AmerenUE Demand Side Management (DSM) Market Potential Study Volume 1: Executive Summary

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EXECUTIVE SUMMARY

AmerenUE engaged a team led by Global Energy Partners, LLC (Global) to perform a Demand Side Management (DSM) Market Potential Study to assess the various categories of electrical energy efficiency and demand response potential in the residential, commercial, and industrial sectors for the AmerenUE service area from 2009 to 2030. The study used updated forecasts of baseline energy use estimates based on the latest information on federal, state, and local codes and standards for improving energy efficiency.

AmerenUE will use the results of this study in its integrated resource planning process to analyze various levels of energy savings and peak demand reductions attributable to both energy efficiency and demand response initiatives at various levels of implementation cost.

This executive summary presents high-level results from this study as well as a preview of selected results from the four-volume report.

Background

The Missouri Rules of the Department of Economic Development (4 CSR 240-22) require that electric utilities in Missouri prepare an Integrated Resource Plan (IRP) that "[c]onsider[s] and analyze[s] demand-side efficiency and energy management measures on an equivalent basis with supply-side alternatives in the resource planning process." (4 CSR 240-22.010(2)(A)) Section 4 CSR 240-22.050 prescribes the elements of the demand-side analysis, including reporting requirements. A copy of the Missouri rules governing electric utility resource planning is available on the Missouri Secretary of State's website[1].

In 2009, AmerenUE launched a portfolio of such DSM programs on a substantially larger scale than any related efforts the company has initiated in the past. These programs were analyzed and developed in 2008 drawing upon best available secondary data sources. This DSM Market Potential Study updates the previous analysis using primary market data and more detailed and comprehensive analyses.

The key objectives for this study were to:

- Assess and understand technical, economic, achievable and naturally occurring potential for all customer segments in the AmerenUE service area from 2009 to 2030.
- Analyze savings at various levels of cost.
- Conduct primary market research to collect electricity end-use data, customer demographics and psychographics.
- Understand how customers in the AmerenUE service territory make decisions related to their electricity use and energy efficiency investment decisions.
- Develop several scenarios for assessing DSM potential.
- Clearly communicate the DSM Potential in an objective way that is useful for AmerenUE senior management, AmerenUE stakeholders and AmerenUE DSM and IRP staff.

[1] Rules of Department of Economic Development Division 240—Public Service Commission Chapter 22—Electric Utility Resource Planning (4 CSR 240-22.010) – http://sos.mo.gov/adrules/csr/current/4csr/4c240-22.pdf

OVERALL CONCLUSIONS

This study has enlightened AmerenUE about its customer base and the potential for energy savings and peak demand reductions that are possible through energy-efficiency (EE) and demand response (DR) programs. The key highlights are as follow:

- There is more opportunity for program savings than was estimated using secondary data. Achievable potential is higher than what was concluded in the AmerenUE 2008 IRP.
- Concurrent with higher opportunities, budgets to harvest those opportunities reach an annual spend range of $100 million to $200 million by 2015. This range corresponds to 4% and 8% of AmerenUE revenues, a spending level which exceeds nearly all electric utilities in the nation.
- A comprehensive view of measures yielded higher economic potential. The study considered hundreds of measures and there are considerable savings to be had.
- AmerenUE customers are different. They express less interest in DSM investments and they do not all consider AmerenUE to be their “trusted energy advisor” at this time.

DEFINITIONS

Before launching into the discussion of results, a few key terms are defined:

- **Technical potential** is a theoretical construct that assumes all feasible measures are adopted by customers, regardless of cost or customer preferences.
- **Economic potential** is also a theoretical construct that assumes all ***cost-effective*** measures are adopted by customers, regardless of customer preferences.
- **Maximum achievable potential (MAP)** takes into account expected program participation, based on customer preferences resulting from ideal implementation conditions. MAP establishes a maximum target for the EE and DR savings that a utility can hope to achieve through its EE and DR programs and involves incentives that represent a substantial portion of the incremental cost combined with high administrative and marketing costs. It is commonly-accepted in the industry that MAP is considered the hypothetical upper-boundary of achievable savings potential simply because it presumes conditions that are ideal and not typically observed in real-world experience.
- **Realistic achievable potential (RAP)** represents what is considered to be realistic estimates of EE and DR potential based on realistic parameters associated with DR and EE program implementation (i.e., limited budgets, customer acceptance barriers, etc.). RAP is of most interest for this study since it represents the mid-point of achievable potential and corresponds to best practices that are attainable since the estimates are tied to known program experience from around the country.
- **Business as usual (BAU)** represents the existing AmerenUE DSM plan from the 2008 IRP and the associated impacts and costs projected into the future. For this analysis, impacts without alteration were included in the savings and cost-effectiveness assessments to represent a benchmark of what is anticipated under current practices.[2]
- **Baseline forecast** is a reference end-use forecast developed specifically for this study. This estimates what would happen in the absence of any DSM programs, and includes naturally occurring energy efficiency and any codes and standards that were in place as of June 30, 2009. It is the metric against which savings are measured.

[2] Note that it was necessary in this assessment to project savings and costs for the BAU for three additional years (2028-2030) since the IRP assessment only went as far as 2027. Savings for those three years were extended without additional growth. Costs for those three years were extended reflecting growth only due to inflation.

KEY FINDINGS

The key findings from this study encompass the potential savings from EE and DR programs, supply curves for EE and DR programs, and scenario analyses for EE and DR programs. Each set of results is summarized below. Details are presented in Volumes 3 and 4.

Energy Efficiency Potential

Realistic achievable potential in 2030 is 3,165 GWh, which represents 7.3% of total forecasted baseline usage for that year. This represents 25% of technical potential and 44% of economic potential.

- MAP in 2030 is 4,758 GWh, about 11% of the total forecasted sales in 2030. This represents more than a third of technical potential and nearly two-thirds of economic potential.
- BAU in 2030 is 2,740 GWh, 6.3% of total forecasted usage in 2030.

Table 1 and Figure 1 present estimates for all five types of potential for selected years.

Figure 2 presents forecasts of electricity use for each of the five types of potential, as well as the baseline forecast and recent historical sales. By 2030:

- Electricity use in the baseline forecast has increased by 4,432 GWh, an increase of 11.2%.
- RAP offsets growth in the baseline forecast by almost three-fourths.
- MAP more than offsets growth in the baseline forecast.
- Economic potential brings usage down to the level it was in 2005.

Table 1 Summary of Energy Efficiency Potential

	2009	2015	2020	2025	2030
Baseline Electricity Forecast (GWh)	38,839	39,057	40,248	41,899	43,181
Energy Savings (GWh)					
Technical Potential	3,434	9,115	11,098	12,296	12,696
Economic Potential	1,895	4,392	5,475	6,657	7,181
Maximum Achievable Potential	13	1,950	3,943	4,655	4,758
Realistic Achievable Potential	12	1,316	2,627	3,098	3,165
Business as Usual	264	1,399	2,184	2,596	2,740
Energy Savings as % of Baseline					
Technical Potential	8.8%	23.3%	27.6%	29.3%	29.4%
Economic Potential	4.9%	11.2%	13.6%	15.9%	16.6%
Maximum Achievable Potential	0.0%	5.0%	9.8%	11.1%	11.0%
Realistic Achievable Potential	0.0%	3.4%	6.5%	7.4%	7.3%
Business as Usual	0.7%	3.6%	5.4%	6.2%	6.3%

Figure 1 Summary of Energy Efficiency Potential (Savings as % of Baseline)

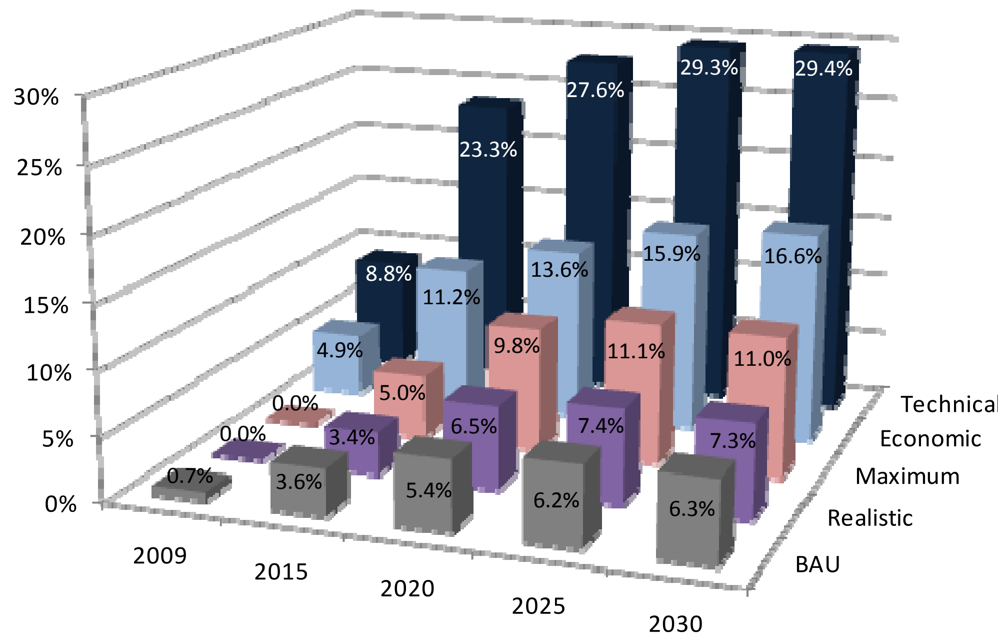
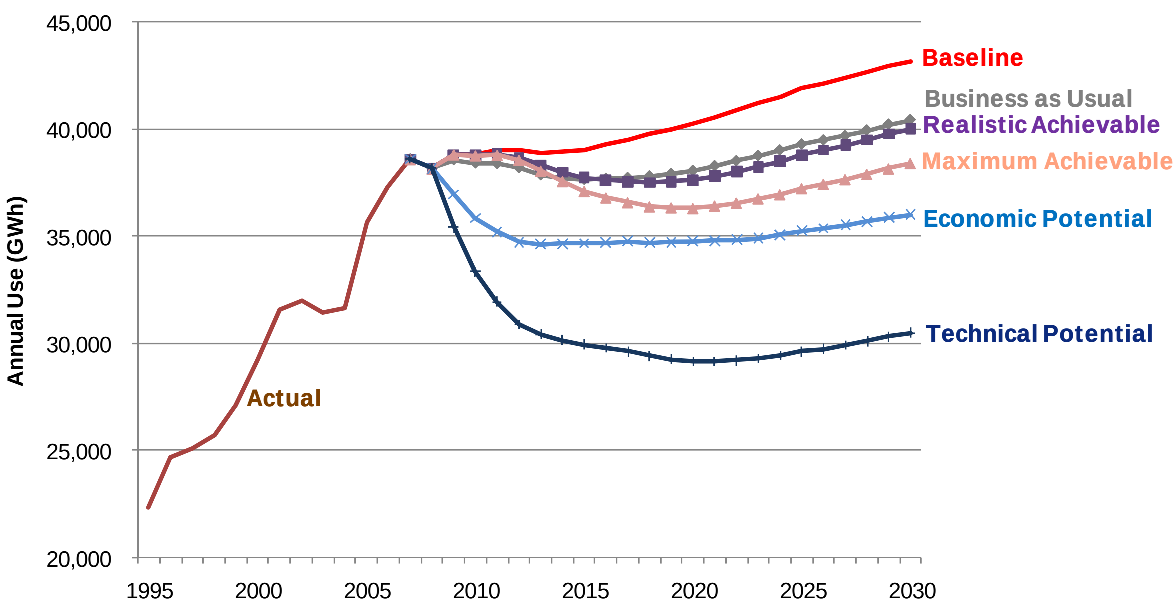


Figure 2 Forecast Summary of Energy Efficiency Potential



In addition to energy savings (GWh), energy efficiency programs also create savings in coincident peak demand (MW). Table 3 presents peak demand savings from EE programs for all five types of potential. The savings are substantial because many of the EE savings result from measures related to air conditioning across all sectors, C&I lighting and motors, all of which have high usage during peak periods. These EE peak demand savings are combined with DR peak demand savings in the following discussion.

Table 2 Summary of Peak Demand Savings from Energy Efficiency Programs

	2009	2015	2020	2025	2030
Baseline Peak Demand Forecast (MW)	**7,642**	**8,003**	**8,356**	**8,752**	**9,127**
Peak Demand Savings (MW)					
Technical Potential	837	2,342	2,932	3,377	3,511
Economic Potential	454	1,166	1,444	1,715	1,846
Maximum Achievable Potential	4	563	1,072	1,269	1,253
Realistic Achievable Potential	4	381	716	846	834
Business as Usual	34	173	271	331	352
Peak Demand Savings as % of Baseline					
Technical Potential	11.0%	29.3%	35.1%	38.6%	38.5%
Economic Potential	5.9%	14.6%	17.3%	19.6%	20.2%
Maximum Achievable Potential	0.1%	7.0%	12.8%	14.5%	13.7%
Realistic Achievable Potential	0.0%	4.8%	8.6%	9.7%	9.1%
Business as Usual	0.4%	2.2%	3.2%	3.8%	3.9%

Demand Response Potential

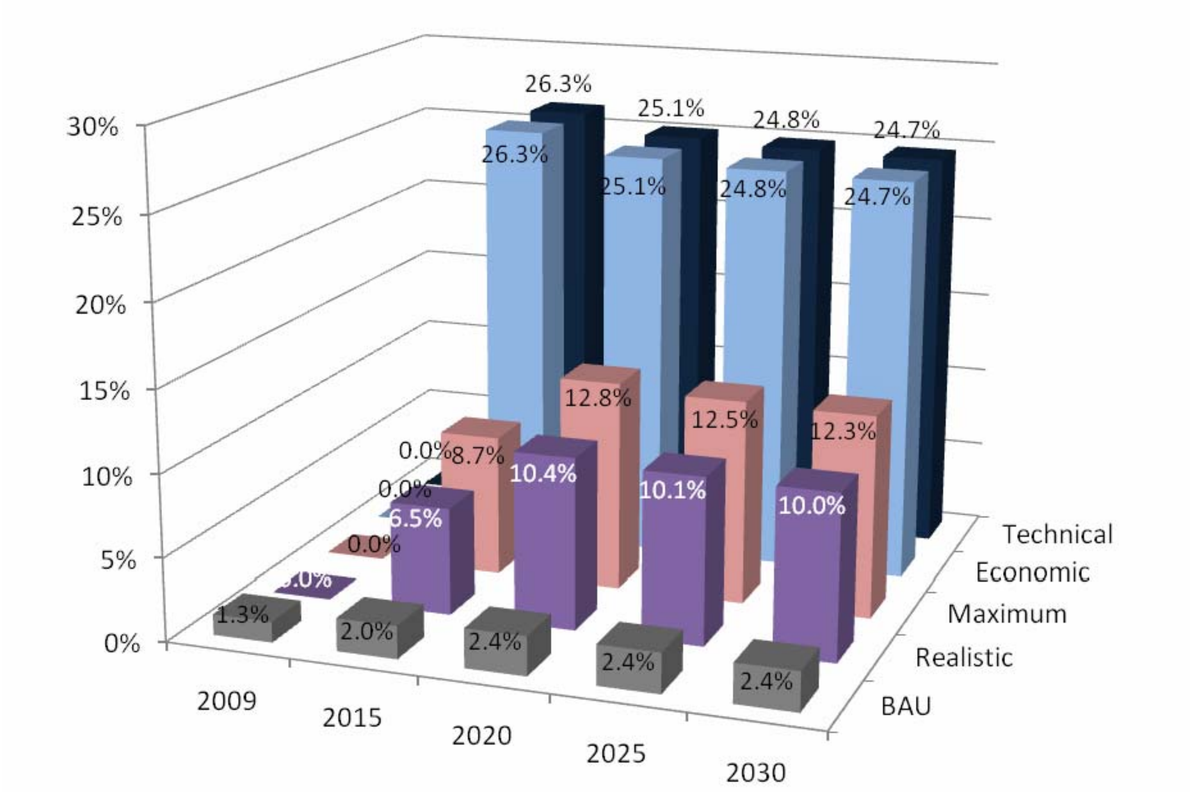
By 2030, achievable savings from demand-response programs are in the range of 914 to 1,126 MW. This represents between 10 and 12% of peak demand in 2030.

Table 3 displays the different levels of potential both as MW/year and as a percentage of baseline forecast. Figure 3 presents the savings as a percentage of coincident peak demand in selected years.

Table 3 Summary of Demand Response Potential

	2009	2015	2020	2025	2030
Baseline Peak Demand Forecast (MW)	**7,642**	**8,003**	**8,356**	**8,752**	**9,127**
Peak Demand Savings (MW)					
Technical Potential	2	2,102	2,098	2,173	2,254
Economic Potential	2	2,102	2,098	2,173	2,254
Maximum Achievable Potential	2	694	1,072	1,090	1,126
Realistic Achievable Potential	2	520	870	885	914
Business as Usual	97	160	199	213	219
Peak Savings as % of Baseline					
Technical Potential	0.0%	26.3%	25.1%	24.8%	24.7%
Economic Potential	0.0%	26.3%	25.1%	24.8%	24.7%
Maximum Achievable Potential	0.0%	8.7%	12.8%	12.5%	12.3%
Realistic Achievable Potential	0.0%	6.5%	10.4%	10.1%	10.0%
Business as Usual	1.3%	2.0%	2.4%	2.4%	2.4%

Figure 3 Summary of Demand Response Potential (Savings as % of Baseline)



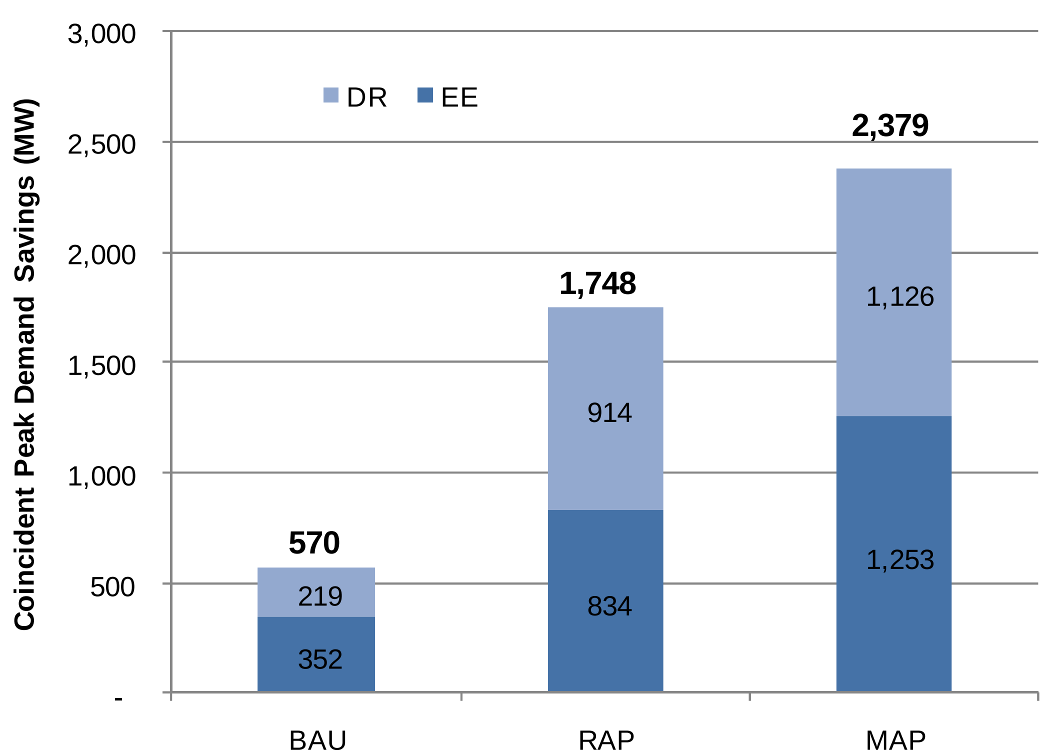
Combined Peak Demand Savings

In addition to peak-demand savings from demand response programs, the energy efficiency programs also yield savings. Throughout the forecast period, peak demand savings from EE programs for RAP and MAP are about the same as the savings from DR programs. However, in contrast to DR programs, the peak-demand savings from EE programs are permanent and non-dispatchable. Together, these savings are substantial and could potentially eliminate the need for new capacity over the next 20 years. Table 4 and Figure 4 present these results.

Table 4 Summary of Peak Demand Savings from EE and DR

	2009	2015	2020	2025	2030
Baseline Peak Demand Forecast (MW)	**7,642**	**8,003**	**8,356**	**8,752**	**9,127**
EE Peak Demand Savings (MW)					
Maximum Achievable Potential	4	563	1,072	1,269	1,253
Realistic Achievable Potential	4	381	716	846	834
Business as Usual	34	173	271	331	352
DR Peak Demand Savings (MW)					
Maximum Achievable Potential	2	694	1,072	1,090	1,126
Realistic Achievable Potential	2	520	870	885	914
Business as Usual	97	160	199	213	219
Total Peak Demand Savings (MW)					
Maximum Achievable Potential	5	1,257	2,144	2,359	2,379
Realistic Achievable Potential	5	901	1,586	1,731	1,748
Business as Usual	131	333	470	544	570
Peak Savings as % of Baseline					
Maximum Achievable Potential	0.1%	15.7%	25.7%	27.0%	26.1%
Realistic Achievable Potential	0.1%	11.3%	19.0%	19.8%	19.2%
Business as Usual	1.7%	4.2%	5.6%	6.2%	6.2%

Figure 4 Combined Peak Demand Savings from DR and EE Programs in 2030



Cost-Effectiveness Analysis

The EE and DR programs were assessed for cost-effectiveness drawing upon the California Standard Practice protocol for DSM economic assessment. For the purposes of this study, four economic test perspectives from the protocol were applied. Each is briefly defined below:

- **The Total Resource Cost (TRC**) test measures benefits and costs from the perspective of the utility and society as a whole.
- **The Utility Cost (UC)** test measures the costs and benefits from the perspective of the utility administering the program.
- **The Ratepayer Impact Measure (RIM**) test measures the difference between the change in total revenues paid to a utility and the change in total costs to a utility resulting from the EE and DR programs.
- The **Participant (Part)** test measures the benefits and costs from the perspective of program participants as a whole.

The cost-effectiveness analysis was performed at an aggregate level, representing the potential effects of each individual EE and DR program in the portfolio.

A spreadsheet model was used as the primary tool for conducting AmerenUE's cost-effectiveness assessment.[3] Table 5 presents the results of the cost-effectiveness analysis.

Table 5 TRC Cost-Effectiveness Results

Program	Total Resource Cost (TRC)			
	Lifetime Benefits (Million$)	Lifetime Costs (Million $)	Net Benefits (Million $)	B/C Ratio
Energy Efficiency Programs				
Maximum Achievable Potential (MAP)	$4,599	$2,921	$1,678	1.57
Realistic Achievable Potential (RAP)	$3,072	$1,856	$1,217	1.66
Business as Usual (BAU)				1.95
Demand Response Programs				
Maximum Achievable Potential (MAP)	$1,124	$514	$610	2.19
Realistic Achievable Potential (RAP)	$898	$406	$492	2.21
Business as Usual (BAU)				1.68

Important insights can also be drawn by looking at the levelized cost of achieving the projected savings. Table 6 presents the estimated levelized costs for the various EE and DR program portfolios.

[3] Global uses its own in-house cost-effectiveness assessment tool.

Table 6 Levelized Cost (Utility Cost perspective)

Type of Potential	Levelized Cost	
	Energy Efficiency Programs ($/kWh)	Demand Response Programs ($/kW-yr)
Maximum Achievable Potential (MAP)	$0.024	$37.45
Realistic Achievable Potential (RAP)	$0.017	$39.69
Business as Usual (BAU)	$0.021	$27.50

As the table indicates, by all measures the EE program portfolio is cost-effective from a levelized cost perspective. Industry average levelized cost tends to range from $0.03 to $0.05 per kWh saved. With the BAU portfolio, the levelized cost is well under that average. Looking at either the MAP or RAP, it is fair to conclude that the portfolio levelized costs are well within industry expectations. For the DR programs, the portfolio is cost-effective from a levelized cost perspective since the levelized cost of new capacity is typically well over $75/kW-year.[4] With any of the three portfolios, the levelized cost is well under half of that average.

Supply Curves

Two key results from this study are two sets of supply curves – one for energy-efficiency programs and the other for demand response programs – that represent MAP, RAP, and BAU.

Figure 5 shows the reference supply curve for energy-efficiency programs for 2030. Key observations include:

- Overall, the 20-year analysis shows a majority of the EE program savings fall under $0.04/kWh. For the BAU portfolio, a total savings of over 5% falls under a very attractive cost-effective cut-off of $0.03/kWh.
- For the RAP portfolio, close to 7% total savings falls under a $0.03/kWh levelized cost.
- The MAP portfolio becomes very costly when reaching beyond the 10% savings level, as the levelized cost to add additional savings beyond a cumulative savings of 10% reaches well over $0.05/kWh.
- Another interesting observation is that RAP holds steady at a levelized cost under $0.02/kWh, going from a cumulative savings of just over 2% to over 5%. Program costs do not appear to substantially increase under RAP until the portfolio reaches over 7% savings.
- While most of the programs are considered cost-effective, there are some higher cost programs which include: HVAC, Lighting and Appliance, and Residential New Construction. Residential New Construction costs are significantly higher than the second most expensive program.
- When comparing the three different curves (BAU, RAP and MAP), it is worth noting that there is a clustering of programs that cost roughly the same (on a levelized $/kWh basis), yet these programs bring about substantial increases in the energy savings potential. For MAP, bringing on the last two most expensive programs brings about measureable increases in savings potential. Thus the slope of the supply curve does not turn in a vertical direction, as is clearly demonstrated in the BAU and to some extent in the RAP cases. This suggests that while MAP is the most expensive portfolio, a bump-up in the expenditures even for the high cost programs yields significantly greater returns in terms of energy savings.

[4] This was the figure used as a proxy avoided capacity cost for the FERC National DR Potential study.

Figure 5 Energy Efficiency Program Supply Curve – Potential by 2030

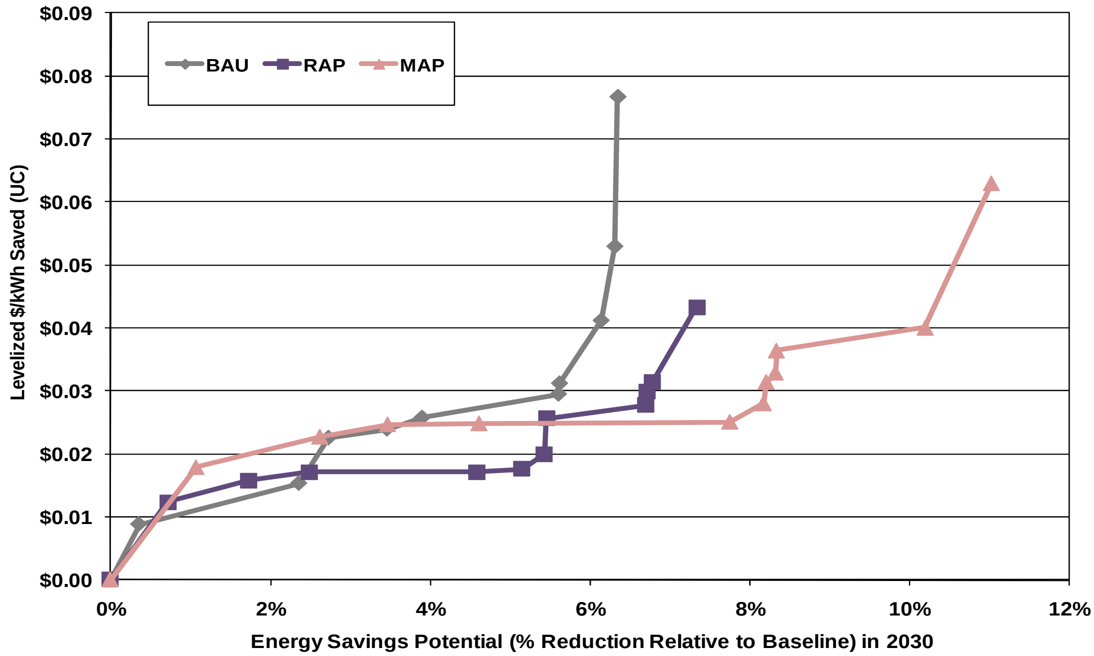
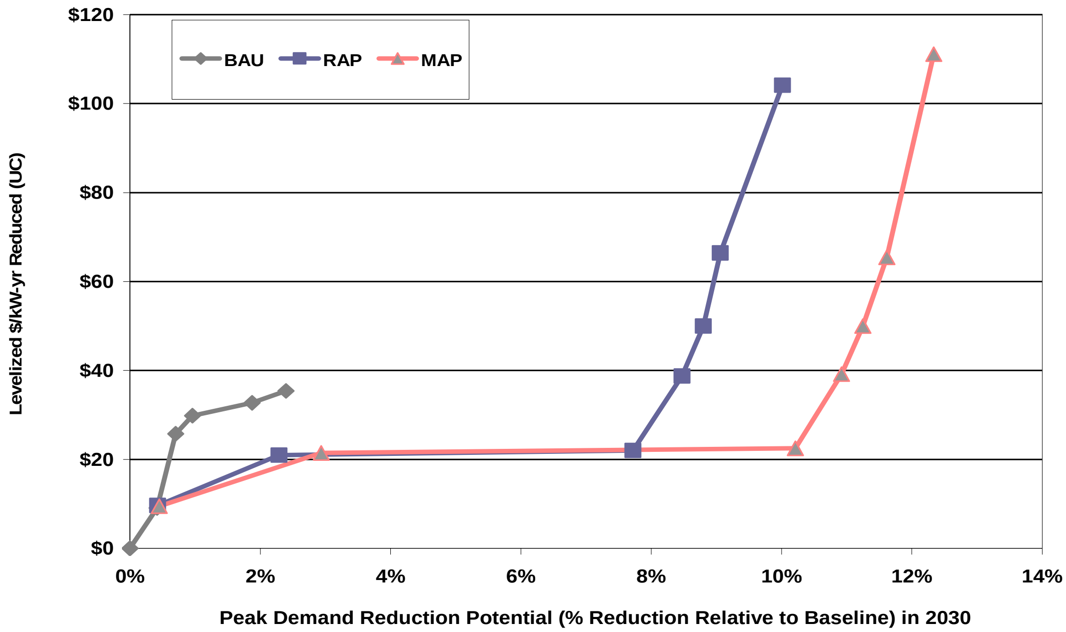


Figure 6 shows the reference supply curve for demand-response programs for 2030. Key observations include:

- In RAP and MAP, the programs as a whole appear to deliver significant peak demand reductions at a cost that is well below $30/kW-year. By any measure, this would also be judged very cost effective when compared to supply-side resources and their associated costs.
- For the BAU portfolio, savings do not go much above the 2% mark, with associated costs jumping up to above $30/kW-year.
- The RAP portfolio brings about savings at over 7% for a cost that is well under $30/kW-year.
- The MAP portfolio yields a higher savings of over 10% for essentially the same cost that is experienced in the RAP case. The reason these costs are comparable relates to the fact that the main differences between RAP and MAP relate to scale-up of DR programs under scenarios of higher incentives and assumptions about greater levels of opt-out pricing in the MAP case, which bring about significantly greater savings for very little extra cost.
- Again, most of the DR programs in each portfolio have a lower levelized cost than the projected avoided capacity costs used in the FERC National Assessment of Demand Response of approximately $75/kW-year in year 2030 indicating that all three portfolios are cost-effective as a whole.

Figure 6 Demand Response Program Supply Curve – Potential by 2030



Program Costs

An important result from this study is an estimation of program spending, both from an annual perspective and cumulative. Figure 7 illustrates the year-by-year EE program spending over the entire 22-year time horizon (2009-2030). The figure illustrates that for BAU and RAP, the annual spend is roughly equivalent (yet the RAP savings are significantly higher than BAU in each year after about 2013). The figure also illustrates the fact that the MAP spend is significantly higher than RAP and BAU. Of course, MAP savings are substantially higher than BAU and RAP. The results lead to the obvious conclusion that it will cost significantly more to get additional savings.

Figure 7 Annual Energy Efficiency Program Spending[5]

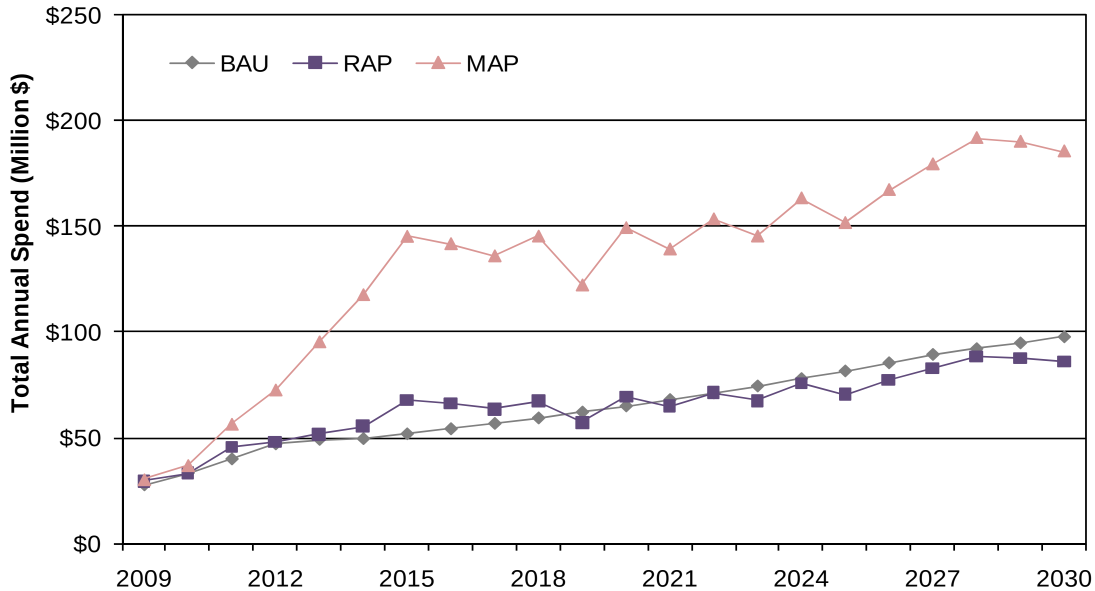
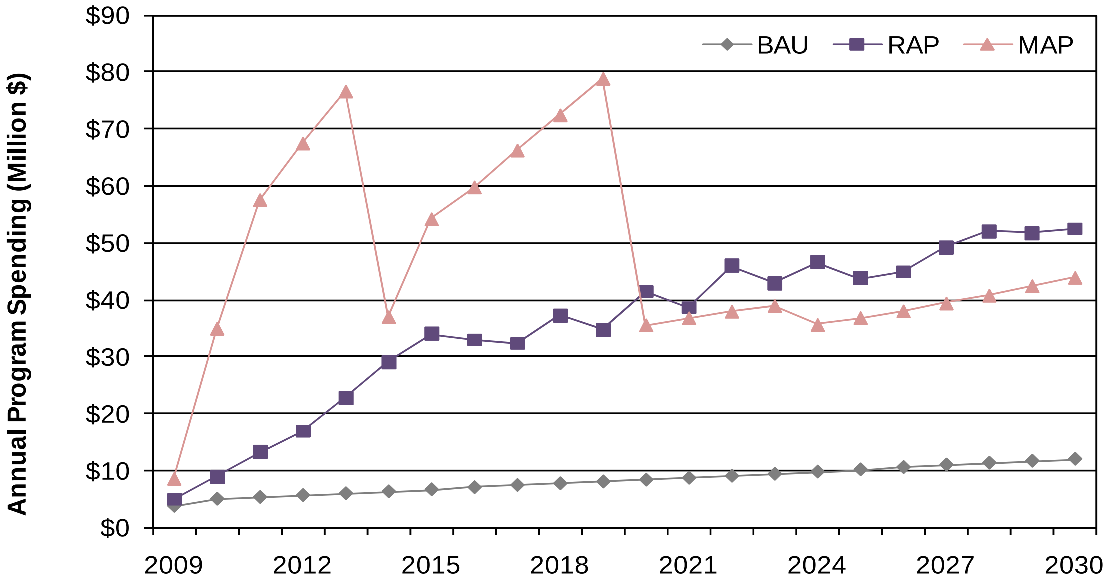


Figure 8 illustrates the year-by-year DR program spending over the entire 22-year time horizon (2009-2030). The figure illustrates significant fluctuations in the annual spending for all three cases. In the RAP case, it is assumed that AMI comes in around 2015 and that opt-in dynamic pricing is implemented afterwards. Since opt-in pricing assumes that participants are voluntary, the rates of growth in spending are what would typically be expected in a DR program.

However, for the MAP case, the spending grows dramatically in the first 5 years (2009-2013), reflecting a significant ramp-up of participation in traditional DR programs such as Direct Load Control and Curtailable as well as newer DR programs such as opt-in dynamic pricing tariffs. Beginning in 2014 the spending drops down for the one year, and then again rises dramatically until about 2020. This is occurring because it is assumed that customers are participating in the dynamic pricing programs on an opt-in or voluntary basis through 2013. In 2014, there is a transition in the pricing program designs from the opt-in style to a more mandatory opt-out style. That means that all customers not currently on a time-based pricing tariff would be defaulted to such a tariff. This transition occurs based on the assumption that the AMI meters begin to become deployed starting in 2015. As AMI deployment is initiated, pricing program expenditures rise to bring on the new participants until 2020 when it is assumed that all available participants are transitioned to the various dynamic pricing programs. While it is merely speculation as to whether opt-out dynamic pricing tariffs would actually be implemented in the AmerenUE service territory during this time, the differences in annual spend between MAP and RAP reveal some important insights about the tradeoffs between opt-out dynamic pricing vs. opt-in dynamic pricing. First, it is clear that there would be significant fluctuations in spending in the dynamic pricing case. Such fluctuations may not be feasible from an AmerenUE operational perspective. Second, as mandatory dynamic pricing tariffs take hold, there is a negative impact on program participation for other non-pricing programs. This situation is clearly revealed in the annual spend, where RAP spending in the last 10 years of the plan is actually higher than MAP spending.

[5] Note that annual spending for MAP and RAP was calibrated to the BAU for the purposes of creating this illustration. The calibration was done such that spending amounts in the first two years of the programs would be roughly comparable across the three levels (MAP, RAP and BAU). The actual analyses of MAP and RAP (in terms of savings and cost-effectiveness) were conducted independently of BAU.

Figure 8 Annual Demand Response Program Spending



Scenario Analysis

Scenario development is a critical part of any planning exercise. While the "reference" case for EE and DR program potential represents the best or most-likely estimate of what the future will look like, it is important to understand the sensitivity of the reference case estimate to key assumptions and to evaluate alternative worlds or scenarios. Based on the results of the potential analysis, it was determined that the realistic achievable potential (RAP) would serve as the representative reference case for conducting the scenarios analysis.

During the various stakeholder meetings convened over the course of this project, several potential future scenarios were outlined and reviewed. In those discussions, it was clear that a whole host of external factors might occur in the future, all potentially influencing the outcome of AmerenUE's EE and DR programs. As a result, the following three scenarios were considered for the analysis:

- **Scenario 1 – Aggressive Codes and Standards**: This scenario represents the implementation of aggressive state building codes which will capture lost opportunities in new construction that might currently be captured (at least in part) in the various DSM new construction programs. Further, the scenario represents aggressive appliance standards that are currently being contemplated at the federal level. As recent increased national attention is being given to role of energy efficiency in the economic recovery and the Smart Grid, it is conceivable that this attention will lead policymakers to increase laws and regulations governing codes and standards beyond existing and planned levels.
- **Scenario 2 – High Infrastructure Costs**: This scenario anticipates greater levels of utility spending due to higher than anticipated costs associated with new generation, compliance with environmental regulations and carbon legislation[6], widespread implementation of the Smart Grid, adoption of distributed generation and solar, and the like.
- **Scenario 3 – Prolonged Recession Beyond 2 Years**: This scenario assumes that the economy does not recover in the next two years, but rather that the recession lasts up to

[6] The Reference scenario assumes passage of legislation similar to the 2009 proposed Waxman-Markey Bill. A carbon cost is included in the forecasts beginning in 2014 that reflects the targets and assumptions therein. These carbon costs are thus included in each scenario unless modified as noted.

five years. As a result, there would be a delayed and weakened carbon legislation passed by the Congress and rate hikes would be kept to a minimum.

Table 7 highlights the key findings of the scenario analysis. The table provides key indicators of the EE and DR programs, including total cumulative expenditure over the entire study time horizon (2009-2030), the levelized cost of saved energy and peak demand, and the percentage reduction relative to the baseline forecast.

Table 7 Scenario Impacts on EE and DR Potential

Parameter	Reference Case (RAP)	Scenario 1: Aggressive Codes and Standards		Scenario 2: High Infrastructure Costs		Scenario 3: Prolonged Recession	
		Value	Percent Change	Value	Percent Change	Value	Percent Change
EE Program Total Expenditure (Million $)	$1,856	$1,555	-16%	$2,394	29%	$1,522	-18%
EE Portfolio Levelized Cost ($/kWh-saved)	$0.017	$0.018	8%	$0.021	23%	$0.018	4%
EE Portfolio % Reduction Relative to Baseline	7.33%	5.18%	-29%	9.12%	24%	5.88%	-20%
DR Program Total Expenditure (Million $)	$406	$370	-9%	$657	62%	$406	0%
DR Portfolio Levelized Cost ($/kW-yr saved)	$39.69	$39.923	1%	$38.87	-2%	$38.88	-2%
DR Portfolio % Reduction Relative to Baseline	10.01%	9.32%	-7%	15.21%	52%	9.94%	-1%

Several observations can be made from the results of the scenario analysis:

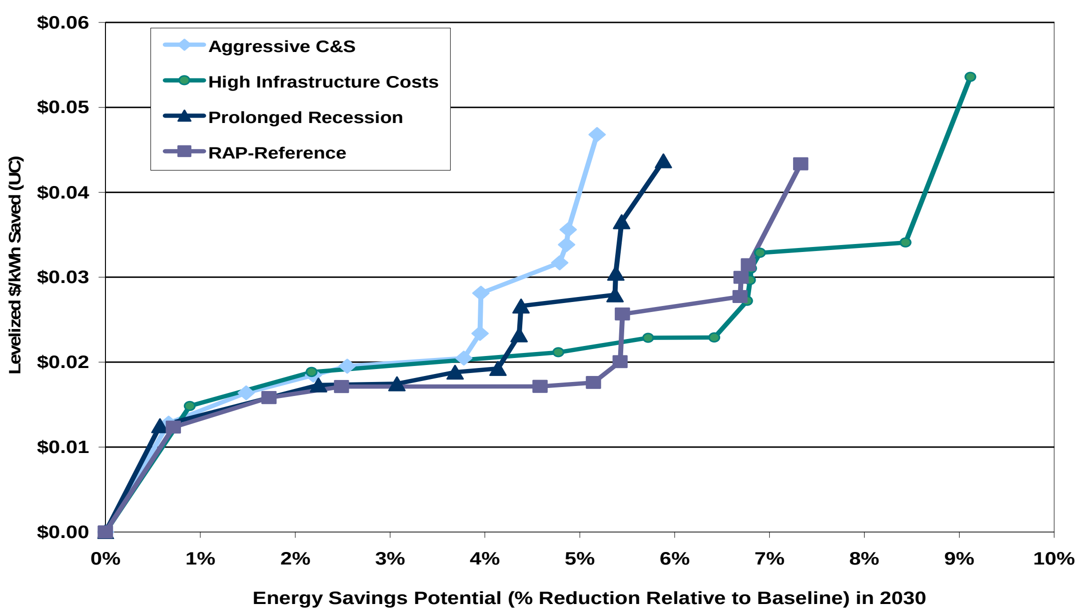
- As we move from the reference case (RAP) to the various scenarios, most of the typical parameters are moving in the direction that is expected. Aggressive codes and standards and a prolonged recession bring about lower expenditure for programs, lower savings relative to the baseline and higher levelized costs. High infrastructure costs bring about higher expenditure for programs, higher savings relative to the baseline and higher levelized cost.
- For Scenario 1 (Aggressive Codes and Standards), total EE expenditures are reduced by 16% and DR expenditures reduced by 9% due mainly to the fact that lower impacts mean that less is being expended for program administration and incentives. Levelized costs for the EE portfolio increase by 8% and for the DR portfolio by 1% indicating that the reduction in expenditures is not leading to a proportional reduction in impacts. Finally, the EE portfolio percentage reduction drops by 29% and the DR reduction drops by 7%, which is largely a function of the aggressive codes and standards taking over nearly a third of the savings projected in the reference case.
- For Scenario 2 (High Infrastructure Costs), total EE expenditures increase by 29% and DR expenditures increased by 62% due mainly to the fact more programmatic activities due to lower avoided costs, more aggressive marketing of programs, and the like. Levelized costs for the EE portfolio increase by 23% and for the DR portfolio drops by a slight 2% indicating that the increase in expenditures is bringing about a proportional increase in impacts (at least for the EE programs) . Finally, the EE portfolio percentage reduction increases by 24% and the DR reduction drops by 52%, This again is mainly driven by the fact that the EE and DR programs are operated at higher budget levels thus bringing about a larger number of participants relative to the Reference Case which in turn leads to greater impacts.

- For Scenario 3 (Prolonged Recession), total EE expenditures decrease by 18% and DR expenditures remaining relatively unchanged. The decrease in EE expenditures is due mainly to the fact few program participants is leading to less in incentives being paid out. DR appears to be relatively unchanged by these exogenous factors. Levelized costs for the EE portfolio increase by 4% and for the DR portfolio decrease by 2% indicating that (like Scenario 1) the reduction in EE expenditures is leading to a proportional reduction in impacts which has very little impact on the levelized cost. Finally, the EE portfolio percentage reduction decreases by 20% and the DR reduction increases drops by less than 1%. This again is mainly driven by the fact that the EE programs are not attracting as many participants because the economic situation is inhibiting the ability of participants to make capital investments. Thus, the resulting impacts are depressed relative to the Reference Case. This situation was not as affected in the DR case.

In addition to estimates of potential for each scenario, EE and DR program supply curves were also developed. The reference case (RAP) and each of the three scenarios are represented as separate supply curves on the same graph, in much the same manner as was presented for the various program implementation levels reported in the previous chapter.

Figure 9 shows the supply curve for AmerenUE's potential EE programs, as reflected by each of the three scenarios for the year 2030. The supply curve from the reference case is provided for comparison purposes.

Figure 9 EE Program Supply Curve – by Scenario, Year 2030



Several observations can be made from the results of the 20-year supply curve analysis for the various scenario assessments of the EE programs:

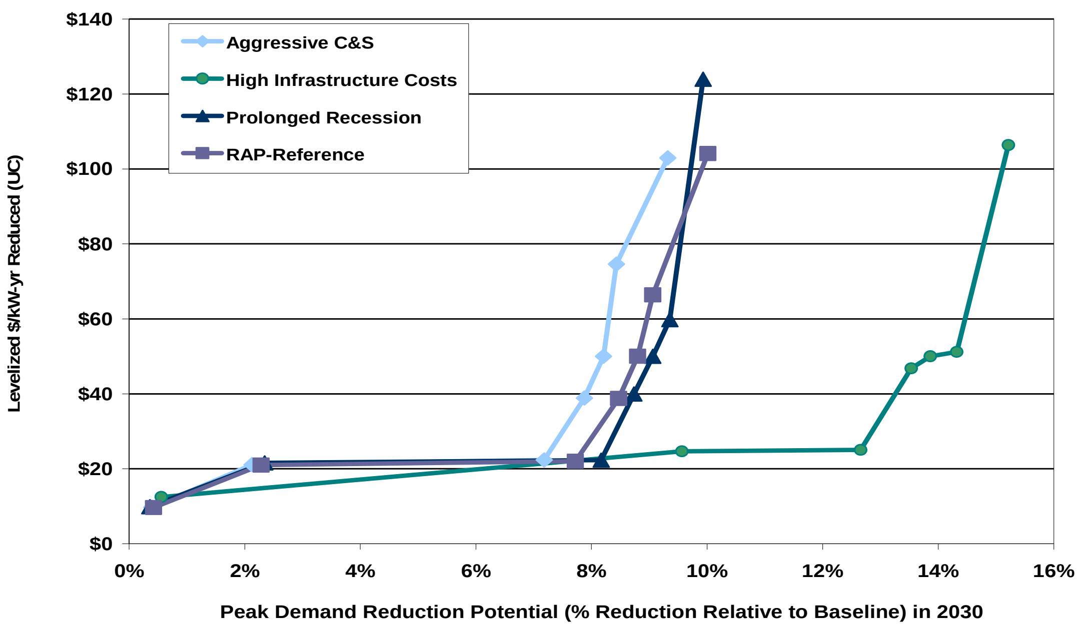
- Up to about 4% energy savings potential, all of the scenarios deliver about the same level of savings at the same level of cost (around $0.02/kWh or less). However, going above that levelized cost threshold, significant variances occur.

- Neither Scenario 1 (Aggressive C&S) nor Scenario 3 (Prolonged Recession) would be favorable from the perspective of an AmerenUE EE program portfolio. Both cases show significantly higher costs for a relatively minimal increase in savings potential.
- Scenario 2 (High Infrastructure Costs) appears to be most favorable from the perspective of bringing about 6.5% in energy savings potential at the lowest level of cost. However, for every extra kWh saved beyond that level, the costs rise dramatically.

Figure 10 shows the supply curve for AmerenUE's potential DR programs, as reflected by each of the three scenarios for the year 2030. Several observations can be made from the results of the 20-year supply curve analysis for the various scenario assessments of the DR programs:

- There is very little difference between the Reference Case and Scenario 1 (Aggressive Codes and Standards) and Scenario 3 (Prolonged Recession). This has mainly to do with the fact that in both instances these external factors have very little influence on the DR program portfolios.
- For Scenario 2 (High Infrastructure Costs) there is a pronounced improvement in the cost of delivered demand relative to the Reference Case. In other words, it does not appear to cost much more on a $/kW-year basis but the savings are significantly greater.

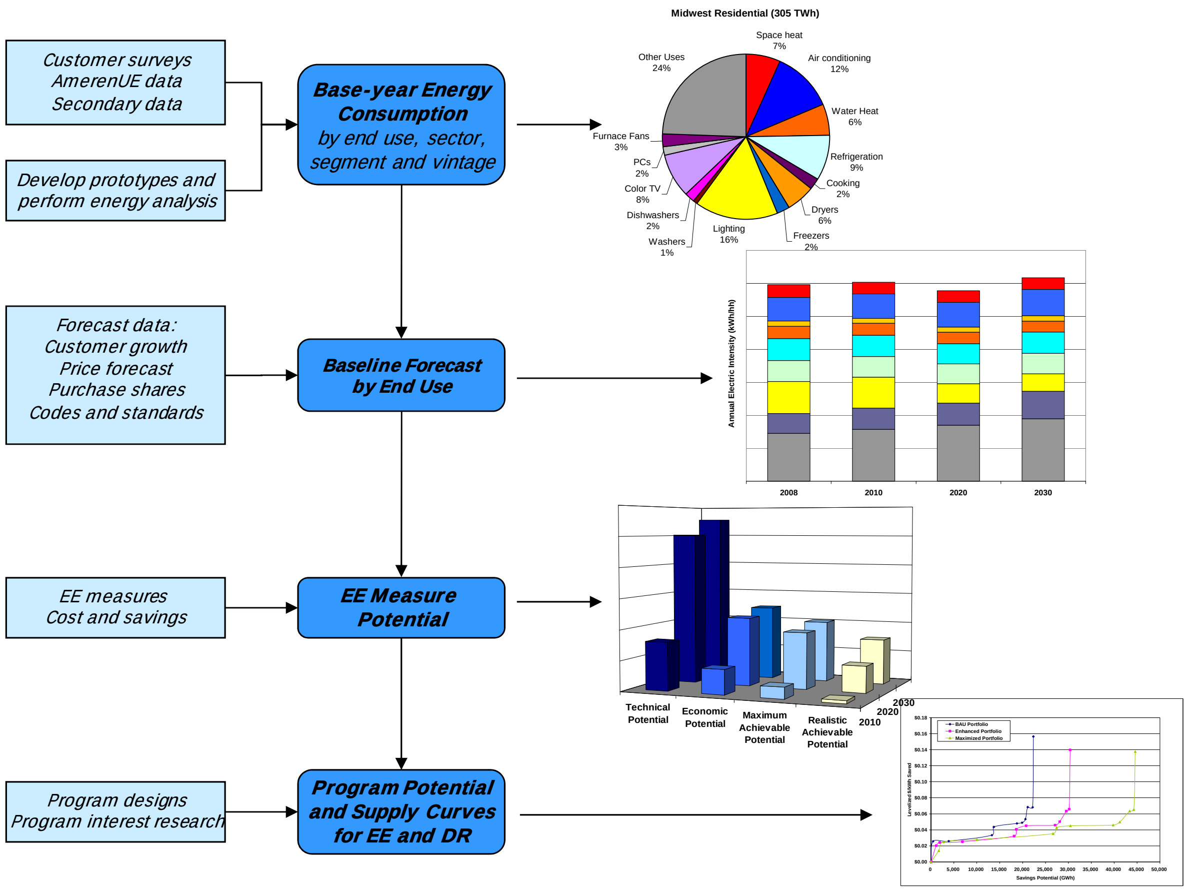
Figure 10 DR Program Supply Curve – by Scenario, Year 2030



STUDY APPROACH

This study represents industry best-practices in assessment of DSM potential. It began with comprehensive market research of AmerenUE customers that covered their current energy-using equipment, behavior and attitudes. The market research results were used to develop base-year usage profiles and the baseline forecast. These, in turn, were used to support the analysis of EE and DR potential at the measure and program levels. Finally, program analysis was used to develop supply curves. Figure 11 depicts this approach.

Figure 11 Overview of Study Approach



The remainder of this Executive Summary provides an overview of the market research and each of the analysis steps.

MARKET RESEARCH

Comprehensive market research about AmerenUE customers was conducted for this project. This research provides a solid foundation for the analyses performed in this study and it also provides a wealth of information for future analyses across many departments at AmerenUE. The market research included:

- Residential customers – online saturation surveys with 1,284 customers and online program interest surveys with 1,126 customers
- Small and medium C&I customers – online saturation surveys with 800 customers and online program interest surveys with 750 customers

- Large C&I customers – online energy-use surveys with 221 customers and online program-interest surveys with 273 customers
- Complex C&I customers – 145 site visits distributed strategically among campuses/locations of AmerenUE's "top customers"
- Trade Allies – 40 telephone interviews

Volume 2 of the report series presents the detailed results of the market research.

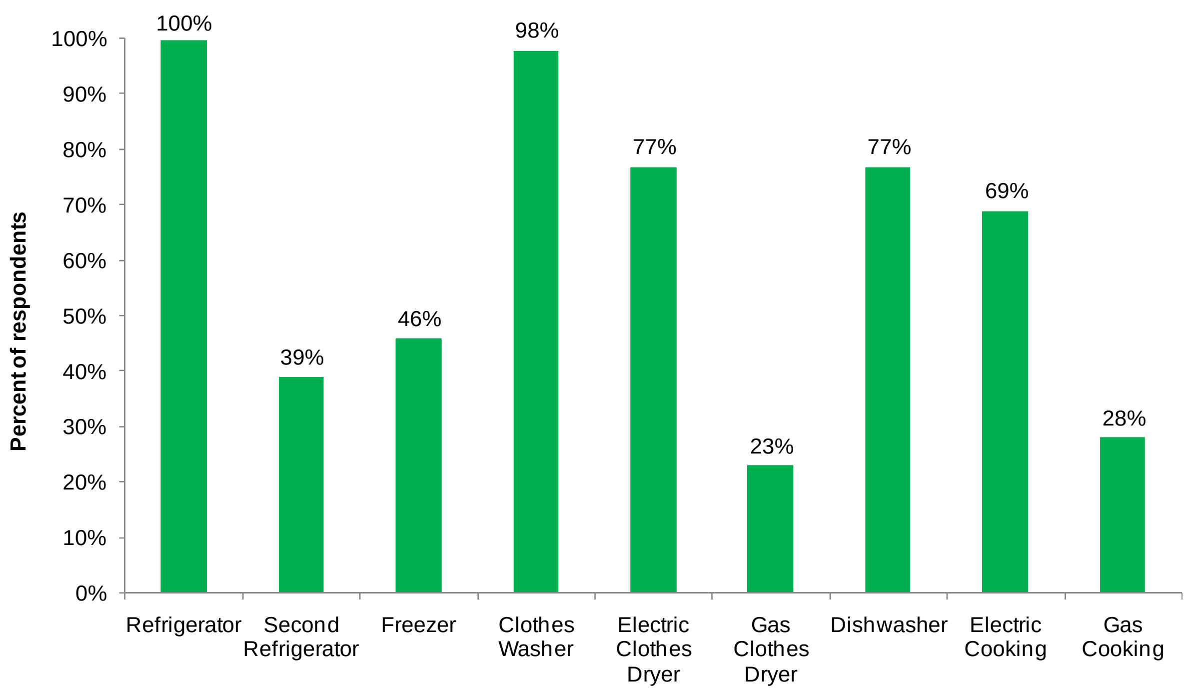
Energy-use Surveys

Energy-use (or saturation) surveys were conducted across all customer classes. Topics included:

- Characteristics of households/homes and businesses/buildings and their occupants
- Heating, cooling and water heating equipment
- Lighting, refrigeration and food service equipment
- Office equipment, electronics and miscellaneous plug loads
- Motors and process uses
- Energy-efficiency measures taken and planned

Figure 12 presents one example of the results from the residential saturation survey.

Figure 12 Saturation Survey Results – Percent of Single-family Homes with Appliances



Program-Interest Research

A hallmark of the AmerenUE study is the research of customer attitudes and behaviors toward energy efficiency and demand response measures and programs. The objectives of this research were to:

1. Help AmerenUE estimate achievable potential

a. How likely are customers within each sector to participate in various energy efficiency programs AmerenUE is considering offering?

b. Which of these energy efficiency measures offer the highest likely participation rates?

c. How does likelihood to participate differ by payback period for the customer?

2. Help AmerenUE understand unique customer segments to support customer marketing and outreach

The topics covered by the program-interest research included:

- Attitudinal questions, which included general attitudes about energy use, energy efficiency, environmental concerns, saving money, comfort, etc.; purchasing attitudes, preferences, practices; and attitudes toward electric utility providers in general and attitudes toward AmerenUE
- Assessment of energy efficiency measures already implemented
- Interest in potential energy efficiency and demand response measures offered by AmerenUE that cover appliance and equipment upgrades to high-efficiency models, improvements in processes that would save energy, and likelihood of undertaking certain energy conservation measures.

Key results from the program interest research included “take rates” for various program concepts. Take-rates represent the likelihood that customers will participate in specific programs and they reflect a snapshot of current behavior and circumstances. They have been adjusted for response bias using industry standard techniques to reflect what customers *actually* do rather than what they *say* they will do.

Figure 13 illustrates the range of take rates for the residential and business sectors. Figure 14 and Figure 15 present likely take rates for specific appliances/equipment.

Figure 13 Range of Take Rates

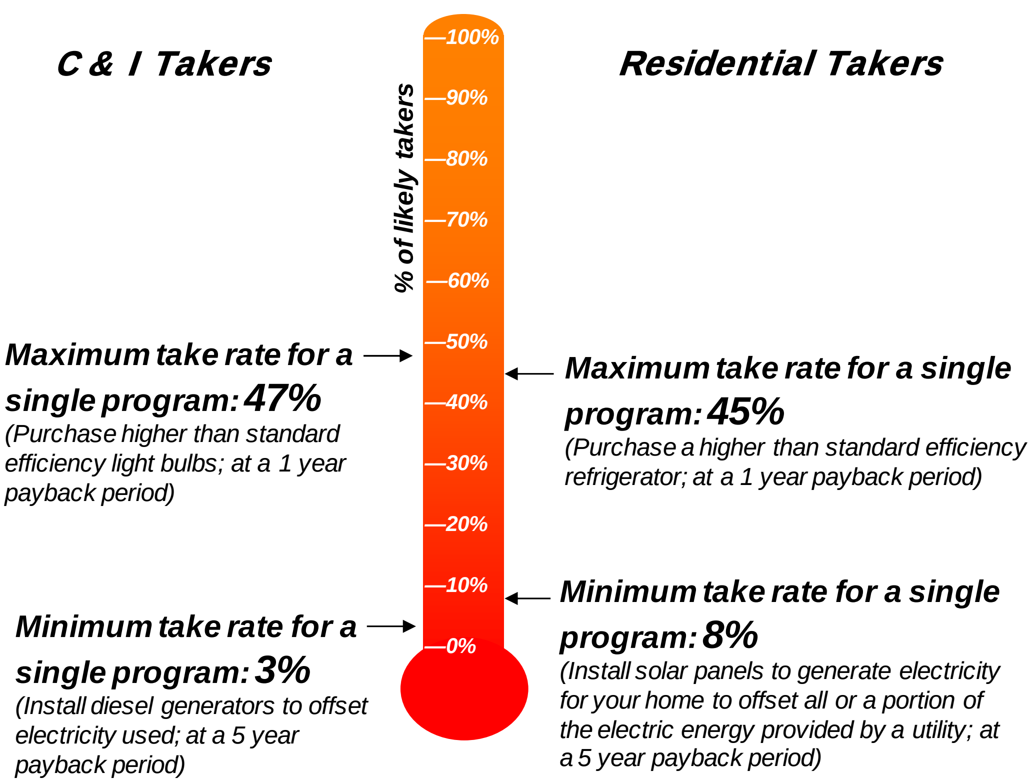


Figure 14 Likely Residential Take Rates for Purchasing High-efficiency Equipment

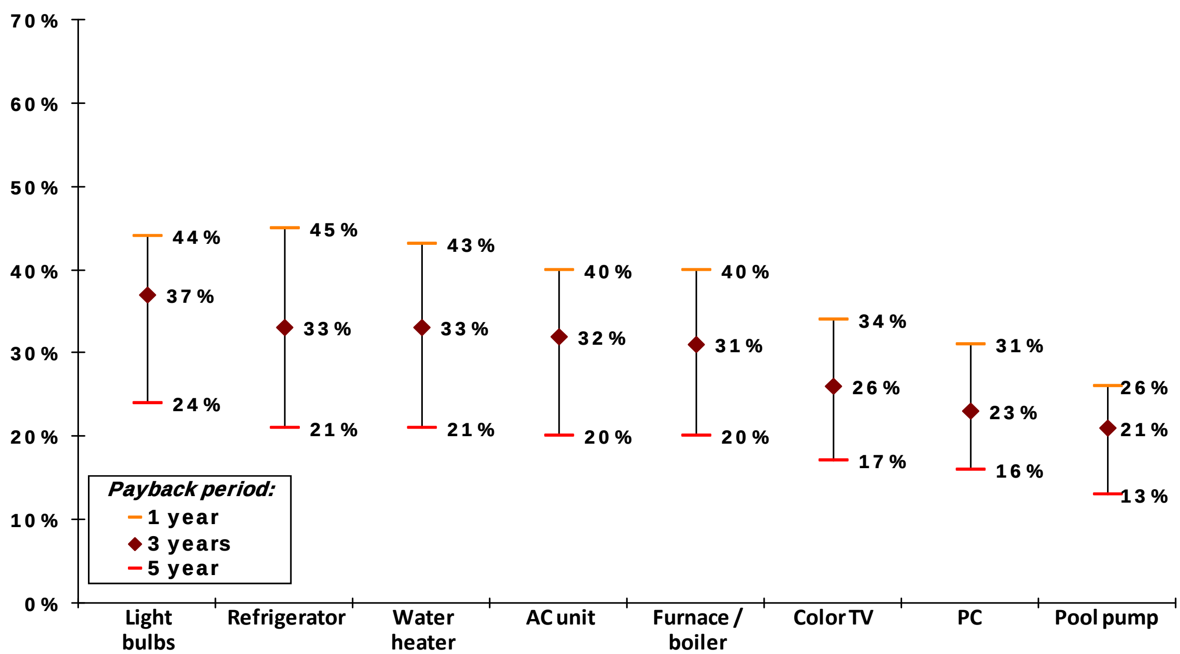
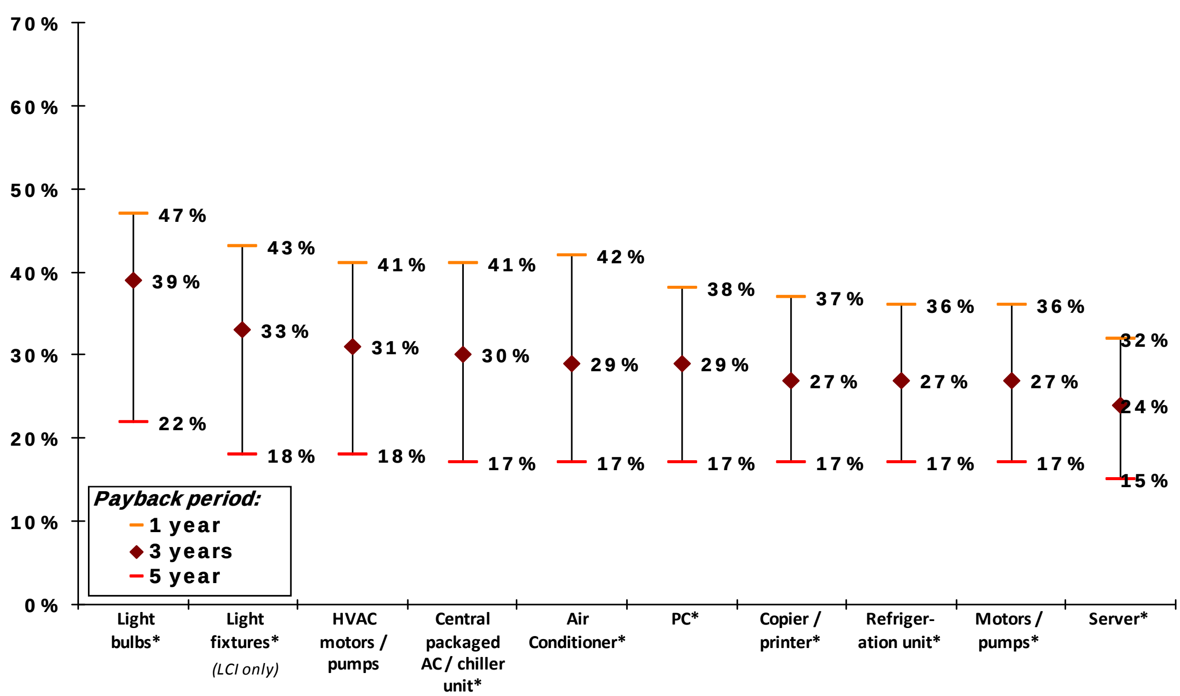


Figure 15 Likely C&I Take Rates for Purchasing High-efficiency Equipment



These take rates are used directly to estimate the various levels of achievable potential for this study – MAP and RAP. Take-rate estimates at a one-year payback were used to estimate MAP. Take-rates at a three-year payback were used to estimate RAP and were ramped up over the 20-year forecast horizon to reflect increased awareness of utility programs.

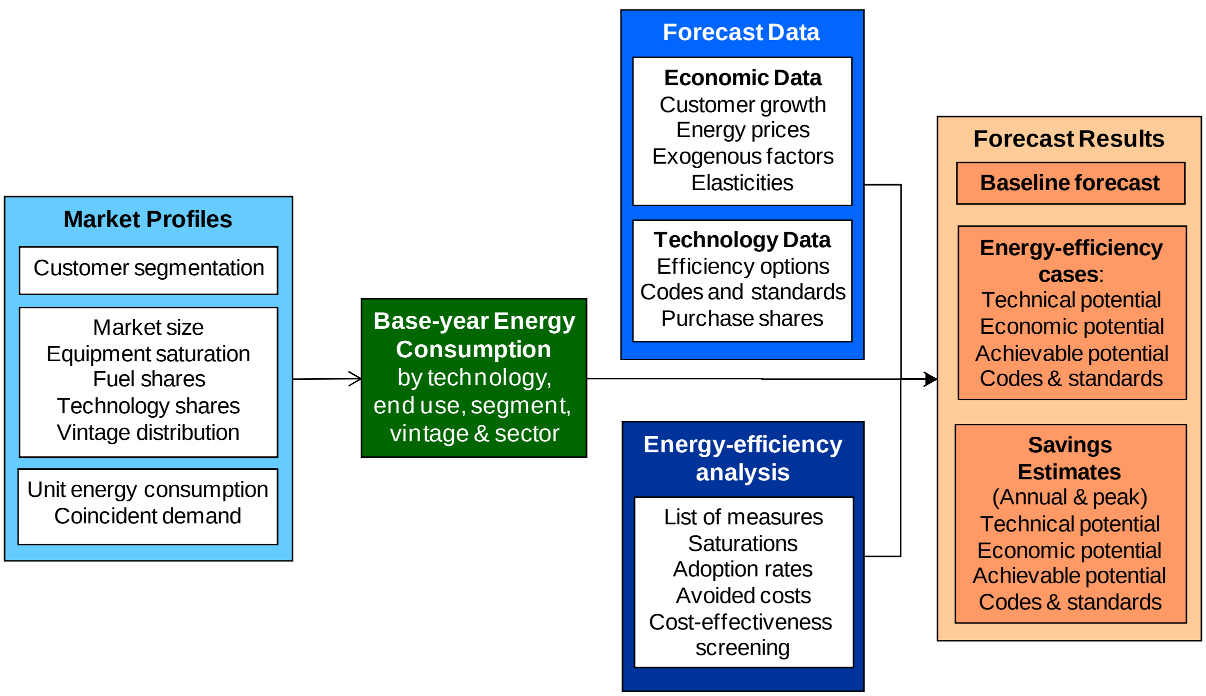
The majority of the AmerenUE take rates under a three-year payback are in the range of 20-40%. Based on observation and expert judgment, these are lower than comparable studies conducted for West Coast and Northeast utilities, which typically show 30-50%. By comparison, a recent similar study conducted by the Electric Power Research Institute identified take rates of 50% or higher, reflecting a mix of states with high and low DSM activity and history.[7] The result of lower take rates is that MAP and RAP for AmerenUE represent a smaller portion of economic potential than what is projected in some other studies.

In addition to the program take rates, the market research results were used to perform a segmentation analysis. These results are also presented in Volume 2.

DEVELOP BASELINE FORECAST

The market research was a primary source of information for the development of energy market profiles, base-year electricity use by end use and the baseline forecast as illustrated in Figure 16. For this study, 2008 was defined as the base-year because it was the most recent year for which complete billing data were available.

Figure 16 Analysis Framework for Baseline and EE Potentials Forecasts



Base-year Energy Use

In 2008, AmerenUE provided 38,165 GWh of electricity to its residential, commercial and industrial customers. The residential and commercial sectors are roughly equal, each accounting for more than one third of total use. The industrial sector accounts for the remaining 28%.

Residential Electricity Use in 2008

In 2008, AmerenUE provided electricity service to 1.04 million households who used 13,993 GWh. Overall, residential customers used 13,498 kWh/household. The market is dominated by

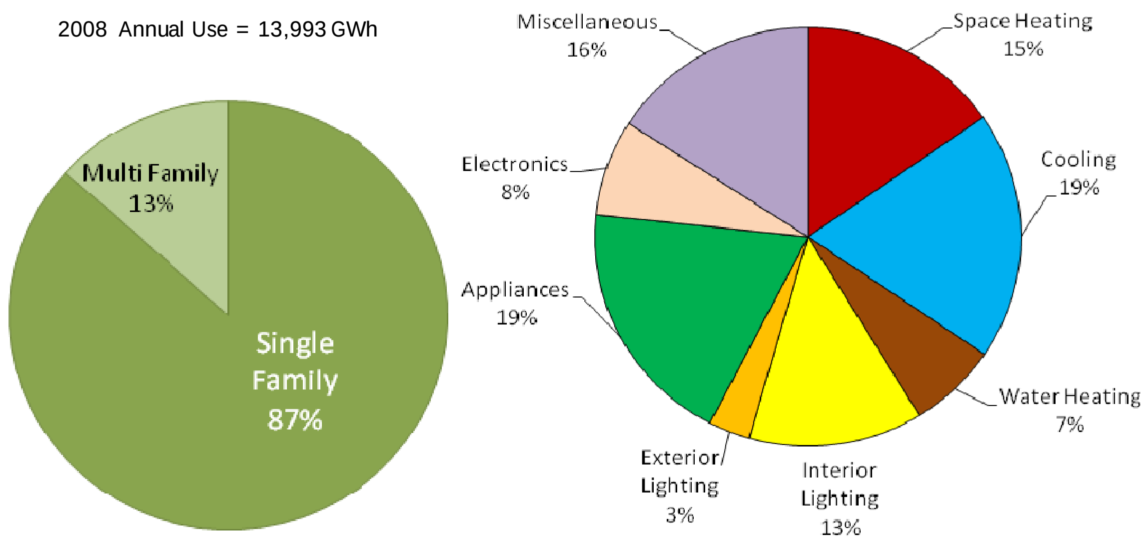
[7] Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010-2030), EPRI, TR 1016987, January 2009, available at www.epri.com.

single-family homes (see Figure 17), which used 14,682 kWh/household on average, compared to multi-family homes which used 8,883 kWh/household.

Appliance information and dwelling characteristics from the market research were combined to develop descriptions of prototypical houses in the AmerenUE service area. These prototypes were analyzed using an engineering simulation model to estimate end-use consumption.[8] Comprehensive energy market profiles that characterize electricity usage by end use and segment are presented in Volume 3.

Figure 17 presents a breakdown of 2008 usage by end use. Air conditioning and white-goods appliances are the largest uses, followed by space heating and interior lighting.

Figure 17 Residential Electricity Usage by Segment and End Use



Commercial Sector Electricity Use in 2008

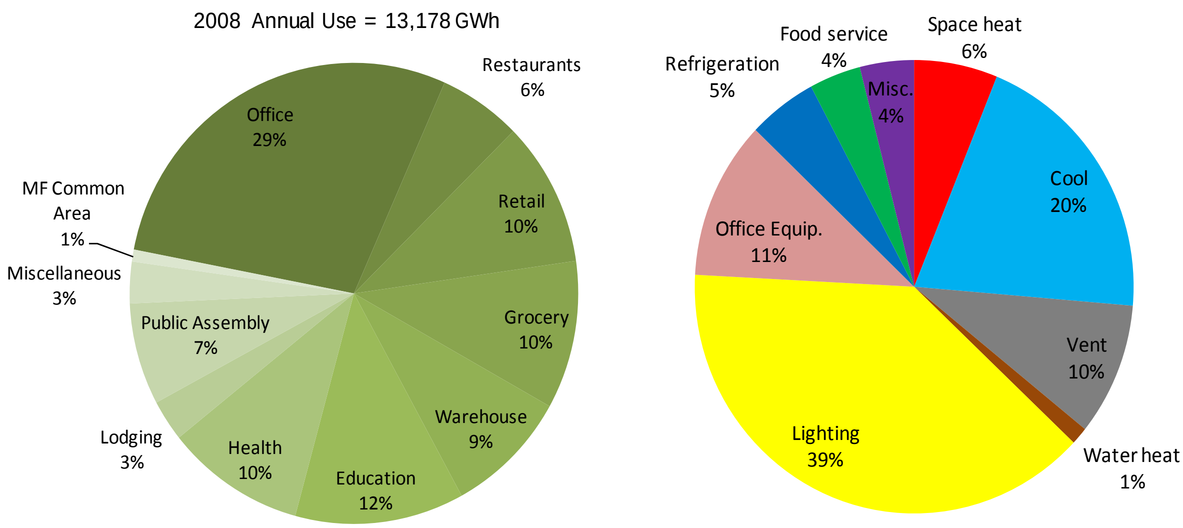
In 2008, AmerenUE provided 13,178 GWh to commercial-sector customers. These businesses occupied 964 million square feet, implying an intensity of 13.7 kWh per square foot per year. The largest segment in the commercial sector is offices, which accounts for 29% of total usage in 2008. All other segments account for 12% or less of total use (see Figure 18).

Information about equipment inventories, business operations and building characteristics from the survey were combined to develop descriptions of prototypical building types in the AmerenUE service area. These prototypes were analyzed in BEST to estimate end-use consumption. Comprehensive energy market profiles that characterize electricity usage by end use and segment are presented in Volume 3.

Figure 18 presents a breakdown of 2008 usage end use. Lighting is the dominant use in the commercial sector, followed by space cooling.

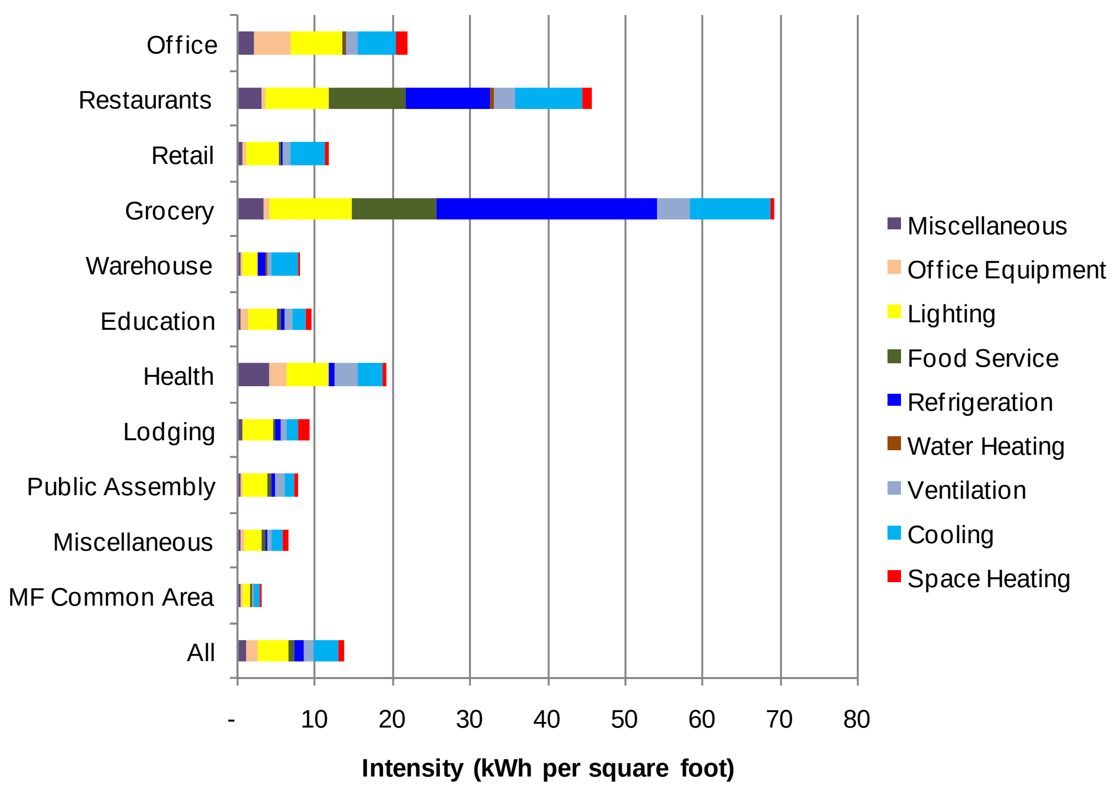
[8] The model used for this purpose is Global's Building Energy Simulation Tool (BEST), which is a user-friendly front-end to the powerful DOE-2 energy simulation model.

Figure 18 2008 Commercial Sector Electricity Usage by Segment and End Use



Electricity use varies considerably by building type and end use. Figure 19 presents the overall intensity in kWh per square foot per year, as well as the end-use breakdown. The grocery and restaurant segments are the most intensive as a result of high refrigeration and food service usage, in addition to lighting and cooling. Lighting and cooling are significant uses across all segments. Office is the largest segment, in terms of absolute kWh usage, and uses about 22 kWh per square foot on average.

Figure 19 Electricity Use by Building Type and End Use

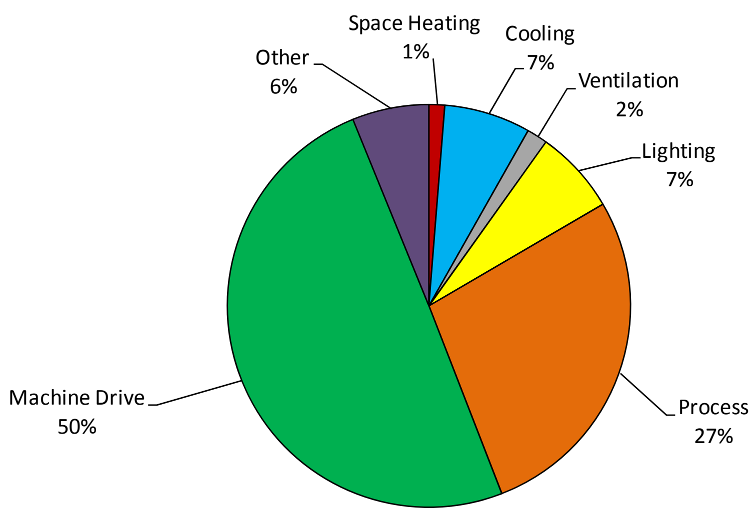


Industrial Sector Electricity Use in 2008

In 2008, AmerenUE provided 10,994 GWh to the industrial sector. Throughout this study, this sector is treated as a whole to protect the confidentiality of AmerenUE's largest customers who might otherwise be identified.

Figure 20 presents a breakdown of 2008 usage by end use for the industrial sector. Machine drives, primarily motors and air compressors, account for 50% of usage in 2008. Electric processes account for just over one fourth of usage. Lighting, cooling, and other uses account for the remaining 23%.

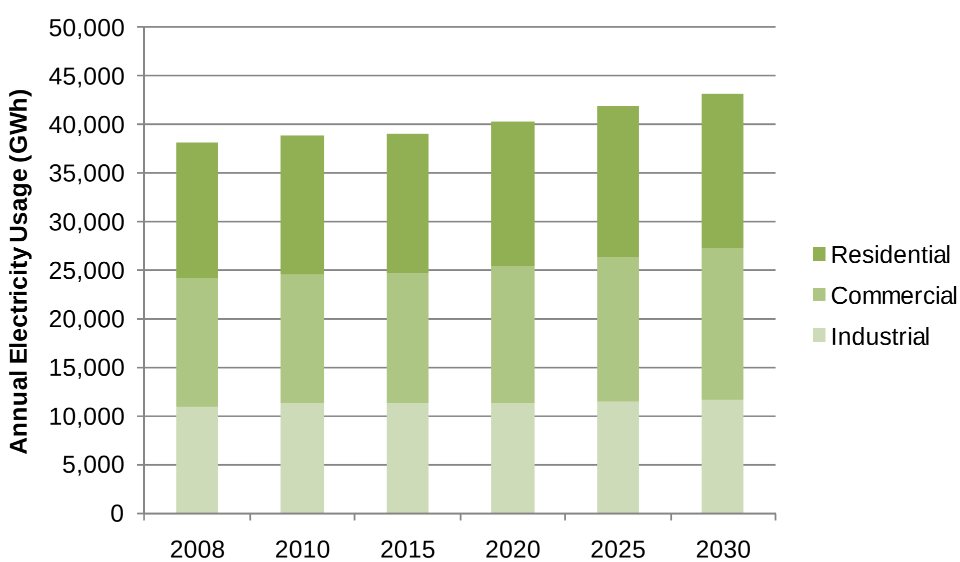
Figure 20 2008 Industrial Electricity Usage by End Use



Baseline End-Use Forecast Results

Using the base-year profiles as a starting point, a baseline end-use forecast was developed for 2009 through 2030 using Global's LoadMAP model. This forecast embodies assumptions about customer growth, electricity prices, technology trends and the impacts of codes and standards. This forecast provides the springboard for the estimation of energy-efficiency potential and is the metric against which EE savings are measured. The total forecast is presented in Figure 21.

Figure 21 Baseline Forecast Summary



Residential Baseline End-use Forecast

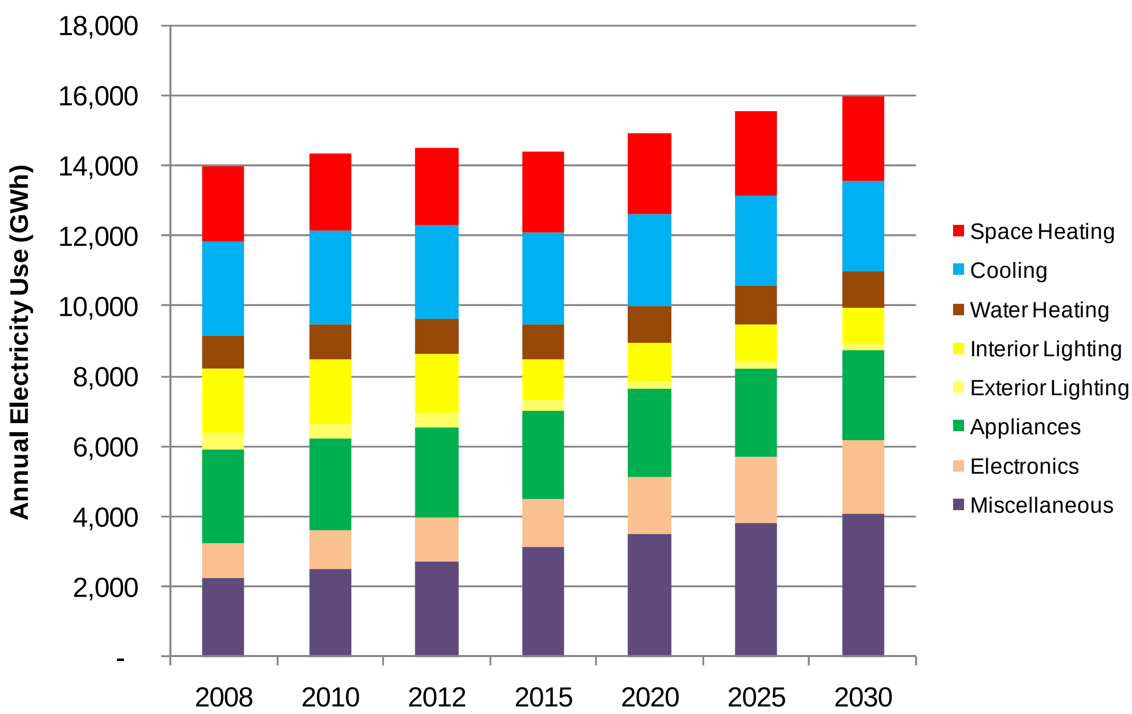
Electricity use is forecast to grow from 13,993 GWh in 2008 to 15,986 GWh in 2030. This is a 14% increase over the 22 years, implying an average growth rate of 0.61%.

