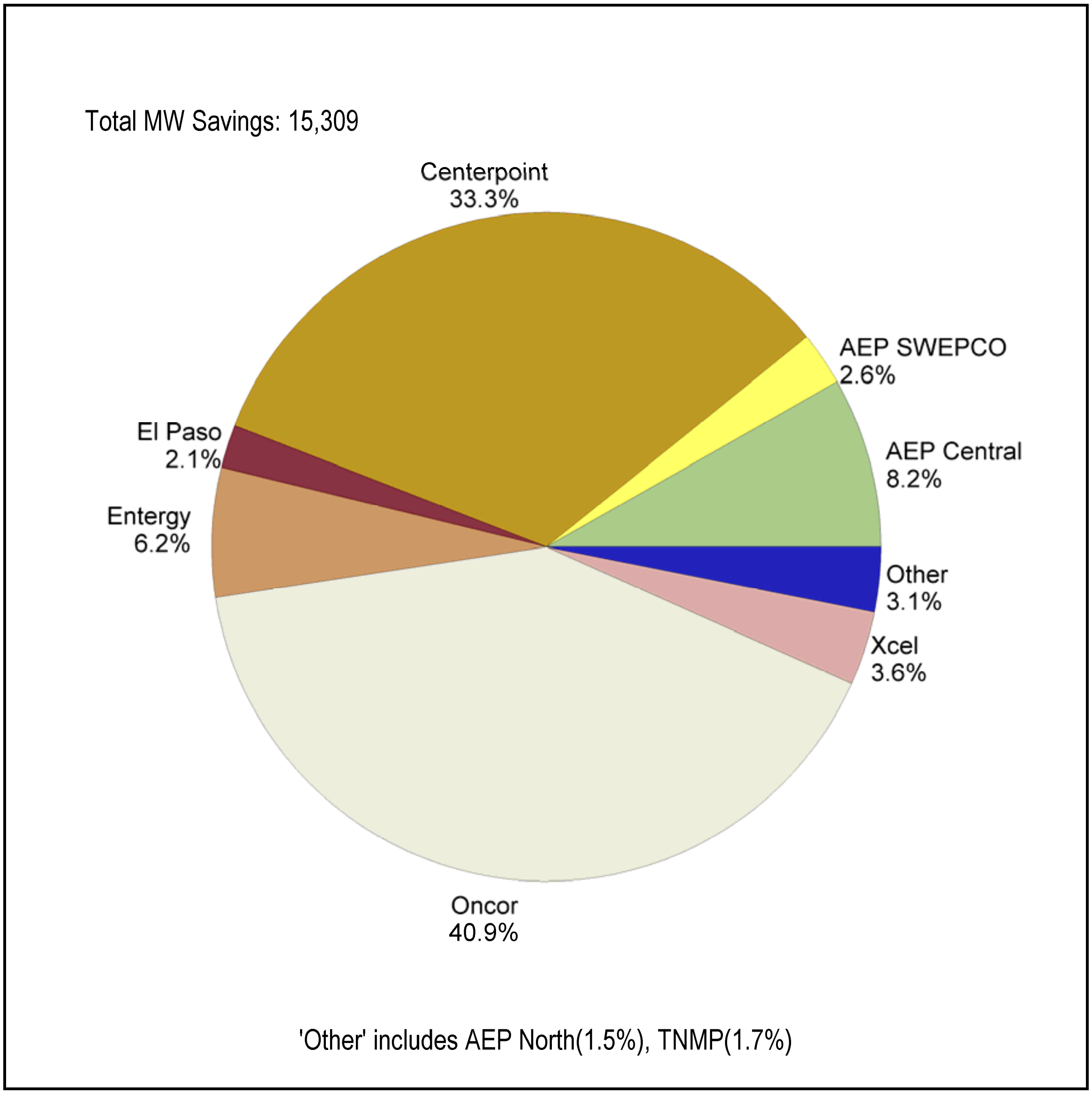


Figure 6-4: Economic Potential to Reduce Peak Demand by Utility



6.1.1 Technical and Economic Potential by Sector Across the Distribution Utilities

This section discusses the relative magnitude of the technical and economic potential to save energy and peak demand in the residential, commercial and industrial sectors. To be conservative the economic potential estimates displayed below assume use of the low forecast of avoided costs. Using the high forecast of avoided costs raises the estimates of economic potential across the board by roughly 23% relative to the estimates produced by the low forecast of avoided costs.

Residential Sector

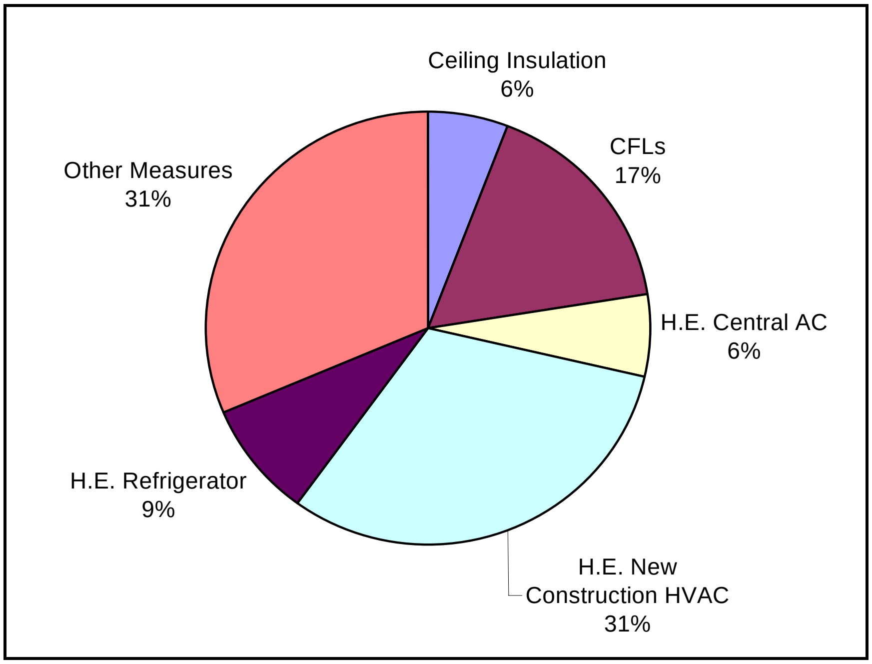
Itron’s estimates of the technical and economic potential to save energy and peak demand in the residential sector by utility service area are shown in Table 6-3. In general estimates of the share of baseline energy and peak demand that can be reduced in the residential sector is higher than the percentage reduction estimates across all sector because there are significant opportunities to reduce HVAC and lighting demand in this sector.

Table 6-3: Technical and Economic Potential Estimates to Save Electricity and Peak Demand in the Residential Sector

Utility	Technical Potential (GWh)	Technical Energy Savings as Percent of Baseline	Economic Potential (GWh)	Economic Energy Savings as Percent of Baseline	Technical Potential (MW)	Technical Demand Savings as Percent of Baseline	Economic Potential (MW)	Economic Demand Savings as Percent of Baseline
AEP Central	4,847	48.3%	2,931	29.2%	1,215	55.4%	792	36.1%
AEP North	856	45.5%	420	22.3%	233	56.1%	108	26.2%
AEP SWEPCO	1,034	39.5%	594	22.7%	309	29.8%	195	18.8%
CenterPoint	13,457	39.6%	8,434	24.8%	4,527	49.8%	2,982	32.8%
El Paso	647	25.2%	394	15.3%	124	21.7%	83	14.6%
Entergy	2,773	34.9%	1,710	21.5%	938	46.1%	617	30.3%
Oncor	19,119	37.4%	11,122	21.8%	6,137	46.9%	3,939	30.1%
TNMP	1,384	40.8%	548	16.2%	438	45.9%	101	10.6%
Xcel	1,477	46.6%	789	24.9%	500	52.0%	302	31.4%
Statewide	45,593	39.1%	26,942	23.1%	14,420	47.5%	9,119	30.1%

One of the most significant opportunities to reduce electricity use in the residential sector is the installation of compact fluorescent lamps (CFL). During the course of this project, utility program managers asked Itron to display the effect of a potential decision to not provide incentives or rebates for the installation of CFL on the overall level of economic savings by sector. Figure 6-5 shows the fraction of total economic savings represented by CFLs using the high avoided cost forecast. Savings from CFLs are estimated at 5,536 GWh out of a total residential potential of 33,050 GWh (using the high avoided cost forecast). Thus removing CFLs reduces economic potential by roughly 17% and the potential to reduce peak demand by roughly 7%.

Figure 6-5: Composition of Economic Potential Energy Savings in the Residential Sector by Major Measure (%)



Commercial Sector

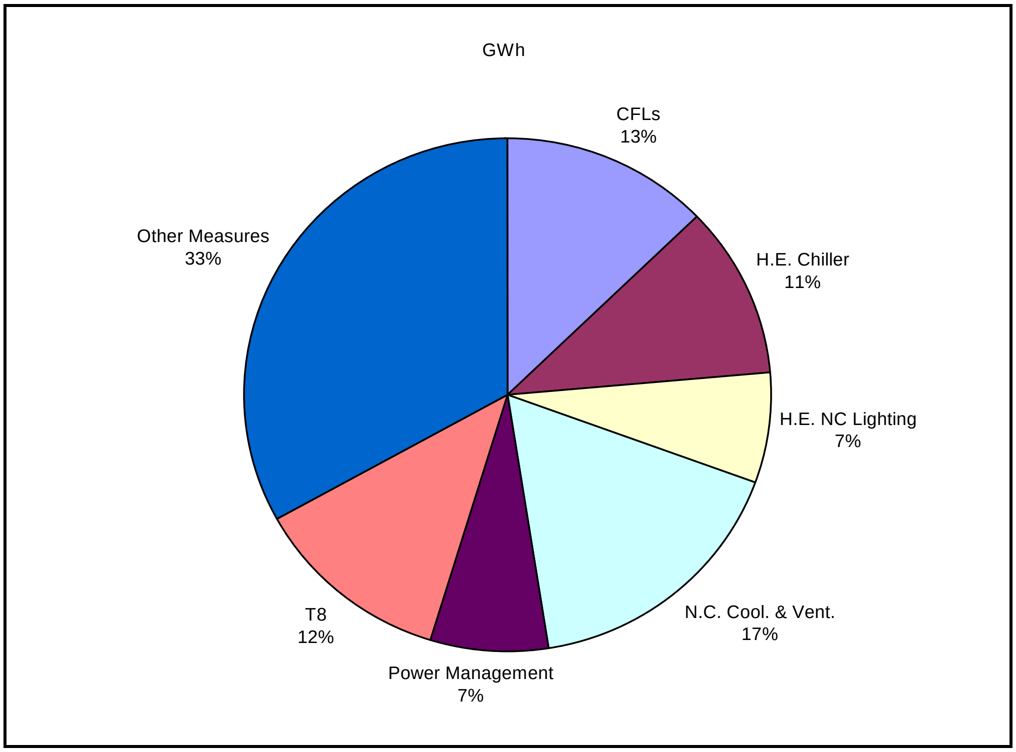
Itron's estimates of the technical and economic potential to save energy and peak demand in the commercial sector by utility service area are shown in Table 6-4. The estimate of technical and economic savings as a fraction of baseline usage is lower in this sector than the all sector estimates at 23% and 20% of baseline peak demand. In addition estimates of technical and economic potential are closer in an absolute sense suggesting that over 90% of the savings found to be technically feasible are also economic in this sector.

Table 6-4: Technical and Economic Potential Estimates for Energy and Peak Savings in the Commercial Sector

Utility	Technical Potential (GWh)	Technical Energy Savings as Percent of Baseline	Economic Potential (GWh)	Economic Energy Savings as Percent of Baseline	Technical Potential (MW)	Technical Demand Savings as Percent of Baseline	Economic Potential (MW)	Economic Demand Savings as Percent of Baseline
AEP Central	2,425	22.1%	2,058	18.8%	408	23.1%	354	20.1%
AEP North	404	19.4%	338	16.3%	107	24.4%	96	21.9%
AEP SWEPCO	597	20.6%	522	18.0%	158	25.6%	146	23.6%
CenterPoint	7,145	18.1%	6,366	16.1%	1,847	22.0%	1,726	20.6%
El Paso	730	18.2%	638	16.0%	232	26.5%	215	24.6%
Entergy	1,114	16.8%	962	14.5%	239	21.6%	212	19.1%
Oncor	10,634	19.9%	9,018	16.9%	2,191	22.1%	1,896	19.1%
TNMP	543	18.6%	470	16.1%	126	22.8%	113	20.5%
Xcel	785	21.3%	674	18.3%	246	28.7%	225	26.3%
Statewide	24,377	19.3%	21,047	16.7%	5,554	22.7%	4,982	20.3%

Figure 6-6 shows the composition of the estimated economic potential to save energy in the Commercial sector for the energy efficiency measures with the largest percentage shares. The largest savings are expected to come from T-8 lamp and electronic ballasts, CFLs, and high efficiency chillers in the existing sector, and high efficiency lighting and cooling and ventilation systems in the commercial new construction market segment.

Figure 6-6: Composition of Economic Potential Energy Savings in the Commercial Sector by Major Measure (%)



Industrial Sector

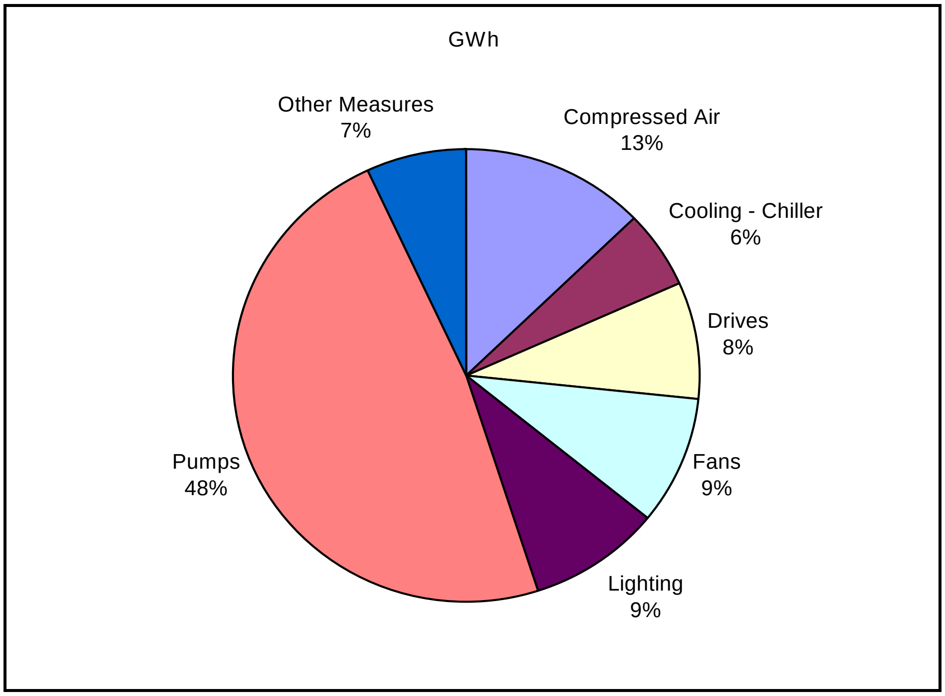
Itron's estimate of the technical and economic potential to save energy and peak demand in the industrial sector are shown in Table 6-5. Economic energy savings range from 4.3 % of baseline industrial usage to 16.6% of baseline usage. The greater variation is due to the significant variations in the share of electricity usage from large scale industrial facilities in each of the nine service areas.

Table 6-5: Technical Potential Estimates for Energy and Peak Savings in the Industrial Sector

Utility	Technical Potential (GWh)	Technical Energy Savings as Percent of Baseline	Economic Potential (GWh)	Economic Energy Savings as Percent of Baseline	Technical Potential (MW)	Technical Demand Savings as Percent of Baseline	Economic Potential (MW)	Economic Demand Savings as Percent of Baseline
AEP Central	930	15.7%	891	15.0%	120	5.5%	114	5.2%
AEP North	148	17.4%	142	16.6%	22	14.7%	21	14.1%
AEP SWEPCO	430	12.3%	412	11.8%	57	11.5%	54	11.0%
CenterPoint	3,527	12.3%	3,384	11.8%	401	11.4%	384	10.9%
El Paso	149	12.0%	142	11.4%	24	15.1%	22	14.3%
Entergy	949	12.8%	908	12.3%	134	12.1%	128	11.6%
Oncor	2,711	10.0%	2,588	9.5%	445	9.5%	424	9.0%
TNMP	316	13.6%	302	13.0%	42	12.1%	40	11.5%
Xcel	162	4.5%	154	4.3%	21	4.2%	20	4.0%
Statewide	9,322	11.6%	8,924	11.1%	1,265	9.6%	1,208	9.2%

Figure 6-7 shows the composition of the estimated economic potential to save energy in the Industrial sector for the energy efficiency measures with the largest percentage shares. The largest savings are expected to come from more efficient pumps, compressed air systems, motor drives, fans and lighting systems.

Figure 6-7: Composition of Economic Potential Energy Savings in the Industrial Sector by Major Measure (%)



6.2 Energy Efficiency Supply Curves

Figure 6-8, Figure 6-9 and Figure 6-10 chart the estimated level of energy savings as a function of avoided electricity costs for the residential, commercial, and industrial sector summed across all nine participating utilities. This provides a visual perspective on the level of savings found to be economic after accounting for interactive savings effects across measures.

Figure 6-8: Residential Energy Supply Curve for All Measures

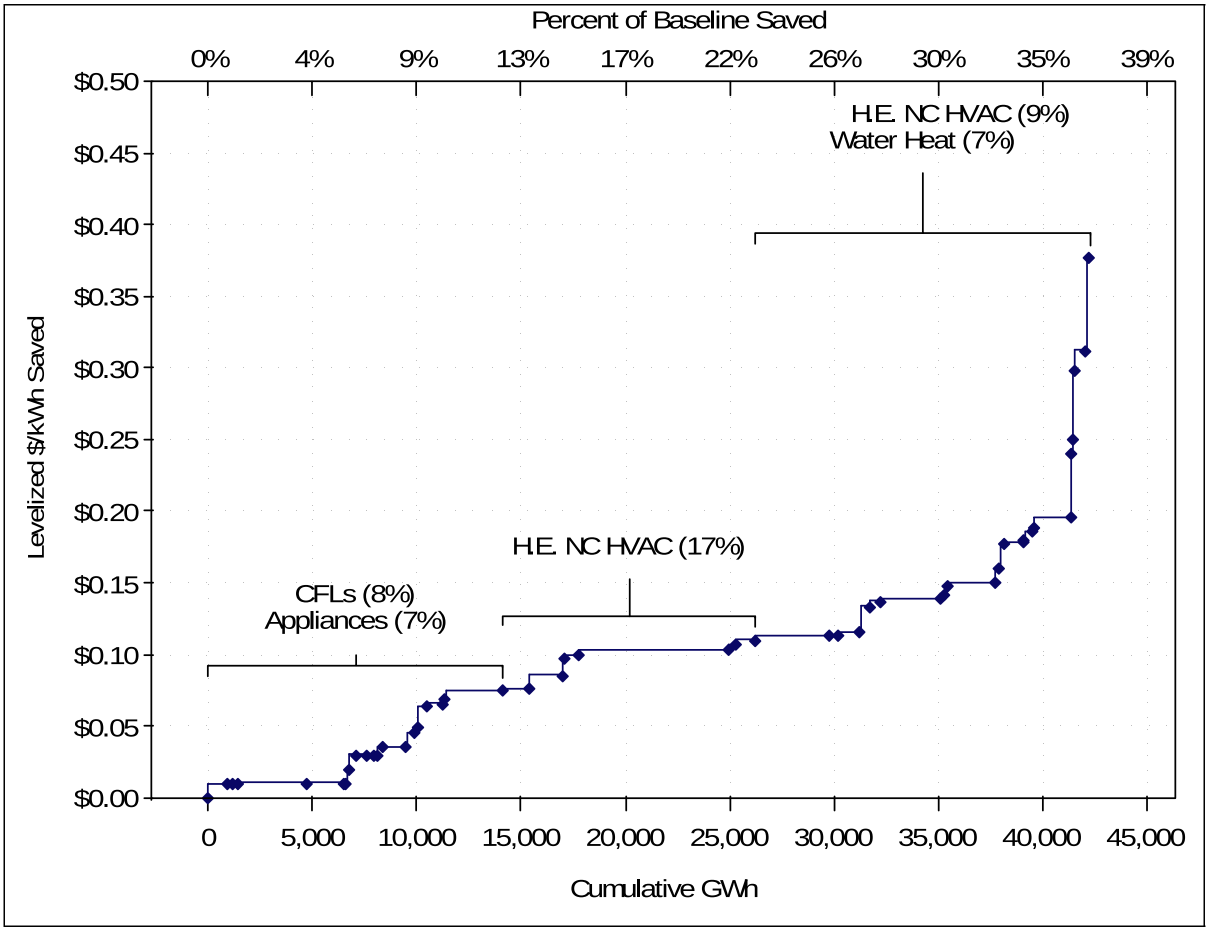


Figure 6-9: Commercial Energy Supply Curve for All Measures

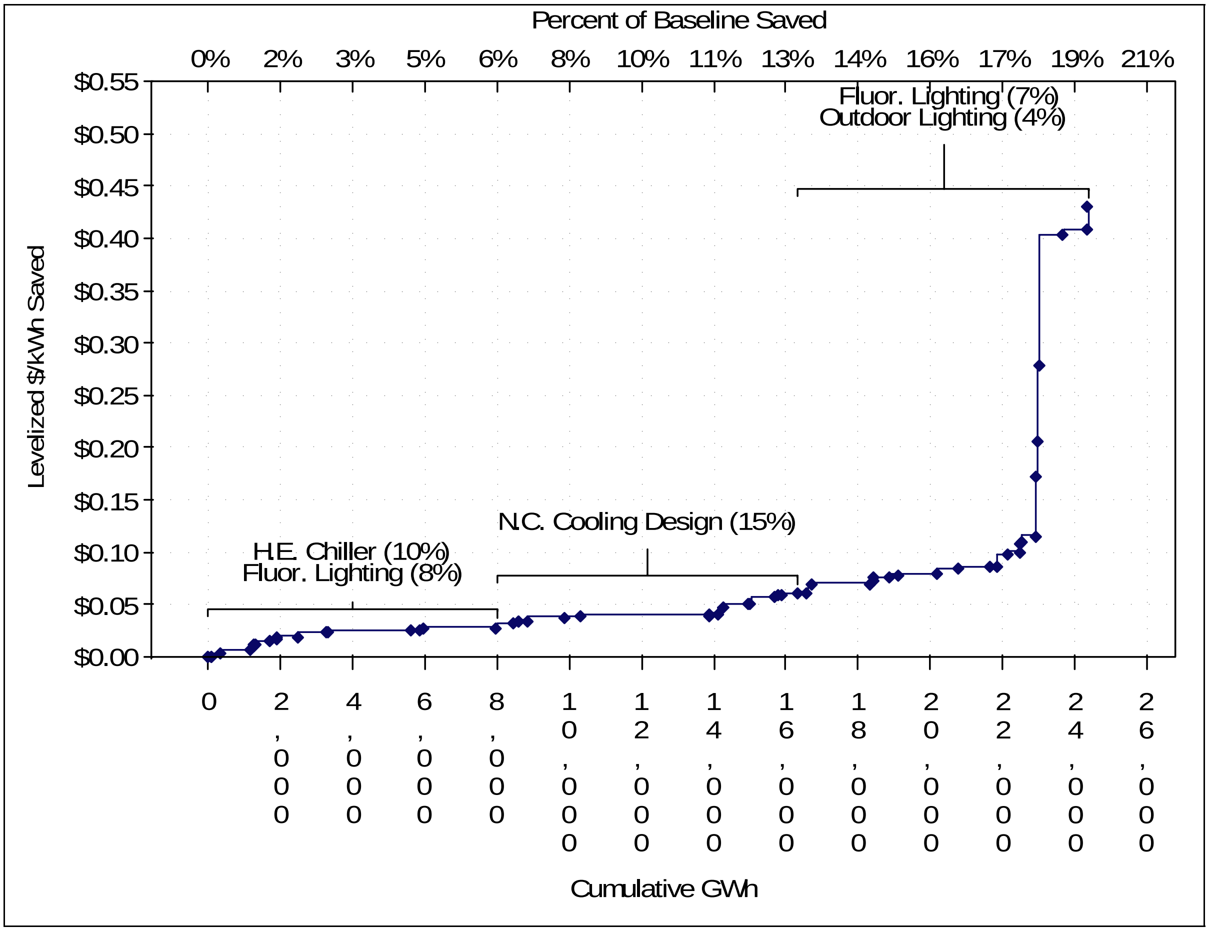
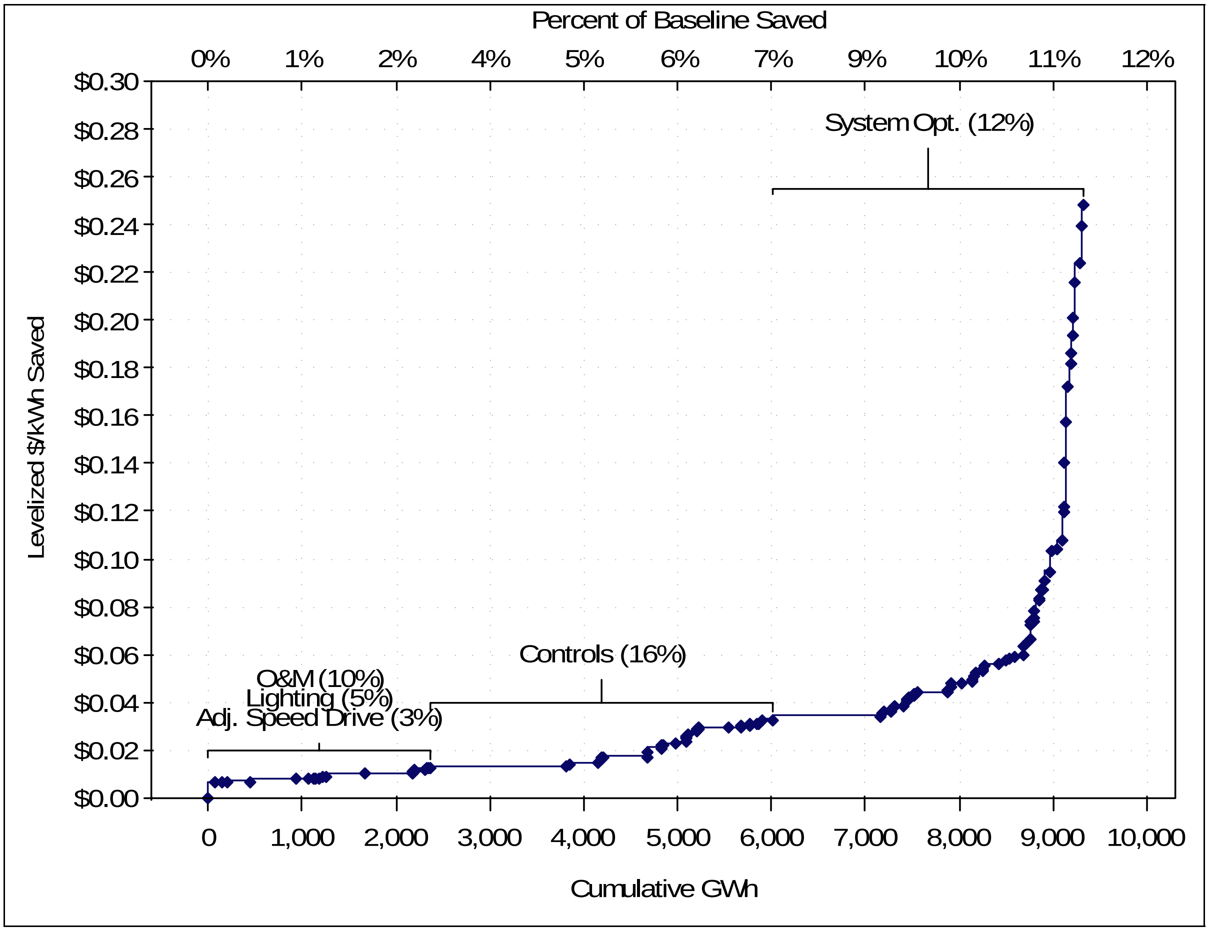


Figure 6-10: Industrial Energy Supply Curve



These figures suggest that the theoretical potential to reduce electricity use varies significantly by sector. Assuming an avoided cost threshold of 10 cents/ kwh, visual inspection of these graphs suggest that residential demand could be reduced by 20-25% in the residential sector, 20% in the commercial sector and 11% in the industrial sector.

7

Achievable Program Savings Forecasts and Assessment of Potential to Change Current Savings Goals

7.1 Overview-Results of Achievable Scenario Analysis

This section presents a range of achievable program savings forecasts corresponding to different forecasts of future retail electricity prices, avoided costs, and the likely effects of improved program designs and higher incentive levels on the rate of energy efficiency measure adoption. To qualify for inclusion in the achievable savings forecasts, all of the measures must be cost-effective and cheaper than the alternative of increased investment in new generation sources or new purchase contracts. Based on this analysis, Itron concludes it is technically feasible to increase the energy and peak savings to the proposed levels of 30% of incremental growth by 2010 and 50% of incremental growth by 2015. However, we believe that some smaller utilities may have difficulties in rapidly ramping up to meet the near-term change in the projected energy and peak savings goals for 2010. Given the need for more staffing resources and uncertainties about how long or if the proposed changes will actually become law, Itron proposes that the 2010 goal be postponed to 2012. Additionally, Itron proposes reformulating the savings goal metric to be calculated based on total peak demand in the previous year, rather than using a fraction of incremental growth in the previous five years. We also develop a range of feasible ramp-up rates on a utility-by-utility basis to meet the proposed goals and provide estimates of the overall costs and benefits of ramping up the energy efficiency programs to meet these goals.

This section includes estimates of the range of achievable program savings at multiple levels: for the sum of all nine Texas utility areas, for each utility service area, and at the residential, commercial, and industrial sector levels for each utility. Higher forecasts of achievable savings levels correspond to an increase in the level of rebates offered for cost-effective measures, the allowance of expenditures to increase public awareness and knowledge of energy efficiency options, and higher forecasts of electricity rates and avoided costs for the next decade.

7.1.1 Descriptions of the Scenarios

The methods used to construct the baseline energy and price forecasts have been described in Section 3, but the key features of each scenario driver are repeated briefly below. There are two primary drivers of the forecast of likely adoption of energy efficient measures:

1. Program incentives as a fraction of the incremental costs of purchasing and installing the measure, and
2. Forecast of avoided costs and retail rates.

Table 7-1 presents the range of values used for these two scenario drivers.

Table 7-1: Scenario Description

Scenario Name	Avoided Cost Forecast	Average Incentive Level as a Fraction of Incremental Measure Cost
Base Case - Low Avoided Cost	Avoided cost increase at rate of inflation 2% per year	33%
Base Case - High Avoided Cost	Avoided cost increase at 5% per year (last five year trend)	33%
High Case - Low	Avoided cost increase at rate of inflation 2% per year	67%
High Case - High Avoided Cost	Avoided cost increase at 5% per year (last five year trend)	67%

In all cases, measures included in these forecasts of achievable savings must pass the total resource cost test. In other words, the present value of the benefits of the energy and peak savings from the programs must exceed the sum of the all program costs and the incremental costs of the measures.

7.1.2 Base and High Achievable Savings Forecasts at the Statewide and Utility Level[14]

Figure 7-1 and Figure 7-2 show the forecast of achievable energy and peak savings respectively at the base and high program funding level on a cumulative basis using the low avoided cost scenario at the statewide level. These figures include the level of energy and peak savings expected to occur naturally in the absence of programmatic effort as the lowest

---

[14] As previously noted, the achievable potential estimates presented in this section and throughout this report exclude savings from screw-in CFLs as per direction from the PUCT and utility management group.

line in the figures. This corresponds to the level of measure adoption predicted to occur given existing levels of measure awareness and market segment thresholds for investing in measures with a payback period of two years or less. Figure 7-1 shows that programs are projected to roughly double the level of overall savings that is expected to naturally occur, achieving, for example, 12,000 GWh of savings in the base incentive case by 2017 as opposed to the expected level of roughly 6,000 GWh of naturally occurring savings in the same year. Pursuit of the higher funding cases, where program incentives are allowed to increase to 67% of incremental costs, is expected to capture an additional 8,000 GWh of savings over the ten-year period—equivalent to the output of two 800 MW coal plants at a 60% capacity factor. These forecasts do not include the potential savings from high voltage customers.