Key observations about this forecast include the following:

- Residential lighting is affected by the passage of the Energy Independence and Security Act (EISA) in 2007, which mandates higher efficacies for lighting technologies starting in 2012. Several lighting technologies are anticipated to meet this standard when it goes into effect, including compact fluorescent lamps (CFL), white light-emitting diodes (LED), and advanced incandescents currently under development. Old stock is phased out over time beginning in 2012. The effect of this standard is a decline in electricity for lighting use by 43% over the forecast period, reflecting a low penetration of CFLs in the AmerenUE service area in 2008.
- Growth in electricity use in electronics is strong and reflects an increase in the saturation of electronics and the trend toward higher-powered computers and larger televisions.
- Growth in miscellaneous use is also substantial. This has been a long-term trend and assumptions have been made about growth in this end use that are consistent with the Annual Energy Outlook.

Figure 22 presents the residential end-use forecast.

Figure 22 Residential Baseline End-use Forecast

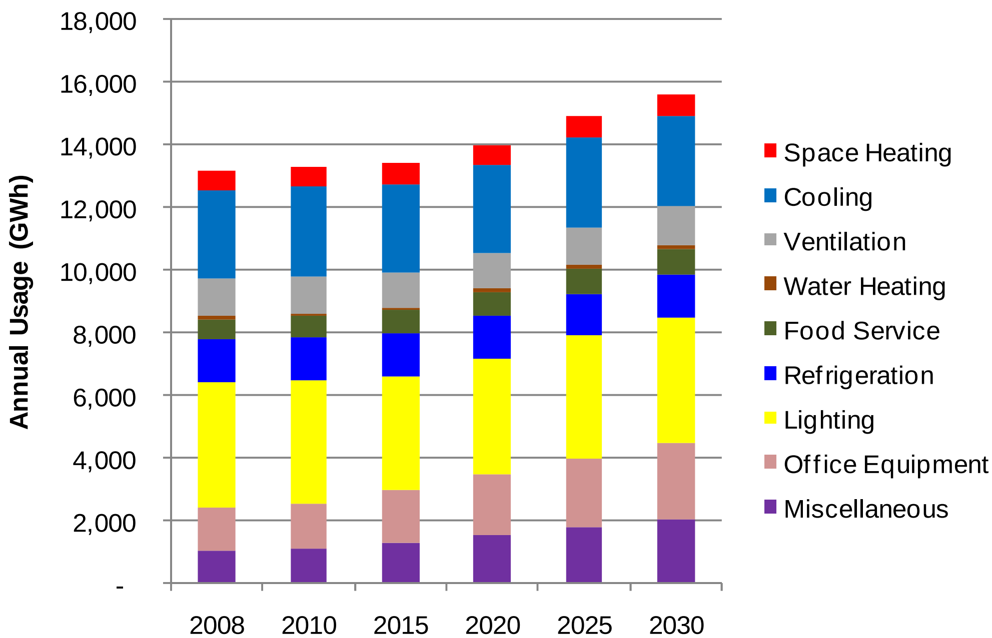


Commercial Baseline End-use Forecast

In the commercial sector, electricity use is forecast to grow from 13,178 GWh in 2008 to 15,615 GWh in 2030. This is an 18% increase over the 22 years, implying an average growth rate of 0.8%.

Figure 23 presents the forecast which shows considerable variation across the end uses. Major uses – cooling, lighting and refrigeration – are relatively flat, while significant growth takes place in office equipment and miscellaneous uses.

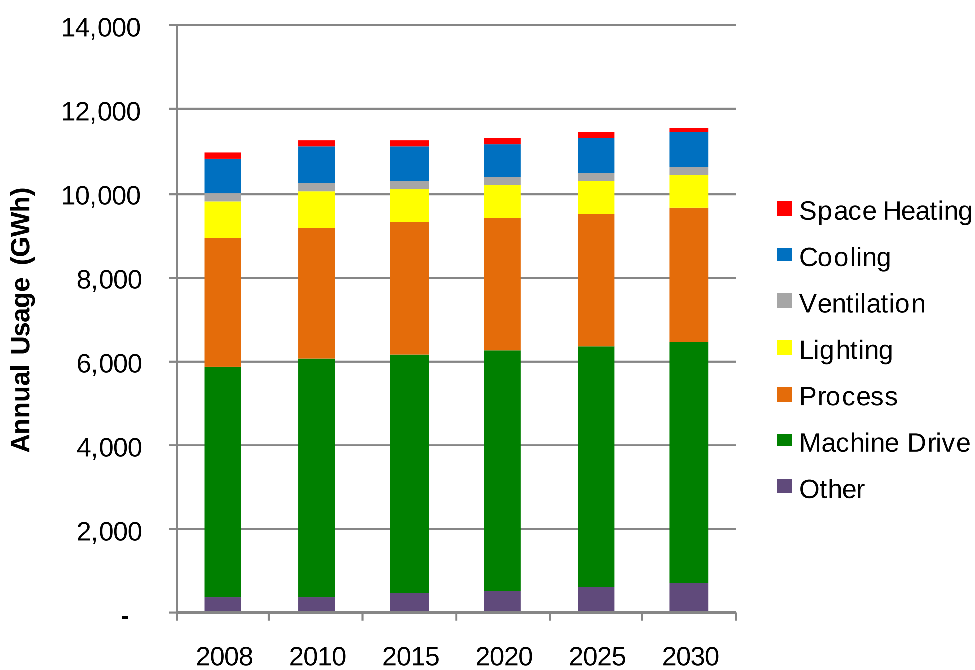
Figure 23 Commercial Baseline End-use Forecast



Industrial Baseline End-use Forecast

Industrial electricity use is projected to stay fairly flat over the next 22 years. Of course, this assumes the continued viability of AmerenUE's largest industrial customers. Electricity use is forecast to grow from 10,994 GWh in 2008 to 11,580 GWh in 2030, an increase of 5%. As in the other sectors, lighting use declines as the result of standards. The primary source of growth is in the other uses. The forecast is depicted in Figure 24.

Figure 24 Industrial Baseline End-use Forecast



POTENTIAL SAVINGS FROM ENERGY EFFICIENCY MEASURES

Once the baseline forecast was developed, analysis of energy-efficiency potential proceeded. This activity began with the identification and screening of energy-efficiency measures. A total of 299 individual measures were considered across all three sectors. The residential analysis included 118 measures, the commercial sector included 120 measures and the industrial sector considered 43 measures. The primary sources for EE measure information include:

- Global's Database of Energy Efficiency Measures (DEEM)
- California's Database of Energy Efficiency Resources (DEER database)
- AmerenUE stakeholder input

The analysis of energy-efficiency measures yielded estimates of energy efficiency for Technical and Economic potential, which were the building blocks of the subsequent program analysis and achievable potentials (see Table 1):

- **Technical potential** is the theoretical upper bound of energy-efficiency savings regardless of cost.
    1. In 2020, technical potential is 11,098 GWh, which represents 27.6% of total usage in that year.
    2. In 2030, technical potential is 12,696 GWh, 29.4% of total usage.
- **Economic potential** is an estimate of all cost-effective energy efficiency savings.
    1. In 2020, economic potential is 5,475 GWh, which represents 13.6% of total usage in that year.
    2. In 2030, economic potential is 7,181 GWh, 16.6% of total usage.

Figure 25 presents the savings as a percent of baseline energy usage in each of selected years.

Figure 25 Summary of Energy-efficiency Measure Potential

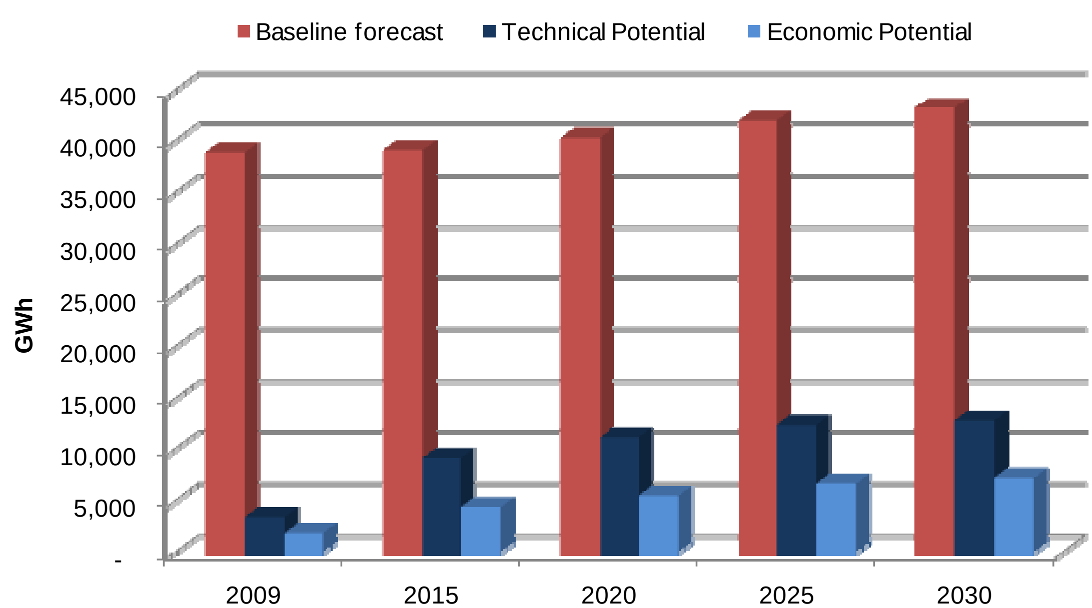
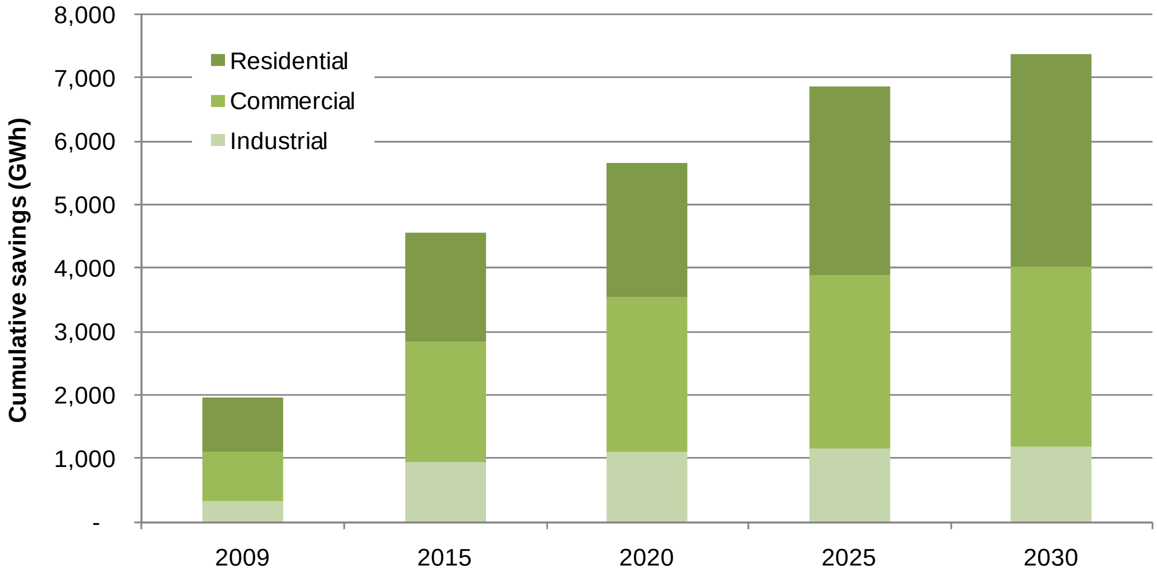


Figure 26 summarizes economic potential by sector. The contributions to savings from the residential and commercial sectors are roughly equal, while the industrial sector is the smallest of the three.

Figure 26 Summary of Economic Potential by Sector



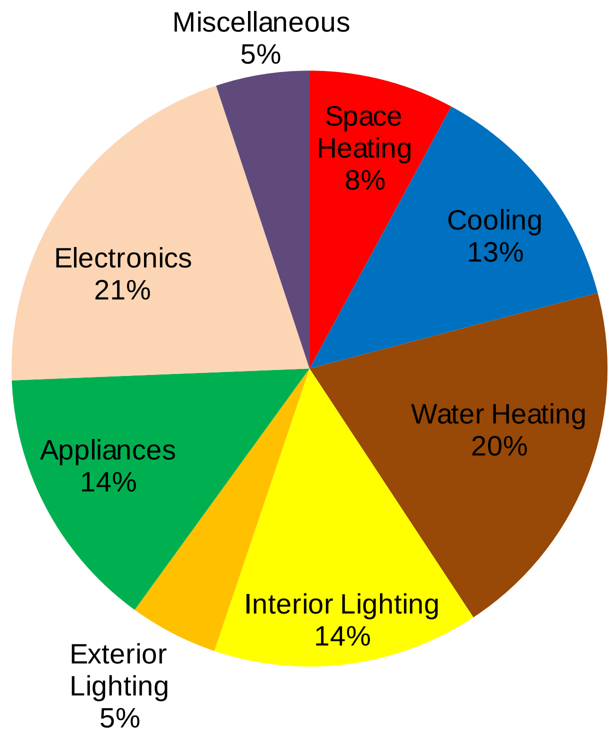
Residential EE Measure Potential

Economic potential in the residential sector in 2030 is 3,348 GWh or 21% of baseline residential usage in that year. The breakdown by end use for selected years is presented in Table 8. Figure 27, which illustrates the end-use breakdown in 2030, shows that there are substantial savings across all end uses in the residential sector, even after the effects of appliance standards.

Table 8 Residential Economic Potential by End Use

	2009	2015	2020	2030
Space Heating	66	191	214	264
Cooling	95	275	328	436
Water Heating	107	338	446	664
Interior Lighting	354	269	291	484
Exterior Lighting	135	195	164	161
Appliances	14	97	196	482
Electronics	19	205	339	688
Miscellaneous	43	123	152	170
Total	**834**	**1,692**	**2,130**	**3,348**

Figure 27 End-use Breakdown of Residential Economic Potential in 2030



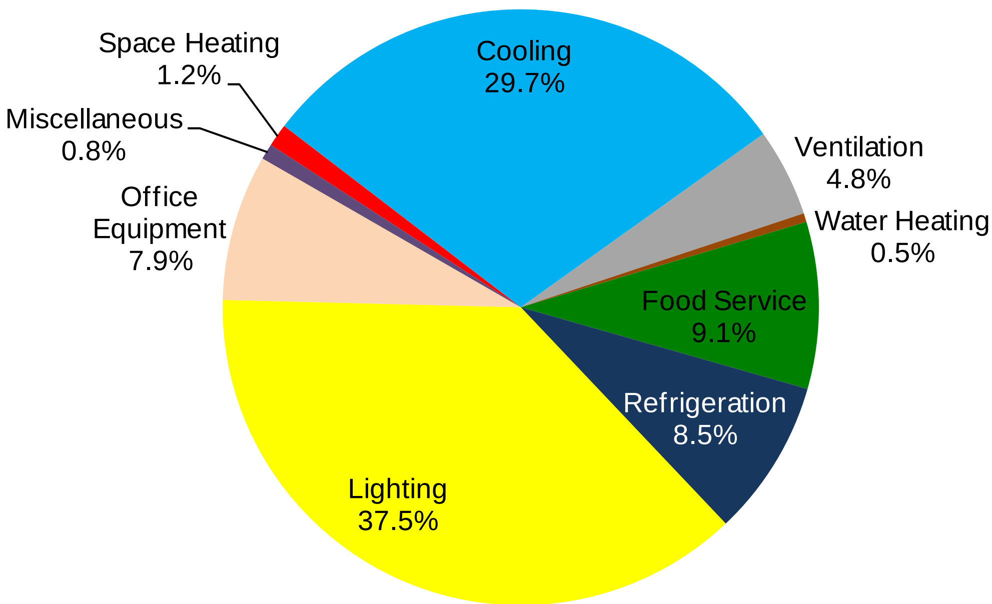
Commercial EE Measure Potential

In 2030, economic potential in the commercial sector is 2,847 GWh or 18% of baseline commercial usage in 2030. The breakdown by end use for selected years is presented in Table 9. Figure 28, which illustrates the end-use breakdown in 2030, shows that lighting and cooling account for the majority of potential savings.

Table 9 Commercial Economic Potential by End Use

	2009	**2015**	**2020**	**2030**
Space Heating	13	32	34	35
Cooling	196	542	679	846
Ventilation	14	95	132	136
Water Heating	2	7	10	13
Food Service	13	118	214	258
Refrigeration	14	90	152	242
Lighting	481	852	1,020	1,066
Office Equipment	42	156	178	226
Miscellaneous	2	12	20	24
Total	**777**	**1,903**	**2,441**	**2,847**

Figure 28 End-use Breakdown of Commercial Economic Potential in 2030



Industrial EE Measure Potential

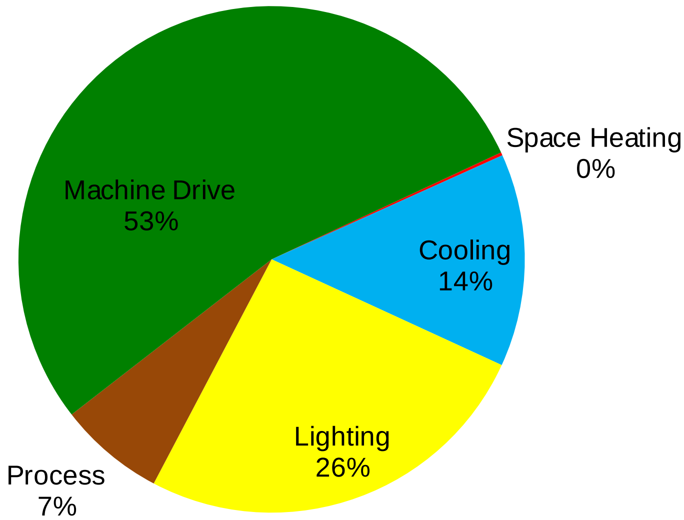
In 2030, economic potential in the industrial sector is 986 GWh or 8.5% of baseline industrial usage in 2030. The breakdown by end use for selected years is presented in Table 10.

Figure 29, which illustrates the end-use breakdown in 2030, shows that machine drives – motors and air compressors account for more than half the potential savings. However, the absolute savings from motors is relatively small for two reasons. First, there are significant savings already embodied in the baseline forecast as a result of the NEMA standards that have been in place for many years and which will begin to require that premium-grade motors be installed in December 2010. Second, industrial customers are savvy and have been able to successfully postpone motor replacement by rewinding existing motors. In addition to motors, there are significant savings opportunities in cooling, lighting and, to a lesser degree, electric processes.

Table 10 Industrial Economic Potential by End Use

	2009	2015	2020	2030
Space Heating	1	1	2	2
Cooling	26	63	75	134
Ventilation	-	-	-	-
Lighting	117	252	251	255
Process	25	65	67	67
Machine Drive	114	416	509	528
Total	**284**	**797**	**904**	**986**

Figure 29 End-use Breakdown of Industrial Economic Potential in 2030



DSM PROGRAM ANALYSIS

The process of developing the EE and DR programs for this study involved an assessment process that is illustrated in Figure 30. This figure depicts the sources of information that were used to guide the development of a portfolio of representative EE and DR programs that could then serve as the basis for detailed analyses, including cost-effectiveness analysis, supply curve assessment and scenario analysis. The results of these various analytics will serve as the inputs necessary for AmerenUE to conduct its current IRP assessment, work through the Missouri regulatory process and support the process of implementation.

Figure 30 Process for Developing Energy Efficiency and Demand Response Programs

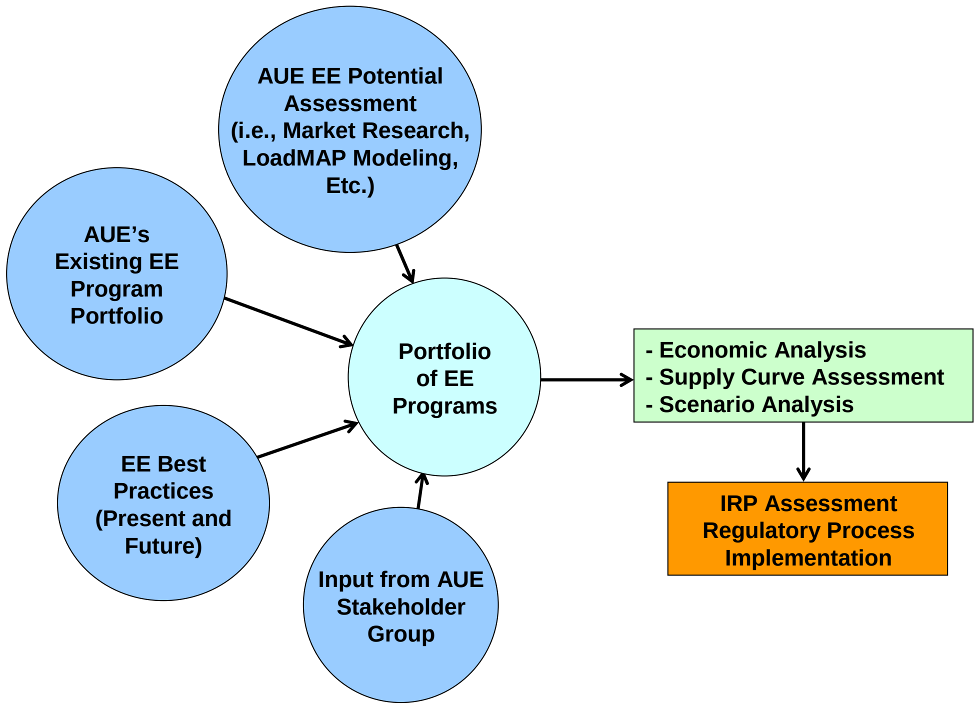


Table 11 identifies the portfolio of energy-efficiency programs considered in the analysis as well as target market segments for each. These programs reflect current industry best practices, but also provide a structure that allows the programs to adapt to meet future needs.

Figure 31 presents realistic achievable potential from energy-efficiency programs in selected years. The largest savings are found in three programs: C&I Standard Incentives, C&I Custom Incentives and Residential Lighting and Appliances

Table 11 Energy Efficiency Programs

Energy Efficiency Program	Target Market Segment(s)
1. Residential Lighting and Appliances	All residential customers
2. Multi-Family Common Area	Owners and property managers of multi-family buildings
3. Residential New Construction	Single-family new constructions
4. Residential HVAC Equipment & Diagnostics	Single-family home customers
5. Residential Energy Performance	Single-family home customers
6. Residential Low Income	Low-income residential customers
7. Residential Appliance Recycling	All residential customers
8. Residential Information/Feedback	All residential customers
9. C&I Standard Incentives	All C&I customers
10. C&I Custom Incentives	All C&I customers
11. C&I New Construction	C&I new constructions
12. C&I Retro-Commissioning	All C&I customers
13. C&I Information/Feedback	All C&I customers

Figure 31 Realistic Achievable Potential from Energy Efficiency Programs

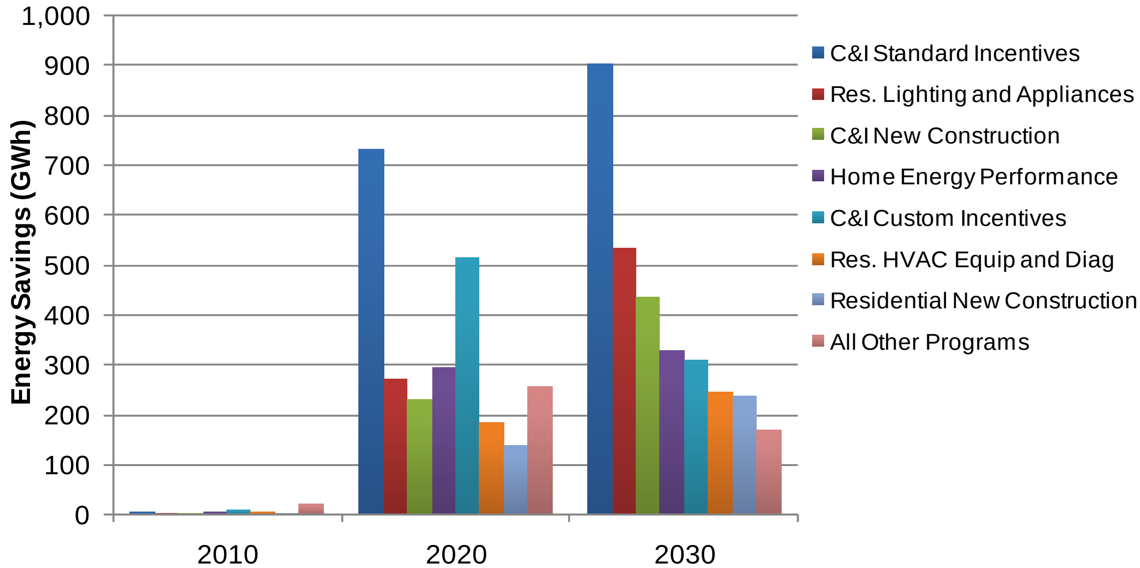
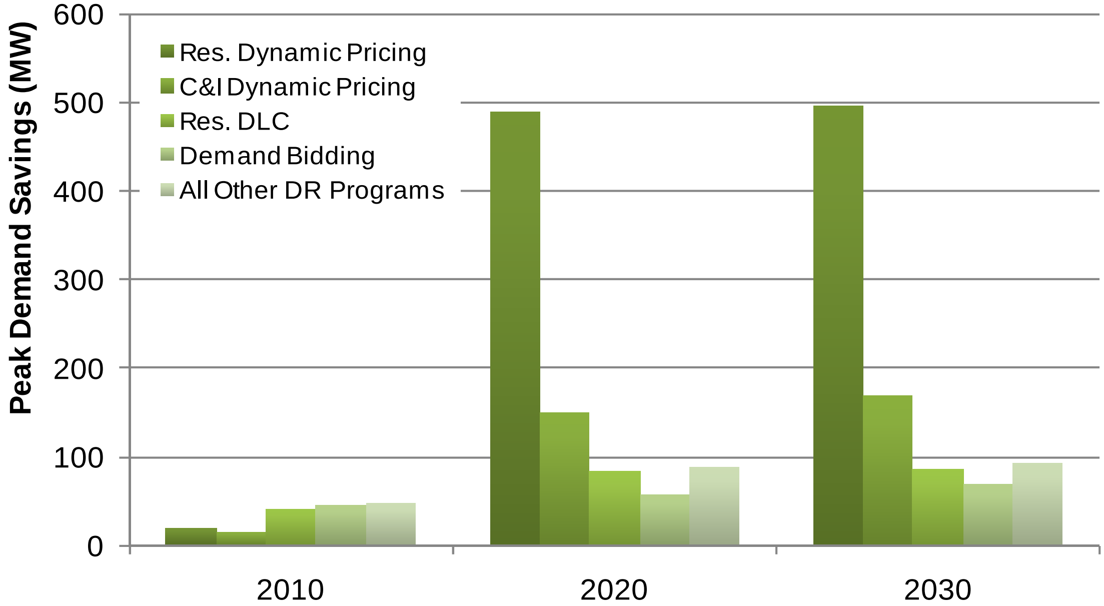


Table 12 identifies the list of demand-response programs included in the analysis together with the target segments for each. Figure 32 presents realistic achievable potential for selected years. In 2010, the majority of savings come from non-pricing programs, but by 2020 the trend is reversed and savings from dynamic pricing programs dominate.

Table 12 Demand Response Programs

Demand Response Program	Target Market Segment(s)
1. Residential Direct Load Control	All residential customers with air conditioning and electric water heating
2. Residential Dynamic Pricing	All residential customers
3. C&I Direct Load Control	All small-sized C&I customers (Rate 2M)
4. C&I Dynamic Pricing	All C&I customers (Rates 2M, 3M, 4M and 11M)
5. Demand Bidding	All medium- and large-sized C&I customers (Rates 3M, 4M and 11M)
6. Curtailable	All large-sized C&I customers (Rates 4M and 11M)
7. DR Aggregator Contracts	All C&I customers (Rates 2M, 3M, 4M and 11M)

Figure 32 Realistic Achievable Potential from Demand Response Programs



COMPARISON WITH OTHER STUDIES

The results of this AmerenUE study have been compared with three recent and relevant studies:

- The EPRI National Potential Study: ***Assessment of Achievable Potential from Energy Efficiency and Demand Response in the U.S. (2010-2030)***, TR 1016987, January 2009
- The Wisconsin Study: ***Energy Efficiency and Customer-Sited Renewable Resource Potential in Wisconsin, For the years 2012 and 2018***, ECW Report Number 244-1, April 2009
- The FERC Study: ***A National Assessment of Demand Response Potential***, Staff Report, June 2009

The EPRI Study

The EPRI Study assessed EE and DR potential for the U.S. and for four Census regions. AmerenUE is part of the Midwest Census region. The EPRI study has a 20-year time horizon and used a bottom-up analysis approach for the residential and commercial sectors, and a top-down approach for the industrial sector. (The AmerenUE study used a bottom-up analysis approach for all three sectors.) The base-year market characterization and the baseline end-use forecast were based on 2008 Annual Energy Outlook prepared by the Energy Information Administration. Energy-efficiency measures were comprehensive but not as extensive as the AmerenUE measure list. Market acceptance rates and program implementation factors were based on a Delphi approach with industry experts. The estimates of realistic achievable potential from this study represent a forecast of what is likely to occur and do not represent what might occur under "aggressive" utility programs. The AmerenUE parameters are based on primary market research with AmerenUE customers.

The Midwest regional results from the EPRI National Potential Study compare with AmerenUE as follows for the year 2030:

- EPRI economic potential in 2030 is 12.3%. AmerenUE economic potential is 16.6% and reflects the more extensive list of energy-efficiency measures.
- EPRI maximum achievable potential in 2030 is 10.1%, compared to the AmerenUE value of 11.0%. This reflects the lower market acceptance rates for AmerenUE based on market research.

- EPRI realistic achievable is 7.5%, compared with 7.3% for AmerenUE.

Even though the AmerenUE economic potential is higher than the EPRI study, the achievable potential estimates are in close alignment reflecting the results of the market research performed for the AmerenUE study.

The Wisconsin Study

The State of Wisconsin Study was conducted by Energy Center of Wisconsin (ECW), with subcontractors ACEEE, GDS Associates and L&S Technical Associates. It defines achievable potential not as a "middle-of-the-road" case, but rather as an upper-bound estimate of what could be achieved with aggressive utility programs. This study used a bottom-up analysis framework for the residential sector and a top-down approach for the C&I sectors. As mentioned above, market and program acceptance rates for AmerenUE are based on primary market research. The Wisconsin study used a Delphi approach to explore an aggressive energy-efficiency future in Wisconsin.

This study is regarded to be aggressive in its findings of energy-efficiency savings. Therefore, the results are compared with the RAP and MAP estimates from AmerenUE. Specifically, over a ten-year horizon, the ECW study concludes:

- Wisconsin economic potential is 18%, compared to 14% for AmerenUE.
- Wisconsin achievable potential is 13%, compared to 7% for AmerenUE RAP and 10% for AmerenUE MAP.

Given the definition of achievable potential used for the Wisconsin study and the approach for developing market acceptance rates, it is not surprising that the Wisconsin estimates of achievable potential are higher than the AmerenUE estimates.

The FERC Study

In 2008-2009, FERC conducted its first assessment of demand-response potential. The analysis was performed for each of the 50 states and the District of Columbia and aggregated to regional and national totals. The results reflect a bottom-up analysis approach that relies on secondary data from a variety of resources.

The definition of achievable potential for the FERC study is similar to that used for the Wisconsin EE study in that it is an aggressive perspective. Specifically, achievable potential is defined as what could be achieved over a ten-year horizon if advanced metering infrastructure (AMI) were deployed universally, dynamic pricing were the default tariff, and other DR programs, such as direct load control, were available to those who opted out of dynamic pricing. The FERC study also estimated an "expanded business as usual" scenario which represents expansion of current programs to all states and with higher participation rates, partial AMI deployment, and optional dynamic pricing tariffs. Participation rates are based on secondary data and expert judgment, whereas the AmerenUE rates are based on primary market research and expert judgment.

The FERC study provides the following estimates for the state of Missouri:

- FERC achievable potential is 19.2%, compared with 11.9% for maximum achievable for AmerenUE
- FERC expanded BAU is 14.1%, compared with 9.6% for realistic achievable potential for AmerenUE.

Since the definition of achievable potential in the FERC study is more aggressive (or optimistic) than that used for the AmerenUE study, it is not surprising that estimates of achievable potential are higher than the AmerenUE estimates.

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AmerenUE Demand Side Management (DSM) Market Potential Study Volume 2: Market Research

Results from the Saturation, Program Interest and Trade Ally Research

Report Number 1287-2

January 2010

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CHAPTER 1

INTRODUCTION

One of the primary objectives of this study was to conduct a comprehensive primary market research effort to better understand the attributes of the AmerenUE service territory. Due to the level of detail involved in the data collection, surveys were simplified for respondents into two types: saturation and program interest. The saturation survey focused on the home or premise characteristics, electricity end-use data, and the saturation of appliances, equipment, and measures. The program interest survey collected similar information about the home or premise characteristics for comparison, but focused on the customer demographics, psychographics, and attitudes. In addition, trade ally in-depth interviews were conducted to gain a qualitative understanding of the willingness of these entities to work with AmerenUE and to promote energy efficiency in AmerenUE's service area.

This report presents the research design as well as some key findings from the various surveys conducted as part of the AmerenUE DSM Potential Study; the residential saturation survey, the residential program interest survey, the commercial and industrial (C&I) saturation survey, the C&I program interest survey, and the trade ally research. Additional market research results related to the potentials modeling are included in Volume 3 which is devoted to the potentials analysis. Neither report volume provides exhaustive coverage of the information gathered from these surveys, as the surveys covered dozens of topics. However, AmerenUE has been provided with all the survey datasets and may analyze the data further.

1.1 REPORT ORGANIZATION

The remainder of this report is organized as follows:

- Chapter 2 discusses the residential research design including sample frame preparation, questionnaire design and data collection
- Chapter 3 presents key findings from the residential saturation survey
- Chapter 4 includes the results from the residential program interest survey
- Chapter 5 presents the C&I research design including sample frame preparation, questionnaire design and data collection
- Chapter 6 presents key findings from the C&I saturation survey
- Chapter 7 includes the results from the C&I program interest survey
- Appendix A presents the survey questionnaires
- Appendix B presents tabulations from the saturation surveys

CHAPTER 2

RESIDENTIAL RESEARCH DESIGN

The residential research design involved three steps: sample frame preparation, questionnaire design, and data collection. A significant amount of work went into the frame preparation in order to target the correct sample to accurately represent the AmerenUE service territory.

2.1 RESIDENTIAL FRAME PREPARATION AND SAMPLE SELECTION

The residential sample frame preparation began with an analysis of AmerenUE's billing accounts for the residential sector for 2008. First, approximately 15% of the total customer population was removed from consideration because a move or change of account did not allow for 12 months of continuous 2008 data. The remaining residential customer accounts were broken up into 5 usage categories based on actual annual usage from the 2008 AmerenUE billing data. Table 2-1 shows how the residential sector is allocated across the usage categories.

Table 2-1 AmerenUE Residential Customer Billing Analysis

2008 Usage Category	Total Number of Accounts	% of Total Accounts	Total kWh	% of Total kWh	Average kWh
Up to 7,000 kWh	180,731	21.4%	779,145,400	6.6%	4,311
7,001 -- 10,000 kWh	153,268	18.1%	1,289,463,200	11.0%	8,413
10,001 -- 14,000 kWh	182,113	21.5%	2,149,085,200	18.3%	11,801
14,001 -- 20,000 kWh	161,656	19.1%	2,675,120,400	22.8%	16,548
Above 20,000 kWh	168,118	19.9%	4,839,636,200	41.3%	28,787
Total	845,886	100%	11,732,450,400	100%	13,870

The breakdown among usage categories was then used to develop a sample target for each of the residential surveys with a goal of collecting 1,000 completed responses per residential survey. Table 2-2 shows how the 1,000 target responses were allocated among the usage categories.

Table 2-2 AmerenUE Residential Sample Target

2008 Usage Category	Total Number of Accounts	% of Total Accounts	Proposed sample	% of total sample
Up to 7,000 kWh	180,731	21.4%	175	18%
7,001 -- 10,000 kWh	153,268	18.1%	175	18%
10,001 -- 14,000 kWh	182,113	21.5%	200	20%
14,001 -- 20,000 kWh	161,656	19.1%	200	20%
Above 20,000 kWh	168,118	19.9%	250	25%
Total	845,886	100%	1,000	100%

Based on this target, AmerenUE provided a sample file containing 80,800 records for residential customers. This file was prepared by removing 4,185 records that had at least one of the following characteristics:

- No reported premise address
- No reported electricity usage
- Duplicate record
- Premise name that was a business, school, or university
- Mailing address for a property management company
- Billing address not in Missouri, or obviously for another party not using power at the premise

Of the remaining 76,615 usable sample records, 66,000 were randomly selected to be used for the residential surveys. Of these, 33,000 were allocated to the saturation survey and 33,000 were allocated to the program interest survey.

2.2 RESIDENTIAL SURVEY DESIGN

Separate survey instruments were used for the residential saturation survey and program interest survey. The residential saturation survey covered a range of topics about home energy use. Specifically, the survey covered the following topics:

- Household and home characteristics
- Heating, cooling and water heating equipment
- Lighting equipment
- Refrigeration equipment
- Kitchen equipment
- Office equipment and other electronics
- Energy Efficiency Measures

The residential program interest survey focused on the customer psychographics and attitudes toward energy efficiency and demand response programs. Specifically, the survey covered the following topics:

- Household and home characteristics
- Heating, cooling and water heating equipment
- Attitudinal questions

1. General attitudes about energy use, energy efficiency, environmental concerns, saving money, comfort, etc;
2. Purchasing attitudes, preferences, practices;
3. Attitudes toward electric utility providers in general and attitudes toward AmerenUE specifically

- Assessment of energy efficiency measures already implemented
- Interest in potential energy efficiency and demand response measures offered by AmerenUE

In order to estimate how the likelihood to participate in DSM programs would vary by payback period, a series of questions was designed using a Van Westendorp variation of price sensitivity modeling.[1] This took the following format:

- Assign programs / measures to categories that are similar in terms of type of action involved For example, treat retrofit measures as one category, add-on measures as another category, etc.
- For each measure category, ask how likely would the respondent be to implement a representative example measure in this category at a standard payback period (3 years)

4. If not likely, how about at a shorter, better payback period (1 year)? (Skip over the 5 year payback question because you can already infer that they would not take action).
5. If likely, how about at a longer payback period (5 years)? (Skip over the 1 year payback question because you can already infer that they would take action).

- How likely would you be to implement each other measure in the category at a standard payback period (3 years)?
- Map these other measures' 1 and 5 year paybacks using the shape of the curve from the representative measure.

In order to qualify to complete either survey, respondents had to meet the following criteria:

- Must have primary or shared responsibility for making energy-related decisions
- Must be at least 18 years old
- Must not work for, or have a household member that works for, a gas or electric utility company
- Must be billed for electricity directly by AmerenUE

The questionnaires are included in Appendix A.

2.3 RESIDENTIAL DATA COLLECTION

An online survey was used to collect responses for the saturation and program interest surveys. The general trend in market research is moving toward online surveys due to the high level of access to the Internet, the lower cost of collecting data, and the speed in which data can be collected. As with any market research approach, there is a potential for bias. Generally with online surveys the tendency is to attract higher income, younger, and higher-educated respondents. For this study, we attempted to reduce that bias by offering a paper version of the survey for those that were interested in participating, recruiting to the survey via postal mail, and setting quotas on electricity usage, age, and division.

Another benefit of using online software tools is that the software tool ensures accurate data collection. The software forces the respondent to answer correctly before moving on to the next question. For example, if the question asks for a percentage, only numbers between 0% and

[1] Based on pricing sensitivity techniques first introduced in 1976 by Dutch economist Peter van Westendorp. See: http://en.wikipedia.org/wiki/Van_Westendorp's_Price_Sensitivity_Meter

100% are accepted. It also saves time by automatically skipping over questions if they do not apply based on previous answers. Another advantage of online surveys as opposed to phone surveys is that pictures of appliances or equipment can be included to help assist the respondent understand the question better. These added capabilities ensure quality data is collected.

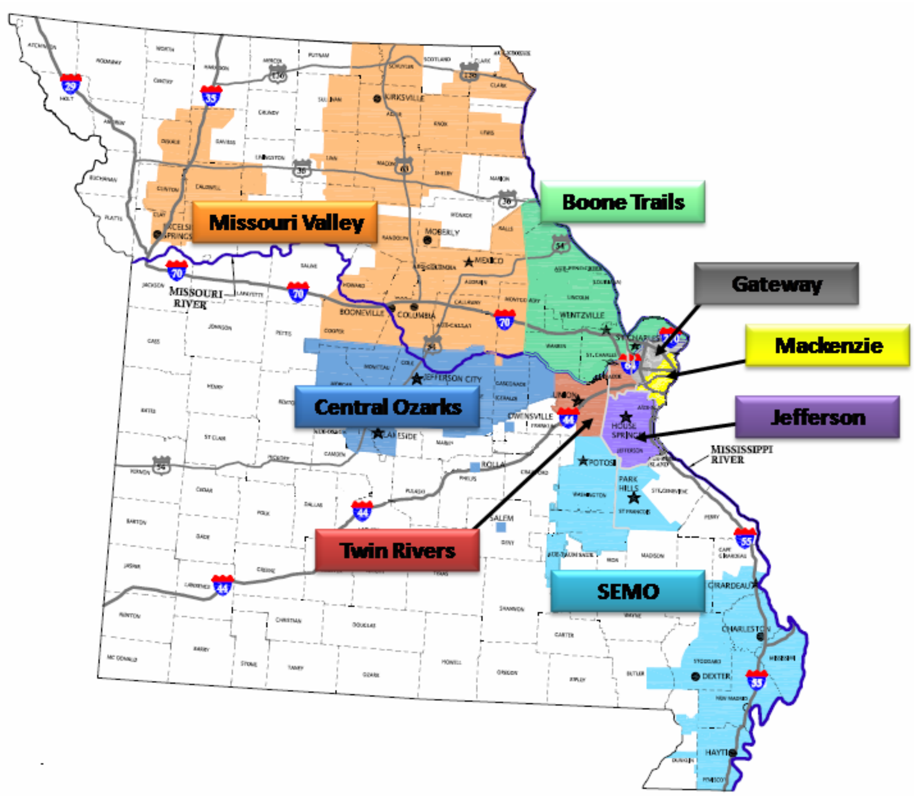
Respondents to the residential saturation survey and program interest survey were recruited through a postcard mailed using the address from the AmerenUE billing database. Once a respondent received a postcard they were asked to go to a secure website and enter their unique code to take the survey. The unique code was tied to the account number and usage from the AmerenUE billing data. The postcard offered customers a $10 Visa cash card for completing the survey. Paper versions of the surveys were mailed to respondents, if requested.

For the saturation survey, invitation postcards were sent in a single mailing wave to the 33,000 customers from the sample. The response to the survey was much higher than expected. Therefore the invitation postcards for the program interest survey were sent in two waves to the mailing addresses for 11,669 of the 33,000 sample records allocated to the program interest survey. In order to get as close as possible to filling the target quota for the 20,000+ kWh usage category, an augment of 4,248 sample records were selected from the pool of records originally allocated to the residential saturation survey that had not completed the saturation survey.

During the data collection process, the following quotas were monitored within each residential survey to insure appropriate and balanced representation:

- **Overall number of completes** – target of 1,000
- **Electricity usage in kWh** – based on the usage category from the sample frame
- **Division** – based on information from the sample frame (Boone Trails, Central Ozarks, Gateway, Jefferson, Mackenzie, Missouri Valley, SEMO, Twin Rivers)
- **Age** – assessed based on question in the survey screener (18-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years, 65 years and over)

Figure 2-1 Map of AmerenUE Divisions



2.3.1 Residential Saturation Survey Data Collection

A total of 1,284 residential saturation surveys were completed; 1,254 were from the online version of the survey and 30 were collected from the paper version. Some responses were excluded due to speed of completion or "straight-lining" responses. If the respondent completed the survey within 25 percent of the average survey length, they were excluded. Also, if the respondent appeared to be "straight-lining" (suspicious patterns in the responses, such as always answering "C") they were also excluded to ensure quality responses.

The online surveys were completed between April 1 and April 8, 2009. Requests for paper surveys were received starting April 1, 2009. Paper surveys were completed, received and data entered by April 21, 2009. The median time to complete the online survey was approximately 29 minutes. The overall response rate for the survey was 8.2% of postcards mailed.

2.3.2 Residential Program Interest Survey Data Collection

A total of 1,126 residential program interest surveys were completed; 1,122 from the online version of the survey and 4 were collected from the paper version. The online surveys were completed between June 13 and July 14, 2009. Requests for paper surveys were received starting on June 13, 2009. Paper surveys were completed, received and data entered by July 21, 2009. The median time to complete the online survey was approximately 27 minutes. Overall the response rate for the survey was 12.0%. Note that the difference in response rate between the residential saturation survey and program interest survey is largely attributable to the difference in the number of postcards sent and that the saturation survey received the necessary responses quickly and therefore was closed early.

The analysis of the Program Interest Surveys was done by Momentum Market Intelligence. The summary of the approach and analysis is in Section 4 of this volume.

2.4 DEVELOPMENT OF EXPANSION WEIGHTS

Once all the saturation survey data were collected, the data were prepared for analysis. This involved development of expansion weights and segmentation for analysis.

To develop the expansion weights, the sample was post-stratified by segment and size. Stratum and size breakpoints were developed to isolate the most extreme cases in their own stratum and split the remainder of each segment to optimally achieve the best accuracy possible given the sample we had in place. In certain strata for certain segments, we augmented the sample with additional cases, as needed.

Expansion weights for each segment and size stratum sample point were computed as the ratio of population energy use to sample energy use.

CHAPTER 3

RESIDENTIAL SATURATION SURVEY RESULTS

3.1 HOUSEHOLD DEMOGRAPHICS

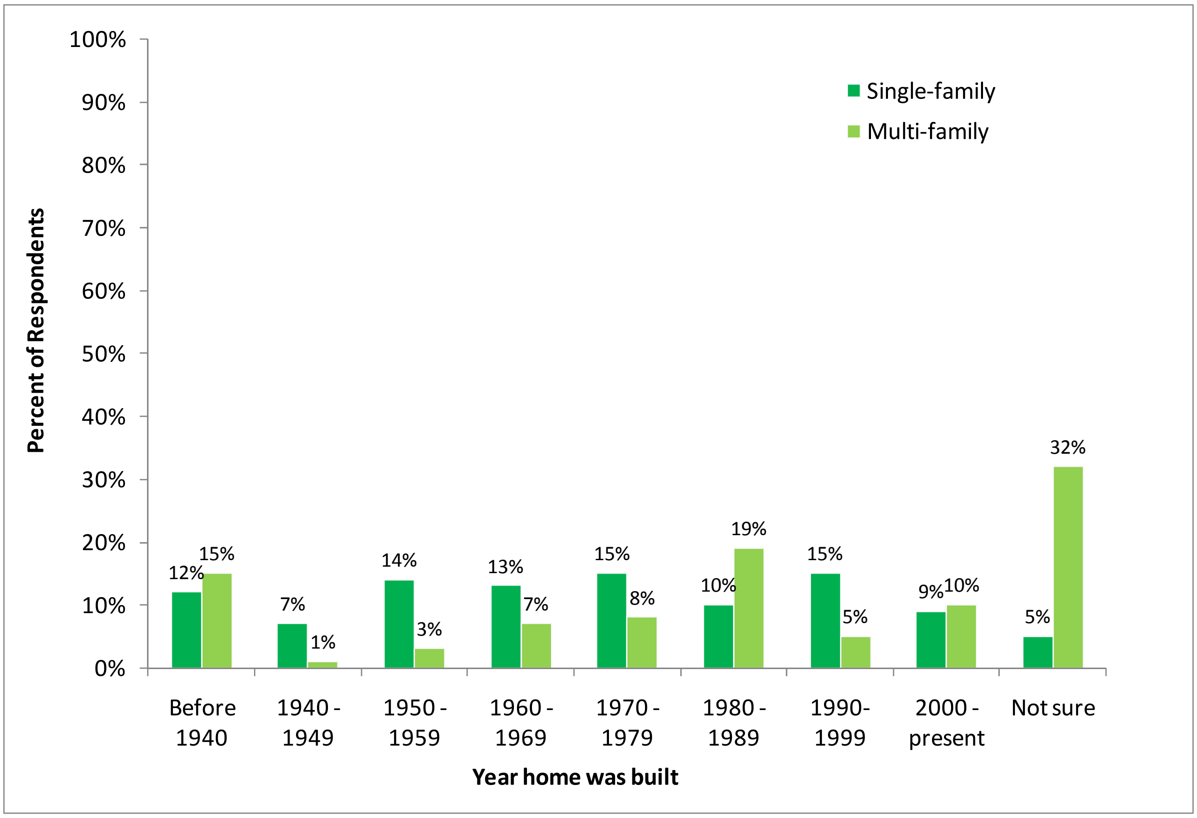
The sample was split by housing type into two segments for analysis: single-family detached homes and multi-family homes. Single-family detached homes include single-family homes and mobile or manufactured homes. The multi-family home segment includes single-family homes that are attached to one or more other homes, multi-family homes in a building with 2-4 units, and multi-family homes in a building with 5 or more units. Eighty-four percent of respondents live in a single-family home while 16% live in a multi-family home. The average number of individuals living in a single-family home is 2.7 and the average number of individuals living in a multi-family home is 1.9.

Several household demographic questions were asked that are important to a household's energy use. Key demographics include the age of home, the size of the home, and the number of individuals who work from home or are home during the weekday.

3.1.1 Age and Size of Home

The approximate year the home was built was asked to determine the age of the home. The age of existing houses is equally distributed with 10 – 17% of single-family homes being built in each decade since 1950. Figure 3-1 shows nineteen percent of single-family homes were built prior to 1950.

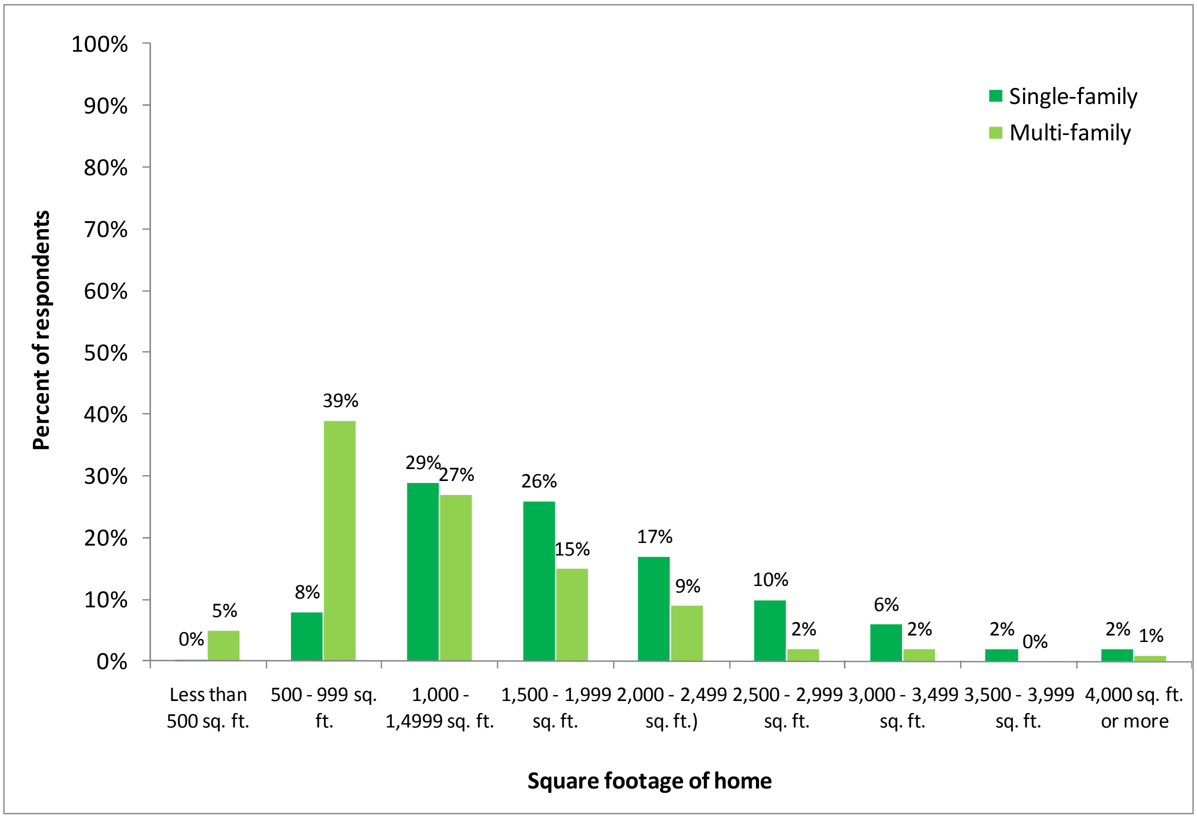
Figure 3-1 Age of Home



Almost a third of respondents did not know when their multi-family home was built (32%). The majority of those that were able to answer the question reported that their multi-family home was built in the last 30 years.

Home size is related to energy use. That is, larger homes use more energy than smaller homes. In the AmerenUE area, the majority of single-family homes are in the 1,000 to 2,499 square foot range (Figure 3-2). Twenty percent of single-family homes are 2,500 square feet or more and only 8% are less than 1,000 square feet. Multi-family homes are significantly smaller with the majority under 1,499 square feet (71%). Almost a quarter of single-family homes are in the 1,500 to 2,499 range and 5% are 2,500 or larger.

Figure 3-2 Size of Home

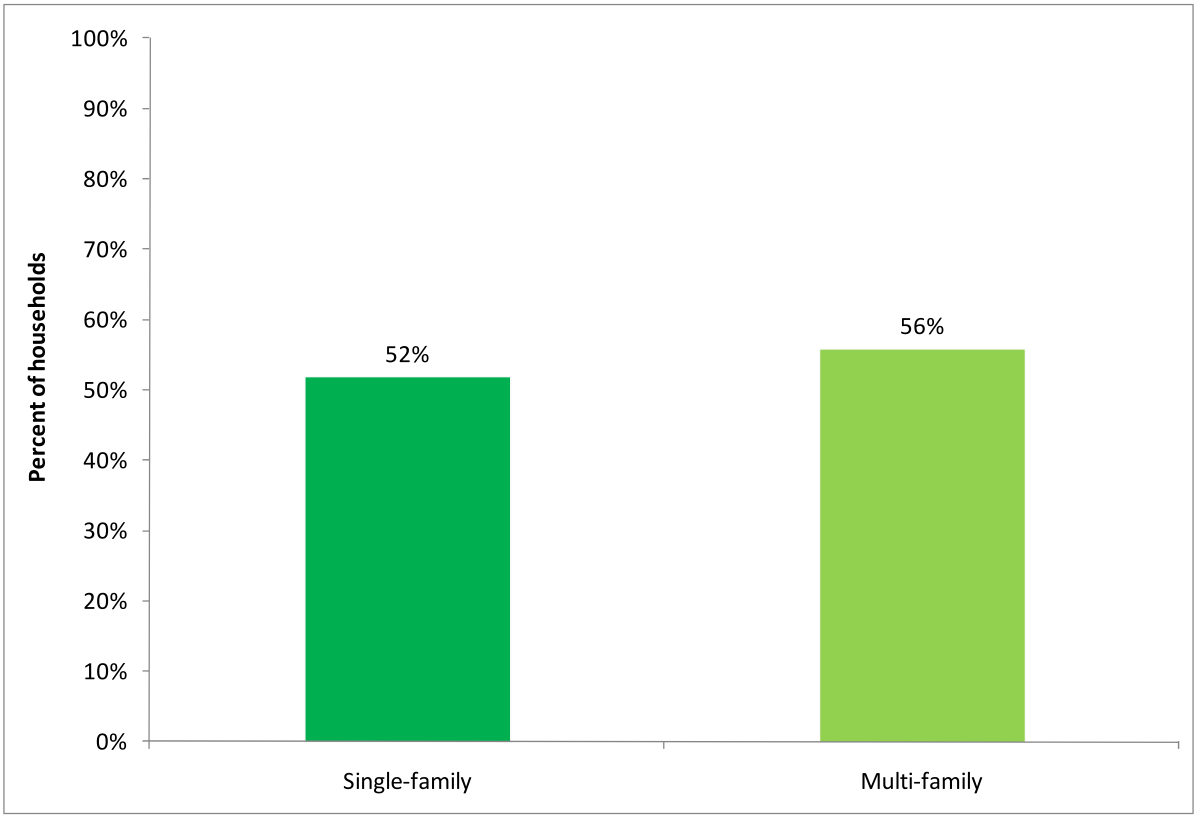


3.1.2 Individuals Home During the Weekday

Energy use tends to be higher in homes where one or more household members are home during the day. Similarly, in the summer, peak demand tends to be higher.

Most homes in the AmerenUE service territory have a member who is regularly home during the day on weekdays (Figure 3-3). Fifty-two percent of single-family and 56% of multi-family customers say someone is home during the weekday, either because they work at home or regularly stay at home all or most weekdays (four days or more).

Figure 3-3 Customers with Someone Home All or Most Weekdays



SEMO and Twin Rivers have the highest percentage of households with someone home during the weekday (Table 3-1).

Table 3-1 Households with Someone Home During the Day by Division

Division	Percent with Someone Home During the Weekday
Boone Trails	53%
Central Ozarks	52%
Gateway	53%
Jefferson	54%
Mackenzie	51%
Missouri Valley	57%
SEMO	68%
Twin Rivers	67%

Lower income households are more likely to have someone home during the weekday (Table 3-2).

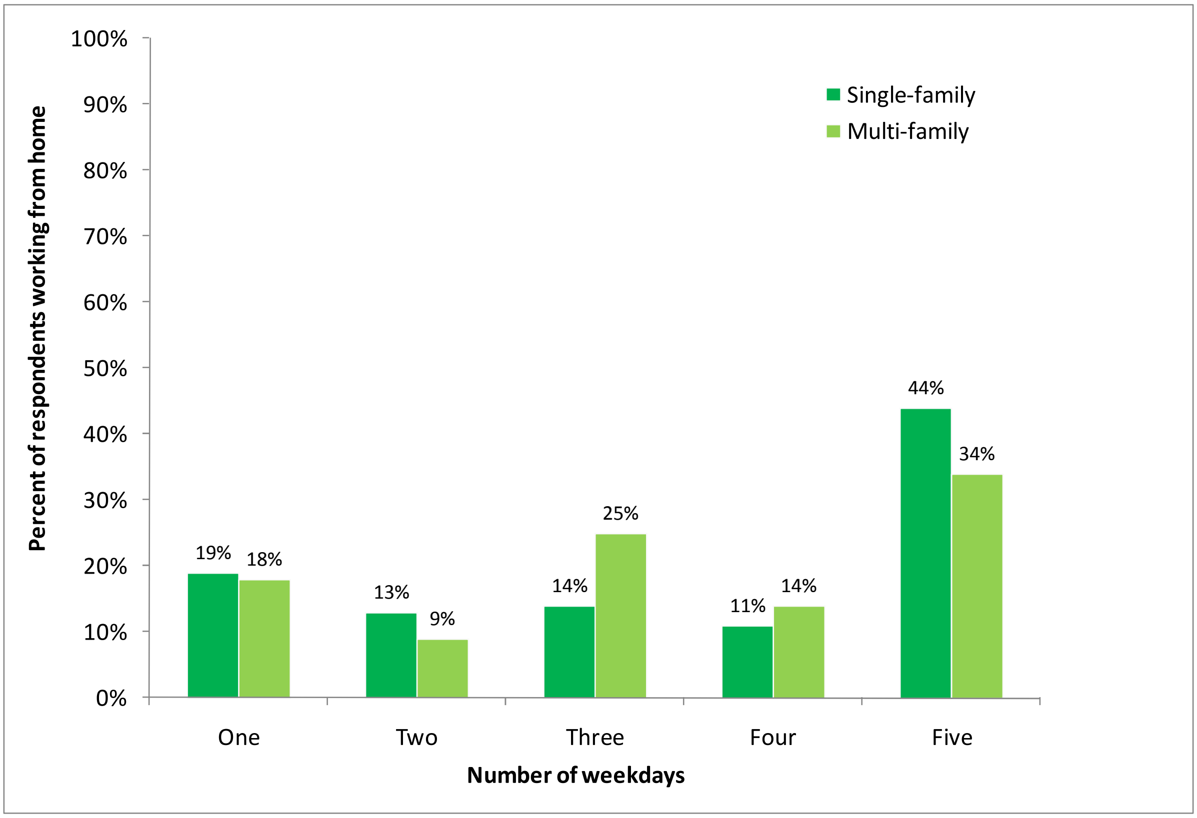
Table 3-2 Households with Someone Home During the Day by Income

Annual Household Income	Percent with Someone Home During the Weekday
Less than $15,000	65%
$15,000 to $29,999	63%
$30,000 to $49,999	54%
$50,000 to $74,999	54%
$75,000 to $100,000	49%
More than $100,000	48%

Within the group presented in Figure 3-3 is a subset of respondents that are working at home. Nineteen percent of respondents in the single-family segment have a member who telecommutes or works from home at least one day during the day on weekdays. A similar percentage (17%) of those living in multi-family homes telecommutes or works from home.

A large proportion of those working from home, do so 5 days a week (Figure 3-4). Note that Figure 3-4 only includes those people who work from home at least once during the week and not the entire population. Respondents living in single-family homes tend to work at home more days than those living in multi-family homes. Note that the percentage numbers shown in Figure 3-4 are the percent of those that work from home, not of the total population.

Figure 3-4 Number of Weekdays Spent Working at Home



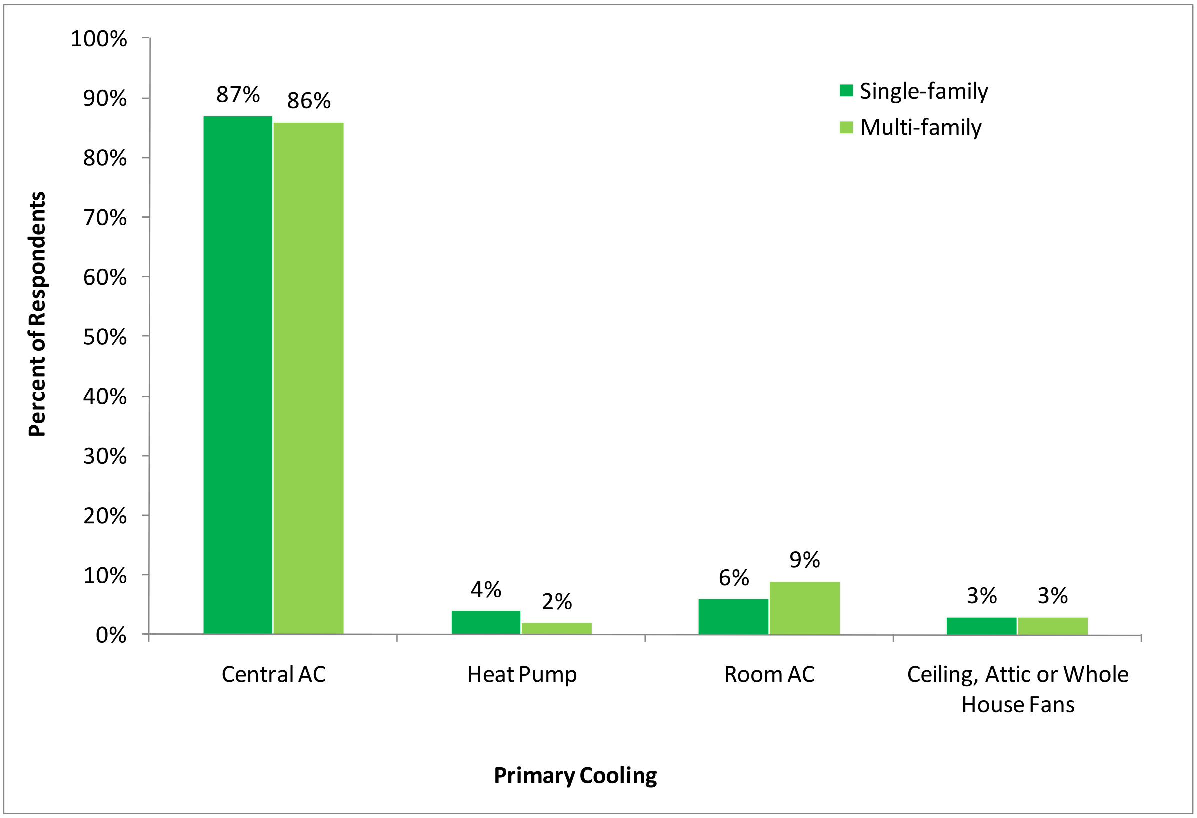
3.2 HOUSEHOLD EQUIPMENT AND APPLIANCES

Respondents were asked about the type of equipment and appliances they have, the type of fuel used for heating, cooling and water heating, and hours of operation for lighting and electronics.

3.2.1 Heating, Cooling and Water Heating

Most respondents have central air conditioning both in single-family homes and multi-family homes (Figure 3-5). Eighty-seven percent of respondents in single-family homes have central air conditioning and an additional 4% have a heat pump for cooling. Eighty-six percent of respondents in multi-family homes have central air conditioning and 2% have a heat pump. The remaining customers rely on room air conditioners or ceiling, whole house, or attic fans.

Figure 3-5 Type of Primary Cooling by Segment

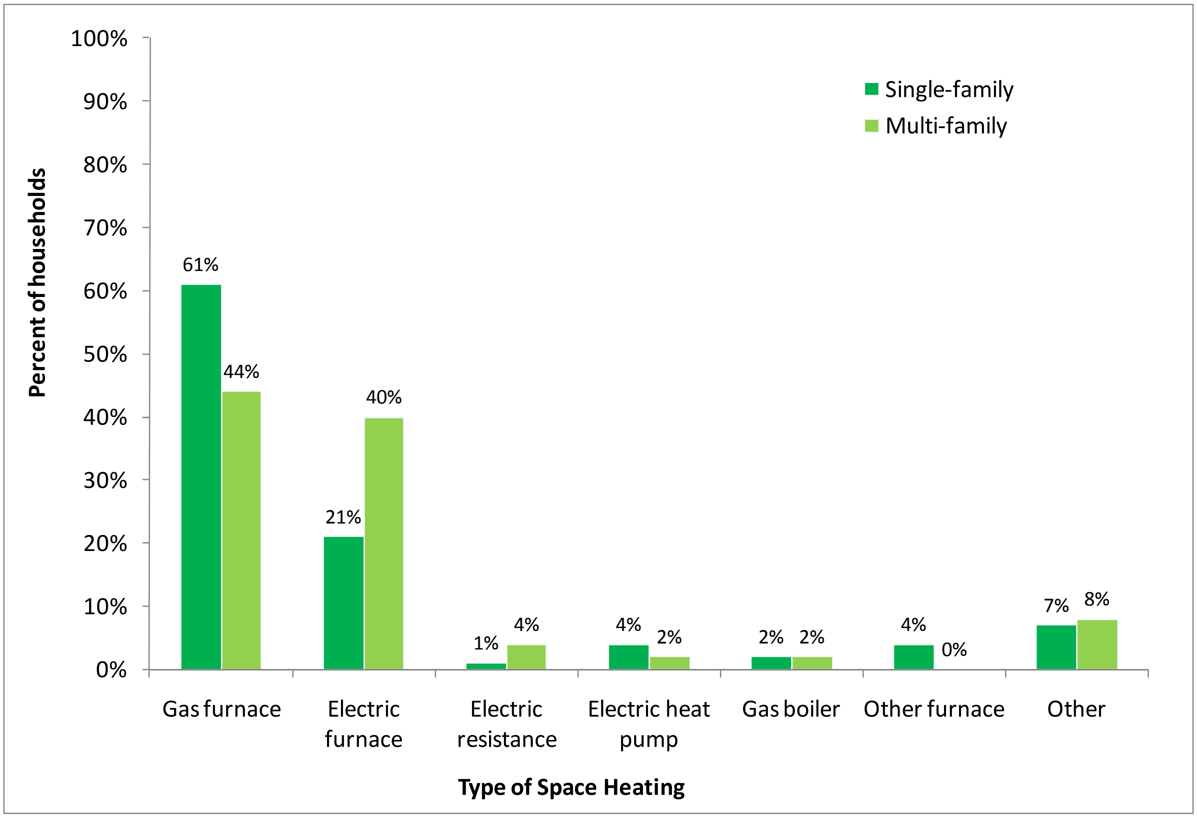


Almost two-thirds of primary cooling systems in single-family homes have been purchased since 1995 compared to 42% in multi-family homes. More than a third of respondents in multi-family homes did not know when their primary cooling system was purchased.

Fifty-one percent of respondents in single-family homes have programmable thermostats, compared to only 27% in multi-family homes.

The majority of respondents in single-family homes have a gas furnace (61%) and twenty-one percent have an electric furnace. Most respondents in multi-family homes have either a gas or an electric furnace (Figure 3-6). Several respondents reported using supplemental heating such as portable space heaters and fireplaces as their main type of space heating; 7% of single-family and 8% of multi-family homes use these other types of space heating.[2]

Figure 3-6 Type of Space Heating



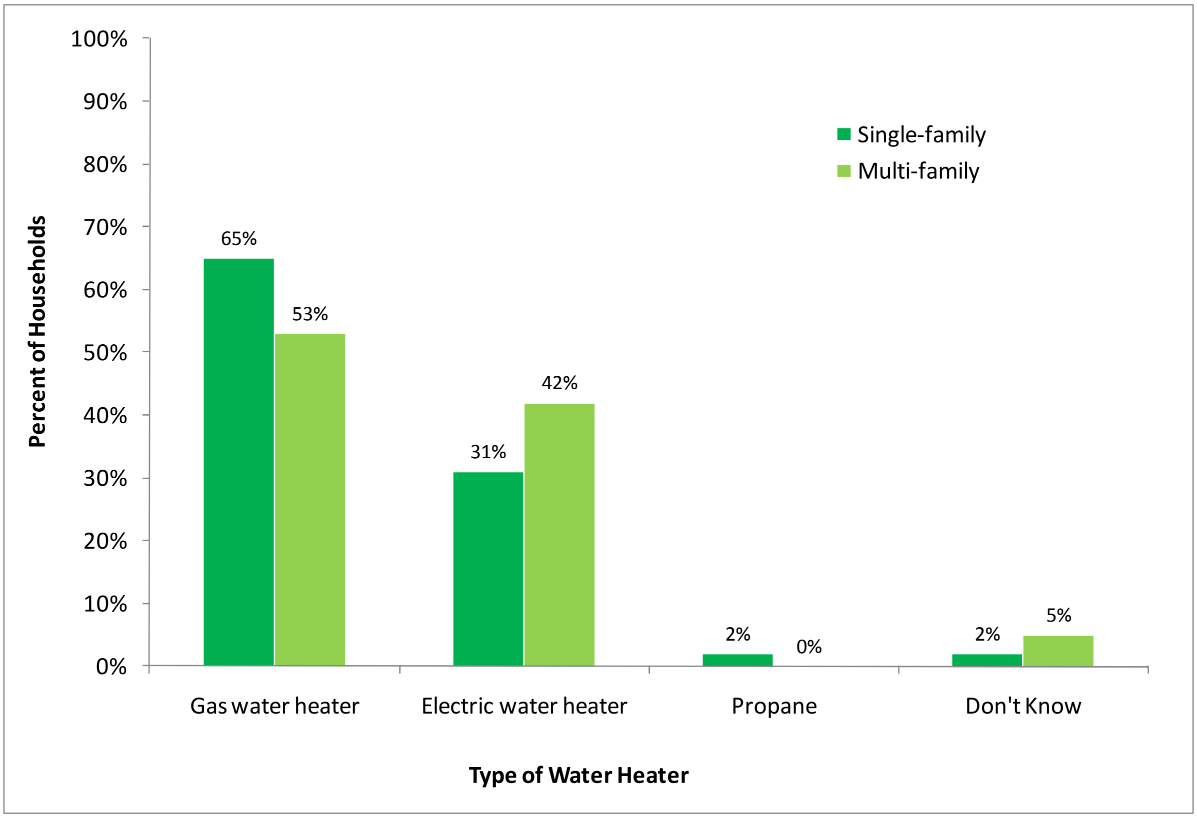
More than half of respondents in single-family homes (50%) say they also have a supplemental heating system. Of those, 49% have portable space heaters, and 21% have fireplaces. The remainder is made up of wall mounted space heaters, electric baseboard or radiant heating, furnaces and wood burning stoves.

Thirty-six percent of respondents in multi-family homes have a supplemental heating system. Similar to the single family home segment this is made up largely of space heaters (63%), followed by electric baseboard or radiant heating (15%). The remainder of the supplemental heating used by the multi-family segment is fireplaces and furnaces.

[2] This compares favorably with the 2006 Missouri Statewide Lighting and Appliance Saturation Survey: in the Missouri study 87% of all customers had a forced-air furnace (gas or electric) and 4% had a heat pump compared to 82% of single family customers in this study with a gas or electric furnace and 4% with a heat pump.

Similar to heating, the majority of respondents in single-family homes have gas water heating, while in multi-family homes the fuel used for water heating is more evenly split between gas and electric (Table 3-7).[3]

Figure 3-7 Water Heating Fuel

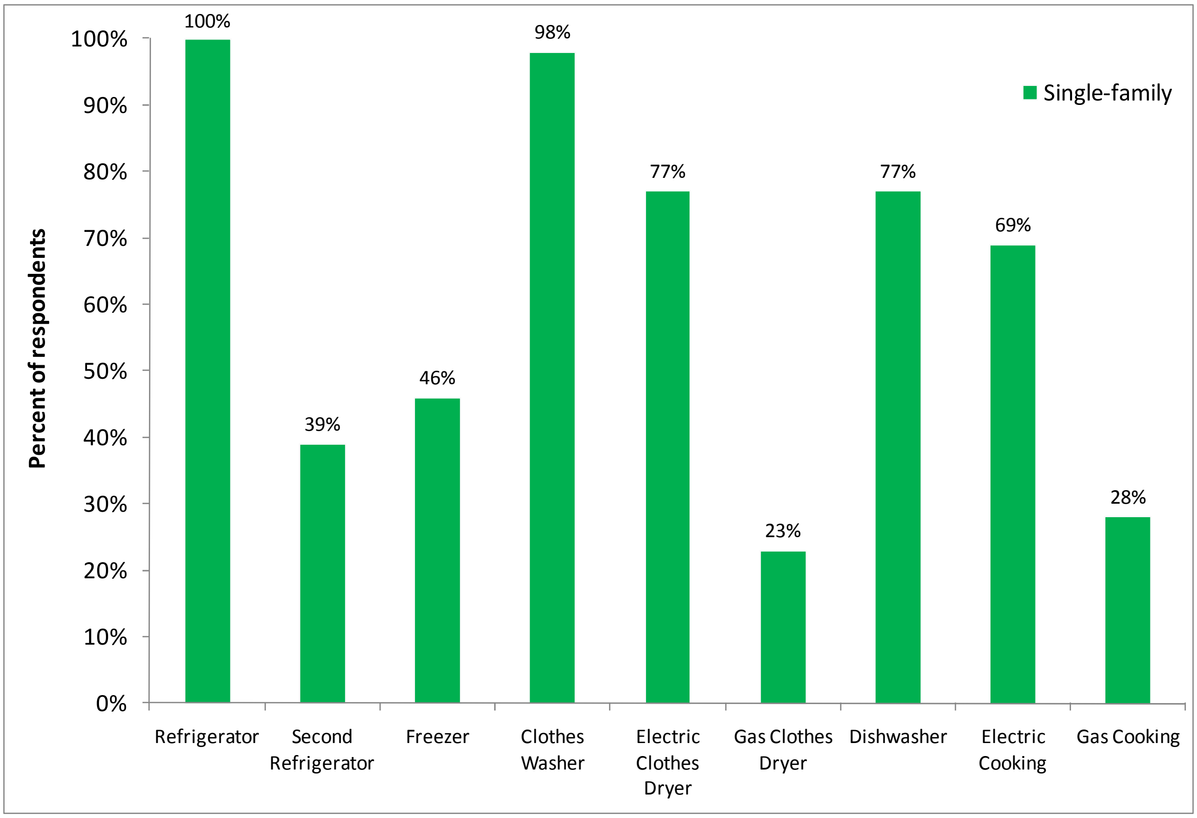


[3] Again this compares favorably to the 2006 Missouri Statewide Study where the majority of water heaters (70%) were gas for all customers compared to 66% in this analysis.

3.2.2 Appliances

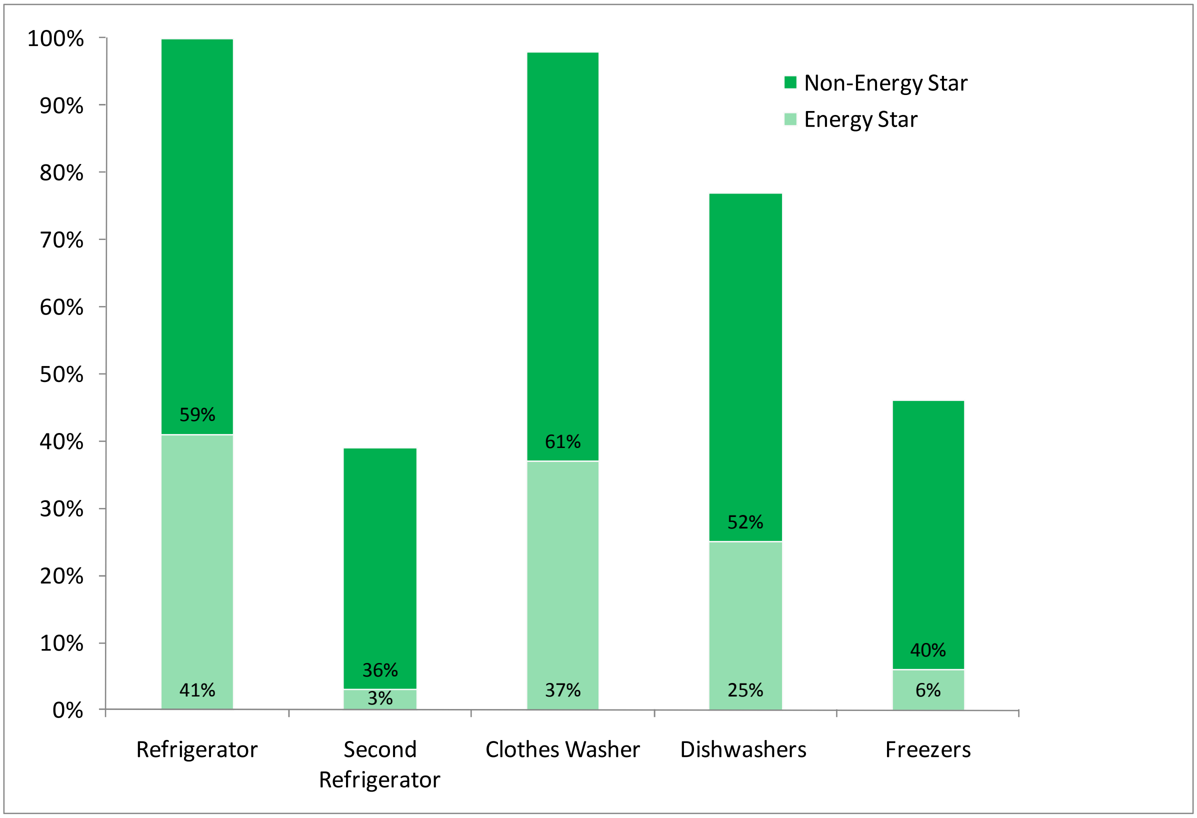
All respondents living in single-family homes have a refrigerator. In addition, almost half have a stand-alone freezer and 39% have a second refrigerator (Figure 3-8). Seventy-seven percent of respondents in single-family homes have a dishwasher and sixty-nine percent use electric for cooking. Ninety-eight percent of respondents in single-family homes also have a clothes washer, and 97% have a clothes dryer. Most clothes washers are top-loading: only 16% say they have a front-loading clothes washer. Seventy-seven percent of respondents have an electric dryer; while 23% have a gas unit.

Figure 3-8 Appliance Saturation – Single-Family Segment



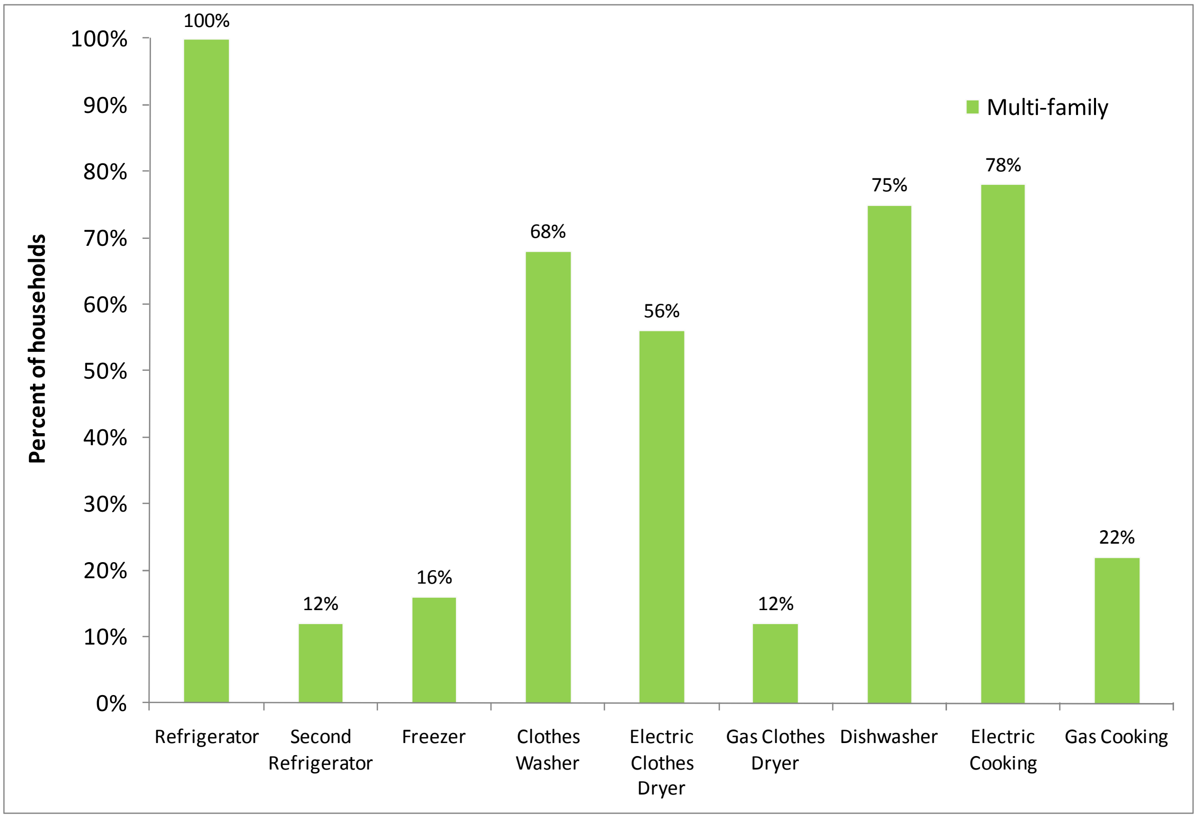
Sixty-two percent of respondents in single-family homes have at least one ENERGY STAR appliance (Figure 3-9). Forty-one percent of refrigerators are ENERGY STAR rated, compared to only 8% of second refrigerators. Thirty-eight percent of clothes washers are ENERGY STAR, while 33% of dishwashers and 13% of freezers carry the ENERGY STAR label.

Figure 3-9 ENERGY STAR Appliances – Single-Family Segment



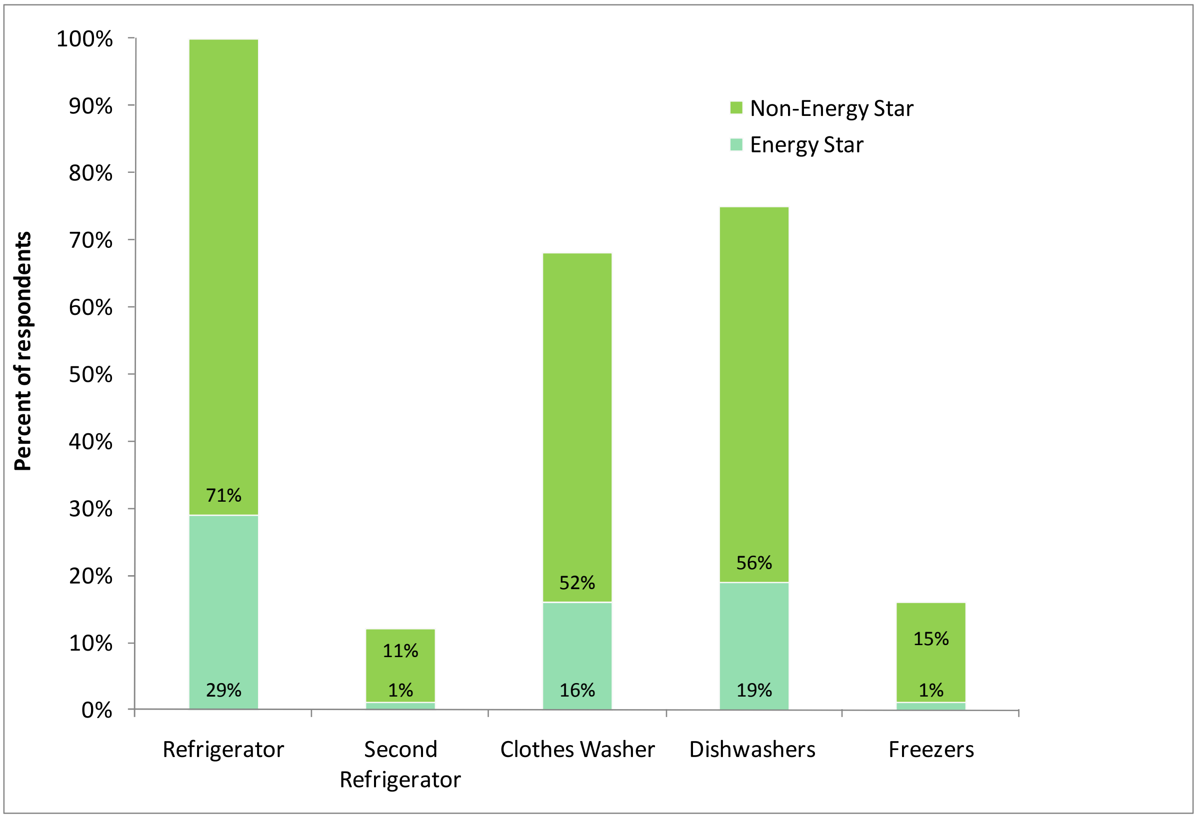
Those living in multi-family homes have fewer appliances. All have a refrigerator, but only 16% have a stand-alone freezer and 12% have a second refrigerator (Figure 3-10). Seventy-five percent have a dishwasher, and 78% use electricity for cooking. Sixty-eight percent have a clothes washer and 68% have either an electric or gas clothes dryer. Twelve percent of the clothes washers are front-loading. Similar to the single-family house segment, the majority of clothes dryers are electric.

Figure 3-10 Appliance Saturation – Multi-Family Segment



Forty-two percent of respondents in multi-family homes have at least one ENERGY STAR appliance. Twenty-nine percent of refrigerators are ENERGY STAR rated, compared to only 3% of second refrigerators (Figure 3-11). Twenty-four percent of clothes washers are ENERGY STAR, while 25% of dishwashers and 5% of freezers carry the ENERGY STAR label.

Figure 3-11 ENERGY STAR Appliances – Multi-Family Segment



Twin Rivers has the greatest proportion of all households with a second refrigerator, while SEMO and Gateway have the lowest saturation of second refrigerators (Table 3-3).

Table 3-3 Households with a Second Refrigerator by Division

Division	Percent of Households with a 2nd Refrigerator
Boone Trails	36%
Central Ozarks	38%
Gateway	27%
Jefferson	33%
Mackenzie	32%
Missouri Valley	40%
SEMO	27%
Twin Rivers	53%

The presence of a second refrigerator appears to have a linear relationship with household income: the higher the income the more likely it is for a household to have a second refrigerator (Table 3-4).

Table 3-4 Households with a Second Refrigerator by Income

Annual Household Income	Percent of Households with a 2nd Refrigerator
Less than $15,000	10%
$15,000 to $29,999	18%
$30,000 to $49,999	24%
$50,000 to $74,999	35%
$75,000 to $100,000	39%
More than $100,000	53%

3.2.3 Lighting

The average number of interior light bulbs in a single-family home is 42, while a multi-family home has an average of 24 total light bulbs (Table 3-5). The majority of light bulbs in both segments are conventional incandescent bulbs. Less than a quarter of light bulbs are CFLs.

Table 3-5 Type of Interior Light Bulbs by Segment

Segment	Total Number of Light Bulbs	Percent Conventional / Incandescent	Percent CFL	Percent Tubular fluorescent	Percent Low voltage	Percent Halogen	Percent Other
Single-family	42	59%	21%	9%	3%	6%	2%
Multi-family	24	61%	18%	8%	4%	8%	1%

The Twin Rivers Division represents the greatest opportunity for a CFL program (Table 3-6). On average only 14% of the light bulbs in a Twin Rivers household are CFLs. Gateway has the highest saturation of CFLs (27%).

Table 3-6 Incandescent and CFL Saturation by Division

Division	Percent of Total Interior Light Bulbs	
	Incandescent	CFL
Boone Trails	64%	20%
Central Ozarks	64%	21%
Gateway	56%	27%
Jefferson	58%	23%
Mackenzie	55%	23%
Missouri Valley	61%	24%
SEMO	66%	22%

Twin Rivers	66%	14%

Income appears to have little to do with the saturation of CFL's in a household (Table 3-7).

Table 3-7 Incandescent and CFL Saturation by Income

Annual Household Income	Percent of Total Interior Light Bulbs	
	Incandescent	CFL
Less than $15,000	63%	27%
$15,000 to $29,999	66%	21%
$30,000 to $49,999	56%	28%
$50,000 to $74,999	60%	21%
$75,000 to $100,000	57%	25%
More than $100,000	57%	21%

Many respondents in single family homes use lighting controls on their interior lighting. Fifty-two percent of respondents in single-family homes use dimmers compared to 27% in multi-family homes. Eighteen percent in single family homes use lighting timers compared to 13% of those in multi-family homes. Eighteen percent in single-family homes use motion detectors compared to 5% of those in multi-family homes.

The average number of exterior light bulbs for single-family homes is 6 while multi-family homes have an average of 3 light bulbs (Table 3-8). Sixty-two percent of the external light bulbs for multi-family homes are incandescent, while single-family homes tend to have more types of light bulbs on the outside of their home.

Table 3-8 Type of Exterior Light Bulbs by Segment

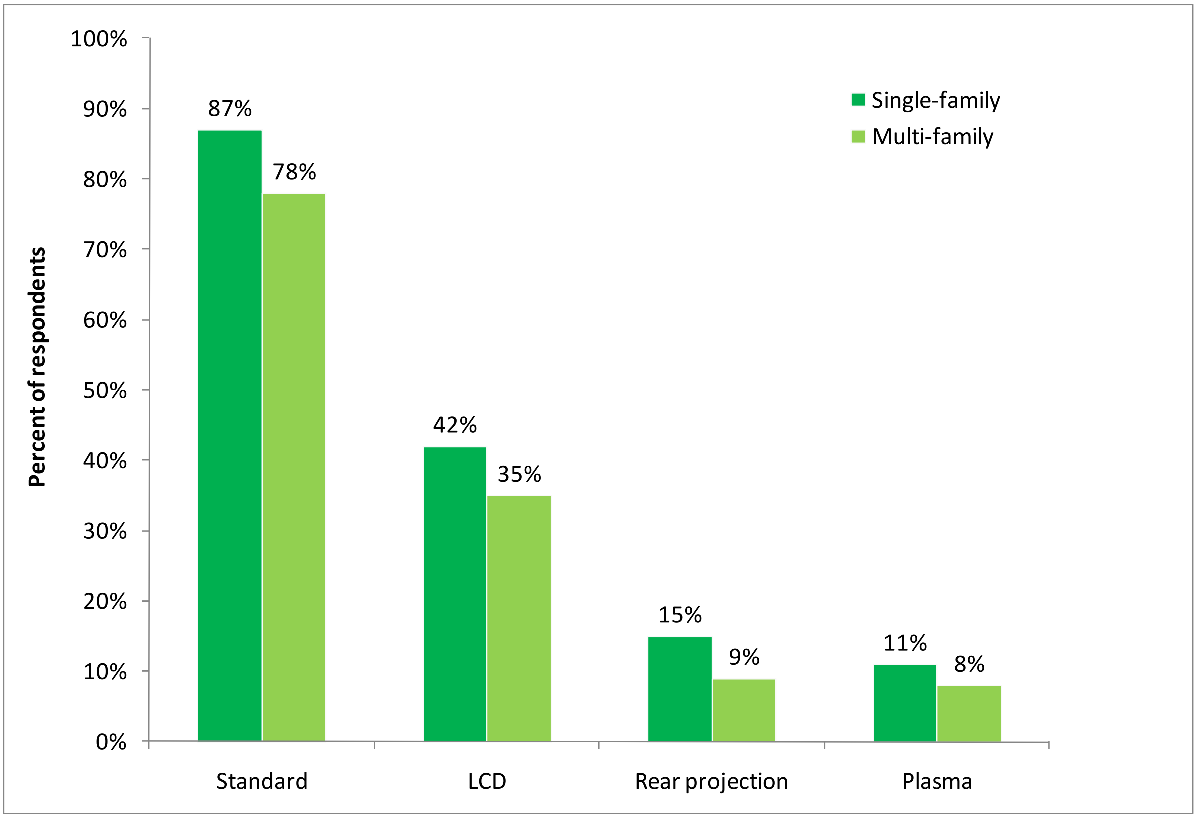
Segment	Total Number of Light bulbs	Percent Conventional / Incandescent	Percent CFL	Percent Halogen	Percent Low voltage	Percent LED	Percent HID
Single-family	6	40%	12%	32%	11%	1%	4%
Multi-family	3	62%	13%	20%	2%	0%	3%

Fifty-four percent of respondents in single-family homes and 38% in multi-family homes use lighting controls on their external lights. Thirty-eight percent of those in single-family homes use motion detectors, compared to 18% in multi-family homes; 26% in single-family homes use dusk-to-dawn lights compared to 13% in multi-family homes; and 11% in both segments use timers.

3.2.4 Electronics

Respondents in single-family homes have an average of 3.3 TVs per household, while those in multi-family homes have an average of 2.7 TVs. The majority of respondents have at least one standard TV, and 42% of those in single-family homes and 35% of those in multi-family homes have at least one LCD TV (Figure 3-12). Smaller percentages have one or more plasma or rear projection TV.

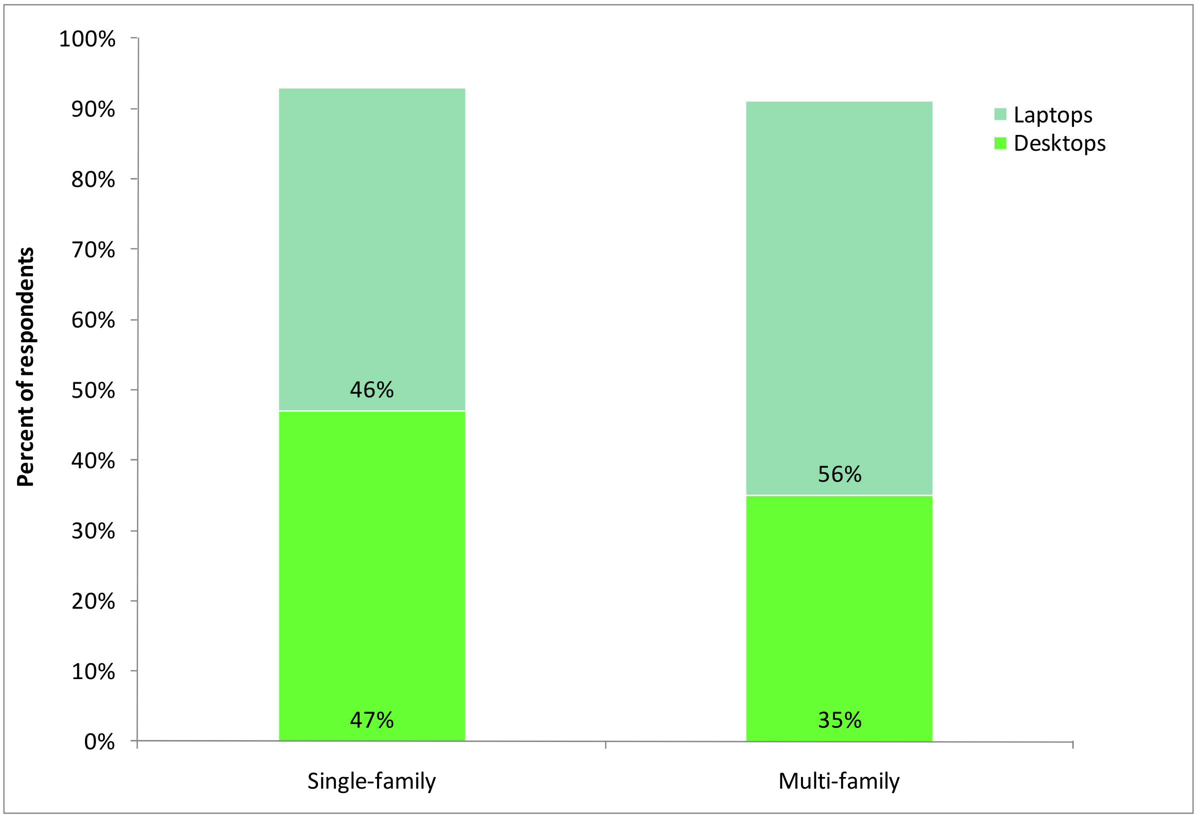
Figure 3-12 Type of TV by Segment



Respondents in single-family homes report that their household watches TV on average a total of 10.1 hours per day on all their TVs combined, while those in apartments watch TV 8.1 hours per day on all their TVs. Twenty-nine percent of respondents in single-family homes and 26% in multi-family homes have at least one ENERGY STAR TV.

Ninety-three percent of respondents in single-family homes and 91% in multi-family homes have at least one computer. Respondents in single-family homes have an average of 1.7 computers evenly split between laptops and desktops (Figure 3-13). Respondents in multi-family homes have an average of 1.5 computers per household. Sixty-one percent of computers in multi-family homes are laptops and 39% are desktops. Respondents in single-family homes have their computers turned on an average of 12.0 hours per day, while those in multi-family homes have their computers on 11.6 hours per day. This takes into consideration respondents who do not shutdown their computer while not in use. Twenty-eight percent of respondents in single-family homes and 31% in multi-family homes have an ENERGY STAR computer.

Figure 3-13 Computer Saturation



3.3 ENERGY ACTIONS

Respondents were asked what recent home improvements they had made, whether they intended to make improvements in the next 6 to 12 months and what types of actions they took to improve their household's energy efficiency. They were also asked about their participation in utility-sponsored energy efficiency programs. This information was used to determine the current saturation of energy-efficiency measures and to develop the adoption rates for the forecast.

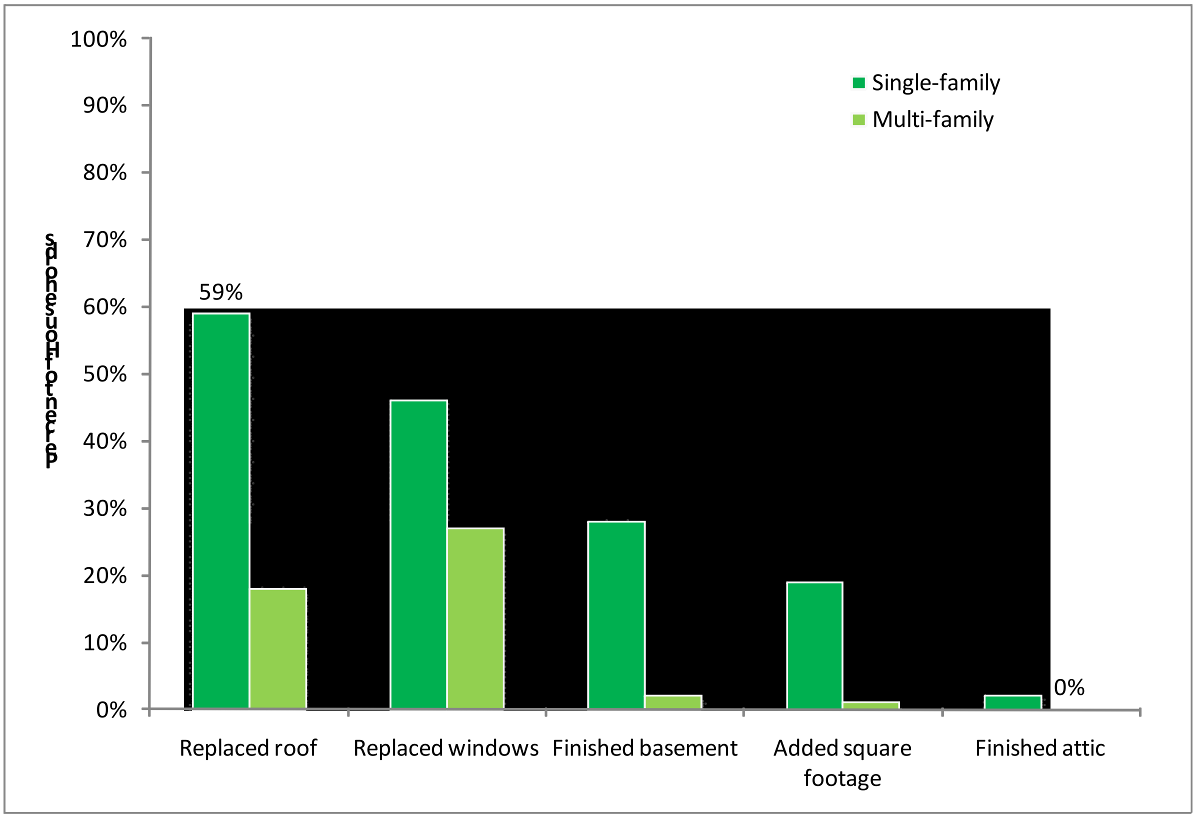
3.3.1 Home Improvements

Most respondents living in single-family homes have made at least some improvements to their home. Eighty-eight percent of respondents in single-family homes said they or a previous owner had made a home improvement or remodeled the home since it was built. Not surprisingly, fewer respondents living in multi-family homes had made improvements. Fifty-four percent of respondents living in multi-family homes said they or a previous occupant/owner had made a home improvement or remodeled the home since it was built.

For the purposes of this analysis home improvement/remodeling efforts are broken into three categories: structural changes, appliance upgrades, and weatherization.

The most popular structural change made by respondents in single-family homes is replacing the roof, followed by replacing windows (Figure 3-14). Fifty-nine percent of respondents in single-family homes replaced their roof and 46% replaced windows. Over a quarter of respondents finished their basement, 19% added square footage and 2% finished their attic.

Figure 3-14 Structural Home Improvements Since Home Was Built

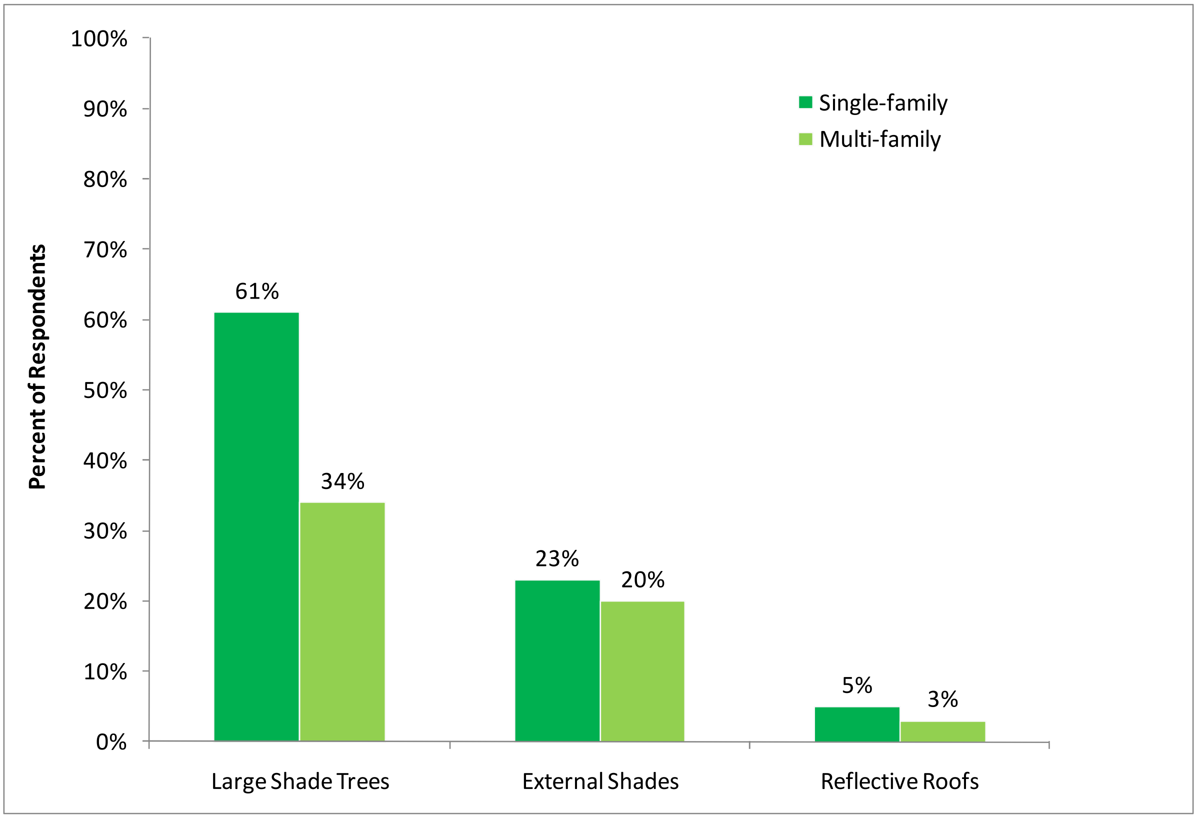


As expected, respondents in multi-family homes did fewer structural changes. The most common change was replacing their windows with almost one quarter of respondents in multi-family homes doing so. Nineteen percent said the roof has been replaced.

Seventy percent of respondents in single-family homes said they use at least one of the measures mentioned in the survey that helps reduce the need for air-conditioning (Figure 3-15). The most popular measure in this category was large shade trees (61%) followed by external shades (23%). Five percent of respondents in single-family homes said they had reflective roofs.

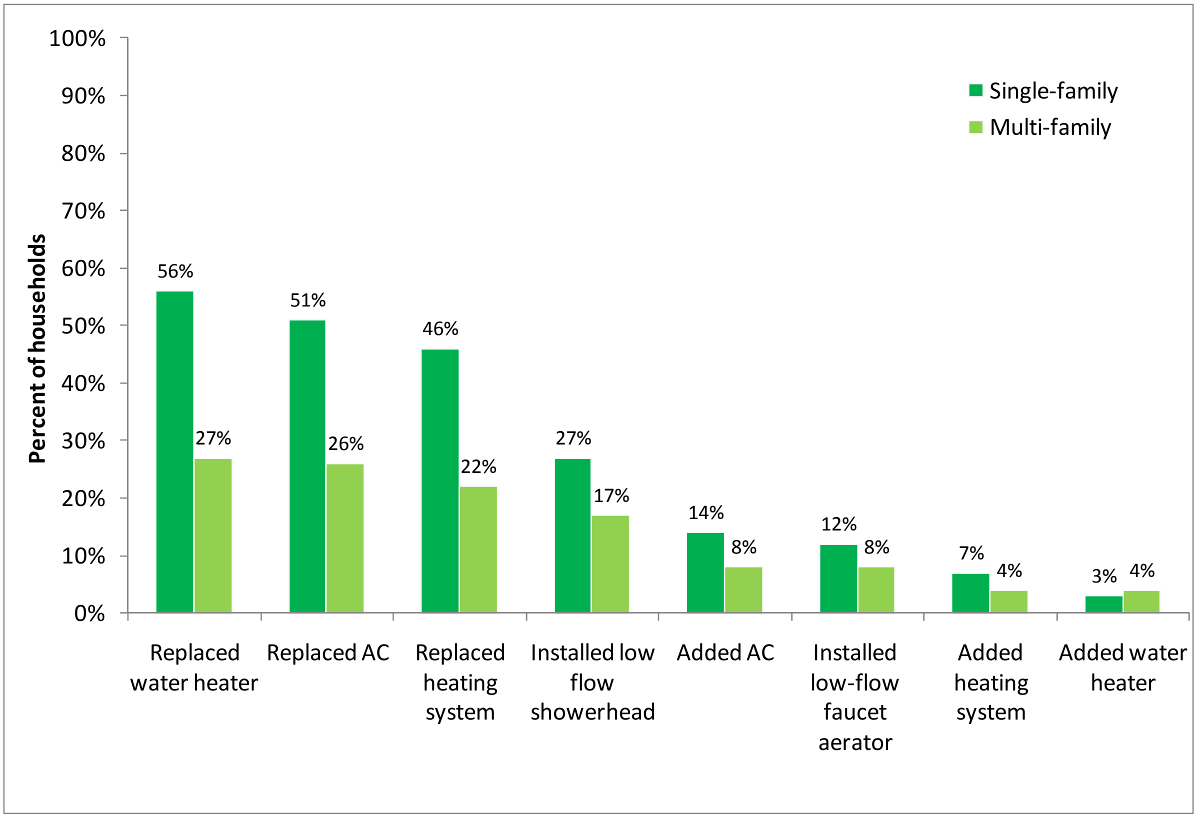
Fewer respondents in multi-family homes (46%) used one of the measures mentioned to reduce the need for air-conditioning. Again the most popular measure was large shade trees (34%) followed by external shades (20%). Three percent of respondents in the multi-family segment reported having a reflective roof.

Figure 3-15 Measures Installed to Reduce Air Conditioning



More than half of the respondents in single-family homes replaced their water heater, and replaced an air conditioner (Figure 3-16). Forty-six percent replaced their heating system. Twenty-seven percent installed low-flow showerheads, and 12% installed low-flow faucet aerators. Small percentages of respondents in single-family homes added additional appliances.

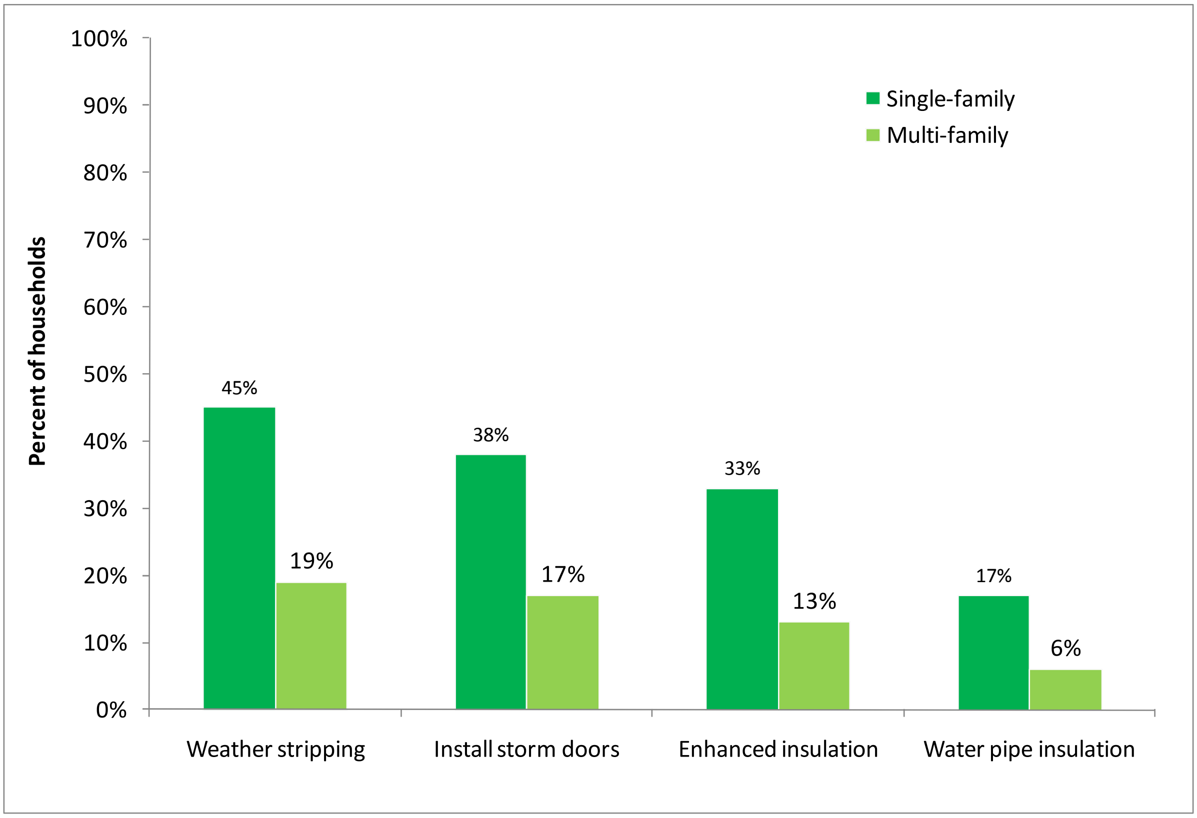
Figure 3-16 Appliance Upgrades Since Home Was Built



Appliance upgrades are the most popular home improvement for respondents living in multi-family homes. Twenty-seven percent have replaced a water heater, 26% have replaced their air conditioner, and 22% have replaced their heating system. Seventeen percent have installed a low-flow showerhead while smaller percentages have installed low-flow faucet aerators or added new appliances.

Almost half of respondents in single-family homes weather stripped/caulked windows and/or doors, 38% installed storm doors, and 33% enhanced insulation of ducts, ceilings, walls, attics and/or the foundation (Figure 3-17). Seventeen percent enhanced water pipe insulation.

Figure 3-17 Weatherization Improvements Since Home Was Built



Nineteen percent of respondents in multi-family homes weather stripped/caulked windows and/or doors, 19% installed storm doors and 13% enhanced insulation of ducts, ceilings, walls, attics and/or the foundation. Six percent enhanced water pipe insulation.

3.3.2 Future Home Improvements

Only 17% of respondents living in single-family homes plan on making home improvements in the next 6 months. Five percent plan to weather strip, 5% plan to install storm doors, 3% plan to replace their roof and 3% plan to add insulation. Less than 3% plan to make the other improvements mentioned.

When asked about their plans in the slightly longer term of 6 to 12 months from now, an additional 10% plan on making such improvements. Six percent plan to replace windows, 5% plan to replace a water heater, 5% plan to enhance insulation and 4% plan to weather strip. Less than 4% plan on making the other improvements mentioned.

For respondents living in multi-family homes, only 9% plan on making home improvements in the next 6 months. Three percent plan to weather strip and 3% plan to add low flow faucet aerators. Less than 2% plan to make the other improvements mentioned.

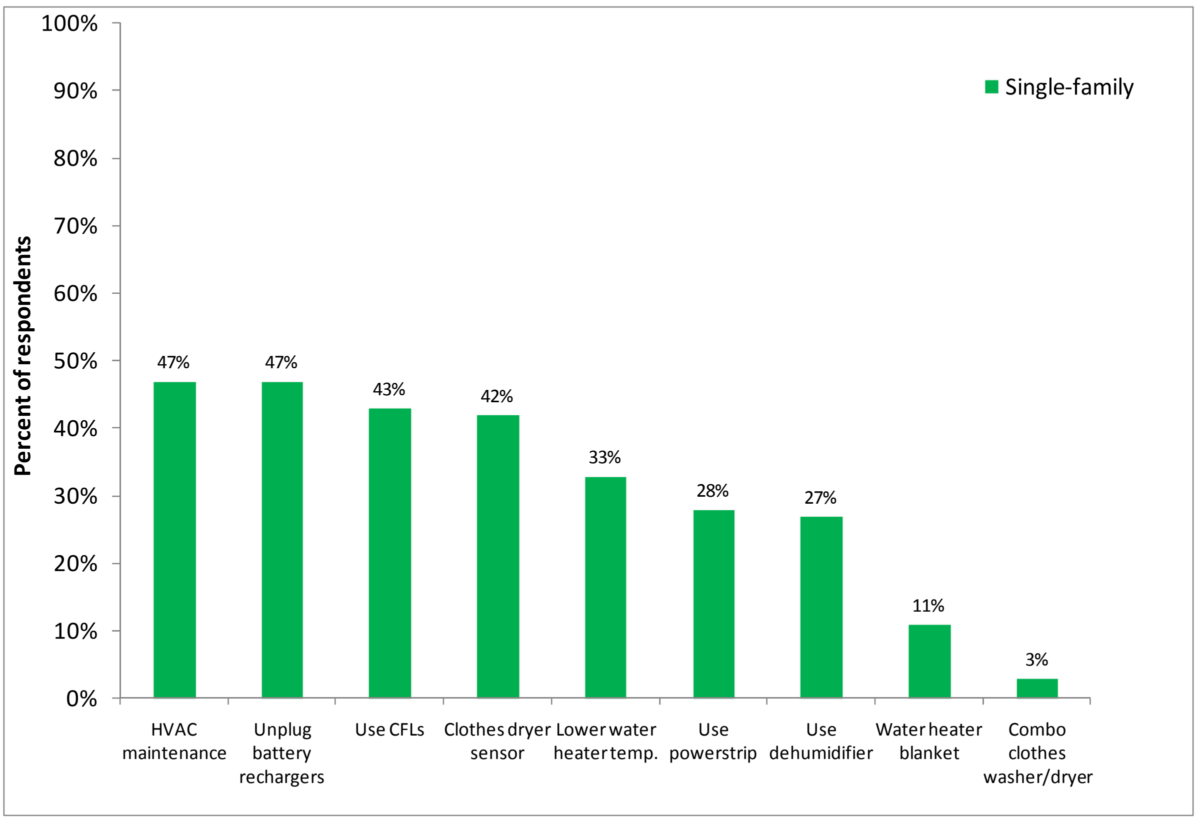
An additional 5% also plan on making improvements in the next 12 months. Three percent plan to replace the heating system and 3% plan on replacing a water heater. Less than 2% plan on making the other improvements mentioned.

3.3.3 Program Awareness and Energy Efficiency Actions

Few customers stated they were aware of AmerenUE programs that offer conservation rebates, loans or price discount programs. Seven percent of respondents living in single-family homes and 7% living in multi-family homes claimed such awareness, and less than 1% of total respondents said they participate in programs. As the AmerenUE Energy Efficiency programs were still largely in their planning stages during the fielding of this survey, this result is reasonable, and establishes a baseline of minimal survey bias that can be used in future market research efforts. Respondents tended not to answer falsely about their awareness and participation in AmerenUE Energy Efficiency programs.

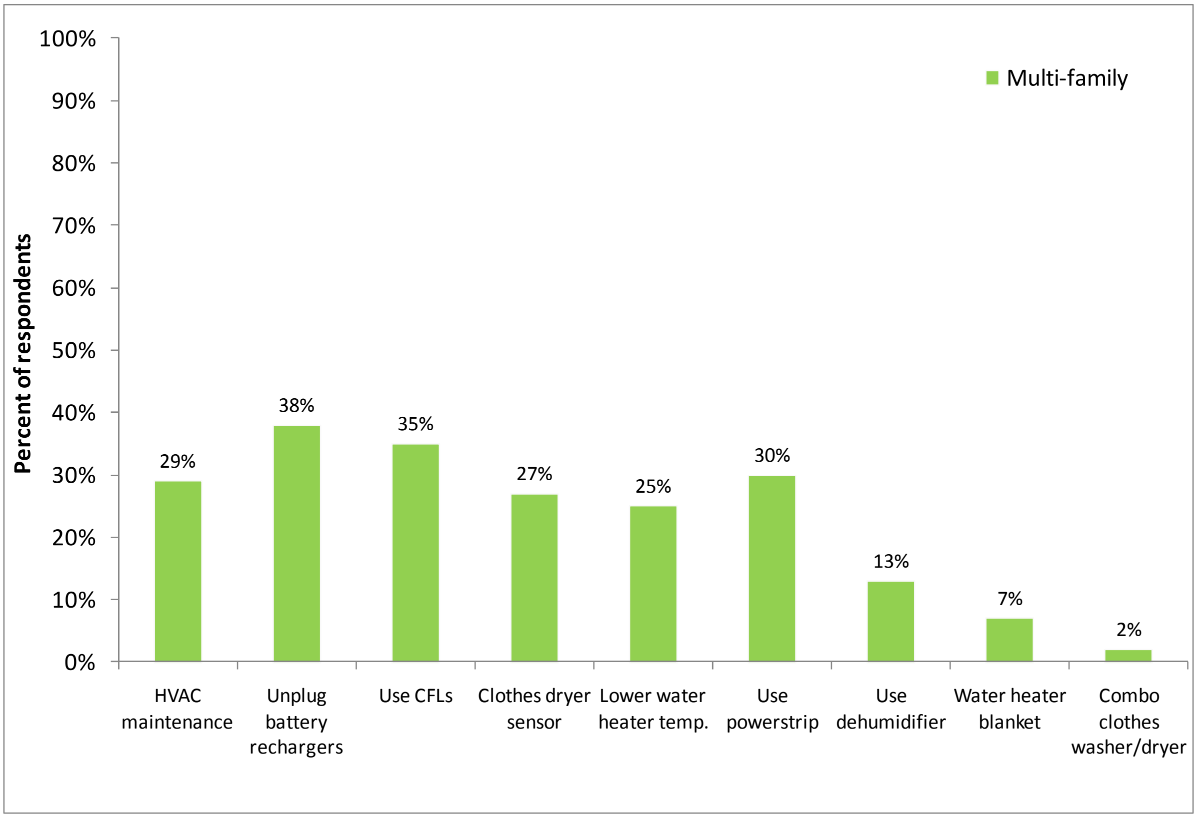
Regardless of program activity, most respondents are taking energy efficiency actions. Eighty percent of respondents living in single-family homes have performed one or more energy-efficiency action, along with 70% of those in multi-family homes. The most popular actions for respondents in single-family homes are performing HVAC maintenance, unplugging battery rechargers when not in use, using compact fluorescent light bulbs (CFLS), and using a clothes dryer with a sensor that turns off the dryer when the clothes are dry (Figure 3-18).

Figure 3-18 Energy Efficiency Actions –Single-Family Segment



The most popular energy efficiency actions for respondents in multi-family homes are similar to actions taken by those in single-family homes, although smaller percentages of respondents in multi-family homes took each action (Figure 3-19).

Figure 3-19 Energy Efficiency Actions –Multi-Family Segment



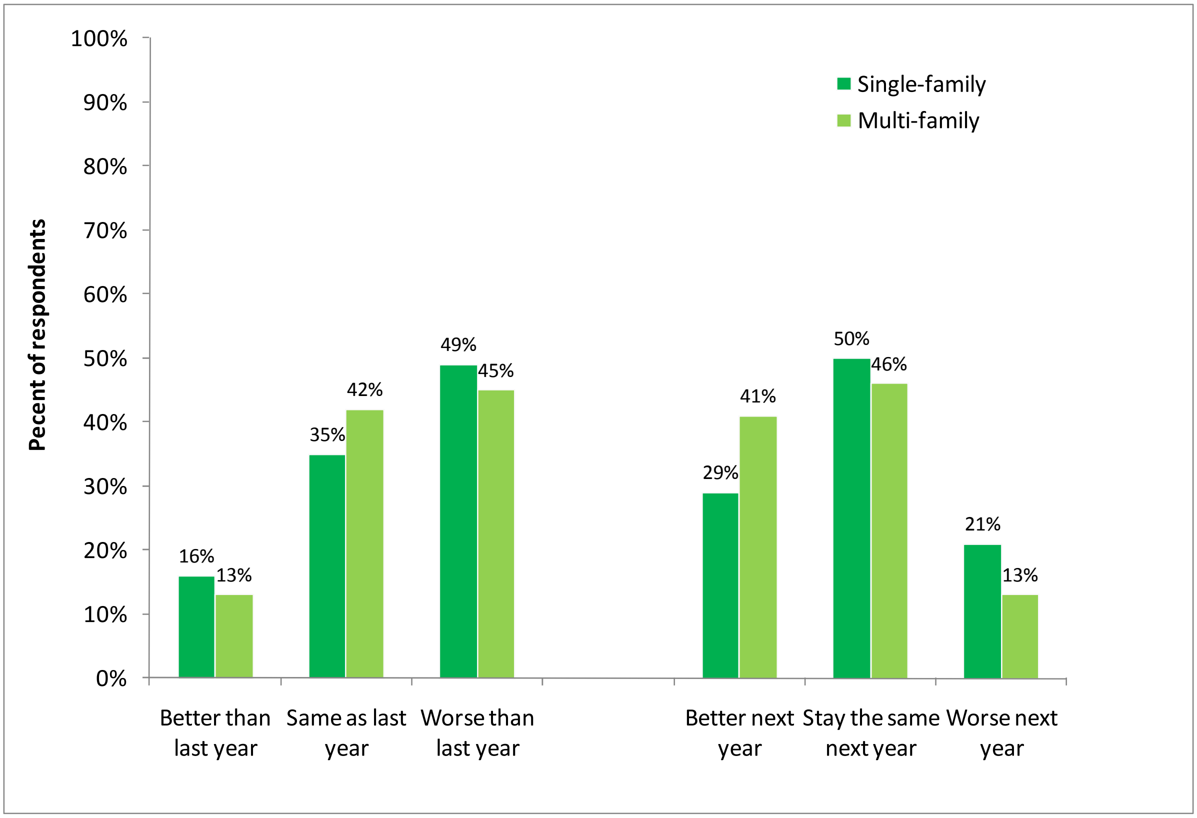
3.3.4 Financial Situation

The respondent's average bill size in the summer and winter and their perceived financial situation were also asked to help determine their financial ability to invest in energy efficient measures and participate in energy efficiency programs.

Respondents in single-family homes have self-reported an average electric bill of $107 in the winter and $140 in the summer. Respondents in multi-family homes have self-reported an average bill of $73 in the winter and $89 in the summer.

Most respondents feel their financial situation is the same or worse compared to a year ago (Figure 3-20), but they are cautiously optimistic. The largest group of respondents feels their financial situation will remain the same in the coming year, but 29% of those living in single-family homes and 41% of those living in multi-family homes think their financial situation will improve.

Figure 3-20 Perceived Financial Situation



3.4 CONCLUSIONS AND RECOMMENDATIONS

The market research performed for AmerenUE's potential study can also be used to inform energy efficiency program design and marketing. Based on the results of this study we conclude the following:

- Most homes in the AmerenUE service territory have someone home during the day on weekdays. This makes marketing AC load control, price response/CPP and peak power rebate programs more of a challenge. Load control programs that control water heaters and other appliances and equipment should be emphasized. Price response program marketing should focus on actions and behaviors that minimize affects on the comfort level of the home.
- The economy has been an obstacle to energy efficiency investments, but customers are cautiously optimistic about their financial prospects. It will be important for all program marketing materials to promote energy cost savings and payback periods.
- Awareness of AmerenUE's programs is very low. A marketing awareness campaign is crucial to future program success. Going beyond traditional bill inserts is key. Booths at trade shows and fairs, free measure giveaways, and energy conservation contests are all options for ramping up program awareness.
- The majority of the light bulb stock in AmerenUE's service territory is incandescent. This again provides an opportunity to educate customers about the new lighting standards and the benefits of CFLs and other energy efficient lighting. If a free bulb give-away is planned, it provides an additional marketing opportunity. CFL programs that include a free bulb, can be

very effective in raising awareness of other AmerenUE programs. The customer is interested in getting a free bulb and therefore is more willing to find out more about other programs the utility has to offer.

- Only half of respondents in single-family homes and even fewer (27%) in multi-family homes have a programmable thermostat. Promoting a thermostat upgrade or combining a programmable thermostat discount or rebate with a price response/CPP program will increase program participation and help customers participate without sacrificing comfort.
- A sizeable group of customers have second refrigerators and there may be a market for an appliance recycling program. It may be possible to retire some of the older second refrigerators. Marketing should focus on the cost to run old refrigerators and the ease of recycling appliances through the program.
- Customers' energy efficiency attitudes show a desire to do more. Education is extremely important to show people what they can do and how it benefits both them and society. A smart grid information feedback program could be a valuable tool to help promote conservation behaviors.

CHAPTER 4

RESIDENTIAL PROGRAM INTEREST SURVEY

AmerenUE DSM Market Potential

Realistic Achievable Potential for Energy Efficiency and Demand Response Program Adoption within the Residential Sector

Global Energy Partners, LLC

Momentum Market Intelligence

August, 2009

Contents

- **Background and Objectives**
- **Methodology**
- **Findings**
  - **Overall Realistic Potential**
  - **Customer Segmentation**
- **Appendix**

Contents

Background and Objectives

- AmerenUE is in the process of investigating market potential for a wide variety of Demand Side Management (DSM) options.
  - Overall this process seeks to understand various categories of electrical energy efficiency and demand response potential in the Residential and Business (Commercial/Industrial) sectors within AmerenUE's service territory.
- AmerenUE intends to use the results of this market potential investigation in an integrated resource planning process to analyze various levels of energy efficiency related savings and peak demand savings attributable to both energy efficiency initiatives and demand response initiatives at various levels of cost savings.
- The phase of the research contained in this report is concerned with exploring Realistic Achievable Potential, which is an integral part of understanding overall market potential.
  - *Realistic Achievable Potential* is a representation of likely customer response to specific measures that could be implemented under realistic program design conditions.
- Broad questions embedded in this phase of this research that will help AmerenUE better understand Realistic Achievable Potential include:
  - How likely are customers within each sector to participate in various energy efficiency programs AmerenUE is considering offering?
  - Which of these energy efficiency measures offer the highest likely participation rates?
  - How does likelihood to participate differ by payback period for the customer?
  - What overall demographic/firmagraphic and psychographic characteristics correspond to a higher likelihood to participate in energy efficiency programs?
  - What segments can be derived within each sector, and how do these segments differ in terms of likelihood to participation and demographic/firmagraphic and psychographic characteristics?
  - Which of these segments represent the best opportunities for AmerenUE to focus their marketing on?
  - What messaging strategies would likely be useful to help foster participation among these high opportunity segments?

Contents

Methodology – Sample Design

- AmerenUE provided a sample consisting of 80,800 Residential customers, which served as the basis for sampling for this research.
  - This customer list provided included a variety of information for each customer, including name, address, annual kWh usage, division, account number, etc.
- 15,917 of the Residential customers provided in the sample were sent a postcard inviting them to go online and complete the survey.
  - With a goal of achieving as representative a sample as possible, these customers were selected from the broader sample based on consideration of their annual kWh usage and division.
  - The postcard offered customers a $10 Visa cash card for completing the survey
- In order to qualify to complete the survey, respondents had to meet the following criteria:
  - Must have primary or shared responsibility for making energy-related decisions
  - Must be at least 18 years old
  - Must not work for a gas or electric utility company and must not have a household member that works for a gas or electric utility company
  - Must be billed for electricity directly by AmerenUE
- A total of 1,126 AmerenUE Residential customers completed the primarily online survey, in English, between June 13 and July 21, 2009.
  - 1,122 of the 1,126 respondents completed the survey online, while 4 were completed on a paper version of the online survey.
    - Note that 38 Residential customers in total returned a paper version of the online survey, but only 4 of these included usable responses.
  - The overall response rate was about 12%
  - Average online survey length was about 27 minutes

Methodology – Questionnaire

- The questionnaire was designed to cover multiple content areas, including:

1. Screening Questions
2. Assessment of Types of Major Energy-Using Equipment Used in the Household
3. Attitudinal Questions, Part I
4. Assessment of Energy Efficiency Measures Already Implemented / CADMUS Questions
5. Attitudinal Questions, Part II
6. Interest in Potential Energy Efficiency and Demand Response Measures Offered by AmerenUE
7. Attitudinal Questions, Part III
8. Questions about Additional Household Characteristics / Demographics

The purpose of this section was to be able to assess respondents' likelihood to participate in a variety of energy efficiency and demand response programs AmerenUE is considering offering.

In order to estimate how likelihood to participate in programs would vary by payback period, this section was designed using a Van Westendorp variation of price sensitivity modeling and took the following format:

- Assign programs / measures to categories that are similar in terms of type of action involved
- For each measure category, ask how likely would the respondent be to implement an example of a measure in this category at a standard payback period (3 years)?
- If no, how about at a shorter payback period (1 year)?
- If yes, how about at a longer payback period (5 years)?
- How likely would you be to implement each other measure in the category at a standard payback period (3 years)?

Attitudinal batteries were designed to assess…

- General attitudes about energy use, energy efficiency, environmental concerns, saving money, comfort, etc;
- Purchasing attitudes, preferences, practices;
- Attitudes toward electric utility providers in general and attitudes toward AmerenUE specifically

Methodology – Data Analysis

Generating Realistic Estimates of Customer Likelihood to Participate in Tested Programs

- Market researchers have long recognized that customers tend to over-estimate their likelihood to participate in new programs and services within the context of a market research study
  - This means that it has been long recognized that some customers who say that they would be "certain" to participate in a given program in a survey would, in reality, not participate
  - This is often referred to as the "say-do" problem; the problem that survey respondents are typically more likely to say they would do something than actually end up doing it
  - The analytic challenge, as a result, is to appropriately adjust stated likelihood-to-participate ratings into more realistic estimate of likely customer response
  - Different options are available for making these adjustments, and the best option depends in part on the nature of the product, service, or program being evaluated. For example, reactions to socially desirable (including "green") options, need to be adjusted down more aggressively, while those for certain new technologies need to be adjusted less.
  - The MMI / GEP team uses a basic method for applying these adjustments that has been used in market research for more than 20 years
  - Originally developed by Proctor and Gamble for adjusting stated intent for products that require "consideration" (i.e., the person has to think about the purchase; it is not typically a "snap decision")
  - This method for adjusting stated intentions to more accurately represent likely customer response has been used in literally hundreds of product, program, and service assessments with very reasonable validity
- The adjustment used to translate "stated intent" to realistic estimates of likely behavior is outlined in the table below; essentially, this adjustment says that if respondents rate a given program as a "10" ("extremely likely to participate"), then the adjustment says that, realistically, only about 70% of those people will sign up for the program; at the other end of the scale, it says that anyone who rates their likelihood to participate as "7" or lower is unlikely to do so at all

Rating on 1-10 scale (10=Extremely likely to participate; 1=Not at all likely to participate)		**Take Rate / Likely Takers** (Percent of those rating *X* that would be likely to participate)
10	→	**70%**
9	→	**46%**
8	→	**23%**
1 through 7	→	**0%**

Methodology – Data Analysis (continued)

Developing Program Adoption Take Rates:

- Since the survey results generate a distribution of responses across the 10-point scale for each program, it is possible to calculate an overall program adoption "take rate" for each program (that is, the likely proportion of customers who would realistically be expected to adopt each program tested)
  - Using the adjustment factors outlined on the prior page, the response distributions for each measure were arrayed and translated into a single "realistic estimate of likelihood to take part in the program" or "take rate" (see the example below)

Take one example:

To calculate the take rate for "Purchasing EE Light Bulbs," at a 3 year payback period:

Total eligible customers: n=1126
rating 10: n=422
rating 9: n=186
rating 8: n=139
rating 1 through 7: n=379

Take rate = ((422*70%)+(186*46%)+(139*23%)+(379*0%)) /1126

Take rate = 36.7%

- Note also that in order to characterize the overall level of opportunity for a given program category, it was at times helpful to calculate an average take rate across programs / measures. This data point is referred to as a "Mean Take Rate" throughout this report and, unless otherwise noted, is calculated by finding the mean across the take rates (at a 3 year payback period) for all programs with an associated payback period component. Programs without an associated payback period were excluded from this calculation.

Methodology – Data Analysis (continued)

Testing programs at different payback levels

- In order to provide insight about the impact that varying payback periods might have on customer response to the programs tested, the survey explored response to each program for which payback period was relevant, at 1, 3, and 5 year payback levels
- The survey used a method developed by an economist by the name of von Westendorp to capture this information; this technique begins by asking respondents to asses their likelihood to adopt a program at a 3 year payback, and then (a) if they respond positively to this option, asks them to respond to a 5 year payback, or (b) if they respond negatively to this option, asks them to respond to a 1 year payback period
- In order to deal with issues of survey length, the tested program measures were sorted into different categories that were similar in terms of scale of investment and type of measure
  - The full 1, 3, and 5 year payback assessment were then conducted for a single program within each category
  - The remaining programs within each category were evaluated at the 3 year payback level only
  - Regression analysis was then used to develop the 1 and 5 year payback values for each measure, using the slopes observed for the example program in each category

Weighting:

- In order to better mirror the Residential market in AmerenUE's service territory, data were weighted by three variables: Division, Annual Energy Usage, Householder age

Methodology – Data Analysis (continued)

Psychographic Segmentation Analysis:

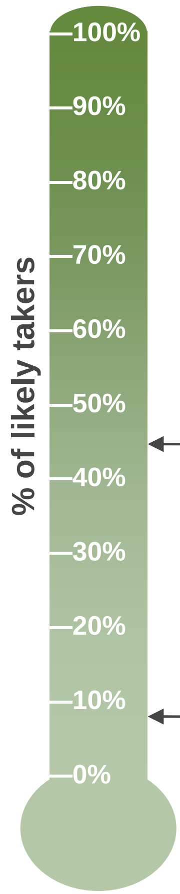
- One of the goals of the analysis was to explore whether or not there were psychographic customer segments that could be helpful in providing an understanding of why customers responded as they did to the programs tested, and to support initial thinking about how to prioritize marketing efforts and marketing communications
- Several steps were involved in developing this psychographic segmentation:
  - First, the team analyzed the groups of items that were included in the questionnaire which were designed to generate psychographic insights (these included Q2, Q18, Q20, Q21, Q28, Q32). The goal of this analysis was to identify groups of items that respondents tended to evaluate similarly. This process is called "factor analysis," and refers to the process of finding and interpreting these groups of items that people think of as similar.
  - Second, the team considered all of the attitudinal factors that were identified in step one, along with a variety of other variables to find the ones that generated the most useful segmentation model. This was partly a trial and error process, but ultimately, the variables selected to be included in the segmentation model included:
    - Annual energy usage (TOTALKWH)
    - A count of energy efficient appliances purchased in last 12 months / plan to purchase in next 12 months (Q4,Q5)
    - Whether they have heard of CFLs before (Q6)
    - A count of the programs at a 3 year payback period rated 8-10 in Q22-Q25 (1-10 scale, 10=Extremely likely to participate)
    - Whether they believe their household has participated in any loans, price discounts or conservation rebate programs provided by AmerenUE in the last 2 years (Q14)
    - A count of specific energy efficiency actions taken (Q15)
    - Overall satisfaction with AmerenUE (Q34)
    - Square footage of their home (Q40)
  - Once these inputs were identified, the team tested a wide variety of segmentation solutions, ultimately selecting a solution that optimized relative segment size, absolute segment sample size, and overall meaningfulness of segment profiles.
    - The solution selected as most appropriate was a solution containing 6 segments with different response patterns to the final set of selected segmentation inputs.

Contents

The range of Take Rates for programs / measures spans from a low of around one-tenth of all eligible customers to a high of nearly one-half of all eligible customers.

Likely Takers

(Total Residential Customers; n=1,126)



Overall maximum and minimum

Maximum take rate for a single program: *45%*
(Purchase a higher than standard efficiency refrigerator; at a 1 year payback period)

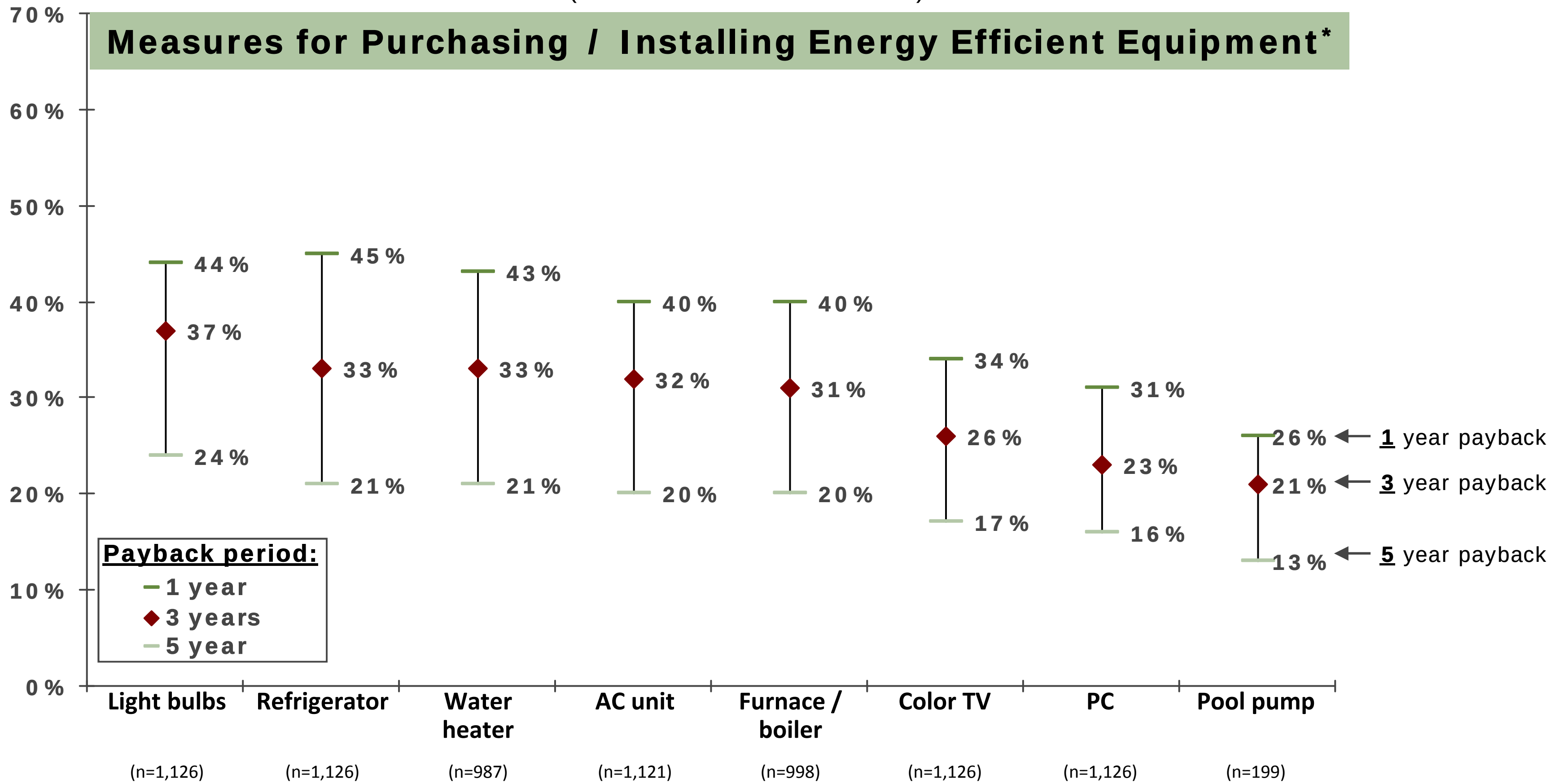
Minimum take rate for a single program: *8%*
(Install solar panels to generate electricity for your home to offset all or a portion of the electric energy provided by a utility; at a 5 year payback period)

Q22-Q27

Purchasing higher than standard efficiency light bulbs, refrigerators, and water heaters on a normal replacement cycle are the measures most likely to be adopted among this group of measures.

Likely Takers By Payback Period

(Total Residential Customers)



Q22/Q23

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*Note: Assumes a normal replacement cycle

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Connecting Missouri

Unsurprisingly, shorter payback periods are more highly favored than longer payback periods; The more quickly a program offers payback, the more likely customers are to adopt.

Likely Takers by Payback Period

(Total Residential Customers, n range=199-1,126)

@ a 1 year payback period

- Maximum: ***45%***
- Mean: ***33%***
- Minimum: ***18%***

@ a 3 year payback period

- Maximum: ***37%***
- Mean: ***25%***
- Minimum: ***13%***

@ a 5 year payback period

- Maximum: ***24%***
- Mean: ***16%***
- Minimum: ***8%***

Q22-Q27

Momentum Market Intelligence

Global Energy Partners, LLC
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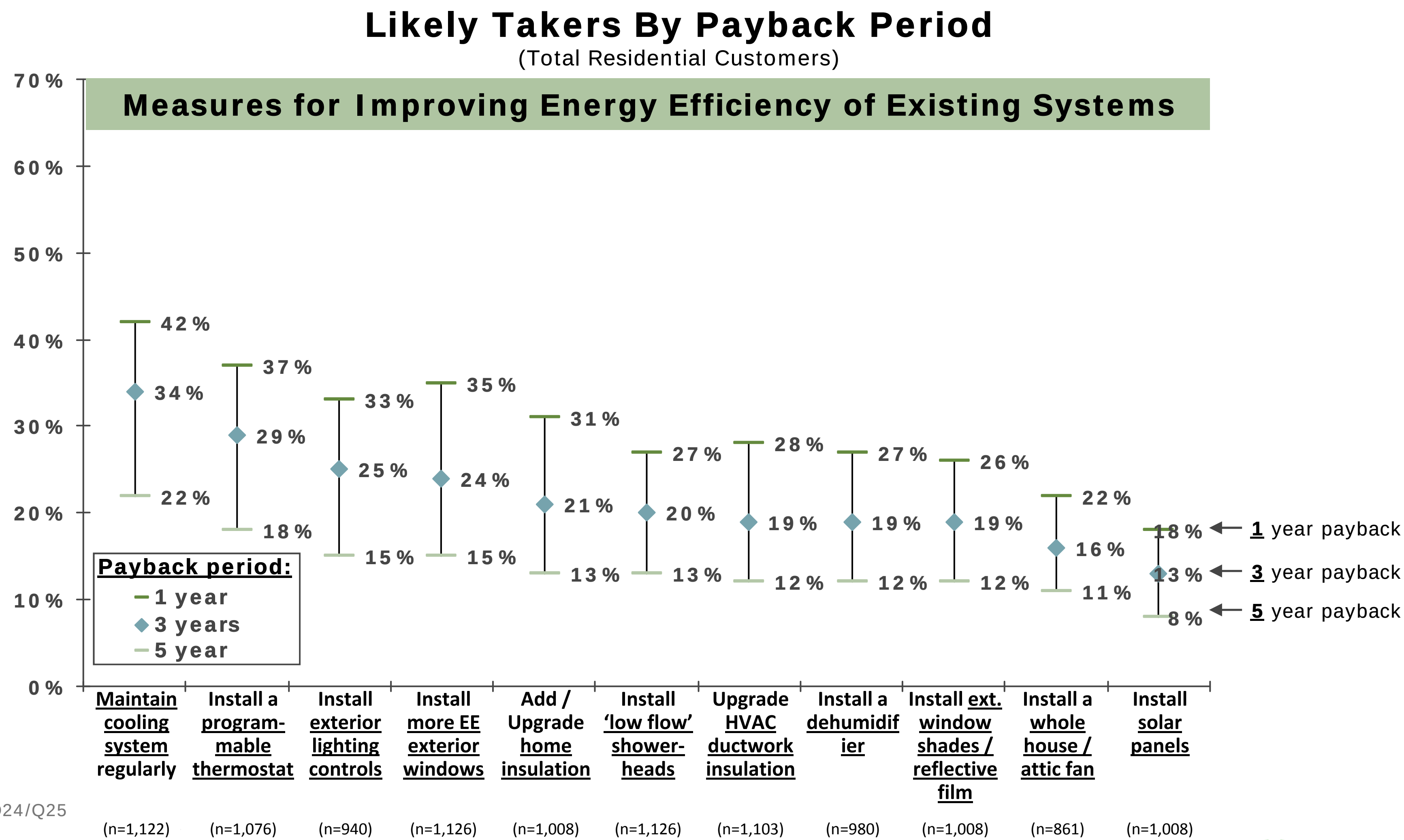
Ameren UE
Connecting Missouri

Regularly performing maintenance on a cooling system and installing a programmable thermostat are the measures most likely to be adopted among measures for improving existing systems.



Q24/Q25

Nearly all of the measures associated with "Purchasing / Installing Energy Efficient Equipment" are in the group of measures with the highest adoption rates.

Measures: Highest Opportunity	Likely Takers @ 3yr Payback (n range=987-1,126)
Purchase EE light bulbs*	37%
Maintain cooling system regularly	34%
Purchase an EE refrigerator*	33%
Purchase an EE water heater*	33%
Purchase an EE air conditioner*	32%
Purchase an EE furnace / boiler*	31%

Measures: Middle Opportunity	Likely Takers @ 3yr Payback (n range=199-1,126)
Install a programmable thermostat	29%
Inspect / repair HVAC ductwork**	27%
Participate in a water heater load control program**	27%
Purchase an EE color TV*	26%
Reduce water heater temperature**	25%
Install exterior lighting controls	25%
Install more EE exterior windows	24%
Add / upgrade home insulation	21%
Swimming pool pump	21%
Get rid of secondary refrigerator**	21%
Install low-flow showerheads	20%

Q22-Q27

It is interesting to note that, because they are based on a normal replacement cycle, the measures in the "Purchasing / Installing Energy Efficient Equipment" group are among those that take the least amount of additional effort to implement, especially in comparison to the measures with the lowest take rates.

Measures: Lowest Opportunity	Likely Takers @ 3yr Payback (n range=861-1,126)
Add HVAC ductwork insulation	19%
Install a dehumidifier	19%
Add external window shades / reflective film	19%
Install a whole house / attic fan	16%
Participate in an AC load control program**	16%
Install solar panels	13%

* Note: Assumes a normal replacement cycle
** Note: No payback period associated with measure

■ = Measures for Purchasing / Installing EE Equipment
■ = Measures for Improving EE of Existing Systems
■ = Measures Requiring No Upfront Investment

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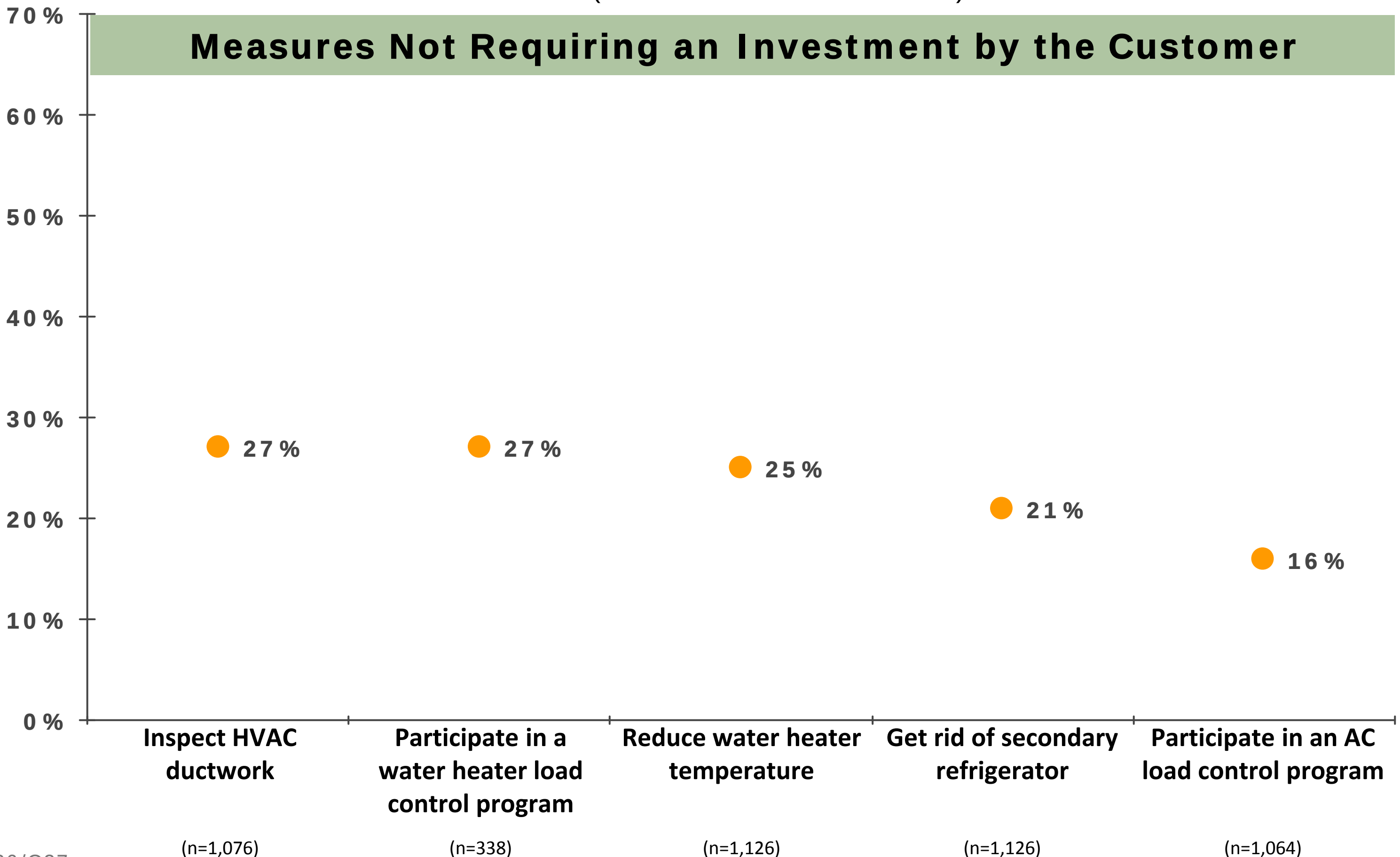
Despite the fact that they require no up-front investment on the part of the customer, measures in this group have lower adoption rates.

Likely Takers

(Total Residential Customers)

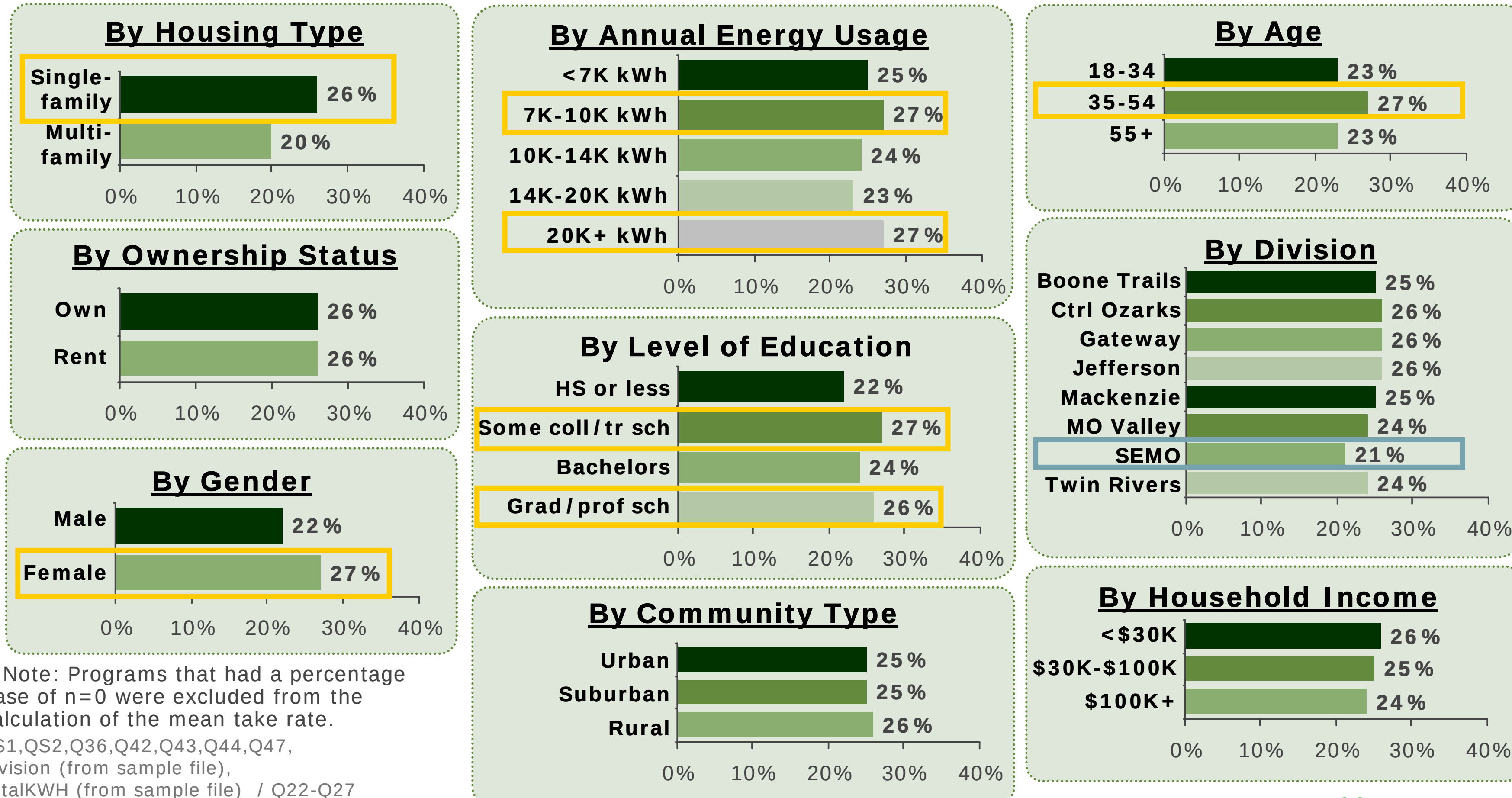


Q26/Q27

Some subtle differences exist in the mean take rates among various demographic groups.

<u>Groups exhibiting the higher opportunity than their counterparts include</u>: those living in <u>single-family housing</u>, <u>35-54 years olds</u>, those using <u>7,000-10,000 kWh or 20,000+ kWh</u> annually, those having achieved <u>some college/trade school or graduate/professional school</u>, and <u>females</u>.

Mean Take Rate* by Demographic Differences



* Note: Programs that had a percentage base of n=0 were excluded from the calculation of the mean take rate.

QS1,QS2,Q36,Q42,Q43,Q44,Q47, Division (from sample file), TotalKWH (from sample file) / Q22-Q27

Indicates a higher mean take rate
Indicates a lower mean take rate

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More striking differences in the mean take rate, however, relate to attitudinal differences.

Unsurprisingly, customers who have highly "green" and/or highly cost-savings-focused attitudes consistently show much higher likelihoods to adopt energy efficiency measures.

Mean Take Rate by General Attitudinal Differences

Q2,Q18,Q20,Q21,Q29 / Q22-Q27

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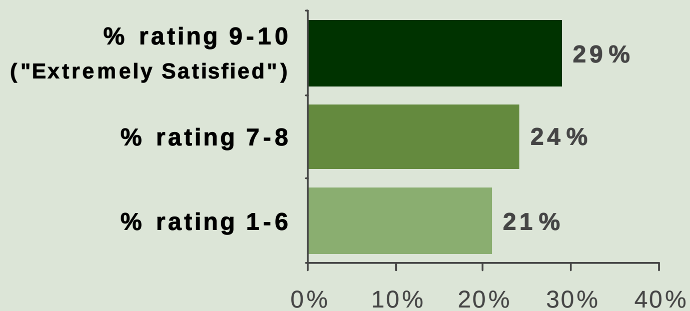
Another key factor in likelihood to adopt energy efficiency measures appears to be the degree to which customers have favorable opinions of AmerenUE.

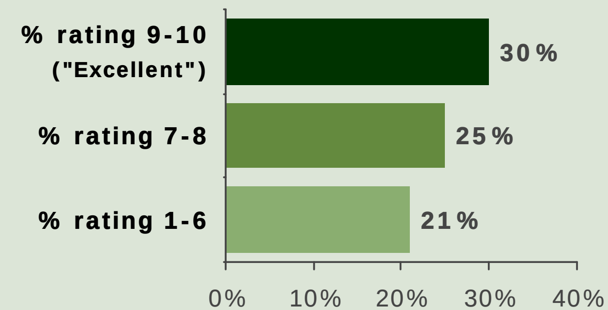
Customers who have more favorable opinions about AmerenUE (are extremely satisfied with AmerenUE, perceive AmerenUE's performance as excellent, strongly agree that AmerenUE is extremely trustworthy) consistently show much higher likelihoods to adopt energy efficiency measures.

Mean Take Rate by Attitudinal Differences about AmerenUE

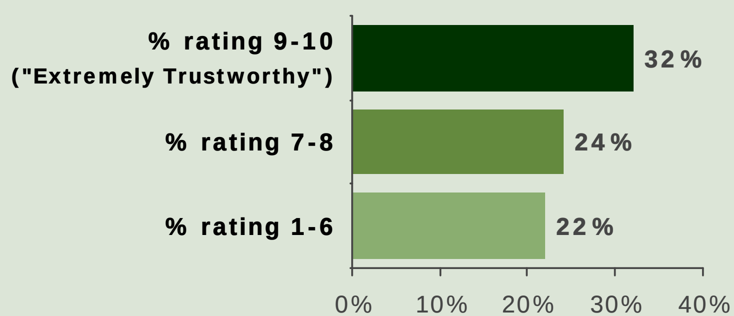
By Overall Satisfaction with AUE



By Perception of AUE's Performance



By Perception of AUE's Trustworthiness



Q32,Q33,Q34 / Q22-Q27

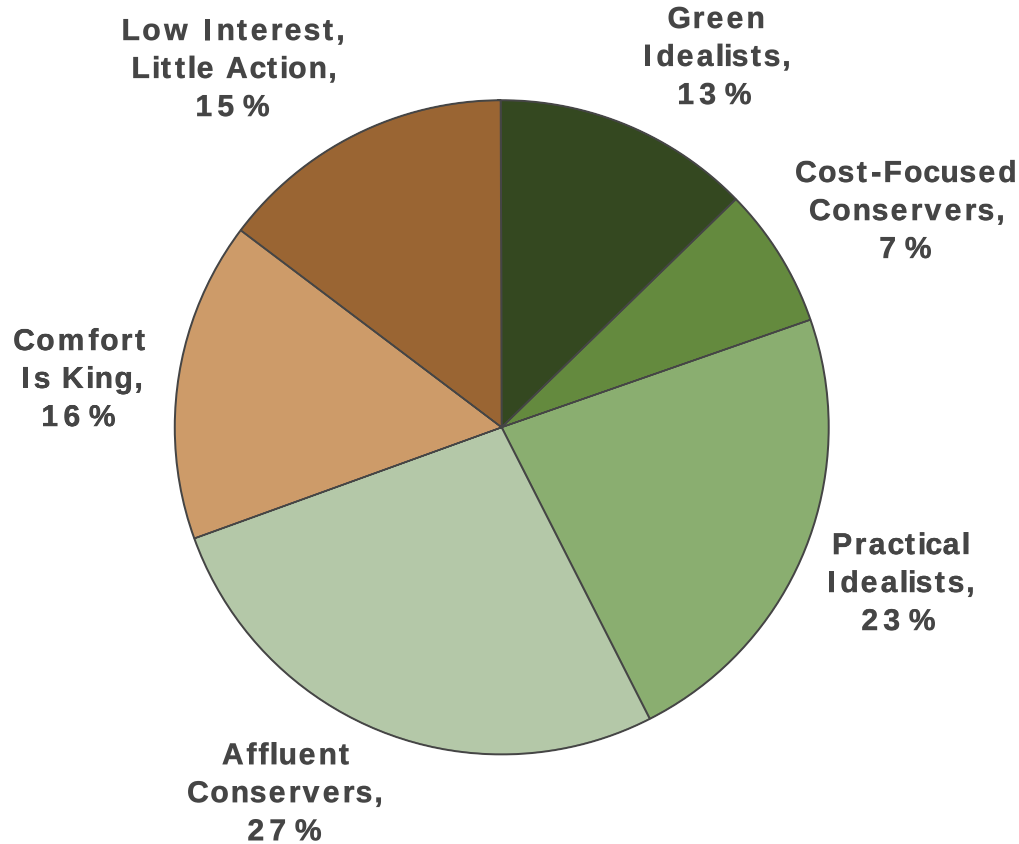
Summary: Overall Response to EE Programs by AmerenUE Customers

- As the preceding pages have suggested, it appears that psychographic factors (attitudes) have a larger impact on customer response to tested EE programs than do demographic differences
  - This means that how customers think about AmerenUE is likely to be much more important in predicting how they will respond to new EE programs offered by the company, than will differences in how they are situated (where they live or how large is their income)
- This is important for two reasons:
  - It may explain why the overall realistic take rates for AmerenUE's programs are lower than they are for those observed at many other US utilities
    - It is the experience of the GEP and MMI teams, for example, that equivalent take rates for other US utilities are often 10-20 percentage points higher than they are in this survey
    - Implicitly, it may be the case that attitudinal differences within your customer population are driving these differences
  - It is even more important to understand the impact of customer attitudes by understanding psychographic segments
    - These segments may identify the confluence of attitudes and concerns that map to differences in overall reaction to potential AmerenUE EE programs
    - In fact, the segmentation analysis reported in the following section focuses on just these issues, focusing in particular, on the role of customer satisfaction in contributing to estimated response to EE programs

Contents

Segment Distribution

The Residential market in AmerenUE's service territory can be described as being comprised of the following six customer segments:



Key Segment Findings

Green Idealists - This segment is the most concerned with conserving/controlling their energy use, both to save money and to protect the environment. EE behaviors are on par with their green ideals, they show some of the greatest interest in participating in future conservation programs and place some of the greatest importance in having a utility that actively encourages conservation participation. They find a great deal of value in having a “green” utility, though opinions of AUE are currently lower than the total customer base.

Cost-Focused Conservers – One of the most concerned (second only to Green Idealists) with conserving energy and the associated costs, as well as the environmental impact of energy use, though controlling costs is more important. EE behaviors are not on par with their ideals, though available budget for conservation may be a big constraint. They show the greatest interest in participating in future conservation programs and place the greatest importance on having a utility that actively encourages conservation participation. They also have the highest opinions of AUE as their electric utility.

Practical Idealists – Though somewhat less concerned with conserving energy, both from a cost-focused and an environmental perspective, the majority still place high importance on both, and are practicing more EE behaviors than the total customer base. They show a higher than average interest in participating in future conservation programs and having a utility that encourages conservation. Opinions of AUE are among the highest.

Affluent Conservers – Least concerned, of the green segments, with conserving energy, though the majority still believe it is socially responsible to conserve, and think it’s important to find ways to control energy costs. Cost savings is a higher priority for them. EE participation is on par or below the total customer base and interest in future conservation programs is only slightly higher. They place less value than the other green segments on having a “green” utility, and opinions of AUE are among the lowest across all the segments.

Comfort Is King – One of the least concerned with conserving energy, either to control costs or protect the environment, though controlling costs would be a higher priority. Levels of EE participation are among the lowest though they are conserving in small ways, suggesting with education they may be encouraged to conserve more down the road. Opinions of AUE are higher than the total AUE Residential customer base.

Low Interest, Little Action – The least concerned with conserving energy, either to control costs or protect the environment. Levels of EE participation are the lowest, as is their interest in participating in future conservation programs. This segment places the lowest value on having a “green” utility and has the lowest opinions of AUE as their electric utility.

Segment Prioritization

Target Segments	Marketing Effort	Potential Load Impact	Receptivity to Future Conservation Programs	Going Forward
Practical Idealists (23%)	Receptive to messages on both the social responsibility of conservation and cost-savings – plus satisfaction with AUE is high, making them likely to trust their utility as a reliable source for energy efficiency suggestions.	Home size and annual kWh usage are slightly above the total, and sheer segment size suggests a large number of end uses that could be impacted. As one of the wealthier segments they may potentially have the income to invest more in energy efficiency.	While take rates are lower than some green segments (max rate of 48% for a 3 year payback program), some of the highest opinions of AUE would likely make them more receptive to further education/encouragement on the benefits of participating.	As they are among the most likely to have purchased/plan on purchasing EE appliances, there is potential ground to be gained in terms of future EE appliance rebate participation. Additional education on the cost-savings associated with home conservation activities is needed.
Green Idealists (13%)	This segment would be the most receptive to messages on the social responsibility and environmental impact of conservation, as well as the associated cost savings, though their somewhat lower opinions of AUE may be a barrier initially.	Homes tend to be smaller and mean annual kWh usage is the lowest of the segments. Furthermore, this segment's small size suggests a smaller portion of the AUE residential customer base that could be impacted.	Their very high level of interest in being "green" and high take rates (max rate of 56% for a 3 year payback program), as well as their high level of participation in other EE activities, suggests they would be likely to participate if offered.	Additional messaging and information that aligns with their "green" ideals, as well as more energy efficiency tips/offerings, may make them more likely to look to AUE as a source for energy efficiency information in the future.
Cost-Focused Conservers (7%)	Very receptive to messages on both the social responsibility of conservation and cost-savings, though cost savings may be a stronger message. They also have the highest opinions of AUE as their utility and a "green" provider making them the most likely to trust AUE as a reliable source for energy efficiency suggestions.	A majority own homes of larger than average size with lower than average annual kWh usage, despite high electricity penetration. With a segment size of only 7% this segment represents a smaller proportion of the load than others. In addition, they may lack the funds to engage in more EE behaviors.	This segment has the highest take rates across all programs, with a max rate of 57% for a 3 year payback program, though their lower levels of participation in EE activities to-date may indicate additional information is needed on the benefits of participating.	Additional education on the cost-savings associated with home conservation activities and EE program participation may raise this segment's participation to more closely match their "green" ideals.

Segment Prioritization (continued)

Target Segments	Marketing Effort	Potential Load Impact	Receptivity to Future Conservation Programs	Going Forward
Affluent Conservers (27%)	Messages around cost savings and the utility working to keep costs as low as possible for its customers will probably work best. Messages related to social responsibility should also have some traction with a portion of the customers in this segment and shouldn't turn off any. However, this segment's relatively low opinions of AUE may make them a somewhat less receptive audience.	Houses in this segment are larger than most and electricity use is about average. As one of the most affluent they probably have the financial means to engage in more EE behaviors than they already do, and at 27% of the total customer base, they present a large portion of AUE Residential customers that could be impacted.	Take rates are the lowest among the green segments, with a max rate of 41% for a 3 year payback program. Though they potentially have the means to participate, additional education is needed on the benefits to them of participating.	This segment's moderate participation in EE activities indicates they are not anti-conservation and could be engaged further given additional education on the benefits to them of participating. While the majority value a utility that actively encourages customers to participate in energy saving programs, their lower opinions of AUE may present a barrier.
Comfort Is King (16%)	This segment will probably be fairly difficult to market to as neither energy costs nor the impact of energy consumption on the environment are high priorities for them. That being said, a message of cost savings would probably play best with this segment.	Though houses tend to be smaller, mean annual kWh usage is highest, despite relatively high natural gas penetration, suggesting a lot of energy savings that could potentially be gained from this segment.	Take rates are the second lowest, with a max rate of 20% for a 3 year payback program. While they have engaged in some EE behaviors, the degree to which they have engaged, and their relatively unengaged attitudes make it unclear how likely they will be to continue to do so in the future	While education is clearly needed, and they may be receptive to it given their relatively high opinions of AUE, increasing EE behaviors may not be easy in the short term and, at least initially, money may be better spent on segments that represent lower hanging fruit.
Low Interest, Little Action (15%)	This segment would be the most difficult to market to as they are the least concerned with energy costs or the environmental impact of energy usage. Additionally, overcoming this segment's relatively low levels of satisfaction with AUE will be a challenge.	Houses in this segment tend to be smaller and annual kWh is lower than the total customer base, suggesting the potential savings to be gained from this segment may be less than other segments. In addition, lower than average incomes may limit the EE behaviors these customers could participate in.	Take rates are the lowest, with a max rate of 8% for a 3 year payback program. While they have engaged in some EE behaviors, the degree to which they have engaged, and their relatively unengaged attitudes make it unclear how likely they will be to continue to do so in the future.	While education is clearly needed, it is unclear if education alone will engage these consumers and make them more interested in conserving. At least initially, money may be better spent targeting other segments that represent lower hanging fruit.

Segment Summaries: The "Greenest" Segments

Green Idealists (13%) are the most concerned with conserving energy, controlling energy costs and protecting the environment. They see the strongest connection between things they can do at home and their impact on the environment. They are also the most likely to take action to conserve energy at home, with the highest rates of participation and broadest diversity of actions taken, and notice savings as a result. This segment has some of the highest take rates across all programs tested, and, while they place the highest level of importance on having a "green" utility, their opinions of AUE are below average on all counts, making them potentially less responsive to future energy efficiency offerings than they would otherwise be. Demographically they are less affluent than the total residential customer base, more educated and use fewer kWh annually.

Cost-Focused Conservers (7%) are also very concerned (second only to the Green Idealists) with conserving/controlling their energy use and the associated costs, as well as the environmental impact of energy use. However, saving money and controlling costs are a higher priority. They see the second strongest connection between things they can do at home and their impact on the environment, but are taking action to conserve energy at a much lower level than the Green Idealists, on par or below the AUE residential customer base. Despite their lower levels of conservation activity, this segment is the most likely to notice savings as a result of the actions they do take, and they have some of the highest take rates across all the programs tested. Furthermore, they place a high level of importance on having a green utility and hold the highest opinions of AUE, indicating they would be very receptive and responsive to future programs and energy efficiency suggestions, provided the funding was available. This segment is the smallest portion of the total AUE residential customer base, least affluent and with the highest percentage of renters, though the majority do still own their home and a high percentage have larger homes than the total customer base. Annual kWh usage is lower than average, despite the highest penetration of electricity.