Figure 7-1: Cumulative Annual Achievable Savings: Naturally Occurring, Base and High Program Funding Scenarios-- Statewide with Low Avoided Costs

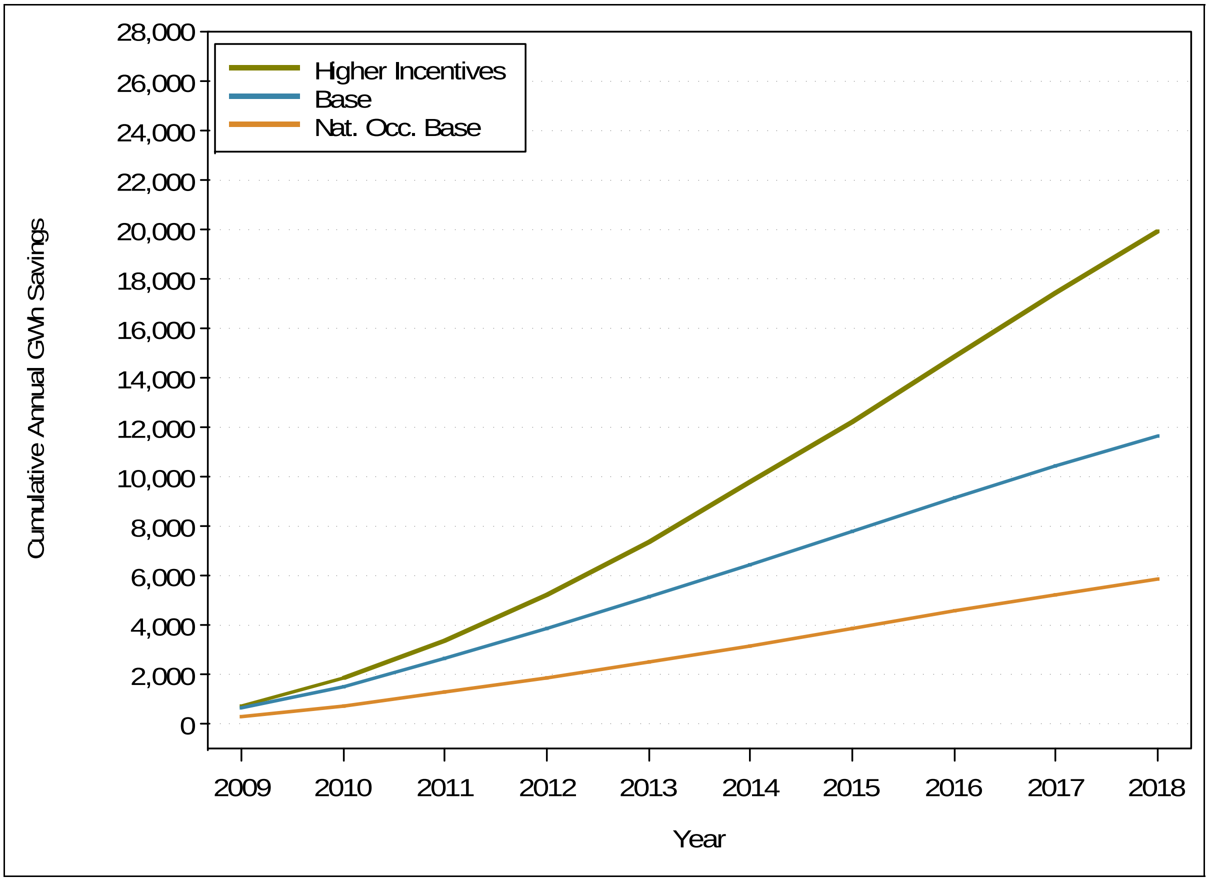


Figure 7-2 shows that programs are projected to roughly double the level of overall peak demand savings that is expected to naturally occur from 1,000 MW to 2,200 MW in the year 2017. Pursuit of the higher funding cases where program incentives are allowed to increase to up to 67% of incremental costs is expected to capture an additional 3,000 MW of peak demand savings over the ten-year period.

Figure 7-2: Cumulative Annual Peak Demand Savings MW, Statewide --Low Avoided Costs

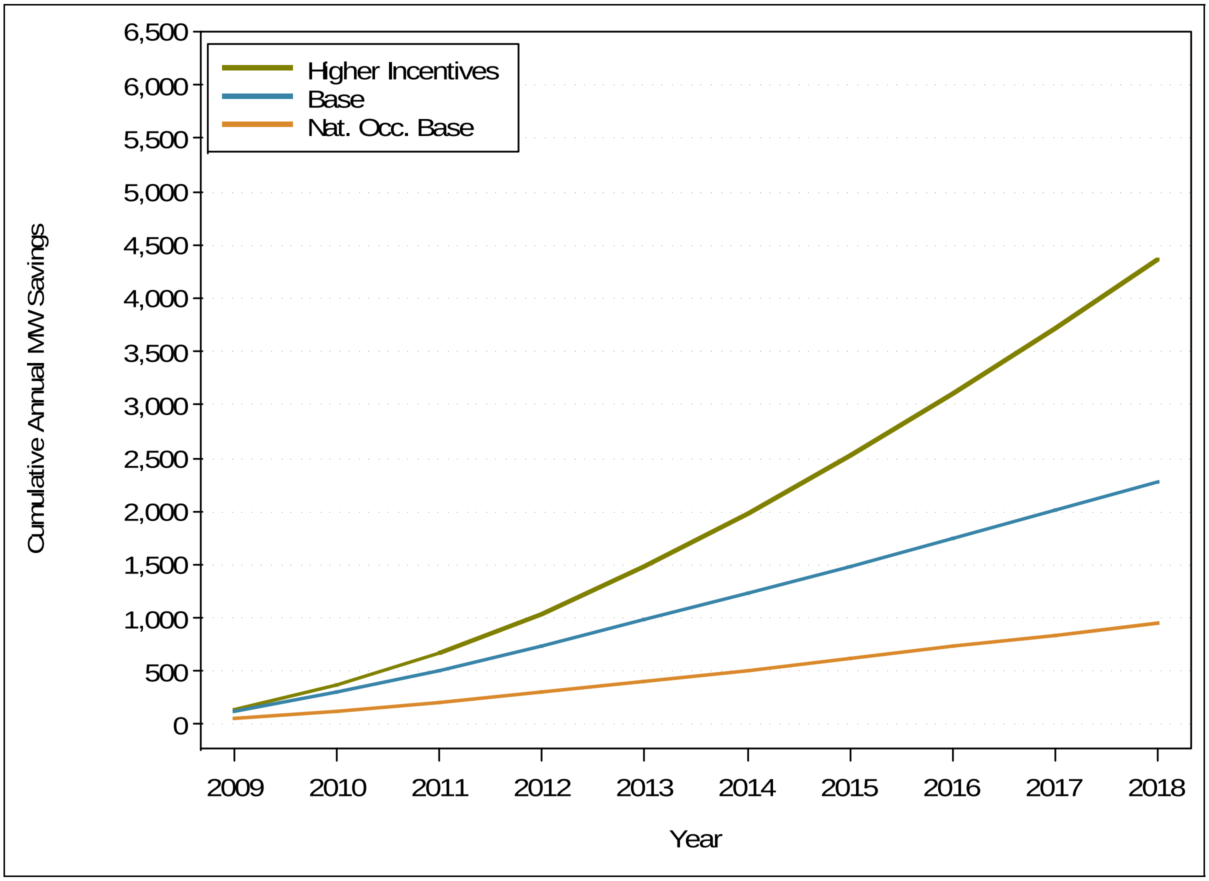


Figure 7-3 and Figure 7-4 show the same achievable savings forecast as before, except we substitute use of the high avoided cost forecast to estimate what is cost-effective from the customers' perspective. This has the net effect of increasing the level of expected energy savings in the Base incentive case by roughly 10%. This is because the high avoided cost case includes the savings from a few measures that now meet the cost-effectiveness threshold given the higher forecast of avoided cost.

Figure 7-3: Cumulative Annual GWh Savings, Statewide - High Avoided Costs

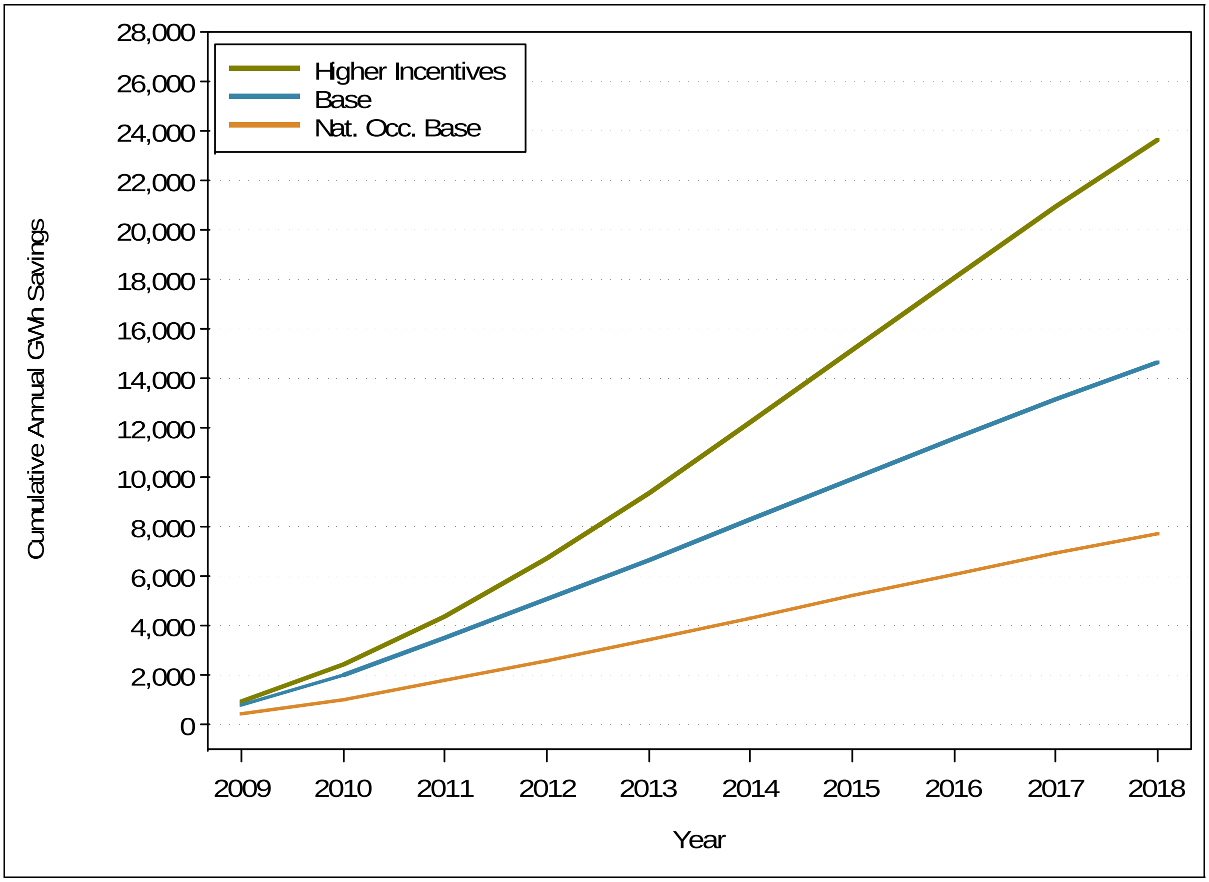
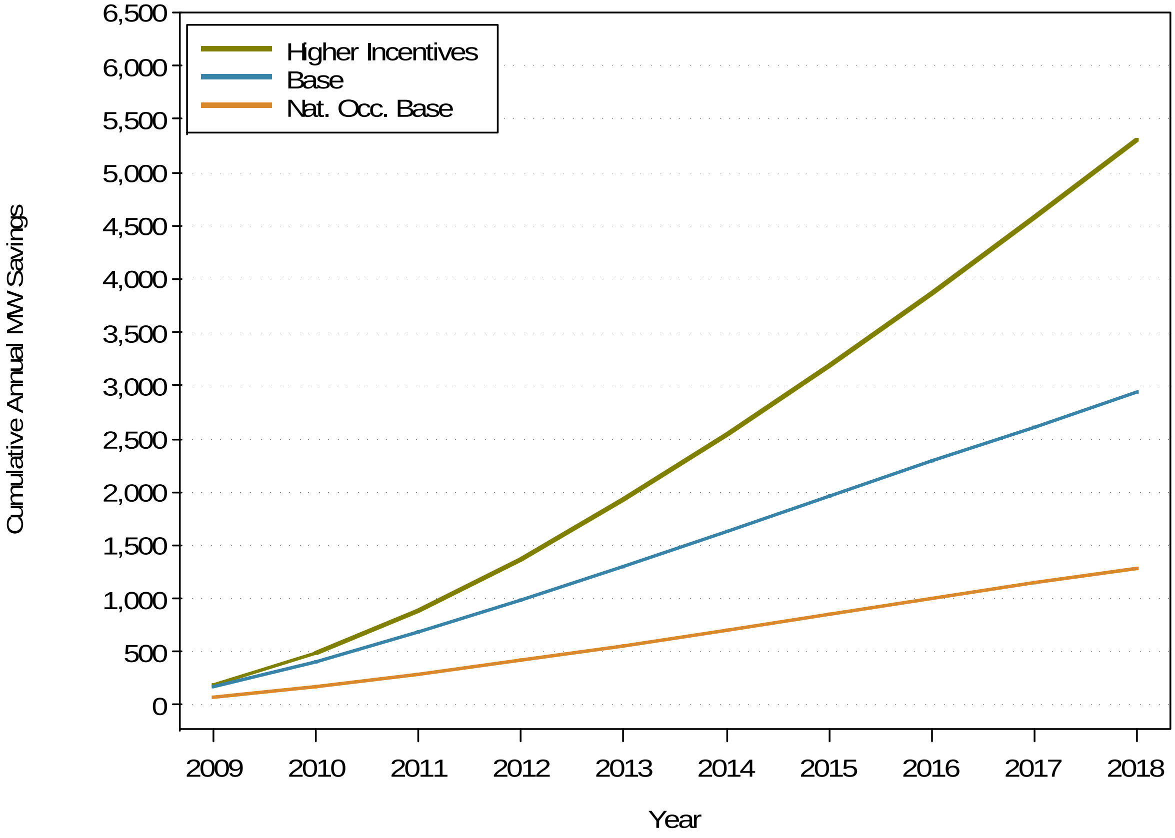


Figure 7-4: Cumulative Annual MW, Statewide - High Avoided Cost Case



7.1.3 Achievable Savings Forecasts at the Sector Level

<u>All Sector Overview</u>

Figure 7-5 and Figure 7-6 displays the projected achievable energy savings from the residential, commercial and industrial sectors over the next decade for the Base and High achievable cases respectively.

Figure 7-5: Forecasts of Achievable Energy Savings for Residential, Commercial, and Residential Sectors: Base and High Incentives Case - Low Avoided Cost (AV)

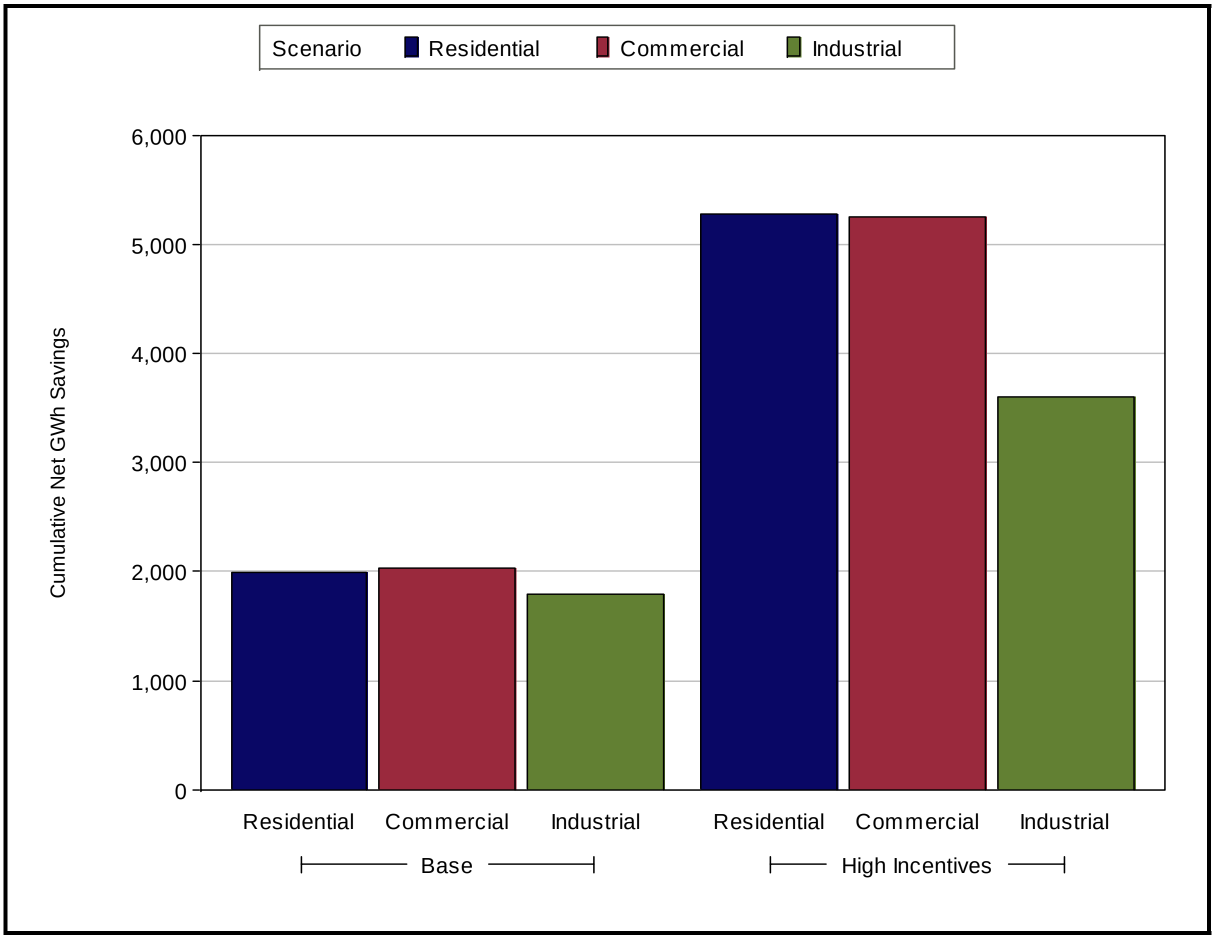
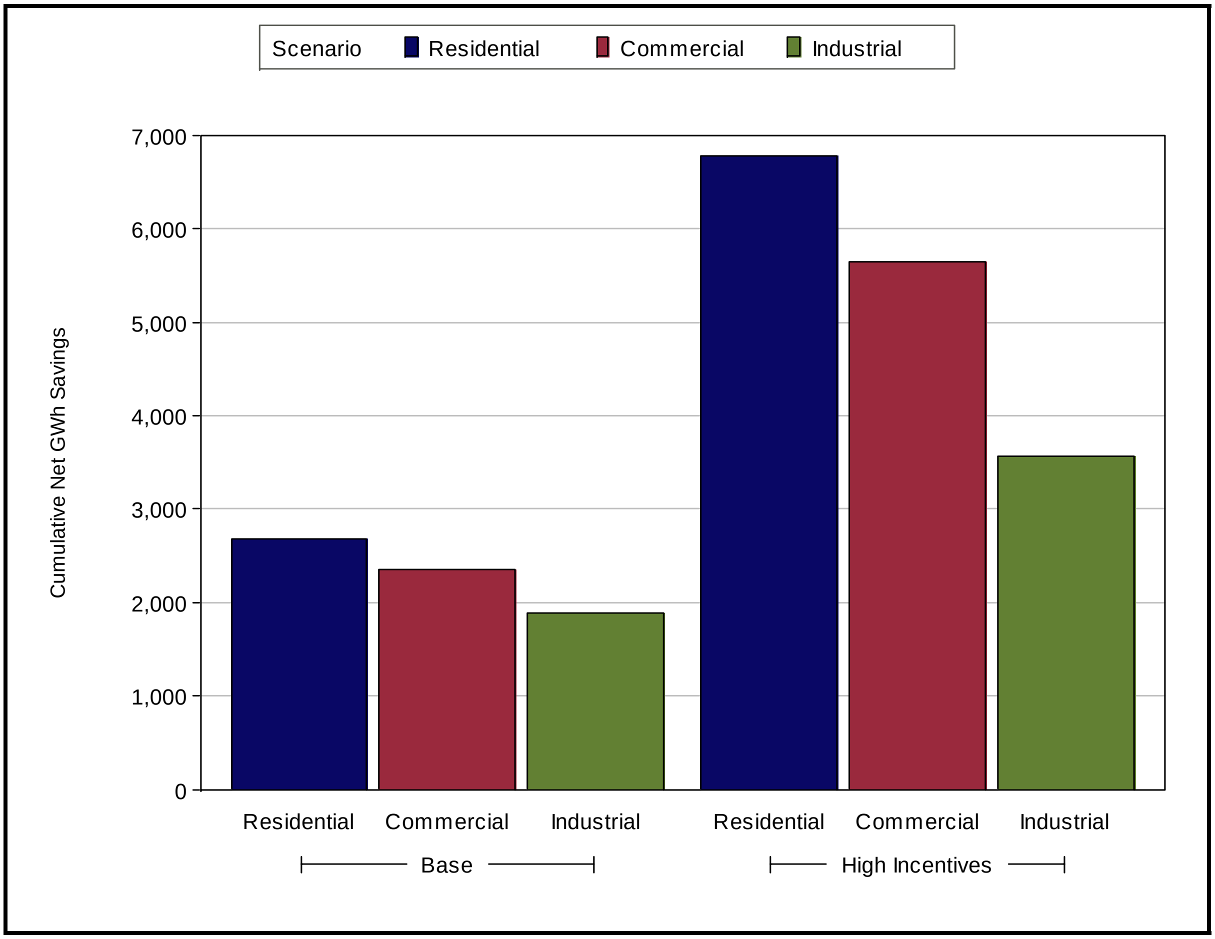


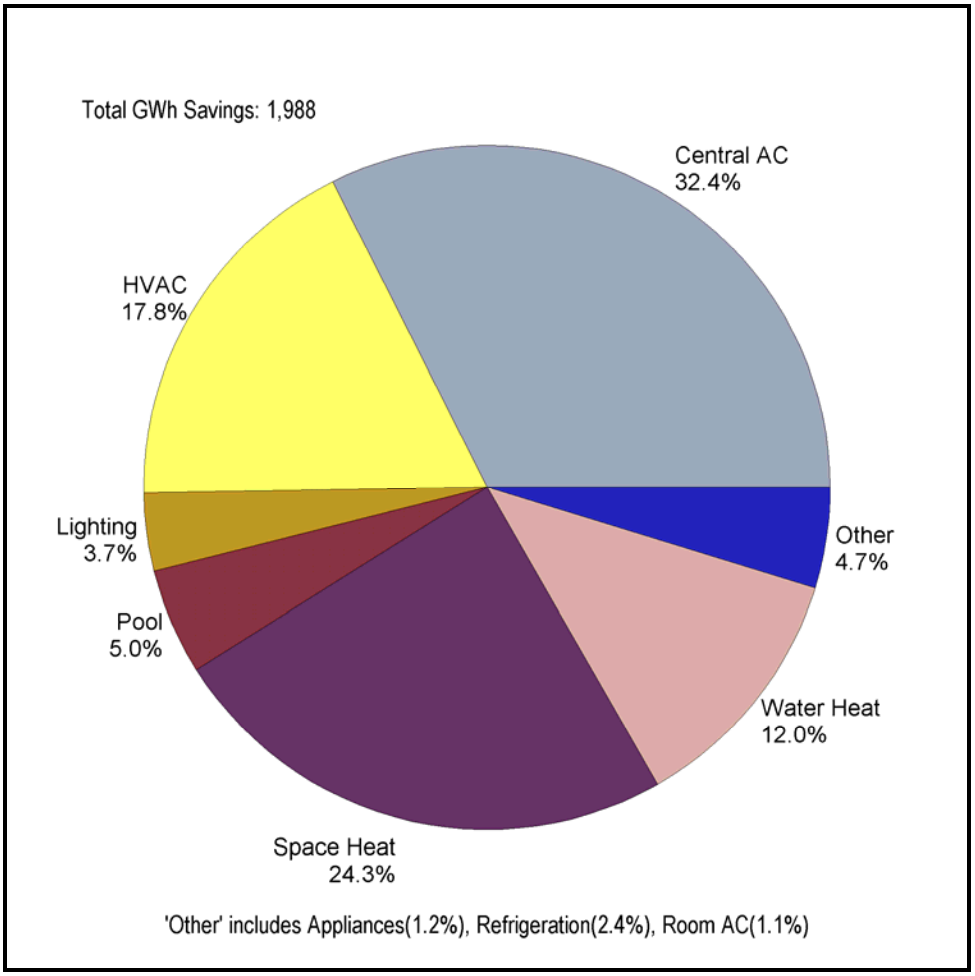
Figure 7-6: Forecasts of Achievable Energy Savings for Residential, Commercial and Industrial Sectors: Base and High Incentive Cases – High Avoided Cost



Residential

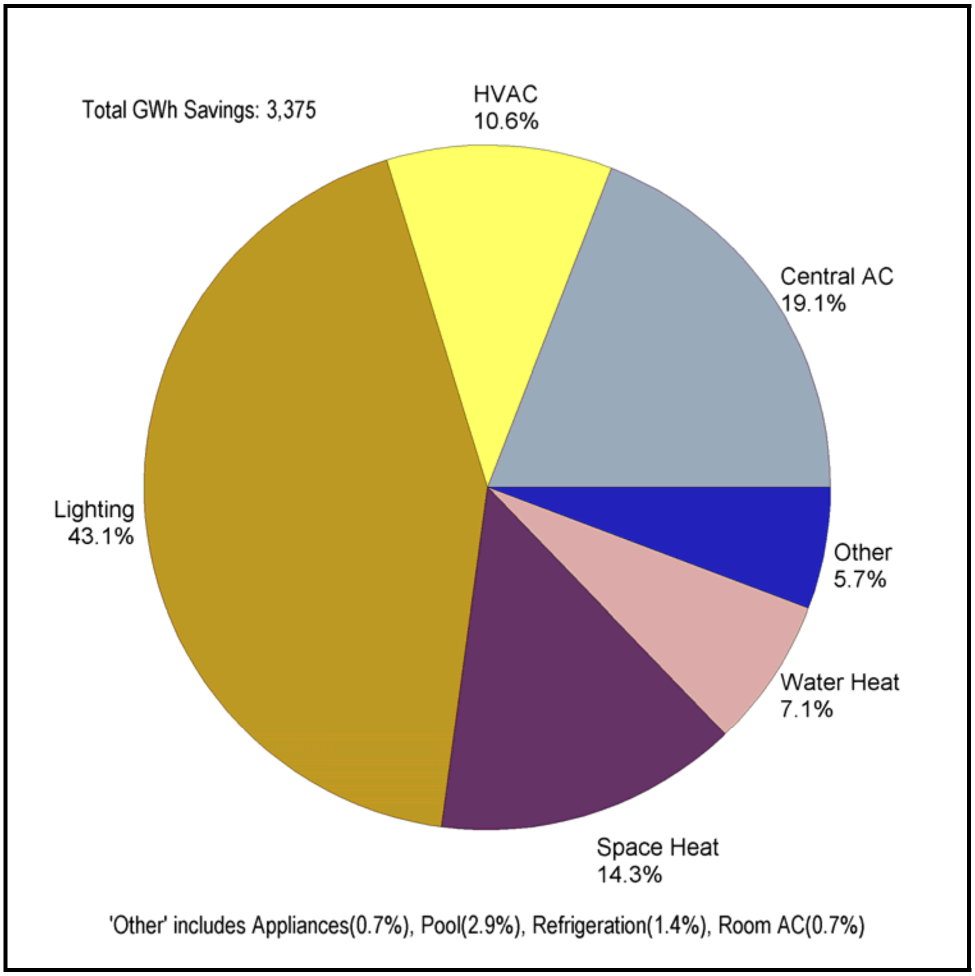
Figure 7-7 and Figure 7-8 show the projected level of savings by end use, with and without the inclusion of CFLs in 2017, the tenth year of the forecast. Achievable savings in Figure 7-7 is dominated by the energy savings achieved by increasing the thermal integrity of heating and cooling systems, while Figure 7-8 demonstrates the tendency for CFL lamps to quickly become the dominant source of savings in the residential sector once these measures become eligible for rebates or other promotions as part of utility programs.

Figure 7-7: Achievable Energy Savings by End Use in the Residential Sector - No CFL Case - Low Avoided Costs



Note: HVAC denotes savings from shell improvements while Central AC savings come from improvements in the SEER rating of the air conditioning systems.

Figure 7-8: Achievable Energy Savings by End Use in the Residential Sector - with CFL Case - Low Avoided Costs



These two different perspectives are provided because whether to heavily promote CFLs as a source of program savings is a strategic choice that the utilities and PUCT should carefully consider. A case can be made to discourage the promotion of CFLs at this stage in the development of the CFL market because of the strong possibility that a large proportion of potential program participants may be free riders, e.g., would have bought the bulbs in the absence of the program. On the other hand, including CFLs in the programs' mix could potentially accelerate CFL sales in Texas and provide a new source of savings for utility program administrators. A decision to include CFLs probably means it will be essential to track net savings as well as gross reported savings in order to ensure that ratepayer dollars are effectively spent. After discussing the pros and cons of including CFLs, utility program managers asked Itron to remove the potential savings from CFLs in the achievable savings forecasts. The effect of this change later is highlighted later in the analysis.

Commercial

Figure 7-9 shows the projected savings by end use for the base achievable case for all nine utilities combined in 2017, the tenth year of the forecast. Approximately 45% of the saving is expected to come from indoor lighting measures, while 32% will come from measures to reduce cooling usage in commercial buildings. The remaining savings will come from refrigeration and ventilation measures.