Segment Summaries: The "Green" Segments

Practical Idealists (23%) are less concerned, than the "greenest" segments with controlling their energy costs and protecting the environment, yet a significant majority do believe it is socially responsible to limit electricity usage and are concerned with finding ways to control their energy costs, with controlling costs as a higher priority. Most see connections between things they can do at home and their impact on the environment, and are taking steps to conserve, like purchasing more energy efficient appliances and weatherizing their homes. And. while nearly half have noticed savings as a result of their conservation nearly a third aren't sure, indicating an opportunity for further education. This segment has the third highest take rates across the tested programs, places a high level of importance on having a green utility, and has some of the highest opinions of AUE, indicating they would likely be receptive to future energy efficiency programs and suggestions. This segment is the segment is the second largest and demographically they are on par with the total residential customer base, with only slightly larger homes, higher annual kWh usage, and higher incomes.

Affluent Conservers (27%) are the least concerned, of the "green" segments, with conserving energy from an environmental or cost-focused perspective, though over half do believe it is socially responsible to limit electricity usage and a significant majority are concerned with finding ways to control their energy costs. Most see connections between some of the things they can do at home and their impact on the environment. They are taking actions to conserve on par with the total AUE residential customer base, and though they are among the least likely to have noticed savings as a result of conservation actions they are also the most likely to be unsure whether they have or not. This segment's take rates are lowest among the green segments but still higher than the residential customer base. Roughly half place a high level of importance on having a green utility, and while opinions of AUE are among the lowest of all the segments, so is their level of familiarity with AUE as their electric utility. This segment is the largest and youngest, one of the most affluent, with larger homes and average electricity usage.

Segment Summaries: The "Brown" Segments

Comfort Is King (16%) are one of the least concerned with conserving, protecting the environment or controlling energy costs. But, when making a choice between cost savings and the environment, cost savings wins out for the vast majority. This segment also places some of the highest value on keeping their houses comfortable, regardless of the cost. They are among the least likely to see a strong connection between the things they can do at home to conserve energy and its impact on the environment, and are among the most likely to admit that they do not think about the environmental impact of their day-to-day purchases. When it comes to conserving energy at home they are taking some of the fewest steps – using at least one CFL and making a consistent effort to turn down their heating/cooling systems at night are the extent of conservation activity for the majority – and few have noticed savings as a result. Take rates across all programs are some of the lowest and they place some of the lowest importance on having a green utility, preferring that their utility just focus on keeping costs low. However, opinions of AUE are higher than the total AUE residential customer base and generally rank second or third among the segments. Demographically, this segment is older, most likely to be retired and one of the most affluent, with higher annual kWh usage than the total customer base.

Low Interest, Little Action (15%) are the least concerned with controlling their energy use / energy costs and the environmental impact of their energy use – though controlling costs is decidedly more important to them. They see the fewest connections between things they can do at home and protecting the environment, and are taking some of the fewest steps to conserve energy in their homes, though with a majority having at least one CFL and making a consistent effort to turn their heating/cooling systems down at night, they aren't completely without conservation awareness. This segment has the lowest take rates among all the programs tested, and places some of the lowest importance on having a green utility, many preferring their utility just focus on keeping costs low. Their opinions of AUE are the lowest of the segments, though they also report the lowest level of familiarity with AUE as their electric utility. Demographically, this segment is younger, slightly less affluent, with average home ownership, but also the highest percentage in multi-family housing.

Residential Segments – At a Glance
Energy Use Attitudes and Evaluation of AmerenUE as an Energy Provider

	Green Idealists	Cost-Focused Conservers	Practical Idealists	Affluent Conservers	Comfort Is King	Low Interest, Little Action
Size	13%	7%	23%	27%	16%	15%
Opportunity	High	High	Medium-High	Medium	Low	Very Low
Energy Use Priorities	Controlling energy costs and environmental impact of energy use valued equally	Controlling energy costs is slightly higher priority than environmental impact of energy use	Controlling energy costs is slightly higher priority than environmental impact of energy use	Controlling energy costs is a higher priority than environmental impact of energy use	Controlling energy costs is a higher priority than environmental impact of energy use	Controlling energy costs is a higher priority than environmental impact of energy use
Shopping Priorities	Positive effects on the environment is a consideration but cost savings is more important	Positive effects on the environment is a consideration but cost savings is more important	Positive effects on the environment is a consideration but cost savings is more important	Cost savings is priority, positive effects on the environment are only a small consideration	Cost savings and comfort are priorities, much less to consider the environmental impact of purchases	Cost savings is priority, positive effects on the environment is low on their radar
Environmental Awareness – Overall & Top 3 actions with greatest perceived impact	Most likely to recognize environmental impact of actions, esp.: ➢ Setting thermostats ➢ Upgrading to EE appliances ➢ Installing/upgrading insulation/windows	Second most likely to recognize environmental impact of actions, esp.: ➢ Upgrading to EE lighting ➢ Setting thermostats ➢ Upgrading to EE appliances	Half to two-thirds are very likely to notice environmental impact of actions, esp.: ➢ Setting thermostats ➢ Installing more efficient home heating system ➢ Installing/upgrading insulation/windows	Roughly half are very likely to notice environmental impact of actions, esp.: ➢ Setting thermostats ➢ Installing/upgrading insulation/windows ➢ Installing more efficient home heating system	Very unlikely to recognize environmental impact of actions. 'Setting thermostats' and 'Installing/upgrading insulation/windows' are the only actions that register as having an impact.	Least likely to recognize environmental impact of actions. Setting thermostats is the only action that registers as having an impact.
Evaluation of AmerenUE as an Energy Provider	Overall AUE ratings and satisfaction levels are below the total customer base; second highest value placed on having a "green" utility	Highest AUE ratings, highest satisfaction with AUE as their electric utility; highest value placed on having a "green" utility	Very high AUE ratings, very high satisfaction with AUE as their electric utility; Large majority place high value on having a "green" utility	Second lowest ratings of AUE; lowest satisfaction with AUE as their electric utility; value having a "green" utility on par with the total customer base	Second highest AUE ratings overall, highest satisfaction with AUE as their electric utility; value having a "green" utility less than most segments	Lowest AUE ratings, lowest satisfaction with AUE as their electric utility; lowest value placed on having a "green" utility

Residential Segments – At a Glance
Energy Efficiency Program Participation

	Green Idealists	Cost-Focused Conservers	Practical Idealists	Affluent Conservers	Comfort Is King	Low Interest, Little Action
Size	13%	7%	23%	27%	16%	15%
Opportunity	High	High	Medium-High	Medium	Low	Very Low
Mean take rate across all programs, given a 3 year payback period	41%	43%	33%	28%	9%	2%
Maximum take rate for a single program, given a 1 year payback period	58%	56%	56%	54%	31%	21%
Maximum take rate for a single program, given a 5 year payback period	39%	48%	30%	24%	12%	4%
Top 5 programs by take rate, given a 3 year payback period	Purchase an EE… ➢ …light bulb ➢ Perform regular cooling system maintenance ➢ …water heater ➢ …refrigerator ➢ …air conditioner	Purchase an EE… ➢ Perform regular cooling system maintenance ➢ …light bulb ➢ …swimming pool pump ➢ …water heater ➢ Install a programmable thermostat	Purchase an EE… ➢ …light bulb ➢ …refrigerator ➢ …water heater ➢ …air conditioner ➢ Perform regular cooling system maintenance	Purchase an EE… ➢ …light bulb ➢ …refrigerator ➢ …water heater ➢ …air conditioner ➢ Perform regular cooling system maintenance	Purchase an EE… ➢ Perform regular cooling system maintenance ➢ …light bulb ➢ …refrigerator ➢ …air conditioner ➢ …water heater	Purchase an EE… ➢ …refrigerator ➢ …light bulb ➢ Perform regular cooling system maintenance ➢ Install EE exterior windows ➢ Install a programmable thermostat
Likelihood to participate in load control programs	Second most likely segment to participate in an AC program; one of the most likely to participate in a water heater program.	Most likely segment to participate in a water heater program; Most likely segment to participate in an AC program	Second most likely to participate in a water heater program; much less likely for an AC program, though slightly more likely than the total customer base.	Likelihood to participate in programs is on par or slightly below the total customer base.	Second least likely to participate in either program.	Least likely to participate in either program.

Residential Segments – At a Glance
Likely Takers given a 3 year payback period

Ranked by Total (not shown)	Green Idealists	Cost-Focused Conservers	Practical Idealists	Affluent Conservers	Comfort Is King	Low Interest, Little Action
Size	13%	7%	23%	27%	16%	15%
Measures for purchasing/installing energy efficient equipment*						
Light bulb	56%	55%	48%	41%	17%	7%
Refrigerator	46%	41%	45%	40%	16%	8%
Water heater	47%	52%	44%	40%	12%	1%
Air conditioner	46%	44%	43%	39%	14%	2%
Furnace or boiler	44%	49%	42%	37%	12%	2%
Color TV	42%	43%	38%	29%	7%	1%
PC	41%	39%	31%	27%	7%	0%
Swimming pool pump	30%	54%	27%	19%	7%	0%
Measures for improving energy efficiency of existing systems						
Maintain cooling system regularly	51%	57%	43%	38%	20%	5%
Install a programmable thermostat	45%	50%	37%	37%	9%	3%
Install exterior lighting controls	44%	43%	31%	28%	8%	2%
Install more EE exterior windows	39%	38%	29%	27%	10%	5%
Install improved home insulation	41%	41%	30%	22%	5%	0%
Install “low flow” showerheads	36%	44%	27%	20%	4%	1%
Add insulation to HVAC ductwork	40%	39%	27%	17%	2%	0%
Install a dehumidifier	36%	36%	26%	19%	4%	1%
Add external windows shades/reflective film	33%	39%	26%	19%	5%	1%
Install a whole house/attic fan	31%	35%	20%	17%	4%	3%
Install solar panels	33%	20%	15%	14%	2%	3%
Measures not requiring an investment by the customer**						
Inspect HVAC ductwork	45%	53%	35%	26%	12%	7%
Water heater Load Control Program	32%	56%	32%	24%	17%	6%
Reduce water heater temperature	41%	46%	32%	26%	7%	7%
Get rid of secondary refrigerator	36%	43%	27%	19%	8%	6%
AC Load Control Program	28%	33%	19%	16%	8%	3%

* Note: Assumes a normal replacement cycle

** Note: No payback period associated with measure

Questions? Contact:

Global Energy Partners, LLC
http://www.gepllc.com

Momentum Market Intelligence
http://www.mointel.com

August, 2009

Contents

List of All Programs / Measures Tested

- **Category 1** (Q22-Q23): How likely would your household be to buy the higher than standard efficiency model (and take the rebate), rather than buying an equivalent standard efficiency model of each item?
  - Purchase a higher than standard efficiency refrigerator
  - Purchase a higher than standard efficiency air conditioner
  - Purchase a higher than standard efficiency furnace or boiler
  - Purchase a higher than standard efficiency water heater
  - Purchase a higher than standard efficiency color TV
  - Purchase a higher than standard efficiency personal computer
  - Purchase higher than standard efficiency light bulbs (higher than standard efficiency light bulbs could be compact fluorescent light bulbs (CFLs) or lower wattage incandescent light bulbs than you usually buy)
  - Purchase a higher than standard efficiency swimming pool pump

- **Category 2** (Q24-Q25): How likely would your household be to make each improvement (and take the rebate)?
  - Install a whole house / attic fan to improve air flow in your home
  - Install a dehumidifier in your home
  - Add insulation to the ductwork that serves your cooling and/or heating or systems
  - Perform regular maintenance on your cooling system in order to improve its performance
  - Install a thermostat on your heating and / or cooling system that would allow you to pre-set different heating or cooling levels for different days and different times of the day
  - Install "low flow" showerheads that reduce the amount of hot water used
  - Add external window shades or reflective film on windows that would reduce the amount of direct sunlight entering your home
  - Install additional or upgraded home insulation
  - Install controls on your outside lights that make sure they are only on at certain times
  - Install solar panels to generate electricity for your home to offset all or a portion of the electric energy provided by a utility

List of All Programs / Measures Tested (Continued)

- Category 3* (Q25-Q26)

Please indicate how likely you would be to take any of these energy saving actions.

- Reduce the temperature of the hot water that your water heater delivers
- Get rid of a secondary refrigerator that you may only use sometimes and might be in a garage or basement
- Conduct an inspection of your heating / cooling ductwork to find, repair, and seal any leaks

Please indicate how likely your household would be to sign up for this type of ***[LOAD CONTROL]*** program…

- …for your water heater
- …for one or more of your air conditioner units

[*NOTE: No payback periods were associated with Category 3 programs / measures]

Eligibility & Take Rates

Program / Measure	% Eligible	Likely Takers		
		1 year payback period	3 year payback period	5 year payback period
Category 1: Programs / Measures for Purchasing / Installing Energy Efficient Equipment*				
Light bulbs	100%	44%	37%	24%
Refrigerator	100%	45%	33%	21%
Water heater	84%	43%	33%	21%
AC unit	>99%	40%	32%	20%
Furnace / boiler	85%	40%	31%	20%
Color TV	100%	34%	26%	17%
PC	100%	31%	23%	16%
Pool pump	15%	26%	21%	13%
Category 2: Programs / Measures for Improving Energy Efficiency of Existing Systems				
Perform regular cooling system maintenance	>99%	42%	34%	22%
Install a Programmable thermostat	95%	37%	29%	18%
Install exterior lighting controls	80%	33%	25%	15%
Install more energy efficient windows	100%	35%	24%	15%
Upgrade home insulation	86%	31%	21%	13%
Install 'low flow' showerheads	100%	27%	20%	13%
Upgrade HVAC ductwork insulation	97%	28%	19%	12%
Install a dehumidifier	87%	27%	19%	12%
Install external window shades / reflective film	86%	26%	19%	12%
Install a whole house / attic fan	78%	22%	16%	11%
Install solar panels	86%	18%	13%	8%
Category 3: Programs / Measures Not Requiring an Investment by the Customer [NOTE: PAYBACK PERIODS NOT APPLICABLE]				
Inspect HVAC ductwork	95%	27%		
Participate in water heater load control program	30%	27%		
Reduce water heater temperature	100%	25%		
Get rid of secondary refrigerator	100%	21%		
Participate in AC load control program	93%	16%		

Q22-Q27

* Note: Assumes a normal replacement cycle

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CHAPTER 5

C&I RESEARCH DESIGN

The research design involved three steps: frame preparation, questionnaire design, and data collection. A significant amount of work went into the frame preparation in order to target the correct sample to accurately represent the AmerenUE service territory. This included a separate analysis of the top customer accounts which were analyzed through onsite surveys conducted by engineers from Washington University in St. Louis.

5.1 C&I SURVEY APPROACH

For this analysis, we decided to combine the online survey approach with onsite surveys, which allowed us to take a census approach; meaning each customer account was approached to participate in the survey instead of a random sample.

The customer universe was approached in three ways. The largest customers/premises were identified and treated individually and specially – primarily through onsite surveys. Accounts with several small or medium locations with the same mailing address were grouped together and the largest premise was surveyed using the online approach. The remaining small and medium C&I customers were contacted via direct mail for the online survey. In the end, we attempted to contact each business customer to participate in the survey.

5.2 C&I FRAME PREPARATION AND SAMPLE SELECTION

AmerenUE provided a database of 135,799 account records of commercial and industrial customers, which was used to construct a sample file that was used for the saturation and program interest surveys. Each customer record included the following categories of information:

- Account number
- Customer name
- Service address
- Mailing address
- NAICS code
- Annual electricity use for 2008
- Peak demand (for demand-metered customers)

Several steps were taken to prepare the sample. The first step was to flag the accounts in the database for aggregating with other accounts or excluding from the sample. Approximately 30,500 meters/accounts were set aside or eliminated based on the following:

1. Accounts corresponding to lights, pumps and other “unmetered” accounts were removed from the sample.
2. Accounts attached to low-energy use structures, such as pools, barns, traffic lights, sprinkler systems, signs, etc. were identified as potential exclusions from the universe based on their inability to effect significant change in energy usage, and also the likelihood that they could not be aggregated with adjacent structures to form a main account.

3. Accounts attached to structures, or other end-use designations that could represent parts of a single-service premise (i.e., sidewalk lights, restrooms, elevator, 'rear', or 'front') were identified for potential aggregation into 'main' accounts.
4. Service accounts attached to the same enterprise name, but with adjacent addresses, were identified for potential aggregation into 'main' accounts.
5. Service accounts attached to telecom, railroad, and outdoor advertising companies were flagged for potential removal
6. Records identified as Top customers or high energy users were set aside for the onsite survey analysis

The remaining meters/accounts, approximately 106,000, were aggregated to physical premises using a base algorithm that searched for 80% similarity of mailing addresses with complete manual inspection to both remove inappropriate matches and aggregate additional meters as appropriate. This aggregation yielded 80,932 premises accounting for 13,726 GWh. The final population used for the business universe included the following:

- 80,932 non 0-X premises representing 13,726 GWh (59% of the total) [4]
- 4,420 large 0-X meters/accounts representing 819 GWh (4% of the total)
- 1,313 meters/accounts associated with top accounts representing 8,636 GWh (37% of the total)

Table 5-1 shows the distribution of premises by sector.

Table 5-1 AmerenUE C&I Distribution of Premises by Sector

	Top Customers		Large O-X	
Sector	**Accounts**	**MWh**	**Accounts**	**MWh**
Industrial	307	6,697,858	701	331,353
Commercial	1,006	1,937,929	3,719	488,061
Grand Total	1,313	8,635,787	4,420	819,414
% of Total	2%	37%	5%	4%
	Other Premises		**Total Master File**	
Sector	**Accounts**	**MWh**	**Accounts**	**MWh**
Industrial	11,223	3,582,586	12,231	10,611,796
Commercial	69,709	10,144,300	74,434	12,570,290
Grand Total	80,932	13,726,886	86,665	23,182,086
% of Total	93%	59%	100%	100%

[4] In the AmerenUE database, "0-X" addresses are locations for which no specific street address exists. The bill is mailed to a billing address, but the physical location is found by following free form instructions, such as "500 feet north of intersection of X & Y." These could be metered or unmetered facilities.

5.2.1 Onsite Interview Sample Selection

From the original customer universe, 8,320 records were set aside as potential sample for the onsite interviews to be conducted by Global and Washington University in St. Louis. They were selected based on the following criteria:

1. Accounts identified as Top Customers by AmerenUE
2. Accounts with the highest energy usage (totalkWh>20,000,000 kWh)
3. Records with a premise address of "0X" that had a totalkWh>10,000 kWh

The potential sample for the onsite interviews was 8,320 accounts. These accounts represent 3,477 premises and 186 Top Customers. Global and engineers from Washington University in St. Louis attempted to contact each of the Top Customers.

Top customers included customers with a single location with high energy use or multiple smaller locations. For Top Customers with multiple locations, onsite surveys were conducted at a few locations. For example, Dierbergs, a major grocery store retailer in the area, has 24 premises; therefore onsite surveys were done at 3 representative Dierbergs stores. Another type of Top Customer is a location with multiple buildings, such as Washington University in St. Louis. For these types of customers, onsite surveys were done at a representative sample of the buildings to estimate the equipment saturation for all of the buildings. In the case of Washington University in St. Louis, onsite surveys were conducted at 10 representative buildings.

5.2.2 SMB and Online LCI Sample Selection

After excluding records for the onsite analysis, the remaining 78,732 accounts were split into two groups: small and medium businesses (SMB), and large commercial and industrial (LCI) customers. These two groups became the basis for the sampling file used for the four online surveys for the commercial and industrial sector (SMB saturation, LCI saturation, SMB program interest, and LCI program interest. Many of these records showed duplicate mailing addresses with other records in this group, so we took steps to reduce the number of records to be used for sampling among groups of duplicate records.

First we categorized each record into one of the following four groups:

- Group A – Unique mailing address: no other records have the same mailing address
- Group B – Duplicate mailing addresses: 2-5 records have the same mailing address
- Group C – Duplicate mailing addresses: 6-10 records have the same mailing address
- Group D – Duplicate mailing addresses: 11+ records have the same mailing address

We then developed rules for identifying records to use for sampling from each of these four groups.

- Group A – Use all records from this group
- Group B – Within each set of records sharing the same mailing address, select only the record with the highest energy usage to be used in the sample file
- Group C – Within each group of records sharing the same mailing address, select only 2 records to be used in the sample file: 1 with the highest energy usage, 1 with modal energy usage

- Group D – Within each group of records sharing the same mailing address, select only 3 records to be used in the sample file: 1 with the highest energy usage, 2 with the most commonly representative or "modal" energy usage[5]

This process yielded a total of 60,511 records to use for sampling. An additional 2,608 records were removed to ensure the quality of the sample. For example, records with no premise address or duplicate records were removed, leaving 57,903 records.

An additional 3,594 records were identified as having a mailing address associated with a third-party billing service provider (e.g. Advantage IQ, CASS) or a property management firm. These records were handled differently from the other records. Instead of sending the survey invitation postcards for these records to the mailing addresses listed in the initial account file, the postcards were sent to the premise addresses. The reason for doing this was to directly invite the individuals at the premises to complete the survey, without making it necessary for the invitation to be forwarded on by the third-party billing service providers or property management firms.

Based on data for energy usage (kWh) and industry from the account file, each record was classified as either SMB or LCI according to the rules shown in Table 5-2.

Table 5-2 SMB and LCI Definitions by Industry

Industry	Classification	Energy Usage Cut Point
Elementary/ Secondary Schools	SMB	< 600,000 kWh
	LCI	≥ 600,000 kWh
Colleges and universities	SMB	< 900,000 kWh
	LCI	≥ 900,000 kWh
Lodging	SMB	< 1,400,000 kWh
	LCI	≥ 1,400,000 kWh
Warehouse, Restaurants, Service, Construction, Miscellaneous, Office, Transportation	SMB	< 2,000,000 kWh
	LCI	≥ 2,000,000 kWh
Retail, Utilities	SMB	< 5,000,000 kWh
	LCI	≥ 5,000,000 kWh
Grocery	SMB	> 0 kWh
All other industries	SMB	< 1,000,000 kWh
	LCI	≥ 1,000,000 kWh

The size of the resulting sample frame (57,903 records) together with the expected response rates from the online-survey approach was expected to achieve the total sample size targets in the work plan. Therefore, a census data-collection approach was used. That is, all customers were invited to participate in this study, either for the saturation or the program interest survey. Once the records were allocated to SMB or LCI, records were randomly assigned to the saturation survey or program interest survey. Table 5-3 shows the allocation of sample:

Table 5-3 Allocation of Sample to Surveys

Survey	Number of sample account records
LCI Onsite Saturation	8,320

[5] 'Modal energy usage' records were obtained by ranking the remaining records (after the highest energy usage record was removed) and selecting the median energy usage record(s) from the list.

SMB Saturation	20,765
SMB Program Interest	20,700
LCI Saturation	8,215
LCI Program Interest	8,223

5.3 C&I SATURATION SURVEY DESIGN

Separate survey instruments were used for SMB and LCI customers. Both the SMB and LCI saturation surveys covered a range of topics about building energy use. Specifically, the survey covered the following topics:

- Business and building characteristics
- Heating, cooling and water heating equipment
- Lighting equipment
- Refrigeration equipment
- Office equipment
- Kitchen equipment
- Energy Efficiency Measures
- Utility programs

During the data collection process, the following quotas were monitored within each SMB and LCI survey to insure appropriate and balanced representation:

- **Overall number of completes**
- **Electricity usage** quartiles derived from sample (based on total kWh provided in sample – these quartiles were calculated separately for SMB and LCI)
- **Division** (provided in sample – Boone Trails, Central Ozarks, Gateway, Jefferson, Mackenzie, Missouri Valley, SEMO, Twin Rivers)
- **Industry** (provided in sample)

Both surveys asked the same questions so that the results could be easily merged together for the analysis portion. The primary difference between the SMB and LCI surveys is the number of questions asked; the LCI and onsite survey went into greater detail of the industrial processes and the various pieces of equipment. In addition, the onsite surveys included an additional level of detail on the efficiency levels of the equipment installed. We did not ask that type of information in the online survey because survey respondents don't typically know the information off-hand and their answers might skew the results.

The questionnaires are included in Appendix A. Note that the Program Interest Survey Design is discussed in Section 7 of this Report.

5.4 DATA COLLECTION

5.4.1 C&I Saturation Survey

5.4.1.1 SMB Data Collection

The survey data were collected by Momentum Market Intelligence using an online survey. Customers were invited to participate by postcard. As incentive to participate, customers were offered a special report with tips and information: "*Trends and Opportunities in Managing Energy Use to Reduce Costs*," as well as the option of receiving a $15 Visa gift card if their company policies allowed. Survey invitation postcards were sent in three separate mailing waves to SMB customers. An initial total of 779 surveys were completed online between May 11, 2009 and June 26, 2009. The overall response rate was 5.8%, calculated as the number of individuals who responded (completed, dropped out, disqualified during the screener, or over-quota) divided by the total number of postcards mailed. An additional 21 completes were collected between August 24, 2009 and September 1, 2009 to augment data for the lodging, warehouse, and restaurant sectors. The total number of completed SMB surveys used in this analysis is 800.

5.4.1.2 LCI Online Data Collection

Momentum Market Intelligence conducted the online LCI surveys. Survey invitation postcards for this survey were sent in two separate mailing waves, with postcards sent to the mailing addresses for 8,215 sample records allocated to this survey. These customers were given the special report and the option of receiving a $20 Visa gift card if their company policies allowed. A total of 222 surveys were completed online between June 1, 2009 and August 5, 2009.

5.4.1.3 Onsite Survey Data Collection

Engineers from Washington University in St. Louis conducted onsite surveys with the top customers. The engineer went to the location, interviewed the facility manager, walked through the facilities to observe operations and recorded equipment inventories. Onsite data collection took place between April 27, 2009 and July 31, 2009. Onsite surveys were completed at 145 different locations. From the original target list, 108 locations were surveyed, accounting for 8,913,643 MWh of the targeted Onsite sample energy (82%). An additional 37 onsite surveys were conducted to fill-in gaps in the online market research, such as lodging, restaurants and nursing homes. Customers in the onsite survey sample were given the special report in return for participating.

5.4.1.4 Overall Saturation Data Collection Summary

Table 5-4 shows a summary of the number of completions by survey type and the original segment definition, as defined from the AmerenUE sample frame. AmerenUE has access to each of the final databases so the information can be used in future analysis.

Table 5-4 Summary of Completed Surveys by Survey Type and Original Industry Code

Industry	**SMB**	**LCI**	**Onsite**	**Total**
Agriculture	6	2	1	9
Colleges, Universities, and Professional Schools	6	1	12	19
Computer and Electronic Product Manufacturing	2	2	1	5
Construction	64	8	0	72
Electrical Equipment, Appliance, and Component Mfg	1	2	5	8
Elementary and Secondary Schools	6	4	2	10
Fabricated Metal Product Manufacturing	2	9	6	15
Food manufacturing	4	4	5	13
Furniture and Related Product Manufacturing	1	2	0	3
Government	13	7	1	20
Grocery	14	2	8	24
Health	39	5	14	57
Lodging	16	0	5	6
Machinery Manufacturing	3	5	4	12
Manufacturing -- Miscellaneous	1	1	2	4
Mining	1	0	1	2
Nonmetallic Mineral Product Manufacturing	2	2	4	8
Nursing and Residential Care Facilities	1	1	1	3
Office	152	13	12	177
Paper Manufacturing	4	4	2	9
Petroleum and Coal Products Manufacturing	4	0	11	15
Plastics and Rubber Products Manufacturing	3	2	7	12
Primary Metal Manufacturing	0	0	4	4
Public Assembly	53	29	4	86
Restaurants	14	19	3	34
Retail	100	12	8	119
Services	131	34	7	171
Textile, Apparel, Leather Manufacturing	2	0	0	2
Transportation	9	3	2	14
Transportation Equipment Manufacturing	0	2	1	3
Utilities	1	0	7	8
Warehouse	50	28	4	78
Wood Product Manufacturing	2	1	0	3
Miscellaneous	16	8	6	30
Not classified	76	10	4	90
Total	**799**	**222**	**154**	**1,175**

5.4.2 C&I Program Interest Survey

For the SMB Program Interest Survey, 750 respondents completed the online survey. The surveys were completed between June 8, 2009 and July 11, 2009. The median time to complete the survey was about 25 minutes. The overall response rate was 4.9%. These SMB customers were given the special report mentioned above and the option of receiving a $15 Visa gift card if their company policies allowed.

There were 273 completed LCI Program Interest surveys. The surveys were collected between June 16, 2009 and July 29, 2009. The median time to complete the survey was about 29 minutes. The overall response rate was 4.6%. These LCI customers were given the special report and the option of receiving a $20 Visa gift card if their company policies allowed. The analysis of the Program Interest Surveys was done by Momentum Market Intelligence. The summary of the approach and analysis is in Section 7 of this volume.

5.5 SATURATION SURVEY ANALYSIS

Once all the saturation survey data were collected, the data were prepared for analysis. This involved development of expansion weights and segmentation for analysis. Survey results from the three surveys (SMB, LCI, and Onsite surveys) were combined into one file.

5.5.1 Development of Expansion Weights

To develop the expansion weights, the sample was post-stratified by segment and size. Stratum and size breakpoints were developed to isolate the most extreme cases in their own stratum and split the remainder of each segment to optimally achieve the best accuracy possible given the sample we had in place. In certain strata for certain segments, we augmented the sample with additional cases, as needed. Expansion weights for each segment and size stratum sample point were computed as the ratio of population energy use to sample energy use.

5.5.2 Segmentation for Analysis

For the subsequent steps in this study, it was determined to use actual business type based on the self-reported information from the survey. The data were split by business type into 12 segments for analysis. Table 5-5 shows the distribution of completed surveys by final analysis segment.

Table 5-5 Responses by Segment

Segment	Number of completed surveys	Weighted % of total
Education	40	3%
Grocery	23	2%
Health	60	6%
Lodging	22	2%
Miscellaneous	64	5%
Multi-family[6]	34	3%
Office	246	21%
Public Assembly	112	10%
Restaurant	50	4%
Retail	249	21%
Warehouse	104	9%
Industrial	171	14%
Total	**1,175**	

[6] Multi-family here consists of common areas, offices, and other such facilities. It does not include the individual dwelling units that are considered in the Residential analysis above.

CHAPTER | 6

C&I SATURATION SURVEY RESULTS

To gain an understanding of energy use for each building-type segment, information from the survey about building characteristics and end-use equipment were analyzed. This section presents the results of this analysis.

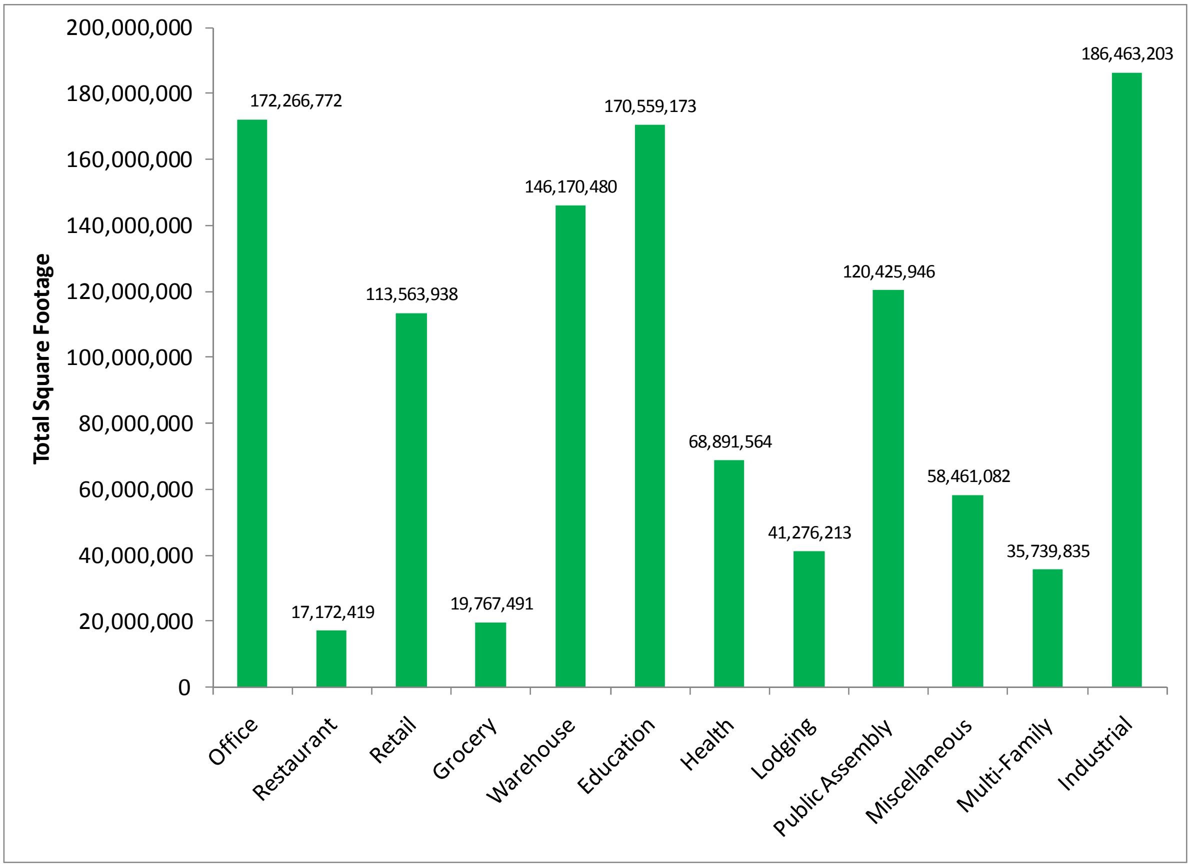
6.1 BUILDING CHARACTERISTICS

Key building characteristics include floor space, age of the building, and number of employees.

6.1.1 Size and Age of Segment Floorspace

Respondents were asked the approximate square footage of all the enclosed floorspace in their building (Figure 6-1). The office and education segments have the most total floorspace while grocery and restaurants have the least.

Figure 6-1 Total Square Footage by Segment



Building age is an indicator of the overall efficiency of the building. Further, buildings constructed most recently tend to be more efficient than older buildings. This is an important distinction in the end-use modeling approach taken for this study.

Respondents were asked to identify when the majority of their building or facility was built. The vast majority of floor space was built since 1960 with much of it built in the last decade (Figure 6-2). Not surprisingly compared with the rest of the country, the three segments with the "newest" buildings are restaurants, grocery and lodging.

Figure 6-2 Age of Floorspace by Segment

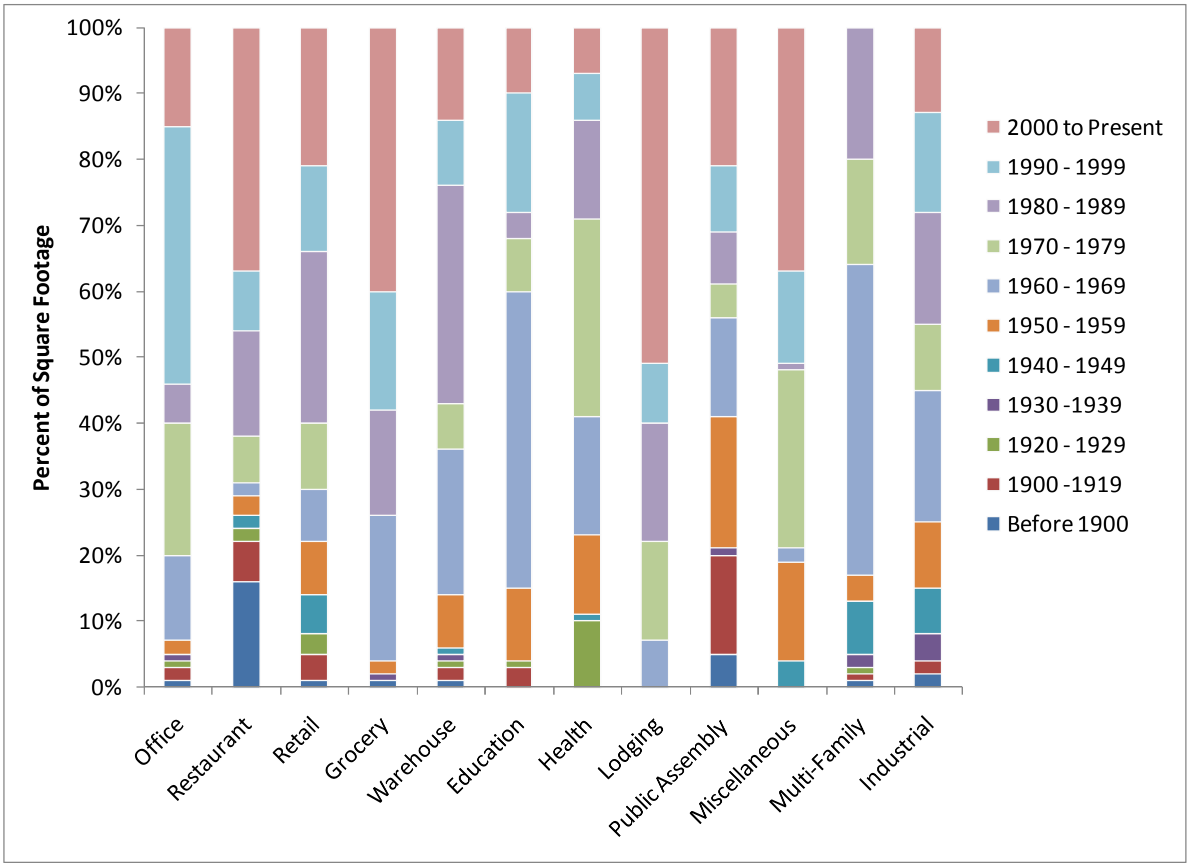
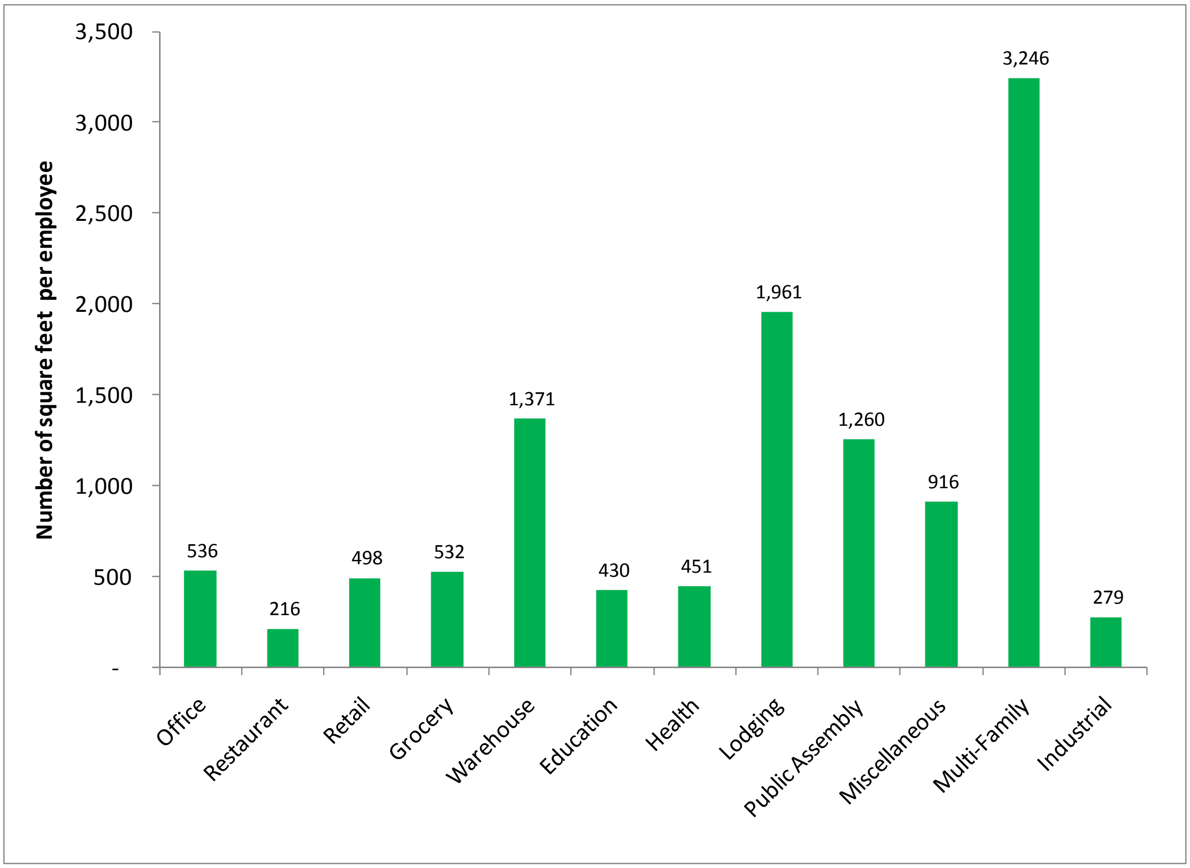


Figure 6-3 shows the number of employees per square foot. The number of employees varies greatly across segments. Multi-family, lodging and warehouse tend to have relatively few employees while industrial and restaurant segments have a lot of employees per square foot of floor space.

Figure 6-3 Employee Density (Square Feet per Employee)



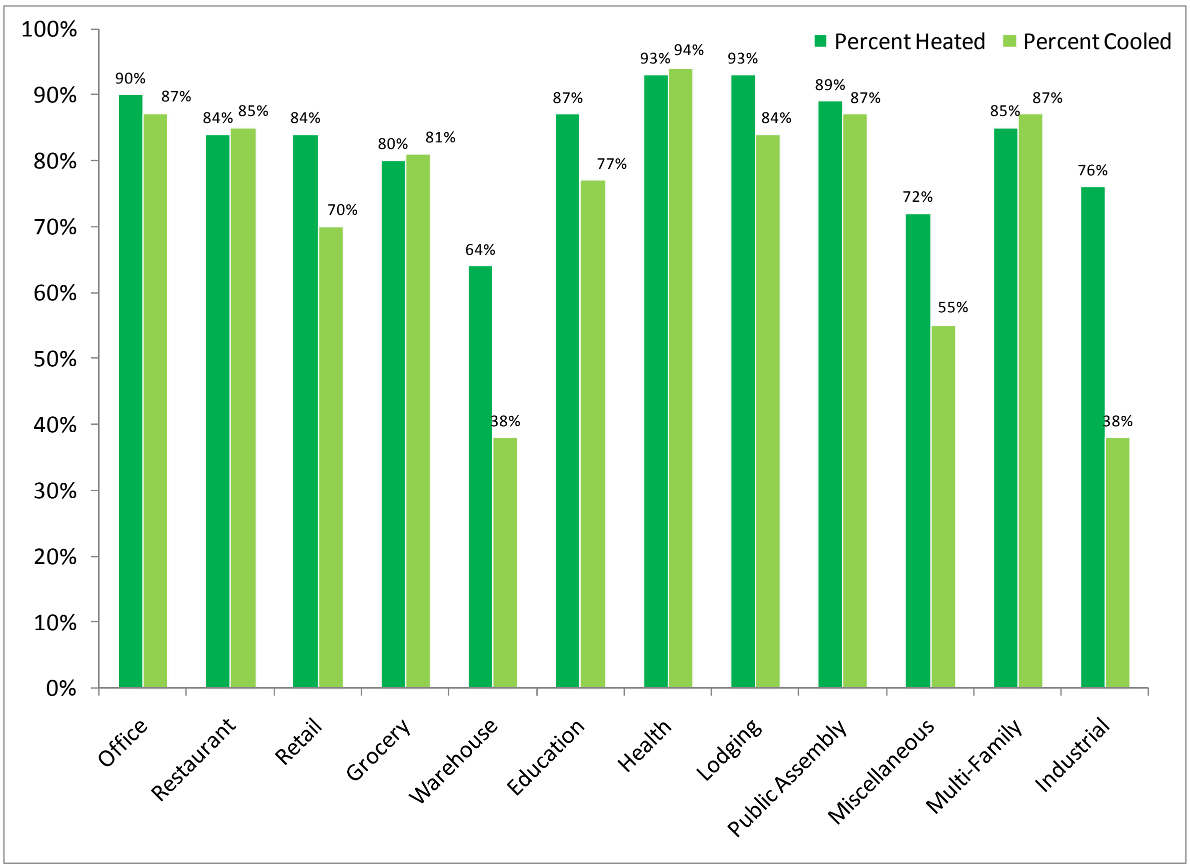
6.2 BUILDING EQUIPMENT

Respondents were asked about the type of heating cooling and water heating equipment used in the building, the type of fuel used and the saturation of different types of lighting.

6.2.1 Heating and Cooling

The heating and cooling numbers presented here represent the percentage of equipment per heated or cooled square feet. The percent of total square footage heated and cooled is shown in Figure 6-4 below.

Figure 6-4 Percent of Floor Space Heated and Cooled by Segment



Roof top Units (RTU's) are the most popular type of primary cooling across all segments (Figure 6-5 and Table 6-1) Chillers and Split Systems are also very prevalent in all types of buildings.

Figure 6-5 Type of Primary Cooling by Segment

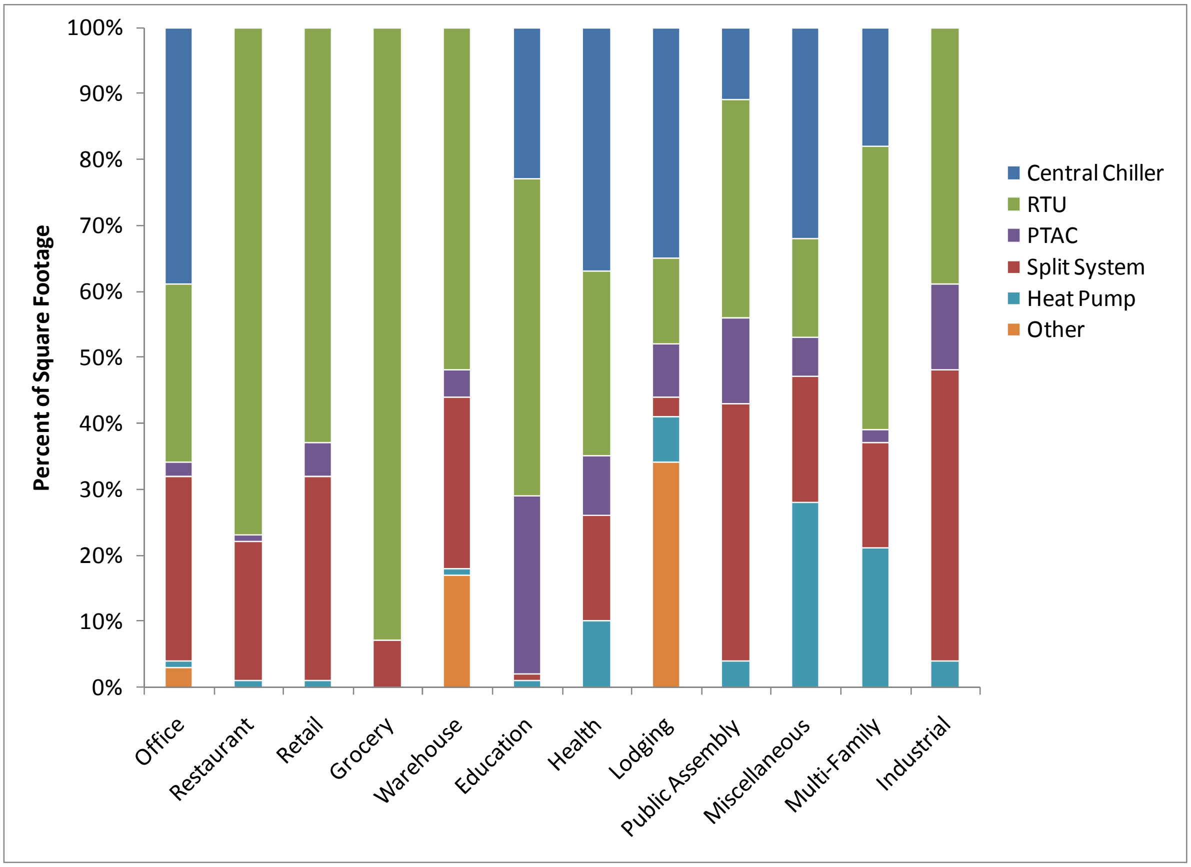


Table 6-1 Primary Cooling by Segment

Segment	Central Chiller	Split System	RTU	PTAC	Heat Pump	Other
Office	39%	28%	27%	2%	1%	3%
Restaurant	0%	21%	77%	1%	1%	0%
Retail	0%	31%	63%	5%	1%	0%
Grocery	0%	7%	93%	0%	0%	0%
Warehouse	0%	26%	52%	4%	1%	17%
Education	23%	1%	48%	27%	1%	0%
Health	37%	16%	28%	9%	10%	0%
Lodging	35%	3%	13%	8%	7%	34%
Public Assembly	11%	39%	33%	13%	4%	0%
Miscellaneous	32%	19%	15%	6%	28%	0%
Multi-Family	18%	16%	43%	2%	21%	0%
Industrial	0%	44%	39%	13%	4%	0%

Natural gas furnaces and boilers are the main types of heating equipment used in most segments (Figure 6-6 and Table 6-3). Lodging is the only segment that uses electricity as its primary heating fuel.

Figure 6-6 Type of Primary Space Heating

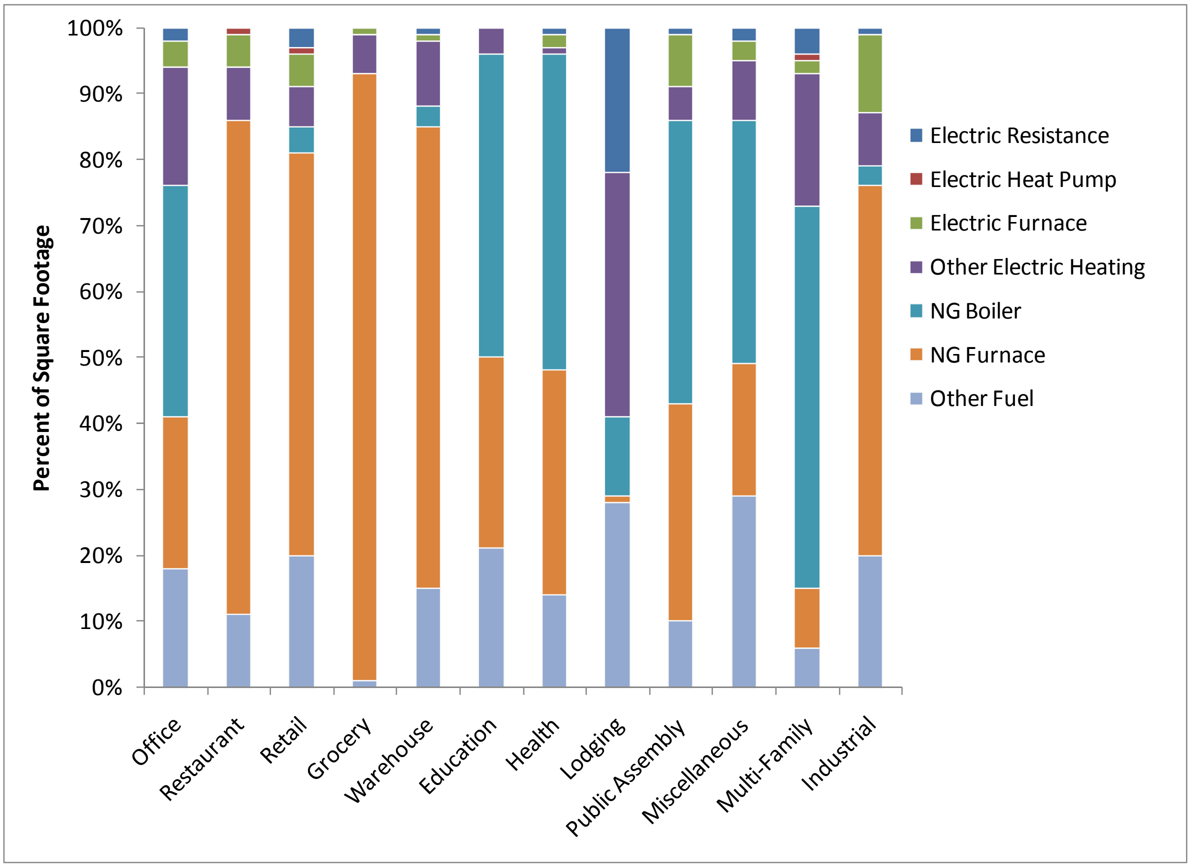


Table 6-2 Primary Space Heating by Segment

Segment	Electric Resistance	Electric Heat Pump	Electric Furnace	Other Electric Heating	NG Boiler	NG Furnace	Other Fuel
Office	2%	0%	4%	18%	35%	23%	18%
Restaurant	0%	1%	5%	8%	0%	75%	11%
Retail	3%	1%	5%	6%	4%	61%	20%
Grocery	0%	0%	1%	6%	0%	92%	1%
Warehouse	1%	0%	1%	10%	3%	70%	15%
Education	0%	0%	0%	4%	46%	29%	21%
Health	1%	0%	2%	1%	48%	34%	14%
Lodging	22%	0%	0%	37%	12%	1%	28%
Public Assembly	1%	0%	8%	5%	43%	33%	10%
Miscellaneous	2%	0%	3%	9%	37%	20%	29%
Multi-Family	4%	1%	2%	20%	58%	9%	6%
Industrial	1%	0%	12%	8%	3%	56%	20%

6.2.2 Water Heating

Natural gas is the fuel used most to heat water in the majority of segments (Figure 6-7 and Table 6-3). But both the office segment and the warehouse segment are more likely to have an electric water heater.

Figure 6-7 Type of Water Heating

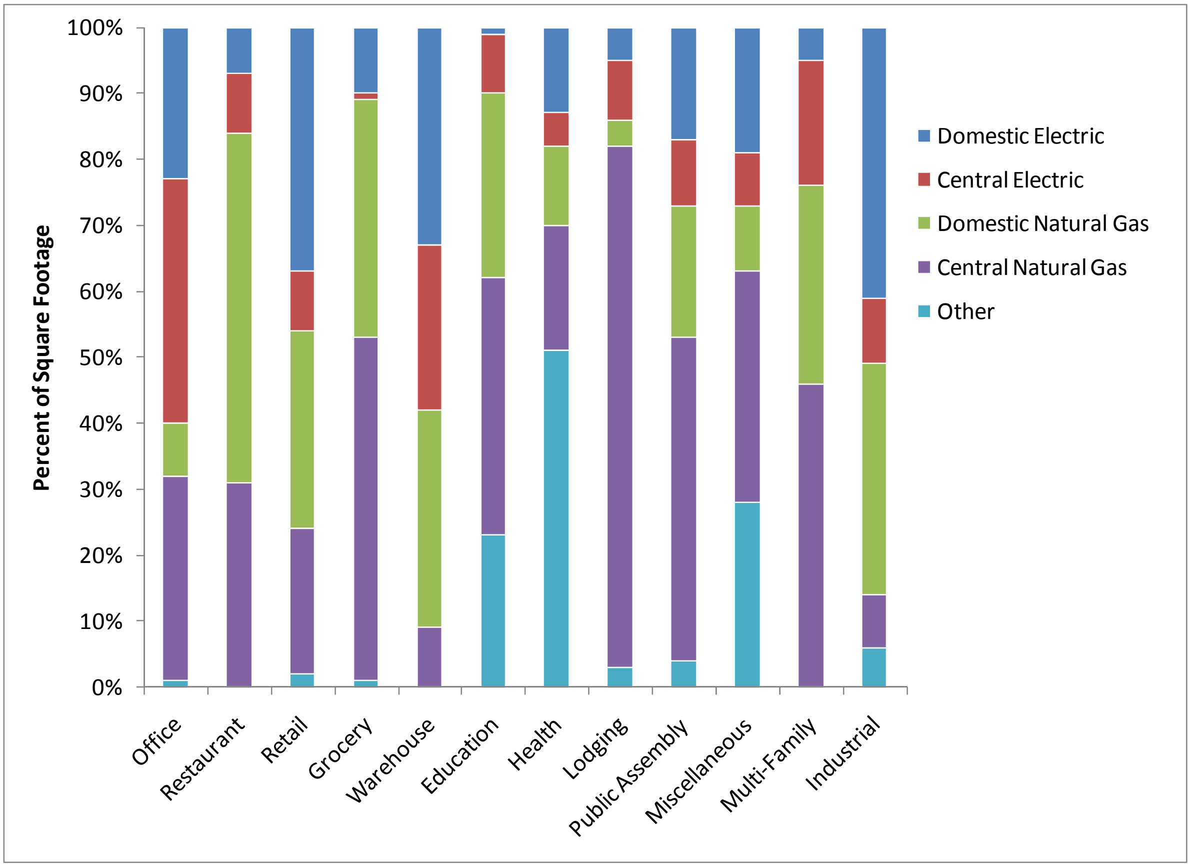


Table 6-3 Water Heating by Segment

Segment	Domestic Electric	Central Electric	Domestic Natural Gas	Central Natural Gas	Other
Office	23%	37%	8%	31%	1%
Restaurant	7%	9%	53%	31%	0%
Retail	37%	9%	30%	22%	2%
Grocery	10%	1%	36%	52%	1%
Warehouse	33%	25%	33%	9%	0%
Education	1%	9%	28%	39%	23%
Health	13%	5%	12%	19%	51%
Lodging	5%	9%	4%	79%	3%
Public Assembly	17%	10%	20%	49%	4%
Miscellaneous	19%	8%	10%	35%	28%
Multi-Family	5%	19%	30%	46%	0%
Industrial	41%	10%	35%	8%	6%

6.2.3 Lighting

Lamp types were classified by category – fluorescent tubes, screw-in and specialty – and then further by type. To quantify the density of lighting types, lighting was specified in lamps per 1000 square feet. Larger values indicate more prevalent lighting.

Table 6-4 Lamps per 1,000 Square Feet – All Indoor

Segment	Fluorescent	Screw-in	Specialty
Office	11.0	3.0	5.1
Restaurant	9.3	10.4	9.0
Retail	6.6	2.7	2.4
Grocery	9.5	4.0	3.2
Warehouse	3.3	1.1	2.5
Education	12.8	6.2	0.3
Health	14.7	4.5	1.9
Lodging	1.4	6.5	0.5
Public Assembly	3.1	3.3	1.1
Miscellaneous	3.9	1.9	2.3
Multi-family	0.9	4.8	2.8
Industrial	5.4	1.2	2.0

The most prevalent type among the indoor fluorescent tubes are the T12 lamps (Table 6-5). Lodging and buildings tend to have more T5's per square foot public assembly buildings tend to have more T8's. T5 lamps are present across all segments, although in smaller numbers than either T8 or T12 lamps.

Table 6-5 Lamps per 1,000 Square Feet – Indoor Fluorescent Tubes

Segment	T5	T8	T12
Office	4.4	1.6	10.3
Restaurant	4.8	3.4	9.0
Retail	0.9	3.9	6.9
Grocery	0.5	1.0	10.4
Warehouse	0.7	1.8	3.0
Education	0.7	2.2	14.1
Health	2.9	3.2	14.5
Lodging	2.0	0.1	1.2
Public Assembly	1.4	3.4	2.2
Miscellaneous	3.7	2.4	3.8
Multi-family	0.1	0.1	0.9
Industrial	2.9	1.4	4.5

As shown in Table 6-6, CFL's are found most often in the restaurant, education and lodging sector. For every 144 square feet of floor space in restaurants there is a CFL. Metal Halides and LED screw-in bulbs tend to be rare, but the segment that uses LED bulbs the most often is restaurants. Incandescent bulbs are the most used screw-in light bulb in the miscellaneous, multi-family, public assembly, warehouse and industrial sectors.

Table 6-6 Light bulbs per 1,000 Square Feet – Indoor Screw-in Bulbs

Segment	Incandescent	CFL	Metal Halide	LED
Office	2.2	2.5	0.3	3.0
Restaurant	6.5	6.9	0.9	18.5
Retail	1.9	2.0	1.7	2.1
Grocery	1.8	4.3	1.5	2.1
Warehouse	1.2	0.7	0.8	0.4
Education	4.6	6.0	0.4	0.0
Health	2.5	3.0	0.3	2.0
Lodging	2.0	5.2	0.2	0.2
Public Assembly	2.4	1.6	0.4	1.4
Miscellaneous	1.7	0.9	0.5	0.6
Multi-family	7.8	1.8	0.0	0.4
Industrial	1.3	0.5	0.8	0.2

Halogen/quartz bulbs are the only specialty bulbs that are used in all the segments with restaurants having the most halogen/quartz bulbs (Table 6-7).

Table 6-7 Light bulbs per 1,000 Square Feet –Specialty Bulbs

Segment	Neon	Induction	Halogen/ Quartz	High Pressure Sodium	Low Pressure Sodium
Office	0.9	0.6	3.3	1.1	1.2
Restaurant	3.0	0.8	11.6	5.6	0.0
Retail	0.9	2.8	2.6	1.4	0.6
Grocery	2.0	0.0	2.3	0.0	0.0
Warehouse	0.1	0.3	1.3	2.5	0.0
Education	0.0	0.0	0.6	2.2	0.2
Health	5.6	4.5	1.6	0.3	0.5
Lodging	0.0	0.1	0.5	0.1	0.0
Public Assembly	6.3	0.8	0.8	1.1	1.2
Miscellaneous	0.3	0.7	1.1	3.5	0.0
Multi-family	0.0	0.0	3.0	0.5	0.0
Industrial	0.0	1.6	1.4	1.4	1.5

Type of exterior lighting varies by segment; in the grocery, miscellaneous and retail sectors LED lights are used most often for exterior lighting, while in the lodging and multi-family sectors CFL's are the most prevalent (Table 6-8).

Table 6-8 Light bulbs per 1,000 Square Feet –Exterior Lighting

Segment	Incandescent	CFL	Fluorescent	LED	Exit
Office	1.7	1.3	1.3	1.8	0.5
Restaurant	1.1	2.2	11.6	1.4	1.4
Retail	1.2	2.3	2.9	90.9	0.5
Grocery	1.5	1.7	3.4	17.9	0.4
Warehouse	0.1	0.3	0.7	0.4	0.4
Education	0.4	0.0	0.1	0.0	0.2
Health	0.3	0.2	0.1	0.3	0.3
Lodging	0.4	1.0	0.1	0.1	0.2
Public Assembly	0.8	0.4	1.3	0.3	0.3
Miscellaneous	0.2	0.2	1.0	3.4	1.4
Multi-family	0.7	4.3	0.3	0.3	0.6
Industrial	0.7	0.1	0.3	0.0	0.2

6.3 ENERGY EFFICIENCY MEASURES

Respondents were asked what energy efficiency measures they have implemented in the last three years and what measures they had planned in the next two years. The measures were divided into five categories: lighting, HVAC, water heating, building structure and equipment upgrades. This information was used to determine the current saturation of energy-efficiency measures and to develop the adoption rates for the forecast.

6.3.1 Measures Implemented

HVAC upgrades and installing energy management systems (EMS) are the most popular measures installed across all segments (Table 6-9). Installing variable speed drives (VSD) varies more by segment: health is more likely to have installed a VSD drive which is consistent with the fact that they are more likely to have the HVAC and other motors to upgrade.

Table 6-9 HVAC Measures Implemented in Last 3 years

Segment	Percent of Square Feet							
	HVAC Upgrade	Solar Panels	Heat Recovery	Duct Insulation	Retro-commissio n-ing	VSD Drive	Economizer	EMS
Office	31%	0%	0%	4%	6%	14%	33%	47%
Restaurant	8%	1%	2%	1%	2%	1%	7%	2%
Retail	19%	2%	5%	5%	3%	3%	22%	21%
Grocery	14%	0%	5%	8%	3%	0%	56%	44%
Warehouse	17%	0%	0%	8%	3%	0%	8%	9%
Education	43%	1%	0%	0%	5%	4%	19%	20%
Health	20%	0%	3%	0%	13%	24%	53%	46%
Lodging	44%	1%	0%	1%	0%	10%	8%	12%
Public Assembly	24%	1%	0%	6%	7%	9%	19%	27%
Miscellaneous	56%	0%	0%	7%	16%	2%	11%	10%
Multi-family	19%	0%	0%	14%	17%	12%	28%	10%
Industrial	35%	1%	2%	9%	1%	12%	29%	33%

Pipe insulation is the most popular water heating measure, followed by water heater upgrades.

Table 6-10 Water Heating Measures Implemented in Last 3 years

Segment	Percent of Square Feet				
	Water Heater Upgrade	Pipe Insulation	Reducing Temperature	Low Flow Nozzles	Faucet Aerators
Office	25%	42%	6%	4%	1%
Restaurant	19%	14%	16%	5%	3%
Retail	17%	22%	8%	4%	4%
Grocery	1%	73%	1%	2%	2%
Warehouse	14%	27%	1%	1%	1%
Education	10%	67%	6%	1%	5%
Health	20%	64%	1%	1%	3%
Lodging	19%	10%	40%	8%	24%
Public Assembly	20%	16%	10%	9%	6%
Miscellaneous	55%	3%	39%	17%	42%
Multi-family	22%	6%	21%	13%	17%
Industrial	23%	32%	12%	8%	1%

Lighting upgrades have been implemented in 12% or more of the floor space in all the segments. Switching to CFLs has been a popular measure (Table 6-11). Installing occupancy or daylighting sensors is less prevalent. Although 41% of the floor space in the multi-family segment has had occupancy sensors installed.

Table 6-11 Lighting Measures Implemented in Last 3 years

Segment	Percent of Square Feet					
	Lighting Upgrade	Delamping	CFLs	Task Lighting	Occupancy Sensors	Daylighting
Office	44%	10%	22%	5%	18%	10%
Restaurant	14%	17%	30%	3%	4%	6%
Retail	19%	16%	15%	1%	10%	11%
Grocery	23%	6%	19%	0%	1%	1%
Warehouse	12%	6%	21%	14%	3%	3%
Education	30%	13%	15%	0%	0%	0%
Health	55%	34%	48%	16%	10%	1%
Lodging	25%	31%	84%	0%	9%	3%
Public Assembly	24%	15%	39%	9%	6%	3%
Miscellaneous	37%	28%	41%	38%	6%	4%
Multi-family	14%	10%	51%	43%	41%	6%
Industrial	47%	9%	21%	11%	14%	3%

Overall very few building structure upgrades have been implemented in the last 3 years (Table 6-12). The miscellaneous and lodging segments have implemented more building structure measures than others segments[7].

Table 6-12 Building Structure Measures Implemented in Last 3 years

Segment	Percent of Square Feet			
	Window Upgrade	**Insulation**	**External Shades**	**Cool Roof**
Office	6%	4%	5%	11%
Restaurant	2%	7%	7%	1%
Retail	4%	8%	8%	12%
Grocery	1%	12%	0%	1%
Warehouse	8%	21%	5%	6%
Education	0%	5%	4%	3%
Health	1%	12%	2%	23%
Lodging	32%	5%	4%	0%
Public Assembly	3%	16%	13%	11%
Miscellaneous	10%	22%	39%	0%
Multi-family	5%	18%	5%	3%
Industrial	11%	12%	8%	14%

[7] • The miscellaneous segment appears to be fairly progressive in regards to energy efficiency. The segment is a varied mix of businesses so no one particular type dominates; therefore making generalizations about the companies difficult. One difference may be that there are several public service/government businesses in this segment. These types of businesses tend to be more progressive due to government incentives. This segment also includes construction businesses which are also savvier about energy efficiency improvements.

Overall very few equipment upgrades have been implemented in the last 3 years (Table 6-13). A couple of segments have focused on upgrading equipment: thirty-eight percent of the lodging floor space has upgraded office equipment and almost a third of the miscellaneous floor space has had a refrigeration, office equipment and/or kitchen equipment upgrade.

Table 6-13 Equipment Upgrades Implemented in Last 3 years

	Percent of Square Feet			
Segment	**Refrigeration upgrade**	**Pool Upgrade**	**Office Equipment Upgrade**	**Kitchen Equipment Upgrade**
Office	4%	0%	8%	1%
Restaurant	5%	0%	11%	7%
Retail	4%	1%	9%	2%
Grocery	4%	0%	4%	0%
Warehouse	6%	0%	9%	11%
Education	5%	0%	8%	4%
Health	6%	9%	4%	0%
Lodging	2%	3%	38%	1%
Public Assembly	6%	0%	15%	14%
Miscellaneous	35%	0%	30%	31%
Multi-family	19%	1%	12%	19%
Industrial	5%	1%	13%	2%

6.3.2 Planned Measures

Significant proportions of many of the segments plan to add an energy management system in the next 2 years (Table 6-14). The health and grocery segments plan to implement the most HVAC measures in the next two years, followed closely by the education and miscellaneous segments.

Table 6-14 HVAC Measures Planned for Next 2 years

	Percent of Square Feet							
Segment	**HVAC Upgrade**	**Solar Panels**	**Heat Recovery**	**Duct Insulation**	**Retro-commission-ing**	**VSD Drive**	**Economizer**	**EMS**
Office	13%	6%	5%	6%	4%	5%	36%	50%
Restaurant	17%	11%	11%	8%	14%	11%	18%	13%
Retail	11%	7%	6%	7%	11%	6%	27%	25%
Grocery	41%	0%	1%	0%	1%	41%	56%	44%
Warehouse	12%	2%	1%	5%	5%	9%	8%	10%
Education	25%	7%	7%	7%	12%	12%	25%	26%
Health	18%	1%	12%	10%	21%	3%	54%	57%
Lodging	14%	8%	10%	12%	16%	10%	18%	17%
Public Assembly	11%	10%	13%	8%	8%	7%	22%	33%
Miscellaneous	13%	23%	25%	1%	23%	23%	35%	10%
Multi-family	3%	12%	0%	2%	0%	0%	29%	29%
Industrial	10%	7%	4%	3%	6%	10%	27%	34%

The miscellaneous segment is the only segment with significant plans to implement water heating measures; a quarter or more of the miscellaneous floor space is planning pipe insulation, reducing water heating temperature and low flow nozzles (Table 6-15).

Table 6-15 Water Heating Measures Planned for the Next 2 years

	Percent of Square Feet				
Segment	**Water Heater Upgrade**	**Pipe Insulation**	**Reducing Temperature**	**Low Flow Nozzles**	**Faucet Aerators**
Office	3%	2%	3%	3%	3%
Restaurant	5%	6%	6%	5%	9%
Retail	9%	9%	4%	4%	7%
Grocery	1%	0%	0%	0%	0%
Warehouse	3%	3%	7%	7%	7%
Education	5%	7%	6%	8%	7%
Health	2%	13%	13%	12%	11%
Lodging	6%	8%	6%	8%	12%
Public Assembly	1%	8%	4%	4%	6%
Miscellaneous	7%	25%	27%	27%	5%
Multi-family	6%	12%	1%	4%	4%
Industrial	3%	4%	3%	8%	3%

Several lighting upgrades, delamping projects and CFL projects are planned in the C&I sector for the next 2 years (Table 6-16). More than half (55%) of the health floor space, and 44% of office floor space will undergo a lighting upgrade. Forty-two percent of the miscellaneous segment floor space will change out regular bulbs for CFLs. Significant proportions of the building floor space will also have occupancy sensors installed.

Table 6-16 Lighting Measures Planned for Next 2 years

Segment	Percent of Square Feet					
	Lighting Upgrade	Delamping	CFLs	Task Lighting	Occupancy Sensors	Daylighting
Office	44%	10%	9%	11%	16%	5%
Restaurant	14%	17%	13%	7%	16%	12%
Retail	19%	16%	12%	13%	16%	13%
Grocery	23%	6%	13%	0%	6%	0%
Warehouse	12%	6%	5%	6%	14%	11%
Education	30%	13%	13%	8%	23%	7%
Health	55%	34%	14%	13%	19%	13%
Lodging	25%	31%	8%	0%	34%	32%
Public Assembly	24%	15%	21%	6%	10%	11%
Miscellaneous	37%	28%	42%	3%	44%	5%
Multi-family	14%	10%	10%	0%	6%	6%
Industrial	36%	14%	13%	18%	25%	12%

The miscellaneous segment is planning significant building structure improvements and the education sector is planning to upgrade the windows in 44% of its floor space (Table 6-17). Cool roofs have yet to catch on, but seem to be gaining some momentum in the multi-family and health segments.

Table 6-17 Building Structure Measures Planned for the Next 2 years

	Percent of Square Feet			
Segment	**Window Upgrade**	**Insulation**	**External Shades**	**Cool Roof**
Office	6%	3%	5%	3%
Restaurant	10%	7%	10%	1%
Retail	12%	9%	11%	0%
Grocery	4%	12%	0%	0%
Warehouse	5%	23%	2%	2%
Education	44%	7%	7%	6%
Health	4%	26%	11%	8%
Lodging	12%	4%	0%	0%
Public Assembly	12%	21%	10%	4%
Miscellaneous	32%	28%	50%	0%
Multi-family	21%	3%	12%	12%
Industrial	7%	9%	9%	2%

The grocery segment is planning significant refrigeration upgrades in the next 2 years, while the miscellaneous segment is planning refrigeration, office equipment and kitchen equipment upgrades (Table 6-18).

Table 6-18 Equipment Upgrade Measures Planned for the Next 2 years

Segment	Percent of Square Feet			
	Refrigeration upgrade	Pool Upgrade	Office Equipment Upgrade	Kitchen Equipment Upgrade
Office	4%	1%	5%	3%
Restaurant	15%	11%	6%	8%
Retail	13%	5%	8%	6%
Grocery	46%	0%	0%	0%
Warehouse	3%	1%	1%	1%
Education	17%	7%	19%	13%
Health	12%	1%	11%	11%
Lodging	11%	11%	13%	19%
Public Assembly	15%	7%	14%	13%
Miscellaneous	40%	0%	43%	41%
Multi-family	4%	13%	1%	2%
Industrial	8%	2%	10%	3%

6.4 CONLUSIONS AND RECOMMENDATIONS

The market research performed for AmerenUE's potential study can also be used to inform energy efficiency program design and marketing. Based on the results of this study we conclude the following:

- There are still gains to be made by promoting CFLs. CFLs are the primary screw-in light bulb used in all segments, but incandescent screw-in bulbs are still in use.
- An opportunity exists for occupancy sensors. Except for the multi-family segment, few segments have implemented them. The education and lodging segments show the most interest in this technology and should be the first to be targeted.
- The lodging segment has primarily electric heat and few energy efficient measures are planned by this segment in the next 2 years. Marketing materials specifically focused on educating the lodging industry about ways to improve electric heat efficiency may be a worthwhile investment.
- The office and warehouse segments primarily have electric water heaters. These segments should be primary targets for marketing water heater efficiency programs.
- In the next 2 years several HVAC and lighting energy efficiency measures are planned in the industrial sector. Upgrading to an EMS system is planned for more than a third of industrial floor space in the next 2 years and economizers are planned for more than a quarter of the floor space. A lighting upgrade is planned for more than a third of the floor space, and occupancy sensors are planned for a quarter of the floor space. It will be important to have account managers to help ensure that their industrial customers with planned projects are able to see them through. Support can be provided through education, contractor referrals, and program incentives.

  A large percentage of the education segment plans to upgrade its windows, while in the grocery segment many plan to upgrade their refrigeration equipment. This segment would most likely welcome specific information about efficiency and rebates that will help them make intelligent purchasing decisions.

CHAPTER 7

C&I PROGRAM INTEREST RESULTS

AmerenUE DSM Market Potential

Realistic Achievable Potential for Energy Efficiency and Demand Response Program Adoption within the Business Sector

Global Energy Partners, LLC

Momentum Market Intelligence

August, 2009

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Background and Objectives

- AmerenUE is in the process of investigating market potential for a wide variety of Demand Side Management (DSM) options.
  - Overall this process seeks to understand various categories of electrical energy efficiency and demand response potential in the Residential and Business (Commercial/Industrial) sectors within AmerenUE's service territory.
- AmerenUE intends to use the results of this market potential investigation in an integrated resource planning process to analyze various levels of energy efficiency related savings and peak demand savings attributable to both energy efficiency initiatives and demand response initiatives at various levels of cost savings.
- The phase of the research contained in this report is concerned with exploring Realistic Achievable Potential, which is an integral part of understanding overall market potential.
  - *Realistic Achievable Potential* is a representation of likely customer response to specific measures that could be implemented under realistic program design conditions.
- This particular report addresses Realistic Achievable Potential within the Business (Commercial / Industrial) sector.
- Broad questions embedded in this phase of this research that will help AmerenUE better understand Realistic Achievable Potential within the Business sector include:
  - How likely are customers within the Business sector to participate in various energy efficiency programs AmerenUE is considering offering?
  - Which of these energy efficiency measures offer the highest likely participation rates?
  - How does likelihood to participate differ by payback period for the customer?
  - What overall firmographic and psychographic characteristics correspond to a higher likelihood to participate in energy efficiency programs?
  - What segments can be derived within the Business sector, and how do these segments differ in terms of likelihood to participation and firmographic and psychographic characteristics?
  - Which of these segments represent the best opportunities for AmerenUE to focus their marketing on?
  - What messaging strategies would likely be useful to help foster participation among the high opportunity segments?

Contents

Methodology – Sample Design

- AmerenUE provided a list of 135,799 records of Commercial and Industrial accounts, which yielded a total of 87,052 sample records when multiple accounts belonging to a single premise were aggregated. This file served as the basis for sampling for this research.
  - This list of records included a variety of information for each customer, including premise name, address, annual kWh usage, division, industry, account number, etc.

- Sample records were allocated to either Small-to-Medium Business (SMB) or Large Commercial / Industrial (LCI) based on industry and annual kWh usage.*

- Sample records were also categorized based on the number of records with the same mailing address. For records with duplicate mailing addresses, the record with the highest energy usage was selected for sampling (plus a record with average energy usage in some instances).*

- A total of 28,923 Business customers provided in the sample were sent a postcard inviting them to go online and complete the survey associated with their business type (SMB or LCI):

	Number of customers invited to complete the survey
Small-to-Medium Business (SMB)	20,700
Large Commercial / Industrial (LCI)	8,223
Total Business customers	28,923

  - The postcard offered SMB customers a $15 Visa cash card plus a special report for completing the survey; LCI customers were offered a $20 Visa cash card plus a special report for completing the survey.

*See Slide 39 in the Appendix for additional information on Sampling Methodology.

Methodology – Sample Design (Continued)

- In order to qualify to complete the survey, SMB respondents had to meet the following criteria:
  - Respondent must be knowledgeable about decision-making about energy issues for the business at the specified location
  - Business must be billed for electricity directly by AmerenUE or billed through a third-party service provider
  - Business at the specified location must occupy enclosed space

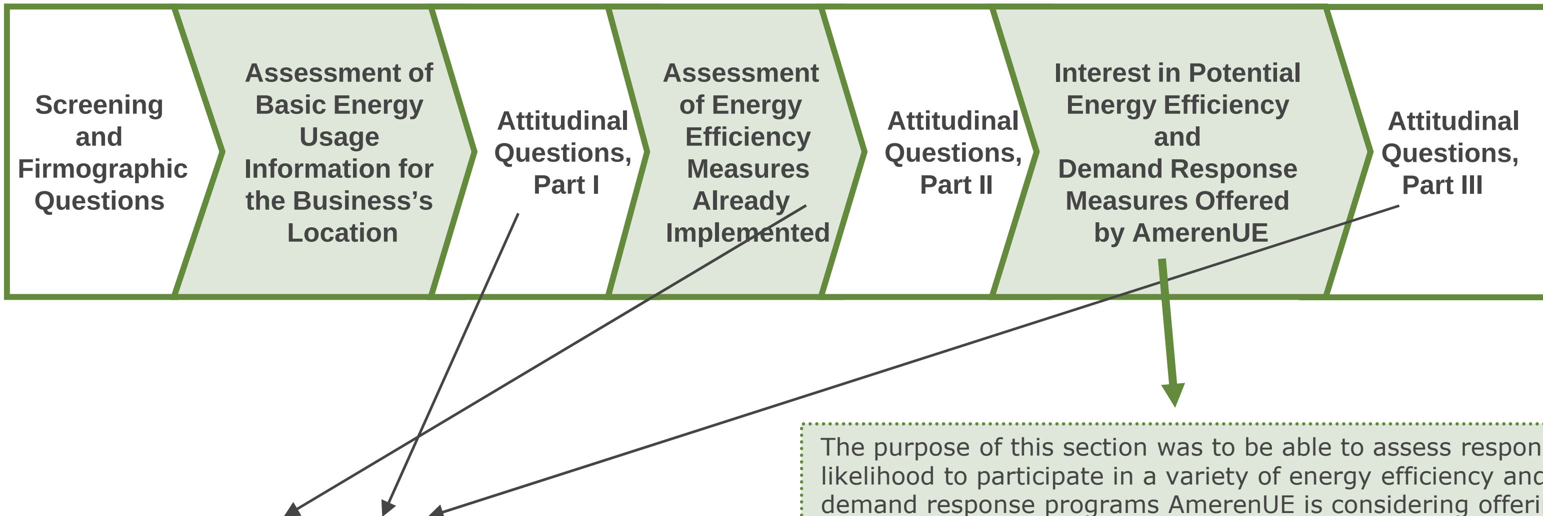
- In order to qualify to complete the survey, LCI respondents had to meet the following criteria:
  - Respondent must be knowledgeable about decision-making about energy issues for the business at the specified location
  - Business must occupy at least one building / structure at the specified location
  - Business must make some or all of the decisions relating to management of energy operations at the specified location
  - Business must pay for some or all of the energy bills at the specified location

- A total of 1,023 AmerenUE Business customers completed the online survey, in English, between June 8 and July 29, 2009:

	Number of completed surveys	Time period of survey data collection	Response rate	Average survey length
Small-to-Medium Business (SMB)	750	June 8 – July 11, 2009	4.9%	About 25 minutes
Large Commercial / Industrial (LCI)	273	June 16 – July 29, 2009	4.6%	About 29 minutes
Total Business customers	1,023	June 8 – July 29, 2009	4.8%	About 26 minutes

Methodology – Questionnaire

- The questionnaires were designed to cover multiple content areas, including:



<u>Attitudinal batteries were designed to assess…</u>

- General attitudes about energy use, energy efficiency, environmental concerns, saving money, comfort, etc;
- Purchasing attitudes, preferences, practices;
- Attitudes toward electric utility providers in general and attitudes toward AmerenUE specifically

The purpose of this section was to be able to assess respondents' likelihood to participate in a variety of energy efficiency and demand response programs AmerenUE is considering offering.

In order to estimate how likelihood to participate in programs would vary by payback period, this section was designed using a <u>Van Westendorp variation of price sensitivity modeling</u> and took the following format:

- Assign programs / measures to categories that are similar in terms of type of action involved
- For each measure category, ask how likely would the respondent be to implement an example of a measure in this category at a standard payback period (3 years)?
- If no, how about at a shorter payback period (1 year)?
- If yes, how about at a longer payback period (5 years)?
- How likely would the respondent be to implement each other measure in the category at a standard payback period (3 years)?

Methodology – Data Analysis

Generating Realistic Estimates of Customer Likelihood to Participate in Tested Programs

- Market researchers have long recognized that customers – even business customers – tend to over-estimate their likelihood to participate in new programs and services within the context of a market research study
  - This means that it has been long recognized that some customers who say that they would be "certain" to participate in a given program in a survey would, in reality, not participate
  - This is often referred to as the "say-do" problem; the problem that survey respondents are typically more likely to say they would do something than actually end up doing it
  - The analytic challenge, as a result, is to appropriately adjust stated likelihood-to-participate ratings into more realistic estimate of likely customer response
  - Different options are available for making these adjustments, and the best option depends in part on the nature of the product, service, or program being evaluated. For example, reactions to socially desirable (including "green") options, need to be adjusted down more aggressively, while those for certain new technologies need to be adjusted less.
  - The MMI / GEP team uses a basic method for applying these adjustments that has been used in market research for more than 20 years
  - Originally developed by Proctor and Gamble for adjusting stated intent for products that require "consideration" (i.e., the person has to think about the purchase; it is not typically a "snap decision")
  - This method for adjusting stated intentions to more accurately represent likely customer response has been used in literally hundreds of product, program, and service assessments with very reasonable validity
- The adjustment used to translate "stated intent" to realistic estimates of likely behavior is outlined in the table below; essentially, this adjustment says that if respondents rate a given program as a "10" ("extremely likely to participate"), then the adjustment says that, realistically, only about 70% of those people will sign up for the program; at the other end of the scale, it says that anyone who rates their likelihood to participate as "7" or lower is unlikely to do so at all

Rating on 1-10 scale (10=Extremely likely to participate; 1=Not at all likely to participate)		**Take Rate / Likely Takers** (Percent of those rating *X* that would be likely to participate)
10	→	**70%**
9	→	**46%**
8	→	**23%**
1 through 7	→	**0%**

Methodology – Data Analysis (continued)

Developing Program Adoption Take Rates:

- Since the survey results generate a distribution of responses across the 10-point scale for each program, it is possible to calculate an overall program adoption "take rate" for each program (that is, the likely proportion of customers who would realistically be expected to adopt each program tested)
  - Using the adjustment factors outlined on the prior page, the response distributions for each measure were arrayed and translated into a single "realistic estimate of likelihood to take part in the program" or "take rate" (see the example below)

Take one example:

To calculate the take rate for "Installing an Energy Management System," at a 3 year payback period:

Total eligible customers: n≈1,023
rating 10: n≈91
rating 9: n≈88
rating 8: n≈147
rating 1 through 7: n≈697

Take rate = ((91*70%)+(88*46%)+(147*23%)+(697*0%)) / 1,023

Take rate = 13.2%

- Note also that in order to characterize the overall level of opportunity for a given program category, it was at times helpful to calculate an average take rate across programs / measures. This data point is referred to as a "Mean Take Rate" throughout this report and, unless otherwise noted, is calculated by finding the mean across the take rates (at a 3 year payback period) for all programs with an associated payback period component. Programs without an associated payback period were excluded from this calculation.

Methodology – Data Analysis (continued)

Testing programs at different payback levels

- In order to provide insight about the impact that varying payback periods might have on customer response to the programs tested, the survey explored response to each program for which payback period was relevant, at 1, 3, and 5 year payback levels
- The survey used a method developed by an economist by the name of von Westendorp to capture this information; this technique begins by asking respondents to asses their likelihood to adopt a program at a 3 year payback, and then (a) if they respond positively to this option, asks them to respond to a 5 year payback, or (b) if they respond negatively to this option, asks them to respond to a 1 year payback period
- In order to deal with issues of survey length, the tested program measures were sorted into different categories that were similar in terms of scale of investment and type of measure
    - The full 1, 3, and 5 year payback assessment were then conducted for a single program within each category
    - The remaining programs within each category were evaluated at the 3 year payback level only
    - Regression analysis was then used to develop the 1 and 5 year payback values for each measure, using the slopes observed for the example program in each category

Weighting:

- In order to better mirror the Business market in AmerenUE's service territory, data were weighted by four variables: Business Type (SMB vs. LCI), Division, Annual Energy Usage, Industry

Data Merge:

- Data for SMB and LCI were collected in separate surveys, but given that the questionnaires were virtually identical (the only real differences were in the screener), the data files were merged after attitudinal factor analyses showed much similarity between the two respondent types.