Figure 7-9: Projected Achievable Energy Savings for the Commercial Sector: Base Achievable Case - Low Avoided Costs

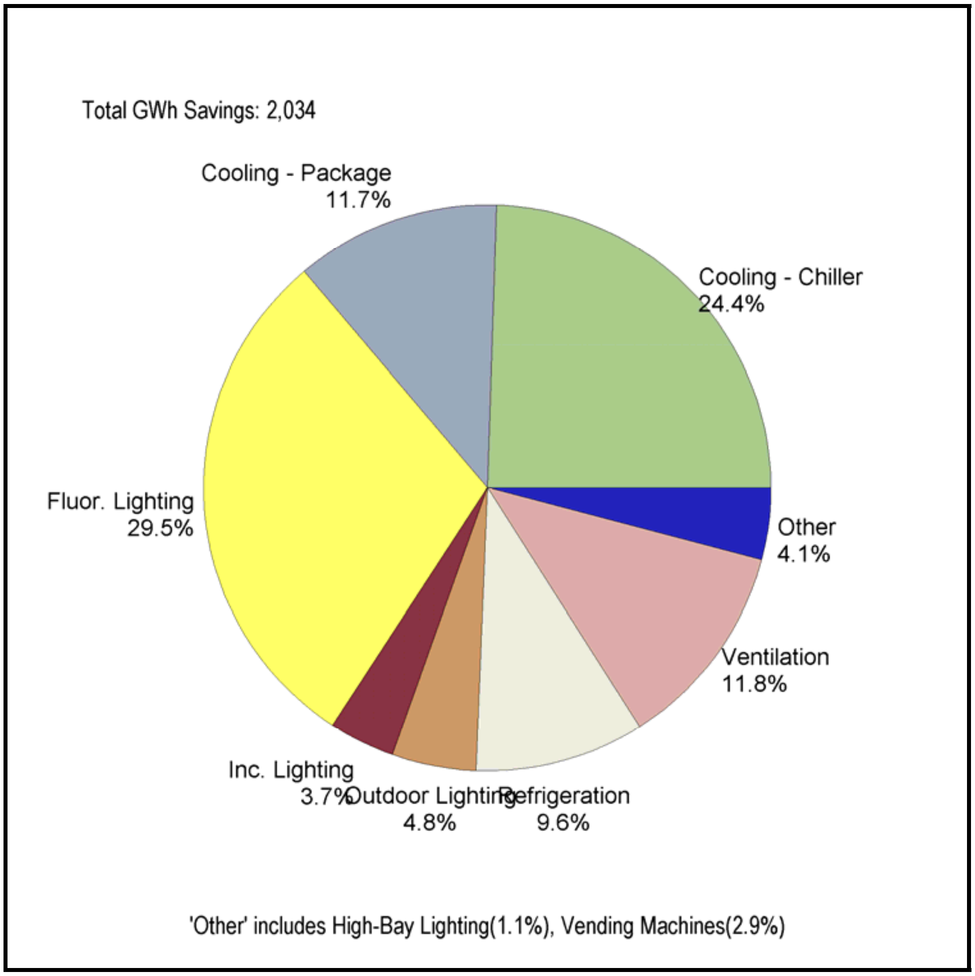
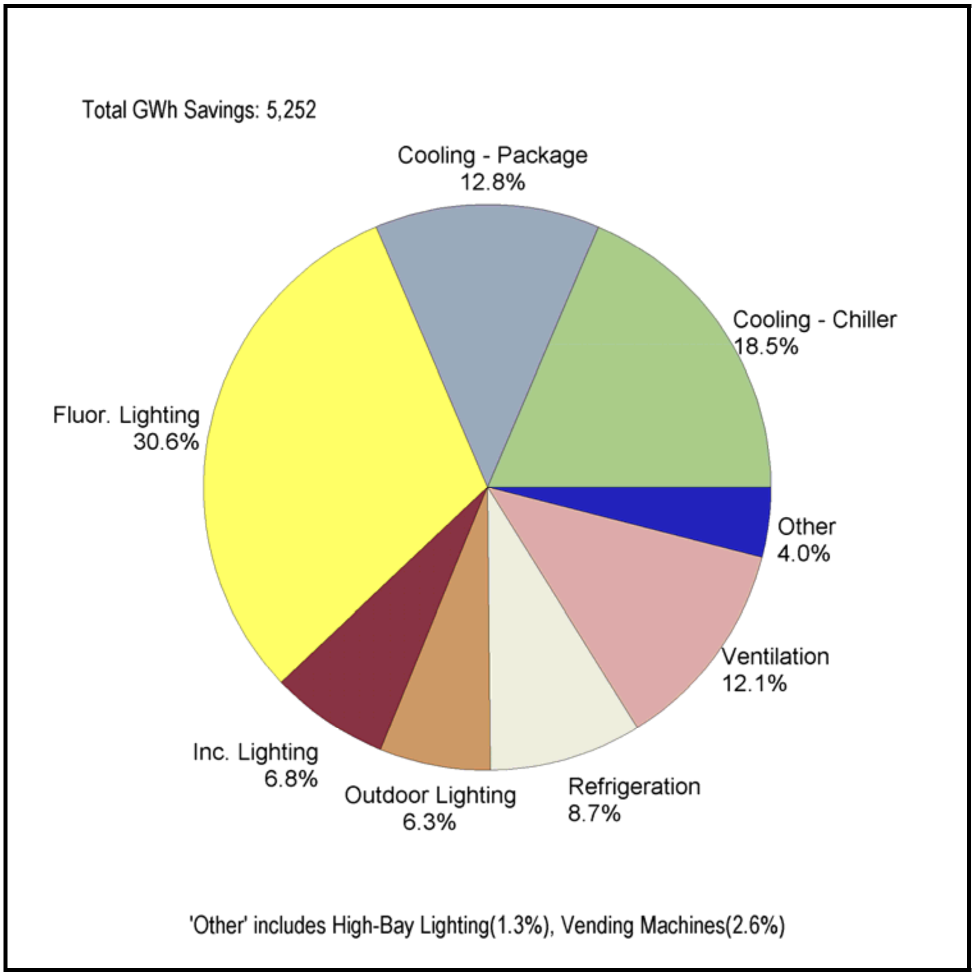


Figure 7-10 shows the same breakout of energy savings by end uses for the High incentives case in the tenth year of the forecast. The end-use shares of savings are roughly the same as for the Base incentive case even though the level of savings is 5,232 GWh, roughly double the 2,034 GWh of annual savings projected in the Base incentive case.

Figure 7-10: Projected Achievable Energy Savings for the Commercial Sector: High Achievable Case - Low Avoided Costs



Industrial - With and Without High Voltage Customers

Figure 7-11 shows the anticipated annual energy savings for the industrial sector in 2017 for the Base achievable savings case. Figure 7-12 shows the same breakout for the High achievable savings forecast.

Figure 7-11: Projected Savings by Measure Type - Industrial Base Case - Low Avoided Costs

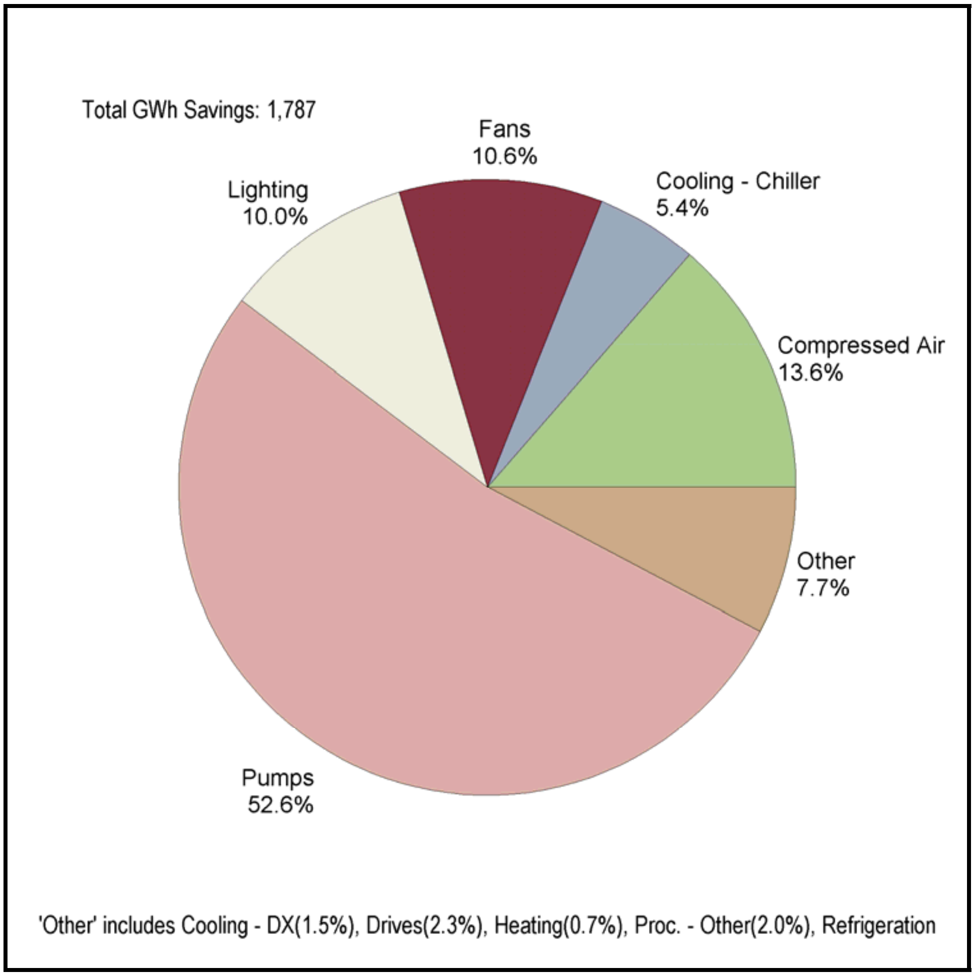
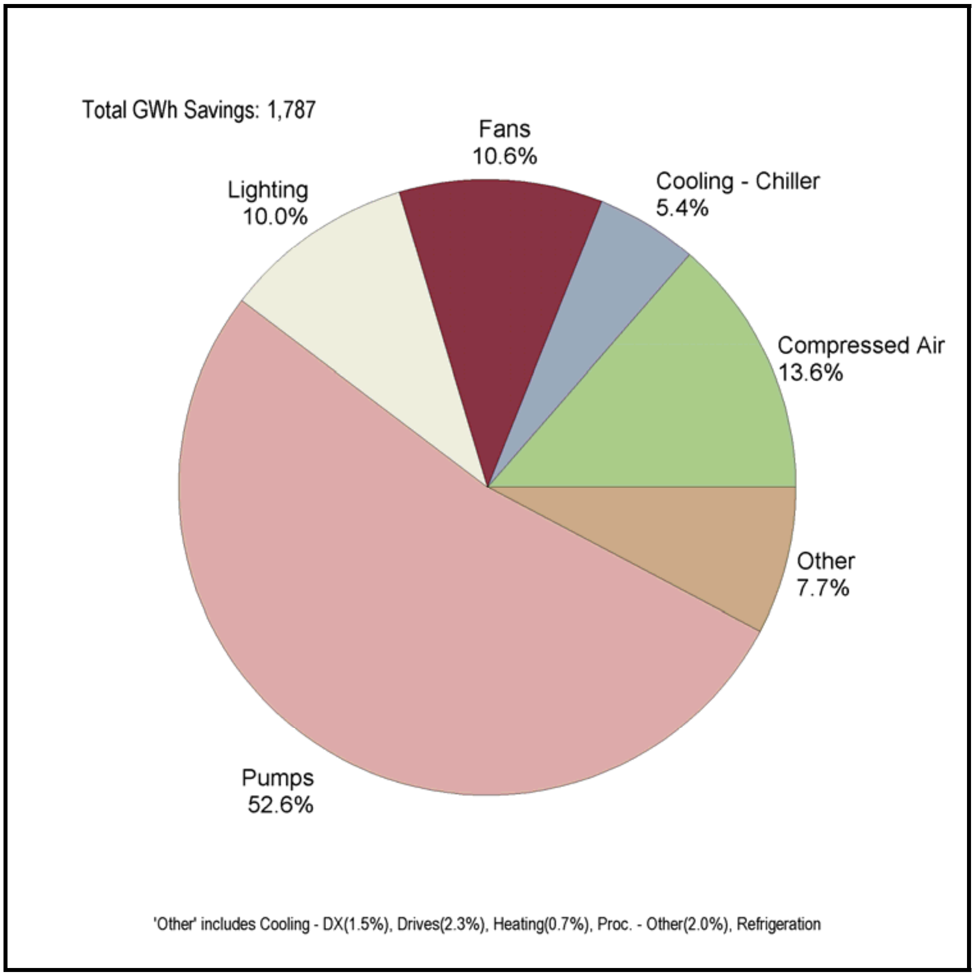


Figure 7-12 shows that projected savings shares for industrial measure groups in the High incentives case are roughly the same as projected in the Base case, while total energy savings are roughly 30% higher in the High achievable case at 7,495 GWh vs. 5,795 GWh in the Base case.

Figure 7-12: Projected Energy Savings by Measure Type - Industrial High Achievable Case - Low Avoided Costs



The legislation requests an estimate of the reduction in achievable savings with and without high voltage commercial and industrial customers. Itron understands that the PUCT has interpreted the most recent legislation to exempt large industrial customers with high voltage transmission service from paying for and participating in energy efficiency programs. To be consistent with this interpretation, Itron has estimated the fraction of industrial usage represented by large customers and by the major industrial segments based on consultations with experts at each investor-owned utility. Table 7-2 provides an estimate of the split between small and large (high voltage) industrial customers by industry type and for the state as a whole. In many cases, high voltage sales were provided by specific industries and were applied accordingly. In cases where high voltage sales were for the industrial sector as a whole, they were allocated to the different industry types proportionately based on the estimated sales for all accounts.

Table 7-2: Industrial Energy Use for High Voltage (HV) and Non High Voltage Industrial Customers in 2007

Industry	GWh - All Accounts	GWh - No HV Accounts	HV Share of GWh
Agriculture	175.5	175.2	0.2%
Chemicals	20,203.20	3,060.90	84.8%
Construction	65.1	65	0.2%
Electronics	2,935.40	1,489.10	49.3%
Fab. Metals	1,592.50	857.1	46.2%
Food	4,117.20	2,368.50	42.5%
Ind. Mach.	2,116.50	1,353.70	36.0%
Instruments	336.1	166.4	50.5%
Leather	25.2	12.3	51.3%
Lumber	958	502.4	47.6%
Mining/Extraction	8,820.70	5,881.00	33.3%
Misc. Man.	368.3	180.8	50.9%
Paper	1,279.70	669.1	47.7%
Petroleum	8,758.30	2,674.20	69.5%
Prim. Metals	1,954.20	930.4	52.4%
Printing	67	34.4	48.6%
Rubber/Plastics	3,660.60	2,027.10	44.6%
Stone, Clay, Glass	2,614.30	1,434.40	45.1%
TCU	2,094.70	731	65.1%
Textiles	256.7	148	42.3%
Tobacco	0.6	0.4	33.5%
Transp. EQ	1,219.70	657.8	46.1%
All Industries	63,619.40	25,419.10	60.0%

In general, because the goal basis is set relative to incremental load growth, removing the sales and savings potential from high voltage customer's results in only slightly lower savings targets and, at the same time, removes a significant savings potential from these high voltage customers. Thus, excluding high voltage customers would likely make goal attainment more difficult for most utilities. This is likely because much of this high voltage load is from the industrial sector, which has a lower growth forecast than the residential and commercial sectors.

Table 7-3 shows the differences in projected peak savings targets for 2015 for each of the utilities as a result of removing the high voltage customers. By excluding high voltage customers, the largest drop in savings goals is 12% for CenterPoint because over 28% of its nonresidential peak demand is from customers with high voltage service. This compares to the statewide peak demand where high voltage nonresidential customers represent 16.6% of base peak demand. For most utilities, including high voltage customers reduces the peak savings goals by less than 6%. The average difference statewide is only 7%.

Table 7-3: 2015 Peak Savings Targets with and without High Voltage Customers

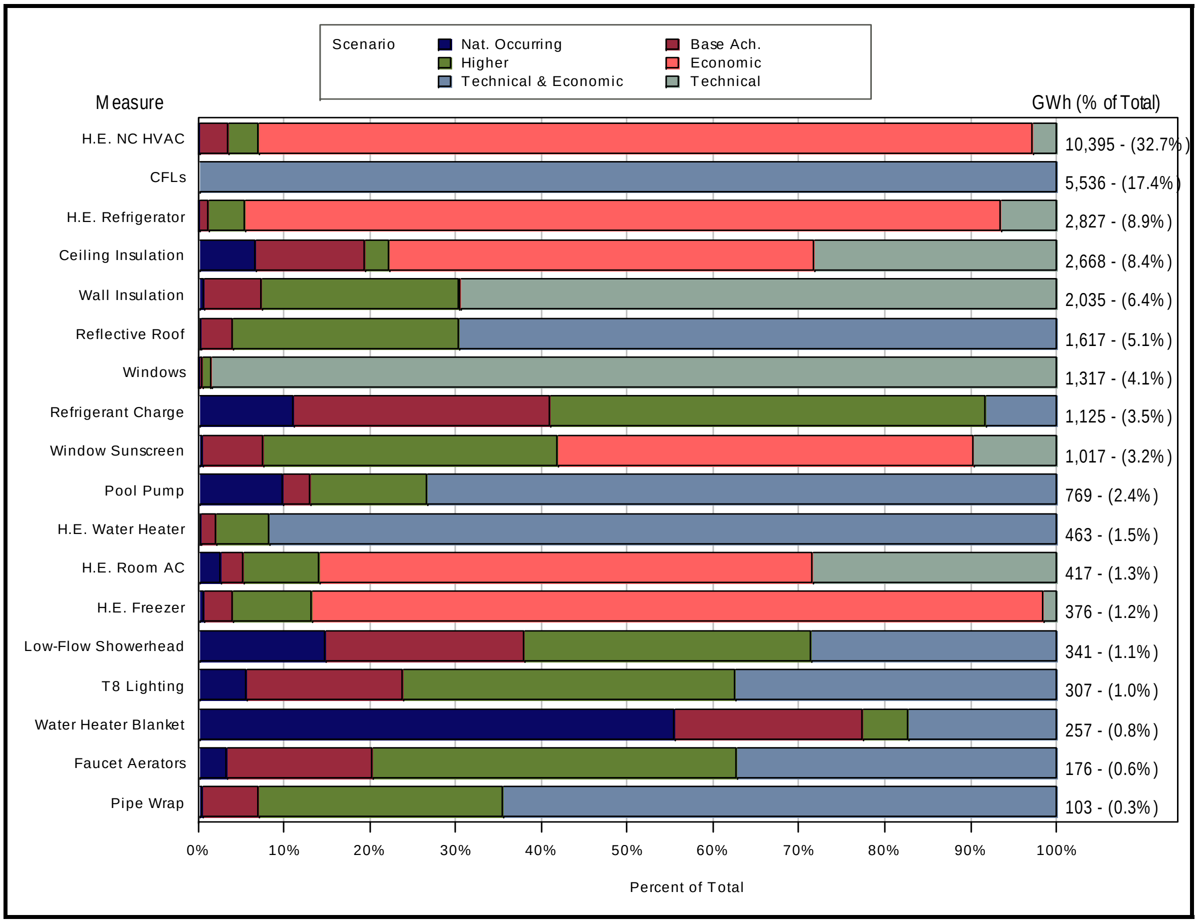
Utility	MW Savings Target in 2015 with HV Customers	MW Saving Target in 2015 w/o HV Customers	Percentage Difference
AEP Central	25.1	24.7	1.8%
AEP North	2.8	2.8	0.0%
AEP SWEPCO	12.2	11.1	9.1%
CenterPoint	134.3	117.9	12.2%
El Paso	18.9	18.4	2.6%
Entergy	37.8	35.4	6.4%
Oncor	174.3	163.7	6.1%
TNMP	14.6	13.8	5.4%
Xcel	15.5	15.5	0.0%
Statewide	435.6	403.3	7.4%

This table shows that including or excluding high voltage customers is not likely to affect the estimated peak savings goals in 2015 significantly. However, excluding these customers will probably result in a lower overall level of savings achieved in Texas. This is because programs could achieve roughly a 790 GWh increase in savings by 2015 from high voltage nonresidential customers in the Base scenario and 2,400 GWh from high voltage nonresidential customers under the High incentive achievable forecast. These incremental savings from high voltage customers compare to the total estimated achievable potential of 10,330 GWh and 329 MW for the nonresidential sector in the High incentives scenario and 7,292 GWh and 203 MW in the Base case. The proportional increase in additional savings to be captured from high voltage customers (11% for the Base case and 23% for the High incentive case) is higher than the estimated reduction in the peak savings goals of 7.4 % when they are excluded. Thus, excluding high voltage customers will make it more difficult for utilities to meet the 2015 peak and energy savings goals.

7.1.4 Measure Level Composition of Forecast by Sector- Residential, Commercial and Industrial

Figure 7-13, Figure 7-14, and Figure 7-15 show the estimated levels of technical, economic, achievable, and naturally occurring savings for specific measures considered in this analysis at the sector level. These charts provide information related to the share of energy savings projected to be both economic and achievable. The measures are rank ordered from top to bottom based on their proportional contribution to the total technical potential to conserve energy in each sector using the low forecast of avoided costs. The charts show graphically what proportion of the technical potential savings from each measure is projected to be economic, achievable in two cases (Base and High incentive), and the level of naturally occurring savings from this measure. For example, 72% of the total technical potential from ceiling insulation is projected to be economic, 30% of the savings could be captured in the high achievable case, 25% of the savings could be captured in the base case, and roughly 12% of the forecasted savings is projected to be naturally occurring, i.e., happen in the absence of the program.

Figure 7-13: Statewide Measure Savings by Type of Potential – Residential Low Avoided Cost[15]



---

[15] Note that all of the savings from CFLs are shown as technical and economic but there are no achievable savings because we were directed to remove CFLs from the achievable forecasts. The reasons for this decision are discussed later in the section.

Figure 7-14: Statewide Measure Savings by Type of Potential – Commercial Low Avoided Cost Scenario

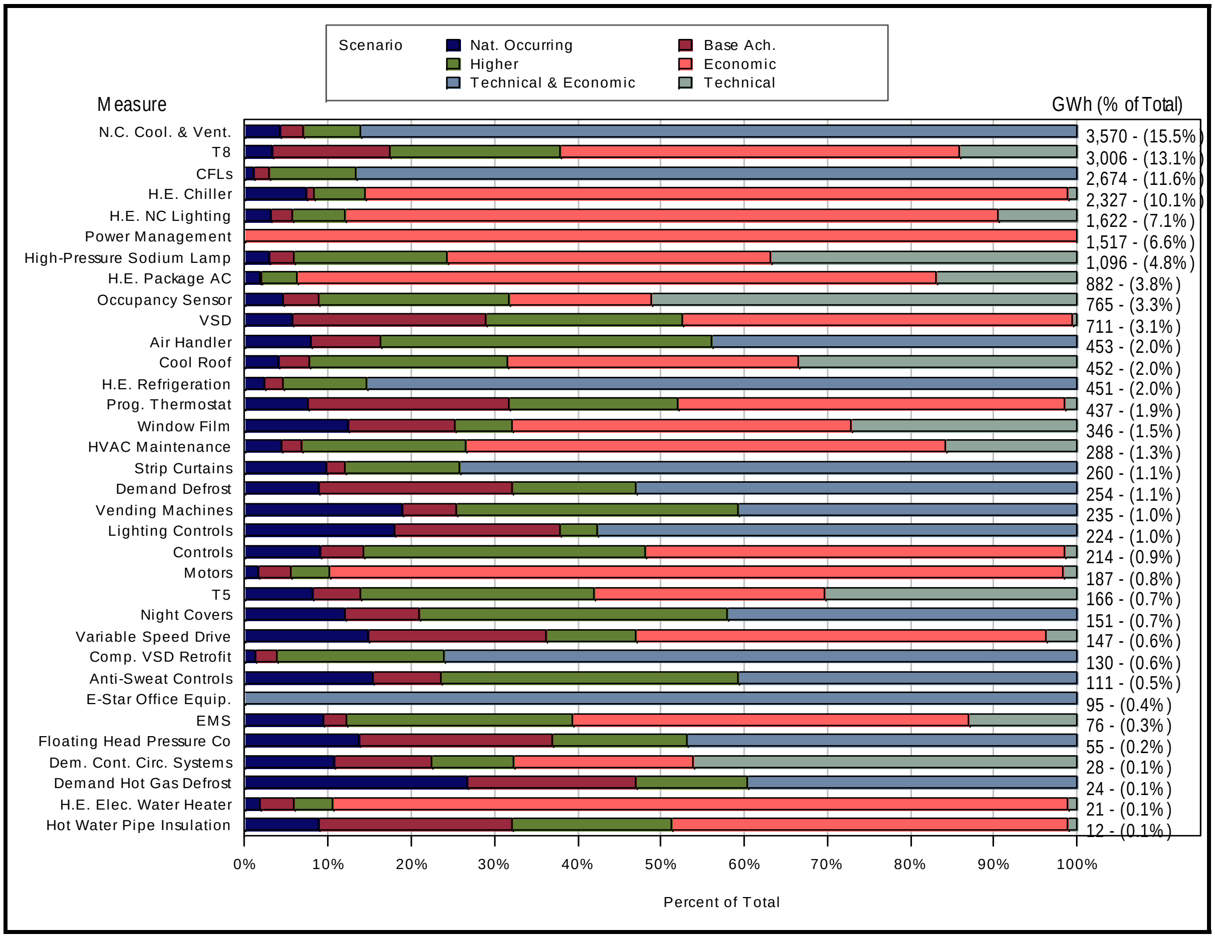
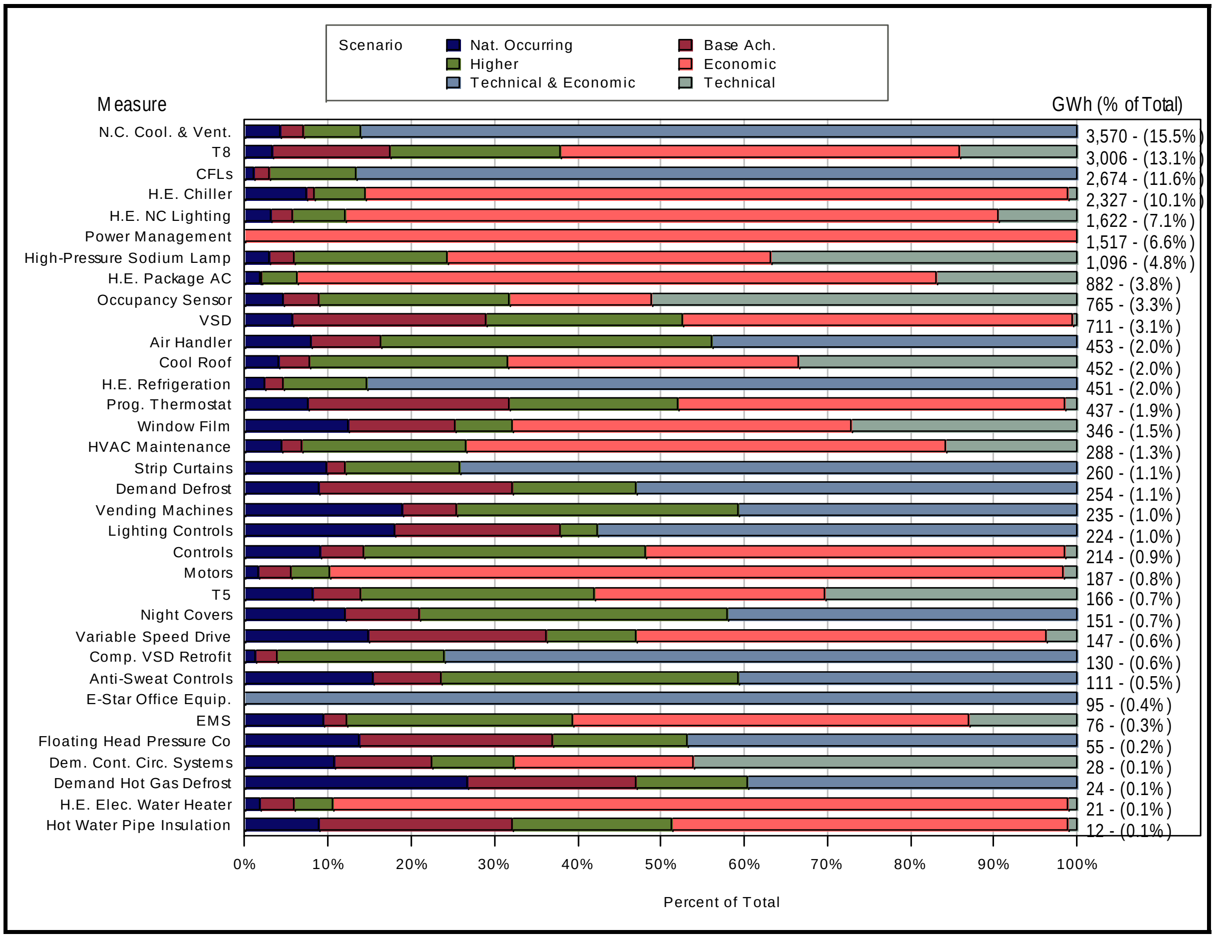


Figure 7-15: Statewide Measure Savings by Type of Potential – Industrial Low Avoided Cost



7.1.5 Program Costs and Rate Impact of Alternative Scenarios

Figure 7-16 shows the annual funding required to produce the energy and peak savings in the Base and High achievable forecasts at the statewide level using the low projection of avoided costs. Figure 7-17 presents the same information for the high forecast of avoided costs.

Figure 7-16: Annual Program Funding - Base and High Achievable Case - Low Avoided Costs

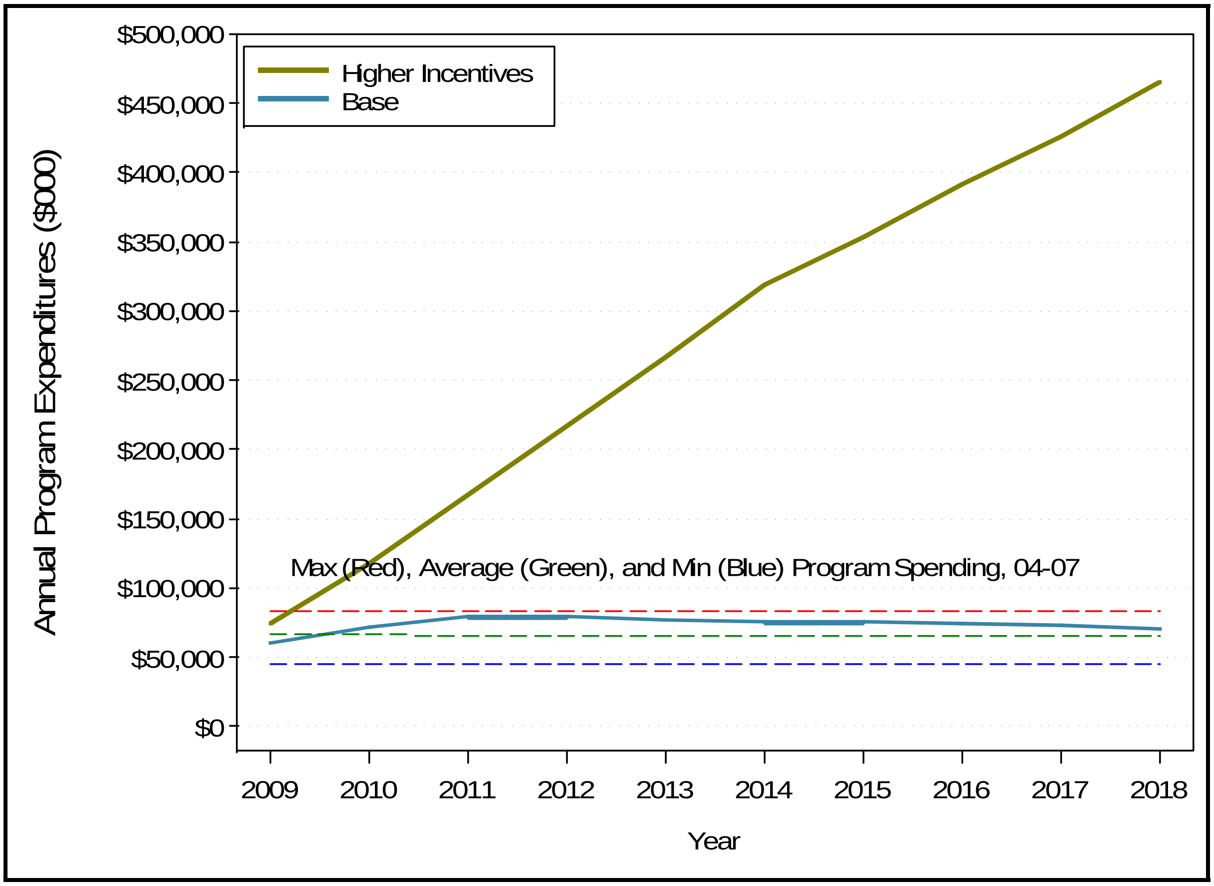
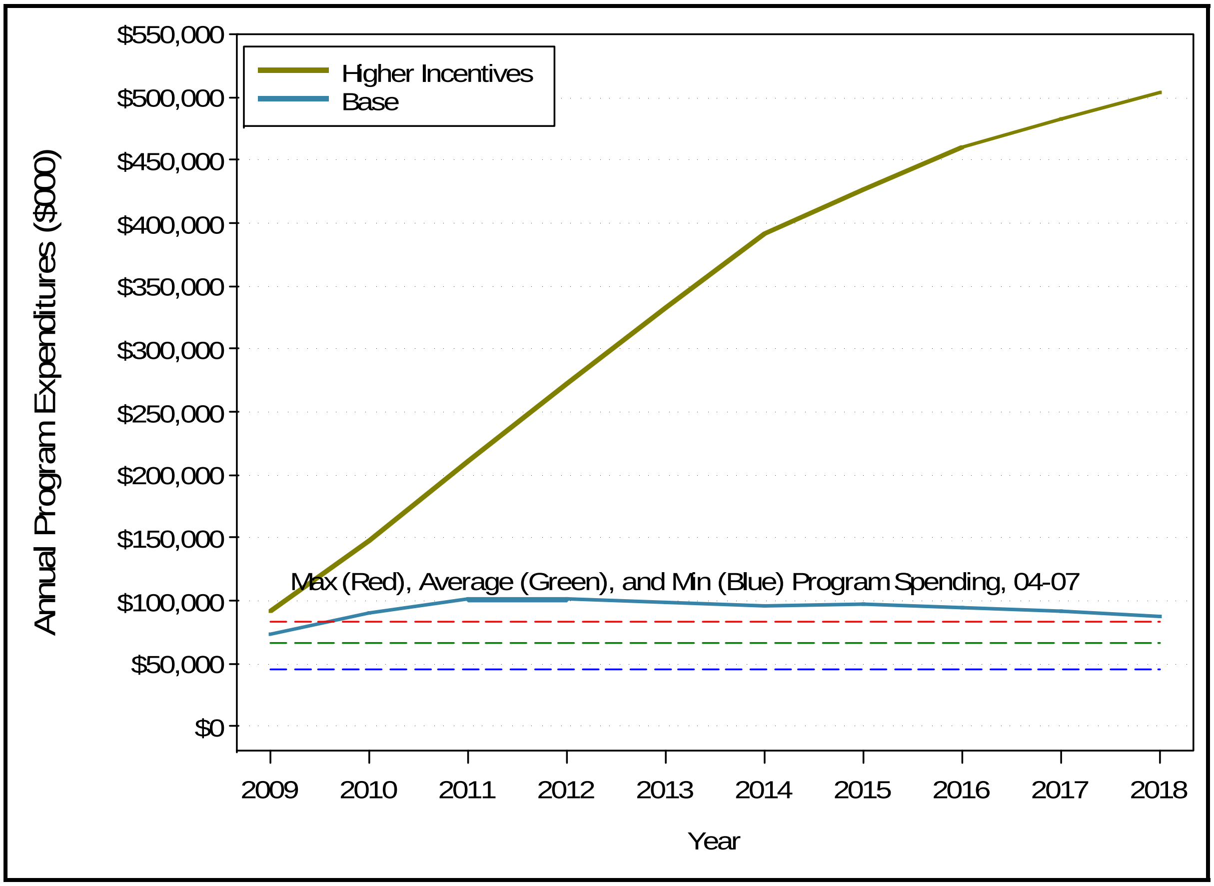


Figure 7-17: Annual Program Funding - Base and High Achievable Case – High Avoided Costs



Both charts forecast funding levels that are significantly higher than the average statewide program funding levels from 2004 to 2007. The average ($65.9 million), minimum ($45 million), and maximum annual funding ($84 million) levels during this period are identified as dotted lines in the figures above.