Methodology – Data Analysis (continued)

Psychographic Segmentation Analysis:

- One of the goals of the analysis was to go beyond traditional firmographic segmentation approaches, and explore whether or not there were psychographic customer segments that could be helpful in providing an understanding of why customers responded as they did to the programs tested, and to support initial thinking about how to prioritize marketing efforts and marketing communications
- Several steps were involved in developing this psychographic segmentation:
  - First, the team analyzed the groups of items that were included in the questionnaire which were designed to generate psychographic insights (these included Q9, Q18, Q20, Q32, Q35). The goal of this analysis was to identify groups of items that respondents tended to evaluate similarly. This process is called "factor analysis," and refers to the process of finding and interpreting these groups of items that people think of as similar.
  - Second, the team considered all of the attitudinal factors that were identified in step one, along with a variety of other variables to find the ones that generated the most useful segmentation model. This was partly a trial and error process, but ultimately, the variables selected to be included in the segmentation model included:
    - Annual energy usage (TOTALKWH)
    - Industry type (INDUSTRY) or Building Type (S7)
    - Number of employees (Q9)
    - Square footage (9A/9B)
    - A count of energy efficient appliances purchased in last 12 months (Q11)
    - Whether they have replaced any of their facility's interior lighting with high efficiency lighting in the last 12 months (Q12)
    - Whether they believe their business has participated in any loans, price discounts or conservation rebate programs provided by AmerenUE in the last 2 years (Q15)
    - Approach to implementing energy efficiency actions (Q16)
    - A count of the programs at a 3 year payback period rated 8-10 in Q22-Q29 (1-10 scale, 10=Extremely likely to participate)
    - Overall satisfaction with AmerenUE (Q37)

Methodology – Data Analysis (continued)

Psychographic Segmentation Analysis (continued):

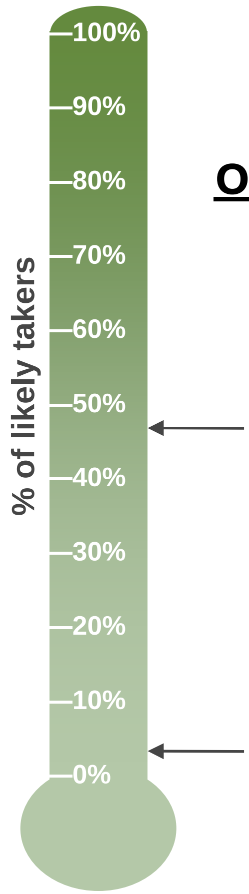
- Once the initial segmentation inputs were identified, the team tested a wide variety of segmentation solutions, ultimately selecting a solution that optimized relative segment size, absolute segment sample size, and overall meaningfulness of segment profiles.
  - The solution selected as most appropriate was a solution containing 7 segments with different response patterns to the final set of selected segmentation inputs
- Note that the team also ultimately chose to create a combined segmentation model that combined the SMB and LCI subpopulations that were explored in this work; the reasons for this were that:
  - The factor analyses conducted for the attitudinal items revealed very similar patterns when conducted separately for the SMB and LCI populations (in other words, these businesses appeared to be responding to these items in similar ways)
  - The segments that were generated when the analysis was done separately for SMB and LCI populations were also very similar
  - In the interests of parsimony, then, it made sense to the team to construct a single segmentation model, rather than two separate models that were nearly identical

Contents

The range of Take Rates for programs / measures spans from a low of around one-twentieth of all eligible Business customers to a high of nearly one-half of all eligible Business customers.

Likely Takers

(Total Business Customers; n=1,023)



Overall maximum and minimum

Maximum take rate for a single program: ***47%***

(Purchase higher than standard efficiency light bulbs; at a 1 year payback period)

Minimum take rate for a single program: ***3%***

(Install diesel generators to offset electricity used; at a 5 year payback period)

Q22-Q31

Note: A few programs were excluded from the calculation of these statistics due to insufficient sample sizes (n<30).

Overall, Business customers tend to be much more likely to adopt when payback periods are shorter.

Likely Takers by Payback Period

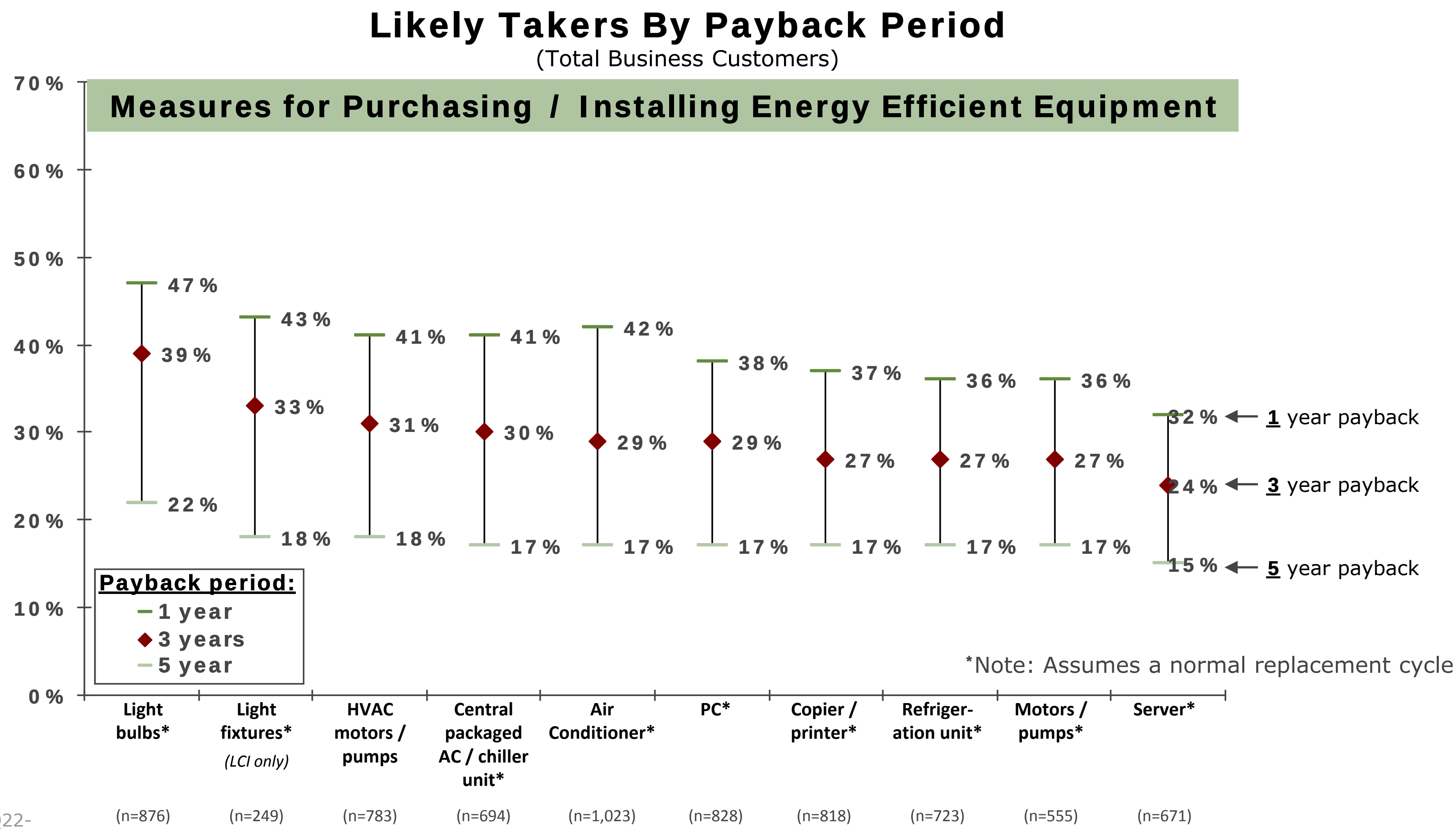
(Total Business Customers, n range=249-1,023)

@ a **1** year payback period	@ a **3** year payback period	@ a **5** year payback period
Maximum: *47%*	Maximum: *39%*	Maximum: *22%*
Mean: *33%*	Mean: *22%*	Mean: *13%*
Minimum: *9%*	Minimum: *5%*	Minimum: *3%*

Q22-Q31

Note: A few programs were excluded from the calculation of these statistics due to insufficient sample sizes (n<30).

Purchasing higher than standard efficiency light bulbs and fixtures, HVAC motors / pumps, and cooling equipment on a normal replacement cycle are the measures most likely to be adopted among this group of measures.

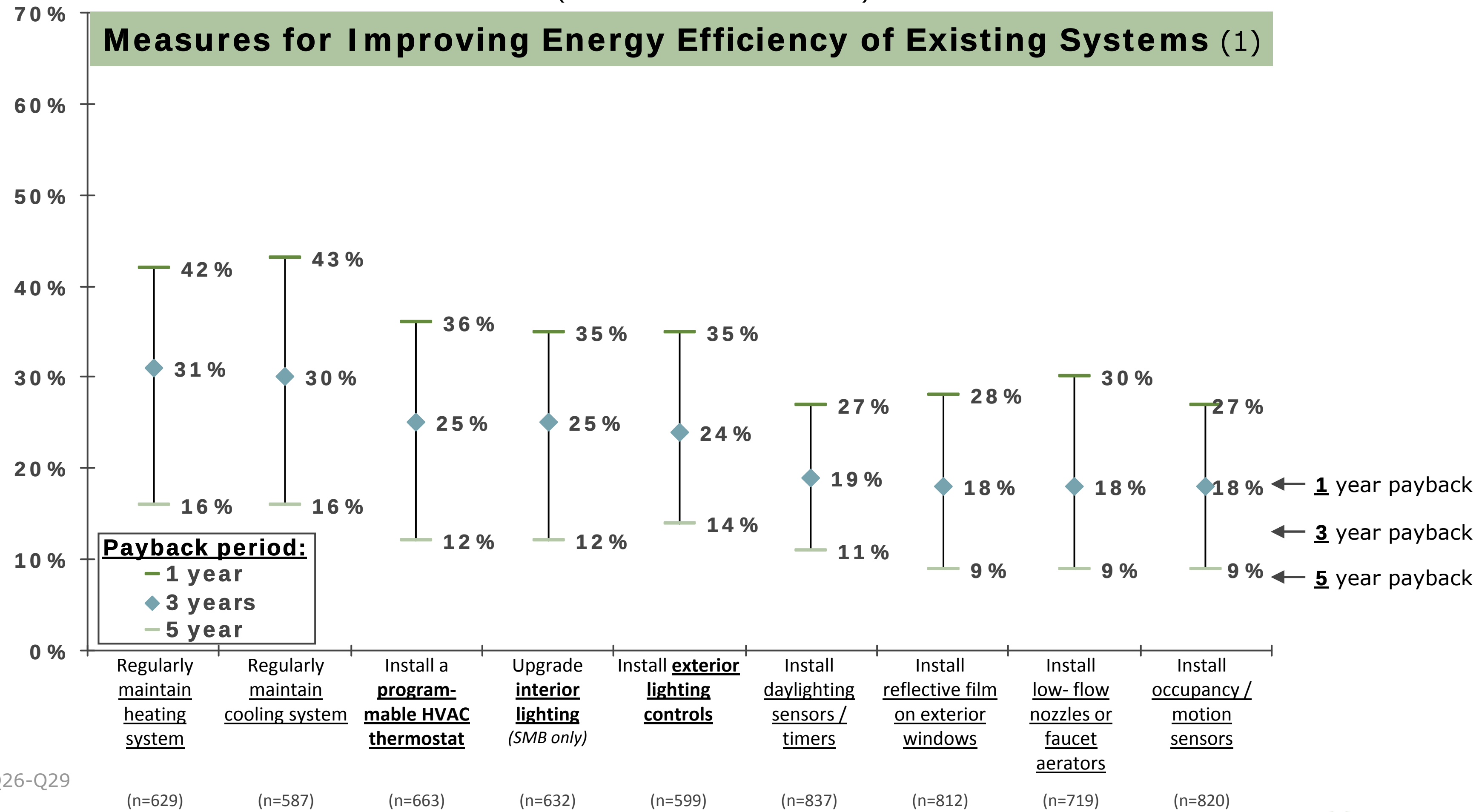


Q22-Q23

Note: Data for a few measures tested is not reported due to insufficient sample sizes (n<30)

Regularly performing maintenance on heating and cooling systems and installing a programmable thermostat are the measures most likely to be adopted among measures for improving existing systems.

Likely Takers By Payback Period
(Total Business Customers)



Q26-Q29

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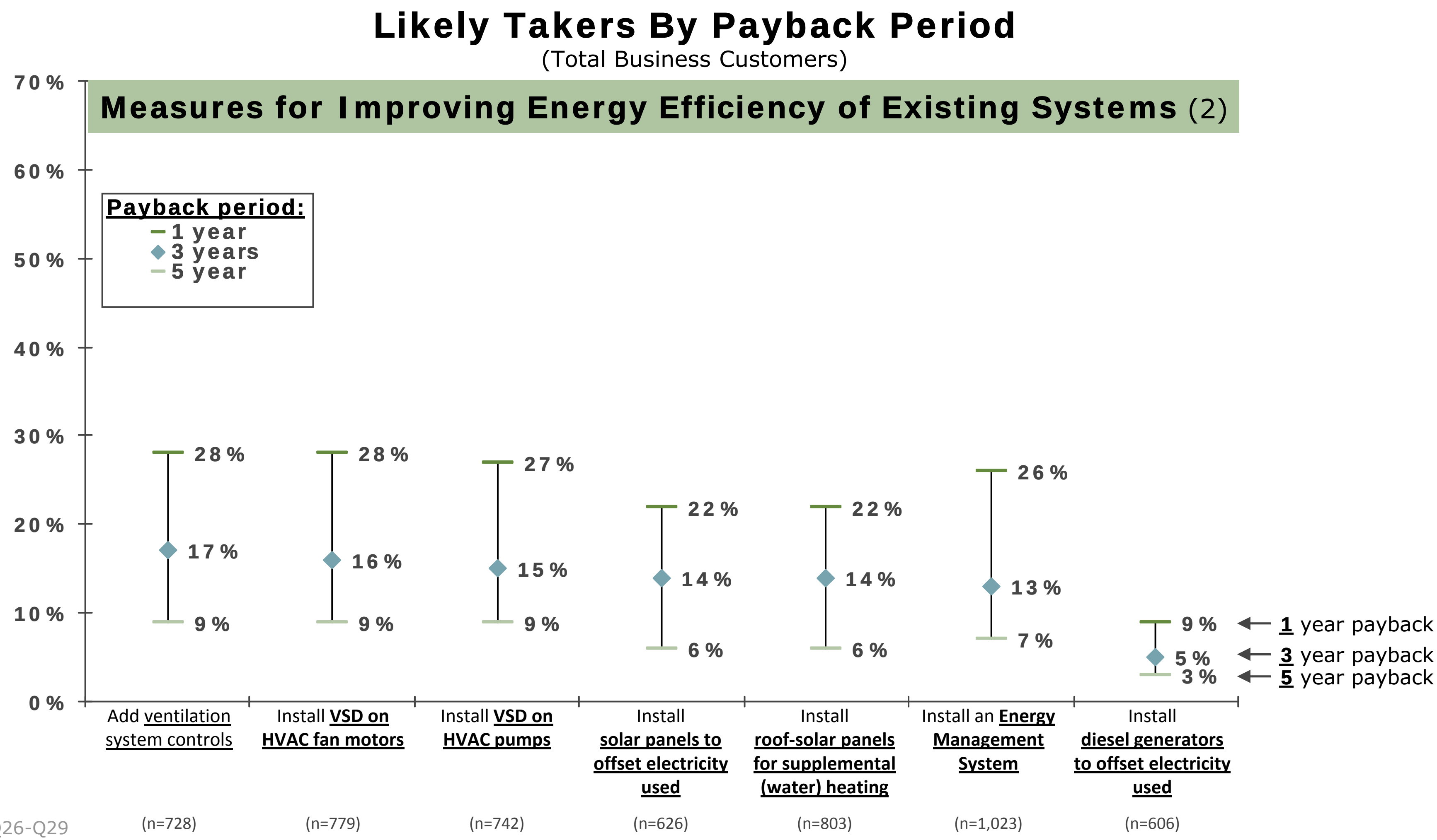
Note: Data for a few measures tested is not reported due to insufficient sample sizes (n<30).

Ameren UE Connecting Missouri

Measures associated with distributed generation are among the measures least likely to be adopted for improving existing systems.



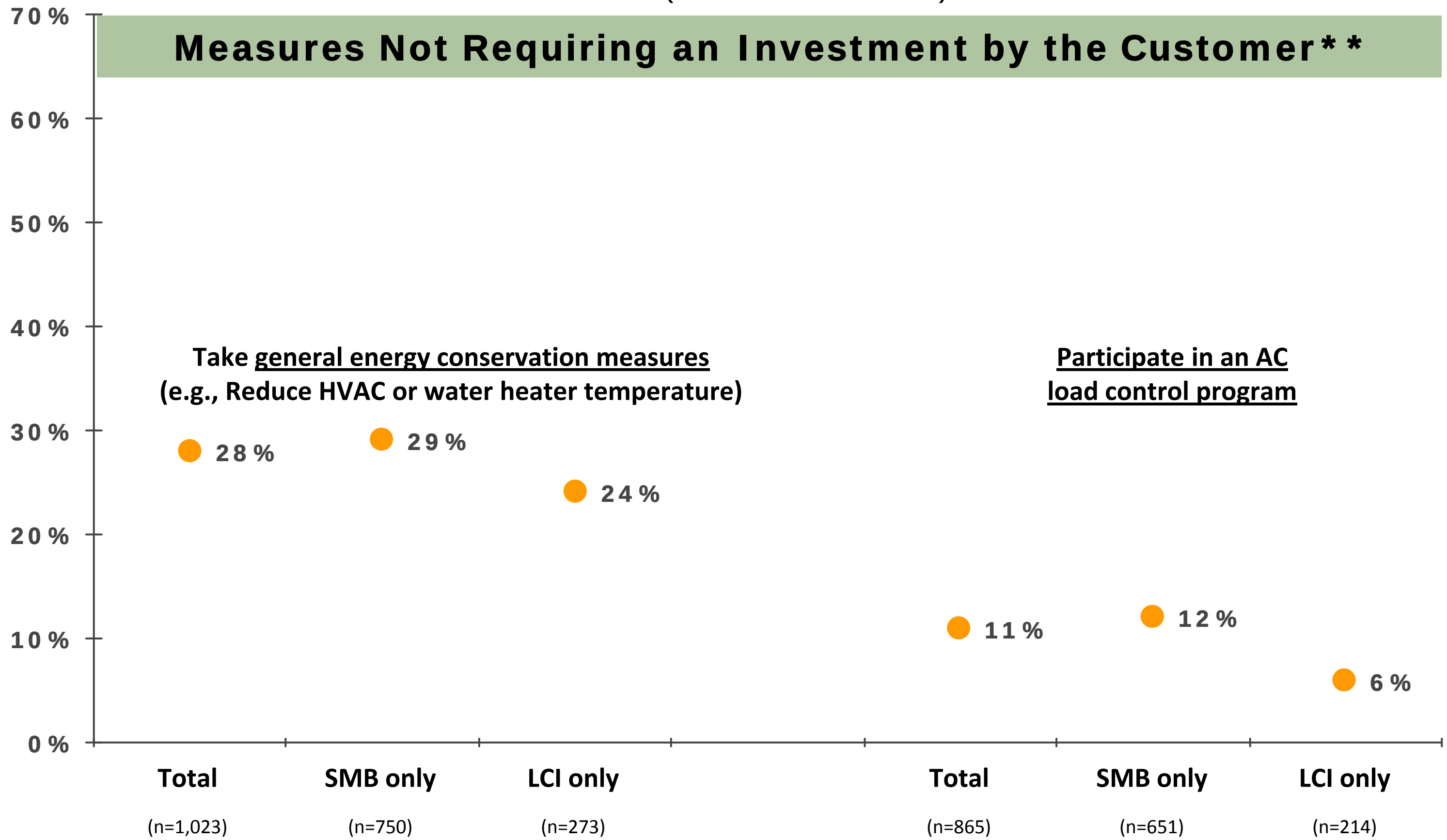
Momentum Market Intelligence
Global Energy Partners, LLC An Employee-Owned Company

Note: Data for a few measures tested is not reported due to insufficient sample sizes (n<30)

Ameren UE Connecting Missouri

Some Business customers, particularly SMB, indicate a willingness to take general energy conservation measures, but are much less likely to participate in an AC load control program.

Likely Takers
(Business Customers)



Q30/Q31

** Note: No payback period associated with measure

Measures associated with "Purchasing / Installing Energy Efficient Equipment" tend to be among the group of measures showing the highest opportunity for adoption.

Measures: Highest Opportunity	Likely Takers @ 3yr Payback (n range=249-1,023)
Purchase EE light bulbs*	39%
Purchase EE Light fixtures *(LCI only)* *	33%
Purchase EE HVAC motors / pumps	31%
Maintain heating system regularly	31%
Maintain cooling system regularly	30%
Purchase an EE central packaged air conditioner / chiller unit*	30%
Purchase an EE air conditioner*	29%
Purchase an EE PC*	29%

Measures: Middle Opportunity	Likely Takers @ 3yr Payback (n range=555-1,023)
Purchase an EE copier / printer*	27%
Purchase an EE refrigeration unit*	27%
Purchase EE motors / pumps*	27%
Install a programmable thermostat	25%
Reduce water heater temperature **	28%
Upgrade interior lighting *(SMB only)*	25%
Install exterior lighting controls	24%
Purchase an EE server*	24%
Install daylighting sensors or timers	19%
Install reflective film on ext. windows	18%
Install 'low flow' nozzles or faucet aerators	18%
Install occupancy / motion sensors	18%

It is interesting to note that, because they are based on a normal replacement cycle, the measures in the "Purchasing / Installing Energy Efficient Equipment" group are among those that take the least amount of additional effort to implement, especially in comparison to the measures with the lowest take rates.

Measures: Lowest Opportunity	Likely Takers @ 3yr Payback (n range=606-1,023)
Add ventilation system controls for variable air volumes	17%
Install VSD on HVAC fan motors	16%
Install variable speed on HVAC drives / pumps	15%
Install solar panels to offset electricity used	14%
Install roof-solar panels for supplemental (water) heating	14%
Install an Energy Management System	13%
Participate in an AC load control program**	11%
Install diesel generators to offset electricity used	5%

* Note: Assumes a normal replacement cycle
** Note: No payback period associated with measure

■ = Measures for Purchasing / Installing EE Equipment
■ = Measures for Improving EE of Existing Systems
■ = Measures Requiring No Upfront Investment

Q22-Q31

Momentum Market Intelligence

Global Energy Partners, LLC
An Employee-Owned Company

Note: Data for a few measures tested is not reported due to insufficient sample sizes (n<30)

Ameren UE
Connecting Missouri

Overall, SMB and LCI show similar patterns in likelihood to adopt, with both Business types sharing many of their the top ranking opportunities.

Comparison of Top Ranking Measures between SMB and LCI

Rank of Take Rates @ a 3 Year Payback Period	SMB	LCI	Shared Top Opportunity
Purchase EE light bulbs*	1	1	✓
Purchase EE Light fixtures *(LCI only)* *	n/a	3	
Purchase EE HVAC motors / pumps	3	2	✓
Maintain heating system regularly	2	6	✓
Maintain cooling system regularly	4	4	✓
Purchase an EE central packaged air conditioner / chiller unit*	5	5	✓
Purchase an EE air conditioner*	7	8	✓
Purchase an EE PC*	6	Not in Top 10 for LCI	
Purchase an EE copier / printer*	8	Not in Top 10 for LCI	
Purchase an EE refrigeration unit*	10	9	✓
Purchase EE motors / pumps	9	7	✓
Install exterior lighting controls	Not in Top 10 for SMB	10	

■ = Top 1-5 Ranking Measures
■ = Top 6-10 Ranking Measures

* Note: Assumes a normal replacement cycle

Q22-Q31

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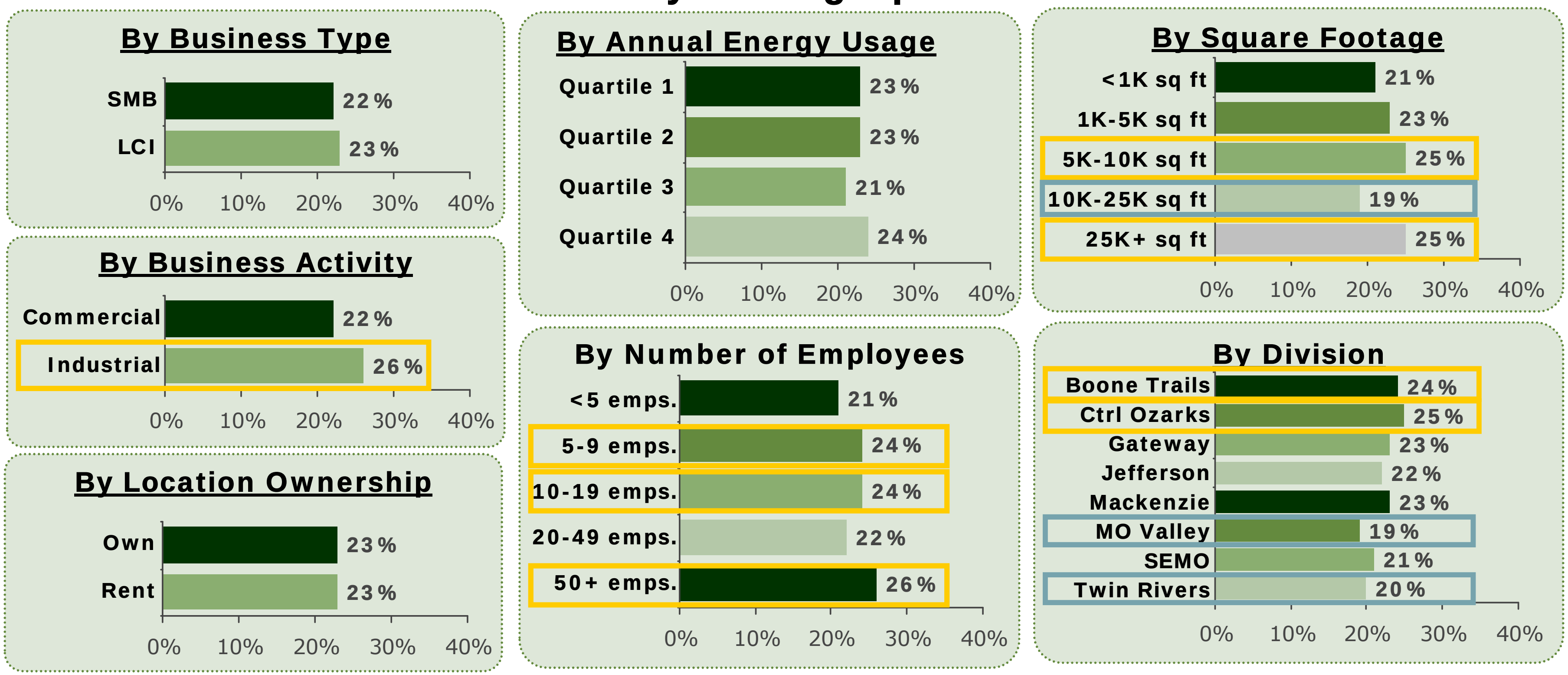
Note: A few programs were excluded from the calculation of these statistics due to insufficient sample sizes (n<30).

Firmographics that show subtle differences in overall likelihood to adopt programs / measures include type of business activity, number of employees, square footage, and division.

Groups exhibiting higher opportunity than their counterparts include: those whose primary business activity is industrial in nature (manufacturing/processing/production), those with 5-19 or 50+ employees, those that occupy a location with 5,000-10,000 or 25,000+ square feet of floorspace, and those located in Boone Trails and Central Ozarks.

Mean Take Rate* by Firmographic Differences



STUDY,QS4,QS7,QS9,QS9A, Division (from sample file), TotalKWH (from sample file) / Q22-Q31

Indicates a higher mean take rate

Indicates a lower mean take rate

Note: A few programs were excluded from the calculation of these statistics due to insufficient sample sizes (n

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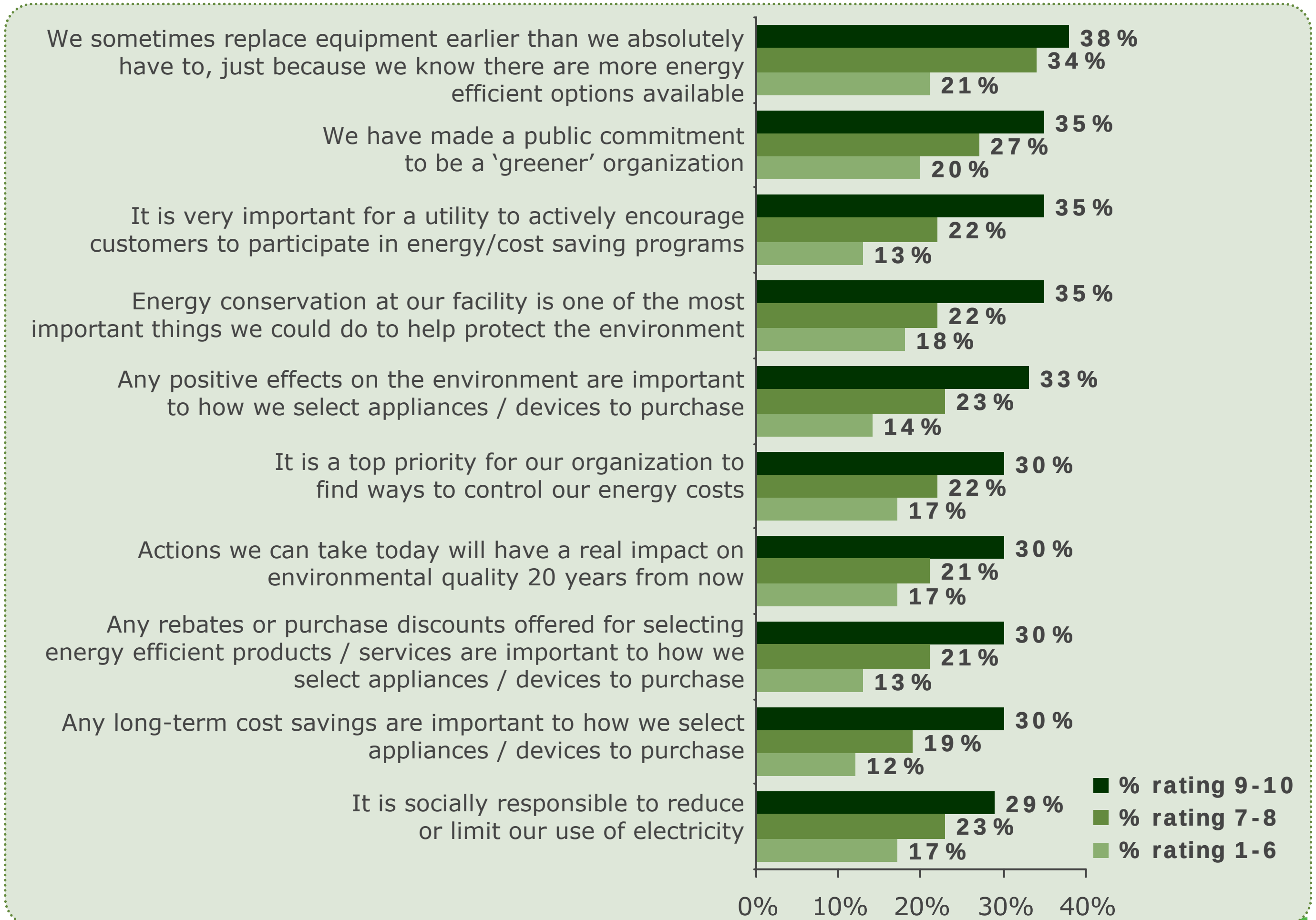
Ameren UE Connecting Missouri

Attitudinal differences, however, tend to correspond to much more salient differences in the mean take rate.

Higher likelihoods to adopt energy efficiency measures are most associated with “greener” attitudes, as well as some attitudes showing a focus on cost-savings.

Mean Take Rate by General Attitudinal Differences



Q9,Q18,Q20,Q32 / Q22-Q31

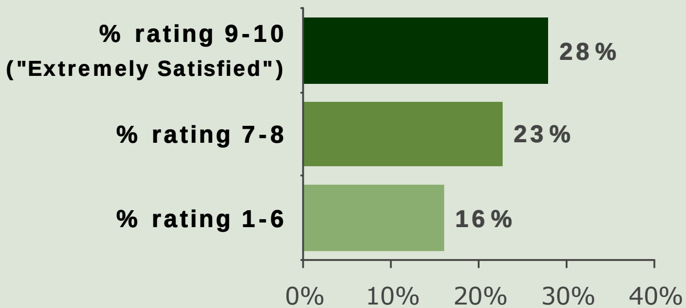
Note: A few programs were excluded from the calculation of these statistics due to insufficient sample sizes (n<30).

Higher likelihoods to adopt energy efficiency measures / programs also correspond noticeably to more favorable perceptions of AmerenUE.

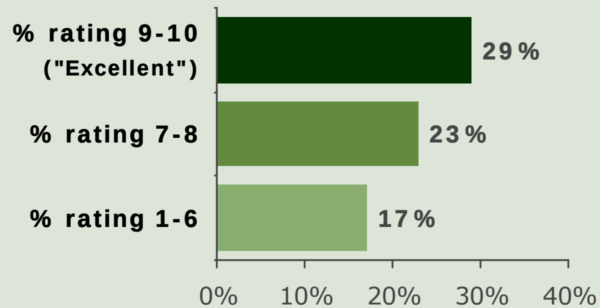
Customers who have more favorable opinions about AmerenUE (are extremely satisfied with AmerenUE, perceive AmerenUE's performance as excellent, strongly agree that AmerenUE is extremely trustworthy) consistently show higher likelihoods to adopt energy efficiency measures.

Mean Take Rate by Attitudinal Differences about AmerenUE

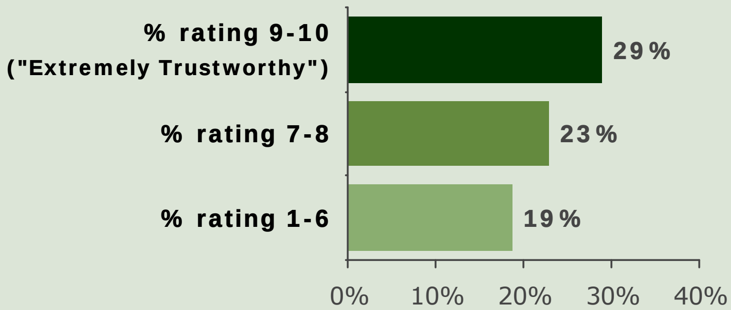
By Overall Satisfaction with AUE



By Perception of AUE's Performance



By Perception of AUE's Trustworthiness



Note: A few programs were excluded from the calculation of these statistics due to insufficient sample sizes (n<30).

Q35,Q36,Q37 / Q22-Q31

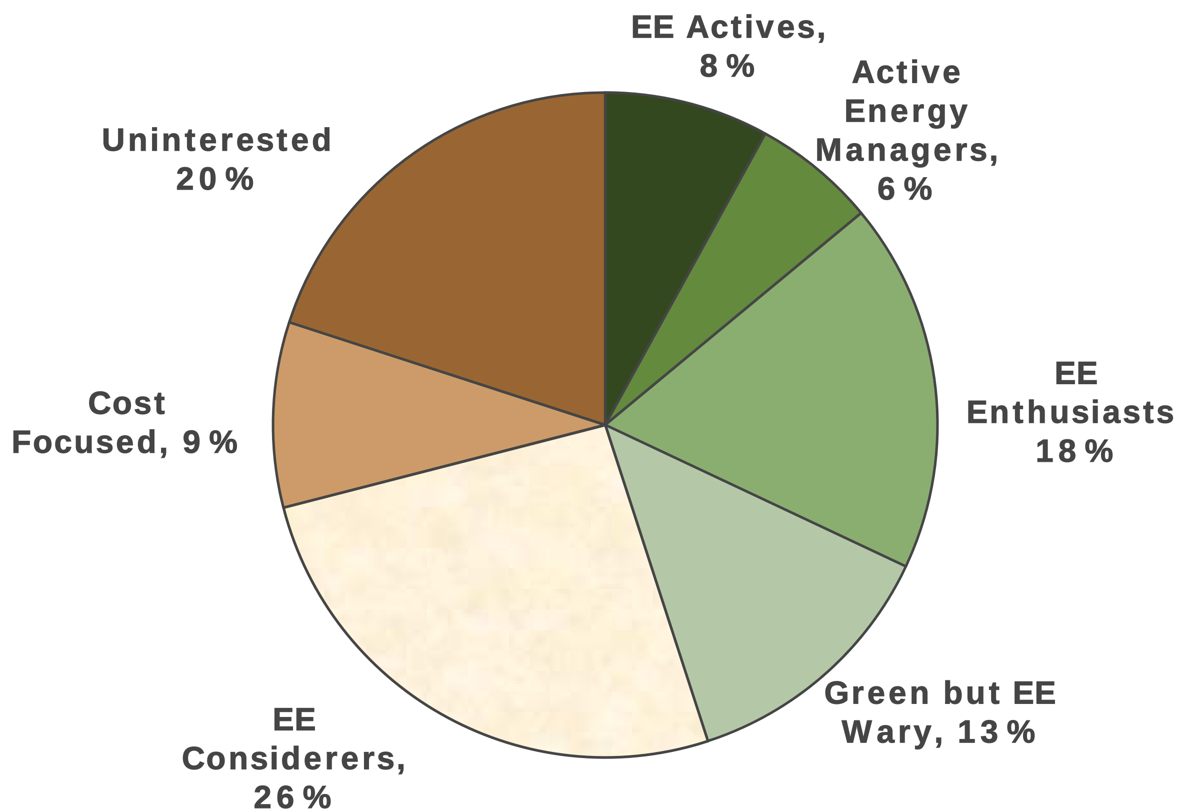
Summary: Overall Response to EE Programs by AmerenUE Customers

- As the preceding pages have suggested, it appears that psychographic factors (attitudes) have a larger impact on customer response to tested EE programs than do most firmographic differences
  - This means that how business customers think about AmerenUE is likely to be in some, or even many situations, more important in predicting how they will respond to new EE programs offered by the company, than will differences in their business (by size, industry, or the like)
- This is important for two reasons:
  - It may explain why the overall realistic take rates for AmerenUE's programs are lower than they are for those observed at many other US utilities
    - It is the experience of the GEP and MMI teams, for example, that equivalent take rates for other US utilities are often 10-20 percentage points higher than they are in this survey
    - Implicitly, it may be the case that attitudinal differences within your customer population are driving these differences
  - It is even more important to understand the impact of customer attitudes by understanding psychographic segments
    - These segments may identify the confluence of attitudes and concerns that map to differences in overall reaction to potential AmerenUE EE programs
    - In fact, the segmentation analysis reported in the following section focuses on just these issues, focusing in particular, on the role of customer satisfaction in contributing to estimated response to EE programs

Contents

Segment Distribution

The Business market in AmerenUE's service territory can be described as being composed of the following seven customer segments:



Key Segment Findings

EE Actives - This segment is the most concerned with conserving energy, both to save money and to limit their impact on the environment. They are paying the closest attention to facility energy usage and making the most EE improvements, though EE purchases and lighting upgrades have been lower, over the last 12 months, than other "green" segments. They show some of the greatest interest/potential in participating in future conservation programs, and place the greatest importance on having a green utility that actively encourages conservation participation. Opinions of AUE are above the total business base but lower than other "green" segments.

Active Energy Managers – Also very concerned with conserving energy, both to control costs and be socially responsible. Additional education is needed, however, on the long-term environmental impact of energy usage. After EE Actives, they are taking the most steps to monitor their energy usage and make EE improvements, and have made the most EE purchases, of all the segments, in the last 12 months. They show some of the greatest interest/potential in participating in future conservation programs and place some of the highest importance on having a utility that actively encourages conservation. Opinions of AUE are above the total business base but lower than other "green" segments.

EE Enthusiasts – The majority of businesses in this segment are concerned with controlling their energy costs and recognize the social responsibility and environmental impact of energy use. They are monitoring facility energy usage and making some EE improvements, and are the most likely to notice savings as a result. They have made the second most EE purchases in the last 12 months, and show the greatest interest in participating in the programs tested. They place the third highest importance on having a green utility and hold the second highest opinions of AUE.

Green but EE Wary – Overall interest in conservation is the lowest of the "greens", though still above the total business base. They are the least concerned, of the green segments, with controlling energy costs, though environmental awareness and recognition of the social responsibility of conservation are higher than EE Enthusiasts. They are monitoring their energy usage and making EE improvements on par with the total business base, and have made EE purchases in the last 12 months slightly above. They show the least interest, of the "greens", in the programs tested and place the least importance in having a green utility, though they also have the highest opinions of AUE.

EE Considerers– Interest in conservation, to either control costs or reduce environmental impact, is below the total business base, though recognition of the social responsibility of conservation is higher than the other "brown" segments. Though upfront cost is the most important factor in energy-related decisions, the majority will also consider purchasing more EE options when there are incentives available. Among the "brown" segments they are taking the most steps to monitor their energy usage and make EE upgrades; show the greatest interest in the programs tested; place the highest importance in having a green utility and hold the highest opinions of AUE.

Cost Focused – One of the segments least concerned with conserving energy to reduce environmental impact, but the most likely, of the "browns" to show concern for controlling energy costs. In addition, upfront cost is the biggest consideration when making energy-related purchase decisions. The majority are monitoring their energy usage but rarely making upgrades, and they are the most likely to be unsure of any energy savings associated with the actions they have taken. The majority are not making EE purchases; importance placed on having a green utility and opinions of AUE are the second lowest.

Uninterested - The least concerned with conserving energy, either to control costs or protect the environment. Levels of EE participation are the lowest, as is their interest in participating in future conservation programs. This segment places some of the lowest value on having a "green" utility and has the lowest opinions of AUE as their electric utility.

Segment Prioritization

Target Segments

	Marketing Effort	Potential Load Impact	Receptivity to Future Conservation Programs	Going Forward
EE Enthusiasts (18%)	Very receptive to messages on both the social responsibility of conservation and cost-savings, though cost savings may be a stronger message. They also have some of the highest opinions of AUE as their utility, and a "green" provider, making them likely to trust AUE as a reliable source for energy efficiency suggestions.	This segment is one of the largest, presenting a significant number of AUE customers that could be impacted. In addition, facility size and yearly kWh used are among the highest, suggesting there is potentially a lot of energy savings to be gained from this segment.	This segment is the most receptive to the tested programs, and the fact that they are already engaging in some EE activities, and noticing savings, suggests they would be very likely to participate if offered	This segment's history of engaging in EE behaviors suggest they will be likely to continue doing so in the future. Despite this, there is a lot of potential ground to be gained in terms of participation in rebate programs, increased CFL usage, and other EE behaviors. Additional education is needed on the benefits of CFL usage and rebate programs.
Active Energy Managers (6%)	Very receptive to messages on the social responsibility and environmental impact of conservation, as well as the associated cost savings. Their somewhat lower opinions of AUE may be a barrier initially, but shouldn't ultimately limit their participation in "green" initiatives.	Facilities are largest and kWh usage among the highest, suggesting a lot of energy savings that could potentially be gained, despite the smaller size of this segment.	Their level of interest in the tested programs, as well as their high levels of participation in other EE activities, suggest they would be likely to participate if offered.	This segment's history of engaging in energy efficiency behaviors suggests they will be likely to continue doing so in the future, making them a lucrative segment in terms of energy savings. Additional education is needed on the long term impact of energy usage, as well as the availability of AUE incentive programs.
EE Actives (8%)	This segment would be the most receptive to messages on the social responsibility and environmental impact of conservation, as well as the associated cost savings. Their somewhat lower opinions of AUE may be a barrier initially, but shouldn't ultimately limit their participation in "green" initiatives.	Facility size and annual kWh usage are among the lowest, and at only 8%, this segment represents a smaller portion of the load than others.	This segment is one of the most receptive to the tested programs, and the most likely to factor the availability of rebates/incentives into their energy-related purchase decisions. The fact that they are engaging in some EE activities suggests they would be likely to participate if offered.	Despite this segment's "green-ness" there is a lot of potential ground to be gained in terms of greater participation in rebate programs, CFL use and other EE behaviors. Their "green" ideals and participation in some EE activities suggests they may just lack awareness/education on the benefits of EE appliances and rebate programs.

Segment Prioritization (continued)

Target Segments

	Marketing Effort	Potential Load Impact	Receptivity to Future Conservation Programs	Going Forward
Green but EE Wary (13%)	This segment would be receptive to messages on the social responsibility and environmental impact of conservation, as well as cost savings. Though they don't value a green utility as much as the other green segments, they have the highest opinions of AUE as their utility, making them likely to trust AUE as a reliable source for energy efficiency suggestions.	Facility size and annual kWh usage are higher than some segments, though at 12% they present a smaller number of AUE customers that could be impacted. With greener ideals than their history of engaging in EE activities suggests, there may be opportunity for increased EE participation, and a significant reduction in energy usage, given education on the benefits of participating.	Take rates are the lowest among the green segments, and additional education is needed on the benefits to them of participating.	This segment's moderate participation in EE activities indicates they are not anti-conservation and could be engaged further given additional education on the benefits of CFL usage, EE purchases, rebate programs, and EE upgrades they can make to their facilities.
EE Considerers (26%)	The messages around cost savings and the utility working to keep costs as low as possible for its customers will probably work best. While social responsibility environmental protection messages may work less well due to this segment's lack of education on these issues, they should not turn off these customers.	Though facility size and annual kWh usage are smaller, this segment is the largest, presenting a significant number of AUE customers that could be impacted.	This segment shows greater interest in the tested programs than the other "brown" segments, but also more than the Green but EE Wary segment. However, given this segment's low levels of participation in EE activities to date, and relatively unengaged attitudes, it is difficult to tell how likely they would be to participate in future programs. If they better understood the cost benefits to them of participating they may be more likely to increase their participation in EE activities in the future.	While education is clearly needed, it is unclear if education alone will engage these consumers and make them more interested in conserving. At least initially, money may be better spent on segments that represent lower hanging fruit. This segment's sheer size, and moderate potential for future engagement, however, may make them a target for conservation efforts longer term.

Segment Prioritization (continued)

Target Segments	Marketing Effort	Potential Load Impact	Receptivity to Future Conservation Programs	Going Forward
Cost Focused (9%)	This segment would be fairly difficult to market to as they are generally unconcerned or at least inattentive to their energy consumption and its impact on costs and the environment. That said, a message of cost savings would probably play best with this segment. Additionally, a fair bit of education would be required to help this segment understand how these EE programs could help save them money and its unclear whether such education could ultimately change behaviors.	Facilities are second largest and annual kWh usage is the highest, suggesting there is potentially a lot of energy savings to be gained from this segment.	This segment shows the second lowest interest in the programs tested. While this segment has engaged in some energy efficiency behaviors, the degree to which they have engaged, and their relatively unengaged attitudes suggest this may not have been intentional, making it unclear how likely they will be to continue to do so in the future.	While education is clearly needed, it is unclear if education alone will engage these consumers and make them more interested in conserving. At least initially, money may be better spent targeting other segments that represent lower hanging fruit. This segment's high load impact, however, may make them a target for conservation efforts longer term.
Uninterested (20%)	This segment would be one of the most, if not the most, difficult segments to market to as they are unconcerned with energy costs or the impact of energy consumption on the environment. Additionally, overcoming this segment's low levels of satisfaction with AUE, particularly in regards to its leadership in energy conservation, will be a challenge.	Though facility size and annual kWh usage are smaller, this segment is one of the largest, presenting a significant number of AUE customers that could be impacted.	This segment shows the least interest in the programs tested. Active energy conservation is not on this segment's list of priorities, possibly not even on their radar. Even tying these issues to cost savings may not be enough to get their attention.	While education is clearly needed, it is unclear if education alone will engage these consumers and make them more interested in conserving. At least initially, money may be better spent on segments that represent lower hanging fruit. This segment's sheer size, however, may make them a target for conservation efforts longer term.

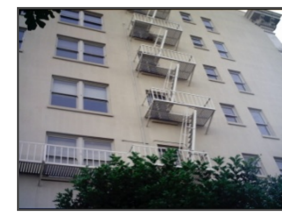
Segment Summaries: The "Greenest" Segments

EE Actives (8%) are the most concerned with conserving energy, both to protect the environment and control energy costs. They are the most likely to recognize how actions today can affect the environment in the future and have made the strongest public commitment to being a "greener" organization. When shopping they are the most likely to consider the up-front cost, long-term cost savings and positive environmental impact of their purchases equally. They are also the most likely to pay attention to the availability of rebates/incentives offered for EE purchases. They are taking the most actions to improve the energy efficiency of their facilities and are among the most likely to notice savings as a result of their actions. In the past 12 months, they have purchased EE appliances/devices and lighting for their facilities on par or slightly above the total Business customer base. This segment has some of the highest take rates across all programs tested, and, while they place the highest level of importance on having a "green" utility, their opinions of AUE are lower than some of the green segments. Most are unaware of/not sure if AUE offers rebate programs, and most that are aware haven't participated. The majority of businesses in this segment own their facilities, and the majority of facilities are less than 2,000 sq ft. This segment has the most commercial customers (100%), largely office or retail, with the highest proportion of restaurants, and < 5 employees; mean annual kWh usage is second lowest (after Uninterested).

Active Energy Managers (6%) are one of the most concerned with controlling energy costs and the environmental impact of energy use. They have some of the highest awareness of the future environmental impact of today's actions, but are the least aware, of the green segments, of the long-term threat of global warming. When shopping they put a lot of weight on both the upfront cost and long-term cost savings, and are also are very likely to consider the environmental impact of their purchases and pay attention to incentives/rebates offered for selecting more EE options. They are one of the top segments taking action to improve the energy efficiency of their facilities and are among the most likely to notice savings as a result. They are the most likely to have purchased EE appliances/devices, especially EE office equipment, and have purchased/installed the most EE lighting, in the last 12 months. This segment has some of the highest take rates across all programs tested, and, while they place the second highest importance on having a "green" utility, their opinions of AUE are lower, though still above the total customer base. Most are unaware of/not sure if AUE offers rebate programs, and most that are aware haven't participated. This segment has the highest percentage of businesses that own their facility (100%) and facility size is distilled into the lowest (roughly 75%) and highest (roughly 25%) categories. The majority of businesses are commercial with the largest proportion of schools and second largest of manufacturing facilities; the majority of businesses have 20-99 employees; mean annual kWh usage is second highest (after Cost Focused).

Segment Summaries: The "Green" Segments

EE Enthusiasts (18%) are among the most concerned with controlling energy costs and the environmental impact of energy use, though controlling costs is more important to them. When shopping for energy related products/services, both upfront and long-term cost savings are the highest priority, though the environmental impact of their purchases is also on their radar, and the majority will pay attention to the availability of rebates/incentives offered for making EE purchases. The majority are monitoring their energy usage; making more EE upgrades than the total business base and are the most likely of all the segments to notice cost/energy savings as a result of their actions. They are the second most likely to have purchased EE appliances/devices in the last 12 months, especially office and cooling equipment, and also the second most likely to have purchased/installed EE lighting. This segment has the highest take rates across all tested programs; they place the third highest importance on having a green utility and have the second highest opinions of AUE. Most are unaware of/not sure if AUE offers rebate programs, and most that are aware haven't participated. The majority of businesses in this segment own their facility; the majority of facilities are < 5,000 sq. ft, with high proportions in the office and real estate/construction sectors and < 9 employees; mean annual kWh is the third highest of the segments.



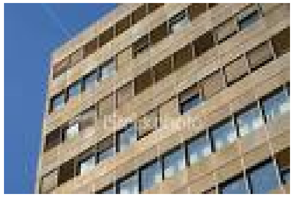
Green but EE Wary (13%) are the least concerned, of the "green" segments, with controlling energy costs, but have greater environmental awareness, and concern with the environmental impact of energy use, than EE Enthusiasts. However, when shopping for energy related products/services, both upfront and long-term cost savings play the biggest role, and positive environmental impact factors into their decisions less than the other "greens". The majority are monitoring their energy usage, making EE upgrades, and noticing energy savings as a result, on par with the total business base. Of those who bought appliances/devices in the last 12 months, the majority were EE, but they purchased/installed the least EE lighting of any of the "green" segments. They have the lowest take rates, among the "green" segments, across all tested programs, and also below the total business base; they place the least importance, among the "greens" on having a green utility, but have the highest opinions of AUE. Most are unaware of/not sure if AUE offers rebate programs, and most that are aware haven't participated. The majority of businesses in this segment own their facility but the proportion of renters is the highest; the majority of facilities are < 2,000 sq. ft, with the highest proportion of businesses in the apartment/condominium association sector and < 5 employees; mean annual kWh is among the lowest.

Segment Summaries: The "Brown" Segments

EE Considerers (26%) are less concerned with conserving energy, either to control costs or protect the environment, than the total business base, but have the highest level of environmental awareness, and concern for the environmental impact of energy use, among the "brown" segments. When shopping for energy related products/services, cost, especially upfront cost, is the biggest consideration. While they are the least likely to consider the environmental impact of their purchases, the majority are still likely to pay attention to the availability of rebates/incentives offered for buying EE items. This segment is monitoring their energy usage and making EE upgrades on par with the total business base, but have noticed energy cost savings less. They have purchased fewer EE appliances and lighting options than the total business base, though not the fewest among the "brown" segments. Surprisingly, EE Considerers show greater interest in the tested programs than the other "browns", but also the Green but EE Wary segment. Among the "browns" they place the highest level of importance in having a green utility and have the highest opinions of AUE. Most are unaware of/not sure if AUE offers rebate programs, and most that are aware haven't participated. The majority of businesses in this segment own their facility; facilities are the smallest, 88% <5,000 sq. ft, with high proportions in the office and retail sectors and < 5 employees; mean annual kWh usage is among the lowest.

Cost Focused (9%) have the lowest awareness/concern for the environmental impact of energy usage, but are the most concerned, of the brown segments, with controlling energy costs. When shopping for energy related products/services upfront cost is their primary consideration, with long-term cost savings from reduced energy usage factoring second. The majority are monitoring their energy usage but rarely making upgrades. They purchased EE appliances/devices and lighting options in the last 12 months less than the total business base, but when they did purchase EE lighting it was in large amounts, more than 20 bulbs. This segment has the second lowest take rates across all tested programs; places the second lowest importance on having a "green" utility and has the second lowest opinions of AUE, with the majority giving AUE 'average' ratings. This segment has the highest proportion of Industrial customers and the highest proportion of businesses in the manufacturing sector. The majority of businesses in this segment own their facility, with facilities >10,000 sq. ft., 10-50 employees and the highest mean annual kWh usage.

Segment Summaries: The "Brown" Segments



Uninterested (20%) are the second least concerned with conserving energy, either to control costs or reduce environmental impact, though controlling costs is a higher priority. Upfront cost is the most important factor when they make purchase decisions, and they are the second least likely to consider the environmental impact of their purchases. When it comes to conserving energy, this segment is doing the least. They are the least likely to monitor their energy usage and are making the fewest upgrades. They have also made the fewest EE purchases, both appliances/devices and lighting options, in the last 12 months. This segment has the lowest take rates across all tested programs. They place the least importance in having a green utility, preferring their utility just focus on keeping costs low. They also have the lowest opinions of AUE, with the majority giving AUE 'average' ratings. The majority of businesses in this segment own their facility; the majority of facilities are <5,000 sq. ft, with high proportions in the office and retail sectors and < 5 employees; mean annual kWh is the lowest

Business Segments – At a Glance
Energy Use Attitudes and Evaluation of AmerenUE as an Energy Provider

	EE Actives	Active Energy Managers	EE Enthusiasts	Green but EE Wary	EE Considerers	Cost Focused	Uninterested
Size	8%	6%	18%	13%	26%	9%	20%
Opportunity	High	High	Very High	Medium	Low	Low	Very Low
Energy Use Priorities	Most concerned with protecting the environment and controlling energy costs	Protecting environment and controlling energy costs are both high priorities	Protecting environment and controlling energy costs are both high priorities	Protecting environment and controlling energy costs are both high priorities	Less concerned with controlling costs/protecting the environment; cost is a higher priority	One of the least concerned with cost or environmental impact; comfort is the top priority	One of the least concerned with cost or environmental impact
Shopping Priorities	Upfront costs, long-term savings, and positive environmental impact are equally important.	Long-term savings from reduced energy usage and upfront costs are the top priorities. Positive environmental impact is also on their radar.	Long-term savings from reduced energy usage and upfront costs are the top priorities. Positive environmental impact is also on their radar.	Long-term savings from reduced energy usage and upfront costs are the top priorities.	Long-term savings from reduced energy usage and upfront costs are the top priorities.	Upfront cost is the first priority, long-term savings from reduced energy usage is second.	Upfront cost is the top priority.
Organization's approach to monitoring/ upgrading energy efficiency	Majority monitor energy usage; most likely to make consistent efforts to make facility more EE	Majority monitor energy usage; second most likely to make consistent efforts to make facility more EE	Majority monitor energy usage and make more upgrades than the total Business customer base.	Majority monitor energy usage, making few to some upgrades on par with the total Business customer base	Majority monitor energy usage, making few to some upgrades on par with the total Business customer base	Majority monitor energy usage but make some of the fewest upgrades	Majority monitor energy usage but make few upgrades; highest proportion who don't monitor energy efficiency at all
Evaluation of AmerenUE as an Energy Provider	Ratings and level of satisfaction, regarding AUE, are slightly above the total Business customer base; highest importance placed on having a "green" utility	Ratings and level of satisfaction, regarding AUE, and importance placed on having a "green" utility are slightly above the total Business customer base	Second highest AUE ratings and satisfaction with AUE as their electric utility; second highest importance placed on having a "green" utility	Highest AUE ratings, highest satisfaction with AUE as their electric utility; Majority place high importance on having a "green" utility	Ratings and level of satisfaction, regarding AUE, and importance placed on having a "green" utility are slightly below the total customer base;	Second lowest ratings and level of satisfaction, regarding AUE, and second lowest importance placed on having a "green" utility	Lowest ratings and level of satisfaction, regarding AUE, and lowest importance placed on having a "green" utility

Business Segments – At a Glance
Energy Efficiency Program Participation

	EE Actives	Active Energy Managers	EE Enthusiasts	Green but EE Wary	EE Considerers	Cost Focused	Uninterested
Size	8%	6%	18%	13%	26%	9%	20%
Opportunity	High	High	Very High	Low	Medium	Low	Very Low
Mean take rate across all programs, given a 3 year payback period	38%	35%	41%	14%	23%	10%	2%
Maximum take rate for a single program, given a 1 year payback period	62%	59%	61%	51%	49%	42%	26%
Maximum take rate for a single program, given a 5 year payback period	37%	39%	35%	21%	23%	13%	7%
Top 5 programs by take rate, given a 3 year payback period	Purchase an EE… ➢ Maintain heating system ➢ …light bulb ➢ Maintain cooling system ➢ Install exterior lighting controls ➢ …air conditioner	Purchase an EE… ➢ …motor/pump ➢ …light bulb ➢ Maintain cooling system ➢ …HVAC motor/pump ➢ …light fixture (LCI only)	Purchase an EE… ➢ …light bulb ➢ Maintain heating system ➢ …HVAC motor/pump ➢ …motor/pump ➢ …central AC/chiller unit	Purchase an EE… ➢ …light bulb ➢ Maintain heating system ➢ …PC ➢ …Copier/printer ➢ Upgrade interior lighting fixtures/lamps/ ballasts (SMB only)	Purchase an EE… ➢ …light bulb ➢ …central AC/chiller unit ➢ …HVAC motor/pump ➢ …air conditioner ➢ …refrigeration unit	Purchase an EE… ➢ …light bulb ➢ …central AC/chiller unit ➢ …Air conditioner ➢ …HVAC motor/pump ➢ light fixture (LCI only)	Purchase an EE… ➢ …light bulb ➢ …Air conditioner ➢ Install exterior lighting controls ➢ Maintain heating system ➢ …Personal computer

Business Segments – At a Glance
Likely Takers given a 3 year payback period

Ranked by Total (not shown)	EE Actives	Active Energy Managers	EE Enthusiasts	Green but EE Wary	EE Considerers	Cost Focused	Uninterested
Size	8%	6%	18%	13%	26%	9%	20%
Measures for purchasing/installing energy efficient equipment*							
Light bulbs	55%	52%	56%	39%	41%	30%	14%
Light fixtures (LCI only)	***	46%	50%	***	***	17%	***
HVAC motors/pumps	42%	49%	51%	23%	35%	19%	2%
Central packaged air conditioner/chiller unit	40%	40%	48%	21%	36%	22%	2%
Air conditioner	45%	40%	46%	22%	33%	21%	6%
Personal computer	43%	45%	48%	25%	31%	8%	3%
Copier / printer	39%	38%	47%	24%	30%	15%	3%
Refrigeration unit	36%	42%	45%	20%	32%	12%	1%
Motors/pumps	40%	***	49%	19%	30%	16%	2%
Server	34%	45%	44%	13%	26%	12%	1%
Measures not requiring an investment by the customer**							
Reduce water heater temperature	47%	30%	36%	30%	21%	20%	13%
Participate in an AC Load Control Program	21%	4%	17%	13%	8%	2%	5%

* Note: Assumes a normal replacement cycle ** Note: No payback period associated with measure ***Not reported: Insufficient sample size (n<30)

Business Segments – At a Glance
Likely Takers given a 3 year payback period

Ranked by Total (not shown)	EE Actives	Active Energy Managers	EE Enthusiasts	Green but EE Wary	EE Considerers	Cost Focused	Uninterested
Size	8%	6%	18%	13%	26%	9%	20%
Measures for optimizing energy efficiency of existing equipment							
Maintain heating system	57%	44%	52%	25%	30%	13%	3%
Maintain cooling system	52%	49%	48%	22%	31%	16%	3%
Install a programmable HVAC thermostat	42%	34%	47%	10%	27%	12%	1%
Upgrade interior lighting fixtures/lamps/ballasts	41%	***	46%	23%	25%	13%	1%
Install exterior lighting controls	48%	44%	43%	15%	22%	6%	4%
Install daylighting sensors	35%	28%	40%	6%	17%	8%	0%
Install reflective film on exterior windows	44%	24%	36%	4%	19%	3%	1%
Install 'low flow' nozzles or faucet aerators	33%	27%	35%	14%	14%	6%	1%
Install occupancy / motion sensors	38%	28%	38%	6%	16%	5%	0%
Add ventilation system controls for variable air volumes	35%	23%	35%	1%	16%	5%	0%
Install VSD on HVAC fan motors	31%	27%	36%	3%	13%	3%	0%
Install variable speed on HVAC drives/ pumps	31%	27%	35%	1%	12%	2%	0%
Install solar panels to generate a portion of your electricity	18%	21%	31%	3%	14%	7%	1%
Install roof-solar panels for supplemental heating	23%	20%	30%	3%	13%	5%	0%
Install an Energy Management System	29%	27%	27%	7%	11%	5%	1%
Install diesel generators to generate a portion of your electricity	8%	8%	13%	0%	4%	1%	0%

***Not reported: Insufficient sample size (n<30)

Questions? Contact:

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August, 2009

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- Methodology
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  - Customer Segmentation
- **Appendix**

Methodology – Sample Design

- Sample records were allocated to either Small-to-Medium Business (SMB) or Large Commercial / Industrial (LCI) based on industry and annual kWh usage. Records were allocated to SMB using the following kWh cutpoints by industry:
  - < 600,000 for Elementary/secondary schools
  - < 900,000 for Colleges and universities
  - < 1,400,000 for Lodging
  - < 2,000,000 for Warehouse, Restaurants, Services, Construction, Miscellaneous, Office, Transportation
  - < 5,000,000 for Retail, Utilities
  - < 1,000,000 for all other Industries (except Grocery)
  - Grocery = all SMB

- Sample records were also categorized based on the number of records with duplicate mailing addresses. For each group (Group A,B,C or D, below) of records with duplicate mailing addresses, the record with the highest energy usage was selected for sampling, and additional records from each group were selected based on the following methodology:

Group Definitions	Sampling rule	Total	SMB	LCI
Group A: Unique mailing addresses	All records designated as available to be selected for sampling	23,399	18,578	4,821
Group B: 2-5 records with the same mailing address	Only the record with the highest energy usage designated as available for sampling	3,140	1,657	1,483
Group C: 6-10 records with the same mailing address	One record with the highest energy usage and one record with modal* energy usage designated as available for sampling	559	234	325
Group D: 11+ records with the same mailing address	One record with the highest energy usage and two records with modal* energy usage designated as available for sampling	1,825	231	1,594
Total number of sample records allocated to this survey		28,923	20,700	8,223

*Modal energy use record(s) were obtained by ranking the remaining records (after the highest energy usage record was removed) and selecting the median energy usage record(s) from the list.

List of All Programs / Measures Tested

- Category 1 (Q22-Q25): How likely would your business be to buy the higher than standard efficiency model (and take the rebate), rather than buying an equivalent standard efficiency model of each item?
  - Purchase a higher than standard efficiency air conditioner
  - Purchase a higher than standard efficiency central / packaged air conditioner or chiller unit
  - Purchase a higher than standard efficiency refrigeration unit
  - Purchase a higher than standard efficiency copier / printer
  - Purchase a higher than standard efficiency personal computer
  - Purchase a higher than standard efficiency server
  - Purchase higher than standard efficiency light bulbs (higher than standard efficiency light bulbs could include compact fluorescents, T-5, T-8 or Super T-8 fluorescents)
  - Install higher than standard efficiency fans on chiller units
  - Purchase higher than standard efficiency motors or pumps
  - Replace pumps or motors that are part of your HVAC system with higher than standard efficiency motors the next time you need to replace one of these pumps

List of All Programs / Measures Tested (Continued)

- Category 2 (Q26-Q29): How likely would your organization be to make each improvement (and take the rebate)?
  - Install an Energy Management System
  - Perform regular maintenance on your cooling system in order to improve its performance
  - Install variable speed drives on chiller pumps
  - Install an Economizer
  - Perform regular maintenance on your heating system in order to improve its performance
  - Install solar panels on your roof that would provide some portion of your heating and / or water heating needs
  - Install variable speed drives on pumps that are part of your HVAC system
  - Add controls to your ventilation system to enable variable – rather than constant – air volumes
  - Install variable speed drives on fan motors that are part of your HVAC system
  - Install a programmable, clock-based thermostat on your HVAC system to provide basic automation for these systems
  - Install "low flow" nozzles or faucet aerators that reduce the amount of hot water used
  - Upgrade portions of your lighting system including fixtures, lamps and/or ballasts
  - Install occupancy / motion sensors to turn lights off when rooms are not in use
  - Install daylighting sensors or time clocks / timers to turn interior lights off at specified times when not in use
  - Install a timer on the swimming pool pump to control the number of hours it operates
  - Install a solar heating system
  - Install solar panels to generate electricity for your facility to offset all or a portion of the electric energy provided by a utility
  - Install diesel generators to generate electricity for your facility to offset all or a portion of the electric energy provided by a utility
  - Install reflective film on exterior windows
  - Install controls on your outside lights that make sure they are only on at certain times

List of All Programs / Measures Tested (Continued)

- Category 3* (Q25-Q26)
  - Please indicate how likely business is to undertake energy conservation measures such as turning down the office thermostat or reducing the temperature of your hot water heaters.
  - Please indicate how likely your organization would be to sign up for this type of ***[AC LOAD CONTROL]*** program.

[*NOTE: No payback periods were associated with Category 3 programs / measures]

Eligibility & Take Rates TOTAL BUSINESS CUSTOMERS

Program / Measure	% Eligible	Likely Takers		
		1 year payback period	3 year payback period	5 year payback period
Category 1: Programs / Measures for Purchasing / Installing Energy Efficient Equipment*				
Light bulbs	85%	47%	39%	22%
Light fixtures *(LCI only)*	24%	43%	33%	18%
HVAC motors / pumps	78%	41%	31%	18%
Central packaged air conditioner / chiller unit	68%	41%	30%	17%
Air conditioner	100%	42%	29%	17%
Personal computer	82%	38%	29%	17%
Fans on chiller units	1%	**Data not reported due to insufficient sample size		
Copier / printer	81%	37%	27%	17%
Refrigeration unit	73%	36%	27%	17%
Motors / pumps	55%	36%	27%	17%
Server	68%	32%	24%	15%
Category 2: Programs / Measures for Improving Energy Efficiency of Existing Systems				
Perform regular heating system maintenance	60%	42%	31%	16%
Perform regular cooling system maintenance	57%	43%	30%	16%
Install a programmable, clock-based HVAC-thermostat	67%	36%	25%	12%
Upgrade interior lighting *(SMB only)*	62%	35%	25%	12%
Install exterior lighting controls	60%	35%	24%	14%
Install daylighting sensors or time clocks / timers	82%	27%	19%	11%
Install reflective film on exterior windows	80%	28%	18%	9%
Install 'low flow' nozzles or faucet aerators	71%	30%	18%	9%
Install occupancy / motion sensors	82%	27%	18%	9%
Add ventilation system controls for variable air volumes	73%	28%	17%	9%
Install VSD on HVAC fan motors	77%	28%	16%	9%
Install VSD on HVAC pumps	74%	27%	15%	9%
Install solar panels to offset electricity used	62%	22%	14%	6%
Install roof-solar panels for supplemental (water) heating	80%	22%	14%	6%
Install an Energy Management System	100%	26%	13%	7%
Install diesel generators to offset electricity used	60%	9%	5%	3%
Install a swimming pool pump timer	2%	**Data not reported due to insufficient sample size		
Install VSD on chiller pumps	1%	**Data not reported due to insufficient sample size		
Install an Economizer	1%	**Data not reported due to insufficient sample size		
Install a swimming pool solar heating system	3%	**Data not reported due to insufficient sample size		
Category 3: Programs / Measures Not Requiring an Investment by the Customer [NOTE: PAYBACK PERIODS NOT APPLICABLE]				
Reduce water heater temperature	100%	25%		
Participate in AC load control program	83%	10%		

Q22-Q31

* Note: Assumes a normal replacement cycle

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Eligibility & Take Rates SMB CUSTOMERS ONLY

Program / Measure	% Eligible	Likely Takers		
		1 year payback period	3 year payback period	5 year payback period
Category 1: Programs / Measures for Purchasing / Installing Energy Efficient Equipment*				
Light bulbs	84%	47%	39%	22%
HVAC motors / pumps	75%	39%	29%	17%
Central packaged air conditioner / chiller unit	65%	41%	29%	17%
Personal computer	84%	38%	29%	18%
Air conditioner	100%	42%	28%	16%
Copier / printer	82%	37%	28%	18%
Motors / pumps	70%	36%	27%	17%
Refrigeration unit	73%	35%	27%	17%
Server	67%	32%	23%	15%
Fans on chiller units	<1%	**Data not reported due to insufficient sample size		
Category 2: Programs / Measures for Improving Energy Efficiency of Existing Systems				
Perform regular heating system maintenance	61%	41%	31%	16%
Perform regular cooling system maintenance	56%	42%	29%	17%
Install a programmable, clock-based HVAC-thermostat	67%	35%	26%	12%
Upgrade interior lighting *(SMB only)*	85%	35%	25%	12%
Install exterior lighting controls	58%	33%	23%	13%
Install daylighting sensors or time clocks / timers	80%	27%	19%	11%
Install reflective film on exterior windows	79%	28%	19%	9%
Install 'low flow' nozzles or faucet aerators	67%	30%	18%	9%
Install occupancy / motion sensors	83%	27%	18%	9%
Add ventilation system controls for variable air volumes	74%	28%	17%	9%
Install VSD on HVAC fan motors	74%	27%	15%	9%
Install VSD on HVAC pumps	70%	27%	15%	9%
Install solar panels to offset electricity used	59%	22%	14%	6%
Install roof-solar panels for supplemental (water) heating	80%	21%	14%	6%
Install an Energy Management System	100%	25%	13%	7%
Install diesel generators to offset electricity used	57%	8%	5%	3%
Install a swimming pool pump timer	2%	**Data not reported due to insufficient sample size		
Install a swimming pool solar heating system	3%	**Data not reported due to insufficient sample size		
Install VSD on chiller pumps	<1%	**Data not reported due to insufficient sample size		
Install an Economizer	<1%	**Data not reported due to insufficient sample size		
Category 3: Programs / Measures Not Requiring an Investment by the Customer [NOTE: PAYBACK PERIODS NOT APPLICABLE]				
Reduce water heater temperature	100%	26%		
Participate in AC load control program	84%	11%		

Q22-Q31

* Note: Assumes a normal replacement cycle

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Eligibility & Take Rates LCI CUSTOMERS ONLY

Program / Measure	% Eligible	Likely Takers		
		1 year payback period	3 year payback period	5 year payback period
Category 1: Programs / Measures for Purchasing / Installing Energy Efficient Equipment*				
Light bulbs	87%	49%	40%	21%
HVAC motors / pumps	86%	47%	36%	21%
Light fixtures *(LCI only)*	91%	43%	33%	18%
Central packaged air conditioner / chiller unit	76%	44%	32%	18%
Motors / pumps	15%	38%	31%	17%
Air conditioner	100%	45%	31%	17%
Refrigeration unit	74%	40%	29%	17%
Server	70%	36%	26%	16%
Copier / printer	77%	35%	25%	16%
Personal computer	78%	35%	25%	15%
Fans on chiller units	5%	**Data not reported due to insufficient sample size		
Category 2: Programs / Measures for Improving Energy Efficiency of Existing Systems				
Perform regular cooling system maintenance	59%	47%	32%	16%
Perform regular heating system maintenance	60%	47%	31%	15%
Install exterior lighting controls	64%	41%	28%	15%
Install a programmable, clock-based HVAC-thermostat	65%	39%	24%	13%
Install reflective film on exterior windows	83%	29%	18%	9%
Install VSD on HVAC fan motors	86%	32%	18%	9%
Install daylighting sensors or time clocks / timers	86%	28%	18%	10%
Add ventilation system controls for variable air volumes	69%	31%	17%	9%
Install VSD on HVAC pumps	83%	31%	17%	8%
Install 'low flow' nozzles or faucet aerators	80%	31%	17%	8%
Install occupancy / motion sensors	77%	28%	17%	8%
Install an Energy Management System	100%	30%	15%	7%
Install solar panels to offset electricity used	71%	23%	14%	6%
Install roof-solar panels for supplemental (water) heating	79%	23%	14%	6%
Install diesel generators to offset electricity used	69%	12%	6%	3%
Install VSD on chiller pumps	3%	**Data not reported due to insufficient sample size		
Install an Economizer	3%	**Data not reported due to insufficient sample size		
Install a swimming pool pump timer	4%	**Data not reported due to insufficient sample size		
Install a swimming pool solar heating system	4%	**Data not reported due to insufficient sample size		
Category 3: Programs / Measures Not Requiring an Investment by the Customer [NOTE: PAYBACK PERIODS NOT APPLICABLE]				
Reduce water heater temperature	100%	22%		
Participate in AC load control program	82%	5%		

Q22-Q31

* Note: Assumes a normal replacement cycle

CHAPTER 8

TRADE ALLY RESULTS

This chapter presents the results of the in-depth interviews with trade allies to gain a qualitative understanding of the willingness of these entities to work with AmerenUE and to promote energy efficiency in AmerenUE's service area.

8.1 RESEARCH APPROACH

The in-depth interviews were conducted by Momentum Market Intelligence between May 6 and June 15, 2009. Forty in-depth interviews were conducted and each interview lasted from 30 to 45 minutes.

Each respondent was required to go through a screening process that verified that the interviews represented a broad range of trade allies (Table 8-1). Specifically respondents represented the following:

- A mix of sales and executive staff responsible for determining energy-related products/services offered to customers and those knowledgeable about why customers buy what they do regarding energy efficiency levels
- A mix of annual revenue, no more than half under $2.5 million, at least 10 over $10 million
- A mix of head count, no more than 10 organizations under 50 employees
- No more than half from greater St. Louis; all must do business in Eastern MO; only from target zip codes

Table 8-1 Respondent Industry Criteria

Respondent Industry Criteria				
		Residential	**Business**	**Mixed Res. / Bus.**
Construction / Contracting	**Contractors / HVAC & General**	1	2	2
	Lighting	0	4	4
	Windows / Insulation	0	2	4
Industrial Goods & Services		N/A	5	N/A
Appliances / Electronics		5	N/A	N/A
Energy Services		0	1	1
Property / Facility Management	**General**	3	1	1
	Low-income	2	0	2

The discussions covered a range of topics about end customer perception and acceptance of energy efficiency products and generally covered the following topic areas.

- The value of energy efficiency

- Where end customers stand on energy efficiency
- Response to energy efficiency options
- Key barriers and key aids
- AmerenUE's role

Certain industries required dedicated questions; there were different versions of the survey guide for respondents who sell physical products, respondents who exclusively sell services, and property managers.

A note on the terms used to define different populations in this chapter:

- "Trade Allies" (TA) will be used to refer to the firms interviewed in this research; firms that have – or at least could have – some role in affecting the decisions that end customers could make regarding the acquisition of more energy efficient devices or equipment by making such equipment available (or not), recommending it (or not), or the like. Note that calling these firms "trade allies" does not mean that they are actually "allies" of AmerenUE, in the sense that they would necessarily support AmerenUE's interests on these issues – they may do so, but this is an open question
- "End customers" refers to businesses or residential households that are the direct customers of AmerenUE

The findings presented below cover three main areas: Energy efficiency push from trade allies, energy efficiency pull from end business customers and AmerenUE's role. The results are presented separately for the four types of trade ally businesses that were interviewed: construction and contracting services, industrial goods and services, energy services and property and facility management.

8.2 BUSINESS CUSTOMERS

8.2.1 Push from Trade Allies

8.2.1.1 Construction and contracting

Respondents in the Construction/Contracting trades note substantial barriers to promoting EE among business customers.

Demand Side Barriers

- Their customer contact might not be with the end-user, and they may not have authority to influence purchasing; or in the case of a developer or similar business, might be focused only on upfront costs.
- Large business customers have a chain of stakeholders, making it difficult to make suggestions; small businesses often lack EE education/awareness, as well as resources to invest in EE.

Supply Side Barriers

- A substantial portion of their work is competitive bid, and therefore subject to pricing constraints.

Trade allies say they still present EE options when they can. Some offer EE alternatives during the bidding process, when they think it makes them more competitive. Once they have a job, they say they often list out EE options and payback info, as part of the full range, but will only make an effort to promote EE if the customer's interests are aligned.

The majority of trade allies see selling EE products as in their best interests, because EE sales benefit their firm -- either directly or via increased customer satisfaction:

- EE products (windows, doors, and lighting in particular) typically bring in more revenue.

- Selling EE products can give their firm the benefit of a ‘green’ reputation.
- Many EE products have a short enough payback period to appeal to customers. (2-8 years for certain lighting products. LED exit signs were one example of a product with quick payback).
- EE construction does offer a quantifiable payback, and these options appeal to customers that can take a long-term view. In addition, there are some state and federal agencies that require a certain level of EE in their buildings’ construction, and more agencies are getting on board.
- Some EE products (particularly windows and energy management systems) are higher quality, resulting in fewer customer callbacks for servicing and more satisfied customers in general.

> “We know, at least in the products that we sell, that particular [EE] window is the best quality and will have the least amount of call backs. That works two ways. That keeps us from running out and spending more money to service the product, but it also makes my customers happier that they don’t have issues with them, and then we are more likely to get referrals and recommendations.”
>
> -Co-owner, Window/door supplier

> “It could be in our interest, because truthfully selling energy efficient products, most of the time you are selling a higher ticket item.”
>
> -Regional Executive Manager, Lighting Contractor

8.2.1.2 Industrial goods and services

TA firms selling industrial goods/services say they always offer EE options to their customers, and some make an extra effort to promote them. All TA organizations interviewed see selling EE options as being in their best interests. There is a push in the industrial sector to reduce production costs and avoid raising prices. Some trade allies see this trend developing and recognize an opportunity to build a competitive EE edge.

TAs say that selling EE raises customer satisfaction, making them more likely to be repeat customers; a minority of TA respondents also mention recommending EE options because they want to help conserve electricity.

> “We are strongly promoting energy efficiency...That is the main flagship promotion we are doing right now. For our product, steam products, we have been conducting a certified ASME code or procedure that was written for testing for energy efficiencies. We have done those tests and our products have come out favorably. We are promoting that very aggressively within our industry – that we are very energy efficient.”
>
> -Regional Sales Manager, Metal Working Machinery

Allies say they are more comfortable recommending EE products when they have supporting documentation to show customers; particularly those that are unfamiliar with EE and wary of buying products that are new to their facilities.

In cases where these firms don’t strongly promote EE options, it is because they believe there aren’t EE options that fit that customer’s needs, or EE options receive/have received poor end customer response

In the components trade, as opposed to packaged systems, energy efficiency isn’t always marketable. EE components don’t necessarily yield energy savings, as energy consumption also depends on other factors, i.e. the end-use application, operational requirements, etc.

EE has not been a focus for some industrial sectors. As a result, comfort and familiarity with these products are low among customers and the trade allies that serve them.

8.2.1.3 Energy services

Note that only one energy services firm serving exclusively business customers is included in the sample: the following section is based on a single interview and may not be representative of the larger market.

This firm believes that prospective customers already see energy efficiency as a high priority, so there is no need to sell the importance of energy efficiency. In fact, interest is so high now that the respondent's company is turning down projects.

Because the benefits of energy efficiency are taken as a given, the challenge for this firm is in designing the most appropriate package for each customer's needs. The typical first step is an energy audit, which is used to quantify the possible gain from implementing EE solutions. Typically, prospective customers initially ask for the most energy-efficient versions for everything, but re-assess when they understand the costs of that approach. The energy services company needs to design a package that fits the available budget and has a payback time that the customer finds appropriate – 15 to 20 year payback periods are typical.

8.2.1.4 Property and facility management

Property management firms typically view evaluating EE solutions as a component of their obligation to protect their clients' interests. They say they try to keep up to date with best practices, and assess which measures make sense for their property owners.

> "Ten years ago everything was T12 bulbs, T12 bulbs. Now if you walk into an office building and they have T12 bulbs, you kind of look at the owner…'What are you thinking? Do you know what the payback is to replace those?'"
>
> -Property manager for business properties

For measures requiring little investment, (e.g., replacing filters in air conditioners or weather-stripping doors), property managers can act without consulting the owners. Measures requiring more extensive spending (e.g., replacing windows or updating HVAC), the owner's approval is needed before property managers can move ahead.

Property managers report limited success in implementing more expensive EE projects, and identify property owners' bottom line as the key obstacle. Though owners may pay utility bills for common areas, tenants pay the lion's share. As a result, owners typically have little incentive to invest in EE measures, though there are some exceptions to this rule.

For instance, one respondent manages an older office building that uses a boiler for heat, with the owner paying. This owner is motivated to update the heating system with something more efficient.

> "Generally speaking, they [owners] will do the right thing at home, and try and make money on everything else."
>
> -Property manager for business properties

Another respondent who manages office properties notes that his firm handles upgrades differently: tenants split building maintenance costs, including any upgrades, and are billed once per year. The tenants would need to approve any major EE upgrades, and would pay the costs over several years, with the building owner bearing the initial cost. This model appears to be unusual, mentioned by only one respondent. However, it's important to be aware that some properties have a very different approach to funding EE work.

8.2.2 Pull from End Customers

8.2.2.1 Construction and contracting

Construction and contracting Trade Allies say they are willing to recommend EE options, but have to stay within the constraints imposed by customer budgets/interest.

The majority of end customers do not start out requesting EE and, while they are often willing to listen to EE suggestions from TAs (when accompanied by detailed payback information) they remain primarily cost-focused. If end customers are willing to consider more EE options, they look at them on a case by case basis; they want to know the paybacks, and feel confident of the investment. Most end customers are believed to not be willing to pay for the most highly energy efficient options.

Of end customers willing to consider EE options, a few are believed to see PR benefits in a green image and may seek the recognition of LEED certification. However, most see cutting costs as the key priority. When customers do not select EE options it is understood to primarily be related to cost, education, and/or their level of investment in the end-use property.

> "I don't know that we have ever had anybody say, 'I want the best.' They want to see a payback. There is a limit to what they will pay for it."
>
> -Sr. Project Manager, Lighting Contractor

Many customers are understood to have a strict construction budget that only accounts for upfront cost, not ongoing energy costs over time. If there is budget flexibility, they often lack an understanding of payback periods and awareness of the cost benefits associated with EE.

> "I think most commercial companies have a budget. If it is an emergency thing, then obviously they haven't even budgeted for that. It usually boils down to the lowest price. That is pretty much it on a commercial application."
>
> -Sales Estimator, General Contractor

If the customer is not the owner, developer and tenant, they typically are not seen as having the power to select EE options or won't be concerned with how long-term operating costs impact their bottom line.

8.2.2.2 Industrial goods and services

Cost, unfamiliarity, and lack of education are the 3 key barriers to adoption for their industrial customers, say TAs.

TAs say most customers don't request EE products upfront, when buying goods or services. Awareness and familiarity are still too low and many end customers are not aware of these products. Additionally most of those who are aware don't have enough familiarity to feel comfortable with them. The minority of end business customers who seek EE products from TAs from the start cite a desire to lower energy costs or qualify for a green credit. Sometimes they want a specific EE product they saw in an advertisement or trade magazine.

TAs suggest that about half of customers are responsive to at least some EE recommendations, when accompanied by documentation of the benefits. Large businesses are seen as more responsive than small, because they are more willing to try new things and are more flexible on upfront costs. Choosing an item that isn't an approved standard could require redesigning an application – a negative outcome that will impact the employee's standing in their firm.

> "Prior to doing that [getting supporting EE data], we would, on a sales call, mention that we are more energy efficient, here is how we work... There has been more than one occasion where we have been asked, well, what documentation do you have to prove that. Well, we now have that. We now present it. We print it up, we hand it out, and we give it as a piece of sales literature, basically, if need be."
>
> -Regional Sales Manager, Metal Working Machinery

TAs feel certain that reducing energy costs is a growing priority in the industrial sector; increased EE awareness in the customer base, along with tools and education to help trade allies promote EE more effectively, will help build momentum.

> "Most of these plants are being charged with doing what your survey is about – cutting energy, cutting costs, running more efficiently. They are all doing it because they can't make it up on the customer end. They have to increase their margins by doing it more efficiently on the production side rather than on the sales side."
>
> -Regional Sales Manager, Metal Working Machinery

8.2.2.3 Energy services

The respondent notes that demand for his company's services are growing; the recession is pushing organizations to find ways to cut costs. Key customer segments include schools, hospitals, and local government.

Work for hospitals has slowed recently; hospital revenue has been impacted by the economy, and they are less able to carry out EE programs. However, the education market has stayed strong – the respondent commented that his company has been successful helping school districts secure funding for EE projects through no tax increase bonds and lobbying legislative bodies. He also sees emerging opportunities in local governments, which he feels are particularly likely to have old and inefficient infrastructure.

It appears that there is still a good deal of low hanging fruit for energy services companies: many customers are upgrading infrastructure that has been in place for decades and may have been done badly or cheaply initially.