Rate Impacts of the Proposed levels of Program Funding and Energy Savings

The model also calculates the lost revenue associated with each achievable funding scenario. In this case, lost revenue is the sum of the program costs for that year and the difference between retail prices and avoided costs in that same year divided by the forecast of total sales for that year for the utility area in question.

Setting higher savings goals will require utilities to increase program funding, which by definition will lead to some, albeit modest, rate impacts in the short run, but will also produce highly positive net total resource benefits. Itron's analysis shows that modestly higher rates will be more than offset by lower energy bills for the average customer in the longer run (see Table 7-4).

The potential average rate impacts associated with the Base and High incentive cases range from 0.01 cents/kWh to 0.04 cents per kWh. The estimated rate impact depends on the avoided cost forecast (because these values affect the present value of savings achieved by programs) and the assumed level of program funding (the Base or the High incentive cases). The high avoided cost forecast and High incentive case produces the highest estimate of rate impact at 0.04 cents/kWh. Conversely, the low avoided cost case and lower funding levels associated with the Base incentive levels yield the smaller average rate impact of 0.01 cents per kWh. The low avoided cost and High incentive case yields an average rate impact of 0.033 cents per kWh, while the high avoided cost and Base incentive case yields 0.014 cents per kWh.

7.1.6 Bill Impacts for the Base and High Incentive Scenarios

Table 7-4 shows the impact of potential revenue impacts (from the utility perspective) and bill savings (from the customer's perspective) for a typical residential household. Potential revenue impacts are calculated as the lost revenues (at full retail price) minus avoided cost benefits plus program costs divided by total residential sales times a typical residential usage of 833 kWh/month (10,000 kWh/year). Average bill savings are derived by dividing the annual savings in the residential sector by total residential sales and multiplying back by the same 833 kWh/month. Note that comparison of these values is not a cost-effectiveness metric. Cost-effectiveness is shown from the total resource cost perspective in Figure 7-18.

Table 7-4: Estimated Potential Revenues Impacts and Bill Savings from Efficiency Programs for a Typical Residential Customer

Scenario Definition	Average Annual Potential Revenue Impacts*	Average Annual Bill Savings
	$/Household-Month**	$/Household-Month**
Base Incentive- Low Retail Rate	$0.09	$0.18
Base Incentive- High Retail Rate	$0.12	$0.25
High Incentive- Low Retail Rate	$0.27	$0.48
High Incentive- High Retail Rate	$0.36	$0.62

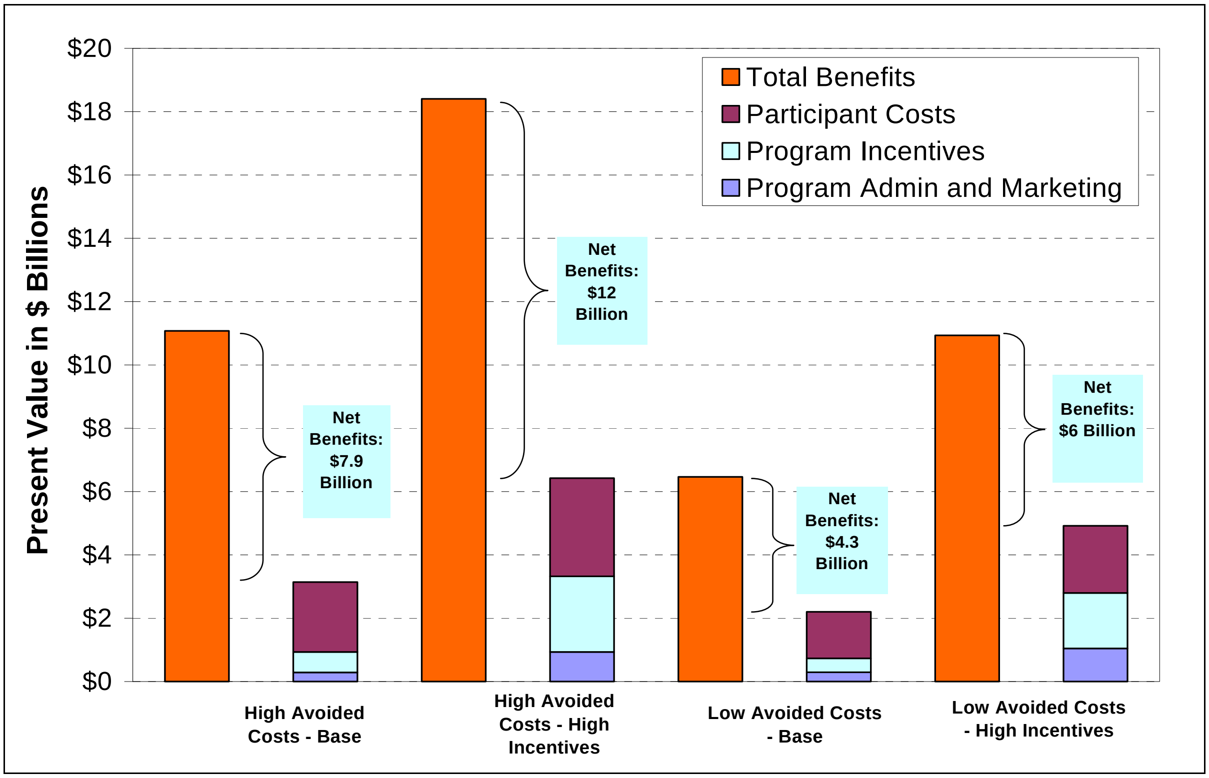
*Revenue reduction from reduced sales (at retail rate of $0.12/kWh reduced) minus avoided cost benefits (at ~$0.08 per kWh saved) plus program costs.

**For a typical household with annual consumption of 10,000 kWh/Year.
Typical equivalent monthly bill would be roughly $100/month at $0.12/kWh.

7.1.7 Overall Costs and Benefits of Expanding the Energy Efficiency Programs in Texas

Figure 7-18 shows the estimated program costs with the present value of the energy and peak savings projected from the programs under four different scenarios or forecasts of achievable savings and likely avoided costs. In all cases, the benefit-cost ratio exceeds 2.0 and net benefits to the citizens of Texas range from $4.2 billion to $11.9 billion as a result of capturing the savings from expanded energy efficiency programs over the next decade.

Figure 7-18: Projected Total Costs and Benefits of the Four Achievable Savings Forecasts: Total Benefits Compared to Program and Participant Costs



7.2 Discussion of Uncertainties

It is important for readers and users of this information to understand the methods and data sources used to develop these forecasts (see Sections 2, 3, and 4) and the associated types and levels of uncertainty in the forecasts of achievable savings. In this subsection, we discuss the general areas and types of uncertainties in all efficiency forecasting efforts. The next subsection summarizes some of the specific areas of uncertainty associated with this study.

7.2.1 General Discussion of Uncertainty in Efficiency Forecast Estimates

There are two principal classes of uncertainty underlying the results presented in forecasts of energy efficiency potential. The first area is uncertainty associated with estimates of the current characteristics of end-use electricity consumption and energy efficiency measure data (hereafter, "current market" uncertainty). The second area concerns estimates of the future potential for energy efficiency, which is affected by the uncertainty in the first area as well as uncertainty in future energy prices and electric load forecasts, changes in market and energy efficiency measure characteristics over time, and forecasts of customer adoption of measures as a function of program interventions, among other factors (hereafter, "forecast" uncertainty).

While there is considerable overlap in the underlying data associated with both types of uncertainty, it is useful to separate these classes of uncertainty for two reasons. First, the study attempts to reduce the effects of the two types of uncertainty through different approaches. Second, although both types of uncertainty could be reduced through further research, the types of research necessary are significantly different across the two classes.

With respect to the first class of uncertainty noted above, current market uncertainty, readers and users of this study should recognize that estimates of energy efficiency potential involve a process of modeling the substitution of energy efficiency equipment and systems in place of existing and baseline energy equipment and systems. As such, this process starts with estimates of current equipment characteristics and energy use by end use and market segment. These data typically are provided as inputs to energy efficiency potential studies and are, in the best of cases, developed from up-to-date and statistically accurate studies that involve detailed collection of technology market shares and comprehensive modeling of end-use consumption and peak demand. When these data are absent, outdated, or inaccurate, the uncertainty in estimates of current equipment shares and associated consumption and peak demand directly impacts estimates of energy efficiency potential because energy efficiency potential varies by equipment type and market segment.

Energy efficiency measure data are the second type of data associated with current market uncertainty. Examples of energy efficiency measure data include estimates of the current incremental costs and savings of energy efficiency measures, the useful lives of those measures, their current market saturation levels, and estimates of the fraction of the market for which energy efficiency equipment and systems could substitute for existing equipment and systems. Fortunately, considerable data on the costs and savings associated with energy efficiency measures were available for this study. Nonetheless, uncertainties exist to varying degrees in estimates of costs and savings by efficiency measure opportunity. In general, new measures (e.g., those on the market for two years or less) have somewhat greater uncertainty in costs and savings than measures that have been on the market for longer periods (e.g., three years or more). The most significant uncertainty in the measure-level data is also in the area of measure saturation. Measure-level saturation data typically come from the same types of sources discussed above for baseline equipment consumption and saturation data.

With regard to forecasting uncertainty, it should be somewhat obvious that forecasts of energy efficiency potential and electricity demand are also affected by current market uncertainty. In any forecasting process, one wants to begin with an assessment of current conditions that is as accurate as possible; errors in estimates of current conditions are otherwise carried forward and exacerbated. However, even with perfect data on current market conditions, forecasts are subject to their own uncertainties by their very nature. For this study, the following are key areas of forecast uncertainty:

- Future end-use consumption levels and equipment shares,
- Future incremental costs and savings for measures on the market today,
- Future energy efficiency program funding levels,
- Future customer adoption levels of energy efficiency measures as a function of program intervention types and levels, efficiency measure cost-effectiveness, equivalence of service of efficiency measures as compared to standard practice, and market barriers, and
- Future benefit-cost ratios for energy efficiency measures, which, in addition to uncertainty in future measure costs and savings, are a function of uncertainty in the following:
  - Energy and capacity prices, both retail and wholesale,
  - The value included, if any, of environmental externalities, and
  - The level of the discount rate used in financial analyses of efficiency measures.

As noted above, there is also uncertainty with future forecasts for Texas utilities’ electricity sales and peak demand. If the future demand for electricity turns out to be higher than currently forecast, then there will be more potential for savings from energy efficiency measures. Likewise, if the future demand for electricity is lower than expected, the potential for savings from energy efficiency measures will be lower than the figures provided in this report.

7.2.2 Specific Key Areas of Uncertainty for this Study

From these general elements, we can now focus on the specific areas of uncertainty that account for the largest portion of estimated efficiency potential. These areas are noted and discussed briefly below.

- ***Short- and long-term energy and demand growth rates by utility and sector***. Energy and demand growth rates affect both estimates of total potential and the portion of the potential associated with new construction. The ten-year growth estimates provided to Itron by ERCOT and the participating utilities are shown in Section 3. These growth rates are relatively high for a number of utilities, likely consistent with observed growth rates over the recent past. The ERCOT forecasts, which account for the majority of sales, were published in May 2008. However, the recent and growing economic downturn probably was not incorporated into these forecasts. A major reduction in the short-term load forecast would have a direct effect on the Legislature's metric of 30% savings of incremental load growth in 2010. In addition, a reduction in the rate of load growth would significantly reduce the amount of savings associated with the new construction segment in this study.

- ***Cost-effectiveness and total cost impact of savings opportunities in new construction***. There is considerable uncertainty in the cost-effectiveness of the two residential new construction cooling measures (20% reduction in base cooling and 50% reduction in base cooling). The estimates of savings and costs were obtained from Frontier's recent residential new construction study; however, that study did not provide a breakout of cooling versus heating costs and benefits. As a result, Itron did not have the information necessary to accurately allocate the costs in the study to the cooling package. Itron is currently estimating allocation based on the ratio of cooling to heating load in existing construction, but this is a very uncertain approach. TRC values for the residential new construction packages are approximately 1.0; therefore, the results are very sensitive to allocation of costs and the actual, real-world packages may be more or less cost-effective, perhaps below the cost-effectiveness threshold. The current result is that these savings are included and adoption of the 20% and 50% cooling improvement packages increases dramatically under the Higher incentives case but with a relative high cost impact on the portfolio.

- ***Amount of efficiency savings associated with market forces*** (i.e., naturally occurring efficiency). Itron's estimates of efficiency potential over the next ten years in Texas include savings from natural market forces, that is, exclusive of any further market intervention. On a statewide basis and across all sectors and vintages, Itron's estimates of naturally occurring savings are about half of gross savings in the Base Avoided Costs, Base Incentives scenario (i.e., implied net-to-gross ratio of 0.5). Under the Base Avoided Costs, Higher Incentives scenario, the naturally occurring savings represent about one-third of the gross savings (i.e., implied net-to-gross ratio of 0.66). A significant portion of these estimated naturally occurring savings (roughly two-thirds) comes from a small number of measures, principally CFLs (32%, 26% residential, 6% commercial), industrial pumping (18%), commercial T8 lighting (7%), and industrial lighting (6%).

- ***Total savings from residential CFLs.*** There is considerable uncertainty in any forecast of residential CFL adoption given the large amount of potential savings, rapidly decreasing measures costs, high consumer benefit-cost ratio, and still uncertain consumer acceptance levels. The current Base and Higher incentive scenarios result in very high levels of CFL adoption – 80 to 90% of households reaching the full technical potential (with 50% of technical potential is estimated to be naturally occurring).

7.3 Assessment of Potential Changes to Energy Savings Goals as Proposed in Recent Legislation

The Texas Legislature has requested information on whether efficiency goals in Texas could be increased to 30% of incremental annual peak demand growth for 2010 and 50% of incremental annual peak demand growth for 2015. In addition, the Legislature is interested in Itron’s assessment of the feasibility of achieving energy savings goals equivalent to the same fractions of incremental growth for 2010 and 2015.

7.3.1 Estimated Peak Savings Goals

Table 7-5 shows High and Base forecasts of achievable peak demand savings compared to the savings goal equivalent to 30% of incremental annual peak demand growth for 2010 and to 50% of incremental growth in 2015 for the low avoided cost scenarios. These forecast models reflect the current policy of excluding high voltage customers from participating in energy efficiency programs and, subsequently, remove potential energy and peak savings from CFLs. These forecasts are presented in gross savings terms (e.g., the savings totals include naturally occurring savings estimates). Itron chose to present the savings in this format because current regulatory requirements compare gross program savings to the current savings goals; there is no requirement to estimate the net savings from these programs. If the PUCT chooses to set savings goals on a net basis, then the forecasts of achievable would need to be reduced by roughly 30% to 40% by subtracting the naturally occurring savings from the model’s forecast of gross savings from utility programs.

Table 7-5: Peak Savings Goals Compared to Base and High Achievable Savings Forecasts (Annual, not Cumulative MW per Year)

	30% of Inc Growth in 2010			50% of Inc Growth in 2015		
	Savings Target	**Base Achievable**	**High Achievable**	**Savings Target**	**Base Achievable**	**High Achievable**
	MW	**MW**	**MW**	**MW**	**MW**	**MW**
AEP Central	7.7	13.5	17.2	24.7	20.1	39.6
AEP North	0.6	2.8	3.6	2.8	4.2	8.9
AEP SWEPCO	6.2	3.3	4.2	11.1	5.5	11.8
CenterPoint	77.2	44.8	59.5	117.9	67.3	149.7
El Paso	9.2	3.4	4.3	18.4	4.5	8.6
Entergy	7.8	9.2	12.0	35.4	14.1	30.1
Oncor	78.1	53.9	70.8	163.7	84.3	194.5
TNMP	9.1	3.1	4.0	13.8	4.7	10.6
Xcel	5	8	10	16	10	19
Statewide	201	142	186	403	214	473

7.3.2 Estimated Energy Savings Goals

The Commission recently required regulated Texas utilities to meet energy savings goals in addition to peak savings goals as a result of legislation passed in late 2007. The Commission directed utilities to use a 0.20 capacity factor to convert the peak savings goal to a corresponding energy savings goal for each year.[16] An alternative interpretation of how to calculate the energy savings goal for a given year is to calculate the energy savings goals the same way that the peak savings goals are calculated. This requires calculating the average rate of sales growth over the previous five years and then applying the legislatively specified fraction of 30 or 50% of this incremental growth to derive the annual savings target. The discussion below shows that using the fraction of incremental growth method results in energy savings goals that are a factor of 2 to 3 higher than the energy savings goals derived using the .20 capacity factor. Itron found that there was some disagreement in Texas about how to use this capacity factor to convert MW to GWh. In most jurisdictions with energy and peak savings goals, Itron has found that the industry practice is to use a peak to energy savings ratio similar to the ratio found when comparing the overall system peak demand and energy consumption. This peak to energy usage ratio is usually in the range of 0.20 to 0.24; in other words, peak savings (MW)/energy saving (GWh) = 0.20.

---

[16] PUCT Rule 25.181 Section (c) 2 defines capacity factor as " The ratio of the annual energy savings goal, in kWh, to the peak demand goal for the year, measured in kW, multiplied by the number of hours in the year";

A peak to energy ratio of 0.20 translates to a simple multiplication of peak savings (MW) by 1/.20 or a factor of 5 to derive GWh savings. For example, peak savings of 1 MW translate to energy saving of 5 GWh. This is equivalent to assuming that the peak savings from the average measure is spread over 5,000 of the 8,760 hours in a year or roughly 65% of the time. In some jurisdictions, the peak to energy savings ratio has approached 0.25 for portfolios that emphasize programs with a higher fraction of peak savings measures, which translates to a factor of 4 multiplier.

It is our understanding that the current practice used by the Texas utilities is to interpret the term "capacity factor" to be a direct estimate of the fraction of hours in a year when the average peak savings will occur. Thus, the peak to energy savings multiplier used in Texas is 0.20×8760/1,000 MWh/GWh=1.75. This implies a peak to energy use ratio of 0.575. This could only occur if utility programs focused on achieving peak savings through air conditioning measures and did not provide incentives for lighting, motors, and other measures that save energy over the majority of hours in the year.

One way to clarify these different interpretations is to assume that the load factors or shape of energy efficiency measures is likely to mirror the relationship between peak to energy use in each of the utility service territories in the long run. Itron looked at the relationship between peak to energy use in 2007 for the three largest utilities, AEP, CenterPoint, and Oncor. We calculated average peak to energy ratios in 2007 ranging from 0.18 to 0.21, with an average of 0.201. These calculations support Itron's approach to estimating the savings goals directly from the energy sales forecast, which roughly equates to a factor of 5 to convert MW peak goals to GWh goals because this is the ratio of peak to energy use seen in the real world.

Table 7-6 shows the impact of using the alternative interpretations to estimate energy savings goals for 2010 and 2015 using the current 1.75 multiplier to convert MW savings to GWh in the utility filings compared to the energy forecast-based approach used in Itron's method. Method 1 uses the forecasts of energy demand growth by service territory to estimate the incremental growth in sales and then calculates the savings goal as a fraction of the average incremental growth. Method 2 uses the current utility interpretation of the definition of a 0.20 capacity factor to convert MW savings targets to MWh energy savings goals. The results clearly show that using the capacity factor method reduces the estimated savings goals by 58% to 61%, depending on the utility service area.

Table 7-6: Comparisons of Savings Targets using Alternative Methods to Estimate Savings Goals in 2010 and 2015[17]

	Savings Target MWH in 2010		Savings Target MWH in 2015		
Method for Estimating Energy Savings Goal	**Using 0.3% of Incremental Sales Growth**	**Using .20 Capacity Factor**	**Using 0.5% of Incremental Sales Growth**	**Using .20 Capacity Factor**	**Percentage Decrease from Use of Capacity Rule in 2015**
Utility	MWh	MWh	MWh	MWh	%
AEP Central	33,865	13,508	104,099	43,235	58.5%
AEP North	2,044	1,025	11,738	4,857	58.6%
AEP SWEPCO	28,978	10,822	48,124	19,461	59.6%
Centerpoint	301,885	135,182	532,285	206,510	61.2%
El Paso	37,638	16,067	84,113	32,307	61.6%
Entergy	17,525	13,725	160,370	62,045	61.3%
Oncor	324,229	136,868	732,234	286,807	60.8%
TNMP	39,934	15,940	62,009	24,206	61.0%
Xcel	25,169	8,920	69,043	27,208	60.6%
Statewide	811,267	352,058	1,804,015	706,636	60.8%

Capacity factor is 0.20 which translates to following conversion factor:
Conversion facto r= MW *8760*.20 (cf) = MWh goal
MW *1752 = MWh goal

Clearly, the utilities' use of a peak to energy savings conversion factor of 1.75 compared to using a factor of 4 or 5 will yield much lower energy savings goals for 2010 and 2010. It is possible that the Commission decided as a matter of policy to deemphasize the importance of achieving energy savings relative to peak savings by decreasing the energy savings goals by a factor of 3 when it adopted this definition of a capacity factor in mid 2008. However, it is recommended that the Commission reconsider this peak to energy conversion issue because of the potential to discourage utilities from installing measures that save both energy and peak use in the future. Appendix E shows the impact of using the lower savings numbers in comparison to the achievable forecasts for each utility area.

The energy savings goals presented below use the actual relationship or ratio between peak and energy savings in the energy and peak demand forecasts rather than using the 0.20 capacity factor discussed above.[18]

---

[18] If the Commission decides the utilities have used the correct interpretation of its rule to convert peak to energy savings goals, Itron has produced a parallel set of figures and tables that compare the target savings goals to the achievable forecasts in Appendix H. It is reasonable to conclude that the electric utilities will have little if any difficulty meeting their energy savings goals for 2010 and 2015 if the 1.75 conversion factor is used to convert the peak savings to MWh targets for the same years.

Table 7-7 shows the relationship between proposed energy savings goals in 2010 and 2015 compared to Itron's forecasts of Base and High achievable energy savings. Again, the picture is mixed with respect to the relative challenge to meet the savings goals for the different utility service territories. The table suggests it will be difficult for AEP SWEPCO, CenterPoint, El Paso, and Texas New Mexico Power to meet the 2010 energy savings goals.

Table 7-7: Energy Savings Goals Compared to Base and High Achievable Savings Forecasts (units are MWh per Year in each year, not cumulative)

	30% of Inc Growth in 2010			50% of Inc Growth in 2015		
Utility	Savings Target MWH	Base Achievable MWH	High Achievable MWH	Savings Target MWH	Base Achievable MWH	High Achievable MWH
AEP Central	33,865	73,411	92,516	104,099	106,005	198,290
AEP North	2,044	16,393	20,483	11,738	23,450	44,773
AEP SWEPCO	28,978	18,186	22,836	48,124	30,448	58,826
Centerpoint	301,885	166,217	214,572	532,285	245,573	495,985
El Paso	37,638	13,448	17,128	84,113	18,708	35,347
Entergy	17,525	45,616	57,204	160,370	67,036	126,626
Oncor	324,229	291,404	369,815	732,234	436,501	883,836
TNMP	39,934	18,489	23,069	62,009	27,089	50,072
Xcel	25,169	27,590	34,826	69,043	36,841	68,633
Statewide	811,267	670,753	852,448	1,804,015	991,652	1,962,388

Figure 7-19 and Figure 7-20 compare the High and Base estimates of achievable peak savings potential to relative to the proposed peak goals for the two groupings of investor owned utilities: the larger investor-owned investor utilities including Oncor, CenterPoint, Entergy, and AEP Central and the remaining smaller investor-owned utilities.[19] The figure is designed to show that specific utilities should be able to achieve the new savings goal when the target savings levels are exceeded by either the Base or High incentive achievable savings estimates. Two separate groupings are provided to highlight the contrast in meeting the goals based on the initial starting point and size of the programs in each grouping.

Figure 7-19 compares the peak demand savings targets with achievable forecasts for the four larger investor-owned utilities: Oncor, CenterPoint, Entergy, and AEP Central. This

---

[19] The achievable potential forecasts discussed in this section include potential savings from high voltage customers currently not allowed to participate in efficiency programs. The effect of excluding them from baseline forecasts, estimate savings goals and forecasts of savings is discussed in a later section. In addition these forecasts do not include potential savings from screw in CFLs because of a decision reached by program managers that is explained later.

analysis shows that it will be harder for all of these larger utilities to meet the 2010 saving goals relative to the 2015 savings goals. This is due to ramp-up constraints caused by the limited time between a proposed change in the 2010 peak goals that might be adopted in mid 2009 or 2010 and the effective date of the new saving goal on December 31, 2010. For AEP Central, and Entergy, both the base and high achievable forecasts exceed the 2010 goals by a significant amount, indicating the goal is definitely achievable. For Oncor, the target savings goal of 78 MW in 2010 is 10% higher than the high saving forecast of 71 MW in 2010, but the 2015 savings target is 16 % lower than the high achievable savings forecast for the same year. For CenterPoint, the 2010 peak savings goal of 77 MW is 30% higher than the high achievable savings forecast (60MW), but the 2015 peak savings target is 21% lower than the comparable high savings forecast in 2015. These comparisons suggest that it will be more difficult in the short run to meet the 2010 goals, but that all of the larger utilities should be able to meet the 2015 savings goals by switching to more effective program designs and higher funding levels. Strategies for dealing with the problems identified here for the 2010 peak savings goals are discussed later after a review of the forecasts for the smaller utilities.

Figure 7-19: Comparison of Peak Savings Targets to Achievable Forecasts-Base and High Large Texas Investor-Owned Utilities

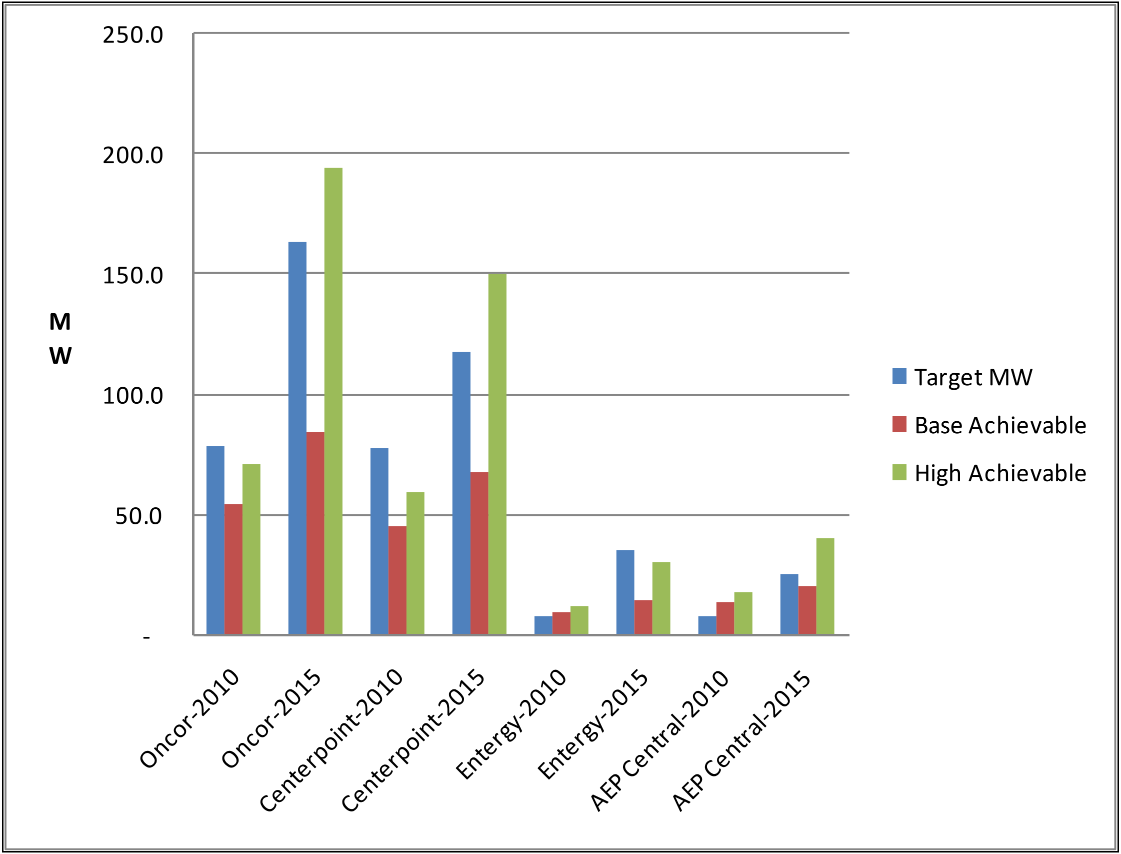


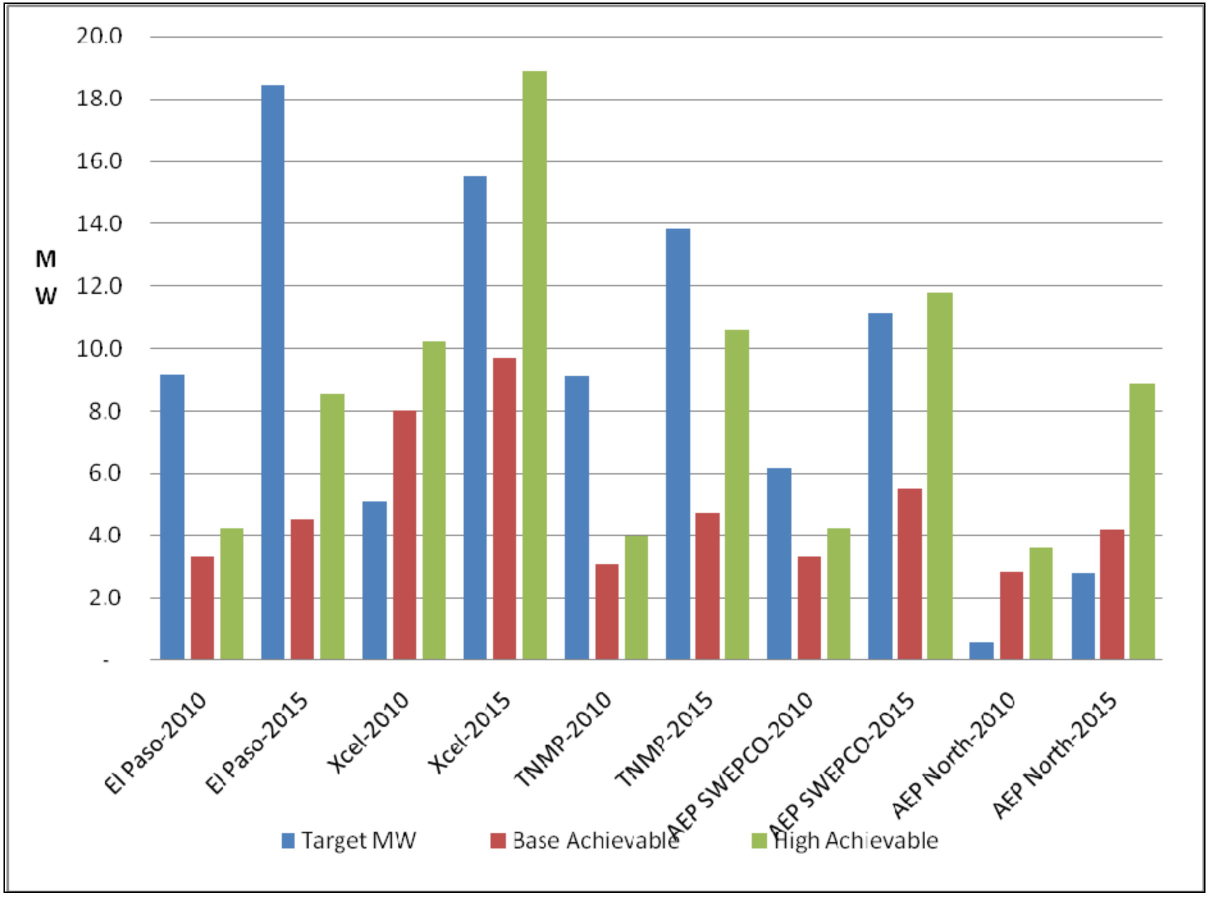
Figure 7-19 provides the same comparisons of target goals to achievable savings forecasts for the smaller utilities. This chart shows it will be more difficult for three of the five smaller utilities to reach the proposed savings goals in 2010 and very difficult to reach the 2015 savings goals for two of the smaller utilities, TNMP, and El Paso Electric.