> "We always try to attack the mechanical [HVAC] systems and we try to attack the lighting, as far as lamps or ballasts or fixtures. That is typically where the money is really being thrown out the door."
>
> -Employee at an energy services firm

The key obstacles on the customer side are implementation costs, gaining board approval, resistance to change, and relatively low energy rates. Boards that make final decisions on spending may not be educated on EE issues. Customers have some hesitation around advanced equipment that may not be familiar to them: as the respondent notes, "Missouri is called the Show Me State." Relatively low energy rates compared to other parts of the country lengthen payback times and make it harder to justify EE investments.

8.2.2.4 Property and facility management

Though prospective tenants may ask about energy efficiency, it is typically not a top priority. Moreover, their questions show limited familiarity with EE issues. Property managers report that prospective tenants ask about utility bills, rather than specifically asking about insulation, HVAC systems, weather-stripping, and so on.

> [Commenting that most potential renters ask about energy efficiency]
>
> "I think they are savvy enough to know that they have to pay for it, and they want to know what it is going to cost them."
>
> -Property manager for business properties

LEED-certified buildings are an exception to this rule: they attract tenants who see energy efficiency as a priority.

Once organizations have taken up tenancy, they are not likely to explicitly request EE upgrades. Maintenance requests usually center on physical repairs like leaking pipes, though one respondent noted that a drafty window might also drive a tenant to request a maintenance call.

8.2.3 AmerenUE's Role

8.2.3.1 Construction and contracting

Most construction and contracting trade allies would like to see AmerenUE involved in promoting EE. They would value AmerenUE's endorsement as recommended providers of EE products/services. They think AmerenUE could help market EE, and educate customers, leveraging their existing channels and name recognition.

There are a few TAs that are not opposed to AmerenUE's involvement, but don't understand why the company would want to be involved. They see AmerenUE as being in the business of selling energy and don't know why the company would want to promote EE or how it would benefit from a partnership with them.

> "I don't know if I have a perspective on Ameren. I think Ameren's role would be to produce clean energy and sell energy. The more energy AmerenUE sells, the better off AmerenUE is. I don't know what their end game is."
>
> -Vice President, General Contracting

These TAs would like to see:

- Rebate and incentive programs for business customers. Ideally, these would be available at the time of sale, reducing the upfront cost, which is a key driver for many customers.
- Education/advertising initiatives for both allies and customers. Educate customers on the cost and environmental benefits of EE, how it all works, what programs are available.
- Advance notice of customer offerings, so trade allies can make sure they know how they can be involved. Also, give them the information they need to discuss/recommend EE options for their customers.

8.2.3.2 Industrial goods and services

> "For us to go into a customer saying we are partnering with AmerenUE on efficiencies of energy usage, etc., and here is what we are offering. AmerenUE and we together are doing this. That would be very beneficial."
>
> -Regional Sales Manager, Metal Working Machinery

Most trade allies think partnering with AmerenUE would be beneficial and have suggestions for how AmerenUE can help them promote EE:

- Leverage their position and advertising capabilities to get the EE message to customers more effectively.
- Help promote TAs to customers by recommending them as providers of EE solutions.
- Help educate trade allies about the EE products and programs that are available.
- Raise customer awareness on how to reduce energy costs and provide specific data on costs and savings from EE products.
- Target through trade magazines as well as using broad campaigns/advertising.
- Educate and train trade allies, to help them promote EE more effectively to customers
- Provide educational handouts they can distribute.
- Provide supporting materials they can use to more effectively recommend EE; help them find new ways to promote EE.

> "I still think energy efficient is a broad term and it is just like the trendy thing to talk about now. I'm not sure that everybody really understands what the benefits are, how it benefits everybody directly."
>
> -Manager, Electric Components Retailer

> "The more that AmerenUE can, from a PR standpoint, publicize the fact that they are energy efficient and here is what we recommend and we are partnering with company A or company B, and because of that we are more efficient. It is just good PR."
>
> -Regional Sales Manager, Metal Working Machinery

Along with education, incentive/rebate programs would also help sway customers.

8.2.3.3 Energy services

The respondent likes the idea of AmerenUE being involved in promoting energy services to its customers. His primary focus is education. Even more than raising awareness of EE issues, he would like AmerenUE to inform its customers about performance contractors and their services. He supports the idea of rebates on EE products or services (e.g., energy audits), but this was not top of mind for him; his initial suggestions were all around education.

He says many organizations are unfamiliar with the concept of performance contractors where an energy services firm will take on the risk by installing energy saving measures and be paid based on the energy bill savings over time rather than the upfront costs. He likes the idea of AmerenUE maintaining a list of approved partners; he feels this would enhance his firm's credibility.

> "[It would be good] if AmerenUE spreads the news about companies like us...we still find clients who are like 'Who are you?' Tell them what we do, and they say 'oh yeah, that's a great idea.'"

He feels that AmerenUE can be a more credible source for this kind of information than his company.

> "If a utility company said 'hey, if you put this in, you would be paying us less money,' that would drive the point home a little bit more than hearing it from us...there's always going to be a few people who think we're used car salesmen."

8.2.3.4 Property and facility management

Property managers for business properties are positive about AmerenUE partnering with them to promote energy efficiency. The top suggestions for AmerenUE's role are providing education and financial incentives.

Suggestions for education include helping property managers understand how to maximize ROI for spending on energy efficiency: which upgrades save the most energy? One respondent specifically mentions lighting retrofits and air conditioning as areas where he'd like more information. Another respondent stated that he'd like to learn how to calculate costs and expected payback time for EE upgrades. Respondents don't see value in education initiatives for tenants; they recommend addressing property managers and owners.

> "I'm sure it wouldn't hurt talking to the tenants, but I think it would be a waste of time."
>
> -Property manager for business properties

There are several suggestions for industry organizations that could help AmerenUE reach property managers and owners, including IREM (Institute of Real Estate Management), SIOR (Society of Industrial and Office Realtors) and BOMA (Building Owners and Managers Association).

As in other industries, rebates and other incentives are seen as an effective way to drive EE upgrades. Rebates that shrink the cost difference between EE products and non-EE alternatives will help property managers use more EE products.

> "I think anything AmerenUE can do, whether it's offering some kind of credit or something to get newer, more efficient things installed, would be great."
>
> -Property manager for business properties

8.3 RESIDENTIAL CUSTOMERS

8.3.1 Push from Trade Allies

8.3.1.1 Construction and contracting

The majority of firms in the construction/contracting trades say they want to promote the most energy efficient options available to customers. With higher profit margins (particularly windows) and improved customer satisfaction, from reduced energy costs and improved home values, selling EE products can be in their best interests.

They can make a strong case for choosing EE options --

- moderate to substantial reduction in energy use over non-EE products
- marketable 5-10 year payback periods in many cases
- higher quality materials, more durable, more reliable (particularly windows), improved operability and features (HVAC).

> "We get a lot of referral business off the people who buy our higher end windows because they like them so much they tell everybody their know. From that aspect, yes, we are going to push our most energy efficient window every time."
>
> -Division Manager, Home Remodeling Firm

The few trade allies that are new to promoting EE recognize it as a key developing trend, and are exploring it more.

TAs say they promote EE when they think customers will be receptive. They make little effort to promote EE options to customers who appear uninterested or unwilling.

> "If a contractor comes in and says 'they've shot out all the windows' you know that's going to be a plain-Jane [window]."
>
> -Co-owner, Window/Door Retailer

TAs are building strategies to improve customer receptivity to EE by providing more education on payback periods and other benefits of EE options, and developing lower cost EE options for customers with budget constraints.

8.3.1.2 Appliance and electronics retailers

The majority of retailers say they recommend EE appliances/electronics to their customers most, if not all of the time. Their decisions about when and to whom they recommend EE products are driven by their evaluation of the customer's needs and wants. Most of those who say they do recommend EE appliances/electronics only see small differences in efficiency between specific models.

Retailers report that ENERGY STAR qualified products account for the majority of their sales; they feel that efficiency differences between different ENERGY STAR models are minimal. Retailers variously cite LCD TVs, and EE refrigerators, clothes washers, and dishwashers as products that could potentially save a meaningful amount of energy; there is no consensus. In addition to saving energy, ENERGY STAR washers/dishwashers also use significantly less water; this is particularly attractive for customers on the St. Louis water system.

Those who don't usually recommend EE appliances/electronics say they don't see any difference in levels of EE between models. A few retailers who don't see significant differences in EE between appliance models also note that the ENERGY STAR label, the standard quantifier of EE in their appliances, does not always give a complete picture of the energy usage of an appliance. Manufacturers want ENERGY STAR certification for their products to respond to customer demand, but some retailers feel the certification is misleading. Appliances can be ENERGY STAR compliant, without being very energy efficient, and vice versa.

Retailers would like to have more concrete, detailed information on the energy used by an appliance, and how it compares to a comparable non-EE appliance, to use when recommending EE to customers. Note that retailers report little to no revenue difference between ENERGY STAR vs. non ENERGY STAR appliances.

> [Speaking on the ENERGY STAR rating]
>
> “As to what it means, I don’t fully understand myself. They don’t send us any information to speak of to suggest how that is a benefit or what kind of money is saved or what is the difference between say one item that might have the compliance and another that doesn’t.
>
> -Owner of a consumer electronics retail and installation company

8.3.1.3 Energy services

Note that only one energy services firm serving residential customers is included in the sample: the following section is based on a single interview and may not be representative of the larger market.

The Energy Services consultant we interviewed is very familiar with and involved in recommending energy efficiency. They are in the business of designing custom solutions to reduce energy consumption in a broad range of residences.

To be successful, they need to understand the range of EE options available and be able to understand what works for each property. Beginning with a complex energy audit, analysis and budget requirements, they show each customer a range of options that would fit their needs. They say they recommend the highest EE options that their customers can afford and that make sense for the individual situation.

Even if a customer has the budget/interest, they don’t like to recommend options just because they are the most EE, if there are more basic EE improvements that can be made first. The basic EE improvements they recommend first, that tend to have the fastest payback are insulation, window upgrades, tightening the building envelope, EE lighting and HVAC upgrades.

> “People don’t understand. They see all of this stimulus money and all this stuff about wind and solar and say that’s what I want. They don’t understand that tightening up the envelope of the house and looking at the systems and whether your furnace and air conditioner are working properly and your light bulbs are right is where you need to start. ”
>
> -Marketing manager for an energy services firm

8.3.1.4 Property and facility management

Residential property managers say they are aware of the benefits of energy efficient products, though they may be somewhat less knowledgeable than their counterparts who manage business properties. One business property manager mentioned hiring an engineer for cost/benefit analysis of energy efficiency upgrades; the residential property managers interviewed did not have this level of sophistication.

The extent to which EE upgrades have been implemented varies widely. A minority of residential property manager's report performing relatively expensive upgrades like purchasing ENERGY STAR appliances or upgrading windows in their properties. The largest group only undertakes less costly upgrades, like installing CFL lights, and weather-stripping doors. A third, small group says they haven't done any upgrades. Members of this group manage market rate properties as well as low-income properties.

> [On replacing common area lights with CFLs]
>
> "Basically it came down to just how often we have to pay someone to change a light bulb. Every time we step onto the property, it costs the owner...labor is more expensive than light bulbs, no matter what the light bulbs cost."
>
> -Property manager for residential properties

As with business property managers, justifying the initial investment is the main barrier to implementing EE upgrades. Because tenants pay the bulk of utility costs, it is difficult for owners to recoup most EE spending.

> [Describing top barriers to wider use of EE products]
>
> "Money, money, and money."
>
> -Property manager for residential properties

8.3.2 Pull from End Customers

8.3.2.1 Construction and contracting

TAs say that very few customers request EE products initially, but many are receptive to suggestions, when accompanied by education on the benefits. Customers focused on cutting energy costs usually want the highest EE options they can afford.

Barriers to purchase for EE options are lack of education and unwillingness/inability to pay higher upfront costs. Contractors or retailers with a mixed customer base note upfront cost can be a particular barrier for residential customers.

> "I think a lot of it comes down to dollars. I think people are willing to spend a certain amount, they will spend a little bit more, to pick up that energy efficiency, but it has got to make sense from a financial standpoint for them. I don't think people are going to pay two and three times as much to do a little more to protect the environment."
>
> -Executive Management, Windows/Doors Retailer

With EE lighting upgrades, residents often need to replace their fixtures too. Also, when upgrading lighting fixtures and/or windows they often need to hire an installer. These material and labor costs, when added to the upfront cost of the more efficient item, can increase the payback period beyond a reasonable timeframe. Relatively low energy usage, compared to business customers, can further lengthen payback periods. In addition, energy costs are not high enough to make EE a high priority for most residential customers.

> "With commercial you have a big guy at a desk saying, hey, look, I want the energy bill cut. Whatever you have to do, do it. But if somebody just walks in off the street and wants ten light bulbs for their house, they are more like, well, it is going to cost me $40 for those 10 bulbs versus $2.30 for the other bulbs. Tell me why I should do this."
>
> -Sales, Lighting Retailer

TAs say they are willing to recommend EE options – though they are still constrained by customer demand, there is more flexibility than with business customers.

8.3.2.2 Appliance and electronics retailers

TAs indicates that when shopping, the majority of customers have energy efficiency on their checklist of features, but it isn't a high priority. That said, many customers are at least open to considering EE options, if the information on associated cost savings is included in the sales pitch. From a retailer perspective, the main reasons customers don't select energy efficient options are:

- Prohibitive upfront costs.
- A focus on other product features and/or energy conservation isn't a consideration or priority.

Due to low energy costs and a lack of education, customers don't understand the financial, or other, benefits to EE products.

> "If they think they can spend a little more upfront and then save money in the long run – look at the machine as an investment – most people are going to be willing to do that."
>
> -Salesperson at a kitchen/bathroom appliance retailer

To change this outcome TAs need concrete numbers, explaining how much energy non-EE products use vs. EE products, with payback periods and additional savings clearly laid out. They would also like to see more campaigns to raise awareness of the costs associated with not conserving.

> "People want concrete, relatable info on how much energy they use, how much energy a different product uses, and how much money they save from the difference."
>
> -Owner of a consumer electronics retail and installation company

8.3.2.3 Energy services

Customers who seek out a residential energy services firm are already interested in EE and aware of the benefits. The majority of customers are focused on lowering their energy costs; some are also looking to reduce the environmental impact of their energy consumption. Most customers are receptive to EE recommendations, and want the highest EE options they can afford within their budget.

According to our respondent, the key barriers for preventing homeowners from seeking EE solutions are upfront costs and a lack of awareness of the cost benefits associated with EE. This company believes that with increased EE understanding and incentives providing a push, more residents would seek solutions to reduce their energy consumption.

> "Education is important, but unless it is tied to something else – there is not enough education out there, don't get me wrong about the value – but unless it is tied to some incentives for 'what's in it for me', it is going to be a lot of wasted money."
>
> -Marketing manager for an energy services firm

8.3.2.4 Property and facility management

Most renters are believed to be concerned with the size of their utility bills, and think about how much electricity they use. Renters at high-end properties are most likely to think in terms of carbon footprints and energy efficiency; other renters are more likely to focus on the bill amount.

However, energy efficiency is not a strong-enough selling point to drive most property owners and managers to invest in it. Even for the most environmentally-aware renter, energy efficiency is typically not the most important criteria in picking a home: traditional concerns like location are still the top priority.

> "Say you're LEED certified or you have used energy efficient materials; people definitely like that. I don't know if it will sway you between living here or there, because location and schools are always more important, and of course where you work too... High efficiency would be the 6th or 7th indicator."
>
> -Property manager for residential properties

Similarly, even though renters in subsidized housing are especially sensitive to high utilities bills, the limited supply of low-income housing means that these renters typically can't make energy efficiency their top priority.

8.3.3 AmerenUE's Role

8.3.3.1 Construction and contracting

Most firms in the Construction/Contracting trades think AUE should partner with them. The most frequent recommendations are education, partnerships and incentives.

Educating end users on EE benefits, the concept of payback periods, available products and their benefits will increase customer demand for EE and make it easier for allies to recommend.

> "You have to let us know what you are doing so that we can talk intelligently to our customers. AmerenUE has to say, look, this is what we are going to offer them so if you have products that you can offer to allow them to do this, then you will benefit from it that way...Once we know what AmerenUE is requesting, then we can offer it to the customers also."
>
> -Sales Representative, Lighting Retailer

TAs feel AmerenUE can build partnerships by publishing a list of approved trade allies so customers have a starting point. They also would welcome joint-venture-type partnerships with AmerenUE. They feel AmerenUE should improve existing incentive programs, increase advertising, make the rebate application process less complicated or make them worth more, and make rebates available at the time of sale, to draw in more of the customer base that is focused on upfront costs.

> "Well, I think AmerenUE needs to get onboard with providing rebates or completely paying for the energy audits, like the co-ops already do. That would be a big step right there. I think they ought to look at bringing back... what was called a Green Key homebuilding program."
>
> -Energy management specialist, HVAC

> "Rebates are nice, but the problem – from what I've heard and seen – a lot of people forget about rebates. There are so many hoops you have to jump through to get that rebate. You purchase the product, you hear about the rebate, but then four weeks later the product gets installed and you forget about the rebate."
>
> -Division Manager, Home Remodeling

Finally TAs feel AmerenUE should increase offerings to residential customers, who are currently under-served.

8.3.3.2 Appliance and electronics retailers

Across the board, retailers like the idea of AmerenUE partnering with them. They would like to focus on educating customers on the benefits of EE and advertising how EE appliances can save money. Increasing customer interest in EE, and placing EE appliances top-of-mind, will drive more customers to their stores and help generate sales. Even though selling ENERGY STAR appliances vs. non-ENERGY STAR is revenue-neutral, because the bulk of the models they carry are ENERGY STAR, their business will benefit if customers are driven to upgrade their appliances to more EE models. Specifically they would like AmerenUE to --

- Help educate customers on the benefits of using EE appliances and electronics, focusing on the cost savings involved.
- Provide concrete numbers and realistic scenarios to help customers understand how much energy they use per appliance, how much that costs them, and how much they will save by using an EE appliance.
- Advertise at the local level, partnering with retailers, as well as through targeted TV campaigns.

Retailers feel that customer rebates are a good idea if:

- The rebate amount is significant relative to the cost of the appliance; i.e., a $10 rebate on a $1,000 appliance will not have much impact.
- Rebates are offered at time-of-sale, involving the retailer; this would increase customer participation.

Some would like to see a rebate offered for both retailer and customer. They also want AmerenUE to ensure that small business owners have opportunities to participate, as well as big box stores and that the utility partners with retailers to design customer-facing EE programs that will work for them too.

8.3.3.3 Energy services

According to our respondent, a partnership with AmerenUE would be very valuable in this area. They feel the key areas of focus should be to educate/inform, and provide incentives, as described below.

Information

- Coordinate with energy services firms to ensure consistency of the EE information and programs they offer to customers.
- Educate about the EE cost benefits as well as environmental responsibility, but tie education to incentives so it sticks.

Incentives

- Offer certification to residents who make their houses more energy efficient, emphasizing the potential home-value increase.
- Offer rebates for home energy audits, not individual EE items. An energy audit is the most important first step; it will provide a base for further EE education/participation.

> "People aren't acting right now, but I think if there were incentives on their bills, they saw that they could save money, they would be more comfortable, they would get a tax credit, they would get their money back, they could get a sticker on their door that says this has been something, something so the value goes up – all those kinds of concrete things, people are concrete."
>
> -Marketing manager for an energy services firm

8.3.3.4 Property and facility management

Almost all residential property managers like the idea of AmerenUE partnering with them to promote energy efficient products. Like business property managers, the most frequent suggestions are education and incentives.

One key difference is that some residential property managers recommend targeting tenants as well as property managers and owners. In particular, they offer a number of suggestions for reaching low-income renters: including EE pamphlets in the move-in packet that HUD sends to subsidized housing tenants, visiting churches, senior centers and housing developments to carry out EE education in person, and CFL bulb giveaways to drive word of mouth.

Education for property owners and managers is also of interest. While business property managers mention that they want to learn to perform payback calculations, residential property managers are less specific, stating simply that they want more information about currently available energy efficient products.

As with business properties, any financial incentive that narrows the cost difference between EE products and non-EE products is welcome and will help property managers and owners justify purchasing more EE products. One respondent comments specifically that he would like financial incentives for energy audits, which he feels are unaffordable.

> "We have a 700 unit property and it was going to be $50,000 to have an energy audit. That's only the cost of inspection."
>
> -Property manager for residential properties

ABOUT GLOBAL

Established in 1998, Global Energy Partners, LLC is a premier provider of energy and environmental engineering and technical services to utilities, energy companies, research organizations, government/regulatory agencies and private industry.

Global's offerings range from strategic planning to turn-key program design and implementation and technology applications.

Global is an employee-owned consulting organization committed to helping its clients achieve strategic business objectives with a staff of world-class experts, state of the art tools, and proven methodologies.

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An Employee-Owned Company

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CHAPTER 1

INTRODUCTION

AmerenUE engaged a team led by Global Energy Partners, LLC (Global) to perform a Demand Side Management (DSM) Market Potential Study to assess the various categories of electrical energy efficiency and demand response potential in the residential, commercial, and industrial sectors for the AmerenUE service area from 2009 to 2030. The study used updated forecasts of baseline energy use estimates based on the latest information on federal, state, and local codes and standards for improving energy efficiency.

AmerenUE will use the results of this study in its integrated resource planning process to analyze various levels of energy savings and peak demand reductions attributable to both energy efficiency and demand response initiatives at various levels of implementation cost.

The estimation of potential savings from energy efficiency measures is an important step in the process of developing DSM program potential and supply curves. This volume describes the process of and results from estimation of technical potential and economic potential, the building blocks for estimating energy-efficiency program potential.

The report is organized into the following chapters:

- *Chapter 2 – Study Approach* describes the overall approach and the analysis steps taken to conduct the study
- *Chapter 3 – Baseline Forecast* describes the development of the baseline forecast and presents the forecast results for the residential and business sector over a 10 year planning horizon.
- *Chapter 4 – Energy Efficiency Potential* presents the results for technical, economic, and achievable potentials

A series of appendices provides details behind specific aspects of the analysis and results.

CHAPTER 2

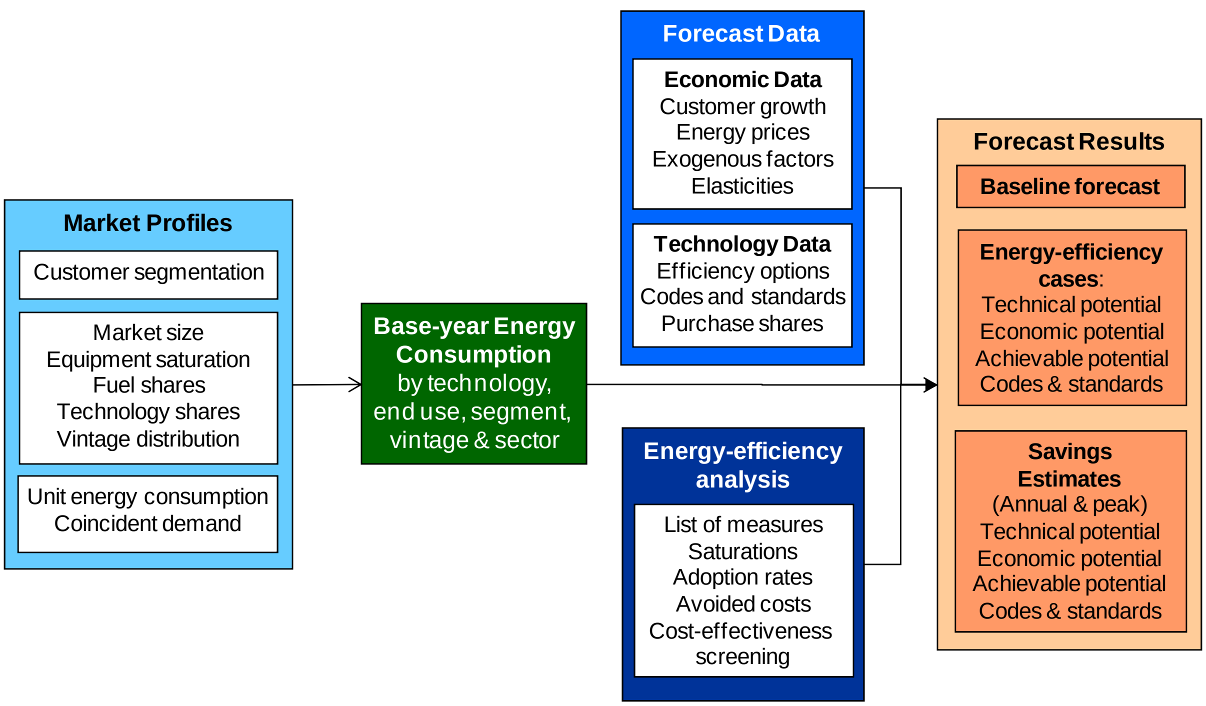
ANALYSIS APPROACH

A depiction of the analysis approach is presented in Figure 2-1. To execute this approach the following steps were taken:

1. Developed a market research and data development plan for the residential and business sectors. This is described in detail in Volume 2: Market Research
2. Developed base-year energy market profiles and a baseline energy forecast
3. Identified and analyzed energy-efficiency measures appropriate for the AmerenUE service area
4. Estimated energy-efficiency potential

The steps are described in further detail throughout the remainder of this section.

Figure 2-1 Depiction of Analysis Framework



2.1 BASELINE ENERGY USE

The analysis of energy-efficiency potential begins with a snapshot of how customers use energy in a recent base year and a forecast of what energy use is likely to be in absence of new utility programs. The base year for this study is 2008, the most recent year for which a full year of billing data is available at the outset of the project.

This section describes the base-year market profiles and the baseline forecast.

2.1.1 Base-year Market Profiles

Market profiles characterize electricity use in terms of sector, customer segment, and end-use technology for the base year. For this study, the base year is 2008, the year for which complete billing data were available from AmerenUE at the outset of the study. The elements in a market profile include:

- Market size represents the number of customers in the segment
- Fuel share embodies the saturation of appliances or equipment and the share of homes using electricity (e.g., homes with electric space heating).
- Unit energy consumption (UEC) describes the amount of electricity consumed by a specific technology in homes that have the technology. Similarly, for the commercial and industrial sectors, end-use indices (EUIs) describe the electricity consumed per square foot of floor space by a specific technology in premises that utilize the technology.
- Intensity represents the average use for the technology/end use across all homes or buildings/facilities. It is computed as the product of the fuel share and the UEC or EUI.
- Total energy use (GWh) is the total energy used by a technology/end use in the segment. It is the product of the number of households and intensity.

For each segment within each sector, two sets of market profiles were developed. The *average home/building* market profile represents all homes, buildings and facilities in the AmerenUE service area in 2008. The *new home/building* profile represents new construction in the AmerenUE service area.

Fuel share and whole-building intensity estimates were developed primarily from customer survey data and AmerenUE billing data. For the average home/building profiles, all the survey data were used. In most cases, the sample sizes were sufficient to develop segment and end-use level estimates directly from the survey. The results were cross-checked and validated against various secondary sources[1]. As needed, some minor adjustments were made. For the new home/building profiles, sample points from homes/buildings constructed in the previous five years were used to identify trends between new and average buildings since the sample sizes were too small to develop segment-level estimates for each technology. These trends were applied to the average profiles to develop the new home/building profiles. For example, if the overall new-building saturation of electric heat pumps was 10% higher in new homes than in all homes, then the new-home heat pump share in single family and multi-family homes was increased by 10% percent. Again, the results were compared against various secondary sources and adjustments were made as warranted.

UECs and EUIs were developed using a prototype modeling approach described below.

2.1.2 Prototype Modeling

Prototype modeling refers to the use of primary and secondary data to create a representative set of prototypes for each housing and building type. The prototypes are fed into a building simulation model and are used for the following:

- To develop UECs and EUIs for the baseline market profiles
- To develop UECs and EUIs for each technology option in the forecast
- To compute unit savings from energy-efficiency measures for the analysis of EE potential

For each residential segment and commercial building type in the study, a prototype model was developed. To develop prototypes specific to AmerenUE, typical building characteristics and operating behavior from the market research were combined with local weather data[2] and

[1] Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010-2030), EPRI TR 1016987, January 2009.;CBECS, 2005,

[2] For this study, TMY weather data from Lambert International Airport in St. Louis were used to represent the AmerenUE service area.

existing prototypes from the Midwest regional database of the EPRI National Study[3] were combined. The following survey data were incorporated into the prototypes:

- Floor area and number of floors
- Building construction and insulation levels
- Air conditioning and ventilation equipment
- Space heating equipment
- Lighting equipment
- Refrigeration equipment
- Water heating equipment
- Miscellaneous equipment such as office equipment, laundry and cooking appliances
- Occupancy levels, operating hours and operating controls

Summary descriptions of the prototypes are presented in Appendix B

Once the prototypes were developed, Global's Building Energy Simulation Tool (BEST) model, a derivative of the DOE-2 model was applied to each prototype to estimate the UEC and EUI values for each segment and technology. The DOE-2 model is best suited for estimating energy use for space heating, cooling and ventilation. Therefore, for some end uses such as motors, electronics and lighting, engineering calculations were used to supplement BEST.

2.1.3 Baseline Forecast

Once the base-year market profiles were developed, the next step was to develop a baseline end-use forecast for each customer segment and end use. The baseline forecast represents a forecast of expected electricity use in absence of new utility programs. It embodies naturally-occurring efficiency and the effects of appliance/equipment standards and building codes as follows:

- Naturally-occurring efficiency results from consumer behavior and response to changing energy prices, technology improvements, and other exogenous factors. For AmerenUE, rising electricity prices and technology trends are factored into the baseline forecast.
- Appliance/equipment standards are modeled explicitly through the specification of technology choices available to customers during the forecast period. For example, the EISA lighting standard is modeled by removing standard incandescent lamps from the list of technologies available for residential interior screw-in lighting beginning in 2012.
- Current building codes are embodied in the new home/building market profiles. The appliance/equipment saturations, UECs and EUIs, and whole-house/building intensities reflect current new-construction practices, which in turn reflect building codes.

The baseline forecast considers only those codes and standards that are currently on the books and does not speculate about future codes and standards. However, aggressive future codes and standards were contemplated in the scenario analysis described in Volume 4.

The baseline forecast is a stand-alone deliverable from this study, but it also provides the starting point for estimating energy-efficiency potential and it is the metric against which EE savings are compared.

[3] Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010-2030), EPRI TR 1016987, January 2009.

The Load Management Analysis and Planning tool (LoadMAP™) was utilized to develop the baseline forecast. Built in Excel, the LoadMAP framework is both accessible and transparent and has the following key features.

- Embodies the basic principles of rigorous end-use models (such as EPRI's REEPS and COMMEND) in a more simplified, accessible form.
- Includes stock-accounting algorithms which treat older, less efficient appliance/equipment stock separately from newer, more efficient equipment. Equipment is replaced according to the measure life defined by the user.
- To balance the competing desires of simplicity and robustness, the model incorporates the important modeling details, where market data are available, and treats end uses separately to account for varying importance and availability of data resources.
- Isolates new construction from existing equipment and buildings and treats purchase decisions for new construction, replacement upon failure, early replacement, and non-owner acquisition[4] separately.
- Uses a simple logic for appliance and equipment decisions. Some models embody decision models based on efficiency choice algorithms or diffusion models. While these have some merit, the model parameters are difficult to estimate or observe and sometimes produce anomalous results that require calibration or even overriding. The outlined approach allows the user to drive the appliance and equipment choices year by year directly in the model. This flexible approach allows users to import the results from diffusion models or to input individual assumptions. The framework also facilitates sensitivity analysis.
- Includes appliance and equipment models customized by end use.
- Accommodates various levels of segmentation. Analysis can be performed at the sector level (e.g., total residential) or for customized segments within sectors (e.g., housing type or income level).

The LoadMAP model provides forecasts of baseline energy use by sector, segment, end use and technology for existing and new buildings using forecasts and assumptions about the following:

- Customer growth
- Electricity prices and price elasticities
- The set of available efficiency levels for each technology, which reflects appliance and equipment codes
- Purchase decisions for appliances and equipment

Table 2-1 summarizes the LoadMAP datasets. There is one dataset for each of the three sectors. For each category, there are residential, commercial and industrial datasets, along with segment and vintage variation.

Chapter 3 presents the base-year market profiles and the baseline forecast.

[4] Non-owner acquisition represents the decision to acquire an appliance or piece of equipment in an existing home or premise. An example is when a homeowner of an existing dwelling who did not previously have a clothes washer acquires a clothes washer.

Table 2-1 Data Requirements for the Baseline Forecast in LoadMAP™

Data element	Description	Key sources
Global study inputs	Market size (households and floor space) Customer growth forecasts, electricity price forecast Price elasticities	Customer surveys AmerenUE customer forecasts AmerenUE retail price forecast LoadMAP default values
Fuel/technology saturations	Percentage of households/floor space with a specific electric technology	Customer surveys and secondary sources
UEC/EUI	Base-year UECs and EUIs for each technology and vintage	Prototype modeling
Vintage distributions for appliances and equipment	For each technology, a distribution of the age of the appliance or equipment	Customer surveys, analysis of past codes and standards, DOE appliance data
Efficiency data	Set of available efficiency options for each technology. levels and base-year annual consumption	EE measure database (Appendix A), Prototype modeling
Purchase shares	For each technology, the share of equipment purchases in the base year and in each forecast year	Customer surveys Annual Energy Outlook forecast assumptions[5] Analysis of codes and standards

2.2 ENERGY-EFFICIENCY MEASURE ANALYSIS

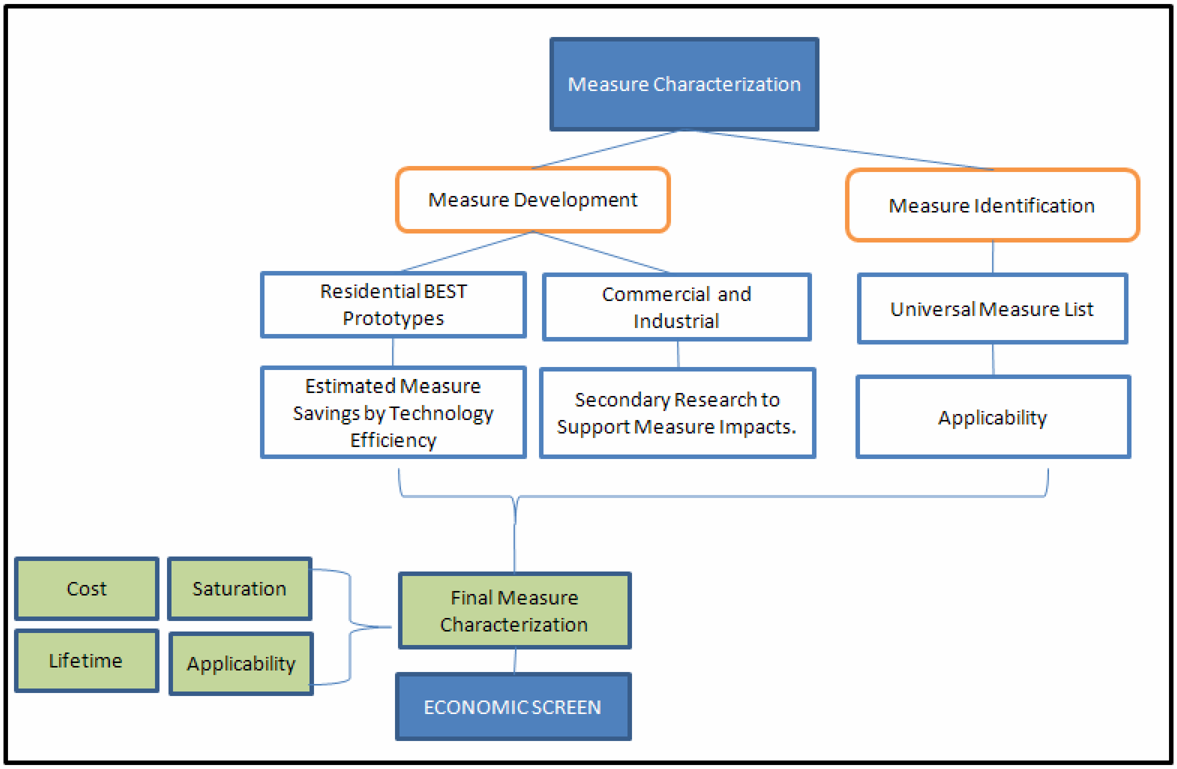
The framework for analyzing energy-efficiency measures is presented in Figure 2-2. It begins with identifying and characterizing energy efficiency measures and performing economic screening.

The framework for assessing savings from energy-efficiency measures involves identifying the list of energy efficiency measures to include in the analysis, characterizing each measure, and performing cost-effectiveness screening.

The analytical framework for developing the measure savings assessment for all sectors closely follows the frameworks described for the baseline development. The BEST model was used to develop "change cases" relative to the baseline prototypes. The installation of more aggressive energy efficiency measures was reflected in these change cases by increasing levels of energy efficiency from baseline to maximum efficiency levels.

[5] Baseline purchase decisions were developed based on the Energy Information Agency's *Annual Energy Outlook* report (2008), which utilizes the National Energy Modeling System (NEMS) to produce a self-consistent supply and demand economic model. Equipment purchase options were calibrated to match manufacturer shipment data for recent years and trended forward.

Figure 2-2 Approach for Measure Assessment



2.2.1 List of Energy Efficiency Measures

The first step is to identify the list of relevant energy-efficiency measures. A list of energy efficiency measures was compiled for each customer sector from various sources:

- Global's Database of energy efficiency measures (DEEM). In 2004, Global prepared a database of energy efficiency measures for residential and commercial segments across the U.S. This is analogous to the DEER database developed for California. Global updated the database in 2008 for the EPRI National Potential Study.
- EPRI National Potential Study
- Ameren stakeholder input

The measures identified cover all major types of end-use equipment, as well as devices and actions to reduce energy consumption. The list of energy-efficiency measures for each sector is presented in Appendix A.

This preliminary list of measures was then separated into two categories for modeling in LoadMAP: equipment measures and non-equipment measures:

- **Equipment measures** relate to major pieces of energy-using equipment and the opportunity to upgrade to more efficient options relative to a minimum efficiency level. For example, an equipment measure for residential refrigerators would involve an upgrade from the minimum level of efficiency (as required by federal standards, in this case) with an Energy Star model. For equipment measures, it is possible to have numerous efficiency levels for a specific technology. The minimum efficiency level is dictated either by an appliance/equipment code or the lowest efficiency level available in the marketplace. For example, the set of equipment options for residential central air conditioners begins with the federal standard SEER 13 unit as the lowest level available, adds several incremental SEER levels and includes ductless mini-split system with variable refrigerant flow as the highest-efficiency option. The equipment measure, in this case, is high-efficiency central air conditioning, but it reflects several specific efficiency options. Equipment measures are aligned with the technologies described in the market profiles.

- **Other measures** save energy by reducing energy consumption but do not involve replacement or purchase of major end-use equipment (such as a refrigerator or air conditioner). An example of this group of measures would be a programmable thermostat that is pre-set, for example, to run the air conditioner only when people are home. Non-equipment measures fall into one of the following categories:
  - Building shell - windows, insulation, roofing material
  - Equipment controls - thermostat, occupancy sensors
  - Equipment maintenance - cleaning filters, changing setpoints
  - Whole-building design - natural ventilation, passive solar lighting
  - Displacement measures - ceiling fan offsets central air conditioner consumption

Non-equipment measures can apply to more than one end use. For example, insulation levels will affect both space heating and cooling energy consumption.

To address the issue of interaction among measures, LoadMAP first estimates savings from equipment measures, which result in reduced base energy use. Savings from other measures are then assessed relative to the reduced base usage. For example, for residential central AC, equipment replacement to higher-efficiency options are assessed first, which results in lower use for cooling. Then other cooling related measures, such as AC maintenance, are assessed relative to the lower baseline.

The mapping of the preliminary measure list to LoadMAP measures is presented in Appendix A.

2.2.2 Measure Characteristics

For each type of equipment and other measure in the study, the following data were developed:

- **Energy impacts**: These represent the reduction in annual energy use relative to the baseline. These are expressed in percentage terms. For the residential and commercial sectors, the BEST simulation model was used to determine the savings impacts for individual measures. The key advantage of utilizing BEST is that interactive effects between lighting and building construction and HVAC uses are captured and quantified[6]. Another benefit of the prototype modeling is that AmerenUE's territory specific weather conditions were used to derive savings. In this case Typical Meteorological Year (TMY) weather data for Lambert International Airport in St. Louis was used. For the industrial sector, savings were estimated using a combination of BEST analysis, engineering calculations, and secondary data including energy efficiency program best practices.
- **Peak demand impacts**: Savings during the peak demand periods are specified for each measure. These impacts depend on each measure's "coincidence" with the system peak. To develop the peak demand impacts, a set of peak factors were developed from prototype modeling using BEST and Global's proprietary end-use load shape database.
- **Measure costs.** Measure costs include the cost of equipment, labor for installation and a 10% mark-up for administration. The measure costs are quantified on a per-unit basis for the residential and per-square-foot basis for the commercial and industrial sectors. These costs were developed using a variety of secondary resources such as RSMeans, the DEER Database, and Global's DEEM Database.

[6] For example, if incandescent lamps in a retail shop are replaced with CFLs, BEST captures the savings for lighting and the coincident savings for cooling. The combined savings, which are predominantly from lighting, are accounted for in lighting savings in LoadMAP.

For equipment replacement and new construction purchases, the incremental cost is used instead of full measure costs. Incremental cost is the cost difference between the standard efficiency option and the high-efficiency option. Incremental costs were computed directly from the full-cost data.

- **Applicability**: Applicability defines the households or floorspace to which a measure applies. For example, central air conditioner maintenance applies only to those homes with central air conditioning. Applicability factors were developed directly from the survey data, as well as secondary sources and expert opinion.
- **Feasibility**: Feasibility defines the fraction of the applicable market to which the measure applies. For example, feasibility for photosensors is less than 100% because it is not technically possible to use photosensors in shaded areas. Similarly, whole-house fans can only be installed in homes with sufficient attic space. These factors were developed from the survey data as well as secondary data and engineering judgment.
- **Measure lifetimes**. This represents the average life of the measure. Measure lifetimes were obtained from Global's Database of Energy Efficiency Measures (DEEM), with refinements based on a review of California's DEER database.
    1. For equipment measures, this is the average life of the equipment. At the end of the equipment life, a new purchase decision is made.
    2. For other measures, this is the period of time for which measure savings are included in the analysis. At the end of the measure life, it is assumed that the measure savings persist.

Table 2-2 presents a sample of the detailed data inputs behind equipment measures for residential central air conditioners. It displays the various efficiency levels available, as well as the corresponding useful life metrics, annual use and costs

Table 2-3 presents the other measures that apply to homes with central air conditioning.

Table 2-2 Sample Equipment Measures for Central Air Conditioning

Efficiency Level	Useful Life	Usage (kWh)	Cost
SEER 13	18	2,707	$3,794
SEER 14	18	2,482	$3,952
SEER 15	18	2,398	$4,130
SEER 16	18	2,326	$4,776
SEER 18	18	2,213	$5,531
SEER 20	18	2,189	$6,194
Ductless VRF	18	1,895	$8,193

Table 2-3 Sample Non-Equipment Measures

End Use	Measure	Energy Savings (%)	Base Saturation	Applic-ability	Cost	Lifetime
Cooling	Programmable Thermostat	7%	51%	56%	$114	11
Cooling	AC Maintenance	11%	25%	100%	$150	3
Cooling	Infiltration Control	2%	46%	90%	$354	12
Cooling	Duct Repair	19%	12%	50%	$500	18
Cooling	External Shades	9%	23%	70%	$3,060	15
Cooling	Storm Doors	2%	38%	75%	$320	12
Cooling	Reflective Roof	6%	5%	10%	$1,549	18
Cooling	Radiant Barrier	3%	5%	90%	$922	12
Cooling	Duct Insulation	4%	15%	75%	$500	18
Cooling	High Efficiency Windows	8%	47%	90%	$7,500	20
Cooling	Ceiling Insulation	24%	33%	38%	$1,950	20
Cooling	Wall Insulation	9%	33%	50%	$3,200	20
Cooling	Ceiling Fan	11%	56%	75%	$260	15
Cooling	Whole-House Fan	9%	4%	19%	$274	20
Cooling	Dehumidifier	9%	4%	8%	$300	12
Cooling	Attic Fan	1%	12%	23%	$115	18

2.2.3 Economic Screening

In order to assess economic potential, it is first necessary to perform an economic screen on each measure. The economic screen applied in this study is a Total Resource Cost (TRC) test that compares the lifetime benefits (both energy and peak demand savings) of each applicable measure with lifetime cost. The lifetime benefits are obtained by multiplying the annual energy and demand savings for each measure by AmerenUE's avoided costs for each year, and discounting the dollar savings to a present value basis. The measure savings, costs and lifetimes are obtained as part of the measure characterization. With economic screening for the purposes of computing economic potential at the measure level (in contrast to programs), incentives are not included. They represent a simple transfer from one party to another, which has no effect on the overall measure cost.

For each measure, an economic screening was performed as follows:

- The economic evaluation of every measure in the screens is conducted relative to a baseline option or condition. For instance, in order to determine the kilowatt-hour (kWh) savings potential of a measure, its kWh consumption must be compared to the kWh consumption of a baseline option or condition.
- The economic screen uses incremental costs for situations in which the decision is between the purchase and installation of a standard efficiency unit and a high-efficiency unit. For instance, the incremental cost of an ENERGY STAR refrigerator is the additional cost of purchasing this unit compared to a comparable unit without the ENERGY STAR rating. Full costs were used for measures where the baseline condition does not exist. For example, full costs were used for whole-house fans and air conditioner maintenance.
- The economic screening was conducted only for measures that are applicable to each building type and vintage; thus, if a measure is deemed to be irrelevant to a particular building type and vintage, it is excluded from the respective economic screen table.

Within the framework of the LoadMAP model, this screening is performed dynamically in order to account for changing savings and cost data. Changes in these inputs to the economic screen can result in measures passing for some, but not all of the years in the forecast; however, all details presented in this report are based on the analysis performed for the first forecast year.

2.3 ASSESSMENT OF ENERGY-EFFICIENCY POTENTIAL

A key objective of this study is to estimate the potential for energy savings through energy efficiency activities in the AmerenUE service territory. The potential impact of energy efficiency activities is the cumulative total of all energy-related projects, including the replacement of a unit which has failed with an efficient unit, retrofit/early replacement of equipment, an improvement to the building envelope, and the application of controls to optimize energy use.

This part of the study involves estimating technical potential and economic potential at the measure level, defined as follows:

- **Technical Potential**. Technical potential is defined as the theoretical upper limit of energy efficiency potential. It assumes that all feasible measures are adopted by customers, regardless of cost. Technical potential is obtained by setting all new equipment purchases at the time of equipment failure to the most efficient available option. Examples of technologies incorporated into technical potential include:

    1. Ductless "mini-split" air conditioners with variable refrigerant flow
    2. Ground source heat pumps, with desuperheater for water heating
    3. Multiple-drawer refrigerators and freezers
    4. Solid state (LED) lighting for general service, both interior and exterior

    Technical potential also assumes the adoption of every available non-equipment measure, where applicable. For example, technical potential includes installation of high-efficiency windows in each new construction opportunity and repair and sealing of air ducts in existing buildings. Non-equipment measures are phased in according to an adoption path developed for each technology for the estimation of maximum achievable potential (as discussed in Volume 4).

- **Economic Potential**. Economic potential represents the adoption of the most efficient ***cost-effective*** measures. As described above, an economic screen is performed to determine which measures are economically viable. The results are then incorporated into the purchase decisions to reflect the most efficient measure that passes the screen. For the analysis presented here, the Total Resource Cost (TRC) test was applied, which compares the lifetime energy and capacity benefits to the incremental cost, including the administrative costs associated with any energy efficiency program. As with technical potential, both equipment measures and other measures are phased in.

Results of this assessment are presented in Chapter 4.

CHAPTER 3

BASELINE FORECAST

The purpose of the baseline assessment is to provide a detailed summary of the electricity use for each sector by segment and end use. The baseline forecast serves as the reference against which energy efficiency savings are measured.

This chapter is organized into four parts. It addresses each of the three sectors (residential, commercial and industrial) individually. Then it combines the forecast results. For each sector, the market segmentation, base-year market profiles and the end-use forecast results are presented.

3.1 RESIDENTIAL SECTOR

In 2008, Ameren provided 14 terawatt-hours (TWh) of electricity to approximately 1 million individual residences. This implies an overall household intensity of 13,498 kWh per household per year. These three values comprise the control totals for the residential baseline analysis.

3.1.1 Market Segmentation

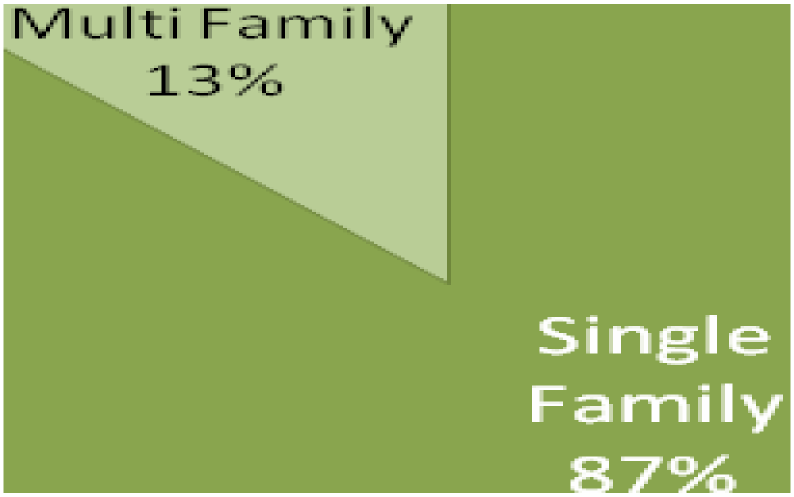
In order to accurately categorize the electricity use for the AmerenUE residential customer base, the residential sector was divided into two segments: single family and multi-family homes. Table 3-1 presents electricity use, households and intensity for the two segments. As expected, the intensity for multi-family homes is considerably smaller than for single-family homes. This reflects smaller home size and a lower saturation and usage of appliances.

Table 3-1 Residential Electricity Use in 2008

Housing Types[7]	Annual Use (GWh)	Households	Intensity (kWh/household)
Single Family	12,114	825,073	14,682
Multi Family	1,879	211,548	8,883
Total	**13,993**	**1,036,621**	**13,498**

[7] Common areas in multi-family buildings are accounted for in the commercial sector with the segment name of multi-family common area.

Figure 3-1 Residential Electricity Use by Customer Segment 2008



Further distinctions were made to characterize two vintages in the housing stock:

- Existing homes are defined as all dwellings in the housing stock. It reflects the average thermal shell characteristics and customer behavior for this group of dwellings. All the customer survey data were used to develop the profiles for existing homes.
- New construction is defined to represent new dwellings built in 2009 and in the future. This segment reflects current construction practices, building codes, appliance standards, and customer purchase decisions and behavior. Survey data for homes built in or after 2000 are used to represent new construction in the AmerenUE service area.

In addition, the residential market was segmented by end uses and technologies as shown in Table 3-2. This definition was developed to be consistent with the primary uses of electricity in the residential sector and the list of energy efficiency measures included in the analysis (see Appendix A for a list of residential measures).

Table 3-2 Residential End Uses and Technologies

End Use	Technology
Space Heating	Electric Resistance
	Furnace
	Heat Pump
	Supplemental Heating
Cooling	Central AC
	Heat Pump
	Room AC
Water Heating	Water Heater
	Pool Heater
Interior Lighting	Screw-in
	Linear Fluorescent
	Low Voltage
Exterior Lighting	Outdoor Lighting
Appliances	Refrigerator
	Second Refrigerator
	Freezer
	Clothes Dryer
	Clothes Washer
	Cooking
	Dishwasher
Electronics	Color TV
	Desktop PC
	Laptop Computer
Miscellaneous	Furnace Fan
	Miscellaneous
	Pool Pump

3.1.2 Base-year Market Profiles

Residential market profiles describe electricity use in terms of customer segment and end use. As described in Chapter 2, the elements in a market profile include market size, presence of end uses and technologies and annual energy use.

Figure 3-2 presents the end-use breakout for the residential sector. Four main end uses, appliances, lighting, cooling, and space heating account for about two-thirds of total use. Additional electricity consumption is allocated among electric water heaters and electronics (personal computers, televisions, home audio, video game consoles, etc). The remaining energy is classified as miscellaneous, and includes such devices as furnace fans, pool pumps, and other “plug” loads.

This contrasts with usage in the West North Central census division, shown in Figure 3-3. In the division, the largest uses are miscellaneous and appliances (including refrigeration). A key distinction for AmerenUE is the relative share of electric space heating in its service area which is higher than for the division as a whole.

Figure 3-2 Residential Electricity Consumption by End Use, 2008

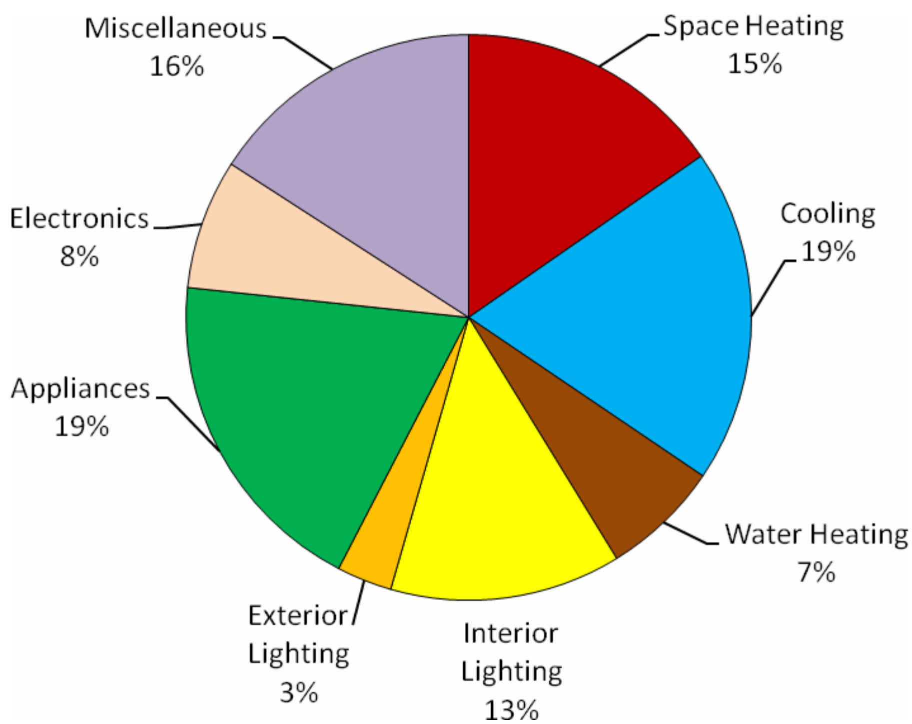


Figure 3-3 Comparison of Residential Electricity Usage by End Use

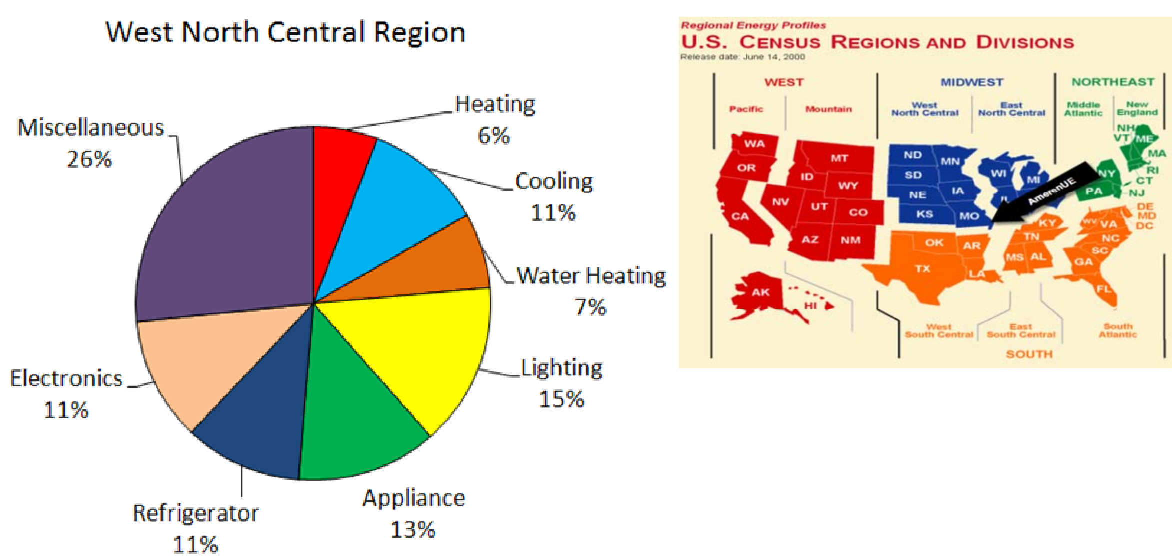
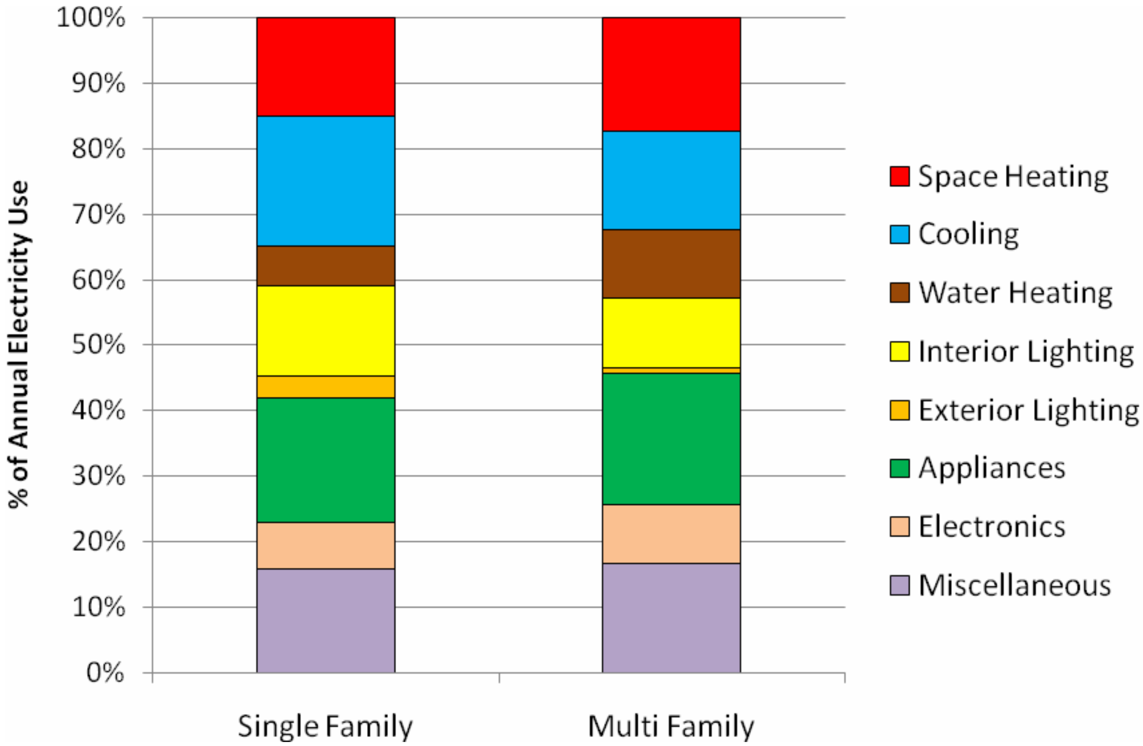


Figure 3-4 presents the end-use shares of total electricity use for each housing type. The relative consumption by cooling and lighting is lower for the multi-family segments than for single family homes, while appliances and electronics have a fairly constant share across segments.

Figure 3-4 End-Use Shares of Total Electricity Use by Housing Type, 2008



A summary of the total residential sector market profile is provided in Table 3-3. This table presents the following information:

- The share of homes with the end use and technology. In the case of color TVs, the saturation reflects the average number of color TVs per home.
- Unit energy consumption (UEC) represents the amount of electricity used per year in kWh for the technology in homes that have the technology.
- Intensity is the average use for a technology across all homes (computed as the product of the saturation and the UEC)
- Annual use is the amount of electricity use for this technology in the residential sector (computed as the product of all residential households and intensity.

The market profiles for single-family and multi-family homes are presented in Appendix C.

Table 3-3 Total Residential Sector Market Profile

End Use	Technology	Saturation (% of HH)	UEC (kWh/HH)	Intensity (kWh/HH)	Annual Use (GWh)
Space Heating	Heat Pump	4%	6,171	230	239
Space Heating	Electric Resistance	1%	6,200	87	90
Space Heating	Furnace	24%	6,807	1,603	1,662
Space Heating	Supplemental Heating	48%	313	151	156
Cooling	Central AC	88%	2,684	2,366	2,452
Cooling	Room AC	5%	2,203	115	120
Cooling	Heat Pump	4%	2,771	100	104
Water Heating	Water Heater	33%	2,565	858	890
Water Heating	Pool Heater	3%	2,115	55	57
Interior Lighting	Screw-in	89%	1,923	1,714	1,777
Interior Lighting	Linear Fluorescent	8%	353	28	29
Interior Lighting	Low Voltage	3%	1,434	43	45
Exterior Lighting	Outdoor Lighting	81%	529	426	442
Appliances	Refrigerator	100%	837	837	868
Appliances	Second Refrigerator	43%	1,154	500	518
Appliances	Freezer	45%	615	275	285
Appliances	Clothes Washer	95%	114	109	113
Appliances	Dishwasher	77%	79	61	63
Appliances	Clothes Dryer	73%	674	489	507
Appliances	Cooking	69%	441	305	317
Electronics	Desktop PC	48%	570	271	281
Electronics	Laptop Computer	52%	195	102	106
Electronics	Color TV	293%[8]	215	630	653
Miscellaneous	Furnace Fan	59%	109	64	66
Miscellaneous	Pool Pump	10%	2,041	197	204
Miscellaneous	Miscellaneous	100%	1,882	1,882	1,951
Total				**13,498**	**13,993**

3.1.3 Baseline Forecast

Once the base-year market profiles were developed, the next step was to develop a forecast of annual energy use by customer segment and end use. To develop the forecast, the LoadMAP model was implemented. The key forecast assumptions are summarized in Table 2-1. In addition, the following assumptions were implemented for the residential sector.

- For space heating, new homes purchase either heat pumps or furnaces, but not electric resistance. The survey data showed a trend toward furnaces, likely due to the relatively low cost of electricity at Ameren.

[8] For color TVs, the saturation reflects the average number of TVs per home (293% = 2.93 TVs per home).

- In 2006, a new Federal standard for central air conditioners went into effect, requiring all newly manufactured air conditioners to meet SEER 13 or better. This standard applies to replace-upon-burnout in existing construction and new construction.
- Federal efficiency standards for residential appliances, including refrigerators, clothes washers, and dishwashers are scheduled to be revised over the coming years. The AmerenUE forecast takes into account the most recent refrigeration standards (from 2007) but does not include anticipated standards for clothes washers and dishwasher in the baseline forecast. (A scenario assuming aggressive codes and standards is presented in Volume 4.)
- Residential lighting is affected by the passage of the Energy Independence and Security Act (EISA) in 2007, which mandates higher efficacies for lighting technologies starting in 2012. Several lighting technologies are anticipated to meet this standard when it goes into effect, including compact fluorescent lamps (CFL), white light-emitting diodes (LED), and advanced incandescents currently under development. Old stock is phased out over time beginning in 2012.
- In November 2008, ENERGY STAR 3.0 for color televisions went into effect. This standard sets the rules for becoming ENERGY STAR qualified. One such criterion is that TVs must not exceed 1 watt of power in standby mode.

Table 3-4 presents forecast results for each of the segments and the sector total. Figure 3-5 and Table 3-5 present the residential electricity use baseline forecast at the end use level for the residential sector. Table 3-6 presents the forecast in terms of electricity use per household. Key observations about this forecast include the following:

- The primary reason for the reduction in the baseline forecast beginning in 2012 is the federal lighting standards. The effect of this standard in the potentials analysis causes a decline in electricity for lighting use by 43% over the forecast period. The effect of EISA 2007 on national residential lighting over the same time horizon is projected by EIA to be a 24% reduction.[9] The AmerenUE reduction is larger due to the low penetration of CFLs in 2008.
- Growth in electricity use in electronics is strong and reflects an increase in the saturation of electronics and the trend toward higher-powered computers and larger televisions.
- Growth in miscellaneous use is also substantial. This has been a long-term trend and assumptions have been made about growth in this end use that are consistent with the Annual Energy Outlook.[10]

Table 3-4 Residential Electricity Consumption by Segment (GWh)

Segment	2008	2010	2012	2015	2020	2025	2030	% Change 2008-30
Single family	12,114	12,379	12,533	12,356	12,779	13,287	13,663	12.8%
Multi-family	1,879	1,939	1,990	2,025	2,134	2,242	2,323	23.6%
Total	**13,993**	**14,318**	**14,522**	**14,381**	**14,913**	**15,529**	**15,986**	**14.2%**

[9] AEO 2009, Updated Reference Case, Supplemental Table 4.
[10] See discussion on miscellaneous category above.

Figure 3-5 Residential Baseline Electricity Forecast by End Use

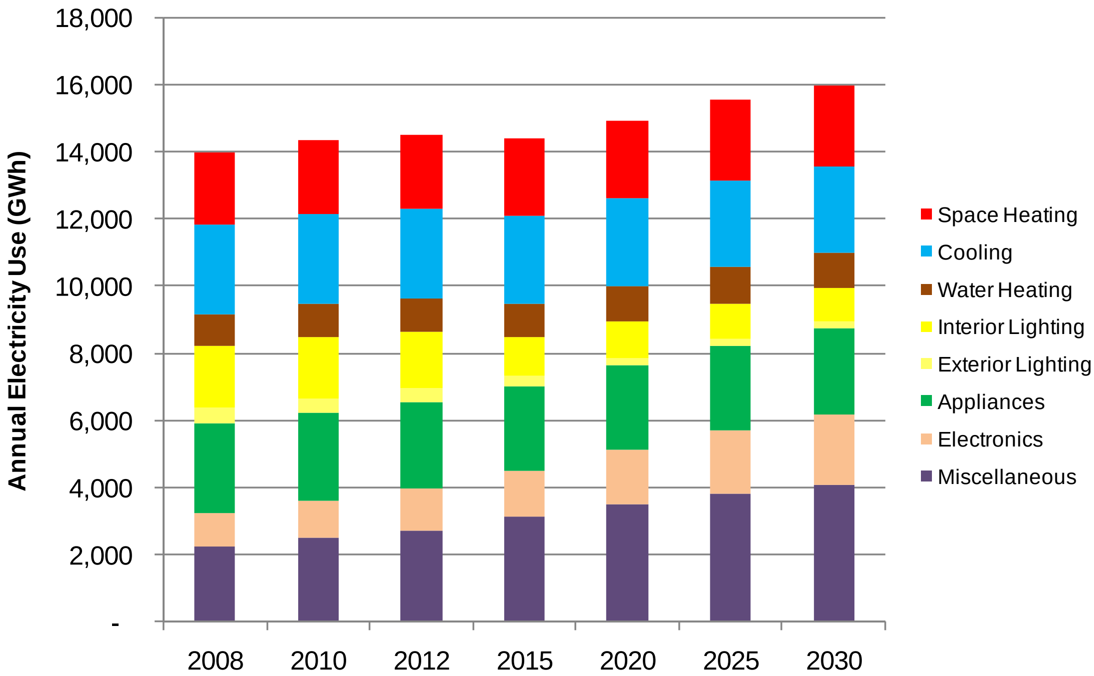


Table 3-5 Residential Baseline Electricity Forecast by End Use (GWh)

End Use	Technology	2008	2010	2020	2030	% Change ('08-'30)
Space Heating	Electric Resistance	90	91	92	92	2%
	Furnace	1,662	1,706	1,812	1,888	14%
	Heat Pump	239	242	248	249	4%
	Supplemental Heating	156	160	171	177	13%
Cooling	Central AC	2,452	2,419	2,359	2,359	-4%
	Heat Pump	104	107	113	116	12%
	Room AC	120	119	115	115	-4%
Water Heating	Water Heater	890	914	985	1,005	13%
	Pool Heater	57	58	61	60	5%
Interior Lighting	Screw-in	1,777	1,778	1,029	923	-48%
	Linear Fluorescent	29	29	31	31	8%
	Low Voltage	45	46	47	48	8%
Exterior Lighting	Outdoor Lighting	442	449	205	203	-54%
Appliances	Refrigerator	868	843	797	807	-7%
	Second Refrigerator	518	458	360	366	-29%
	Freezer	285	282	282	284	0%
	Clothes Dryer	507	517	540	548	8%
	Clothes Washer	113	115	119	121	7%
	Cooking	317	327	354	367	16%
	Dishwasher	63	64	67	70	11%
Electronics	Color TV	653	697	999	1,298	99%
	Desktop PC	281	301	451	580	106%
	Laptop Computer	106	113	165	210	98%
Miscellaneous	Furnace Fan	66	69	73	74	11%
	Miscellaneous	1,951	2,209	3,231	3,789	94%
	Pool Pump	204	205	207	206	1%
Total		**13,993**	**14,318**	**14,913**	**15,986**	**14%**

Table 3-6 Forecast of Residential End Use Consumption per Household

End Use	Technology	2008 (kWh/hh)	2010 (kWh/hh)	2020 (kWh/hh)	2030 (kWh/hh)	% Change ('08-'30)
Space Heating	Electric Resistance	87	87	81	78	-10%
	Furnace	1,603	1,619	1,611	1,615	1%
	Heat Pump	230	230	221	213	-7%
	Supplemental Heating	151	152	152	151	0%
Cooling	Central AC	2,366	2,296	2,097	2,017	-15%
	Heat Pump	100	101	101	99	-1%
	Room AC	115	113	102	98	-15%
Water Heating	Water Heater	858	867	876	859	0%
	Pool Heater	55	55	54	51	-7%
Interior Lighting	Screw-in	1,714	1,687	915	790	-54%
	Linear Fluorescent	28	28	27	26	-5%
	Low Voltage	43	43	42	41	-4%
Exterior Lighting	Outdoor Lighting	426	426	182	174	-59%
Appliances	Refrigerator	837	800	709	690	-18%
	Second Refrigerator	500	435	320	313	-37%
	Freezer	275	268	251	243	-12%
	Clothes Dryer	489	491	480	469	-4%
	Clothes Washer	109	109	106	103	-5%
	Cooking	305	310	315	314	3%
	Dishwasher	61	60	59	60	-2%
Electronics	Color TV	630	661	888	1,109	76%
	Desktop PC	271	286	401	496	83%
	Laptop Computer	102	107	147	180	76%
Miscellaneous	Furnace Fan	64	65	65	63	-2%
	Miscellaneous	1,882	2,096	2,873	3,240	72%
	Pool Pump	197	194	184	176	-11%
Total		**13,498**	**13,587**	**13,259**	**13,669**	**1%**

3.2 COMMERCIAL SECTOR

The commercial sector in 2008 consumed 13.2 TWh of electricity, which accounts for 35% of total AmerenUE electric consumption. Total floor space in the commercial sector is 964 million square feet, which implies an average intensity of 13.7 kWh per square foot in 2008.

3.2.1 Market Segmentation

Based on the analysis of the survey data collected and analyzed for this project, the commercial sector is comprised of 11 segments:

- Office
- Restaurant
- Retail
- Grocery
- Warehouse
- Education
- Health
- Lodging
- Public Assembly

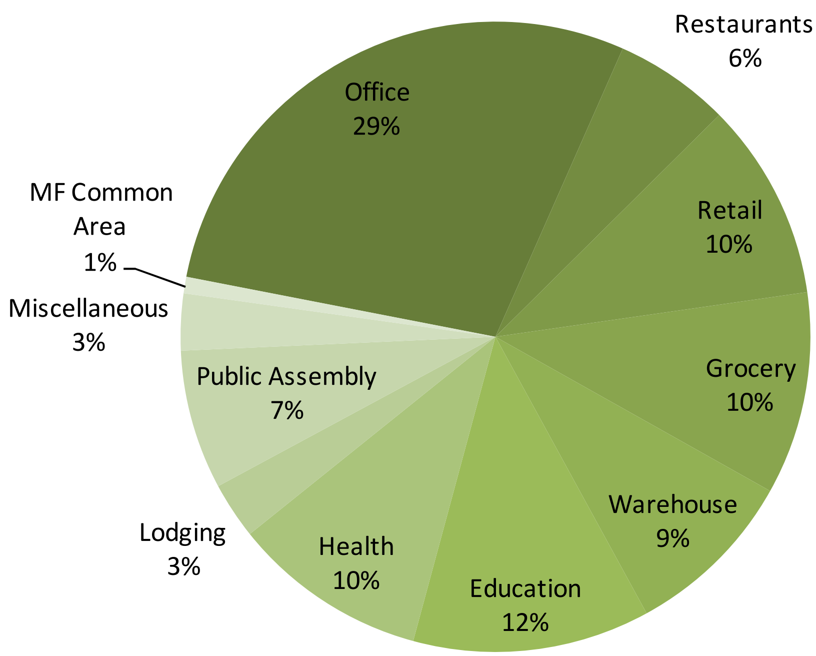
- Miscellaneous
- Residential Multi-Family (MF) Common Area

Table 3-7 presents segment-level information about annual electricity use, floor space and intensity. Figure 3-6 presents the breakdown of annual electricity use by segment.

Table 3-7 Commercial Electricity Use in 2008

Segment	Annual Use (GWh)	Floor space (million square feet)	Intensity (kWh/sq.ft.)
Office	3,764	172.3	21.8
Restaurants	784	17.1	45.9
Retail	1,339	113.6	11.8
Grocery	1,371	19.8	69.2
Warehouse	1,172	146.2	8.0
Education	1,605	170.6	9.4
Health	1,322	68.9	19.2
Lodging	382	41.3	9.3
Public Assembly	943	120.4	7.8
Miscellaneous	384	58.5	6.6
MF Common Area	111	35.7	3.1
Total	**13,178**	**964.4**	**13.7**

Figure 3-6 Commercial Electricity Consumption by Segment, 2008



As with the residential sector, commercial space was divided into new and existing construction for the analysis. Further segmentation was performed by breaking out usage into the end uses and technologies as shown in Table 3-8.

Table 3-8 Commercial End Uses and Technologies

Electric End Use	Technology
Space Heating	Heat Pump
	Electric Resistance
	Furnace
	Other Heating
Cooling	Central Chiller
	Rooftop Packaged Units (RTU)
	Split System
	Packaged Terminal Air Conditioners (PTAC)
	Other Cooling
	Heat Pump
Ventilation	Ventilation System
Water Heating	Central Water Heater
	Domestic Water Heater
Lighting	Indoor Screw-in
	Indoor Fluorescent
	Exit Signs
	Specialty Lamps
	Outdoor Screw-in
	Outdoor Fluorescent
Office Equipment	Desktop Computer
	Laptop Computer
	Server
	Monitor
	Printer/copier/fax
	Point-of-sale (POS) Terminal
Refrigeration	Walk in Refrigeration
	Glass Door Display
	Solid Door Refrigerator
	Open Display Case
	Vending Machine
	Icemaker
Food Service	Broiler
	Fryer
	Griddle
	Oven
	Range
	Dishwasher
	Steamer
	Hot Food Container
	Food Prep
Miscellaneous	Laundry Equipment
	Pool Equipment
	Non-HVAC Motor
	Elevator
	Escalator
	Other Miscellaneous

3.2.2 Base-year Market Profiles

After annual electricity use, floor space and intensities were defined, comprehensive market profiles were developed for each segment. Table 3-9 presents the 2008 market profile for the commercial sector as a whole, representing a composite of the ten buildings and residential common area. This market profile includes:

- Saturations of floor space with each electric end use. For space heating, cooling and water heating, this embodies the electric fuel share. For space heating and cooling, it also embodies the fraction of conditioned space.
- End-use indices (EUI) represent the amount of electricity used per square foot of floor space in buildings where the equipment is present
- Intensity is the average use across all floor space (computed as the product of saturation and EUI)
- Annual use is the total consumption in 2008 for each end use (computed as the product of the intensity and total commercial-sector square feet)

Table 3-9 Total Commercial Sector Market Profile

End Use	Saturation (% of floor space)	EUI (kWh/sq.ft.)	Intensity (Avg. kWh/sq.ft)	Annual Use (GWh)
Space Heating	16%	4.40	0.68	659
Cooling	93%	3.49	3.24	3,125
Ventilation	100%	1.20	1.20	1,158
Water Heating	21%	0.44	0.09	89
Lighting	100%	4.11	4.11	3,959
Office Equipment	100%	1.43	1.43	1,381
Refrigeration	100%	1.21	1.21	1,162
Food Service	100%	0.66	0.66	637
Miscellaneous	100%	1.05	1.05	1,008
Total			**13.67**	**13,178**

The breakdown of annual electricity usage by end use is shown in Figure 3-7. Lighting is the largest single end use in the commercial sector, accounting for just under one third of total usage. Cooling is second, followed by office equipment. Each of the other end uses accounts for less than 10% of total usage.

This contrasts with usage in the West North Central census division, shown in Figure 3-8. Across the division, miscellaneous usage is the dominant use, followed by lighting. A key benefit of the primary market research and modeling is better characterization of end-use energy use than is possible using secondary data.

Figure 3-7 Commercial Electricity Consumption by End Use, 2008

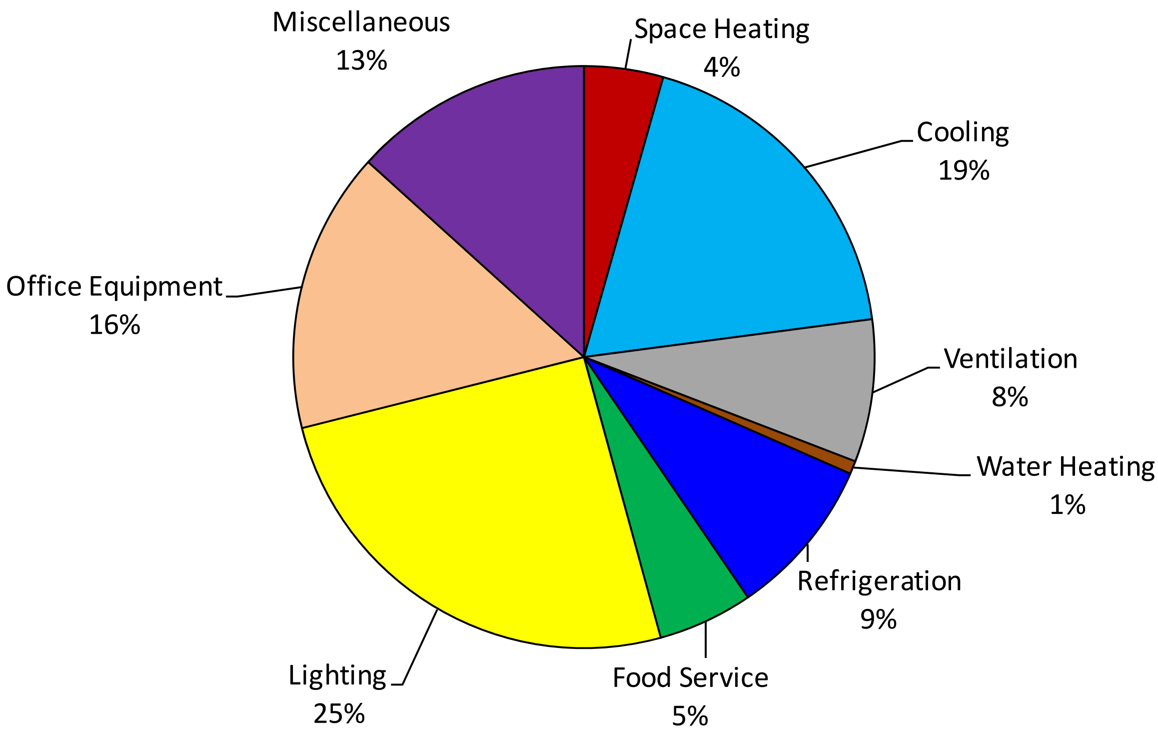
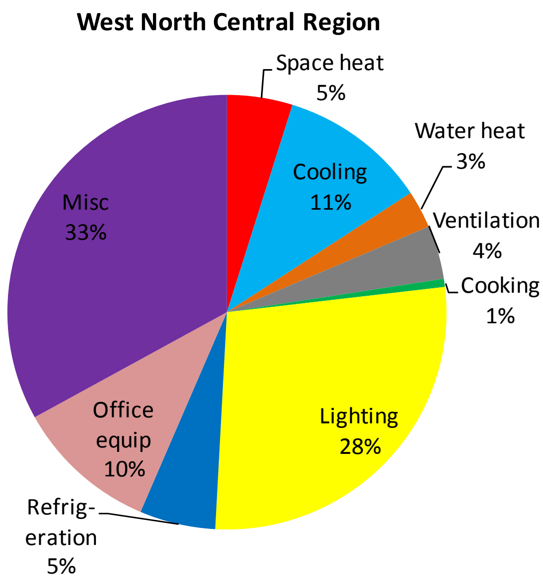
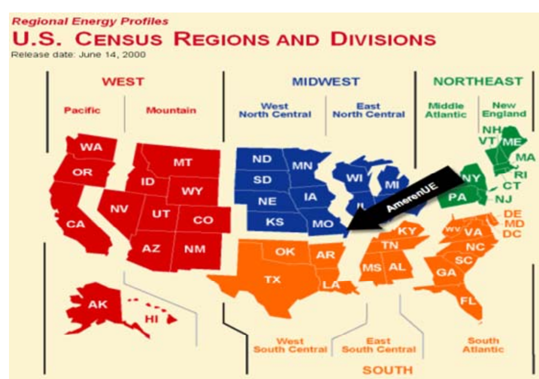


Figure 3-8 Comparison of Commercial Sector Electricity Usage by End Use



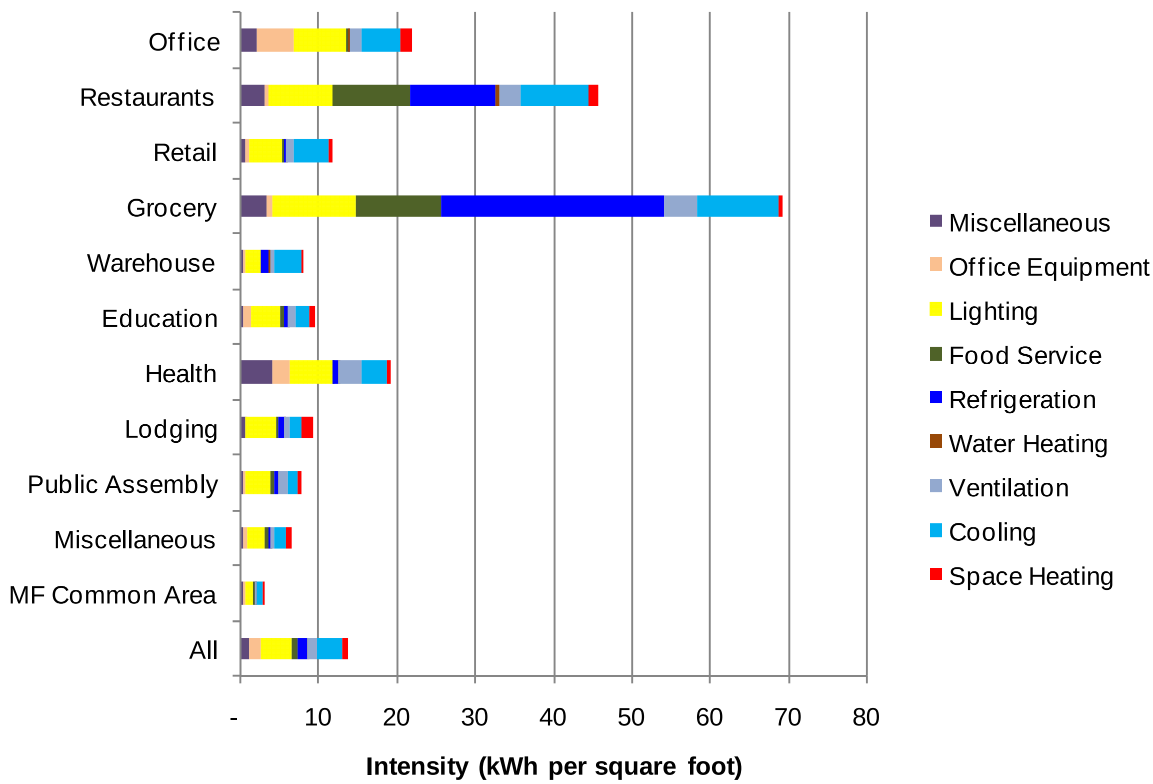


The end-use composition of electricity use varies by building type, as shown in Figure 3-9. Restaurants and grocery stores are the most energy intensive. Warehouses are the least intensive. In addition to this variation in total use, the end-use breakdown also varies considerably.

- Lighting is a major end use across all building types, as is cooling
- Refrigeration has a large share of total use in grocery stores and restaurants
- Office equipment has substantial use in offices, health and education
- The miscellaneous end use is highest in health, since this end use captures medical equipment

Market profiles for each segment are presented in Appendix C.

Figure 3-9 End-use Shares of Total Use by Building Type



3.2.3 Baseline Forecast

The commercial baseline forecast was developed using the same approach and similar data sources that were used for the residential sector. AmerenUE provided forecasts of customer growth and retail electricity prices. Purchase shares for technologies and efficiency levels were obtained from the primary market research and the Annual Energy Outlook forecast.

Table 3-10 presents the baseline forecast for the commercial sector. While the total consumption increases by 18% over the forecast horizon, there is variation over the building types. Education, Offices and Health have the highest growth, while Grocery grows the slowest.

Table 3-10 Commercial Electricity Consumption by Segment (GWh)

Building Type	2008	2010	2020	2030	Change 2008-30
Office	3,764	3,813	4,133	4,706	25%
Retail	1,339	1,360	1,416	1,571	17%
Restaurants	784	785	793	853	9%
Grocery	1,371	1,386	1,397	1,487	8%
Warehouse	1,172	1,180	1,191	1,293	10%
Education	1,605	1,590	1,770	2,068	29%
Health	1,322	1,345	1,467	1,649	25%
Lodging	382	379	372	401	5%
Public Assembly	943	949	958	1,040	10%
Miscellaneous	384	386	390	423	10%
MF Common Area	111	112	113	123	10%
Total	**13,178**	**13,285**	**14,001**	**15,615**	**18%**

The baseline forecast by end use for the commercial sector is displayed graphically in Figure 3-10, and in tabular form in Table 3-11. There is considerable variation across the end uses. Major uses – cooling, lighting and refrigeration – are relatively flat, while significant growth takes place in office equipment and miscellaneous uses.