Figure 7-20 provides the same comparisons of target goals to achievable savings forecasts for the smaller utilities. This figure shows it will be more difficult for three of the five smaller utilities to reach the proposed savings goals in 2010 and very difficult for two of the smaller utilities, TNMP, and El Paso Electric, to reach the 2015 savings goals.

For El Paso Electric and TNMP, the difficulties lie in the relatively low peak savings achieved by their programs in 2007 as a fraction of peak demand and their relatively higher forecasts of peak demand growth. Xcel and AEP North should have an easier time reaching their 2010 and 2015 goals since their forecasts of high achievable savings are higher than the savings target. Finally, the comparisons in this figure also show it will be more difficult for SWEPCO to meet its 2010 goal than its 2015 goal. This is because its high achievable savings forecast is lower than the savings target in 2010 and higher than the peak savings target in 2015.

The substantial difference between the proposed target goals and the estimated achievable savings potential for the smaller utilities is due, in part, to the use of an incremental goals savings metric that sets goals based on historical incremental growth rates rather than the overall level of sales and peak demand in the area. This metric makes it more difficult for smaller utilities with relatively high projected rates of peak growth (for example El Paso) to meet their targeted peak savings goals. In addition, the current program administrative cost limit of 10% of all costs has limited the level of staff devoted to program development and marketing in these utilities, which may have contributed to lower levels of initial savings relative to their baseline sales and peak demand in 2007.

Figure 7-20: Comparison of Peak Demand Savings Targets to Achievable Base and High Savings Forecasts- for the Small Texas Investor-Owned Utilities



7.4 Reasons for the Differences in Meeting the Proposed Savings Goals

Forecasts of higher peak demand growth rates lead to higher peak savings goals over time, resulting in more difficulty for utilities with the higher peak savings growth to achieve the peak savings goals. Utilities with a higher than average forecast of peak and energy savings growth over the next ten years include CenterPoint, which has a forecasted rate of energy growth of 2.1% per year, Entergy with an annual sales growth rate of 2.6% per year, and El Paso Electric, which has a forecasted growth rate of 2.8% per year. These three utilities have relatively higher savings targets than the other utilities with forecasted rates of growth less than 2% per year. Consequently, it is expected that they will have a larger challenge in meeting their savings targets, particularly in the near term by 2010.

These differences can be illustrated by looking at the goals for the two largest investor-owned utilities—CenterPoint and Oncor. The proposed energy and peak savings goals for CenterPoint in 2010 and 2015 are consistently higher than those for Oncor despite the fact that Oncor's baseline 2007 electricity sales and peak demands are 20 to 25% higher than the corresponding sales and peak for CenterPoint. This is because the current goal mechanism focuses on reducing the rate of sales growth in high growth areas regardless of the underlying size and capacity of the utility to expand their efficiency programs, which is a function of total electricity revenues, and not expected growth.

An alternative strategy for dealing with the differential difficulty in meeting the proposed legislative savings goals is to change the way the savings goals are calculated. This strategy is described after analyzing potential ramp up constraints to meeting the 2010 goals.

7.4.1 Potential Challenges in Ramping Up Program Savings to Meet the Near Term Savings Goal in 2010

In the previous section, the analysis showed there was a sufficient amount of cost-effective investments or "achievable potential" in each utility service area to support an increase in the energy savings goals set by the legislature for the majority of utilities by 2015. However, this analysis did not take into account the current level of savings being achieved by each utility's programs and the possibility that there would be too little time between the beginning of 2009 and end of 2010 to dramatically ramp up savings to achieve the much higher levels of savings found to be achievable in the previous section.

Table 7-8 calculates the annual percentage increase in savings that would have to be achieved by each utility from 2007 to 2010 in order to achieve the higher savings goal equivalent to 30% of the incremental growth in energy sales. To reach each savings goal, the annual percentage increase in savings required to reach the new savings targets exceeds 40% per year for four of the nine utilities over a two-year period. This sustained increase in annual energy savings is not likely to be achieved in such a short period. The four utilities with the high ramp up requirements are shaded tan in Table 7-8.

Table 7-8: Historical Program Savings Experience Compared to Proposed Energy Savings Goals in 2010

Utility	Average Annual Energy Savings 2004-2007	2010 Savings Target (30% Inc)	Annual Percentage increase 2007 to 2010 to reach goal
	MWH	MWH	%
AEP Central	28,930	33,865	5%
AEP North	6,674	2,044	-33%
AEP SWEPCO	6,182	28,978	67%
Centerpoint	99,314	301,885	45%
El Paso	2,477	37,638	148%
Entergy	14,254	17,525	7%
Oncor	225,115	324,229	13%
TNMP	4,547	39,934	106%
Xcel	10,573.8	25,168.8	34%
Statewide	398,067	811,267	27%

Our review of program experience in Texas over the last seven years and in other states suggests that it can be very difficult to achieve extremely high rates of increase in program resources and accomplishments in very short periods.[20] This is because such rapid expansions require increases in staffing, marketing, processing, and quality control. Utilities either must build this capability through internal hiring or must outsource many aspects of program implementation. In either case, significant expansions in capacity typically take years to achieve.

Table 7-9 provides a similar comparison of historical peak savings achieved by each utility compared to the near term savings goals. Similar ramp up problems emerge when comparing the peak savings goals equivalent to 30% of annual peak demand growth in 2010 with the annual peak savings reported by IOU over the last three years from 2004 to 2007. Again, the tan colors represent rates of growth in savings that may be difficult to achieve. The requirement to increase annual peak demand savings by a factor of 3 for TNMP and a factor of 9 for El Paso may prove to be very difficult to achieve.

---

[20] For a discussion of the ramp up problem for electricity see M Messenger, Proposed Electricity Savings Goals for California (Publication #100-03-021, October, 2003, California Energy Commission) (pages 13 and 14)

Table 7-9: Historical Program Peak Savings Compared to 2010 Peak Savings Goals

Utility	Average Annual Energy Savings 2004-2007	2010 Savings Target (30% Inc)	Annual Percentage increase 2007 to 2010
	MW	MW	%
AEP Central	9.0	7.7	-5%
AEP North	4.0	0.6	-47%
AEP SWEPCO	2.0	6.2	46%
Centerpoint	40.4	77.2	24%
El Paso	1.0	9.2	109%
Entergy	5.3	7.8	14%
Oncor	83.1	78.1	-2%
TNMP	3.0	9.1	45%
Xcel	3.0	5.1	19%
Statewide	150.8	200.9	10%

In general, Itron's experience in other states has shown that it is difficult to double annual energy savings in less than three years elapsed time, equivalent to a 35% per year growth rate for three years in a row. Since each Texas utility will only have 12 to 18 months to ramp up to achieve the new goals (assuming new goals are adopted in the summer of 2009 and the ramp up period lasts to December 2010), Itron suggests either reducing the energy savings goals for the five individual utilities with high ramp up requirements (shown in Table 7-9) to 25% of incremental peak demand growth in 2010 or postponing the effective date of the increase in energy and peak savings goals (to 30% incremental sales growth) to the year 2012.

This change would be important if the PUCT or Legislature desires to continue to maintain a uniform savings goal for all utilities. This postponement would allow utilities more time to develop a balanced portfolio of programs and work on increasing public awareness in the first few years of the ramp up. Alternatively different savings goals expressed as an incremental fraction of annual growth in demand could be developed for each utility. Itron is willing to provide individualized utility goals if this is determined to be the best path.

7.4.2 Assessment of the Feasibility of Meeting the Proposed Savings Goals for 2015

Table 7-10 presents the ramp up rates or annual increases needed to achieve the 2015 savings goals. These results suggest it is technically and economically feasible to achieve these higher levels for the majority of Texas utilities. As the tan shading suggest, Itron finds that El Paso, Entergy, Excel, and TNMP may have a more difficult time meeting the savings goals given their initial starting point of annual energy savings achieved between 2004 and 2007.

Table 7-10: Ramp Up Growth Rates Required to Reach the 2015 Energy Savings Targets

Utility	Average Annual Energy Savings 2004-2007	2015 Savings Target (50% Inc)	Annual Percentage increase 2007 to 2015
	MWH	MWH	%
AEP Central	28,930	104,099	20.07%
AEP North	6,674	11,738	8.40%
AEP SWEPCO	6,182	48,124	34.07%
Centerpoint	99,314	532,285	27.10%
El Paso	2,477	84,113	65.47%
Entergy	14,254	160,370	41.31%
Oncor	225,115	732,234	18.35%
TNMP	4,547	62,009	45.25%
Xcel	10,573.8	69,042.8	30.74%
Statewide	398,066.7	1,804,015.4	290.76%

Table 7-11 shows the identical comparison of the ramp up rates required to achieve the 2015 Peak Savings Goals. This table suggests that El Paso may have trouble in achieving a 52% per year increase in peak savings every year for nine years in order to achieve the 18-fold increase in peak savings required between 2007 and 2015. The high rates of annual increase in annual savings for El Paso, and Entergy, shown in Table 7-11 (and shaded in tan) suggest these two utilities may also have problems in ramping up to reach the 2015 savings targets.

Table 7-11: Ramp Up Rates Required to Reach the 2015 Peak Savings Targets

Utility	Average Annual Energy Savings 2004-2007	2015 Savings Target (50% Inc)	Annual Percentage increase 2007 to 2015
	MW	MW	%
AEP Central	9.0	24.7	15%
AEP North	4.0	2.8	-5%
AEP SWEPCO	2.0	11.1	28%
Centerpoint	40.4	117.9	17%
El Paso	1.0	18.4	52%
Entergy	5.3	35.4	31%
Oncor	83.1	163.7	10%
TNMP	3.0	13.8	24%
Xcel	3.0	15.5	26%
Statewide	150.8	403.3	15%

Many of the problems noted in setting savings goals as a function of incremental growth can be avoided by setting savings goal using different and more stable metrics. An alternative to setting goals as a percentage of incremental growth would be to set saving goals as a function of baseline electricity sales and demand. Use of this metric has the following advantages:

- Simplifying the calculation of the energy and peak savings goal,
- Providing utilities with a more predictable savings goal that is a function of the absolute size of the utility rather than changes in the rate of incremental growth,
- Mitigating the calculation anomalies caused by utilities that actually experience reductions in sales over time, and
- Avoiding the need to ramp up or ramp down programs in concert with booms or busts in economic activity, which often has a big impact on incremental sales growth.

The disadvantages of setting goals as a fraction of actual sales include the following:

- It may be more valuable for rate payers for utilities to ramp up energy savings in service areas where incremental growth is surging, and
- Linking savings goals to incremental sales growth may have certain resource planning benefits assuming that programs can rapidly scale up and down savings in response to changes in forecast sales or peak demand.

Table 7-12 compares the performance of utility program administrators over the last four years and the level of performance required to meet the proposed savings goals using an alternative metric—annual energy savings achieved as a fraction of total load in the same year.

Table 7-12: Texas Utility Program Performance: Annual Savings as a Fraction of Annual Sales

	History				Future	
Texas Distribution Utilities	**2004**	**2005**	**2006**	**2007**	**Fraction Equivalent to 2010 Goal**	**Fraction Equivalent to 2015 Goal**
Oncor	0.27%	0.24%	0.15%	0.21%	0.20%	0.63%
CenterPoint	0.14%	0.15%	0.16%	0.11%	0.51%	0.97%
AEP-SWEPCO	0.05%	0.16%	0.06%	0.07%	0.29%	0.62%
AEP-Central	0.12%	0.15%	0.16%	0.12%	0.30%	0.50%
AEP-North	0.25%	0.14%	0.11%	0.11%	0.04%	0.21%
Entergy	0.04%	0.04%	0.06%	0.05%	0.60%	0.78%
SPS-Xcel	0.11%	0.14%	0.07%	0.20%	0.21%	0.69%
El Paso Electric	0.00%	0.09%	0.10%	0.18%	0.76%	1.28%
TNMP	0.13%	0.06%	0.05%	0.05%	0.66%	0.83%
Average	0.12%	0.13%	0.10%	0.12%	0.40%	0.72%

This table compares each utility’s historic performance (using the metric of annual savings compared to annual load over time) and with respect to the goal levels proposed in the legislation. Comparing the metrics in the second to last columns for 2010 with the historic performance of each utility shows how some utilities with lower load growth fare relatively well, e.g., are not required to make any significant increases in their overall effort. For example, the proposed “incremental growth sales goal of 30% of incremental growth for Oncor is equivalent to 0.20% of its projected sales in 2010, which is almost identical to its performance in 2007 at 0.21 % of sales. By contrast, CenterPoint, a utility projecting significant sales growth in the next five years, will be required to increase their performance from 0.11% of 2007 sales to 0.51% of sales in 2010, a five-fold jump.

In Itron’s view, this table demonstrates the potential inequities of basing proposed energy savings goals on relatively unstable indicators such as average incremental growth over a short period like five years. A more equitable savings metric might require each utility to improve the fraction of savings to annual sales by 50 % to 150% by the year 2010 relative to their performance in 2007 or the average performance over the previous three years. This could be accomplished by switching to a sales metric based on requiring savings as a fraction of previous year sales or peak demand rather than incremental growth. This idea is explored in the next section.

Another strategy for dealing with the ramp up constraints and challenges faced by small utilities, and utilities with higher than average growth, is to change the savings metric to be based on savings relative to absolute sales or peak demand rather than a fraction of the projected incremental peak growth. Table 7-13 shows the net effect of switching the metrics from 30% and 50% of incremental growth in peak growth to 0.36% of base peak demand in 2010 and 0.66% of peak demand in 2015, respectively (the values of 0.36% and 0.66% of total peak demand were calculated to result in the same statewide total savings goal as the current percent of incremental growth metric). The result is that the calculated peak savings goals decrease for some utilities, increase for some, and stay relatively neutral for others. Note though that for those utilities with increases, the alternative goals are still relatively close in 2010 to their 2007 accomplishments. Overall, we believe the alternative metric is fairer and increases the likelihood of attainment for the utilities in aggregate.

Table 7-13: Effect of Establishing Alternative Savings Metric for 2010 and 2015 by Utility Area, While Retaining Equivalent Statewide Targets

Utility	Reported Savings	Saving Goals for 2010		2010 Difference	Saving Goals for 2015		2015 Difference
	2007 Savings MW	30% of Incremental Growth MW	0.36% of Total Base MW	Base MW Goal vs. Incremental MW (%)	50% of Incremental Growth MW	0.66% of Total Base MW	Base MW Goal vs. Incremental MW (%)
Oncor	65	78.1	82.3	5%	163.7	163.0	0%
CenterPoint	39	77.2	62.4	-24%	117.9	128.1	8%
AEP-SWEPCO	2	6.2	6.4	4%	11.1	12.6	12%
AEP-Central	9	7.7	18.3	58%	24.7	35.9	31%
AEP-North	1	0.6	3.2	81%	2.8	6.0	54%
Entergy	5	7.8	12.1	36%	35.4	24.7	-43%
SPS-Xcel	4	5	7	25%	16	13.5	-15%
El Paso Electric	1	9.2	4.3	-112%	18.4	9.2	-99%
TNMP	2	9.1	5.4	-70%	13.8	9.2	-49%
Statewide	128	201.0	201.2	0%	403.3	402.4	0%
🟦	MW goals resulting from new savings metric set at 0.35 or 0.7% of peak demand						
	Savings calculations exclude potential savings from high voltage customers and from CFLs						

Table 7-14 shows the net effect of switching the metrics from 30% and 50% of incremental growth in peak demand to 0.3% of total peak demand in 2010 and 0.5% of total peak demand in 2015, respectively. In this table, the 2015 target using the alternative metric is set a bit lower at the statewide level than what would equate to the 50% of incremental load growth metric. This reduced total target would reduce the pace of the necessary ramp up for many utilities and generally increase the likelihood of meeting the goals for all utilities, especially if high voltage customers and screw-in CFLs are excluded from programs. If the fall in projected peak savings is considered a big problem, Itron would recommend increasing the peak savings goal at a slightly higher level, between 0.55 and 0.60% of the previous year's peak demand, rather than increasing all the way to 0.7%, which of course is an option as well if maintaining the statewide 50% of growth target is paramount.

Table 7-14: Effect of Establishing Alternative Savings Metric for 2010 and 2015 with Reduced 2015 Statewide Total

Utility	**Reported Savings**	**Saving Goals for 2010**		**2010 Difference**	**Saving Goals for 2015**		**2015 Difference**
	2007 Savings MW	30% of Incremental Growth MW	0.3% of Total Base MW	Base MW Goal vs. Incremental MW (%)	50% of Incremental Growth MW	0.5% of Total Base MW	Base MW Goal vs. Incremental MW (%)
Oncor	65	81.6	69.0	-18%	174.3	122.7	-42%
CenterPoint	39	43.0	52.3	18%	134.3	96.5	-39%
AEP-SWEPCO	2	6.0	5.4	-11%	12.2	9.5	-29%
AEP-Central	9	9.1	15.4	41%	25.1	27.1	7%
AEP-North	1	0.6	2.6	78%	2.8	4.5	38%
Entergy	5	7.4	10.1	27%	37.8	18.6	-103%
SPS-Xcel	4	5	6	10%	16	10	-53%
El Paso Electric	1	9.6	3.6	-163%	18.9	7.0	-172%
TNMP	2	9.7	3.6	-165%	14.6	7.0	-110%
Statewide	***129***	***171.9***	***167.8***	***-2%***	***435.6***	***303.0***	***-44%***
🟦	MW Goals resulting from new metric of 0.3 or 0.5% of peak demand						
🟧	Savings reported in Annual Reports						

7.4.3 Recommended Changes to Achieve the Higher Energy and Peak Savings Goals

Itron's analysis supports an increase in energy and peak savings goals in the near and long term, but the ultimate success of such an effort depends on providing the utility administrators with the tools, resources, and motivation to ramp up their programs. The analysis suggests that it will be difficult, if not impossible, to achieve the higher levels of achievable savings unless current restrictions on the type of programs allowed and the ability to hire staff to create more effective programs are gradually mitigated or removed.

The following changes in regulatory policy are recommended to maximize the chances that utility program administrators will be able to meet the savings goals recommended in this document. These recommendations are based on interviews with energy efficiency companies and administrators in Texas, while the other recommendations are the by-product of Itron's analysis of the reported program savings and forecasts of achievable savings as a function of program awareness and rebate levels.

1. Replace the 10% administrative cost limit with a requirement that utilities demonstrate their overall program portfolio was cost-effective using either the program administrator cost test or the total resource cost test. Alternatively, the limit could be kept intact while amending the definition of administrative costs could be amended to exclude marketing and training costs, which typically are counted as program delivery costs in most jurisdictions we work with. This second option is not preferred because of the findings from the policy interviews that the administrative cost limit is reducing the level of creative program design and development that will be essential if the programs are to increase the level of savings captured by their program.
2. Allow utilities to market their programs directly to their customers in addition to providing indirect marketing messages through energy service companies. This change is needed because the surveys of commercial customers in this project showed that awareness of the existence of energy efficiency programs was relatively low in Texas compared to the levels achieved in other states. Increased awareness of programs and associated energy efficiency benefits usually leads to increases in the number of customers willing to purchase and install energy efficiency measures.
3. Limit incentive payments provided by utility programs to a maximum of 100% of incremental measure costs but with an average share of incremental costs that is significantly lower, for example, 50%, to ensure that end users co-pay for their efficiency installations (increasing the likelihood that the measure will be maintained, properly utilized, and fully valued).
4. Consider establishing a stronger statewide marketing organization to increase general awareness of energy efficiency products and access to energy efficiency service suppliers. This organization could be hired to work directly for all of the investor-owned utilities, work directly for the PUCT at a statewide level, or work under the direction of the State Energy Conservation office.
5. Consider encouraging even closer cooperation between utility new construction programs and the State Energy Conservation office to jointly pilot test and

demonstrate new designs and technologies in new buildings that will then be incorporated into future codes five to ten years later.

6. Consider increasing the rewards available to utility program administrators for successful utility energy efficiency programs.
7. Consider establishing special funding for programs designed to achieve greater savings for rural areas with low levels of awareness and a scarcity of energy service companies providing efficiency products and services.

8

Responses to Technical and Policy Questions Posed by the Texas Legislature

This section provides answers to the specific quantitative questions posed by the Texas legislature in Section A questions 1 through 6 and then provides specific responses to the policy questions posed by the legislature in Section B Questions 1 through 6.

8.1 Responses to Proposed Questions Posed by the Legislature with Respect to the Economic and Achievable Levels of Energy Savings and How These Compare to the Proposed Savings Goals for the Years 2010 and 2015

(1) the technical, economic, and achievable potential, and natural occurrence of energy efficiency in the service areas of investor-owned utilities in Texas, in kilowatts and kilowatt hours;

Answer: The estimates of the technical and economic potential to save energy are provided in Section 6. Figure 8-1 and Figure 8-2 integrate these technical and economic estimates with the estimated range of achievable savings estimates (base and high) and naturally occurring savings presented in Section 7. Figure 8-1 shows the relative relationship between technical, economic, high achievable and base achievable, and naturally occurring cumulative energy savings over the period 2008-2017. Base achievable reduction in energy is estimated at roughly 25% of the technical potential and 8% of projected baseline sales in the year 2017 for both the high and low forecast of avoided costs.

Figure 8-1: Estimates of Technical, Economic, Achievable and Naturally Occurring Energy Savings from 2008 to 2017

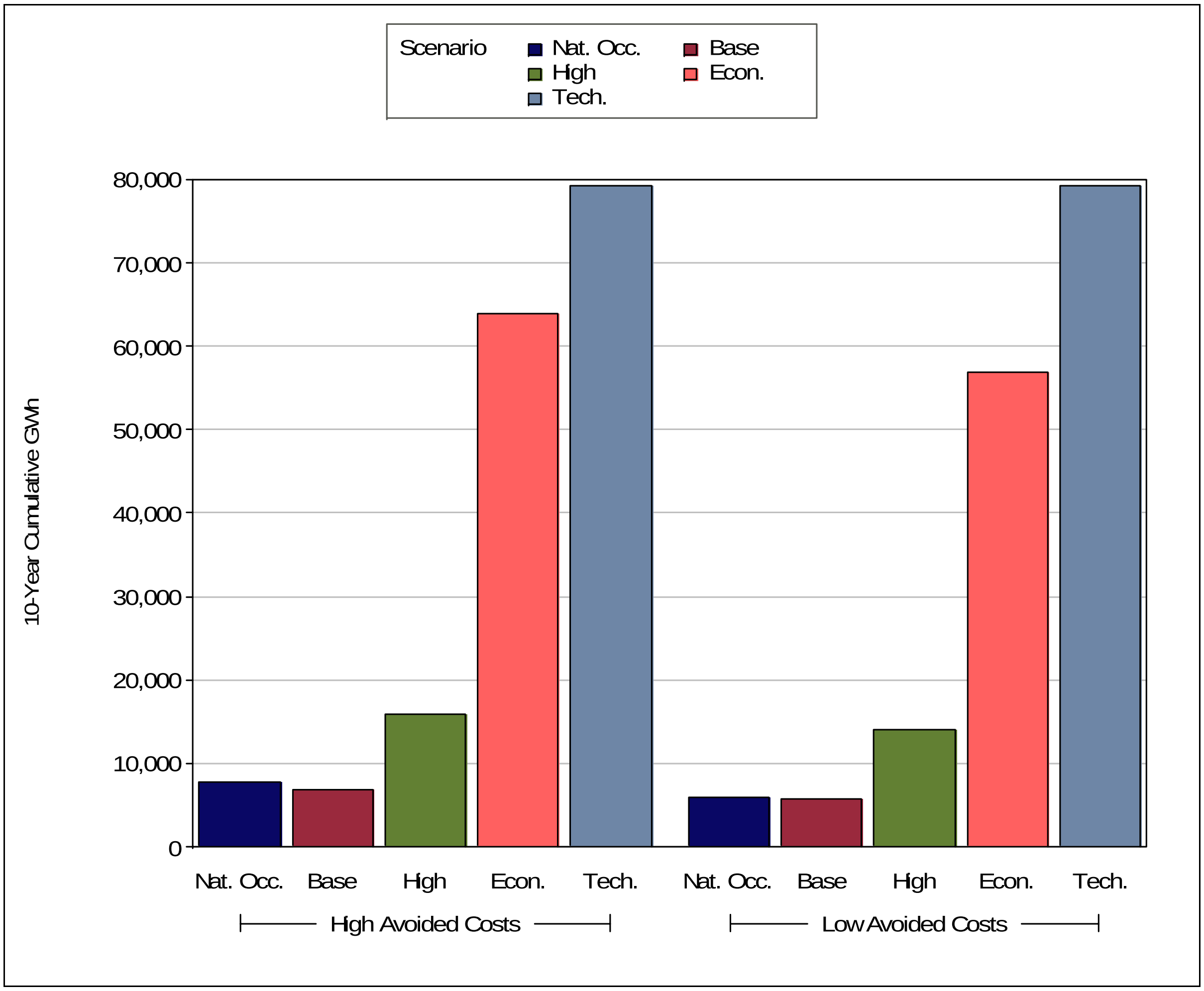
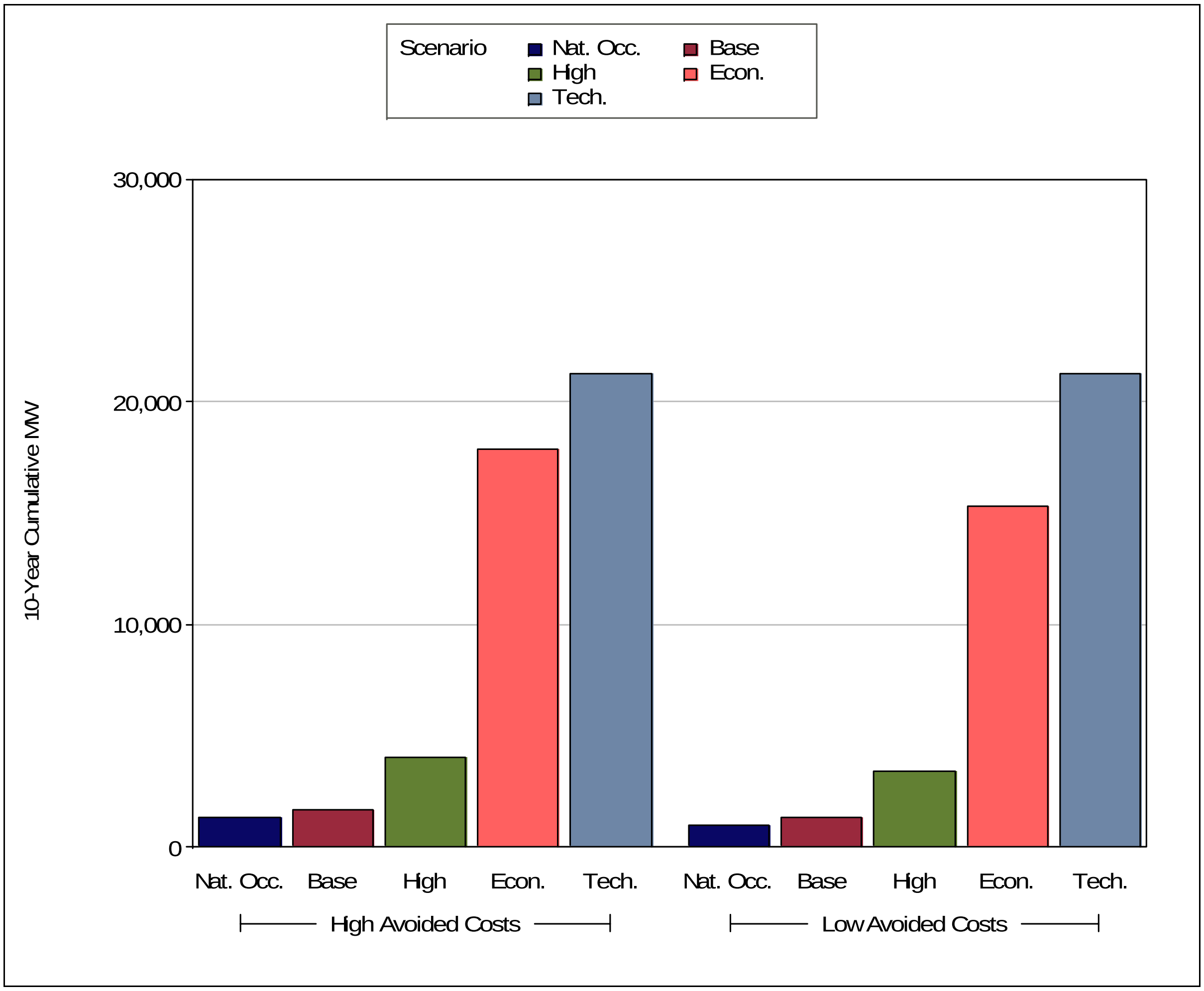


Figure 8-2 shows the same relative relationship between technical, economic, high achievable, base achievable, and naturally occurring peak demand savings summed over the period 2008-2017. The base achievable reduction in peak demand is estimated at roughly 25% of the technical potential savings and 10% of projected peak demand in the year 2017.