Figure 3-10 Commercial Baseline Electricity Forecast by End Use (GWh)

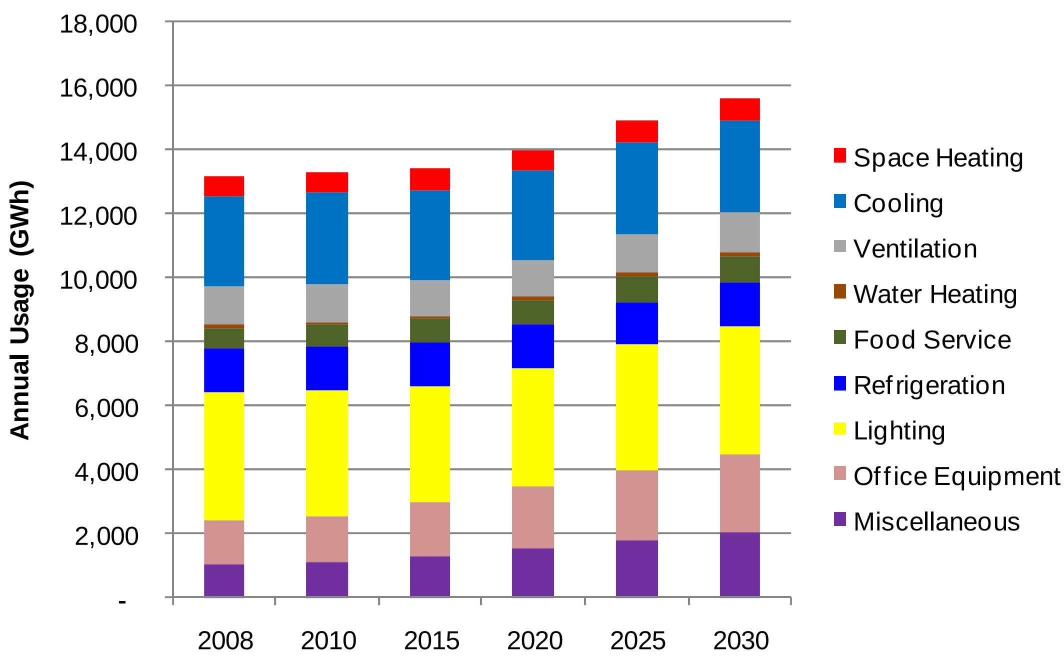


Table 3-11 Commercial Baseline Electricity Forecast (GWh) by End Use

End Use	2008	2010	2020	2030	% Change ('08-'30)
Space Heating	622	634	652	687	10%
Cooling	2,837	2,846	2,792	2,892	2%
Ventilation	1,167	1,164	1,154	1,236	6%
Water Heating	99	100	106	114	16%
Refrigeration	1,374	1,380	1,327	1,389	1%
Food Service	671	696	764	825	23%
Lighting	3,991	3,935	3,722	3,956	-1%
Office Equipment	1,387	1,435	1,916	2,439	76%
Miscellaneous	1,029	1,096	1,569	2,078	102%
Total	**13,178**	**13,285**	**14,001**	**15,615**	**18%**

3.3 INDUSTRIAL SECTOR

AmerenUE's industrial sector accounts for 10,994 GWh in 2008, or 29% of the total. The sector is treated as a single segment in the potentials modeling. The end-use and technology breakdown is presented in Table 3-12.

Table 3-12 Industrial End Uses and Technologies

End-Use	Technology
Space Heating	Heat Pump
	Electric Resistance
	Furnace
Cooling	Central Chiller
	Rooftop Packaged Units (RTU)
	Split System
	Packaged Terminal Air Conditioners (PTAC)
	Other Cooling
	Heat Pump
Ventilation	Ventilation System
Process	Process Cooling/Refrigeration
	Process Heating
	Electrochemical Process
Lighting	Indoor Screw-in
	Indoor Fluorescent
	Outdoor Screw-in
	Outdoor Fluorescent
Machine Drive	Less than 5 HP
	5-24 HP
	25-99 HP
	100-249 HP
	250-499 HP
	500 or more HP

Other	Other Uses

3.3.1 Base-year Market Profiles

Table 3-13 presents the 2008 market profile for the industrial sector. The overall energy intensity of the industrial sector is 59 kWh per square foot, of which machine drives make up 50% and processes make-up almost a third. The breakdown of annual electricity use by end use is shown in Figure 3-11.

Within these end uses, the majority of energy use is the result of industrial processes, including machine drives, process heating and other uses. These are represented in Figure 3-11 below as nearly 80% of industrial electricity consumption. While they comprise a smaller portion of the industrial load, lighting and HVAC applications made up over 1,800 GWh in 2008.

Table 3-13 Total Industrial Sector Market Profile

Electric End Use	Technology	Saturation (% of floor space)	EUI (kWh / sq.ft.)	Intensity (kWh / sq.ft.)	Annual Use (GWh)
Space Heating	Heat Pump	3%	4.01	0.12	22
	Electric Resistance	4%	11.76	0.47	88
	Furnace	4%	4.59	0.18	34
Cooling	Central Chiller	9%	2.52	0.23	42
	RTU	62%	4.16	2.58	481
	Split System	10%	13.30	1.33	248
	PTAC	5%	4.78	0.24	45
	Heat Pump	3%	5.80	0.17	32
	Other Cooling	2%	2.51	0.05	9
Ventilation	Ventilation System	37%	2.71	1.00	187
Lighting	Indoor Screw-in	100%	1.39	1.39	259
	Indoor Fluorescent	100%	3.10	3.10	577
	Outdoor Screw-in	100%	0.09	0.09	17
Process	Process Cooling/Refrigeration	2%	168.55	4.06	757
	Process Heating	26%	31.13	8.16	1,521
	Electrochemical Process	3%	162.31	4.19	782
Machine Drive	Less than 5 HP	90%	5.88	5.32	992
	5-24 HP	80%	7.55	6.05	1,128
	25-99 HP	72%	9.20	6.66	1,243
	100-249 HP	65%	9.58	6.26	1,167
	250-499 HP	24%	10.46	2.48	462
	500 or more HP	26%	11.07	2.88	538
Other	Other Uses	100%	1.95	1.95	365
Total				**59.0**	**10,994**

3.3.1 Baseline Forecast

The industrial baseline forecast was developed using the same approach and similar data sources that were used for the commercial sector. The baseline forecast for the industrial sector is displayed graphically in Figure 3-12, and in tabular form in Table 3-14. The overall result is an increase of 5% between 2008 and 2030,

Figure 3-11 Industrial Electricity Consumption by End Use, 2008

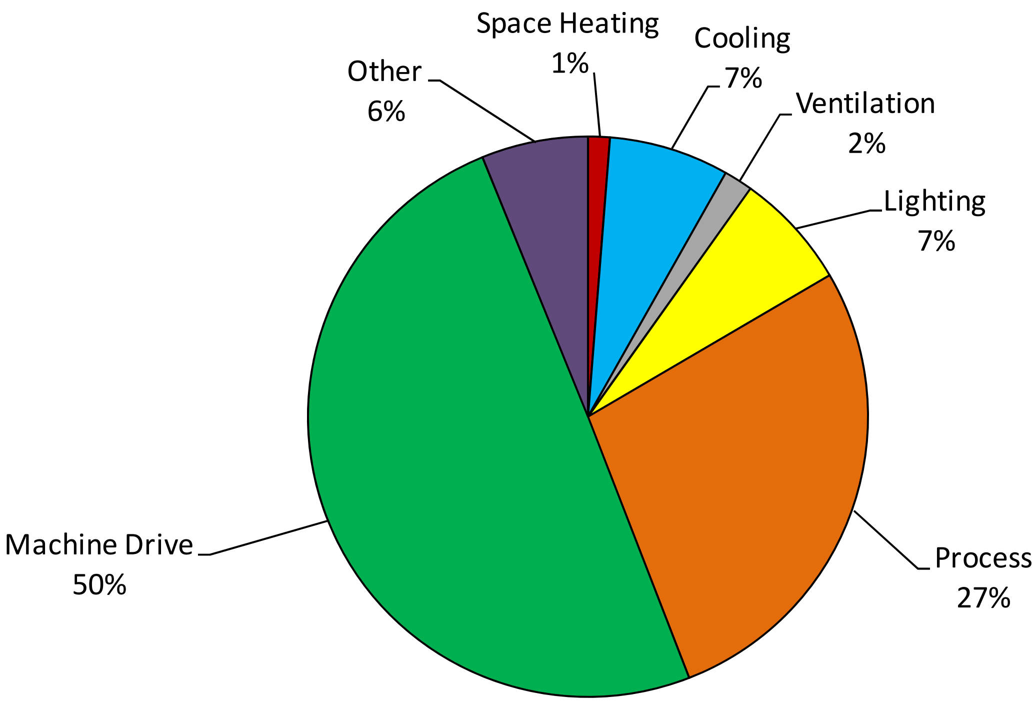


Figure 3-12 Industrial Baseline Electricity Forecast by End Use

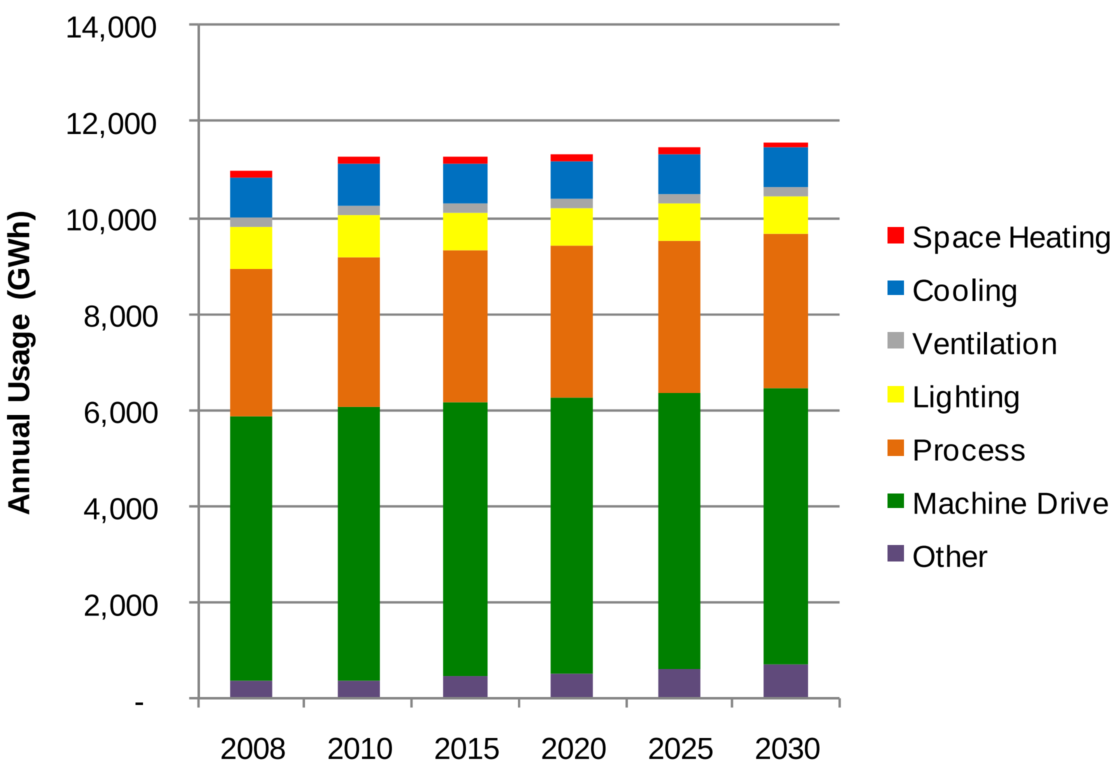


Table 3-14 Industrial Baseline Forecast by End Use and Technology

Electric End Use	Technology	2008	2010	2020	2030	Change 2008-30
Space Heating	Heat Pump	22	22	21	21	-8%
	Electric Resistance	88	89	89	89	2%
	Furnace	34	35	35	35	3%
Cooling	Central Chiller	42	42	41	41	-2%
	RTU	481	477	452	452	-6%
	Split System	248	249	233	229	-7%
	PTAC	45	44	42	41	-7%
	Heat Pump	32	32	30	30	-8%
	Other Cooling	9	10	10	10	3%
Ventilation	Ventilation System	187	191	192	193	3%
Lighting	Indoor Screw-in	259	265	165	166	-36%
	Indoor Fluorescent	577	590	595	600	4%
	Outdoor Screw-in	17	17	11	11	-35%
Process	Process Cooling/Refrigeration	757	773	781	789	4%
	Process Heating	1,521	1,554	1,570	1,585	4%
	Electrochemical Process	782	799	807	815	4%
Machine Drive	Less than 5 HP	992	1,014	1,024	1,035	4%
	5-24 HP	1,128	1,152	1,163	1,173	4%
	25-99 HP	1,243	1,270	1,283	1,296	4%
	100-249 HP	1,167	1,192	1,205	1,217	4%
	250-499 HP	462	472	473	475	3%
	500 or more HP	538	550	556	563	5%
Other	Other Uses	365	402	556	713	95%
Grand Total		**10,994**	**11,244**	**11,334**	**11,580**	**5%**

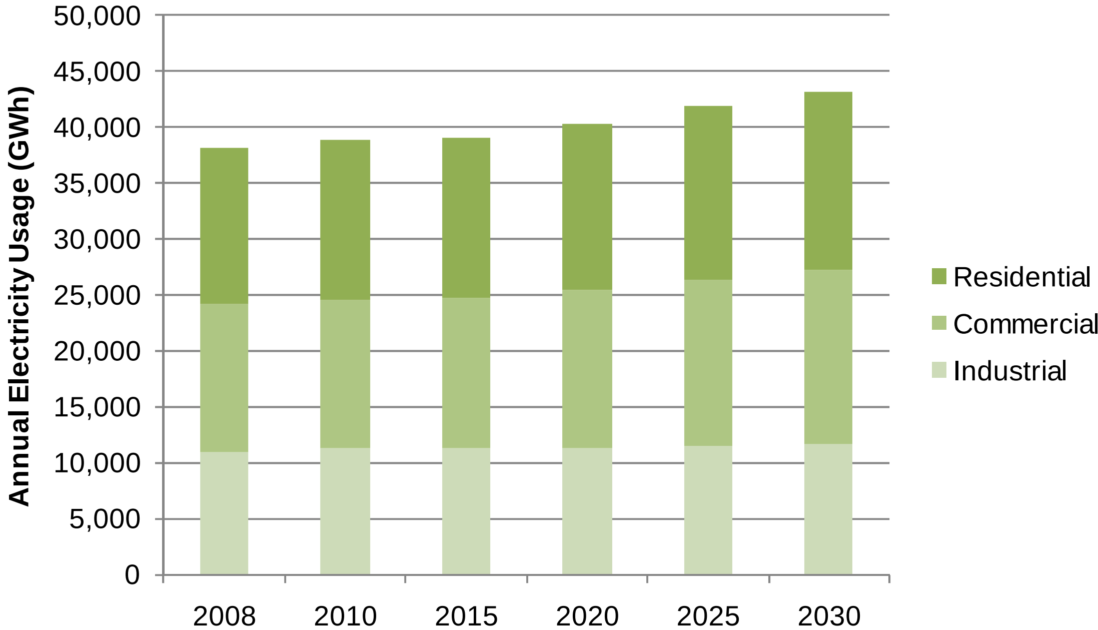
3.4 OVERALL FORECAST RESULTS

Table 3-15 and Figure 3-13 present the combined baseline end-use forecast across all three sectors. The overall increase over the 22-year period is 13% and the average annual growth rate is 0.6%. The commercial sector shows the strongest growth. This forecast is the reference against which energy-efficiency savings are measured.

Table 3-15 AmerenUE Baseline Electricity Forecast

Sector	2008	2010	2015	2020	2025	2030	Avg. Growth 2008-30
Residential	13,993	14,318	14,381	14,913	15,529	15,986	0.61%
Commercial	13,178	13,285	13,397	14,001	14,917	15,615	0.77%
Industrial	10,994	11,244	11,279	11,334	11,453	11,580	0.24%
Total	**38,165**	**38,847**	**39,057**	**40,248**	**41,899**	**43,181**	**0.60%**

Figure 3-13 AmerenUE Baseline Electricity Forecast by Sector



CHAPTER | 4

TECHNICAL AND ECONOMIC POTENTIAL

4.1 SUMMARY OF ENERGY EFFICIENCY POTENTIAL

As discussed in Chapter 3, electricity consumption in the residential, commercial and industrial sectors in 2008 was 38,165 GWh. In absence of new DSM programs, as represented by the baseline forecast, electricity use is expected to increase to 43,181 GWh in 2030. This forecast forms the basis for the estimation of energy-efficiency potential and it is the metric against which savings are compared.

The analysis of energy-efficiency measures yields estimates of energy efficiency for two types of potential:

- **Technical potential** is the theoretical upper bound of energy-efficiency savings regardless of cost.
    1. In 2020, technical potential is 11,098 GWh, which represents 27.6% of total usage in that year.
    2. In 2030, technical potential is 12,696 GWh, 29.4% of total usage.
- **Economic potential** is an estimate of all cost-effective energy efficiency savings.
    1. In 2020, economic potential is 5,475 GWh, which represents 13.6% of total usage in that year.
    2. In 2030, economic potential is 7,181 GWh, 16.6% of total usage.

Table 4-1 presents the overall summary of energy-efficiency potential. The upper part of the table presents energy savings in GWh. The lower part presents peak-demand savings. Figure 4-1 presents the energy savings graphically for technical and economic potential.

Table 4-2 presents potential by sector. In 2009, the residential sector has the highest share of savings as a result of strong savings in lighting, prior to the lighting standard that takes effect in 2012. By 2020, the cumulative contribution is roughly equivalent for the residential and commercial sectors; together these two sectors account for over 85% of total savings.

These results represent savings at the measure level. Program-level savings are described in Volume 4.

Table 4-1 Summary of Energy Efficiency Potential

	2009	2015	2020	2025	2030
Baseline Electricity Forecast (GWh)	38,839	39,057	40,248	41,899	43,181
Energy Savings (GWh)					
Technical Potential	3,434	9,115	11,098	12,296	12,696
Economic Potential	1,895	4,392	5,475	6,657	7,181
Energy Savings as % of Baseline					
Technical Potential	8.8%	23.3%	27.6%	29.3%	29.4%
Economic Potential	4.9%	11.2%	13.6%	15.9%	16.6%
Baseline Peak Demand Forecast (MW)	7,642	8,003	8,356	8,752	9,127
Peak Demand Savings (MW)					
Technical Potential	837	2,342	2,932	3,377	3,511
Economic Potential	454	1,166	1,444	1,715	1,846
Peak Savings as % of Baseline					
Technical Potential	11.0%	29.3%	35.1%	38.6%	38.5%
Economic Potential	5.9%	14.6%	17.3%	19.6%	20.2%

Figure 4-1 Summary of Energy Efficiency Potential

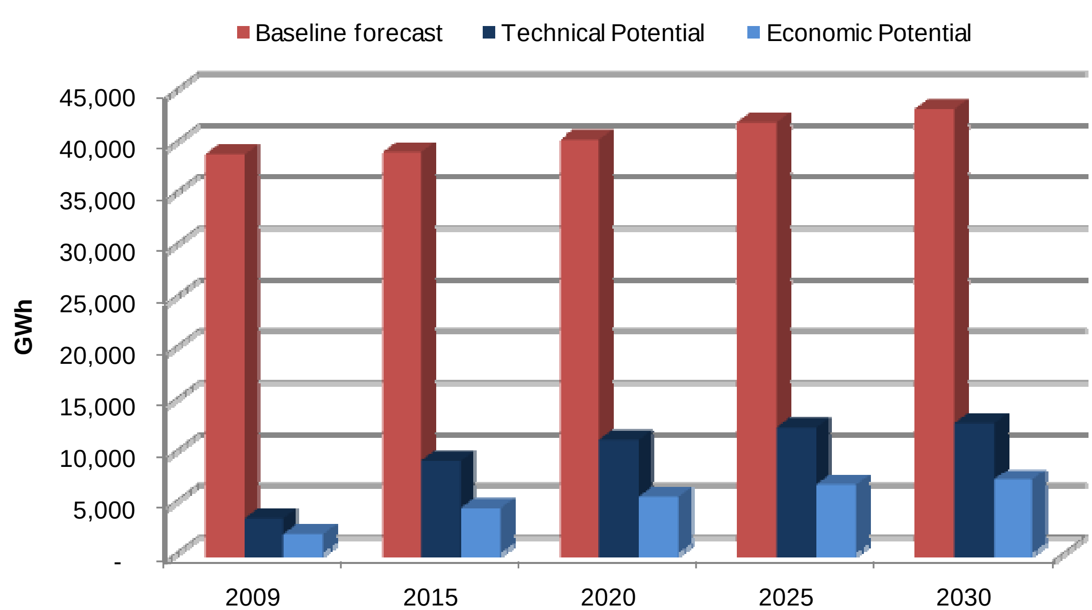
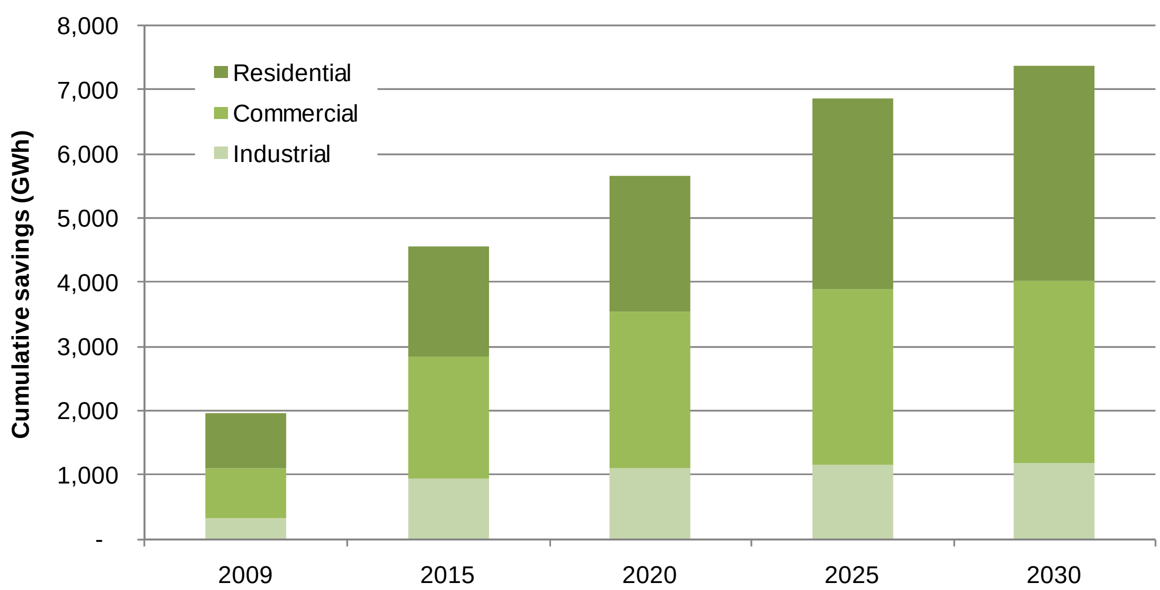


Table 4-2 Energy Efficiency Potential by Sector (GWh and Peak MW)

	2009	2015	2020	2025	2030
Energy Savings (GWh)					
Technical Potential (GWh)					
Residential	1,727	4,550	5,477	6,100	6,275
Commercial	1,333	3,503	4,385	4,893	5,096
Industrial	375	1,062	1,236	1,302	1,325
Total	**3,434**	**9,115**	**11,098**	**12,296**	**12,696**
Economic Potential (GWh)					
Residential	834	1,692	2,130	2,985	3,348
Commercial	777	1,903	2,441	2,727	2,847
Industrial	284	797	904	946	986
Total	**1,895**	**4,392**	**5,475**	**6,657**	**7,181**
Peak Demand Savings (MW)					
Technical Potential (MW)					
Residential	465	1,326	1,647	1,891	1,959
Commercial	773	2,140	2,677	3,084	1,467
Industrial	17	58	75	82	85
Total	**1,255**	**3,524**	**4,399**	**5,058**	**3,511**
Economic Potential (MW)					
Residential	229	577	699	863	953
Commercial	423	1,075	1,330	1,574	830
Industrial	14	44	53	58	63
Total	**665**	**1,696**	**2,083**	**2,495**	**1,846**

Figure 4-2 Summary of Economic Potential by Sector



4.2 ENERGY EFFICIENCY POTENTIAL FOR THE RESIDENTIAL SECTOR

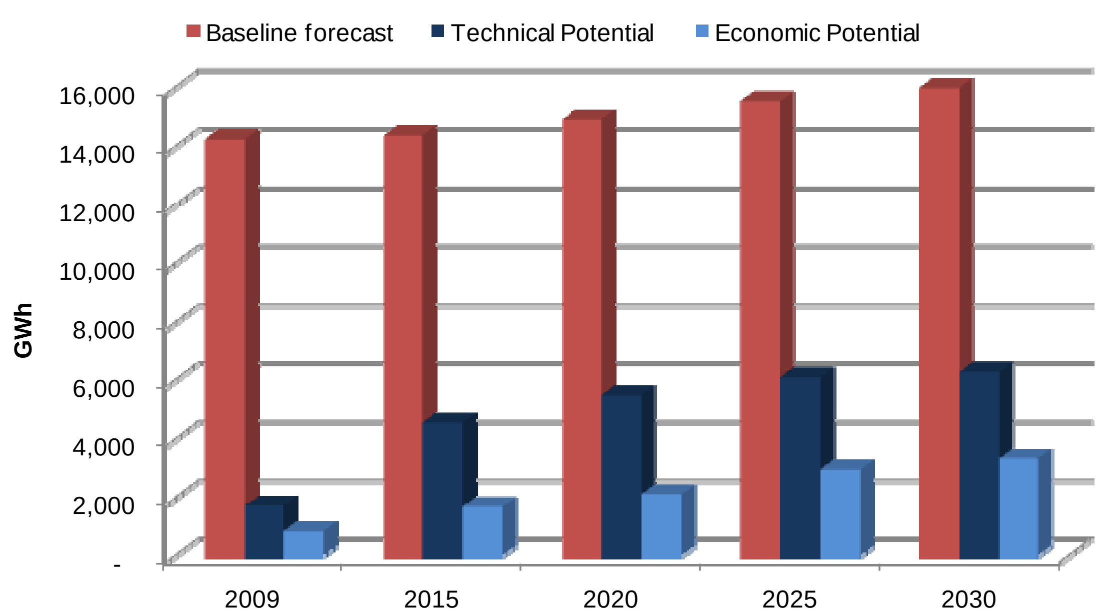
The residential sector accounts for the largest share of technical and economic potential throughout the forecast horizon. Estimates for technical and economic potential for the residential sector are presented in Table 4-3. Figure 4-3 depicts the potential estimates graphically. Key findings include:

- In 2020, technical potential is 5,477 GWh, which represents 36.7% of total residential usage in that year. In 2030, technical potential is 6,275 GWh, 39.3% of total usage.
- In 2020, economic potential is 2,130 GWh, which represents 14.3% of total usage in that year. In 2030, economic potential is 3,348 GWh, 20.9% of total usage.

Table 4-3 Residential Energy Efficiency Potential

	2009	2015	2020	2025	2030
Baseline Electricity Forecast (GWh)	14,247	14,381	14,913	15,529	15,986
Energy Savings (GWh)					
Technical Potential	1,727	4,550	5,477	6,100	6,275
Economic Potential	834	1,692	2,130	2,985	3,348
Energy Savings as % of Baseline					
Technical Potential	12.1%	31.6%	36.7%	39.3%	39.3%
Economic Potential	5.9%	11.8%	14.3%	19.2%	20.9%
Peak Demand Savings (MW)					
Technical Potential	465	1,326	1,647	1,891	1,959
Economic Potential	229	577	699	863	953

Figure 4-3 Residential Energy Efficiency Potential



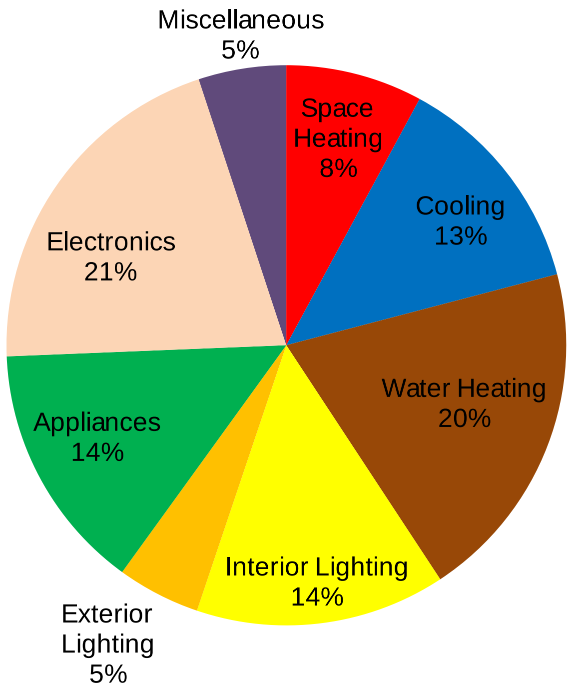
4.2.1 Residential Potential Estimates by End Use

Table 4-4 provides a summary of technical and economic potential for each of the primary end uses isolated in this study. The end-use share of economic potential in 2030 is shown in Figure 4-4; significant savings are possible in all end uses in the residential sector.

Table 4-4 Residential Potential by End Use

		Savings (GWh)			
End Use	**Type**	**2009**	**2015**	**2020**	**2030**
Space Heating	Technical	245	713	813	923
	Economic	66	191	214	264
Cooling	Technical	434	1,224	1,451	1,708
	Economic	95	275	328	436
Water Heating	Technical	191	638	836	999
	Economic	107	338	446	664
Interior Lighting	Technical	505	712	657	539
	Economic	354	269	291	484
Exterior Lighting	Technical	170	256	188	185
	Economic	135	195	164	161
Appliances	Technical	80	431	722	873
	Economic	14	97	196	482
Electronics	Technical	58	446	651	873
	Economic	19	205	339	688
Miscellaneous	Technical	45	130	161	175
	Economic	43	123	152	170
Total	**Technical**	**1,727**	**4,550**	**5,477**	**6,275**
	Economic	**834**	**1,692**	**2,130**	**3,348**

Figure 4-4 End-use Shares of Residential Economic Potential in 2030



4.2.2 Residential Potential Estimates by Measure Type

Table 4-5 presents economic potential from equipment measures. For most measures, economic potential steadily increases. A few end uses exhibit a different outcome:

- Interior lighting potential starts out strong and then declines as a result of the EISA lighting standard. After 2020, the potential increases substantially because LED lighting becomes cost-effective.
- Water heating potential increases substantially between 2020 and 2030 as a result of heat pump water heaters becoming cost effective.
- Clothes dryer potential also increases as a result of microwave clothes dryers becoming cost effective.

Table 4-5 Residential Economic Potential Savings – Equipment Measures (GWh)

End Use	Technology	2009	2015	2020	2030
Space Heating	Heat Pump	1.4	11.0	23.9	69.9
	Supplemental Heating	3.0	16.5	20.1	24.1
Cooling	Central AC	11.6	60.9	92.9	176.2
	Heat Pump	-	2.8	10.6	31.4
	Room AC	0.6	5.1	12.1	15.2
Water Heating	Water Heater	20.8	122.3	214.2	397.5
	Pool Heater	-	-	9.7	43.4
Interior Lighting	Screw-in	339.1	238.0	259.3	452.7
	Linear Fluorescent	0.3	1.1	1.0	0.7
Exterior Lighting	Outdoor Lighting	135.4	195.3	164.0	160.8
Appliances	Refrigerator	4.5	40.0	76.3	160.2
	Second Refrigerator	-	1.0	4.6	41.9
	Freezer	3.5	16.9	24.9	32.2
	Clothes Dryer	1.0	7.7	32.6	164.5
	Clothes Washer	0.7	5.9	11.3	17.0
	Cooking	2.5	14.4	25.5	40.6
	Dishwasher	1.6	11.0	21.2	25.2
Electronics	Color TV	9.2	106.1	218.4	327.3
	Desktop PC	6.1	71.8	88.1	266.4
	Laptop Computer	3.8	26.5	32.2	94.6
Miscellaneous	Furnace Fan	2.1	11.8	18.5	25.1
	Pool Pump	6.9	37.5	58.8	70.0
Total		**554.2**	**1,003.6**	**1,420.3**	**2,636.6**

Table 4-6 presents economic potential for other measures. The measure with highest savings across all years is Repair and Seal Ducts, which impacts both space heating and cooling use. Pool pump timers and low flow showerheads also show significant savings potential.

Table 4-6 Residential Economic Potential for Other Measures (GWh)

Measure	2009	2015	2020	2030
Advanced New Construction Designs	1.6	14.9	17.9	18.4
Doors, Storm and Thermal	0.2	1.3	1.4	1.4
Ducting, Repair and Sealing	79.2	193.3	198.6	199.1
Faucet Aerators	10.1	25.6	26.4	26.5
Home Energy Display	41.1	89.5	91.0	91.0
Hot Water Saver	12.5	31.9	32.9	33.0
Insulation, Ceiling	18.5	49.1	51.0	51.1
Insulation, Foundation	0.7	5.0	5.5	5.5
Insulation, Wall Cavity	1.7	10.9	12.0	12.2
Occupancy Sensor	3.6	7.1	7.2	7.2
Pipe - Hot Water, Insulation	0.1	0.4	0.4	0.4
Pool, Pump Timer	34.3	73.9	74.9	74.9
Showerheads, Low-Flow	29.4	75.0	77.4	77.6
Thermostat, Clock/Programmable	12.7	29.3	29.9	30.0
Water Heater, Tank Blanket/Insulation	15.4	37.9	39.0	39.1
Water Heater, Thermostat Setback	18.9	43.2	44.0	44.0
Total	**280.0**	**688.3**	**709.5**	**711.5**

4.3 ENERGY EFFICIENCY POTENTIAL FOR THE COMMERCIAL SECTOR

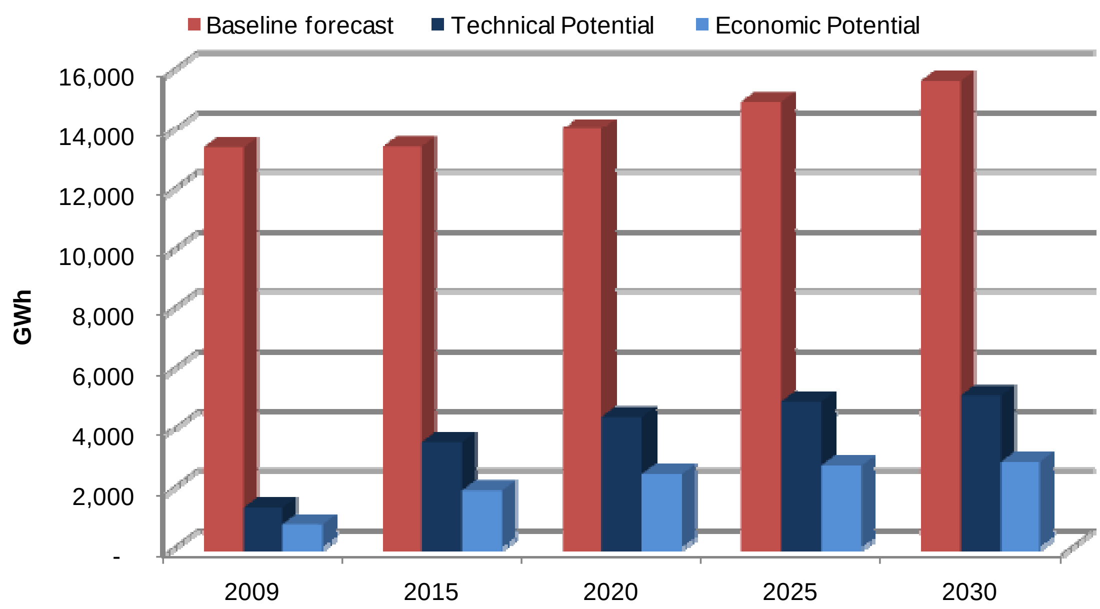
Table 4-7 presents estimates for the technical and economic potential for the commercial sector. Figure 4-5 depicts the potential estimates graphically. Key findings include:

- In 2020, technical potential is 4,385 GWh, which represents 31.3% of total usage in that year. In 2030, technical potential is 5,096 GWh, 32.6% of total usage.
- In 2020, economic potential is 2,441 GWh, which represents 17.4% of total usage in that year. In 2030, economic potential is 2,847 GWh, 18.2% of total usage.

Table 4-7 Energy Efficiency Potential for the Commercial Sector

	2009	2015	2020	2025	2030
Baseline Electricity Forecast (GWh)	13,364	13,397	14,001	14,917	15,615
Energy Savings (GWh)					
Technical Potential	1,333	3,503	4,385	4,893	5,096
Economic Potential	777	1,903	2,441	2,727	2,847
Energy Savings as % of Baseline					
Technical Potential	10.0%	26.1%	31.3%	32.8%	32.6%
Economic Potential	5.8%	14.2%	17.4%	18.3%	18.2%
Peak Demand Savings (MW)					
Technical Potential	355	959	1,210	1,403	1,467
Economic Potential	211	545	691	795	830

Figure 4-5 Commercial Energy Efficiency Potential



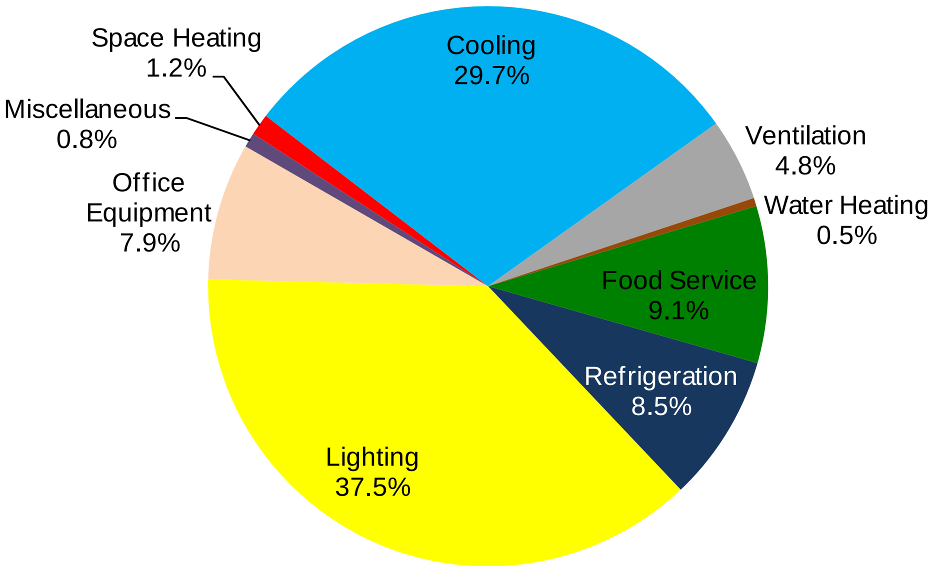
4.3.1 Commercial Potential Estimates by End Use

The commercial sector accounts for the second-largest share of savings potential throughout the forecast period. Table 4-8 presents estimates for economic and technical potential for the main uses isolated for this study. Unlike the residential sector, two end uses provide the majority of savings: lighting and cooling, as shown in Figure 4-6.

Table 4-8 Commercial Potential by End Use

		Savings (GWh)			
End Use	**Type**	**2009**	**2015**	**2020**	**2030**
Space Heating	Technical	31	80	91	97
	Economic	13	32	34	35
Cooling	Technical	325	926	1,187	1,510
	Economic	196	542	679	846
Ventilation	Technical	51	357	505	528
	Economic	14	95	132	136
Water Heating	Technical	12	41	60	77
	Economic	2	7	10	13
Food Service	Technical	17	140	241	273
	Economic	13	118	214	258
Refrigeration	Technical	21	124	206	322
	Economic	14	90	152	242
Lighting	Technical	735	1,393	1,579	1,633
	Economic	481	852	1,020	1,066
Office Equipment	Technical	139	425	490	626
	Economic	42	156	178	226
Miscellaneous	Technical	2	16	26	31
	Economic	2	12	20	24
Total	**Technical**	**1,333**	**3,503**	**4,385**	**5,096**
	Economic	**777**	**1,903**	**2,441**	**2,847**

Figure 4-6 End-use Shares of Commercial Sector Economic Potential in 2030



4.3.2 Commercial Sector Potential Estimates by Measure Type

Table 4-9 presents the economic-potential savings from replacement of major end-use equipment or purchase of new equipment in new construction. In the early forecast years, indoor screw-in lighting, which is currently dominated by standard incandescent lamps, accounts for over half the potential economic savings. In the later years of the forecast, indoor fluorescent lamp systems account for the largest savings among the equipment measures. There are also substantial savings possible in cooling equipment, particularly roof-top units.

Table 4-9 Commercial Economic Potential – Equipment Measures (GWh)

End Use	Technology	2009	2015	2020	2030
Space Heating	Heat Pump	0.3	2.4	3.9	4.9
Cooling	Central Chiller	4.4	23.3	43.9	78.6
	Heat Pump	0.3	2.9	4.6	5.7
	PTAC	0.5	3.1	5.7	7.9
	Roof Top Units	14.4	95.9	189.6	301.5
	Split System	1.5	14.0	23.7	39.5
Ventilation	Ventilation System	10.9	87.1	124.6	128.3
Water Heating	Central Water Heater	0.2	0.9	1.4	1.9
	Domestic Water Heater	1.4	4.7	7.1	10.6
Food Service	Broiler	0.1	0.9	1.5	1.6
	Dishwasher	0.2	3.0	5.8	7.6
	Food Prep	0.3	2.3	4.0	4.5
	Fryer	0.6	4.6	8.0	9.0
	Griddle	0.2	1.3	2.3	3.1
	Hot Food Container	1.6	19.6	44.0	62.9
	Oven	8.7	72.0	124.3	141.0
	Range	0.6	5.0	8.6	10.1
	Steamer	1.1	9.1	15.7	18.0
Refrigeration	Glass Door Display	0.0	0.2	0.3	0.8
	Icemaker	1.4	5.3	8.8	10.3
	Open Display Case	0.0	0.1	0.2	0.4
	Solid Door Refrigerator	0.8	7.0	12.6	21.3
	Vending Machine	0.6	4.9	7.9	9.2
	Walk in Refrigeration	7.7	64.6	114.4	192.1
Lighting	Indoor Fluorescent	49.6	296.0	460.9	488.5
	Indoor Screw-in	257.9	199.1	187.9	201.0
	Outdoor Fluorescent	4.2	21.3	31.7	32.1
	Outdoor Screw-in	30.5	16.7	13.2	17.4
Office Equipment	Desktop Computer	8.4	26.9	30.4	37.9
	Laptop Computer	0.9	3.3	4.0	5.4
	Monitor	10.9	34.6	39.0	48.3
	POS Terminal	0.3	1.2	1.4	1.9
	Printer/copier/fax	17.9	77.2	85.4	102.6
	Server	3.3	12.5	17.7	29.5
Miscellaneous	Laundry Equipment	0.0	0.3	0.6	0.8
	Non-HVAC Motor	0.4	2.5	4.2	5.7
	Pool Equipment	1.0	9.3	15.3	17.7
Total		**443.3**	**1,135.3**	**1,654.9**	**2,059.5**

Table 4-10 presents the economic potentials for other measures. Throughout the forecast horizon, the largest savings come from packaged air conditioner maintenance, energy management systems, delamping and reflector installation in fluorescent lamp systems, and lighting retrocommissioning.

Table 4-10 Commercial Economic Potential for Other Measures (GWh)

Other Measure	2009	2015	2020	2030
Advanced New Construction Designs	1.0	13.9	18.2	19.0
Air Conditioner - Packaged, Maintenance	39.6	110.9	114.9	115.1
Chilled Water, Reset	16.3	51.0	53.8	54.0
Chiller, VSD Centrifugal	15.3	52.3	56.6	57.2
Condenser Water, Temperature Reset	1.2	3.6	3.9	3.9
Controls, Anti-Sweat Heater	1.4	4.3	4.5	4.5
Controls, Floating Head Pressure	1.1	3.3	3.5	3.5
Daylighting Controls	7.4	26.7	29.2	29.5
Ducting, Repair and Sealing	0.7	1.8	1.8	1.8
Economizer, Installation	5.7	21.8	24.1	24.4
Energy Management System	22.5	88.5	98.0	99.2
Exhaust Hoods - Cooking, Sensor Control	2.0	7.3	7.9	8.0
Fans, Energy-Efficient Motors	0.8	1.8	1.9	1.9
Faucet Aerators and Low Flow Nozzles	0.1	0.3	0.3	0.3
Fluorescent, Delamp and Install Reflectors	38.4	120.3	126.6	127.0
Heat Pump - Air-Source, Maintenance	3.6	9.9	10.2	10.2
Hot Water, Reset	1.4	3.9	4.1	4.2
Hot Water, Variable-Flow System	0.2	0.7	0.7	0.7
Hotel Guestroom Controls (occupancy)	3.2	7.3	7.5	7.5
Insulation, Ceiling	8.0	23.9	24.9	24.9
Insulation, Wall Cavity	0.0	0.4	0.5	0.5
LEED Building Design	0.2	2.6	3.5	3.6
Light Colored Roof	7.5	19.6	20.2	20.2
Lighting Retrocommissioning	34.0	107.6	114.8	115.6
Occupancy Sensors	12.0	42.1	45.8	46.2
Photosensors, Outdoors	0.7	2.1	2.2	2.2
Pumps, Variable Speed Control	1.5	6.0	6.7	6.8
Radiant Barrier	0.6	1.6	1.7	1.7
Water Heater, Tank Blanket/Insulation	0.2	0.4	0.4	0.4
Water Heater, Thermostat Setback	0.1	0.3	0.3	0.3
Windows, High Efficiency	4.1	14.5	15.8	16.0
Total	**230.5**	**750.8**	**804.3**	**810.3**

4.4 ENERGY EFFICIENCY POTENTIAL FOR THE INDUSTRIAL SECTOR

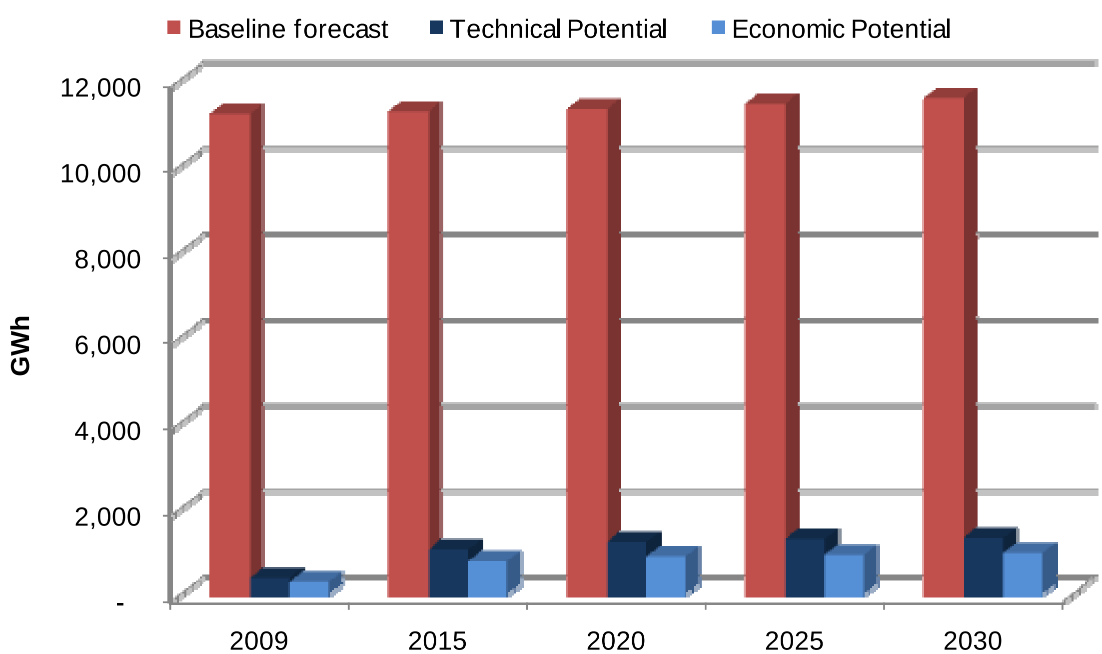
The industrial sector is the smallest of the three sectors in terms of the baseline forecast and potential savings. Table 4-11 presents estimates for technical and economic potential for the industrial sector. Figure 4-7 depicts the potential estimates graphically. Key findings include:

- In 2020, technical potential is 1,236 GWh, which represents 10.9% of total usage in that year. In 2030, technical potential is 1,325 GWh, 11.4% of total usage.
- In 2020, economic potential is 904 GWh, which represents 8.0% of total usage in that year. In 2030, economic potential is 986 GWh, 8.5% of total usage.

Table 4-11 Industrial Segment Energy Efficiency Potential

	2009	2015	2020	2025	2030
Baseline Electricity Forecast (GWh)	11,228	11,279	11,334	11,453	11,580
Energy Savings (GWh)					
Technical Potential	375	1,062	1,236	1,302	1,325
Economic Potential	284	797	904	946	986
Energy Savings as % of Baseline					
Technical Potential	3.3%	9.4%	10.9%	11.4%	11.4%
Economic Potential	2.5%	7.1%	8.0%	8.3%	8.5%
Peak Demand Savings (MW)					
Technical Potential	17	58	75	82	85
Economic Potential	14	44	53	58	63

Figure 4-7 Industrial Energy Efficiency Potential



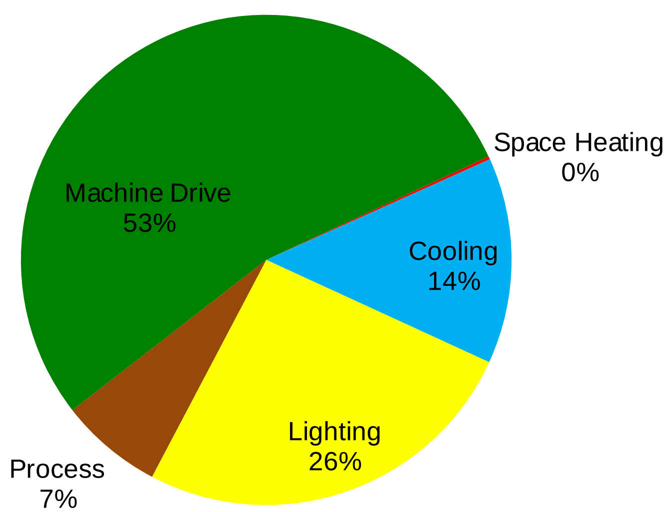
4.4.1 Industrial Potential Estimates by End Use

Table 4-12 presents industrial potential by type and end use. The share of economic potential in 2030 is presented in Figure 4-8. In the industrial sector, the story for baseline consumption and savings is dominated by machine drives. However, the absolute savings from motors is relatively small for two reasons. First, there are significant savings already embodied in the baseline forecast as a result of the NEMA standards that have been in place for many years and which will begin to require that premium-grade motors be installed in 2010. Second, industrial customers are savvy and have been able to successfully postpone motor replacement by rewinding existing motors. In addition to motors, there are significant savings opportunities in cooling, lighting and, to a lesser degree, electric processes.

Table 4-12 Industrial Potential by End Use

		Savings (GWh)			
End Use	**Type**	**2009**	**2015**	**2020**	**2030**
Space Heating	Technical	4	10	13	14
	Economic	1	1	2	2
Cooling	Technical	77	223	291	355
	Economic	26	63	75	134
Ventilation	Technical	2	14	21	21
	Economic	-	-	-	-
Lighting	Technical	153	334	335	338
	Economic	117	252	251	255
Process	Technical	25	65	67	67
	Economic	25	65	67	67
Machine Drive	Technical	114	416	509	528
	Economic	114	416	509	528
Total	**Technical**	**375**	**1,062**	**1,236**	**1,325**
	Economic	**284**	**797**	**904**	**986**

Figure 4-8 End-use Shares of Industrial Sector Economic Potential in 2030



4.4.2 Industrial Sector Potential Estimates by Measure Type

Table 4-13 presents estimates of economic potential for equipment measures in the industrial sector. As mentioned above, machine drives account for the majority of savings. Within the machine drive group, the largest savings are in the smaller motors-those less than 100 hp. This is a result of the fact that larger motors have been subject to stringent standards for many years.

Table 4-13 Industrial Economic Potential – Equipment Measures (GWh)

End Use	Technology	2009	2015	2020	2030
Cooling	Central Chiller	0.1	0.3	0.7	1.9
	Heat Pump	-	-	1.3	4.7
	PTAC	0.2	1.2	2.7	4.8
	RTU	-	-	-	39.1
	Split System	1.3	10.8	19.5	32.6
Lighting	Indoor Fluorescent	18.4	93.7	143.0	146.1
	Indoor Screw-in	82.9	128.1	79.5	79.7
	Outdoor Fluorescent	0.0	0.0	0.0	0.0
	Outdoor Screw-in	4.3	4.6	2.7	2.8
Machine Drive	Less than 5 HP	10.9	55.2	74.7	78.8
	5-24 HP	12.4	62.8	84.8	89.4
	25-99 HP	14.0	70.6	95.5	100.7
	100-249 HP	6.5	32.9	44.5	47.0
	250-499 HP	2.5	12.6	16.9	17.8
	500 or more HP	3.0	15.0	20.3	21.5
Total		**156.6**	**487.8**	**586.2**	**666.6**

Table 4-14 presents economic potential for other measures. A measure related to machine drives, Variable Frequency Drives, accounts for more than half the economic-potential savings throughout the forecast.

Table 4-14 Industrial Economic Potential for Other Measures (GWh)

Other Measure	2009	2015	2020	2030
Air Conditioner - Packaged, Maintenance	22.7	46.0	46.4	46.4
Daylighting Controls	11.5	25.7	26.2	26.3
Electrochemical Process, various efficiency improvements	8.4	21.7	22.5	22.5
Heat Pump - Air-Source, Maintenance	2.8	5.7	5.8	5.8
Machine Drive, Variable Frequency Drives	65.1	166.8	172.6	173.2
Process Cooling, various efficiency improvements	8.3	21.4	22.2	22.3
Process Heating, various efficiency improvements	8.3	21.5	22.3	22.4
Total	**127.1**	**308.8**	**318.0**	**319.0**

APPENDIX | A

ENERGY EFFICIENCY MEASURES

This appendix presents the list of measures that was included in the analysis. It also identifies the LoadMAP module ("equipment measures" or "other measures") to which each measure was assigned.

Residential Energy Efficiency Measures

Residential End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
Cooling	Air Conditioner - Central, Energy Star or better	Central AC	
Cooling	Air Conditioner, Proper Sizing of Equipment		Advanced New Construction Designs
Cooling	Natural Ventilation & Cooling		Advanced New Construction Designs
Cooling	Air Conditioner - Central, Maintenance		Air Conditioner - Central, Maintenance
Cooling	Attic Fan - Photovoltaic, Installation		Attic Fan - Photovoltaic, Installation
Cooling	Attic Fan, Installation		Attic Fan, Installation
Cooling	Ceiling Fan, Installation		Ceiling Fan, Installation
Cooling	Dehumidifier		Dehumidifier
Cooling	Whole-House Fan, Installation		Whole-House Fan, Installation
Cooling	Air Conditioner - Central, Ductless Variable Refrigerant Flow	Central AC	
Cooling	Air Conditioner - Room, Energy Star or better	Central AC	
Cooling	Air Conditioner - Central, maximum efficiency	Central AC	
Cooling	Air Conditioner - Room, Energy Star - Max efficiency	Room AC	
Heating	Passive Solar Heating		Advanced New Construction

Residential End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
			Designs
Heating / Cooling	Heat Pump - Central, Maintenance		Heat Pump - Central, Maintenance
Heating / Cooling	Heat Pump, Geothermal or Water Source	Heat Pump	
Heating / Cooling	Ductless, Mini-split A/C	Central AC	
Heating / Cooling	Heat Pump - Central, High Efficiency Air Source	Heat Pump	
Heating / Cooling	Heat Pump - Cold Climate Heat Pump	Heat Pump	
Heating / Cooling	Heat Pump - Room, High Efficiency Air Source	Heat Pump	
Heating / Cooling	Ducting, Insulation		Ducting, Insulation
Heating / Cooling	Ducting, Repair and Sealing		Ducting, Repair and Sealing
Heating / Cooling	Thermostat, Clock/Programmable		Thermostat, Clock/Programmable
Heating / Cooling	Doors, Storm and Thermal		Doors, Storm and Thermal
Heating / Cooling	External Shades or Overhangs/Fins		External Shades or Overhangs/Fins
Heating / Cooling	Infiltration Control (caulk, weather strip, etc.)		Infiltration Control (caulk, weather strip, etc.)
Heating / Cooling	Insulation, Ceiling		Insulation, Ceiling
Heating / Cooling	Insulation, Foundation		Insulation, Foundation
Heating / Cooling	Insulation, Wall Cavity		Insulation, Wall Cavity
Heating / Cooling	Insulation, Wall Sheathing		Insulation, Wall Sheathing
Heating / Cooling	Insulation, Ceiling + Radiant Barrier		Radiant Barrier
Heating / Cooling	Roofs, High Reflectivity		Roofs, High Reflectivity
Heating / Cooling	Windows, High Efficiency/Energy Star		Windows, High Efficiency/Energy Star
Heating / Cooling	Windows, High Efficiency/Energy Star - Max efficiency		Windows, High Efficiency/Energy Star - Max efficiency
Heating / Cooling	Windows, Install reflective film		Windows, Install reflective film
Heating / Cooling	Windows, Shading		Windows, Shading

Residential End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
Water Heating	Faucet Aerators		Faucet Aerators
Water Heating	Aerator		Faucet Aerators
Water Heating	Pipe - Hot Water, Insulation		Pipe - Hot Water, Insulation
Water Heating	Showerheads, Low-Flow		Showerheads, Low-Flow
Water Heating	Water Heater, Tank Blanket/Insulation		Water Heater, Tank Blanket/Insulation
Water Heating	Water Heater, Thermostat Setback		Water Heater, Thermostat Setback
Water Heating	Water Heater, Timer		Water Heater, Timer
Water Heating	Water Heating, Drain water Heat Recovery		Water Heating, Drain water Heat Recovery
Water Heating	Water Heating, Hot Water Saver		Water Heating, Hot Water Saver
Water Heating	Water Heater - Electric, High-Efficiency	Water Heating	
Water Heating	Water Heater, Heat Pump	Water Heating	
Water Heating	Water Heater, Ground-Source Heat Pump	Water Heating	
Water Heating	Water Heater - Electric, Tankless	Water Heating	
Water Heating	Solar Water Heating System	Water Heating	
Lighting	Day lighting		Advanced New Construction Designs
Lighting	Occupancy Sensor		Occupancy Sensor
Lighting	Outdoor Lighting - Photovoltaic, Installation		Outdoor Lighting - Photovoltaic, Installation
Lighting	Outdoor Lighting - Time clock Installation		Outdoor Lighting - Timeclock Installation
Lighting	Photo sensor Control - Lighting, Outdoor		Photo sensor Control - Lighting, Outdoor
Lighting	Compact Fluorescent Lamps	Screw-In	
Lighting	Compact Fluorescent Lamps, Outdoor	Outdoor Lighting	
Lighting	Fluorescent, T5 Lamps and Fixtures	Linear Fluorescents	
Lighting	Fluorescent, T8 Lamps and Fixtures	Linear Fluorescents	
Lighting	High Pressure Sodium Lamps,	Outdoor Lighting	

Residential End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
	Outdoor		
Lighting	Low Pressure Sodium Lamps, Outdoor	Outdoor Lighting	
Lighting	Metal Halide, Outdoor	Outdoor Lighting	
Lighting	Modular CFL, Pinned based	Screw-in	
Lighting	Fluorescent, Super T8 Lamps and Fixtures	Fluorescents	
Lighting	LED, White	Screw-in	
Lighting	LED, White - Outdoor	Screw-in	
Appliances	Home Electronics, Reduce Standby Wattage		Home Electronics, Reduce Standby Wattage
Appliances	Clothes Dryer - Electric, High Efficiency	Clothes Dryer	
Appliances	Clothes Washer, Energy Star or better	Clothes Washer	
Appliances	Clothes Washer, Horizontal Axis	Clothes Washer	
Appliances	Clothes Washer, Inverter-Drive	Clothes Washer	
Appliances	Combination Ovens	Cooking	
Appliances	Convection Oven - Electric, High Efficiency	Cooking	
Appliances	Dishwasher, Energy Star or better	Dishwasher	
Appliances	Freezer, Compact	Freezer	
Appliances	Freezer, Energy Star or better	Freezer	
Appliances	Home Electronics - Copier/Printer, Energy Star	Miscellaneous	
Appliances	Home Electronics - DVD/VCR/Audio, Energy Star	Miscellaneous	
Appliances	Home Electronics - Monitor, Energy Star	Electronics	
Appliances	Home Electronics - Personal Computer, Energy Star	Electronics	
Appliances	Home Electronics - Television, Energy Star	Electronics	
Appliances	Home Electronics - Television, CEE 2	Electronics	

Residential End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
Appliances	Induction Stovetop	Cooking	
Appliances	Range and Oven - Electric, Energy Star or better	Cooking	
Appliances	Refrigerator/Freezer, Energy Star or better	Refrigerator	
Appliances	Refrigerator/Freezer, Multiple Drawers	Refrigerator	
Appliances	Refrigerator/Freezer, Removal of secondary unit	Refrigerator	
Appliances	Refrigerator/Freezer, Energy Star (Advanced)	Refrigerator	
Appliances	Clothes Washer, Energy Star - Max Efficiency	Clothes Washer	
Appliances	Clothes Washer / Dryer, Combination - Max Efficiency	Clothes Washer	
Appliances	Combination Ovens - Max Efficiency	Cooking	
Appliances	Dishwasher, Energy Star - Max Efficiency	Dishwasher	
Appliances	Freezer, Energy Star - Max Efficiency	Freezer	
Appliances	Home Electronics - Copier/Printer, Energy Star - Max Efficiency	Miscellaneous	
Appliances	Home Electronics - DVD/VCR/Audio, Energy Star - Max Efficiency	Miscellaneous	
Appliances	Home Electronics - Monitor, Energy Star - Max Efficiency	Desktop Computer	
Appliances	Home Electronics - Personal Computer, Energy Star - Max Efficiency	Desktop Computer	
Appliances	Home Electronics - Television, Energy Star - Max Efficiency	TV	
Appliances	Range and Oven - Electric, Energy Star or better - Max Efficiency	Cooking	
Whole Building	Energy-Efficient		Advanced New Construction

Residential End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
	Manufactured Homes (New Construction)		Designs
Whole Building	Energy Star Homes (New Construction)		Advanced New Construction Designs
Whole Building	Passive Solar Design		Advanced New Construction Designs
Whole Building	Energy Star Homes (New Construction) - Max efficiency		Advanced New Construction Designs
Whole Building	Advanced New Construction Designs		Advanced New Construction Designs
Whole Building	Home Energy Management System		Home Energy Display
Misc	Pool, Pump Timer		Pool, Pump Timer
Misc	Pool, Solar Heating System	Pool Heater	
Misc	Pool, Efficient Pool Pumps	Pool Pumps	
Misc	Pool, Efficient Pool Pumps - Max efficiency	Pool Pumps	
Misc	Pool, Heating System	Pool Heater	

Commercial Energy Efficiency Measures

Commercial End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
Cooling	Air Conditioner - Packaged, High-Efficiency	RTU	
Cooling	Air Conditioner - Packaged, Ductless Variable Refrigerant Flow	RTU, Split System	
Cooling	Air Conditioner - Packaged, Maintenance		Air Conditioner - Packaged, Maintenance
Cooling	Air Conditioner - Room, Energy Star or Better	PTAC	
Cooling	Air Conditioner, Proper Sizing of Equipment		Advanced New Construction Designs
Cooling	Chilled Water, Reset		Chilled Water, Reset
Cooling	Chilled Water, Variable-Flow System	Central Chiller	
Cooling	Chiller - Air-Cooled, High-Efficiency	Central Chiller	
Cooling	Chiller - Water-Cooled, High-Efficiency	Central Chiller	
Cooling	Chiller, VSD Centrifugal		Chiller, VSD Centrifugal
Cooling	Cooling Tower, High-Efficiency Fans		Cooling Tower, High-Efficiency Fans
Cooling	Condenser Water, Temperature Reset		Condenser Water, Temperature Reset
Cooling	Economizer, Installation		Economizer, Installation
Cooling	Air Conditioner - Room, Energy Star or Better	Room AC	
Cooling	Chiller - Variable Refrigerant Flow	Central Chiller	
Cooling	Natural Ventilation & Cooling		Advanced New Construction Designs
Heating	Hot Water, Reset		Hot Water, Reset
Heating	Hot Water, Variable-Flow System		Hot Water, Variable-Flow System
Heating	Passive Solar Heating		Advanced New Construction Designs

Commercial End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
Heating	Radiant (Infrared) Heating System	Other Heating	
Heating / Cooling	Heat Pump - Air-Source, High-Efficiency	Heat Pump	
Heating / Cooling	Heat Pump - Cold Climate Heat Pump	Heat Pump	
Heating / Cooling	Heat Pump - Room, High Efficiency	PTAC	
Heating / Cooling	Heat Pump, Geothermal or Water Source	Heat Pump	
Heating / Cooling	Heat Pump - Air-Source, Maintenance		Heat Pump - Air-Source, Maintenance
Heating / Cooling	Ducting, Insulation		Ducting, Insulation
Heating / Cooling	Ducting, Repair and Sealing		Ducting, Repair and Sealing
Heating / Cooling	Energy Management System		Energy Management System
Heating / Cooling	Fans, Energy-Efficient Motors		Fans, Energy-Efficient Motors
Heating / Cooling	Fans, Variable Speed Control		Fans, Variable Speed Control
Heating / Cooling	HVAC Retrocommissioning		HVAC Retrocommissioning
Heating / Cooling	Pumps, High-Efficiency Motor		Pumps, High-Efficiency Motor
Heating / Cooling	Pumps, Variable Speed Control		Pumps, Variable Speed Control
Heating / Cooling	Thermostat, Clock/Programmable		Energy Management System
Heating / Cooling	Heat Recovery Make-Up Air Units		Heat Recovery Make-Up Air Units
Heating / Cooling	Variable Air-Volume Systems	Ventilation Systems	
Heating / Cooling	External Shades or Overhangs/Fins		External Shades or Overhangs/Fins
Heating / Cooling	Insulation, Ceiling		Insulation, Ceiling
Heating / Cooling	Radiant Barrier		Radiant Barrier
Heating / Cooling	Insulation, Wall Cavity		Insulation, Wall Cavity
Heating / Cooling	Windows, High Efficiency		Windows, High Efficiency
Water Heating	Faucet Aerators and Low Flow Nozzles		Faucet Aerators and Low Flow Nozzles
Water Heating	Pipe - Hot Water, Insulation		Pipe - Hot Water, Insulation
Water Heating	Water Heater -	Water Heater,	

Commercial End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
	Electric, High-Efficiency	Central & Domestic	
Water Heating	Water Heater - Electric, Tankless	Water Heater, Central & Domestic	
Water Heating	Water Heater, Heat Pump	Water Heater, Central & Domestic	
Water Heating	Water Heater, Ground-Source Heat Pump	Water Heater, Central & Domestic	
Water Heating	Water Heater, Tank Blanket/Insulation		Water Heater, Tank Blanket/Insulation
Water Heating	Water Heater, Thermostat Setback		Water Heater, Thermostat Setback
Water Heating	Water Heating, Hot Water Saver		Water Heating, Hot Water Saver
Water Heating	Water Heating, Hot Water Storage		Water Heating, Hot Water Storage
Water Heating	Solar Water Heating System	Water Heater, Central & Domestic	
Ventilation	Exhaust Hoods - Cooking, Sensor Control		Exhaust Hoods - Cooking, Sensor Control
Ventilation	Ventilation, CO2-Controlled		Ventilation, CO2-Controlled
Lighting	Compact Fluorescent Fixtures	Indoor Screw-in	
Lighting	Compact Fluorescent Lamps	Indoor Screw-in	
Lighting	Compact Fluorescent Lamps, Outdoor	Outdoor Screw-in	
Lighting	Day lighting Controls, Outdoors		Day lighting Controls
Lighting	Fluorescent, De-lamp and Install Reflectors		Fluorescent, De-lamp and Install Reflectors
Lighting	Fluorescent, High Bay Fixtures	Indoor Fluorescent	
Lighting	Fluorescent, T5 Lamps and Fixtures	Indoor Fluorescent	
Lighting	Fluorescent, T8 Lamps and Fixtures	Indoor Fluorescent	
Lighting	Fluorescent, Super T8 Lamps and Fixtures	Indoor Fluorescent	
Lighting	High-Pressure Sodium Lamps	Indoor Screw-in	
Lighting	LED Exit Lighting	Exit Signs	

Commercial End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
Lighting	Lighting Retro commissioning		Lighting Retro commissioning
Lighting	Low Pressure Sodium Lamps, Outdoor	Outdoor Screw-in	
Lighting	Metal Halide, Outdoor	Outdoor Screw-in	
Lighting	Metal Halide Lighting with Pulse Start	Outdoor Screw-in	
Lighting	Occupancy Sensors		Occupancy Sensors
Lighting	Outdoor Lighting - Photovoltaic, Installation (parking lots)		Outdoor Lighting - Photovoltaic, Installation (parking lots)
Lighting	Task Lighting		Task Lighting
Lighting	Time Clocks and Timers (lighting)		Time Clocks and Timers (lighting)
Lighting	Compact Fluorescent Lamps - Modular	Indoor Screw-in	
Lighting	LED, White	Indoor Screw-in	
Lighting	LED, White - Outdoor	Outdoor Screw-in	
Lighting	LED Traffic Lights	Not Included	
Lighting	Day lighting Designs for Interior Lighting		Advanced New Construction Designs
Lighting	Hotel Guestroom Controls (occupancy)		Occupancy Sensors
Office Equipment	Office Electronics - Copier/Printer, Energy Star	Printer/copier/fax	
Office Equipment	Office Electronics - Monitor, Energy Star	Monitor	
Office Equipment	Office Electronics - Personal Computer, Energy Star	Desktop Computer, Laptop Computer	
Office Equipment	Office Electronics - Server, Energy Star	Server	
Office Equipment	Office Electronics - Other Electronics, Energy Star	POS Terminal	
Office Equipment	Office Electronics - Copier/Printer, Max Efficiency	Copier/Printer, Max Efficiency	
Office Equipment	Office Electronics - Monitor, Max Efficiency	Monitor, Max Efficiency	

Commercial End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
Office Equipment	Office Electronics - Personal Computer, Max Efficiency	Personal Computer, Max Efficiency	
Office Equipment	Office Electronics - Server, Max Efficiency	Server, Max Efficiency	
Office Equipment	Office Electronics - Other Electronics, Max Efficiency		
Refrigeration	Compressor, High-Efficiency	Walk in Refrigeration	
Refrigeration	Compressor, Parallel Unequal	Walk in Refrigeration	
Refrigeration	Compressor, Multi-plex	Walk in Refrigeration	
Refrigeration	Controls, Anti-Sweat Heater		Controls, Anti-Sweat Heater
Refrigeration	Controls, Floating Head Pressure		Controls, Floating Head Pressure
Refrigeration	Glass Doors, Installation		Glass Doors, Installation
Refrigeration	Reach-In Coolers and Freezers	Solid Door Refrigerator, Glass Door Display	
Refrigeration	Icemaker, High Efficiency	Icemaker	
Whole Building	Passive Solar Design		Advanced New Construction Designs
Whole Building	Integrated Design Process for New Construction		Advanced New Construction Designs
Whole Building	LEED Building Design		Advanced New Construction Designs
Whole Building	Advanced New Construction Designs		Advanced New Construction Designs
Cooking	Cooking Equipment, Max Efficiency	Separated by Technology	
Cooking	Cooking Equipment, High Efficiency	Various Cooking Equipment	
Misc	Pool, Efficient Pool Pumps - Max efficiency	Pool Pumps	
Misc	Comprehensive Retro commissioning		HVAC Retro commissioning, Lighting Retrofit
Misc	Vending Machine, High Efficiency	Vending Machine	
Misc	Pool, Pump Timer		Pool, Pump Timer

Commercial End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
Misc	Pool, Solar Heating System	Pool Equipment	
Misc	Pool, Efficient Pool Pumps	Pool Equipment	

Industrial Energy Efficiency Measures

Industrial End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
Cooling	Air Conditioner - Packaged, High-Efficiency	RTU	
Cooling	Air Conditioner - Packaged, Ductless Variable Refrigerant Flow	RTU - Ductless VRF	
Cooling	Air Conditioner - Packaged, Maintenance		Air Conditioner - Packaged, Maintenance
Cooling	Air Conditioner - Room, Energy Star or Better	PTAC	
Cooling	Chilled Water, Reset		Chilled Water, Reset
Cooling	Chilled Water, Variable-Flow System		Pumps, Variable Speed Control
Cooling	Chiller - Air-Cooled, High-Efficiency	Central Chiller	
Cooling	Chiller - Water-Cooled, High-Efficiency	Central Chiller	
Cooling	Chiller, VSD Centrifugal		Chiller, VSD Centrifugal
Cooling	Cooling Tower, High-Efficiency Fans		Cooling Tower, High-Efficiency Fans
Cooling	Condenser Water, Temperature Reset		Condenser Water, Temperature Reset
Cooling	Economizer, Installation		Economizer, Installation
Heating	Hot Water, Reset		Hot Water, Reset
Heating	Hot Water, Variable-Flow System		Hot Water, Variable-Flow System
Heating / Cooling	Heat Pump - Air-Source, High-Efficiency	Heat Pump	
Heating / Cooling	Heat Pump - Cold Climate Heat Pump	Heat Pump	
Heating / Cooling	Heat Pump - Room, High Efficiency	Heat Pump	
Heating / Cooling	Heat Pump, Geothermal or Water Source	Heat Pump GSHP	
Heating / Cooling	External Shades or Overhangs/Fins		External Shades or Overhangs/Fins
Heating / Cooling	Ducting, Insulation		Ducting, Insulation
Heating / Cooling	Ducting, Repair and Sealing		Ducting, Repair and Sealing
Heating / Cooling	Energy Management System		Energy Management System
Heating / Cooling	Fans, Energy-Efficient Motors		Fans, Energy-Efficient Motors
Heating / Cooling	Fans, Variable Speed Control		Fans, Variable Speed Control
Heating / Cooling	HVAC Retro commissioning		HVAC Retro commissioning
Heating / Cooling	Pumps, High-Efficiency Motor		Pumps, High-Efficiency Motor

Industrial End Use	Energy Efficiency Measure	Equipment Measures	Other Measures
Heating / Cooling	Pumps, Variable Speed Control		Pumps, Variable Speed Control
Heating / Cooling	Thermostat, Clock/Programmable		Energy Management Systems
Heating / Cooling	Ventilation, CO2-Controlled		Ventilation, CO2-Controlled
Lighting	Day lighting Controls - Outdoors		Day lighting Controls - Outdoors
Lighting	T5/Electronic Ballasts	T5/Electronic Ballasts	
Lighting	T8/Electronic Ballasts	T8/Electronic Ballasts	
Lighting	High-Pressure Sodium Lamps	High-Intensity Discharge Lamps	
Lighting	LED Exit Lighting	LED Exit Lighting	
Lighting	Super T8 Fluorescent Lamps	Super T8 Fluorescent Lamps	
Lighting	Time Clocks and Timers (lighting)		Energy Management Systems
Lighting	LED Interior Lighting	LED Interior Lighting	
Lighting	LED Exterior Lighting	LED Exterior Lighting	
Motors	High-efficiency motors	Machine Motors	
Process cooling	Various generic efficiency improvements		Various generic efficiency improvements
Process heating	Various generic efficiency improvements		Various generic efficiency improvements

APPENDIX | B

PROTOTYPE DESCRIPTIONS

This appendix presents summary descriptions of the prototypes for the residential and commercial sectors.