Figure 8-2: Estimates of Technical, Economic, Achievable and Naturally Occurring Peak Demand Savings from 2008 to 2017



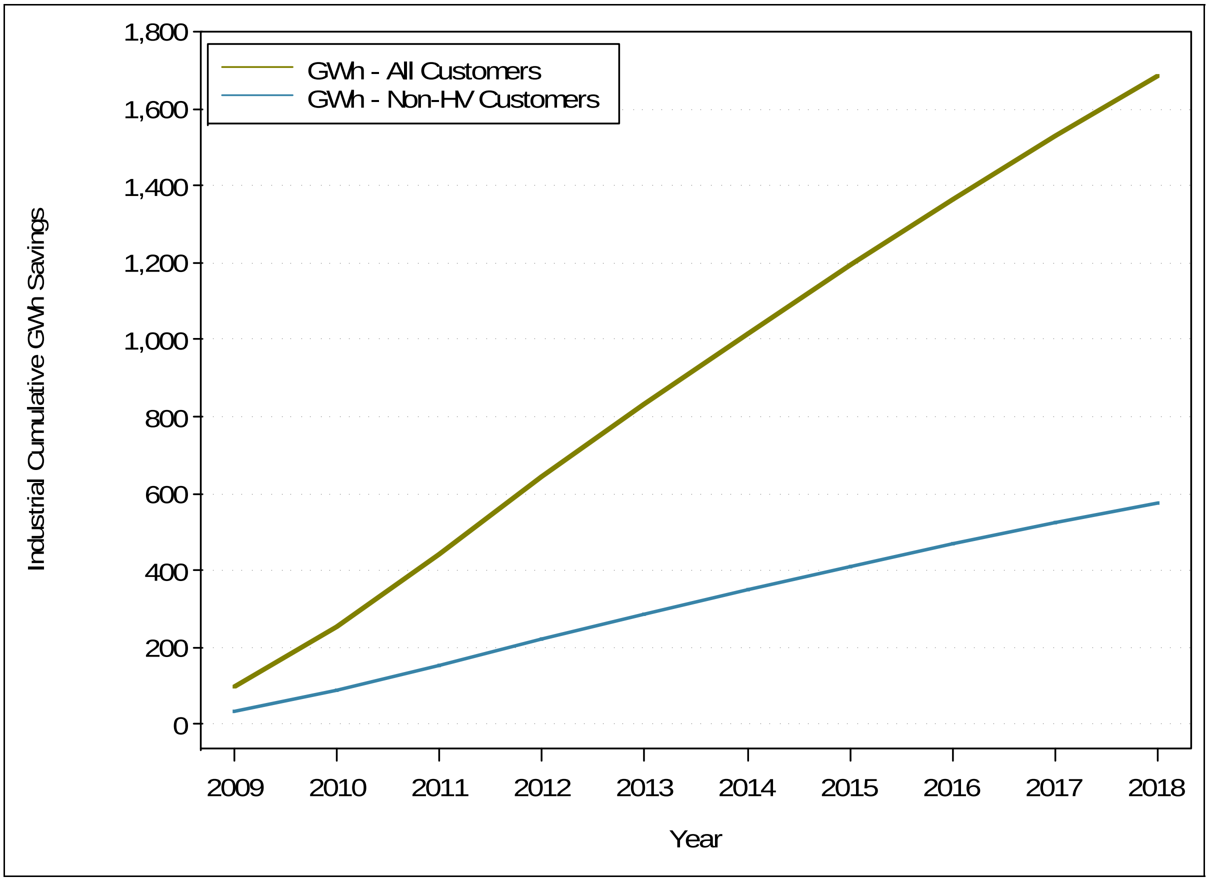
(2) *the kilowatt and kilowatt hour savings that are economically achievable through utility energy efficiency programs in accordance with PUCT rules, except any rules that prescribe budget limits, and an estimate of the cost of the programs to achieve such savings (that is, the PUCT rules in effect on the date that the study begins)*;

Answer: Estimates of economically achievable levels of savings are provided in Section 7.3, Table 7-1 through 10. The forecasts of achievable savings in both the base and high incentive cases would likely require changes to the allowable level of marketing expenses. Both cases also represent significant increases in savings and expenditures from current levels of efforts and would likely require large increases in staffing or outsourcing and a broader set of program options. Under both cases, it would be useful to expand collection of data on what is happening in the energy efficiency market and the incremental costs of promoted measures to ensure that programs maximize their market effectiveness and that incentives offered are cost-effective.

(3) *for energy savings and costs specified in paragraph (1) or (2), estimates of achievable savings for each utility service area and each customer class in a service area, including industrial customers, and an estimate of the cost of the programs to achieve such savings for each class and service area*;

Answer: Forecasts of Achievable savings including all industrial customers are provided in Section 7 in Figure 7-1 through Figure 7-8. A separate estimate of the anticipated reduction in energy and peak savings if industrial customers with high voltage service were excluded from participation in each utility area is provided in Section 7.1.5. Figure 8-3 summarizes the difference in projected achievable savings with and without savings from high voltage industrial customers for the sum of all utility areas.

Figure 8-3: Statewide Achievable Industrial Sector Savings with and without High Voltage Industrial Customers Base funding –Low Avoided Cost case



(4) *whether an increase in the energy efficiency goal for programs administered by the PUCT to 30 percent of the growth in demand for electricity for each utility is achievable by December 31, 2010, if programs for industrial customers are included and if programs for industrial customers are not included*;

Answer: Itron's assessment of the feasibility of reaching the proposed savings goal by December 31st, 2010 is provide in Section 7.3.1. In general the exclusion of high voltage industrial customers reduces the anticipated energy and peak savings for all sectors by roughly 13% but this reduction is not sufficient to make it infeasible for utilities to achieve the proposed savings goal for 2010. A bigger problem is the requirement to rapidly ramp up program energy savings from 2007 levels to the 2010 goals without knowing if or when the proposed goals will be formally adopted until sometime between the middle of 2009 and the beginning of 2010. This problem and our suggested solution to it are addressed in Section 7.3.1.

(5) *whether an increase in the energy efficiency goal for programs administered by the PUCT to 50 percent of the growth in demand for electricity for each utility is achievable by December 31, 2015, if programs for industrial customers are included and if programs for industrial customers are not included*;

Answer: Our assessment of the feasibility of reaching the proposed peak demand savings goal by December 31st, 2015 is provided in Section 7.3.2. In general the exclusion of industrial customers reduces the anticipated peak savings by roughly 14% but this reduction is not sufficient to make it infeasible to achieve the proposed savings goal. A bigger problem is the requirement for some utilities to rapidly ramp up and sustain annual program energy savings at a rate exceeding 30% per year relative to 2007 levels over an 8 year period. This problem and some suggested solutions to it are addressed in Section 7.3.2. Another key issue is whether to include savings from measures, e.g., compact fluorescent lamps, that have both large gross and naturally occurring savings potentials. Exclusion of such measures would make it more difficult to the reach the savings goals.

(6) *if the energy efficiency goals set out in items (4) and (5) are achievable, the costs and rate impacts associated with meeting these goals*;

Answer: The projected annual funding requirements and resulting rate impacts to provide the funding to meet the savings goals and account for lost revenues for the achievable savings forecasts in items (4) and (5) are discussed in Section 7 and summarized below.

The rate impact is equivalent to the sum of the avoided costs from the programs' savings minus the annual costs of the program and the lost revenues incurred due to the program savings to the utility. The exact rate impacts for each utility will be dependent on the actual rate of growth in avoided energy and capacity costs for each utility service area. Itron's analysis has bracketed the rate of anticipated rate impacts by analyzing the rate impacts assuming low (2% per year nominal) and high (5% per year) growth rates in avoided costs and retail rates over the ten year period.

The projected rate impacts are discussed in Section 7.1.6. The estimated impact of the cost of developing additional programs on a typical customer bill ranges from one to two dollars per month. Table 7-4 provides estimates of potential monthly cost and monthly savings from these programs for the average customer and from customers who participate in the programs.

8.2 Itron's Response to Policy Questions Posed by the Texas legislature

The six policy questions posed by the Legislature and our response are provided below.

(1) whether energy efficiency programs in areas of Texas with competitive retail electric service should be funded by utilities and, if not, whether other sources of funding would be available and effective;

Answer: This question can be interpreted in two different ways:

1. Assess whether there is a need for any program funding at all to achieve the goal of increased energy savings and if so which organizations are the best source of funding for these efforts
2. Assuming that there is a need for energy efficiency programs, what is the best or most stable form of funding for these programs, including an assessment of whether the current funding source , transmission and distribution utilities, is the best source for this funding.

Below we provide answers to both questions; starting with the first one about the need for program funding and finishing with a discussion of funding sources.

<u>A. Assessment of Need for Public Funding of Energy Efficiency Programs</u>

Itron's analysis of current market sales data suggest there is a strong customer demand for energy efficiency services from roughly 50% of the market that self report they have high levels of knowledge of energy efficiency options and specify that new systems installed must be energy efficient. This demand is currently being met by a combination of private contractors in the free market without any form of program assistance and by utility programs. However fully 40% of the customers surveyed rank their knowledge of energy efficiency opportunities as less than 4 on a scale of one in ten and are not satisfied with the level of energy efficiency information provided by their local utility. Thus there seems to be a significant market need for energy efficiency information for a large portion of the existing market that is not being met by the programs or the existing programs alone. Key findings from our survey of commercial building owners that support this conclusion are highlighted below:

Availability of Efficiency Service Providers

Thirty one per cent of the commercial customers in this survey reported they have been approached by an energy efficiency firm or contractor interested in selling them a high efficiency HVAC and lighting systems within the last three years. Building owners in Texas report that 62% of these offers were from contractors not associated with energy efficiency programs while 36% were associated with a utility program.

Low Awareness of Available Program Services

Over 70% of the commercial building owner report they are unaware of any program offered by utilities in Texas. This contrasts with a finding that only 30% of customers in California in 2005 were unaware of the standard offer energy efficiency programs offered for a similar length of time by IOU's in Texas.[21] This lack of awareness is due to differences in market structure in Texas and California that preclude Texas administrators for marketing their programs and the significantly larger portions of the Texas population that live in rural areas not easily reached by marketing efforts starting in the core urban areas.

The difference in awareness is also due to the incredible surge in public awareness of efficiency opportunities caused by the electricity crisis in California in 2001. As discussed in other sections of this report, the Texas legislature should consider authorizing a larger mass media effort to reach both urban and rural areas in Texas with useful information about where to go or who to contact if customers are interested in reducing their energy use through efficiency investments.

---

[21] Itron, 2004-2005 Nonresidential Standard Performance Contract Program: Impact, Process and Market Evaluation (Produced for SCE, CalMAC pub. # SCE 0220.01, September 2008)

Impact of Energy Efficiency Programs on Total Level of Savings Achieved in the Market

Our analysis shows that the impact of the energy efficiency programs has been to roughly double the level of overall savings being captured in the overall market through the use of targeted incentives for more efficient markets and the limited marketing efforts of contractors working with their programs. This is illustrated in Figure 7-2 that shows contrasts the level of naturally occurring savings with estimates of program savings that could be achieved by programs with relatively low levels of incentives (roughly one third of incremental costs) and higher levels of program effort and incentives(roughly two-thirds of incremental costs).

8.2.1 Assessment of the Best Source of Funding for Energy Efficiency Programs

Itron’s potential analysis indicates that there is a potential to capture significantly increased energy and peak savings by increasing utility program funding and effectiveness through expanded program marketing and program design efforts. Total savings could double or triple the total level of savings expected from energy efficiency investments over the next 10 years as compared with market forces alone. So the key question is which organizations are best suited to provide the stable funding needed to achieve these benefits.

Experience over the last thirty years of energy efficiency suggest that investor owned utilities are a relatively stable and robust form of funding Utility funding appears to be the key to meeting the expanded savings goals for efficiency in Texas because there is no strong evidence yet that other market players are willing to self fund an expanded marketing effort.

Today virtually all major efficiency programs in the United States are utility-funded, although not all are administered by utilities. Twenty two out of the twenty four states with public funding sources utilize utilities as a delivery agent for energy efficiency programs. We suggest that utility-funding of programs has been successful (with simplicity and stability as key characteristics) as compared to alternative funding mechanisms and should continue to be the basis of program funding in Texas.

(2) whether energy efficiency programs in areas of Texas with competitive retail electric service could be more effectively and efficiently provided by the competitive market, without utility funding;

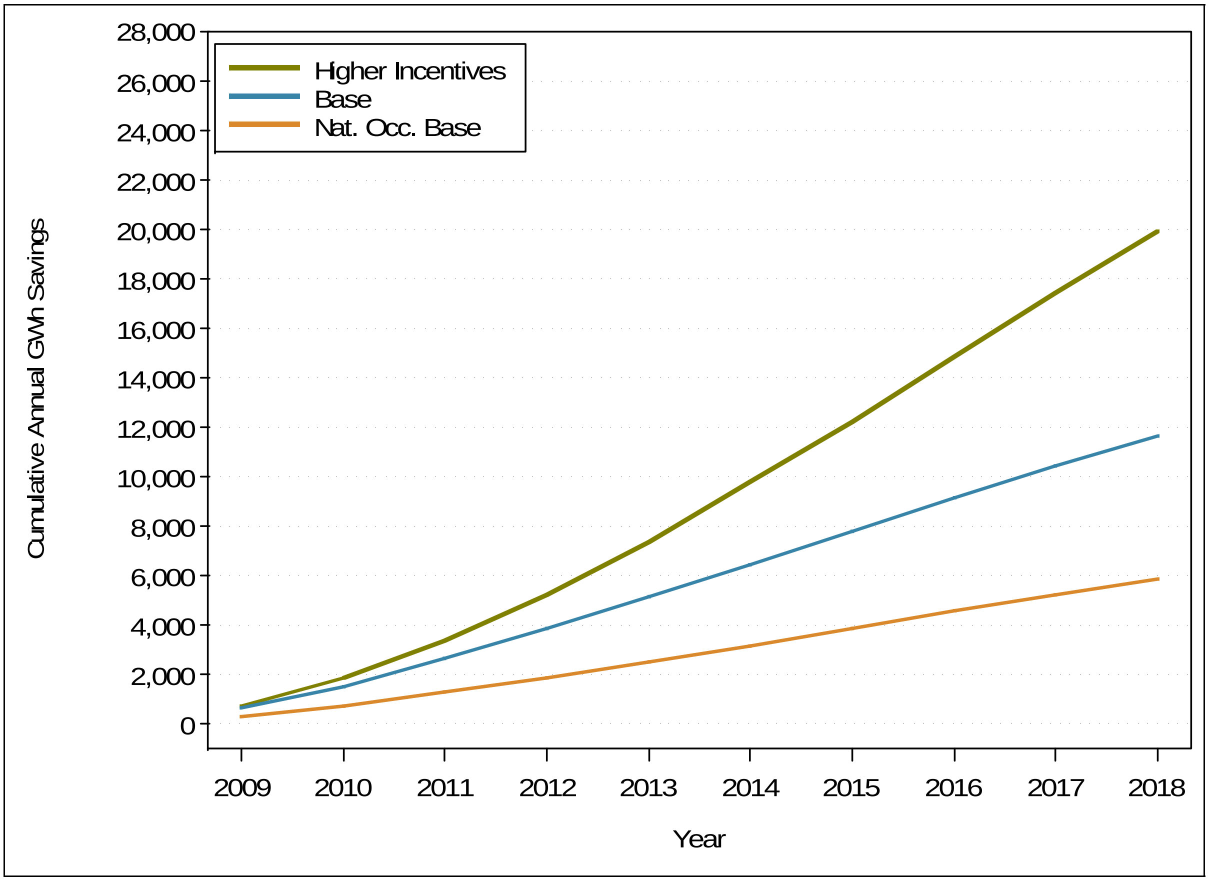
Answer: Itron’s analysis suggests that the level of naturally occurring energy efficiency investment in the nine Texas service areas could be roughly 50% of the savings forecasted for the Base scenario in this study. However, a substantial portion of these naturally occurring savings are expected to come from a small number of high visibility measures, for example, compact fluorescent lamps, commercial and industrial T8 linear fluorescent lighting systems. There is disagreement in the efficiency community about whether there is still a need for programs to promote some of these measures due to the risk of attracting free riders who would have purchased the measure in the absence of the programs. The key question is whether efficiency programs are likely to have a significant effect in accelerating the adoption of these measures above and beyond the level expected due to normal market forces.

Itron's analysis suggests that the programs will have an incremental effect on the sales of these products but the precise level is not known given the scarcity of market sales data in Texas. We do know there is considerable uncertainty around the forecast of the level of residential CFL adoptions that are likely to occur in the absence of programs. In addition, although these measures have high potential for being purchased in the absence of some programs by some segments of the market (naturally occurring savings), there remains opportunity for significant additional net savings from these measures under our program expansion scenarios (as noted above, doubling or tripling savings above naturally occurring levels).

Itron concludes that the removal of utility funding would likely lead to lower levels of total energy savings in Texas. This conclusion is supported by our adoption models that predict incremental savings over and above the level of naturally occurring savings observed in the market and confirmed in our telephone surveys of trade allies in Texas.

Our projections of the level of naturally occurring and program induced savings for the Base and High incentive case over the next decade is illustrated in Figure 8-4 below. The Base case assumes the current practice of providing relatively low levels of incentives (roughly a third of incremental costs) and little if any direct marketing is continued, but that additional measures, such as residential CFLs, are added to the program mix; while the High incentive case also includes the additional measures, allows utilities to spend funds on marketing energy efficiency, and assumes increases in the level of rebates provided up to 67% of incremental costs.

Figure 8-4: Estimates of Achievable Savings for the Base and High Case relative to the forecast of naturally occurring savings



Regardless of the program design assumptions, we project a substantial amount of savings resulting from customers adopting energy efficiency measures with very short paybacks. These naturally occurring savings are predominantly from high visibility measures such as CFLs and commercial T-8 lighting systems that are currently included in utility programs but might not be included if the PUCT decides to try and verify net as opposed to gross levels of savings from the program. Savings from these measures are roughly 50% of the projected gross savings in the Base achievable case and 33% of the gross savings estimated for the High incentives case.

While 50% is a fairly high rate of naturally occurring investment in efficiency compared to the levels observed in other states, the fact remains that even the relatively modest programs operated by the Texas utilities are projected to achieve significantly more energy savings than the private sector alone. This is because programs are the most effective tool to target a variety of market barriers not normally addressed by the private market. (See the listing of market barriers to energy efficiency investment in Section 2, Table 2-4).

These barriers to increased energy efficiency savings may have been exacerbated by the rules in the deregulated electricity market that prohibit investor owned utilities from providing customers with useful information about how to seek out and find private sellers of energy efficiency services or participate in their own programs. While some of the retail electricity service providers have expressed an interest in providing more energy efficiency information to customers, the vast majority report they provide no energy efficiency information because they expect this function to be fulfilled by the private market. In reality, the commercial survey results suggest there is a demand for more information about energy efficiency opportunities by Texas residential and commercial customers but this information for the most part is not being provided by the private market, in part because it is not in the private firms interest to provide customers with information on a variety of products and service providers. Customers desire information about the range of efficiency options available to them from a credible independent source. Current energy efficiency companies and to a certain extent retail energy providers are not considered independent or credible by most customers.

Consequently Itron recommends that investor owned utilities continue to fund energy efficiency programs in Texas, at expanded levels to reach toward the Legislature’s goal targets, and devote more effort to raising the levels of public awareness of energy efficiency opportunities. How to most effectively raise public awareness in different customer segments and what organization(s) should be given this responsibility is covered in the next question.

(3) whether education programs regarding the provision of energy efficiency services in the competitive market should be conducted by the PUCT and be funded by utilities;

Answer: Research has shown that the development of education programs to encourage energy efficiency investments is not likely to succeed unless the organization involved has sufficient experience in developing social marketing campaigns to not only reach and inform but also motivate customers to seek out more energy efficient products and services. While our interviews revealed a number of potential marketing organizations that could develop a marketing campaign in Texas, these organizations are not likely to succeed unless the campaign is familiar with the cultural values or social norms across the different types of communities in Texas and experienced in developing an easy to remember “call to action”.

The stakeholders we interviewed had no strong preference for either the PUCT or the State Energy Conservation office to serve this function but it is likely that either organization could hire the necessary expertise to either outsource the function or develop the necessary expertise in house. The investor owned utilities would probably prefer to pool their funds and hire a separate marketing organization to develop and deliver this campaign. We recommend that a private firm be given the initial assignment because they can be held responsible for the success or failure of their effort based on quantitative indicators of the effectiveness of the campaign. It is far more difficult to hold public organizations or agencies to the same standard of accountability.

(4) policies designed to promote energy efficiency in the areas of Texas that are not open to competitive retail electric service, including the service areas of investor-owned utilities outside of ERCOT and municipal utilities and electric cooperatives; and

Answer: The state legislature and the Public utility Commission should consider the following policies to promote energy efficiency in areas of Texas not open to competitive retail service include:

- Encourage or order municipal utilities to cost share in the development and implementation of a statewide marketing campaign.
- Encourage municipal utilities to meet the same statewide efficiency goals as the investor-owned utilities.
- Develop statewide program designs, procedures, and materials that municipals utilities can leverage to more cost-effectively implement programs in their own territories.
- Encourage more cooperation between municipal utilities, rural electricity cooperatives and the state energy conservation office in the development of new building standards.
- Start a professional energy manager program for rural areas that pays the salaries of talented energy management professionals to provide energy audits and other technical assistance to rural towns currently not reached by utility marketing or standard offer contractors.

(5) regulatory or statutory changes to eliminate any barriers to the increased participation by retail electric providers in the delivery of energy efficiency services and facilitate greater energy efficiency.

Answer: See the list of recommended changes to Regulatory framework in Section 7.3.3 Recommended Changes in Regulatory Framework to increase Energy and Peak Savings. Key changes include modification of existing limits on marketing expenditures, development of a more flexible program design process and consideration of mechanisms to decouple utility revenues from kWh sales and reward utilities for superior program performance.

(6) Potential barriers to the increased participation by retail electric providers in the delivery of energy efficiency services to ERCOT customers, and to the increased potential for energy efficiency in ERCOT or in Texas generally.

Answers: Itron's policy interviews with Texas stakeholders and our review of utility program performance suggested there are barriers to both increased participation by retail electric providers (REPS) and to higher levels of customer acceptance and investment in energy efficiency in general. Each topic is addressed below:

<u>Barriers Identified During Our Interviews with REPS Included:</u>

1. REPS inability or unwillingness to compete for the funds required to deliver energy efficiency programs that require face to face contact with customers and as such can no be carried out by transmission distribution utilities.
2. REPS inability to capture or claim credit for peak and dollar savings achieved by operating successful load management programs (most of the benefits flow to transmission and distribution utilities).
3. REPS inability to propose potential alliances with transmission and distribution utilities caused by what they claimed was a lack of transparent planning processes in Texas and potential regulatory rules prohibiting cooperation between REPS and the local distribution utilities.

On the other hand it is interesting to note that a minority of REPS were interested in providing customers with more information and feedback on the effects of their efficiency programs using new technologies enabled by the deployment of the smart grid. The PUCT should consider supporting a concerted effort to form efficiency partnership between the TDU's and progressive REPS such as Reliant and TDU. These organizations have the same goals and should be able to develop an effective alliance if the current market rules prohibiting cooperation could be relaxed.

Additional Solutions to these barriers include:

1. IOU's could hire non profit firms or private marketing representatives to work with REPS to develop a coordinated marketing campaign and help increase their credibility with customers
2. Allowing IOU's to work with REPS to share both the costs and benefits of load management and energy efficiency programs.
3. Encouraging IOU's to develop contracts with REPS in rural areas to deliver energy efficiency services and real time feedback through smart meters.

Barriers to Increased Energy Efficiency Investment for All Service Areas in Texas

1. Lack of knowledge of energy efficiency opportunities at the customer level
2. Lack of useful feedback for customers on the actual energy cost savings achieved by investing in more efficient measures.
3. Lack of access to changes in the wholesale price market on a day ahead or near real time basis.
4. Lack of any mechanism to address revenue losses incurred by transmission and distribution utilities operating successful energy efficiency programs
5. Lack of TDU profit motivation to field successful programs.

All of these barriers could be addressed by some of the policy initiatives suggested earlier in this report. The reader is referred to Section 7-5 for a full discussion of these policy and regulatory initiatives.

9

Key Sources

For this study, we obtained and developed primary and secondary data from a variety of sources. Each major source used in this study is summarized at the end of this section.

<u>Acknowledgement</u>

Itron would like to thank the participating utilities for providing evaluations of previous programs, forecasts of electricity and peak usage, and previous estimates of measure saturation and electricity savings. Special thanks also go to the Electricity Reliability Council of Texas for providing billing, load research, load forecasts for the utilities within the ERCOT area. Itron also relied to a significant extent on estimates of commercial and residential building characteristics for the West South Central Census region and Texas from the United States Energy Information Agency (RECS and CBECS). Finally important information was provided by Frontier Associates on existing deemed savings estimates and baseline energy usage for new construction sectors. Itron also performed energy-use simulations of prototypical buildings using eight different normalized weather tapes to help understand differences in heating and cooling loads across the nine Texas service territories, the authors.

In addition to the use of secondary data from the sources above, Itron gathered primary measure saturation and building characteristics data in the Texas market using phone based surveys of commercial customers, lighting distributors and contractors and HVAC distributors and contractors in the areas served by the participating utilities. Finally Itron relied on data collected in previous potential studies it has conducted for other western states to estimate the energy savings and incremental costs of the energy efficiency measures selected in this study.

<u>Major Sources</u>

A listing of the primary sources used to prepare the technical and economic potential analysis is provided below.

1) Arthur D Little, *<u>Energy Consumption by Office and Telecommunications Equipment in Commercial Buildings Volume I: Energy Consumption Baseline</u>* (Prepared For the

Office of Building Equipment Office of Building Technology State and Community Programs, U. S. Department of Energy January, 2002)

2) *DEER 2005. 2005 Database on Energy-Efficient Resources (DEER).* Available at: http://eega.cpuc.ca.gov/deer/
3) Energy Information Administration, 1997. *Manufacturing Energy Consumption Survey 1994*. Washington, DC: Energy Information Administration, US Department of Energy.
4) Energy Information Administration. 1999. *1999 Commercial Buildings Energy Consumption Survey (CBECS*) Detailed Tables. Washington, DC. Available at: http://www.eia.doe.gov/emeu/cbecs/set10.html Table 3a. Electricity End-Use Consumption by Principal Building Activity, 1999
5) Energy Information Administration. 2005 Residential Energy Use Tables for the four most populous states. Washington D. C.
6) Energy Information Administration, 2001. *Manufacturing Energy Consumption Survey 1998*. Washington, DC: Energy Information Administration, US Department of Energy. Available at: http://www.eia.doe.gov/emeu/mecs/mecs98/datatables/contents.html#fuel
7) Electricity Reliability Council of Texas, (ERCOT), *2005 Residential Heating & Fuel Type Survey Results (Prepared by Carl Raish and ERCOT staff, March 2006)*
8) ERCOT, staff provided Itron with the latest estimates of historical electricity consumption by power bin and the most recent forecast of sales for the eight weather regions in the ERCOT control area (July, 2008)
9) Itron, *California Commercial Energy Use Survey* (CEUS) (Prepared for the California Energy Commission, Publication Number CEC-400-2006-005, March 2006)
10) Itron, *Public Service New Mexico Electric Energy Efficiency Potential Study; Final Report* (Prepared for the Public Service New Mexico, September 2006)
11) Lone Star Research, *Residential Appliance Saturation Survey*, (Prepared for El Paso Electric Company, July 1997

Appendix A:

Energy Efficiency Measure Descriptions

A.1 Residential Measures

This subsection provides brief descriptions of the residential measures included in this study.

A.1.1 HVAC

Central Air Conditioner Upgrade: Air conditioner equipment includes a compressor, an air-cooled or evaporatively-cooled condenser (located outdoors), an expansion valve, and an evaporator coil (located in the supply air duct near the supply fan). Cooling efficiencies vary based on the quality of the materials used, the size of equipment, the condenser type, and the configuration of the system. Central air conditioners may be of the unitary variety (all components housed in a factory-built assembly) or be a split system (an outdoor condenser section and an indoor evaporator section connected by refrigerant lines and with the compressor at either the outdoor or indoor location). Efficient air conditioner measures involve the upgrade of a standard efficiency unit (13 SEER) to a higher efficiency unit (15 or 17 SEER).

Programmable Thermostat: Setback programmable thermostats are appropriate controls for HVAC equipment that serve spaces with regular occupied and unoccupied periods, resulting in long periods of time when heating and cooling set points can be adjusted.

Ceiling Fans: The convective heat transfer from the body depends on the velocity of the air moving over it. Humans can remain comfortable in a warm humid environment if the air movement is high. For this measure, propeller style fans are hung from the ceiling to provide air motion directly to occupants. Energy savings are assumed to occur, because higher cooling temperature set points are facilitated by the rapid air motion provided by the fans.

Whole House Fans: Whole house fans keep a home cool during the cooling months instead of running the air conditioner. These fans typically consume 0.22 kW (1/3 hp), about one-third the consumption of a central air conditioner. These fans pull cool air from the outside, move air through the house, and/or remove hot air through the attic.

Attic Venting: Attic venting reduces heat gain in the summer and prevents condensation (humidity) in the winter. This measure involves a motor-driven, thermostat-controlled fan.
Proper Refrigerant Charging and Air Flow: This measure involves diagnostic and repair services for existing central air conditioners to improve their efficiency. Inspection and services of AC systems involves checking the refrigerant level, cleaning the coils, cleaning the blower, cleaning or replacing filters, and making sure air is flowing properly through the system.

High Efficiency Room Air Conditioner: Window (or wall) mounted room air conditioners are designed to cool individual rooms or spaces. This type of unit incorporates a complete air-cooled refrigeration and air-handling system in an individual package. Cooled air is discharged in response to thermostatic control to meet room requirements. Each unit has a self-contained, air-cooled direct expansion (DX) cooling system and associated controls. The efficient room air conditioner measure involves the upgrade of a standard efficiency unit (9 SEER) to a higher efficiency unit (11 or 12 SEER).

A.1.2 Space Heating

Variable Speed Furnace Fan: Variable speed drives (VSDs) better match motor speed to load and can therefore lead to significant energy savings compared to constant speed drives. This measure considers the installation of VSDs on residential gas furnace fans.

A.1.3 Building Envelope

Duct Repair: An ideal duct system would be free of leaks, especially when the ducts are outside the conditioned space. Leakage in unsealed ducts varies considerably with the fabricating machinery used, the methods for assembly, installation workmanship, and age of the ductwork. To seal ducts, a wide variety of sealing methods and products exist. Care should be taken to tape or otherwise seal all joints to minimize leakage in all duct systems and the sealing material should have a projected life of 20 to 30 years. Current duct sealing methods include use of computer-controlled aerosol and pre- and post-sealing duct pressurization testing.

Window Film: This measure involves application of a dark-colored film to the existing windows of a home. The film lowers the shading coefficient of a window, reducing the amount of solar heat gain of a building, and thus decreasing the cooling load for the building.

Default Window with Sunscreen: This measure prevents direct sunlight on window surfaces, reducing solar gain and consequent cooling requirements.

Double Pane, Clear Windows to Double Pane, Low-E Windows: Windows affect building energy use through conductive heat transfer (U-value), solar heat gain coefficients (SHGC), daylighting (visible light transmittance), and air leakage. The performance of a window is determined by the type of glass, the number of panes, the solar transmittance, the thickness of, and the gas type used in the gap between panes (for multi-pane windows). Low-emittance or "low-e" windows feature a thin coating that is highly reflective of long wavelength radiation (room temperature heat) and thus reduce wintertime heating requirements. Newer low-e coatings also filter incoming light to block infrared portions of the spectrum and reduce summertime air conditioning requirements. For this study, standard double pane clear windows are specified as having U-value=0.79 and SHGC=0.68. Low-e windows are specified as having U-value=0.5 and SHGC=0.4.

Double Pane, Low-E Windows to Double Pane, Med Low-E^2 Windows: Advanced low-e windows (sometimes called "double low-e" or "low-e^2"), are carefully tuned to filter out specific portions of the spectrum in order to optimize performance in specific climates and locations. For this study, low-e^2 windows are specified with performance parameters preferable for the Southwest region (U-value=0.34 and SHGC=0.34).

Ceiling Insulation: Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. By inhibiting the flow of heat energy, thermal insulation can conserve energy by reducing heat loss or gain of a structure. An important characteristic of insulating materials is the thermal resistivity, or R-value. The R-value of a material is the reciprocal of the time rate of heat flow through a unit of this material in a direction perpendicular to two areas of different temperatures. In this study, we specify two efficiency measures involving ceiling insulation: adding R-19 insulation to un-insulated ceilings, and retrofitting R-19 insulated ceilings to R-38.

Wall Insulation: For existing construction, this measure involves adding R-13 insulation to un-insulated walls. This is usually accomplished by drilling holes into the building's siding and blowing in insulation material.

A.1.4 Lighting

Compact Fluorescent Lighting (CFLs): Compact fluorescent lamps are designed to replace standard incandescent lamps. They are approximately four times more efficient than incandescent light sources. Screw-in modular lamps have reusable ballasts that typically last the life of four lamps. Our analysis assumes that there are twenty four sockets that are compatible with CFL installation out of the total number of sockets/ lamps of 42 for a typical single family household. This results in an applicability factor of 66% and a current saturation of 3.8 bulbs/ household or 9.2 % of all available sockets have at least on CFL.

Super T-8 Lamps with Electronic Ballast: T-8 lamps are a smaller diameter fluorescent lamp than T-12 lamps. When paired with specially designed electronic ballasts, T-8 lamps provide more lumens per watt, resulting in energy savings. Electronic ballasts replace the standard core and coil technology in magnetic ballasts with solid-state components. This technology allows for more consistent control over ballast output and converts power to higher frequencies, causing the fluorescent lamps to operate more efficiently. For existing first generation T-8 systems, this measure is specified as an upgrade to efficiency levels associated with optimal Super T-8 lamp-ballast combinations on a replace-on-burnout basis.

A.1.5 Water Heat

Heat Pump Water Heater: (Emerging Technology) Air-to-water heat pump water heaters extract low-grade heat from the air then transfer this heat to the water by means of an immersion coil. This is the most commonly utilized residential heat pump water heater. The air-to-water heat pump unit includes a compressor, air-to-refrigerant evaporator coil, evaporator fan, water circulating pump, refrigerant-to-water condenser coil, expansion valve, and controls. Residential heat pump water heaters replace base electric units with the same tank capacities. For this study, efficiency of the base unit (measured as the Energy Factor) is specified as 0.88, whereas the efficiency of the heat pump water heater is specified as 2.9.

High Efficiency Water Heater: Higher efficiency water heater have greater insulation to reduce standby heat loss. For this study, efficiency of the base unit (measured as the Energy Factor) is specified as 0.88, whereas the efficiency of the high efficiency electric water heater is specified as 0.93.

Water Heater Blanket (Tank Wrap): Much of water heater efficiency is related to the amount of insulation surrounding the tank. For low-efficiency units, placing an additional layer of insulation around the tank saves energy by reducing the amount of heat loss due to inadequate insulation.

Solar Water Heater: Heat transfer technology that uses the sun’s energy to warm water. Solar water heaters preheat water supplied to a conventional domestic hot water heating system. The energy savings for the system depend on solar radiation, air temperatures, water temperatures at the site, and the hot water use pattern.

Low-Flow Showerhead: Many households are still equipped with showerheads using 3+ gallons per minute. Low flow showerheads can significantly reduce water heating energy for a nominal cost. Typical low-flow showerheads use 1.0-2.5 gallons per minute compared to conventional flow rate of 3.5-6.0 gallons per minute. The reduction in shower water use can substantially lower water heating energy use since showering accounts for about one-fourth of total domestic hot water energy use.

Pipe Wrap: Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. By inhibiting the flow of heat energy, thermal insulation can conserve energy by reducing heat loss or gain.

Faucet Aerators: Water faucet aerators are threaded screens that attach to existing faucets. They reduce the volume of water coming out of faucets while introducing air into the water stream. A standard non-conserving faucet aerator has a typical flow rate of 3-5 gallons per minute. A water-saving aerator can reduce the flow to 1-2 gallons per minute. The reduction in the flow rate will lower hot water use and save energy (kitchen and bathroom sinks utilize approximately 7 percent of total domestic hot water energy use).

A.1.6 Appliances

Energy Star Refrigerator: ENERGY STAR® refrigerators must exceed the stringent new July 1, 2001 minimum federal standards for refrigerator energy consumption by at least 10 percent. As specified for this study, the average efficiency improvement is 15 percent. An energy efficient refrigerator/freezer is designed by improving the various components of the cabinet and refrigeration system. These component improvements include cabinet insulation, compressor efficiency, evaporator fan efficiency, defrost controls, mullion heaters, oversized condenser coils, and improved door seals.

Refrigerator Early Replacement: For this measure we assume replacement of an older refrigerator (10 years old or more) with a new standard-efficiency refrigerator. The early replacement assumes that the same new refrigerator would have been bought, only six years later. Savings for this measure result for six years because the newer refrigerators, given the stringent efficiency standards implemented in 2001, use much less energy than older units.

High Efficiency Freezer: Stand-alone freezers include either upright or chest models. Efficient freezers should exceed standard efficiencies by 10 percent or more. As specified for this study, the average efficiency improvement is 15 percent.

Energy Star Dishwasher: ENERGY STAR® labeled dishwashers must exceed minimum federal standards for dishwasher energy consumption by at least 25 percent. Efficient dishwashers save by using both improved technology for the primary wash cycle, and by using less hot water to clean. They include more effective washing action, energy efficient motors and other advanced technology such as sensors that determine the length of the wash cycle and the temperature of the water necessary to clean the dishes. For this study, efficiency of the base unit (measured as the Energy Factor) is specified as 0.46, whereas the efficiency of the ENERGY STAR® unit is specified as 0.58.

Energy Star Clothes Washer: A standard clothes washer uses various temperatures, water levels, and cycle durations to wash clothes depending on the clothing type and size of the laundry load. A high-efficiency vertical-axis clothes washer, which eliminates the warm rinse option and utilizes a spray technology to rinse clothes, can significantly reduce washer-related energy. Such machines also utilize a spin cycle that eliminates more water from the clothes than conventional clothes washers and are generally driven by more efficient motors. A horizontal axis clothes washer utilizes a cylinder that rotates horizontally to wash, rinse, and spin the clothes. These types of washing machines can be top loading or front loading, and utilize significantly less water (hot and cold) than the standard vertical axis machines. A vertical axis machine generally fills the tub until all of the clothes are immersed in water. In contrast, the horizontal axis machine only requires about one third of the tub to be full, since the rotation of the drum around its axis forces the clothes into the water and thus can drastically reduce the total energy use for washing. These machines are also easier on clothes and use less detergent. For this study, efficiency of the base unit (measured as the Modified Energy Factor) is specified as 1.04, and we consider two efficiency levels for ENERGY STAR® units, 1.42 and 1.60, which correspond to the Tier 1 and Tier 2 efficiency levels defined by the Consortium for Energy Efficiency.

High Efficiency Clothes Dryer: High efficiency clothes dryers incorporate moisture sensors and prevent the frequency and magnitude of over-drying compared standard clothes dryers without moisture sensors.

High Efficiency Pool Pump and Motor: This measure involves the replacement of a standard-efficiency motor and low volume pump with a smaller high-efficiency motor and a new high-volume pump.

Two Speed Pool Pump: Two speed pool pumps saves energy by reducing the energy used during ongoing pool filtering operation.

A.1.7 General Measures that Effect Energy Use at the Household level

In home Display (IHD) System- A portable LED display that provides customers with instantaneous feedback on the kW demand, the last 24 kWh usage, Cost per hour and Cost per day based on current usage patterns. This unit saves energy by inducing customers to turn off appliances or lighting systems before leaving the house and encouraging customers to invest in more efficient systems or shell measures based on repeated exposure to information about the costs of maintaining comfort and lighting levels in the home. The IHD units available on the market can be used in retrofit applications to gather energy data from existing standard “spinning wheel” meters and transmit it wirelessly to the interior display or to gather the same data from Zigby or other wireless networks to collect data from digital meters. Existing evaluations of the impact of IHD’s estimate energy savings per household range from 4% to 18.2 % of household usage but this is a self selected population that may not be typical of the average of all households. Itron has used 4% savings to be conservative.

A.2 Commercial Measures

This subsection provides brief descriptions of the commercial measures included in this study.

A.2.1 Lighting

Super T-8 Lamps with Electronic Ballast: T-8 lamps are a smaller diameter fluorescent lamp than T-12 lamps. When paired with specially designed electronic ballasts, T-8 lamps provide more lumens per watt, resulting in energy savings. Electronic ballasts replace the standard core and coil technology in magnetic ballasts with solid-state components. This technology allows for more consistent control over ballast output and converts power to higher frequencies, causing the fluorescent lamps to operate more efficiently. For existing first generation T-8 systems, this measure is specified as an upgrade to efficiency levels associated with optimal Super T-8 lamp-ballast combinations on a replace-on-burnout basis.

T-5 High-Output Lighting with Electronic Ballast: Like T8 lamps, straight tube T5 lamps are available in nominal 2', 3', 4', and 5' lengths. Standard T-5 lamps have light output and efficiency comparable to T-8/electronic ballast systems. High output T-5 lamps have considerably higher light output: a 1-lamp high output T-5 cross-section can replace a 2-lamp T 8 cross-section. The 5/8" bulb diameter of the T-5 lamp lends itself to low profile luminaries well-suited for cove lighting and display case lighting. Its smaller scale allows for sleeker fluorescent indirect and direct/indirect pendants and shallower profile recessed troffer type luminaries. Because of variances in actual lamp lengths and a different socket design, the T-5 lamp cannot easily be retrofitted in existing T-12 and T-8 luminaries. Consequently, use the T-5 lamp to its best advantage in specially designed luminaries.

Induction Lamps: Inductions lamps take typically take the place of HID lamps. Their advantage is both long life and quick start, which unlike HID lamps, allows them to be turned off and on with the demand. Although induction lamps have a longer service life than other lamp technology they are also more expensive and the light intensity tends to degrade over time. They are most often used in places where the lamps are difficult to reach and replace. Metal Halide Lamps: Metal halide lamps are HID lamps, which are approximately four times more efficacious than incandescent lamps. Metal halide (MH) lamps are a form of high intensity discharge (HID) lighting with good lighting efficiency and excellent color rendition.

Pulse-Start Metal Halide Lamps: Pulse start lamps have a greater light output than standard metal halide, provide a white light and require special ballasts and fixtures for each specific lamp. The pulse start metal halide combined with new, more efficient low current crest factor ballasts using high voltage ignitors provides higher light levels initially (20% more) and significantly more maintained light over time (40% more) than today's standard metal halide.

Compact Fluorescent Lighting (CFLs): Compact fluorescent lamps are designed to replace standard incandescent lamps. They are approximately four times more efficacious than incandescent light sources. Screw-in modular lamps have reusable ballasts that typically last for four lamp lives.

High Pressure Sodium Lamps: In many situations, 400 watt mercury vapor lamps can be replaced by 250 watt high pressure sodium (HPS) lamps. HPS lamps are HID lighting and emit a golden-white or yellow light. The color rendition for HPS lamps is worse than for MV lamps, but the number of lumens per watt, although dependent on the size of the lamps, is much improved over MV lamps.

Reflectors: Optical reflectors are mirrored surfaces installed in fluorescent fixtures to direct light toward a specific area or work surface. By installing optical reflectors, four-lamp and three-lamp fluorescent fixtures can be reduced to two lamp fixtures and still meet the needed lighting levels.

Lighting Control Tune-up: This involves various measures to optimize the customer's current lighting control systems, with measures such as: relocating/tuning occupancy sensors, relocating photocells, optimizing sweep timers, repairing lighting timers, and adjust lighting schedules.

Occupancy Sensors: Occupancy sensors (infrared or ultrasonic motion detection devices) turn lights on upon entry of a person into a room, and then turn the lights off from ½ minute to 20 minutes after they have left. Occupancy sensors require proper installation and calibration. Their savings depend on the mounting type.

Continuous Dimming: (Emerging Technology): Dimming electronic ballasts can be incorporated into a daylighting strategy around the perimeter of office buildings or in areas under skylights. These systems use photocells to reduce power consumption and light output when daylight is available.

Outdoor Lighting Controls (Photocells and Timeclocks): Photocells can be used to automatically control both outdoor lamps and indoor lamps adjacent to skylights and windows. When lights do not need to be on all night, a photocell in series with a time clock provides maximum savings and eliminates the need for manual operation and seasonal time clock adjustments. Time clocks enable users to turn on and off electrical equipment at specific times during the day or week.

10% More Efficient Design (Lighting): This scenario represents a 10 percent reduction in lighting power densities and associated energy usage below current practice. This decrease would be achieved through modest design changes that focus on better optimization of fixture layout and product choices, but would not require aggressive use of controls and daylighting.

20% More Efficient Design (Lighting): (Emerging Technology) This scenario incorporates all of the savings associated with the 10% Improvement case and adds savings associated with advanced lighting controls and daylighting. This represents a 20 percent reduction in energy usage below current practice. Note that summer peak demand savings would be higher under this scenario due to the coincidence of available daylight with this period.

A.2.2 Space Cooling

Chiller Efficiency Upgrade: Centrifugal chillers are used in building types which normally use water-based cooling systems and have cooling requirements greater than 200 tons. Centrifugal chillers reject heat through a water cooled condenser or cooling tower. In general, efficiency levels for centrifugal chillers start at 0.80 kW/ton (for older units) and may go as high as 0.4 kW/ton. This measure involves installation of a high-efficiency chiller (0.51 kW per ton) versus a standard unit (0.58 kW per ton). This measure also serves in the potential analysis as a proxy for other non-centrifugal chiller systems.

Oversized Cooling Towers: Oversized cooling towers require custom manufacturing, so they cost more initially. However, oversized cooling towers save energy by providing a larger interface area between the water and air, thereby decreasing the fan horsepower required for a given tonnage. Installing oversized evaporators and condensers saves energy by reducing internal pressure losses and altering the temperature lift in the chiller. For instance, lowering condenser water entering temperature to 75 deg. F by using an oversized cooling tower can be cost-effective within five years.

VSD – Cooling Circulation Pumps: Variable speed drives installed on chilled water pumps can reduce energy use by varying the pump speed according to the building's demand for cooling. There is also a reduction in piping losses associated with this measure, which can have a major impact on the heating loads and energy use for a building. Pump speeds, however, can generally only be reduced to a minimum specified rate, because chillers and the control valves may require a minimum flow rate to operate.

VSD – Cooling Tower Fans: Energy usage in cooling tower fans can be reduced by installing electronic variable speed drives (VSDs). VSDs are a far more efficient method of regulating speed or torque than other control mechanisms. Energy required to operate a fan motor can be reduced significantly during reduced load conditions by installing a VSD.

Chiller Tune-up/Diagnostics: In addition to some of the activities conducted in a DX tune-up, an optimization of the chilled water plant can include activities such as: optimizing CW/CHW setpoints, improving chiller staging, trimming pump impellers, resetting chilled water supply temperature, and staging cooling tower fan operation.

Energy Management System: The term Energy Management System (EMS) refers to a complete building control system which usually can include controls for both lighting and HVAC systems. The HVAC control system may include on\off scheduling and warm-up routines. The complete lighting and HVAC control systems are generally integrated using a personal computer and control system software.

EMS Optimization: Energy management systems are frequently underutilized and have hundreds of minor inefficiencies throughout the system. Optimization of the existing system frequently results in substantial savings to the measures controlled by the EMS (e.g. lighting, HVAC) by minimizing waste. Improvements can include: building start-up schedule adjustments, improving integrated sequence of operations, calibration of sensors, and relocation of OA sensors.

Cool Roof: The color and material of a building structure surface will determine the amount of solar radiation absorbed by that surface. By using an appropriate reflective material to coat the roof, the roof will absorb less solar radiation and consequently reduce the cooling load.

DX Packaged System Efficiency Upgrade: A single-package A/C unit consists of a single package (or cabinet housing) containing a condensing unit, a compressor, and an indoor fan/coil. An additional benefit of package units is that there is no need for field-installed refrigerant piping, thus minimizing labor costs and the possibility of contaminating the system with dirt, metal, oxides or non-condensing gases. This measure involves installation of a TIER 2 high-efficiency unit (EER=10.9) as compared to a base case unit with EER=10.3.

Tune up/Advanced Diagnostics: The assumed tune-up includes cleaning the condenser and evaporator coils, establishing optimal refrigerant levels, and purging refrigerant loops of entrained air. The qualifying relative performance range for a tune-up is between 60 and 85 percent of the rated efficiency of the unit. Includes fresh air economizer controls providing demand control ventilation and consisting of a logic module, enthalpy sensor(s), and CO2 sensors in appropriate applications.

Low-e Windows: Low-e (short for low-emissivity) windows: These windows have thin metal coatings that permit the entry of short-wave radiation but block the exit of the majority of the long-wave thermal energy. The energy savings from these measures are due to the reduced load placed on the primary cooling equipment.

Air Handler Optimization: Optimization of a building’s air-handling system is concerned principally with the proper sizing and configuration of its HVAC units. Energy savings can result from a variety of improvements, including reduced equipment loads and better functionality of existing equipment.

Window Film: Reflective window film is an effective way to reduce solar energy gains, thus reducing mechanical cooling energy consumption. Windows affect building energy use through thermal heat transfer (U-value), solar heat gains (shading coefficient), daylighting (visible light transmittance), and air leakage.

Evaporative Pre-cooler: (Emerging Technology) Evaporative pre-cooler pre-cools outdoor air through an air-to-water heat exchanger so that the outdoor supply air is sensibly cooled and humidity is not raised. This process is designed to reduce the need for mechanical cooling by providing a cooler than ambient source of supply outdoor air. The effectiveness of this measure is highly dependent on the characteristics of the outdoor and the cooling requirements of the building.

Programmable Thermostat: Setback programmable thermostats are appropriate controls for HVAC equipment that serve spaces with regular occupied and unoccupied periods, resulting in long periods of time when heating and cooling setpoints can be adjusted.

Roof / Ceiling Insulation: Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. By inhibiting the flow of heat energy, thermal insulation can conserve energy by reducing heat loss or gain of a structure. An important characteristic of insulating materials is the thermal resistance, or R-value. The R-value of a material is the reciprocal of the time rate of heat flow through a unit of this material in a direction perpendicular to two areas of different temperatures.

Installation of Air-Side Economizers: Air-side economizers reduce the energy consumption associated with cooling by providing access to outside air – when temperatures permit – in lieu of using mechanical cooling of recirculated indoor air.

10% More Efficient Design (Cooling and Ventilation): This scenario represents a 10 percent reduction in cooling and ventilation power densities and associated energy usage below current practice. This decrease would be achieved through modest design changes that focus on better optimization of cooling and ventilation deign and product choices.

30% More Efficient Design (Cooling and Ventilation): (Emerging Technology) This scenario incorporates all of the savings associated with the 10% improvement case and adds savings associated with more advanced design practices.

A.2.3 Ventilation

Motor Efficiency Upgrade: Premium-efficiency motors use additional copper to reduce electrical losses and better magnetic materials to reduce core losses, and are generally built to more precise tolerances. Consequently, such motors are more reliable, resulting in reduced downtime and replacement costs. Premium-efficiency motors may also carry longer manufacturer’s warranties.

VFD on Motor Installation: Energy usage in HVAC systems can be reduced by installing electronic variable frequency drives (VFDs) on ventilation fans. VFDs are a far more efficient method of regulating speed or torque than throttling valves, inlet vanes and fan dampers. Energy required to operate a fan motor can be reduced as much as 85% during reduced load conditions by installing a VFD.

Installation of Automated Building Ventilation Control (via Occupancy Sensors, CO2 Sensors, Etc.): Often, usage of a building's ventilation control goes beyond what is necessary to maintain a healthy and comfortable environment. A variety of controls can save energy by limiting the use of the ventilation system to minimum amount necessary. Sensors that detect critical contaminants activate ventilations systems only when necessary. Occupancy sensors limit the operation ventilation systems to periods when the building is in use.

A.2.4 Refrigeration

Motor Efficiency Upgrade for Fans and Compressors: In addition to saving energy, premium-efficiency motors are more reliable, resulting in reduced downtime and replacement costs.

Strip Curtains: Installing strip curtains on doorways to walk-in boxes and refrigerated warehouses can produce energy savings due to decreased infiltration of outside air into the refrigerated space. Although refrigerated spaces have doors, these doors are often left open, for example during product delivery and store stocking activities.

Night Covers: Installing film or blanket type night covers on display cases can significantly reduce the infiltration of warm ambient air into the refrigerated space. This reduction in display case loads in turn reduces the electric use of the central plant, including compressors and condensers, thus saving energy. The target market for this measure is small, independently owned grocery stores and other stores that are typically closed at night and restock their shelves during the day. The target cases are vertical displays, with a single- or double-air curtain, and tub (coffin) type cases.

Evaporator Fan Controller for Medium Temperature Walk-Ins: In response to the temperature setpoint being satisfied in a medium temperature walk-in cooler, evaporator fans are cycled to maintain minimum necessary air flow, which prevents ice build-up on the evaporator coils. In conventional systems, fans run constantly whether the temperature setpoint is satisfied or not.

Variable Speed Compressor Retrofit: A variable speed compressor is a screw or reciprocating compressor whose current is modulated by a frequency inverter. A controller senses the compressor suction pressure and modulates the current and therefore the motor speed in response to changes in this pressure. When low load conditions exist, the current to the compressor motor is decreased, decreasing the compressor work done on the refrigerant.

Floating Head Pressure Controls: Floating head pressure controls allow a refrigeration system to operate under lower condensing temperature and pressure settings, where compressor operation is most efficient, working against a relatively low head pressure. The condensing temperature is allowed to float below the design setpoint of, say, 95 deg. F under lower outdoor temperatures, which in-turn lowers the condensate pressure. In a conventional system a higher fixed condensing temperature setpoint is used which results in a lowered capacity for the system, requires extra power, and may overload the compressor motor. Energy savings can be realized if the refrigeration system head pressure is allowed to float during periods of low ambient temperature, when the condensing temperature can be dramatically reduced.

Refrigeration Commissioning: Refrigeration commissioning refers to a process whereby refrigeration systems are subject to inspection on a variety of criteria to ensure efficiency. The commissioning process can involve tests that cover a system’s controls for humidity and temperature, anti-condensation, and heat recovery, among others.

Demand Defrost: Defrost of a refrigeration system is critical to its efficient operation. Demand defrost uses a pressure-sensing device to activate the defrost cycle when it detects a significant drop in pressure of the air across the refrigeration coil. Because load during defrost can be three times that of normal operation, defrosting on demand only – not when an individual operator deems it necessary – can save energy by minimizing the amount of time spent on defrosting.

Humidistat Controls: A humidistat control is a control device to turn refrigeration display case anti-sweat heaters off when ambient relative humidity is low enough that sweating will not occur. Anti-sweat heaters evaporate moisture by heating the door rails, case frame and glass of display cases. Savings result from reducing the operating hours of the anti-sweat heaters, which without a humidistat control generally run continuously. There are various types of control strategies including cycling on a fixed schedule.

A.2.5 Office Equipment

Power Management Enabling: This measure can be applied to PCs, PC monitors, and copiers. For PCs and copiers, manual enabling of the power management features is the only viable solution. For monitors, manual enabling and group enabling via network software are options.

LCD Monitors: LCDs are becoming more attractive options in terms of quality. However, because they cost five times more than a comparable CRT, until prices drop, using them purely as an energy saving measure will not be an option for most desktop users.

External Hardware Controls: Occupancy sensors have been used for years to conserve energy in office lighting applications. The application has expanded to include other office equipment as “plug-load sensors” incorporate an occupancy sensor with a relay that is able to turn equipment that is plugged into it on or off. The plug-load sensors range from devices that control a single electrical outlet or piece of equipment, to devices that control multiple outlets and can work together with other sensors.

Printer Nighttime Shutdown: The simplest action to save printer energy is to shut the machine off at night. While this recommendation is particularly important for conventional printers without power management, it is important to turn off ENERGY STAR printers as well, as they can draw up to 30-45 watts when in low power mode.

A.3 Industrial Measures

A.3.1 Cross-Cutting Electricity Efficiency Measures

Replace motors: This measure refers to the replacement of existing motors with high-efficiency motors. High-efficiency motors reduce energy losses through improved design, better materials, tighter tolerances, and improved manufacturing techniques. With proper installation, high-efficiency motors can run cooler than standard motors and can consequently have higher service factors, longer bearing life, longer insulation life, and less vibration.

Adjustable speed drives (ASDs): Adjustable speed drives better match motor speed to load and can therefore lead to significant energy savings compared to constant speed motors. Typical energy savings associated with ASDs range from 7-60%.

Motor practices: This measure refers to proper motor maintenance. The purposes of motor maintenance are to prolong motor life and to foresee a motor failure. Motor maintenance measures can be categorized as either preventive or predictive. Preventive measures, whose purpose is to prevent unexpected downtime of motors, include electrical consideration, voltage imbalance minimization, motor ventilation, alignment, and lubrication, and load consideration. The purpose of predictive motor maintenance is to observe ongoing motor temperature, vibration, and other operating data to identify when it becomes necessary to overhaul or replace a motor before failure occurs. The savings associated with ongoing motor maintenance could range from 2-30% of total motor system energy use.

Compressed air - operation and maintenance (O&M): Inadequate maintenance can lower compression efficiency and increase air leakage or pressure variability, as well as lead to increased operating temperatures, poor moisture control, and excessive contamination. Improved maintenance will reduce these problems and save energy. Proper maintenance includes regular motor lubrication, replacement of air lubricant separators, fan and pump inspection, and filter replacement.

Compressed air – controls: The objective of any control strategy is to shut off unneeded compressors or delay bringing on additional compressors until needed. Energy savings for sophisticated controls have been around 12% annually. Available controls for compressed air systems include start/stop, load/unload, throttling, multi-step, variable speed, and network controls.

Compressed air - system optimization: This is a general measure that refers to compressed air system improvements (besides sizing, controls, and maintenance) that allow it to perform at maximum energy efficiency. Such improvements could include reducing leaks, better load management, minimizing pressure drops throughout the system, reducing air inlet temperatures, and recovering waste compressor heat for other facility applications.

Compressed air – sizing: This measure refers to the proper sizing of compressors, regulators, and distribution pipes. Oversizing of compressors can result in wasted energy. By properly sizing regulators, compressed air will be saved that is otherwise wasted as excess air. Pipes must be sized correctly for optimal performance or resized to fit the current compressor system. Increasing pipe diameters typically reduces annual energy consumption by 3%.

Pumps - operation and maintenance (O&M): Inadequate maintenance can lower pump system efficiency, cause pumps to wear out more quickly, and increase costs. Better maintenance will reduce these problems and also save energy. Proper pump system maintenance includes bearing inspection and repair, bearing lubrication, replacement of worn impellers, and inspection and replacement of mechanical seals.

Pumps – controls: The objective of pump control strategies is to shut off unneeded pumps or, alternatively, to reduce pump load until needed. In addition to energy savings, proper pump control can lead to reduced maintenance costs and increased pump life.

Pumps - system optimization: This is a general measure that refers to pump system improvements (besides sizing, controls, and maintenance) that allow it to perform at maximum energy efficiency. Such improvements could include pump demand reduction, high-efficiency pumps, impeller trimming, and installing multiple pumps for variable loads.

Pumps – sizing: Pumps that are sized inappropriately result in unnecessary losses. Where peak loads can be reduced, pump size can also be reduced. Replacing oversized pumps with pumps that are properly sized can save 15-25% of the electricity consumption of a pumping system (on average for U.S. industry).

Fans - operation and maintenance (O&M): This measure refers to the improvement of general O&M practice for fans, such as tightening belts, cleaning fans, and changing filters regularly.

Fans – controls: The objective of fan control strategies is to shut off unneeded fans or, alternatively, to reduce fan load until needed. In addition to energy savings, proper fan control can lead to reduced maintenance costs and increased pump life.

Fans - system optimization: This measure refers to general strategies for optimizing fans from a systems perspective, and includes such actions as better inlet and outlet design and reduction of fan sizing, where appropriate.

Fans - improve components: This measure refers to the improvement of fan components, such as replacing standard v-belts with cog v-belts and upgrading to the most energy efficient motors possible.

Replace T-12 by T-8 and electronic ballasts: T-12 tubes consume significant amounts of electricity, and also have extremely poor efficacy, lamp life, lumen depreciation, and color rendering index. Replacing T-12 lamps with T-8 lamps (smaller diameter) approximately doubles the efficacy of the former. Electronic ballasts save 12-30% power over their magnetic predecessors; typical energy savings associated with replacing magnetic ballasts by electronic ballasts are estimated to be roughly 25%.

Metal halides/fluorescents: Metal halide lamps can replace mercury or fluorescent lamps with energy savings of 50%. For even further savings, high-intensity fluorescent lamps can be installed, which can yield 50% electricity savings over standard metal halide (high-intensity discharge) systems.

Switch off/O&M: Lighting is often left on, even when the area or room is not occupied. Sensors can be installed (see below), but savings can also be realized by training personnel to switch off lights (and other equipment) when not needed. Furthermore, adapting switching to the use pattern of the building will enable to control the lighting in those areas where it is needed (e.g. in many assembly areas a single switch controls all lighting, even when lighting would only be needed in a few zones within the assembly hall).

Controls/sensors: Lights can be shut off during non-working hours by automatic controls, such as occupancy sensors, which turn off lights when a space becomes unoccupied. Manual controls can also be used in addition to automatic controls to save additional energy in small areas.

Super T-8s: Super T-8 fluorescent systems are a further development of (standard) T-8 tubes. Super T-8s combine further improvement of the fluorescent tube (e.g. barrier coating, improved fill, enhanced phosphors) with electronic ballasts in a single system.

HVAC management system: An energy monitoring and control system supports the efficient operation of HVAC systems by monitoring, controlling, and tracking system energy consumption. Such systems continuously manage and optimize HVAC system energy consumption while also providing building engineers and energy managers with a valuable diagnostic tool for tracking energy consumption and identifying potential HVAC system problems

Cooling system improvements: The efficiency of chillers can be improved by lowering the temperature of the condenser water, thereby increasing the chilled water temperature differential. This can reduce pumping energy requirements. Another possible efficiency measure is the installation of separate high-temperature chillers for process cooling.

Duct/pipe insulation/leakage: Duct leakage can waste significant amounts of energy in HVAC systems. Measures for reducing duct leakage include installing duct insulation and performing regular duct inspection and maintenance, including ongoing leak detection and repair. Improved duct and pipe insulation can prevent excessive heat/cooling dissipation, thereby improving system energy efficiency.

Cooling circulation pumps – variable speed drives (VSDs): Variable speed drives better match motor speed to load and can therefore lead to significant energy savings compared to constant speed drives. This measure considers the installation of VSDs on cooling circulation pumps.

DX tune-up/advanced diagnostics: The tune-up includes cleaning the condenser and evaporator coils, establishing optimal refrigerant levels, and purging refrigerant loops of entrained air. The qualifying relative performance range for a tune-up is between 60 and 85 percent of the rated efficiency of the unit. Includes fresh air economizer controls providing demand control ventilation and consisting of a logic module, enthalpy sensor(s), and CO2 sensors in appropriate applications.

DX packaged system, EER=10.9, 10 tons: A single-package A/C unit consists of a single package (or cabinet housing) containing a condensing unit, a compressor, and an indoor fan/coil. An additional benefit of package units is that there is no need for field-installed refrigerant piping, thus minimizing labor costs and the possibility of contaminating the system with dirt, metal, oxides or non-condensing gases. This measure involves installation of a TIER 2 high-efficiency unit (EER=10.9) versus a standard unit (EER=10.3.

Window film: Low-emittance windows are an effective strategy for improving building insulation. Low-emittance windows can lower the heat transmitted into a building and therefore increase its insulating ability. There are two types of Low-E glass, high solar transmitting (for regions with higher winter utility bills) and low solar transmitting (for regions with higher summer utility bills).

Programmable thermostat: A programmable thermostat allows control of temperature settings of space heating and cooling, and optimizing settings based on occupancy and use of the building. This will reduce unnecessary heating and cooling outside hours of building use. It may also help in building cooling using nighttime cooling.

Chiller O&M/tune up: This measure refers to the proper inspection and maintenance of chilled water systems. This can include setting correct head pressure, maintaining correct levels of refrigerant, and selecting and running appropriate compressors for part load. Energy saving can also be achieved by cleaning the condensers and evaporators to prevent scale buildup.

Setback temperatures (weekends and off duty): Setting back building temperatures (i.e., turning building temperatures down in winter or up in summer) during periods of non-use, such as weekends or non-production times, can lead to significant savings in HVAC energy consumption.

Replace v-belts: Inventory data suggest that 4% of pumps have V-belt drives, many of which can be replaced with direct couplings to save energy. Based on assessments in several industries, the savings associated with V-belt replacement are estimated at 4%.

ENERGY STAR transformers: This measure refers to the replacement of existing transformers, where feasible, by the latest ENERGY STAR certified transformers. ENERGY STAR transformers ensure a high level of energy efficiency.

A 3.1 Sector-Specific Efficiency Measures (Electricity)

SIC 20 : Food and kindred products

Efficient refrigeration – operations: Refrigeration is an important energy user in the food industries. Operations of refrigeration systems can be improved by applying appropriate settings, opening refrigerated space as short as possible, reducing leakage by controlling doorways, making sure that refrigerated space is used optimally, optimization of defrosting cycle, as well as other small operational changes.

Optimization refrigeration: The refrigeration system can be optimized by improving the operation of the compressors, selecting cooling systems with high COP values, reducing losses in the coolant distribution system, improved insulation of the cooled space, variable speed drives on cooling system, and optimizing the temperature setting of the cooling system.

Bakery – process: Process improvements in the bakery can reduce electricity consumption through selection of energy-efficient equipment for the different processes, optimization of electric ovens, and good housekeeping (e.g. switching equipment off when not in use).

Bakery – process (mixing): About 35% of electricity in bakeries is used to mix and knead the dough. When selecting equipment electricity use should be one of the considerations as energy is the largest cost on a life-cycle basis. Today, energy use is not a criterion. High-efficiency motors, speed control and other measures may reduce electricity consumption.

SIC 23 : Apparel and other textile products

Drying (UV/IR): This measure refers to the use of direct heating methods, such as infrared dryers. Direct heating provides significant energy savings because it eliminates the inefficiency of transferring heat to air and from the air to the wet material. The energy efficiency of direct heating is about 90%.

Membranes for wastewater: Membrane technologies focus on separating the water from the contaminants using semi-permeable membranes and applied pressure differentials. Membrane filtration of wastewater is typically more energy efficient than evaporation methods, and can lead to significant reductions in facility freshwater intake.

O&M/drives spinning machines: Electric motors are the single largest electricity user in spinning mills. Optimization of motor use, proper maintenance procedures (e.g. preventative maintenance), use of new high-efficiency motors instead of re-winding, switching off equipment when not in use can help improve energy efficiency.

SIC 25: Furniture and fixtures

Air conveying systems: Pneumatic or air conveying systems are used to transport material (e.g. sawdust, fibers) in the lumber industry. Energy efficiency improvement is feasible by optimizing the lay-out of the systems, reducing leakages, reducing bends in the system, and improving compressor operations (see also with compressed air systems).

Optimize drying processes: This is a general measure, which refers to the optimization of drying systems through such actions as the use of controls, heat recovery, insulation, and good housekeeping/maintenance.

Heat pumps – drying: This measure refers to the recovery of low grade heat from the drying process via a heat pump, where cost-effective.

SIC 26: Paper and allied products

Gap forming paper machine: The gap former produces a paper of equal and uniform quality at a higher rate of speed. Coupling the former with a press section rebuild or an improvement in the drying capacity increases production capacity by as much as 30%. Energy savings from gap formers come from reduced electricity consumption per ton of product produced.

High consistency forming: In high consistency forming, the furnish (process pulp) which enters at the forming stage has more than double the consistency (3%) than normal furnish. This measure increases forming speed, and reduces dewatering and vacuum power requirements. Application of this technology is limited to specific paper grades, especially low-basis weight grades such as tissue, toweling, and newsprint. Electricity savings are estimated at 8%.

Optimization control PM: Large electric motors are used to run the paper machine. Optimization of the paper machine will reduce electricity use of the drives. Improved control strategies will improve throughput, reduce breakage and downtime, improving the energy efficiency per unit of throughput. Variable speed drives may help to optimize the energy use in water pumps in the paper machine.

SIC 27: Printing and publishing

Efficient practices printing press: Optimizing the use of the printing press by reducing production losses, switching off of the press when not in use and other improved operational practices.

Efficient printing press (fewer cylinders): New printing press designs allow the use of fewer cylinders (or rollers). This reduces the electricity use to drive the printing machine.

Light cylinders: Reducing the weight of the cylinders (or rollers) in the printing machine will reduce the power needed to drive the machine. Using lightweight materials for cylinders has been demonstrated in Europe.

SIC 28 : Chemicals and allied products

Clean room – controls: Reduced recirculation air change rates, while still meeting quality control and regulatory standards can reduce energy use, optimized chilled water systems, reduction of cleanroom exhaust, and, occasionally, a cleanroom is classified at a higher cleanliness level than is necessary for its current use, and by declassifying energy can be saved.

Clean room – new designs: When designing a clean room, energy use should be a primary consideration. Benchmarking tools and design tools are being developed to help improve the energy efficiency of new cleanroom systems. Furthermore, in the design phase the system can be optimized for improved air filtration quality and efficiency, and the use of cooling towers in lieu of water chillers.

Process controls (batch + site): This is a general measure to implement computer-based process controls, where applicable, to monitor and optimize various processes from an energy consumption perspective. In general, by monitoring key process parameters, processes can be fine tuned to minimize energy consumption while still meeting quality and productivity requirements. Control systems can also reduce the time required to perform complex tasks and can often improve product quality and consistency while optimizing process operations. This measure could include the installation of controls based on neural networks, knowledge based systems, or improved sensor technology.

Power recovery: Various processes run at elevated pressures, enabling the opportunity for power recovery from the pressure in the flue gas. The major application for power recovery in the petroleum refinery is the fluid catalytic cracker (FCC). However, power recovery can also be applied to hydrocrackers or other equipment operated at elevated pressures. A power recovery turbine or turbo expander is used to recover energy from the pressure. The recovered energy can be used to drive the FCC compressor or to generate power.

Efficient desalter: Alternative designs for desalting include multi-stage desalters and a combination of AC and DC fields. These alternative designs may lead to increased efficiency and lower energy consumption.

SIC 30 : Rubber and misc. plastics products

O&M – extruders/injection molding: Improved operation and maintenance procedures of extruders, optimization of extruder settings, optimization of the extruder screw shape, optimization of the shape/thickness of the product, and reduction of standby time.

Extruders/injection molding – multipump: The use of multiple pumps and an appropriate control system allow reduced energy use of the extruder when not working at full capacity, only using the pump(s) needed.

Direct drive extruders: Use of a direct drive, instead of a gearbox or belt, will reduce the losses by approximately 15% in extruders.

Injection molding – impulse cooling: Impulse cooling regulates the cooling water use increasing the cooling rate and reducing productivity (and downtime).

Injection molding – direct drive: Use of a direct drive, instead of a gearbox or belt, will reduce the losses by approximately 20% in injection molding machines.

SIC 32 : Stone, clay, glass, and concrete products

Efficient grinding: This is a general measure that refers to efficient grinding technologies, which can include the use of high-efficiency classifiers or separators.

Top-heating (glass): Most electric furnaces use electrodes in the batch to melt the raw materials into glass. Newer designs with top-mounted electrodes can improve and maintain product quality, and obtain a higher share of salable glass, which leads to lower energy intensities (energy per kg of glass produced).

Autoclave optimization: In various processes autoclaves are used to press materials. Multiple autoclaves are used. By synchronizing the time of the use of the individual autoclaves, energy can be reduced by re-using the output of one to operate the other autoclave.

SIC 33 : Primary metal industries

Efficient electric melting: Electric arc furnaces are used in the steel industry to melt scrap. Only one mini mill is operating in California. Multiple options are available to reduce the electricity consumption of the furnace, e.g. foamy slag, oxy-fuel injection, improved transformers, eccentric bottom tapping (EBT), as well as scrap preheating.

Near net shape casting: Near net shape casting is the direct casting of the metal into very nearly the final shape, thereby eliminating other processing steps such as hot rolling, which can lead to significant energy savings.

SIC 38 : Instruments and related products

Optimization process (M&T): This is a general measure for optimizing the efficiency of painting processes, via such actions as the use of process controls, proper maintenance, and reducing the airflow rates in paint booths.

Scheduling: Optimization of the scheduling of various pieces of equipment can reduce downtime and hence save energy. Furthermore, improved control strategies can reduce standby energy use of equipment as part of an optimized scheduling system.

Efficient curing ovens: Efficiency options for curing ovens include the optimization of oven insulation, the use of heat recovery techniques, and the use of direct heating methods, such as infrared heating, microwave heating, and ultraviolet heating.

Machinery: Many machines (e.g. metal processing) use electricity or compressed air to drive the equipment. The use of compressed air systems should be minimized and replaced by direct drive systems, because of the low efficiency of the compressed air supply. Furthermore, many machines do not use high-efficiency motors or speed controls.

SIC 36 : Electrical and electronic products

Efficient processes (welding, etc.): New more power efficient welding technology is developed. For welding robots, new servo-based systems reduce energy use. See also new transformers welding (see section 1.1).

SIC 39 : Misc. manufacturing industries

Process heating: Induction furnaces are often used for electric process heating. Improved operation and maintenance can reduce part-load operation, downtime and tap-to-tap time. Furthermore, high-frequency induction furnaces improve energy use.

Appendix B:

Documentation of SitePro Residential Runs

This appendix contains information on the key inputs used to estimate heating and cooling UEC's for eight separate weather zones in Texas. These results were then weighted to produce utility specific results for each of the nine participating utilities. The building characteristic inputs are available on request. The Weather map and descriptions of the files are presented below.

Weather Map

File Descriptions

Texas_Weather&Prototypes.xls This file is a working document that contains info on weather stations and *SitePro* building prototype definitions.

SitePro_ResidentialRuns.spr This is the database that was used for to generate the *SitePro* results. It is an Access database, but the ".spr" indicates that it is a *SitePro* Residential database. If you change the extension to "mdb" or open this using Access you will see that.

Texas_SiteProRes_Results.mdb Results and some input/setup values can be found in this database in the following tables:

Tables

- **tblLibraryIndex** Is the primary table used to set up the runs (120 of them).
- **expEndUse8760** Contains the end use 8760 results for each run. Electric results are kWh and gas results are in kBtu
- **resElec8760** Contains whole building electric 8760 results in kWh
- **resGas365** Contains whole building gas use in kBtu/day.
- **DailyData ForTexasWeatherStations** Contains highs and lows for every day for each of the weather stations that were used. I suspect you are going to need more than this though, maybe the actual weather files so you can look at the peak days.

Query

- **8760EndUseLoadShapesWithLabels** This query has some labels added to the 8760 end use data (weather and can be exported to an Excel file and contain

Prototype SetUp

Table B-1: Building Prototypes (3 were used)

Segment	LabSegment
SF	Single-Family
SM	Multi-Family (2-4 Units)
LM	Multi-Family (5+ Units)

Table B-2: Weather Stations (8 were used)

TX_CZ	CityName	Market	WeatherFile
1_NORTH	Wichita Falls	North	Wichita Falls, TX Normal
2_NCENT	Fort Worth	NCent	Fort Worth, TX Normal
3_EAST	Lufkin	East	Lufkin, TX Normal
4_FWEST	Midland	FWest	Midland, TX Normal
5_WEST	Abilene	West	Abilene, TX Normal
6_SCENT	Austin	SCen	Austin, TX Normal
7_COAST	Houston	Coast	Houston, TX Normal
8_SOUTH	Corpus Christi	South	Corpus Christi, TX Normal

Table B-3: HVAC Systems (5 were used)

Label	CoolType	HeatType	LabHVAC
EH/CAC	CAC	EF	Elec Furnace/CAC
GH CAC	CAC	GF	Gas Furnace/CAC
HP	EHP	EHP	Heat Pump (Elec.)
EH/RAC	RAC	ER	Elec Baseboard/RAC
GH/RAC	RAC	GR	Gas Room/RAC

Table B-4: Single-Family HVAC Efficiencies

Segment	System Type	HSPF	Cooling Eff (EER)	Cooling Eff (SEER)	Heating Efficiency (AFUE)
SF	SF - GH/RAC		8.8173		75.8122
SF	SF - HP	7.4864		10.4432	
SF	SF - EH/RAC		8.7842		
SF	SF - GH CAC			9.8889	79.3375
SF	SF - EH/CAC			10.0045	

Table B-5: Small Multi-Family HVAC Efficiencies

Segment	System Type	HSPF	Cooling Eff (EER)	Cooling Eff (SEER)	Heating Efficiency (AFUE)
SMF	SMF - GH/RAC		8.473		72.0223
SMF	SMF - HP	6.8154		9.4278	
SMF	SMF - EH/RAC		8.465		
SMF	SMF - GH CAC			8.9973	71.9454
SMF	SMF - EH/CAC			8.884	

Table B-6: Large Multi-Family HVAC Efficiencies

Segment	System Type	HSPF	Cooling Eff (EER)	Cooling Eff (SEER)	Heating Efficiency (AFUE)
LMF	LMF - GH/RAC		8.473		72.0223
LMF	LMF - HP	6.8154		9.4278	
LMF	LMF - EH/RAC		8.465		
LMF	LMF - GH CAC			8.9973	71.9454
LMF	LMF - EH/CAC			8.884	

Results are available for these end uses

Table B-7: End Use Results

Fuel	EndUse
Elec	ClWash
Elec	ColorTV
Elec	Cook
Elec	Cool
Elec	DHW
Elec	DishWash
Elec	Dry
Elec	Freezer
Elec	Heat
Elec	Lighting
Elec	Misc
Elec	Pool
Elec	Refrig
Elec	Spa
Gas	Cook
Gas	DHW
Gas	Dry
Gas	Heat
Gas	Misc

Appendix C:

Summary of Telephone Survey Approach

C.1 Summary of Survey Objectives, Sample Design and Weighted Results

C.1.1 Trade Ally Survey Research Objectives

The trade ally telephone surveys have been designed to gather information to support the following research objectives**:**

1. Collect data on the shares of different types of lighting and HVAC systems being installed in the residential and commercial markets in Texas.

2. Collect data on trade ally estimates of the saturation of different types of equipment for use in estimating the remaining potential for savings from the installation of more efficient equipment.

3. Collect data on trade ally forecasts of the types of equipment they plan to sell in the near future and how these forecasts are affected by new equipment standards for lighting and HVAC systems.

C.1.2 Nonresidential Survey Research Objectives

The nonresidential telephone survey has been designed to gather information to support the following research objectives**:**

1. Determine the baseline saturation and fuel shares for the most prevalent types of HVAC and lighting systems in Texas by commercial building type.

2. Determine the saturation for key energy efficiency measures and types of lamp/ballast lighting systems and the saturation and efficiency levels of prevalent heating and cooling systems.

3. Determine the range of typical electricity prices paid by owners of commercial dwellings and level of customer awareness of, and previous participation in, utility energy efficiency programs.

C.1.3 Nonresidential Sample Design

Nonresidential Sample Frame

A summary table containing the number of businesses within 15 Full-Time Employees (FTE) categories by 4-digit SIC code was pulled from Dunn& Bradstreet for the zip codes including in the study. This summary table was then grouped into the 10 business type categories shown in the table below. Information from the latest EIA tables of estimated energy use per employee for each of the SIC codes was then used to estimate energy use by building type and number of employees.

Table C-1 below summarizes the results of this estimation process. It presents the estimated energy use (in GWh) by building type for each of the population bins for commercial sector customers residing in the seven Texas utility service areas.

Table C-1: Summary of Population GWh by FTE and Business Type

	Employees														
Business Type	**1**	**2-4**	**5-9**	**10-24**	**25 - 49**	**50 - 99**	**100 - 249**	**250 - 499**	**500 - 999**	**1,000 - 2,499**	**2,500 - 4,999**	**5,000 - 9,999**	**10,000 - 14,999**	**15,000 - 19,999**	**20,000+**
College	36	72	68	131	115	171	379	262	575	369	359	144	0	0	0
Food Store	176	2,897	2,165	1,716	1,028	2,184	5,169	912	263	246	0	0	0	0	0
Hospital/Health Care	13	163	109	254	327	576	857	460	612	876	204	245	0	0	0
Hotel/Motel	40	473	306	1,069	858	634	1,058	756	581	271	0	0	0	0	0
Miscellaneous	934	2,579	1,594	1,984	1,412	1,235	1,310	811	549	495	187	125	0	0	0
Office	754	3,743	2,123	2,858	2,065	2,002	2,307	1,151	992	960	620	392	131	0	174
Restaurant	78	517	746	2,872	3,290	2,713	1,542	112	100	93	0	0	0	0	0
Retail	600	2,651	1,588	2,233	1,553	1,091	3,100	1,450	411	186	0	133	0	0	0
Primary and Secondary Schools	38	50	158	399	667	2,114	1,768	273	129	132	40	81	0	0	0
Warehouses	118	913	633	1,075	772	693	767	350	269	84	90	0	0	0	0

Nonresidential Sample Stratification

For this study, building type and customer size are used as the primary sample stratification variables. To develop building type strata, Itron utilized 4-digit SIC code to map customer sites to the following 10 general building types;

1. College
2. Food Store
3. Hospital/Health Care
4. Hotel/Motel
5. Miscellaneous
6. Office
7. Restaurant
8. Retail
9. Primary and Secondary Schools

10. Warehouses

Customer size was developed by roughly splitting the total energy use (GWh), per business type into thirds (i.e. Small, Medium, and Large). Table C-2 below displays the final size categories and their energy use share.

Table C-2: Energy Use (GWh) by Customer Size and Business Type

	Total GWh				Percent of GWh			
Business Type	Small	Medium	Large	Total	Small	Medium	Large	Total
College	972	837	872	2,681	36%	31%	33%	100%
Food Store	5,238	4,928	6,590	16,756	31%	29%	39%	100%
Hospital/Health Care	1,442	1,317	1,938	4,697	31%	28%	41%	100%
Hotel/Motel	1,889	2,549	1,609	6,047	31%	42%	27%	100%
Miscellaneous	5,107	4,630	3,476	13,214	39%	35%	26%	100%
Office	6,621	6,925	6,727	20,272	33%	34%	33%	100%
Restaurant	4,214	3,290	4,560	12,064	35%	27%	38%	100%
Retail	4,839	4,876	5,280	14,995	32%	33%	35%	100%
Primary and Secondary Schools	1,312	2,114	2,423	5,849	22%	36%	41%	100%
Warehouses	1,665	1,847	2,254	5,766	29%	32%	39%	100%
Total	33,298	33,315	35,728	102,341	33%	33%	35%	100%

Table C-3 below presents the number of Full-Time Employees (FTEs) at the site that create each size category.

Table C-3: Number of Full-Time Employees at the Site by Customer Size and Business Type

Business Type	Small	Medium	Large
College	<250	250-999	>999
Food Store	<10	10-99	>99
Hospital/Health Care	<100	100-499	>499
Hotel/Motel	<25	25-249	>249
Miscellaneous	<10	10-99	>99
Office	<10	10-99	>99
Restaurant	<25	25-49	>49
Retail	<10	10-99	>99
Schools (K-12)	<50	50-99	>99
Warehouses	<10	10-49	>49

Nonresidential Sample Allocation Strategy

Having established the building type and customer size stratifications described above, the next step was to choose and implement a strategy to appropriately allocate the 500 survey points across those strata. For this study, we selected the proportional allocation method, with a minimum total sample of 30 for each business type. Proportional allocation is a relatively straightforward exercise where sample quotas are allocated across strata proportionally to some property, in this case annual kWh. The formula for proportional allocation according to annual kWh is presented below.

$$n_h = \frac{N * c_h}{C}$$

where:

n_h = Sample allocated to stratum h
N = Total planned completes
c_h = Annual kWh total for population stratum h
C = Annual kWh for population

Nonresidential Sample Design

Implementing the sample stratification and allocation approaches described above yields the target distribution of the 500 commercial on-site surveys shown below in Table C-4

Table C-4: Proposed Distribution of Nonresidential Surveys by Business Type and Size

Business Type	Small	Medium	Large	Total
College	11	9	10	30
Food Store	24	22	30	76
Hospital/Health Care	9	9	12	30
Hotel/Motel	9	13	8	30
Miscellaneous	23	21	16	60
Office	30	31	30	91
Restaurant	19	15	21	55
Retail	22	22	24	68
Schools (K-12)	7	11	12	30
Warehouses	9	9	12	30
Total	**163**	**162**	**175**	**500**

C.1.4 Trade Allies Sample Design

The trade allies that have been targeted for this study are lighting and HVAC systems contractors and distributors. For the purposes of the surveys, market segments and market actors have been defined. The market segments are air conditioners and lighting; the market actors are distributors and contractors. Table C-5 presents the proposed survey quotas for the targeted trade allies, divided up by market segment and actor. The table also shows the SIC codes associated with the four market segments and actors. The aim of the study is to complete a total of 90 surveys, with 45 surveys to be conducted in each market segment.

Table C-5: Survey Quotas by Market Segment and Actor

Market Actors	SIC Codes	Total
HVAC Distributors	507500; 50750100; 50750101; 50750105; 50750106; 50750109; 507502	15
HVAC Contractors	171100; 17110100; 17110103; 17110400; 17110401; 17110404; 17110405	30
Lighting Distributors	50630000; 50630200; 50630205; 50630400; 50630401 through 50630404	15
Lighting Contractors	17310000; 17319903; 17319904	30
	Total	90

Trade Ally Sample Frame

Table C-6 is a summary of population data obtained from Dun and Bradstreet. The table shows the number of businesses and total revenues or dollar sales for the four market segments and actors sorted by Full-Time Employee (FTE) segments for all of the Texas utilities participating in this study. Business information about the firms was obtained from Dun and Bradstreet using the SIC codes listed in Table C-5.

Table C-6: Summary of Trade Ally Population

Employees at Site	**Air Conditioner**				**Lighting**			
	Distributors		**Contractors**		**Distributors**		**Contractors**	
	Number of Businesses	**Total Sales (MM)**	**Number of Businesses**	**Total Sales (MM)**	**Number of Businesses**	**Total Sales (MM)**	**Number of Businesses**	**Total Sales (MM)**
5,000 - 9,999			1	709.5			1	709.5
1,000 - 2,499							2	250.0
500 - 999			7	469.1	1	1,471.0	6	432.6
250 - 499	1	N/A	9	490.3	5	276.4	15	291.1
100 - 249	12	826.6	45	746.7	18	1,144.8	63	1,003.3
50 - 99	13	122.0	101	726.0	**27**	**688.9**	**148**	**1,776.9**
25 - 49	**37**	**214.6**	**221**	**1,266.3**	**54**	**955.9**	**237**	**1,067.4**
24-10	**136**	**808.1**	**656**	**1,318.0**	226	473.0	740	2,553.9
9-5	206	245.0	1,046	1,596.9	255	166.7	792	355.9
4-2	362	112.7	3,127	454.6	469	138.9	2,162	324.5
1	84	12.1	2,827	521.7	118	15.5	1,916	104.4
unknown	21	24.6	46	526.3	38	150.0	65	181.1
Total	872	2,365.7	8,086	8,825.4	1,211	5,481.1	6,147	9,050.6

Trade Ally Sample Stratification

For this study, market segment, market actor, and business size are used as the primary sample stratification variables. Three business size categories will be used: Large, Medium, and Small. Business size was determined by splitting the total sales (MM) per market segment roughly into thirds. The shaded cells in Table C-6 display the boundaries for these size categories.

Table C-7 displays the estimated percentage of sales represented by each of the three employee bins; Large, Medium, and Small, for this survey of firms doing business in the sponsor’s markets.

Table C-7: Percentage of Sales by Business Size, Market Segment, and Market Actor

Size	**Air Conditioner**		**Lighting**	
	Distributors	**Contractors**	**Distributors**	**Contractors**
Large	40%	38%	53%	30%
Medium	43%	31%	30%	32%
Small	17%	31%	17%	38%

Trade Ally Sample Allocation

Table C-8 presents the proposed sample allocation by business size, market segment, and market using the information above to weight the survey proportions by sales revenue and size of business actor.

Table C-8: Proposed Distribution of Surveys by Business Size, Market Segment, and Market Actor

Size	Air Conditioner		Lighting	
	Distributors	**Contractors**	**Distributors**	**Contractors**
Large	6	10	5	10
Medium	7	10	7	10
Small	2	10	3	10
Total	**15**	**30**	**15**	**30**

C.2 Preliminary Results Nonresidential End-User Survey

C.2.1 Nonresidential End-User Survey Weights

The following weights in Table C-9 were used to scale our results back up to replicate the distribution of energy use of the nonresidential population. This weight was calculated as the ratio of the populations energy use to the number surveyed for each of the 30 business type/size bins.

Table C-9: Nonresidential Survey Weights

Business Type	Small	Medium	Large
College	1.3%	0.9%	2.2%
Food Store	4.2%	3.3%	6.3%
Hospital/Health Care	2.4%	2.2%	2.5%
Hotel/Motel	3.2%	2.8%	2.7%
Miscellaneous	3.2%	3.4%	3.3%
Office	6.7%	4.2%	3.4%
Restaurant	4.9%	4.2%	3.3%
Retail	4.6%	3.2%	4.0%
Schools (K-12)	2.9%	2.9%	3.1%
Warehouses	3.2%	2.8%	2.6%

C.2.2 Nonresidential End-User Final Survey Disposition

Table C-10 shows the number of building owners that responded to the nonresidential survey.

Table C-10: Final Distribution of the Nonresidential End-User Survey by Business Type and Size

Business Type	Small	Medium	Large	Total
College	11	14	6	31
Food Store	19	23	16	58
Hospital/Health Care	9	9	12	30
Hotel/Motel	9	14	9	32
Miscellaneous	24	21	16	61
Office	15	25	30	70
Restaurant	13	12	21	46
Retail	16	23	20	59
Schools (K-12)	7	11	12	30
Warehouses	8	10	13	31
Total	**131**	**162**	**155**	**448**

Appendix D:

List of Interim Deliverables

1. Summary of Kick off meeting and data request to Utilities (June 13, 2008)
2. Final Energy Efficiency measure list in excel sheet (July 15, 2008)

3a. Final Survey Instrument for Nonresidential End Users Survey in Texas Survey Design, (August 8, 2008)

3b. Final Survey Instruments for Trade Ally Surveys in Texas (August 28, 2008)

4. Review of Trends in Reported Energy and Peak Savings for the Texas Distribution Utilities 2001–2007 (Deliverable 4, provided on September 5, 2008)
5. Estimates of Baseline Electricity Sales By Sector and Building Type for Each of the Investor Owned Transmission and Distribution Service Providers in Texas (Deliverable 5 provided on August 27, 2008)
6. Draft Estimates of the Technical and Economic Potential to Save Electricity in Texas (October 14th, 2008)
7. Overview of interim deliverable-Achievable Savings memo (October 30, 2008)

Appendix E:

Comparison of Target Energy Savings Goals to Achievable Savings Forecasts using Two Alternative Conversion Methods

Figures E-1 and E-2 compare the energy savings targets derived using the current method of converting peak to energy savings (used by the Texas utilities) with the high and base forecasts of achievable savings by service area. These charts show that in all cases the high achievable savings target exceeds the savings target and in most cases the low achievable savings forecast also exceeds the savings target. These charts show that meeting the energy savings targets using the 0.20 capacity factor will be much easier than meeting the peak saving goals discussed in the main report.

Figure E-1: Energy Savings Targets for the Larger Investor Owned Utilities (MWH/yr)

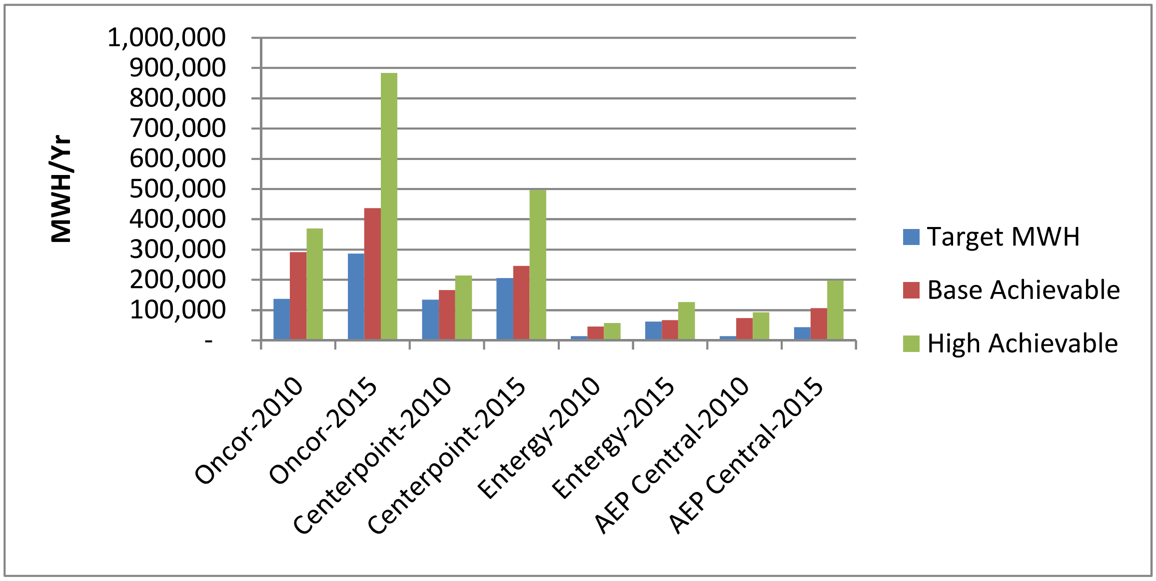
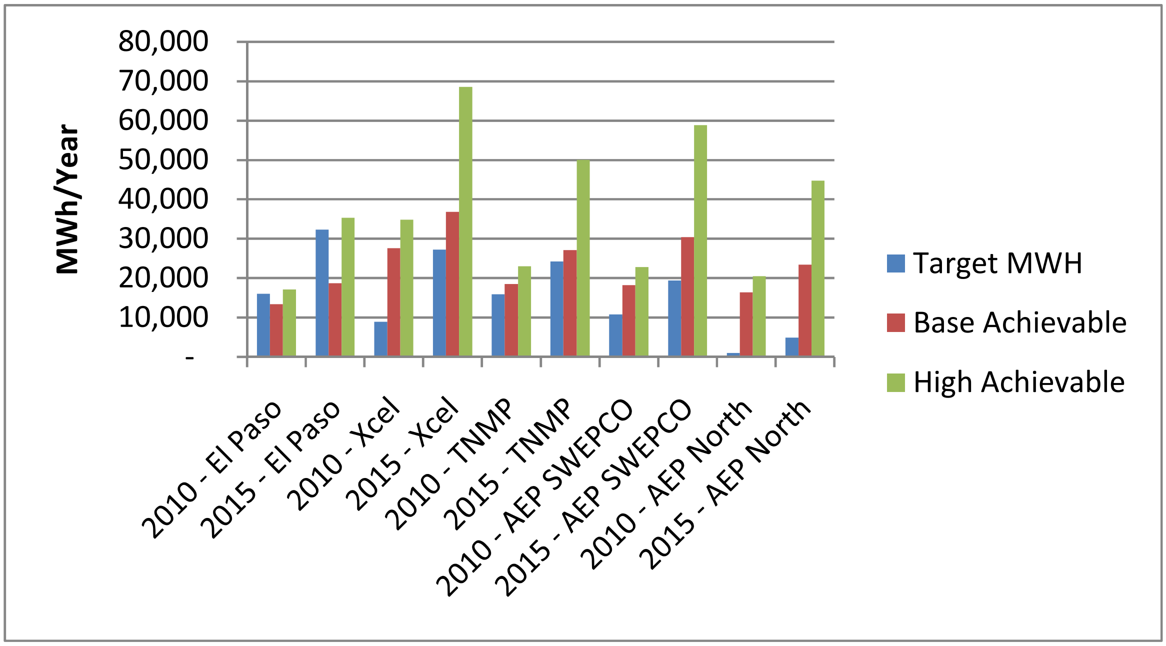


Figure E-2: Energy Savings Targets for the Smaller Investor Owned Utilities (MWH/yr)



The actual values used to create these charts are reproduced in Table E-1 below.

Table E-1: Comparison of Achievable Forecasts to Incremental Energy Savings Targets

Utility	30% of Inc Growth in 2010			50% of Inc Growth in 2015		
Utility	**Savings Target MWH**	**Base Achievable MWH**	**High Achievable MWH**	**Savings Target MWH**	**Base Achievable MWH**	**High Achievable MWH**
AEP Central	13,508	73,411	92,516	43,235	106,005	198,290
AEP North	1,025	16,393	20,483	4,857	23,450	44,773
AEP SWEPCO	10,822	18,186	22,836	19,461	30,448	58,826
Centerpoint	135,182	166,217	214,572	206,510	245,573	495,985
El Paso	16,067	13,448	17,128	32,307	18,708	35,347
Entergy	13,725	45,616	57,204	62,045	67,036	126,626
Oncor	136,868	291,404	369,815	286,807	436,501	883,836
TNMP	15,940	18,489	23,069	24,206	27,089	50,072
Xcel	8,920	27,590	34,826	27,208	36,841	68,633
Statewide	352,058	670,753	852,448	706,636	991,652	1,962,388

Low conversion factor= 1.752*MW=MWh

Appendix F:

Results from Commercial End Use Surveys

These detailed results for four surveys have been compiled into a separate electronic appendix. These include:

- Commercial End-user Survey
- Lighting Distributor and Contractor Survey
- HVAC Distributor Survey
- HVAC Contractor Survey

Appendix G:

Detailed Achievable Savings Forecasts By Utility Service Areas and Energy Efficiency Supply Curves

---

This appendix was provided electronically to the PUCT and participating utilities. See Guide to Electronic Appendices under separate cover.

Appendix H:

Energy Efficiency Potential Model - Input Data

This appendix was provided electronically to the PUCT and participating utilities. See Guide to Electronic Appendices under separate cover.

Appendix I:

Non-Additive Technical Potential – Measure Level Results

This appendix was provided electronically to the PUCT and participating utilities. See Guide to Electronic Appendices under separate cover.