Single Family Residence	Gas Heating		Electric Heating	
	Old	New	Old	New
Parameter				
# of Floors	1+basement	1+basement	1+basement	1+basement
Avg. Ceiling Height [ft]	8.5	8.5	8.5	8.5
Total Conditioned Floor Area [sqft]	2,028	2,506	1,892	2,112
First Floor Area [sqft]	2,028	2,506	1,892	2,112
Basement Fraction	1.00	1.00	1.00	1.00
Avg. Glass % of Wall Area	0.11	0.11	0.11	0.11
Avg. Glass % of Basement Wall Area	0.01	0.01	0.01	0.01
Glass Type	Double-clear	Double-clear	Double-clear	Double-clear
Window Frame Type	Wood	Vinyl	Wood	Vinyl
Wall Type	2x4Frame	2x6Frame	2x4Frame	2x6Frame
Wall Cavity Insulation (R Value)	7.5	19	7.5	19
Wall Sheathing Insulation (R Value)	0	0	0	0
Basement Wall Type	Frame	Frame	Frame	Frame
Basement Wall Cavity Insul. (R Value)	7	11	7	11
Crawlspace Wall Insulation (R Value)	0	0	0	0
Crawlspace Ceiling Insulation (R Value)	11	11	11	11
Roof Insulation (R Value)	25	30	25	30
Door R-Value	2	5	2	5
Lighting Density [W/sqft] (1460 hr/yr)*	1.15	1.05	1.15	1.05
Occupants	3	3	3	3
HVAC				
Cooling Type	Central	Central	Central	Central
Cooling EER	8.2	8.5	8.2	10
Heating Type	Gas-Furnace	Gas-Furnace	Electric-Furnace	Electric-Furnace
Heating Fuel	Natural Gas	Natural Gas	Electricity	Electricity
Heating AFUE [%]	0.75	0.78	0.75	0.78
HP HSPF	6.4	6.8	6.4	6.8
Domestic Hot Water Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.52	0.54	0.83	0.86
Infiltration [air changes per hour]	0.5	0.35	0.5	0.35
Heating Daytime Setpoint [°F]	69	69	70	70
Heat. Setback Setpoint [°F]	68	68	69	69
Cooling Daytime Setpoint [°F]	74	74	73	73
Cooling Setup Setpoint [°F]	73	73	73	73

Multi-Family Residence	**Gas Heating**		**Electric Heating**	
	Old	**New**	**Old**	**New**
Parameter				
# of Floors	1	1	1	1
Total Conditioned Floor Area [sqft]	1,445	1,683	1,357	1,563
Avg. Glass % of Wall Area	0.07	0.11	0.07	0.11
Glass Type	Double-Clear	Double-Clear	Single-Clear	Double-Clear
Window Frame Type	Wood	Vinyl	Wood	Vinyl
Wall Type	2x4Frame	2x6Frame	2x4Frame	2x6Frame
Wall Cavity Insulation (R Value)	11	19	11	19
Wall Sheathing Insulation (R Value)	0	0	0	0
Roof Insulation (R Value)	25	38	25	38
Door R-Value	2	5	2	5
Lighting Density [W/sqft] (1460 hr/yr)*	1.55	1.45	1.55	1.45
Occupants	2	2	2	2
HVAC				
Cooling Type	Central	Central	Central	Central
Cooling EER	8.2	8.5	8.2	10
Heating Type	Gas-Furnace	Gas-Furnace	Electric-Furnace	Electric-Furnace
Heating Fuel	Natural Gas	Natural Gas	Electricity	Electricity
Heating AFUE [%]	0.75	0.78	0.75	0.78
HP HSPF	6.4	6.8	6.4	6.8
Domestic Hot Water Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.52	0.54	0.83	0.86
Infiltration [air changes per hour]	0.5	0.35	0.5	0.35
Heating Daytime Setpoint [°F]	69	69	70	70
Heat. Setback Setpoint [°F]	68	68	70	70
Cooling Daytime Setpoint [°F]	74	74	73	73
Cooling Setup Setpoint [°F]	73	73	72	72

Office	Gas Heating Old	Gas Heating New	Electric Heating Old	Electric Heating New
Parameter				
# of Floors	2	2	2	2
Total Floor Area [sqft]	10,000	10,000	11,000	11,000
Office % of Floor Area	100%	100%	100%	100%
Glass Type	Single-Clear	Double-Clear	Single-Clear	Double-Clear
Wall Type	Brick	Brick	Brick	Brick
Wall Insulation (R Value)	9	11	9	11
Roof Insulation (R Value)	13	19	13	19
Core Lighting Density [W/sqft]	1.81	1.60	1.81	1.60
Perimeter Lighting Density [W/sqft]	1.81	1.60	1.81	1.60
Equipment Density [W/sqft]	1.11	1.04	1.11	1.04
Water Heating Fuel Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.76	0.78	0.96	0.98
HVAC				
Predominant System Type	Packaged	Packaged	Central	Packaged
Central & Packaged Systems				
Distribution Type	Constant Volume	VAV	Constant Volume	VAV
Fan Control	ConstVol	Damper	ConstVol	Damper
Economizer	NO	YES	NO	YES
Packaged Systems				
Heating Type	Furnace	Furnace	Furnace	Furnace
Heating Fuel	Gas	Gas	Electric	Electric
Heating Efficiency (burner eff)	0.75	0.80	0.75	0.80
Heating Efficiency (HP COP@47)	2.0	2.80	2.00	2.80
Cooling Type	ConstVol	VarVolTemp	ConstVol	VarVolTemp
Cooling Efficiency (EER)	8.50	8.9	8.5	8.9
Central Systems				
Cooling Type	Centrifugal	Centrifugal	Centrifugal	Centrifugal
Cooling Efficiency kW/ton	1.41	1.23	1.41	1.23
Cooling Tower	Air	Air	Air	Air
Cooling Tower Fan Control	Two-Speed	Two-Speed	Two-Speed	Two-Speed
Heating Type	Boiler	Boiler	ElectricReheat	ElectricReheat
Boiler Efficiency	0.75	0.80	0.75	0.80
Heating Daytime Setpoint [°F]	71	71	71	71
Heat. Setback/Setup Setpoint [°F]	67	67	67	67
Cooling Daytime Setpoint [°F]	72	72	72	72
Cool. Setback/Setup Setpoint [°F]	74	74	74	74
Boiler Control	Temp-Sched	Temp-Sched	Temp-Sched	Temp-Sched

Restaurant	Gas Heating Old	Gas Heating New	Electric Heating Old	Electric Heating New
Parameter				
# of Floors	1	1	1	1
Total Floor Area [sqft]	3,280	3,280	3,280	3,280
Kitchen % of Floor Area	25%	25%	25%	25%
Entry % of Floor Area	10%	10%	10%	10%
Restrooms % of Floor Area	5%	5%	5%	5%
Glass Type	Single-Clear	Double-Clear	Single-Clear	Double-Clear
Wall Type	Brick	Concrete	Brick	Concrete
Wall Insulation (R Value)	9	13	9	13
Roof Insulation (R Value)	13	19	13	19
Dining Lighting Density [W/sqft]	1.50	1.20	1.50	1.20
Kitchen Lighting Density [W/sqft]	2.00	1.60	2.00	1.60
Entry Lighting Density [W/sqft]	1.65	1.32	1.65	1.32
Restoom Lighting Density [W/sqft]	1.60	1.28	1.60	1.28
Kitchen Equip PD [W/sqft]	3.40	3.00	50.00	50.00
Kitchen Gas PD [kBTU/sqft]	0.5	0.5	0.0	0.0
Dining Plug PD [W/sqft]	0.50	0.44	0.50	0.44
Water Heating Fuel Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.76	0.76	0.96	0.96
HVAC				
Predominant System Type	Packaged	Packaged	Packaged	Packaged
Central & Packaged Systems				
Distribution Type	Constant Volume	Constant Volume	Constant Volume	Constant Volume
Fan Control	ConstVol	ConstVol	ConstVol	ConstVol
Economizer	NO	YES	NO	YES
Packaged Systems				
Heating Type	Furnace	Furnace	Furnace	Furnace
Heating Fuel	Gas	Gas	Electric	Electric
Heating Efficiency (burner eff)	0.75	0.80	0.75	0.80
Heating Efficiency (HP COP@47)	2.4	2.9	2.4	2.9
Cooling Type	ConstVol	ConstVol	ConstVol	ConstVol
Cooling Efficiency (EER)	8.0	9.0	8.0	9.0
Central Systems				
Cooling Type	Reciprocating	Reciprocating	Reciprocating	Reciprocating
Cooling Efficiency kW/ton	1.41	1.41	1.41	1.41
Cooling Tow er	Air	Air	Air	Air
Cooling Tow er Fan Control	Tw o-Speed	Tw o-Speed	Tw o-Speed	Tw o-Speed
Heating Type	Boiler	Boiler	ElectricReheat	Boiler
Boiler Efficiency	0.75	0.80	0.75	0.80
Thermostat setpoints				
Heating Daytime Setpoint [°F]	71	71	71	71
Heat. Setback/Setup Setpoint [°F]	67	67	67	67
Cooling Daytime Setpoint [°F]	73	73	73	73
Cool. Setback/Setup Setpoint [°F]	76	76	76	76
Boiler Control	Temp-Sched	Temp-Sched	Temp-Sched	Temp-Sched

Retail	Gas Heating		Electric Heating	
	Old	New	Old	New
Parameter				
# of Floors	1	1	1	1
Total Floor Area [sqft]	6,557	6,557	6,557	6,557
Showroom % of Floor Area	80%	80%	80%	80%
Storage % of Floor Area	20%	20%	20%	20%
Glass Type	Single-Clear	Double-Clear	Single-Clear	Double-Clear
Wall Type	Brick	Brick	Brick	Brick
Wall Insulation (R Value)	9	13	9	13
Roof Insulation (R Value)	13	19	13	19
Sales Lighting Density [W/sqft]	2.80	2.60	2.80	2.60
Storage Lighting Density [W/sqft]	0.65	0.55	0.65	0.55
Sales Equipment Density [W/sqft]	0.70	0.57	0.70	0.57
Storage Equipment Density [W/sqft]	0.20	0.16	0.20	0.16
Water Heating Fuel Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.76	0.78	0.96	0.98
HVAC				
System Type	Packaged	Packaged	Packaged	Packaged
Distribution Type	Constant Volume	VAV	Constant Volume	VAV
Fan Control	ConstVol	Damper	ConstVol	Damper
Economizer	NO	YES	NO	YES
Heating Type	Furnace	Furnace	Furnace	Furnace
Heating Fuel	Gas	Gas	Electric	Electric
Heating Efficiency (burner eff)	0.75	0.80	0.75	0.80
Heating Efficiency (HP COP@47)	2.00	2.80	2.00	2.80
Cooling Type	ConstVol	VarVolTemp	ConstVol	VarVolTemp
Cooling Efficiency (EER)	8.5	8.9	8.5	8.9
Heating Daytime Setpoint [°F]	70	70	70	70
Heat. Setback/Setup Setpoint [°F]	65	65	65	65
Cooling Daytime Setpoint [°F]	72	72	72	72
Cool. Setback/Setup Setpoint [°F]	75	75	75	75

Grocery Store	Gas Heating		Electric Heating	
	Old	New	Old	New
Parameter				
# of Floors	1	1	1	1
Total Floor Area [sqft]	15,506	15,506	15,506	15,506
Sales % of Floor Area	70%	70%	70%	70%
Storage % of Floor Area	15%	15%	15%	15%
Cashier % of Floor Area	10%	10%	10%	10%
Bakery % of Floor Area	3%	3%	3%	3%
Office % of Floor Area	2%	2%	2%	2%
Glass Type	Single-Clear	Double-Clear	Single-Clear	Double-Clear
Wall Type	Brick	Brick	Brick	Brick
Wall Insulation (R Value)	0	11	0	11
Roof Insulation (R Value)	11	19	11	19
Sales Lighting Density [W/sqft]	1.65	1.28	1.65	1.28
Storage Lighting Density [W/sqft]	1.02	0.80	1.02	0.80
Cashier Lighting Density [W/sqft]	1.32	1.10	1.32	1.10
Bakery Lighting Density [W/sqft]	1.20	1.00	1.20	1.00
Office Lighting Density [W/sqft]	1.50	1.20	1.50	1.20
Sales Equipment Density [W/sqft]	1.10	1.10	1.10	1.10
Storage Equipment Density [W/sqft]	0.90	0.90	0.90	0.90
Cashier Equipment Density [W/sqft]	1.80	1.80	1.80	1.80
Bakery Equipment Density [W/sqft]	5.00	5.00	25.00	25.00
Office Equipment Density [W/sqft]	1.10	1.10	1.10	1.10
Water Heating Fuel Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.76	0.78	0.96	0.98
HVAC				
Predominant System Type	Packaged	Packaged	Packaged	Packaged
Central & Packaged Systems				
Distribution Type				
Fan Control	ConstVol	ConstVol	ConstVol	ConstVol
Economizer	NO	YES	NO	YES
Packaged Systems				
Heating Type	Furnace	Furnace	Electric	Electric
Heating Fuel				
Heating Efficiency (burner eff)	0.75	0.75	0.75	0.75
Heating Efficiency (HP COP@47)	2.0	2.0	2.0	2.0
Cooling Type	ConstVol	ConstVol	ConstVol	ConstVol
Cooling Efficiency (EER)	8.0	10.0	8.0	10.0
Central Systems				
Cooling Type	Reciprocating	Reciprocating	Reciprocating	Reciprocating
Cooling Efficiency kW/ton	1.41	1.23	1.41	1.23
Cooling Tower	Air	Air	Air	Air
Cooling Tower Fan Control	Two-Speed	Two-Speed	Two-Speed	Two-Speed
Heating Type	Boiler	Boiler	ElectricReheat	ElectricReheat
Boiler Efficiency	0.75	0.80	0.75	0.75
Heating Daytime Setpoint [°F]	70	70	70	70
Heat. Setback/Setup Setpoint [°F]	70	70	70	70
Cooling Daytime Setpoint [°F]	71	71	71	71
Cool. Setback/Setup Setpoint [°F]	72	72	72	72
Boiler Control	Temp-Sched	Temp-Sched	Temp-Sched	Temp-Sched

Warehouse	Gas Heating		Electric Heating	
	Old	New	Old	New
Parameter				
# of Floors	1	1	1	1
Total Floor Area [sqft]	22,309	22,309	22,309	22,309
Showroom % of Floor Area	40%	40%	40%	40%
Office % of Floor Area	5%	5%	5%	5%
Storage % of Floor Area	55%	55%	55%	55%
Glass Type	Single-Clear	Double-Clear	Single-Clear	Double-Clear
Wall Type	Brick	Metal	Brick	Metal
Wall Insulation (R Value)	9	13	9	13
Roof Insulation (R Value)	13	19	13	19
Show room Lighting Density [W/sqft]	2.80	2.60	2.80	2.60
Office Lighting Density [W/sqft]	1.90	1.75	1.90	1.75
Storage Lighting Density [W/sqft]	0.65	0.55	0.65	0.55
Sales Equipment Density [W/sqft]	0.50	0.42	0.50	0.42
Office Equipment Density [W/sqft]	0.7	0.59	0.7	0.59
Storage Equipment Density [W/sqft]	0.14	0.12	0.14	0.12
Water Heating Fuel Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.76	0.78	0.96	0.98
HVAC				
Predominant System Type	Packaged	Packaged	Packaged	Packaged
Central & Packaged Systems				
Distribution Type	Constant Volume	VAV	Constant Volume	VAV
Fan Control	ConstVol	Damper	ConstVol	Damper
Economizer	NO	YES	NO	YES
Packaged Systems				
Heating Type	Furnace	Furnace	Electric	Electric
Heating Fuel	Gas	Gas	Electric	Electric
Heating Efficiency (burner eff)	0.75	0.80	0.75	0.80
Heating Efficiency (HP COP@47)	2.00	2.80	2.00	2.80
Cooling Type	ConstVol	ConstVol	ConstVol	ConstVol
Cooling Efficiency (EER)	8.50	8.90	8.50	8.90
Central Systems				
Cooling Type	Reciprocating	Reciprocating	Reciprocating	Reciprocating
Cooling Efficiency kW/ton	1.41	1.23	1.41	1.23
Cooling Tow er	Air	Air	Air	Air
Cooling Tow er Fan Control	Tw o-Speed	Tw o-Speed	Tw o-Speed	Tw o-Speed
Heating Type	Boiler	Boiler	ElectricReheat	ElectricReheat
Boiler Efficiency	0.75	0.80	0.75	0.80
Thermostat setpoints				
Heating Daytime Setpoint [°F]	69	69	69	69
Heat. Setback/Setup Setpoint [°F]	64	64	64	64
Cooling Daytime Setpoint [°F]	73	73	73	73
Cool. Setback/Setup Setpoint [°F]	76	76	76	76
Boiler Control	Temp-Sched	Temp-Sched	Temp-Sched	Temp-Sched

Education	Gas Heating Old	Gas Heating New	Electric Heating Old	Electric Heating New
Parameter				
# of Floors	2	2	2	2
Total Floor Area [sqft]	62,793	62,793	62,793	62,793
Classroom % of Floor Area	67%	67%	67%	67%
Admin. % of Floor Area	22%	22%	22%	22%
Cafeteria % of Floor Area	5%	5%	5%	5%
Library % of Floor Area	6%	6%	6%	6%
Glass Type	Single-Clear	Double-Clear	Single-Clear	Double-Clear
Wall Type	Brick	Brick	Brick	Brick
Wall Insulation (R Value)	9	13	9	13
Roof Insulation (R Value)	13	19	13	19
Classroom Lighting Density [W/sqft]	1.60	1.28	1.60	1.28
Admin. Lighting Density [W/sqft]	1.30	1.04	1.30	1.04
Cafeteria Lighting Density [W/sqft]	1.00	1.00	1.00	1.00
Library Lighting Density [W/sqft]	1.60	1.28	1.60	1.28
Classroom Equipment Density [W/sqft]	0.50	0.50	0.50	0.50
Admin. Equipment Density [W/sqft]	0.75	0.75	0.75	0.75
Cafeteria Equipment Density [W/sqft]	1.00	1.00	1.00	1.00
Library Equipment Density [W/sqft]	1.00	1.00	1.00	1.00
Water Heating Fuel Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.76	0.78	0.96	0.98
HVAC				
Predominant System Type	Packaged	Packaged	Packaged	Packaged
Central & Packaged Systems				
Distribution Type	Constant Volume	VAV	Constant Volume	VAV
Fan Control	ConstVol	Damper	ConstVol	Damper
Economizer	NO	YES	NO	YES
Packaged Systems				
Heating Type	Furnace	Furnace	Electric	Electric
Heating Fuel	Gas	Gas	Electric	Electric
Heating Efficiency (burner eff)	0.75	0.80	0.75	0.80
Heating Efficiency (HP COP@47)	2.00	2.80	2.00	2.80
Cooling Type	ConstVol	ConstVol	ConstVol	ConstVol
Cooling Efficiency (EER)	8.50	8.90	8.50	8.90
Central Systems				
Cooling Type	Reciprocating	Centrifugal	Reciprocating	Centrifugal
Cooling Efficiency kW/ton	1.41	1.23	1.41	1.23
Cooling Tower	Air	Air	Air	Air
Cooling Tower Fan Control	Two-Speed	Two-Speed	Two-Speed	Two-Speed
Heating Type	Boiler	Boiler	ElectricReheat	ElectricReheat
Boiler Efficiency	0.75	0.80	0.75	0.8
Thermostat setpoints				
Heating Daytime Setpoint [°F]	70	70.00	70	70
Heat. Setback/Setup Setpoint [°F]	66	66.00	66	66
Cooling Daytime Setpoint [°F]	72	72.00	72	72
Cool. Setback/Setup Setpoint [°F]	75	75.00	75	75
Boiler Control	Temp-Sched	Temp-Sched	Temp-Sched	Temp-Sched

Health	Gas Heating		Electric Heating	
	Old	New	Old	New
Parameter				
# of Floors	2	2	2	2
Total Floor Area [sqft]	18,623	18,623	18,623	18,623
Healthcare % of Floor Area	55%	55%	55%	55%
Lobby/Public % of Floor Area	25%	25%	25%	25%
Office % of Floor Area	10%	10%	10%	10%
ICU/Lab % of Floor Area	5%	5%	5%	5%
Kitc./Cafeteria % of Floor Area	5%	5%	5%	5%
Glass Type	Single-Clear	Double-Clear	Single-Clear	Double-Clear
Wall Type	Brick	Brick	Brick	Brick
Wall Insulation (R Value)	9	13	9	13
Roof Insulation (R Value)	13	19	13	19
Health Lighting Density [W/sqft]	2.40	2.20	2.40	2.20
Lobby Lighting Density [W/sqft]	1.80	1.44	1.80	1.44
Office Lighting Density [W/sqft]	1.90	1.75	1.90	1.75
ICU Lighting Density [W/sqft]	2.50	2.30	2.50	2.30
Kitchen Lighting Density [W/sqft]	2.00	1.60	2.00	1.60
Health Equipment Density [W/sqft]	1.00	1.00	1.00	1.00
Lobby Equipment Density [W/sqft]	0.50	0.47	0.50	0.47
Office Equipment Density [W/sqft]	1.60	1.49	1.60	1.49
ICU Equipment Density [W/sqft]	5.00	5.00	5.00	5.00
Kitchen Equipment Density [W/sqft]	3.50	3.00	24.00	3.00
Water Heating Fuel Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.76	0.78	0.96	0.98
HVAC				
Predominant System Type	Packaged	Central	Packaged	Central
Central & Packaged Systems				
Distribution Type	Constant Volume	VAV	Constant Volume	VAV
Fan Control	ConstVol	Damper	ConstVol	Damper
Economizer	NO	Yes	NO	YES
Packaged Systems				
Heating Type	Furnace	Furnace	Electric	Electric
Heating Fuel	Gas	Gas	Electric	Electric
Heating Efficiency (burner eff)	0.75	0.80	0.75	0.80
Heating Efficiency (HP COP@47)	2.00	2.80	2.00	2.80
Cooling Type	ConstVol	VarVolTemp	ConstVol	VarVolTemp
Cooling Efficiency (EER)	8.5	8.9	8.5	8.9
Central Systems				
Cooling Type	Reciprocating	Reciprocating	Reciprocating	Reciprocating
Cooling Efficiency kW/ton	1.41	1.23	1.41	1.23
Cooling Tower	Air	Air	Air	Air
Cooling Tower Fan Control	Two-Speed	Two-Speed	Two-Speed	Two-Speed
Heating Type	Boiler	Boiler	ElectricReheat	ElectricReheat
Boiler Efficiency	0.75	0.80	0.75	0.80
Heating Daytime Setpoint [°F]	71.00	71.00	71	71.00
Heat. Setback/Setup Setpoint [°F]	67.00	67.00	67	67.00
Cooling Daytime Setpoint [°F]	71.00	71.00	71	71.00
Cool. Setback/Setup Setpoint [°F]	74.00	74.00	74	74.00
Boiler Control	Temp-Sched	Temp-Sched	Temp-Sched	Temp-Sched

Lodging	Gas Heating Old	Gas Heating New	Electric Heating Old	Electric Heating New
Parameter				
Guestroom Total Floor Area [sqft]	120,339	120,339	120,339	120,339
Guestroom # of Floors	5	5	5	5
Guestroom % of GR Floor Area	95%	95%	95%	95%
Corridor % of GR Floor Area	5%	5%	5%	5%
Public Area Total Floor Area [sqft]	40000	40000	40000	40000
Public Area # of Floors	1	1	1	1
Lobby + Office % of Public Floor Area	60%	60%	60%	60%
Restaurant + Retail % of Public Floor Area	40%	40%	40%	40%
Glass Type	Double-Clear	Double-Clear	Double-Clear	Double-Clear
Wall Type	Concrete	Stucco	Concrete	Stucco
Wall Insulation (R Value)	9	13	9	13
Roof Insulation (R Value)	16	19	16	19
Guestroom Lighting Density [W/sqft]	1.40	0.80	1.40	0.80
Corridor Lighting Density [W/sqft]	1.20	1.00	1.20	1.00
Lobby + Office Lighting Density [W/sqft]	1.60	1.33	1.60	1.33
Restaurant + Retail Lighting Density [W/sqft]	1.65	1.44	1.65	1.44
Guestroom Equipment Density [W/sqft]	1.30	1.30	1.30	1.30
Corridor Equipment Density [W/sqft]	0.43	0.43	0.43	0.43
Lobby + Office Equipment Density [W/sqft]	1.05	1.05	1.05	1.05
Restaurant + Retail Equipment Density [W/sqft]	0.78	0.74	16.91	14.36
Water Heating Fuel Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.76	0.78	0.96	0.98
HVAC				
Predominant System Type	Central	Central	Central	Central
Central & Packaged Systems				
Distribution Type	Constant Volume	VAV	Constant Volume	VAV
Fan Control	ConstVol	Damper	ConstVol	Damper
Economizer	NO	YES	NO	YES
Packaged Systems				
Heating Type	Furnace	Furnace	Electric	Electric
Heating Fuel	Gas	Gas	Electric	Electric
Heating Efficiency (burner eff)	0.75	0.80	0.75	0.80
Heating Efficiency (HP COP@47)	2.4	2.8	2.4	2.8
Cooling Type	ConstVol	VarVolTemp	ConstVol	VarVolTemp
Cooling Efficiency (EER)	8.5	8.9	8.5	8.9
Central Systems				
Cooling Type	Centrifugal	Centrifugal	Centrifugal	Centrifugal
Cooling Efficiency kW/ton	0.85	0.75	0.85	0.75
Cooling Tower	Water	Water	Water	Water
Cooling Tower Fan Control	Two-Speed	Two-Speed	Two-Speed	Two-Speed
Heating Type	Boiler	Boiler	ElectricReheat	ElectricReheat
Boiler Efficiency	0.75	0.80	0.75	0.80
Thermostat setpoints				
Heating Daytime Setpoint [°F]	71	71	71	71
Heat. Setback/Setup Setpoint [°F]	71	71	71	71
Cooling Daytime Setpoint [°F]	71	71	71	71
Cool. Setback/Setup Setpoint [°F]	72	72	72	72
Boiler Control	Temp-Sched	Temp-Sched	Temp-Sched	Temp-Sched

Public Assembly	Gas Heating Old	Gas Heating New	Electric Heating Old	Electric Heating New
Parameter				
# of Floors	2	2	2	2
Total Floor Area [sqft]	16,505	16,505	16,505	16,505
Showroom % of Floor Area	80%	80%	80%	80%
Office % of Floor Area	5%	5%	5%	5%
Storage % of Floor Area	15%	15%	15%	15%
Glass Type	Single-Clear	Double-Clear	Single-Clear	Double-Clear
Wall Type	Brick	Metal	Brick	Metal
Wall Insulation (R Value)	9	13	9	13
Roof Insulation (R Value)	13	19	13	19
Sales Lighting Density [W/sqft]	2.80	2.60	2.80	2.60
Office Lighting Density [W/sqft]	1.90	1.75	1.90	1.75
Storage Lighting Density [W/sqft]	0.65	0.55	0.65	0.55
Sales Equipment Density [W/sqft]	0.50	0.42	0.50	0.42
Office Equipment Density [W/sqft]	0.7	0.59	0.7	0.59
Storage Equipment Density [W/sqft]	0.14	0.12	0.14	0.12
Water Heating Fuel Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.76	0.78	0.96	0.98
HVAC				
Predominant System Type	Packaged	Packaged	Packaged	Packaged
Central & Packaged Systems				
Distribution Type	Constant Volume	VAV	Constant Volume	VAV
Fan Control	ConstVol	Damper	ConstVol	Damper
Economizer	NO	YES	NO	YES
Packaged Systems				
Heating Type	Furnace	Furnace	Electric	Electric
Heating Fuel	Gas	Gas	Electric	Electric
Heating Efficiency (burner eff)	0.75	0.80	0.75	0.80
Heating Efficiency (HP COP@47)	2.00	2.80	2.00	2.80
Cooling Type	ConstVol	ConstVol	ConstVol	ConstVol
Cooling Efficiency (EER)	8.50	8.90	8.50	8.90
Central Systems				
Cooling Type	Reciprocating	Reciprocating	Reciprocating	Reciprocating
Cooling Efficiency kW/ton	1.41	1.23	1.41	1.23
Cooling Tower	Air	Air	Air	Air
Cooling Tower Fan Control	Two-Speed	Two-Speed	Two-Speed	Two-Speed
Heating Type	Boiler	Boiler	ElectricReheat	ElectricReheat
Boiler Efficiency	0.75	0.80	0.75	0.80
Thermostat setpoints				
Heating Daytime Setpoint [°F]	70	70	70	70
Heat. Setback/Setup Setpoint [°F]	65	65	65	65
Cooling Daytime Setpoint [°F]	72	72	72	72
Cool. Setback/Setup Setpoint [°F]	75	75	75	75
Boiler Control	Temp-Sched	Temp-Sched	Temp-Sched	Temp-Sched

Miscellaneous	**Gas Heating**		**Electric Heating**	
	Old	**New**	**Old**	**New**
Parameter				
# of Floors	1	1	1	1
Total Floor Area [sqft]	10,447	10,447	10,447	10,447
Office % of Floor Area	100%	100%	100%	100%
Glass Type	Single-Clear	Double-Clear	Single-Clear	Double-Clear
Wall Type	Metal	Metal	Metal	Metal
Wall Insulation (R Value)	9	13	9	13
Roof Insulation (R Value)	13	19	13	19
Core Lighting Density [W/sqft]	1.90	1.75	1.90	1.75
Perimeter Lighting Density [W/sqft]	1.90	1.75	1.90	1.75
Equipment Density [W/sqft]	1.69	1.48	1.69	1.48
Water Heating Fuel Type	Gas	Gas	Electric	Electric
Water Heater Energy Factor	0.76	0.78	0.96	0.98
HVAC				
Predominant System Type	Packaged	Packaged	Packaged	Packaged
Central & Packaged Systems				
Distribution Type	Constant Volume	VAV	Constant Volume	VAV
Fan Control	ConstVol	Damper	ConstVol	Damper
Economizer	NO	YES	NO	YES
Packaged Systems				
Heating Type	Furnace	Furnace	Electric	Electric
Heating Fuel	Gas	Gas	Electric	Electric
Heating Efficiency (burner eff)	0.75	0.80	0.75	0.80
Heating Efficiency (HP COP@47)	2.00	2.80	2.00	2.80
Cooling Type	ConstVol	VarVolTemp	ConstVol	VarVolTemp
Cooling Efficiency (EER)	8.5	8.9	8.5	8.9
Central Systems				
Cooling Type	Reciprocating	Reciprocating	Reciprocating	Reciprocating
Cooling Efficiency kW/ton	1.41	1.23	1.41	1.23
Cooling Tower	Air	Air	Air	Air
Cooling Tower Fan Control	Two-Speed	Two-Speed	Two-Speed	Two-Speed
Heating Type	Boiler	Boiler	ElectricReheat	ElectricReheat
Boiler Efficiency	0.75	0.80	0.75	0.80
Heating Daytime Setpoint [°F]	70	70	70	70
Heat. Setback/Setup Setpoint [°F]	66	66	66	66
Cooling Daytime Setpoint [°F]	72	72	72	72
Cool. Setback/Setup Setpoint [°F]	75	75	75	75
Boiler Control	Temp-Sched	Temp-Sched	Temp-Sched	Temp-Sched

APPENDIX C

MARKET PROFILES

This appendix presents the base year market profiles for the residential and commercial segments (2008).

Single Family Homes

Electric End Use	Technology	Fuel Share (% of HH)	UEC (ckWh/HH)	Intensity (kWh/HH)	Annual Use (MWh)
Space Heating	Heat Pump	4%	6,980	279	230,369
Space Heating	Electric Resistance	1%	7,671	77	63,291
Space Heating	Furnace	21%	7,978	1,675	1,382,282
Space Heating	Supplemental Heating	50%	349	175	143,980
Cooling	Central AC	88%	3,017	2,663	2,197,438
Cooling	Room AC	5%	2,492	121	99,730
Cooling	Heat Pump	4%	3,071	119	98,319
Water Heating	Water Heater	32%	2,625	840	693,061
Water Heating	Pool Heater	3%	2,300	69	56,930
Interior Lighting	Screw-in	89%	2,151	1,914	1,579,511
Interior Lighting	Linear Fluorescent	8%	421	34	27,788
Interior Lighting	Low Voltage	3%	1,794	54	44,405
Exterior Lighting	Outdoor Lighting	85%	604	513	423,592
Appliances	Refrigerator	100%	837	837	690,586
Appliances	Second Refrigerator	48%	1,245	598	493,063
Appliances	Freezer	49%	647	317	261,573
Appliances	Clothes Washer	98%	127	125	103,003
Appliances	Dishwasher	77%	84	65	53,366
Appliances	Clothes Dryer	75%	713	535	441,208
Appliances	Cooking	69%	440	304	250,492
Electronics	Desktop PC	49%	578	283	233,677
Electronics	Laptop Computer	51%	193	98	81,072
Electronics	Color TV	306%	220	673	555,439
Miscellaneous	Furnace Fan	61%	120	73	60,395
Miscellaneous	Pool Pump	11%	2,200	242	199,668
Miscellaneous	Miscellaneous	100%	1,999	1,999	1,649,320
Total				**14,682**	**12,113,558**

Multi-Family Homes

Electric End Use	Technology	Fuel Share (% of HH)	UEC (ckWh/HH)	Intensity (kWh/HH)	Annual Use (MWh)
Space Heating	Heat Pump	2%	1,973	39	8,347
Space Heating	Electric Resistance	4%	3,177	127	26,884
Space Heating	Furnace	40%	3,304	1,322	279,593
Space Heating	Supplemental Heating	36%	159	57	12,098
Cooling	Central AC	87%	1,380	1,205	254,872
Cooling	Room AC	8%	1,216	94	19,968
Cooling	Heat Pump	2%	1,380	27	5,664
Water Heating	Water Heater	42%	2,200	931	196,867
Water Heating	Pool Heater	0%	2,300		-
Interior Lighting	Screw-in	90%	1,036	932	197,248
Interior Lighting	Linear Fluorescent	7%	67	5	992
Interior Lighting	Low Voltage	3%	28	1	178
Exterior Lighting	Outdoor Lighting	52%	164	85	18,041
Appliances	Refrigerator	100%	837	837	177,066
Appliances	Second Refrigerator	13%	900	117	24,751
Appliances	Freezer	17%	647	110	23,268
Appliances	Clothes Washer	75%	62	46	9,811
Appliances	Dishwasher	75%	59	44	9,361
Appliances	Clothes Dryer	57%	548	312	66,079
Appliances	Cooking	71%	440	312	66,088
Electronics	Desktop PC	39%	578	225	47,687
Electronics	Laptop Computer	61%	193	118	24,863
Electronics	Color TV	209%	220	460	97,270
Miscellaneous	Furnace Fan	43%	65	28	5,913
Miscellaneous	Pool Pump	1%	2,200	22	4,654
Miscellaneous	Miscellaneous	100%	1,426	1,426	301,668
Total				**8,883**	**1,879,230**

All Commercial				
Electric End Use	**Saturation % of sq.ft.**	**EUI (ckWh/sq.ft.)**	**Intensity (kWh/sq.ft.)**	**Annual Use (MWh)**
Space Heating	16%	4.40	0.68	659,338
Cooling	93%	3.49	3.24	3,124,979
Ventilation	100%	1.20	1.20	1,157,613
Water Heating	21%	0.46	0.10	93,702
Lighting	100%	4.11	4.11	3,959,240
Office Equipment	86%	1.67	1.43	1,380,828
Refrigeration	92%	1.31	1.21	1,162,044
Food Service	34%	1.94	0.66	636,470
Miscellaneous	100%	1.04	1.04	1,003,584
Total			**13.67**	**13,177,798**
Offices				
Electric End Use	**Saturation % of sq.ft.**	**EUI (ckWh/sq.ft.)**	**Intensity (kWh/sq.ft.)**	**Annual Use (MWh)**
Space Heating	15%	9.19	1.37	235,289
Cooling	94%	5.28	4.96	854,226
Ventilation	100%	1.64	1.64	282,301
Water Heating	22%	0.29	0.06	10,860
Lighting	100%	6.60	6.60	1,136,634
Office Equipment	98%	4.93	4.83	832,762
Refrigeration	93%	0.18	0.17	29,184
Food Service	18%	1.31	0.24	41,774
Miscellaneous	100%	1.98	1.98	341,223
Total			**21.85**	**3,764,253**
Restaurants				
Electric End Use	**Saturation % of sq.ft.**	**EUI (ckWh/sq.ft.)**	**Intensity (kWh/sq.ft.)**	**Annual Use (MWh)**
Space Heating	18%	6.46	1.14	19,552
Cooling	96%	9.17	8.77	150,523
Ventilation	100%	2.63	2.63	45,178
Water Heating	23%	1.96	0.45	7,790
Lighting	100%	8.04	8.04	138,089
Office Equipment	77%	0.72	0.55	9,502
Refrigeration	84%	13.04	10.94	187,782
Food Service	83%	12.07	10.06	172,754
Miscellaneous	100%	3.08	3.08	52,970
Total			**45.66**	**784,140**

Retail				
Electric End Use	Saturation % of sq.ft.	EUI (ckWh/sq.ft.)	Intensity (kWh/sq.ft.)	Annual Use (MWh)
Space Heating	15%	3.38	0.51	58,362
Cooling	95%	4.61	4.40	499,196
Ventilation	100%	1.03	1.03	116,485
Water Heating	26%	0.48	0.12	13,928
Lighting	100%	4.16	4.16	472,332
Office Equipment	83%	0.79	0.65	74,085
Refrigeration	84%	0.32	0.27	30,424
Food Service	9%	1.50	0.14	15,409
Miscellaneous	100%	0.52	0.52	59,240
Total			**11.79**	**1,339,462**
Grocery				
Electric End Use	**Saturation % of sq.ft.**	**EUI (ckWh/sq.ft.)**	**Intensity (kWh/sq.ft.)**	**Annual Use (MWh)**
Space Heating	7%	9.95	0.65	12,906
Cooling	98%	10.53	10.33	204,220
Ventilation	100%	4.27	4.27	84,320
Water Heating	0%	-	-	-
Lighting	100%	10.66	10.66	210,759
Office Equipment	98%	0.55	0.54	10,667
Refrigeration	96%	29.82	28.51	563,654
Food Service	73%	14.89	10.93	216,010
Miscellaneous	100%	3.44	3.44	67,979
Total			**69.33**	**1,370,515**
Warehouse				
Electric End Use	**Saturation % of sq.ft.**	**EUI (ckWh/sq.ft.)**	**Intensity (kWh/sq.ft.)**	**Annual Use (MWh)**
Space Heating	16%	0.85	0.14	19,736
Cooling	86%	4.18	3.60	525,893
Ventilation	100%	0.53	0.53	77,447
Water Heating	30%	0.46	0.14	19,759
Lighting	100%	2.03	2.03	297,302
Office Equipment	66%	0.32	0.21	30,735
Refrigeration	83%	1.16	0.96	140,157
Food Service	17%	0.72	0.12	17,733
Miscellaneous	100%	0.30	0.30	43,410
Total			**8.02**	**1,172,172**

Education				
Electric End Use	Saturation % of sq.ft.	EUI (ckWh/sq.ft.)	Intensity (kWh/sq.ft.)	Annual Use (MWh)
Space Heating	9%	6.23	0.58	98,376
Cooling	84%	2.28	1.90	324,366
Ventilation	100%	0.89	0.89	152,338
Water Heating	27%	0.44	0.12	20,075
Lighting	100%	3.65	3.65	622,178
Office Equipment	93%	1.15	1.07	181,923
Refrigeration	100%	0.48	0.48	81,201
Food Service	84%	0.42	0.36	60,761
Miscellaneous	100%	0.37	0.37	63,857
Total			**9.41**	**1,605,075**
Health				
Electric End Use	Saturation % of sq.ft.	EUI (ckWh/sq.ft.)	Intensity (kWh/sq.ft.)	Annual Use (MWh)
Space Heating	9%	7.27	0.63	43,526
Cooling	98%	3.28	3.20	220,213
Ventilation	100%	2.81	2.81	193,735
Water Heating	12%	0.97	0.11	7,883
Lighting	100%	5.46	5.46	375,980
Office Equipment	98%	2.34	2.30	158,250
Refrigeration	100%	0.58	0.58	39,939
Food Service	23%	0.59	0.14	9,588
Miscellaneous	100%	3.96	3.96	273,154
Total			**19.19**	**1,322,269**
Lodging				
Electric End Use	Saturation % of sq.ft.	EUI (ckWh/ sq.ft.)	Intensity (kWh/ sq.ft.)	Annual Use (MWh)
Space Heating	63%	2.41	1.53	63,069
Cooling	100%	1.32	1.32	54,547
Ventilation	100%	0.82	0.82	33,864
Water Heating	5%	2.28	0.11	4,701
Lighting	100%	3.89	3.89	160,554
Office Equipment	100%	0.08	0.08	3,199
Refrigeration	100%	0.69	0.69	28,333
Food Service	89%	0.28	0.25	10,418
Miscellaneous	100%	0.57	0.57	23,380
Total			**9.26**	**382,065**

Public Assembly				
Electric End Use	**Saturation % of sq.ft.**	**EUI (ckWh/sq.ft.)**	**Intensity (kWh/sq.ft.)**	**Annual Use (MWh)**
Space Heating	22%	1.96	0.44	52,525
Cooling	88%	1.67	1.47	176,765
Ventilation	100%	1.16	1.16	139,625
Water Heating	39%	0.15	0.06	7,042
Lighting	100%	3.16	3.16	380,210
Office Equipment	75%	0.44	0.33	40,160
Refrigeration	96%	0.37	0.35	42,455
Food Service	37%	1.33	0.50	59,832
Miscellaneous	100%	0.37	0.37	44,366
Total			**7.83**	**942,978**

Miscellaneous				
Electric End Use	**Saturation % of sq.ft.**	**EUI (ckWh/sq.ft.)**	**Intensity (kWh/sq.ft.)**	**Annual Use (MWh)**
Space Heating	30%	2.54	0.75	43,993
Cooling	99%	1.54	1.53	89,601
Ventilation	100%	0.47	0.47	27,661
Water Heating	22%	0.08	0.02	1,070
Lighting	100%	2.23	2.23	130,100
Office Equipment	76%	0.67	0.51	29,744
Refrigeration	95%	0.30	0.28	16,583
Food Service	42%	1.09	0.45	26,545
Miscellaneous	100%	0.31	0.31	18,244
Total			**6.56**	**383,540**

Multi-family Common Area				
Electric End Use	**Saturation % of sq.ft.**	**EUI (ckWh/sq.ft.)**	**Intensity (kWh/sq.ft.)**	**Annual Use (MWh)**
Space Heating	40%	0.85	0.34	12,003
Cooling	87%	0.82	0.71	25,428
Ventilation	100%	0.13	0.13	4,658
Water Heating	18%	0.09	0.02	594
Lighting	100%	0.98	0.98	35,103
Office Equipment	50%	0.55	0.27	9,803
Refrigeration	100%	0.07	0.07	2,333
Food Service	12%	1.29	0.16	5,646
Miscellaneous	100%	0.44	0.44	15,762
Total			**3.11**	**111,329**

AmerenUE Demand Side Management (DSM) Market Potential Study Volume 4: Program Analysis

Global Report Number 1287-4

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CHAPTER 1

INTRODUCTION

AmerenUE engaged a team led by Global Energy Partners, LLC (Global) to perform a Demand Side Management (DSM) Market Potential Study to assess the various categories of electrical energy efficiency and demand response potential in the residential, commercial, and industrial sectors for the AmerenUE service area from 2009 to 2030. The study used updated forecasts of baseline energy use estimates based on the latest information on federal, state, and local codes and standards for improving energy efficiency.

AmerenUE will use the results of this study in its integrated resource planning process to analyze various levels of energy savings and peak demand reductions attributable to both energy efficiency and demand response initiatives at various levels of implementation cost.

This volume focuses on the achievable potential for energy efficiency (EE) and demand response (DR). It builds upon the characterization of AmerenUE's customer base and current energy-usage patterns, the baseline forecast and the estimates of economic potential, all described in Volume 3. The outcome of the analysis is a reference forecast of achievable potential for 2009 through 2030, as well as three alternative scenarios.

When achievable potentials are developed and projected out over a long time horizon, there tends to be a certain degree of uncertainty. Nevertheless the estimates must be reasonable, defensible and backed up with solid detail and citation. While uncertainty in the estimates cannot be fully eliminated, this study takes steps to carefully address that uncertainty by representing achievable potential from a variety of perspectives. Some of those perspectives represent adjustments to EE and DR program delivery that can be controlled by AmerenUE. Other perspectives represent adjustments to the EE and DR program delivery that occur regardless of AmerenUE's efforts to influence the markets for EE and DR measures.

This report is organized into the following chapters:

- *Chapter 2 – Program Analysis Framework* describes the framework that was used to represent EE and DR programs and to conduct the analysis of EE and DR program potential.
- *Chapter 3 – Energy Efficiency Programs* provides brief descriptions for each of the assumed EE programs considered in the analysis.
- *Chapter 4 – Demand Response Programs* provides an overview of the DR program development and brief descriptions for each of the assumed DR programs considered in the analysis.
- *Chapter 5 – Energy Efficiency Program Impacts* presents the results of the EE program analysis at the various achievable potential levels – maximum achievable potential (MAP), realistic achievable potential (RAP) and business-as-usual (BAU).
- *Chapter 6 – Demand Response Program Impacts* presents the results of the DR program analysis at all potential levels – technical, economic, MAP, RAP, and BAU.
- *Chapter 7 – Potential Supply Curves* provides a description of the analysis approach and presents results of the supply curve analysis for the EE and DR programs.
- *Chapter 8 – Scenario Analysis* provides a description of the analysis approach and presents results of the scenario analysis for the EE and DR programs.

A series of appendices provides details behind specific aspects of the analysis and results. They include:

- *Appendix A – EE Program Analysis Parameters* contains the detailed assumptions that drive the analysis of EE program impacts and cost-effectiveness.
- *Appendix B – DR Program Analysis Parameters* contains the detailed assumptions that drive the analysis of DR program impacts and cost-effectiveness.
- *Appendix C – EE Cost-Effectiveness Results* provide the detailed program-specific results of the cost-effectiveness analysis for each EE program level-BAU, RAP and MAP.
- *Appendix D – DR Cost-Effectiveness Results* provide the detailed program-specific results of the cost-effectiveness analysis for each DR program level-BAU, RAP and MAP.
- *Appendix E – Supply Curve Data* presents the summary data that supports the EE and DR supply curves at the various implementation levels (BAU, RAP and MAP).
- *Appendix F – Scenario Analysis Supply Curve Data* presents the summary data that supports the EE and DR scenario analysis supply curves.

CHAPTER 2

PROGRAM ANALYSIS FRAMEWORK

The approach taken for this study involves a stepwise process that first develops representative EE and DR programs. These assumed programs are based on the widely available information about best practices and trends in EE and DR program deployment from around the nation. Next is to establish achievable potential levels. The various levels represent different assumptions about AmerenUE's program implementation efforts. Three levels of achievable potential were assessed– business-as-usual, realistic achievable potential and maximum achievable potential. Each program is defined according to the associated parameters necessary to conduct detailed analyses of their viability – unit-level impacts, costs and numbers of participants. Next, an assessment of the economic viability for each of the EE and DR program levels (BAU, RAP and MAP) was conducted. This assessment included program-specific cost-effectiveness analyses using AmerenUE's avoided costs, discount rate assumptions and other economic parameters combined with the specific program parameters that were developed for this study. Next a series of supply curves were developed to illustrate the levels of savings that can be obtained for higher levels of cost. Finally, scenario analysis was conducted that considered a series of "what-ifs" in order to determine the effect of each scenario on the portfolio of EE and DR programs considered in this study.

2.1 PROGRAM DEVELOPMENT

AmerenUE has begun to develop and implement a variety of EE and DR programs as part of its 2008 Integrated Resource Plan (IRP). The various delivery methods and approaches were designed in a traditional manner, tapping the best available information about what other utilities are doing with regard to EE and DR implementation and essentially replicating those efforts.

To inform the upcoming 2011 IRP planning cycle, this Study aims to improve on the previous plans and assumptions, considering a number of major issues that are listed below:

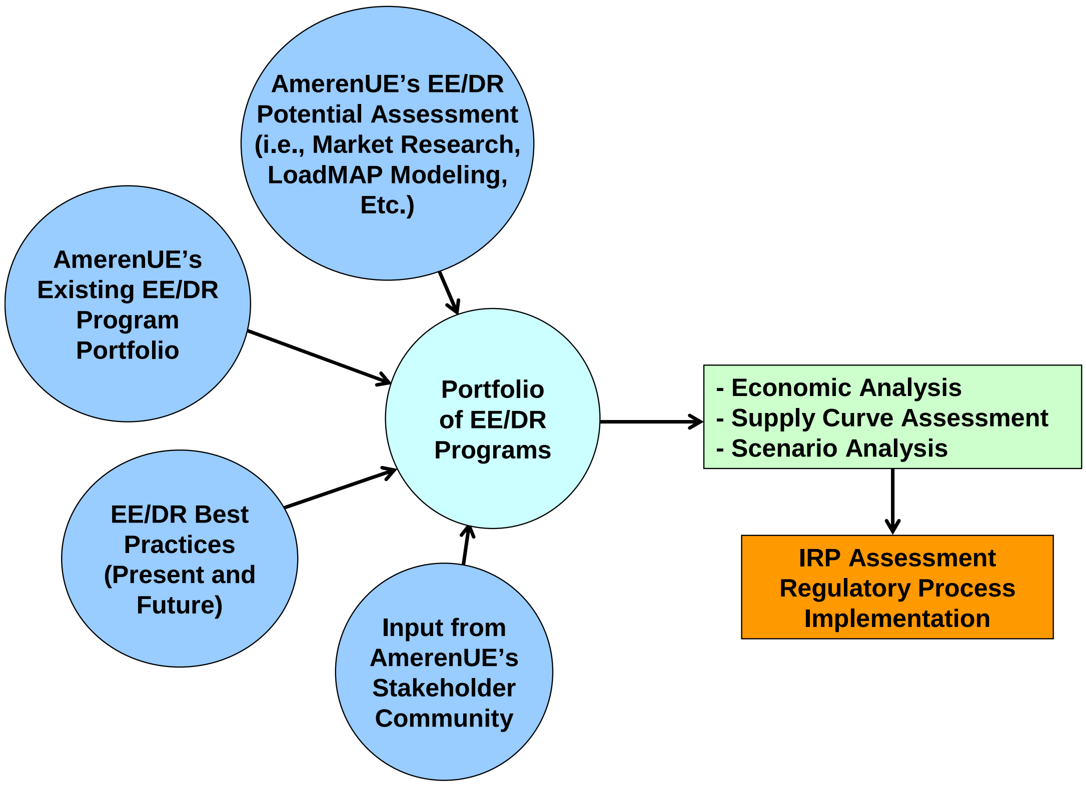
- Are demand side and supply side resources being considered on an equivalent basis in the Resource Planning process, including energy impacts and delivery costs?
- What is the realistic achievable potential for energy efficiency over the short- and long-term time horizons?
- What are the national best practices for EE and DR programs today?
- How might today's EE and DR programs be enhanced or modified to accommodate new technologies and cutting edge marketing approaches?
- To what degree will AmerenUE customers be willing to participate in EE and DR programs?
- Will customers be satisfied with the EE and DR program offerings and are all customer segments appropriately represented?

2.1.1 Program Development Process

The process of developing the EE and DR programs assumed for this study involved an assessment process that is illustrated in Figure 2-1. The figure depicts the sources of information that were used to guide the development of a portfolio of representative EE and DR programs that could then serve as the basis for a variety of detailed analyses, including cost-effectiveness analysis, supply curve assessment and scenario analysis. The results of these various analytics will serve as the inputs necessary for AmerenUE to conduct its upcoming IRP assessment, work through the Missouri regulatory process and begin the process of implementation.

As indicated in the figure, several important information sources were evaluated during the process of formulating the representative EE/DR portfolio. First, this effort relied extensively on the EE and DR potential assessments conducted as part of this study. The magnitude of AmerenUE's technical and economic potential savings fed directly into the program development process. For each segment, end-use market and technology, there was a detailed review of the amount of technical and economic potential with an eye toward how much of that potential might be obtained through programs. Market research informed the description of the current AmerenUE market (particularly customer preferences for various programs and technology types); the LoadMAP^{TM} modeling indicated which technologies would be cost-effective and thus viable for programs.[1] The results of the economic potential ultimately led the program development resources toward those segments and end-use markets that appeared to provide the greatest level of cost-effective savings.

Figure 2-1 Process for Developing EE Programs



Second, this study drew upon the experience and insights gleaned from AmerenUE's existing EE and DR program portfolios. The program mix is based on the 2008 IRP, which represents a solid, comprehensive approach to capturing EE and DR resources, with delivery potential for most markets and end-use segments in the AmerenUE service territory.

Third, the knowledge and experience from industry EE and DR best practices played a significant role in the program development process. Many current and past programs offered by utilities and other third-party implementation entities from across the nation offer a glimpse into how these current practices can best be modified and transferred to conditions specific to the characteristics of the AmerenUE service territory now and into the future. While it is difficult to speculate as to whether those practices will be applicable many years into the future, it was

[1] LoadMAP is a tool which provides forecasts of baseline energy usage and EE/DR potentials for a given set of EE and DR measures and/or programs. LoadMAP was utilized extensively for the programs analysis, as well as the assessment of EE technical and economic potentials described in Volume 3 of this study. LoadMAP was also used as the basis for assessing the DR program impacts (technical, economic, and achievable) described in Chapter 5 of this report.

nevertheless appropriate to glean various trends and insights about program design practices such that EE and DR programs in the latter stages of the planning horizon (e.g., 10-20 years) might be modified and adjusted to accommodate the inevitable changes in the marketplace. For example, this study considers a variety of EE measures that normally would not be included in a study with a short time horizon because they are not deemed cost effective during the early time periods. These measures are introduced into the various EE programs when they become cost-effective. While best practices cannot give us insights about significantly different program designs in the future, the fact that many of the same program designs considered for this study have been in place for many years suggests that they can be modified to accommodate the new measures as they become cost-effective.

Fourth, over the course of developing this Plan, AmerenUE held a number of meetings with key stakeholders in the IRP implementation process. The stakeholders represent a broad constituency of interested parties. The stakeholders provided valuable insights into the various programs and measures that could be implemented as part of this study.

2.1.2 Portfolio of EE and DR Programs

The resulting portfolio of EE and DR programs covers a broad range of energy-efficiency options and delivery mechanisms, including informational campaigns, market transformation initiatives, prescriptive approaches, customized approaches, onsite diagnostics, energy audits, appliance recycling initiatives, and retro-commissioning. Table 2-1 presents a summary of the thirteen EE programs included in this assessment. Table 2-2 presents a summary of the seven DR programs included in this assessment.

Table 2-1 Energy Efficiency Programs

Energy Efficiency Program	Target Market Segment(s)
1. Residential Lighting and Appliances	All residential customers
2. Multi-Family Common Area	Owners and property managers of multi-family buildings
3. Residential New Construction	Single-family new constructions
4. Residential HVAC Equipment & Diagnostics	Single-family home customers
5. Residential Energy Performance	Single-family home customers
6. Residential Low Income	Low-income residential customers
7. Residential Appliance Recycling	All residential customers
8. Residential Information/Feedback	All residential customers
9. C&I Standard Incentives	All C&I customers
10. C&I Custom Incentives	All C&I customers
11. C&I New Construction	C&I new constructions
12. C&I Retro-Commissioning	All C&I customers
13. C&I Information/Feedback	All C&I customers

Table 2-2 Demand Response Programs

Demand Response Program	Target Market Segment(s)
1. Residential Direct Load Control	All residential customers with air conditioning and electric water heating
2. Residential Dynamic Pricing	All residential customers
3. C&I Direct Load Control	All small-sized C&I customers (Rate 2M)
4. C&I Dynamic Pricing	All C&I customers (Rates 2M, 3M, 4M and 11M)
5. Demand Bidding	All medium- and large-sized C&I customers (Rates 3M, 4M and 11M)
6. Curtailable	All large-sized C&I customers (Rates 4M and 11M)
7. DR Aggregator Contracts	All C&I customers (Rates 2M, 3M, 4M and 11M)

These programs have the following broad objectives:

- Increase consumers' awareness of the breadth of energy-efficiency and demand reduction opportunities in their homes or facilities;
- Make significant contribution to AmerenUE's energy saving and demand reduction goals;
- Strengthen customer trust in AmerenUE as their partner in saving energy;
- Produce a permanent improvement in "standard" design practices among building designers and owners that will continue without the need for short-term incentives; and
- Design flexibility to accommodate market changes, new cost-effective EE measures that are not yet commercially available but will likely become available during the 20-year time horizon, and new and as-yet untested program delivery approaches.

Each of the 13 EE programs is briefly described in Chapter 3. Each of the seven DR programs is briefly described in Chapter 4.

2.2 LEVELS OF ACHIEVABLE POTENTIAL

Three levels of achievable potential were considered for this study. These levels comport with the terminology commonly used in the industry for potentials studies. Developing different levels of achievable potential also serves to bound the uncertainty associated with the estimates of potential, particularly over a longer forecast horizon. The three levels of achievable potential are business-as-usual (BAU), realistic achievable potential (RAP) and maximum achievable potential (MAP). Each is described below:

- Business-as-usual (BAU): This level represents AmerenUE's existing portfolio of EE and DR programs from the 2008 IRP and their associated impacts and costs. Thus, it is a reference point, and does not actually use the new baselines, potentials, and program assumptions developed for this study. Furthermore, it is based on forecasts of load growth, avoided costs, measure data, and discount rates that have been updated since the last IRP. For this analysis, impacts without alteration were included in the savings and cost-effectiveness assessments to represent a benchmark of what is anticipated under current practices.[2]
- Realistic Achievable Potential (RAP): This level represents what we consider to be realistic estimates of EE and DR potential based on realistic parameters associated with DR and EE program implementation (i.e., limited budgets, customer acceptance barriers, etc.). RAP is of most interest for this study since it represents the midpoint of BAU and MAP and thus would appear to be the most reasonable achievable potential estimate that most closely corresponds to best practices that are attainable since we tie the estimates to known program experience from around the country.
- Maximum achievable potential (MAP): This level takes into account the highest expected program participation based on customer preferences resulting from ideal implementation conditions. MAP involves incentives that represent an optimal subsidy of the incremental cost, often most or all of it, combined with high administrative and marketing costs. It is commonly-accepted in the industry that MAP is considered the hypothetical upper-boundary of savings potential simply because it presumes conditions that are ideal and not typically grounded in real-world experience.

The overall approach used for developing the RAP and MAP estimates drew extensively on the LoadMAP modeling framework. This framework (described in Volume 3 of this study for EE measures) established the parameters associated with the EE and DR measure savings, measure costs, and measure-level participation rates. Volume 3 presents the results for technical potential and economic potential; economic potential results were the starting point for estimation of MAP and RAP as described below.

[2] Note that it was necessary in this assessment to project savings and costs for the BAU for three additional years (2028-2030) since the IRP assessment only went as far as 2027. Savings for those three years were extended without additional growth. Costs for those three years were extended reflecting growth only due to inflation.

2.2.1 Estimation of MAP and RAP

Measure-level estimates of economic potential provide the starting point for the development of MAP and RAP. Estimates of MAP are developed first. Subsequently RAP is estimated. Each is described below.

To estimate MAP, a set of market acceptance rates (MARs) are applied to economic potential at the measure level. MARs were developed using the program-interest research and the resulting simulator presented in Volume 2. For each program option explored in the program interest research, a take rate was estimated at three payback levels: 1-year payback, 3-year payback and 5-year payback. These take rates represent full awareness of the program by the survey participants. To represent a high level of incentives that are assumed under MAP, the take rates for one-year payback were used. Then, to account for the ramping up and refinement of AmerenUE programs in the future, the take rates are assumed to increase by 1% in each year in absolute terms.

For example, the take rate for central AC in single-family homes at a one-year payback is 43%. This was used directly as the market acceptance rate for the entire forecast horizon in the first program year. In each future year, the MAR was increased by 1% and by 2030 it reaches 63%. MAP in each year is calculated as the MAR for that year multiplied by the economic potential in that year.

To estimate RAP, two additional factors are introduced into the analysis.

- First, awareness is not assumed to be 100%. AmerenUE is just beginning to offer a number of its energy efficiency programs, so awareness of these programs across the entire population is low. To address this, an assumption was made that awareness would be ramped up over an eight-year period. It starts at 25% in 2010 and ramps up to 85% by 2019.
- Second, AmerenUE is not likely to offer incentives across all programs that will result in a one-year payback as doing so would lead to substantial budgetary requirements that would cause significant regulatory disruption. So, the take rates at the three-year payback level were considered the most reasonable and realistic representation for generating estimates of RAP.

When these two additional factors are applied to the central AC example, RAP in 2010 is 8.3% of economic potential. In 2030, it reaches 41.1% of economic potential.

This approach was applied to each energy-efficiency measure included in the analysis. It was also applied to the direct load control demand response programs where we had program interest reseraach data to support the analysis.[3] The take rate for each measure was developed using a mapping of specific energy-efficiency measures to each of the energy efficiency programs profiled in the analysis.

2.3 DEVELOPING PROGRAM ANALYSIS PARAMETERS

The assessment of EE and DR program impacts and cost-effectiveness required definition of the wide-variety of input parameters:

- Measure-level impacts (derived from LoadMAP)
  - Energy savings
  - Demand reductions
- Measure-level incremental costs
- Measure lifetime
- Number of participants (derived from LoadMAP)

[3] For estimating market acceptance for the other DR programs, we relied on secondary data sources as detailed in Chapter 6 of this report.

- Measure incentives (based on application of best practices)
- Program implementation and administration costs (based on application of best practices)

The following sections describe the framework used to define these parameters. Detailed parameters for each of the 13 EE programs are provided in Appendix A. Detailed parameters for each of the seven DR programs are provided in Appendix B.

2.3.1 Measure-Level Impacts

The measure-level energy savings, demand savings, incremental costs, and useful life inputs for each of the programs are primarily based on the same information used to conduct the measure-level economic screen in the LoadMAP model (see Volume 3). There are a several instances, however, where it was not possible or appropriate to use the previous information. Examples of these instances are the appliance removal measures in the Residential Appliance Recycling Program and some of customized measures in the C&I Custom Incentives Program. Also, all of the DR programs could not be assessed in the LoadMAP framework since their impacts and costs are more broadly defined at a programmatic level. In these cases, Global relied on one of the following resources to determine the measure-level energy savings, demand savings, and costs:

- Database of Energy Efficiency Measures (DEEM) for the Midwest region.[4]
- Data on program impacts and costs for DR programs and measures from recent national studies of DR potential including EPRI National Potential Study and FERC DR Potential study.
- Information available from AmerenUE's previous Integrated Resource Plan (2009-2011).
- Engineering calculations and BEST simulations conducted as part of this study.[5]

2.3.2 Number of Participants

The number of participants in each of the programs is primarily based on the LoadMAP model's results from the measure-level MAP and RAP analyses. For each measure passing the economic screen, the LoadMAP model outputs were post-processed to determine the number of residential dwellings or C&I customer facilities that will adopt the measure in each year of the forecast horizon (2009-2030). Once the number of participants for each measure was obtained, the number of participants was linked to each program according to the measures offered in the program.[6]

Similar to the measure-level savings and costs, there were a few instances where the LoadMAP model did not specifically address a particular measure. In these cases, one of the following resources was used to determine the number of participants for the measure:

- Benchmark experience with designing similar EE and DR programs in other regions of the country.
- Trends and patterns identified in the Program Interest surveys
- Information available from AmerenUE's previous Integrated Resource Plan (2009-2011).

2.3.3 Measure Incentives

Incentive levels were assigned to each measure based on Global's previous experience in the design of similar programs in other regions of the country. In addition, a benchmark assessment was conducted by reviewing incentive levels offered by other utilities for similar measures as well

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[4] DEEM is a tool developed and maintained by Global; a complete description of DEEM can be found in Volume 3 of this study.

[5] BEST is a tool developed and maintained by Global; a complete description of BEST can be found in Volume 3 of this study.

[6] It should be noted that as measure lifetimes came to an end, program participants were dropped off the programs. This assumption results in RAP and MAP estimates showing declining rates of growth over time. This assumption was made to accommodate the fact that EE programs should not take credit for the savings unless the cost of the measure is re-burdened at the time that it is replaced. We did not feel that it was appropriate to conclude that these EE programs would necessarily be in place indefinitely. At some point, the market is transformed and customers are re-adopting replacement measures at a level of efficiency that is at least as good as the measure it was replacing.

as information available from AmerenUE's previous Integrated Resource Plan. The incentives are usually expressed as a percentage of the measure's incremental costs. These percentages vary depending on the level (RAP vs. MAP), and are generally tied to the customer payback criteria established as part of the market research efforts for this study. The actual incentive assumptions vary for each program. Detailed incentive levels for each individual program can be found in Appendix A.

2.3.4 Implementation and Administration Costs

The implementation and administration costs for each program were estimated using Global's previous experience in the design of similar programs in other regions of the country. The following specific cost components were identified:

- Program implementation: this cost component includes any implementation support by outside contractors and was usually estimated using a cost matrix based on dollars per kWh energy savings;
- Program evaluation: this cost component was estimated by taking a percentage of the total program costs (including incentives);
- AmerenUE internal labor: this accounts for the cost of administering the program and was estimated by assigning an all-in labor cost of $100,000 per year for one full-time employee (FTE)

Detailed implementation and administration costs for each individual program can be found in Appendix A.

2.4 COST-EFFECTIVENESS ANALYSIS

The EE and DR programs were assessed for cost-effectiveness drawing upon the California Standard Practice protocol for DSM economic assessment. For the purposes of this study, four economic test perspectives from the protocol were applied. Each is defined below:

- **The Total Resource Cost (TRC**) test measures benefits and costs from the perspective of the utility and society as a whole. The benefits are the net present value of the energy and capacity saved by the measures. The costs are the net present value of all costs to implement those measures. Since AmerenUE's customers are taken as a whole, changes in the dollar amounts that flow between them (transfer payments or in this case incentives) are ignored. Programs passing the TRC test (that is, having a B/C ratio greater than 1.0) result in a decrease in the total cost of energy services to all electric ratepayers.
- **The Utility Cost (UC)** test measures the costs and benefits from the perspective of the utility administering the program. As such, this test is characterized as the revenue requirement test. Benefits are considered to be the net present value of the avoided energy and capacity costs resulting from the implementation of the measures. Costs are considered to be the administrative, marketing and evaluation costs resulting from program implementation along with the costs for the rebates. Programs passing the Utility Cost test result in overall net benefits to the utility, thus making the program worthwhile from a utility cost accounting perspective.
- **The Ratepayer Impact Measure (RIM**) test measures the difference between the change in total revenues paid to a utility and the change in total costs to a utility resulting from the energy efficiency and demand response programs. If a change in the revenues is larger or smaller than the change in total costs (revenue requirements), then the rate levels may have to change as a result of the program.
- **The Participant (Part)** test measures the benefits and costs from the perspective of program participants as a whole. Benefits are considered to be the net present value savings that customers receive on their electric bills as a result of the implementation of the energy efficiency and demand response measures. Costs are considered to be the customer's up-front net capital costs to install the measures. If the customer receives some form of a

rebate or credit from the installer, then those costs are considered as a credit to the customer and are subtracted from the customer's total capital costs. In some programs (e.g., direct load control incentives) the credit is greater than the capital costs, so the total costs can be negative.

The cost-effectiveness analysis was performed at an aggregate level, representing the potential effects of each individual EE and DR program in the portfolio. A spreadsheet model was used as the primary tool for conducting AmerenUE's cost-effectiveness assessment.[7] Cost effectiveness results are provided in Chapter 4 for the EE programs and Chapter 5 for the DR programs.

2.4.1 Economic Data used to Support DR Cost-Effectiveness Assessment

The net present value (NPV) of costs and benefits associated with each of the EE and DR programs was estimated from the perspective of the four California Standard Practice tests. All cost and benefit values were escalated at a rate of 3% annually. The discount rate for the NPV is assumed at 4.53%, using real dollars.[8]

Avoided costs were provided by AmerenUE and are based on AmerenUE's "Back to the Future" scenario.[9] This avoided cost scenario includes an assumption about carbon legislation coming online beginning in 2014 based on the proposed Waxman-Markey legislation. The result of the legislation would be in the form of carbon cost adder that starts in 2014 and escalates afterwards in a trajectory through the end of the study period. Two other avoided cost scenarios were included in the scenario assessment – "Grid.com" which represents the situation of high infrastructure costs and "Depression 2.0" which represents a prolonged economic recession. In addition, line losses supplied by AmerenUE at the levels identified in Table 2-3 were included.

Table 2-3 Line Losses by Customer Class

Sector	Energy Loss Percentage	Demand Loss Percentage
Residential	6.72%	7.57%
Commercial	5.83%	6.84%
Industrial	3.76%	4.80%
System-wide	5.24%	6.51%

2.5 SUPPLY CURVE ASSESSMENT

A series of EE and DR supply curves were developed. The purpose of supply curves is to better understand the relationship between energy and demand savings resulting from EE and DR programs and the costs required to reach those savings levels. Programs and their associated impacts are rank-ordered according to their levelized cost. The two data points (levelized cost and cumulative percent savings) are plotted on a line chart. As programs become more expensive, there is a point on the supply curve where it appears that significantly greater cost will be required to reach very little additional EE and DR potential. Supply curves are very important policy tools that can yield insights about a portfolio of EE and DR programs. Such insights are not visible when one is looking at the impacts and costs associated with any one individual program. The results of the supply curve assessment are provided in Chapter 7.

2.6 SCENARIO ANALYSIS

The final step in the program analysis was to conduct a scenario analysis. The steps described above arrive at EE and DR program achievable potential levels that represent a particular perspective on what might happen far into the future. While we maintain that the above approach represents the best predictor of the future, other extraneous factors may come into play that could have an effect on these estimates. It is important for AmerenUE to have visibility

[7] Global uses its own in-house cost-effectiveness assessment tool.
[8] These figures were provided by AmerenUE.
[9] AmerenUE supplied results from a recently-completed scenario and avoided cost study conducted for AmerenUE by Charles River Associates (CRA).

into how these impacts might change should there be factors that affect (both positively and negatively) the implementation of EE and DR programs. The following three scenarios were addressed as part of this study:

- **Aggressive Codes and Standards**: This scenario represented the implementation of aggressive state building codes which will capture lost opportunities in new construction that might currently be captured (at least in part) in the various DSM new construction programs. Further, the scenario represents aggressive appliance standards that are currently being contemplated at the federal level. The anticipated effect of this scenario in the short run is that it might lead to decreases in program level savings because more measures would be captured through the standards. Over the longer term (still within the 20-year planning horizon of this study), existing programs could be adapted to accommodate the more aggressive codes and standards, as they come on line.
- **High Infrastructure Costs**: This scenario represents greater levels of spending due to the high costs associated with pending greenhouse gas legislation, new base load generating resources, environmental retrofits, widespread implementation of Smart Grid and the like. The general effect of these factors brings about an increase in electricity rates beyond expected levels. Program penetration rates tend to increase, more utilities implement DR and EE programs due to the need to mitigate customer rate shocks.
- **Prolonged Recession Beyond 2 Years**: This scenario assumes that the economy does not recover in two years but rather that the recession lasts five or more years. As a result, federal carbon legislation would be postponed and weakened, and rate hikes would be kept to a minimum. Electricity consumption would continue to decrease or stay flat, leading to a smaller DR and EE program savings. AmerenUE's customers would have less ability to make investments in DR and EE measures, which would also lead to a decrease in the program participation rates.

The results of the scenario analysis are provided in Chapter 8.

CHAPTER 3

ENERGY EFFICIENCY PROGRAMS

The purpose of this chapter is to describe briefly each of the thirteen assumed EE programs and then present the range of implementation approaches that are commonly featured for each of the programs based on industry best practices. Variations in the program delivery approaches are suggested where appropriate. For example, many of today's EE programs take an aggressive approach to achieving the desired energy savings by using direct incentives or rebates to buy down the customer's capital outlay for the energy efficiency measures. Rebates have been a large part of the energy efficiency program delivery infrastructure since the beginning of the movement back in the 1980s. However, it is appropriate to speculate that within 20 years there may be more upstream market approaches for certain market segments (e.g., appliances, electronic equipment, etc.) that are not as widely practiced in today's EE program marketplace.

The associated analysis details that were developed to support the build-up of EE potential estimates are provided in Appendix A. It should be noted that the BAU case from AmerenUE's 2008 IRP assumed some type of rollout for each of the programs below except for Programs 7, 8, and 13 (Appliance Recycling, Residential Information/Feedback, and C&I Information/Feedback respectively).

3.1 PROGRAM 1 – RESIDENTIAL LIGHTING AND APPLIANCES

The Residential Lighting and Appliances program is a retrofit and renovation program designed to increase the penetration of ENERGY STAR appliances and lighting measures in the homes of AmerenUE's residential customers. The program enables the adoption of these energy-efficiency measures by offering incentives that help the customer offset extra costs for the purchase and installation of high efficiency equipment for household appliances and lighting measures.

The target market for the Residential Appliances program is residential customers in AmerenUE's service territory and, in particular, those customers with existing equipment that needs replacing or who can be persuaded to replace early. This includes customers in existing single-family and multi-family homes that are either replacing existing equipment or are purchasing equipment for the first time. Both owners and renters are eligible to participate in the program.

These programs are often delivered through cash rebates that are typically paid in a prescriptive format. The rebate-eligible measures are proven technologies about which customers can readily find supporting information. Customers are familiar with cash-back rebates from other types of purchases they make, and the itemized list of included measures provides AmerenUE the opportunity to strengthen relationships with upstream suppliers and influence stocking decisions.

Examples of measures targeted in this program would include the following:

- CFL - Screw-In, ENERGY STAR
- CFL - Fixture, ENERGY STAR
- Air Conditioner - Room, ENERGY STAR
- Ceiling Fan, ENERGY STAR
- Clothes Washer, ENERGY STAR
- Dehumidifier, ENERGY STAR
- Dishwasher, ENERGY STAR

- Freezer, ENERGY STAR
- Refrigerator, ENERGY STAR

Examples of measures not cost effective today but that pass the economic screen in future years within the 20-year time horizon:

- Clothes washer (horizontal axis)
- Refrigerators/Freezers, multiple drawers
- LED lamps (indoor)
- LED lamps (outdoor)

3.2 PROGRAM 2 – MULTI-FAMILY COMMON AREA

The Multi-Family Common Area program is a retrofit and renovation program designed to increase the penetration of efficient lighting, air-conditioning, motors, etc. in the common area of AmerenUE's residential multi-family buildings. The program enables the adoption of these energy-efficiency measures by offering incentives that help the customer offset extra costs associated with such measures. This program is not intended to target customers that reside in the actual multi-family residential units because those customers are already targeted by the Lighting and Appliances program.

The target market for the Multi-Family Common Area program are owners and managers of residential multi-family buildings (e.g. apartments, condominiums, etc.) in AmerenUE's service territory and, in particular, those customers with existing equipment that needs replacing or who can be persuaded to replace early. The target market includes customers who are either replacing existing equipment or are purchasing equipment for the first time.

Incentives are paid in the form of prescriptive rebates for the measures that are featured as part of this program. In addition, a custom measure option will also be available to cover a portion of the costs of energy-efficiency projects that are not suitable for the prescriptive rebate format. The rebate-eligible measures are proven technologies about which customers can readily find supporting information. Customers are familiar with cash-back rebates from other types of purchases they make, and the itemized list of included measures provides AmerenUE the opportunity to strengthen relationships with upstream suppliers and influence stocking decisions.

Examples of measures targeted in this program would include the following:

- CFL - Screw-In, ENERGY STAR
- CFL - Fixture, ENERGY STAR
- Fluorescent T-8
- Fluorescent T-5
- LED Exit Sign
- CFL, Outdoor
- Metal Halide Lamp, Outdoor
- Air Conditioner - Packaged
- Motor, Premium Efficiency
- Custom Measures

Examples of measures not cost effective today but that pass the economic screen in future years within the 20-year time horizon:

- LED lamps (indoor)
- LED lamps (outdoor)

3.3 PROGRAM 3 – RESIDENTIAL NEW CONSTRUCTION

The Residential New Construction program is intended to accelerate the incorporation of energy efficiency in the design, construction, and operation of single-family homes and renovated or reconstructed homes. Upstream designers/builders and owner-builders are offered education on and rebates for the installation of high efficiency end-use equipment and building envelope measures in new residential dwellings.

The eligible market for the Residential New Construction program is all new single-family homes constructed in AmerenUE's service territory along with single-family homes that are completely renovated or reconstructed. The intended target market for participation in the program is residential designers, builders, developers, and owner-builders.

While the energy and peak load savings resulting from this program are accrued by the homeowners of units that include measures installed under the program, and all residential customers who are building new homes would be eligible to participate, the key target audience for the program is trades people most responsible for the design and equipment decisions—builders, developers, and contractors. Homes expected to be targeted for participation include electric water heat and/or air conditioning systems which have the potential to save the most energy.

Consistent with the ENERGY STAR model for home construction, this program takes a "whole home" approach, encouraging designers, builders, and home buyers to think of home performance in total, rather than in terms of the efficiency of individual components. It focuses on raising the standards of all components, from building shell through appliances and fixtures.

The program has the following components:

- Education—teach the new home market stakeholders, and renovation contractors and developers, about the benefits of energy-efficient home design and inform them of AmerenUE's incentives available for the installation of energy-efficient building shells and equipment.
- Cash Incentives—offer rebates or other financial incentives to builders or homeowners for the incorporation of high efficiency end-use equipment and building envelope measures in new residential dwellings; higher rebates are offered to homes that meet higher efficiency standards.

The program offers incentives that encourage the installation of measures that improve home energy performance as a whole, using ENERGY STAR recommended design practices, materials, and appliances. The packages include progressively more and higher efficiency measures, providing opportunities for builders of homes in many price categories to participate. The packages combine a number of measures offered for retrofits under other residential programs into new housing design; many are more cost-effective to install as part of new construction.

The types of measure packages envisaged under this program include the following:

- Bronze Package—(3 measures) ENERGY STAR central AC, ENERGY STAR lighting fixtures, programmable thermostat;
- Silver Package—(7 measures) Bronze Package measures plus: attic / roof insulation, wall insulation, floor/foundation insulation, ENERGY STAR refrigerator;
- Gold Package—(10 measures) Silver Package measures plus: ENERGY STAR windows, ENERGY STAR clothes washer, ENERGY STAR dishwasher;
- Platinum Package—(12 measures) Gold Package measures with ENERGY STAR heat pump water heater, plus: LED lamps.

The program is typically most effective if the incentives are directed to new home builders rather than to the eventual new homeowners, though owner-builders are typically eligible to receive them.

3.4 PROGRAM 4 – RESIDENTIAL HVAC EQUIPMENT AND DIAGNOSTICS

The purpose of the Residential HVAC Equipment and Diagnostics program is to increase awareness of HVAC energy savings opportunities among residential customers and to help them take action using incentives offered by AmerenUE. In addition to the other overall energy-efficiency program objectives, the Residential HVAC Equipment and Diagnostics program aims to develop a workforce trained in assessing and improving HVAC energy efficiency that can, ultimately, transform the market.

The target market for the Residential HVAC Equipment and Diagnostics program is residential customers served by AmerenUE. While the primary market is single-family homeowners, all residential customers are eligible to participate. HVAC contractors who can provide quality diagnostics and installation of HVAC systems are also targeted for participation to deliver the program services. The Residential HVAC Equipment and Diagnostics program has several components:

- HVAC system diagnostics and maintenance — These are comprehensive, on-site inspections and tests used to identify energy-efficiency opportunities related to the home's HVAC system; diagnostics reports contain specific recommendations, including expected costs, energy savings, and resource referrals. Maintenance services such as refrigerant recharge and filter cleaning/replacement are also included as part of the on-site diagnostics;
- Assistance with HVAC Measure Installations — Cash incentives are provided to participants who install HVAC measures recommended from the on-site diagnostics;
- Workforce Training and Participation — Training is offered to the HVAC contractors located within the community as they then are counted on to provide the program services. This also ensures that the contactors are familiar with all the incentives and programs available to customers.

Under this program, incentives are provided to participating customers to offset the costs of the on-site diagnostics performed by the HVAC contractor and other HVAC measures identified and recommended by the contractor as a result of the diagnostics. Cash incentives could be offered for the following measures in a prescriptive format:

- Air Conditioner, Diagnostics and Maintenance
- Air Conditioner, Proper Sizing
- Air Conditioner - Central, ENERGY STAR
- Air Conditioner - Room, ENERGY STAR
- Ducting, Repair and Sealing
- Fan Motor, ECM
- Thermostat, Programmable

Examples of measures not cost effective but that pass the economic screen in future years within 20-year time horizon:

- Heat pump – cold climate
- Heat pump – geothermal

3.5 PROGRAM 5 – HOME ENERGY PERFORMANCE

The target market for the Home Energy Performance program (also called Residential Audits program) is residential customers served by AmerenUE. While the primary market is single-family homeowners, all residential customers are eligible to participate. Contractors who can provide quality audits and installation of recommended measures are also targeted for participation to deliver the program services.

The purpose of the program is to increase awareness of home energy savings opportunities among residential customers and to help them take action using incentives offered by AmerenUE.

In addition to the other overall energy-efficiency program objectives, the program aims to develop a workforce trained in assessing and improving home energy efficiency that can, ultimately, transform the market.

Since the program is mainly intended to educate and empower residential customers to make energy-efficient home improvements, the HEP program contains a limited set of measures: a package of low-cost measures and weatherization measures. Additional measures are recommended by the home auditor and customers may obtain financial incentives through their participation in other AmerenUE programs.

The HEP program has several components:

- Home Performance with ENERGY STAR (HPwES) Audits—These are comprehensive, on-site inspections and tests used to identify energy-efficiency opportunities; audit reports contain specific recommendations, including expected costs, energy savings, and resource referrals;
- Direct Installation of Low-Cost Measures—During the HPwES audit visit, an auditor installs a package of low-cost energy-saving measures, at no additional charge to the customer, to immediately improve the energy performance of the house. Examples of such measures that the auditor installs are as follows:
    - CFL - Screw-In, ENERGY STAR
    - Water Heater, Tank Blanket / Insulation
    - Faucet Aerators
    - Low-Flow Showerheads
    - Thermostat, Programmable
- Assistance with Additional Measure Installations— AmerenUE will provide cash rebates to audit participants who install weatherization measures recommended from the audit, as well as assistance on how to access rebates offered under other AmerenUE programs for additional recommended measures. The following weatherization measures will be offered in a prescriptive format under this program:
    - Insulation, Ceiling
    - Insulation, Floor/Foundation
    - Insulation, Wall Cavity
    - Infiltration Control
- Examples of measures not cost effective today but that pass the economic screen in future years within 20-year time horizon:
    - Heat pump – cold climate
    - Heat pump – geothermal

3.6 PROGRAM 6 – RESIDENTIAL LOW INCOME

The target market for the Residential Low Income program is low-income residents in existing residential units (single-family and multi-family) that are provided with electricity by AmerenUE and who are financially responsible for the electric bill payment. Low-income qualification criteria are typically tied to the federal poverty index, either 150% or 200%. Low-income new construction units are typically excluded from the eligibility for these types of programs.

The purpose of the Residential Low Income program is to educate and assist eligible residential customers with making their homes more energy efficient. The program provides energy-efficiency services and energy education to AmerenUE's low-income customers to help them reduce their energy usage and increase the affordability of their energy bills.

Participating households might receive two types of assistance:

- In-Home Audits and Education—These are on-site inspections and tests used to identify the applicability of energy-savings measures the program offers and to educate residents about ways to reduce their energy usage;
- Direct Installation of Measures—Install measures to reduce energy use in the home at no charge to residents.

In-Home Audits and Education

- Trained auditors perform on-site audits (air leak testing and home inspection) and assess the energy performance of the house; i.e., identify where energy is used and where there are inefficiencies and determine which measures are appropriate to install.
- The auditors discuss the opportunities to reduce energy use and bills with residents. In addition, the auditor will provide a list of potential resources for the customer which provides information on bill savings opportunities.
- Follow-up contacts with the participants reinforce the message of the benefits of energy-saving behaviors (e.g., turning off lights in unoccupied rooms) and adoption of energy-savings measures offered by the auditors.

Direct Installation Components

Applicable measures are installed, at no cost to residents. Examples of such measures in this program are:

- Focus mainly on relatively low-cost measures, such as CFL installations;
- Install weatherization measures such as water heater tank insulation, and other energy saving devices such as low-flow showerhead and faucet aerators;

Assistance with Additional Measure Installations— AmerenUE will provide cash rebates to participants who install additional recommended measures. The following measures will be offered in a prescriptive format under this program:

- Air Conditioner - Room, ENERGY STAR
- Dehumidifier, ENERGY STAR
- Refrigerator, ENERGY STAR

3.7 PROGRAM 7 – APPLIANCE RECYCLING

The eligible population for the Appliance Recycling program is all residential customers in AmerenUE's service territory. The target market of residential customers for the Appliance Recycling program has a short-term and a longer-term component. Respectively, these are residential customers who currently own and operate secondary refrigerator, freezer, or room air conditioning units and customers who are purchasing new replacement units.

The purpose of the Appliance Recycling program is to eliminate a very inefficient usage of electricity in homes: retention of refrigerators, freezers, and room air conditioners for use as secondary units. This is a two-pronged goal: to remove existing secondary units from operation and to prevent existing primary refrigerators, freezers, and room air conditioners from being retained and used as secondary units when customers purchase new units.

The Appliance Recycling program is designed to eliminate retention of old refrigeration equipment from operation as secondary units in homes and to provide safe disposal of these units. The program offers free recycling of units from residences plus customer incentives and education about the benefits of secondary unit disposal, to encourage their participation.

In addition to educating residential customers about the benefits of secondary unit disposal, the program provides services to enable disposal of the units. The two program components are:

- Customer Incentives—including complimentary removal of existing or potential secondary units from customer's home, plus payment of a small incentive for each unit removed;

- Environmental Disposal of Units—including removal of CFCs for the refrigerant, the preparation of the refrigerant for reclamation or recycling, and the recycling of other materials such as the metal and plastic components.

3.8 PROGRAM 8 – RESIDENTIAL INFORMATION/FEEDBACK

The target market for the Residential Information/Feedback program is residential customers served by AmerenUE. While the primary market is single-family homeowners, all residential customers are eligible to participate. This program targets both owners and renters of residential dwellings.

The purpose of the Residential Information/Feedback program is to provide customers with information about their energy usage and costs that is likely to increase awareness of energy and demand savings opportunities among residential customers, and help them reduce usage. Studies have shown that when consumers are provided with timely feedback on their electricity usage, they respond by reducing their use to save money on their electricity bill. Providing energy usage data and information will help customers make more informed decisions about their energy use and lead to energy savings behavior. In addition to the overall energy-efficiency program objectives, this program aims to achieve the following specific objectives:

- Improve customer understanding of how their homes use energy and how they can use it more effectively for less money;
- Provide information that helps procure immediate energy savings through behavioral changes.

This program builds on an assumption that AmerenUE would deploy web-based customer feedback mechanisms in conjunction with a deployment of new so-called smart meters that add more functionality relative to AmerenUE's existing AMR meters. Customers are provided access to interval usage data (both current and historical) through an interactive web portal. The web-portal along with usage data and energy usage analysis tools will serve as a web-based usage information feedback system. This can then be integrated with other systems such as a Smart Meter Data Management System, Customer Billing System, Data Warehousing, and Customer Relationship Management System to provide customers with information on energy and demand savings programs and rates, in order for them to manage electricity costs

The web-portal is designed as a usage feedback internet display system. Registered customers are provided with information to track and display hourly consumption and the estimated effect on bills. The information provided will help customers better understand the effects of how they use electric appliances and make informed decisions on their usage choices. In addition, customers will be notified and alerted (through email, text messaging, and phone calls) if they are approaching higher rate tiers or using more energy than normal during on-peak periods. They may also be notified if they are approaching the threshold level on a pre-specified energy cost budget.

The program is designed to provide information that is likely to educate and empower residential customers to make energy-efficiency improvements, potentially improving the chances that they will participate in one or more of the other EE programs discussed. There are no energy savings measures explicitly associated with this program, and therefore the program does not claim any direct energy savings.

3.9 PROGRAM 9 – C&I STANDARD INCENTIVES

The eligible customer population for the C&I Standard Incentives program is all existing commercial and industrial accounts, including government, public, and non-profit facilities. Within the target market, the focus for this program is the equipment retrofit or change-out market; that is, customers with existing equipment that needs replacing or who can be persuaded to replace early.

The purpose of the C&I Standard Incentives program is to increase awareness of energy savings opportunities and assist customers in acting on those opportunities to decrease energy usage in commercial and industrial facilities. This program is designed for retrofit and replacement projects.

The program is designed to encourage and assist nonresidential customers in improving the energy efficiency of their existing facilities through a broad range of energy efficiency options that address all major end uses and processes. This program offers prescriptive incentives to customers who install high-efficiency electric equipment and engages equipment suppliers and contractors to promote the incentive-eligible equipment.

The program has the following components, to accommodate the variety of customer needs and facilities in this sector:

- Prescriptive Rebates—deemed per-unit savings for itemized measures; easy and appropriate for relatively low-cost or simple measures;
- Quick and easy incentive application for measures with known and reliable energy savings. No pre-approval required;
- Customers purchase and install qualified products from retailers and/or contractors;
- Customers or their contractors submit an incentive form to AmerenUE with information that documents the qualifying sale/installation. The form allows customers to see the exact incentive they can receive. AmerenUE mails rebate checks to customers or their contractors;
- The prescriptive incentives are cash-back rebates that generally cover a portion of the incremental cost of the qualifying models; that is, the cost premium of qualifying models over less-efficient models available.

Examples of measures that receive prescriptive incentives in this program are:

- CFL – Screw-In Bulb, ENERGY STAR
- CFL - Fixture, ENERGY STAR
- Fluorescent, Delamp and Install Reflectors
- Fluorescent, T8
- Fluorescent, T5
- Fluorescent, High-Bay Fixtures
- LED Exit Sign
- CFL, Outdoor
- Metal Halide Lamps, Outdoor
- Occupancy Controls
- Air Conditioner, Packaged
- Air Conditioner, Room
- Air Conditioner, Packaged Terminal
- Heat Pump, Packaged Terminal
- Motor, Premium Efficiency
- Refrigeration Controls, Anti-Sweat Heater Control
- Refrigeration Controls, Beverage Reach-in Cabinet Control
- Vending Machine, High Efficiency or ENERGY STAR

LED lamps (indoor and outdoor) were not cost effective today but they pass the economic screen in future years within the 20-year time horizon are LED Lamps (indoor and outdoor).

3.10 PROGRAM 10 – C&I CUSTOM INCENTIVES

The eligible customer population for the C&I Custom Incentives program is all existing commercial and industrial accounts, including government, public, and non-profit facilities. Within the target market, the focus for this program is the equipment retrofit or change-out market; that is, customers with existing equipment that needs replacing or who can be persuaded to replace early.

The purpose of the C&I Custom Incentives program is to increase awareness of energy savings opportunities and assist customers in acting on those opportunities to decrease energy usage in commercial and industrial facilities. This program is designed for retrofit and replacement projects.

The program is designed to encourage and assist nonresidential customers in improving the energy efficiency of their existing facilities through custom energy efficiency options that address major end uses and processes. This program offers custom incentives to customers who install high-efficiency electric equipment and engages equipment suppliers and contractors to promote the incentive-eligible equipment.

The program has the following components which are designed to accommodate the variety of customer needs and facilities in this sector:

- Custom Rebates—paid on fixed "per kWh saved" basis; appropriate for larger and more complex projects compared to measures offered in the C&I Standard Incentives program;
- Customer referrals to qualified audit providers who can help customers identify appropriate and cost-effective retrofit opportunities;
- Provides financial incentives on projects not suitable for prescriptive incentives because of size or multiple types of equipment involved;

More complex offerings, with the following services and requirements:

- Review design/specification and savings estimates for completeness and applicability of incentives
- Pre- and post-project inspections to estimate and verify savings
- Incentives paid on fixed $/kWh basis

Examples of custom projects include chiller replacements, compressed air system improvements, production process improvements, and experimental technologies.

3.11 PROGRAM 11 – C&I NEW CONSTRUCTION

The target market for the C&I New Construction program is decision makers for the design and/or construction of new facilities and renovation contractors and developers. This program will cover both new constructions and buildings/facilities undergoing "major renovation," defined as buildings where multiple major systems are undergoing significant upgrades.

While the energy and peak load savings resulting from this program will be accrued by the building owners/tenants, the key target market of the program are the professionals most responsible for the design and equipment decisions—architects and engineers, design/builders, developers, and contractors.

The purpose of the C&I New Construction program is to greatly improve the energy efficiency of all newly constructed facilities and facilities that are completely renovated or reconstructed in the AmerenUE service territory. In addition to the overall energy-efficiency program objectives, this program has the following specific objectives:

- Change building design and construction practices used by architects and engineers, contractors, and owners to include all cost-effective energy efficiency designs and equipment.

- Capture "lost opportunities" to reduce electric demand and energy usage in the commercial and industrial sector by providing participants with design assistance and custom rebates or performance contracting for the construction of energy-efficient buildings and facilities.

The C&I New Construction program is designed to instill and accelerate adoption of design and construction practices so that new commercial and industrial facilities are more energy efficient than the current stock. The program provides facility designers and builders with training, design assistance, and incentives to incorporate energy efficient systems and construction practices in newly constructed and renovated facilities.

The program has the following components, directed mainly to the commercial and industrial design and construction community: training, design assistance, and financial incentives.

<u>Training</u>

- General training in best practices—provides technical workshops and other technical developmental activities for the design and engineering community to familiarize and educate them on energy efficient design methods and new technologies.

<u>Design Assistance</u>

- Directed to upstream providers of design and construction services—architects and engineers (A&E), designers/builders, and contractors;
- Project-specific assistance provides a participant with the services of a consulting engineer to evaluate the cost-effectiveness of energy-saving measures under consideration and to recommend measures that may have been overlooked;
- The program also provides design and engineering consultants with validation of their prospective energy efficiency projects in presentations to clients.

<u>Incentives</u>

- Directed to upstream providers of design and construction services but also available to facility owners;
- Custom rebates payable on a "per kWh savings" basis.

3.12 PROGRAM 12 – C&I RETRO-COMMISSIONING

The eligible customer population for the C&I Retro-Commissioning program is all existing commercial and industrial accounts provided with electricity by AmerenUE, including government, public, and non-profit facilities.

Under the C&I Retro-Commissioning program, retro-commissioning activities are eligible to receive incentives. The program is designed in the same manner as the C&I Custom Incentive program. Incentives are paid on a fixed "per kWh saved" basis. Usually there are multiple retro-commissioning measures in a project which are eligible for incentives.

The program has the following components which are designed to accommodate the variety of customer needs and facilities in this sector:

- Custom Rebates—paid on fixed "per kWh saved" basis;
- Customer referrals to qualified retro-commissioning service providers who can help customers identify appropriate and cost-effective retro-commissioning opportunities;
- More complex offerings, with the following services and requirements:
- Review design/specification and savings estimates for completeness and applicability of incentives
- Pre- and post-project inspections to estimate and verify savings
- Incentives paid on fixed $/kWh basis

Examples of retro-commissioning projects include chiller operation scheduling and optimization, outside air optimization, and compressed air system optimization.

3.13 PROGRAM 13 – C&I INFORMATION/FEEDBACK

The eligible customer population for the C&I Information/Feedback program is all existing commercial and industrial accounts provided with electricity by AmerenUE, including government, public, and non-profit facilities.

The purpose of the C&I Information/Feedback program is to provide customers with information about their energy usage and costs that is likely to increase awareness of energy and demand savings opportunities among C&I customers, and help them reduce usage. Studies have shown that when consumers are provided with timely feedback on their electricity usage, they respond by reducing their use to save money on their electricity bill. Providing energy usage data and information will help customers make more informed decisions about their energy use and lead to energy savings behavior. In addition to the overall energy-efficiency program objectives, this program aims to achieve the following specific objectives:

- Improve customer understanding of how their facilities use energy and how they can use it more effectively for less money;
- Provide information that helps procure energy savings and demand savings through behavioral changes.

This program builds on an assumption that AmerenUE would deploy web-based customer feedback mechanisms in conjunction with a deployment of new so-called smart meters that add more functionality relative to AmerenUE's existing AMR meters. Customers are provided access to interval usage data (both current and historical) through an interactive web portal. The web-portal along with usage data and energy usage analysis tools will serve as a web-based usage information feedback system. This can then be integrated with other systems such as a Smart Meter Data Management System, Customer Billing System, Data Warehousing, and Customer Relationship Management System to provide customers with information on energy and demand savings programs and rates, in order for them to manage electricity costs.

The web-portal is designed as a usage feedback internet display system. Registered customers will be provided with information to track and display hourly consumption and the estimated effect on bills. The information provided will help customers better understand the effects of how they use electricity and make informed decisions on their usage choices. In addition, customers will be notified and alerted (through email, text messaging, and phone calls) if they are approaching higher rate tiers or using more energy than normal during on-peak periods. They may also be notified if they are approaching the threshold level on a pre-specified energy cost budget.

The program is designed to provide information that is likely to educate and empower C&I customers to make energy-efficient facility improvements, potentially improving the chances that they will participate in one or more of the other EE programs discussed. There are no energy saving measures explicitly associated with this program, and therefore the program does not claim any direct energy savings.

CHAPTER 4

DEMAND RESPONSE PROGRAMS

A total of seven assumed demand response programs and associated delivery mechanisms were developed for this DR potential assessment. The programs cover a broad range of DR options including Direct Load Control (DLC), Pricing, Curtailment, and Aggregator Contracts. AmerenUE customers were segmented into four, rate-based groups to determine eligibility for each program. Table 4-1 presents a matrix of the seven demand response programs by eligible customer segment.

Table 4-1 Demand Response Program Matrix

Demand Response Program	Residential [1M]	Small C&I [2M]	Medium C&I [3M]	Large C&I [4M, 11M]
Direct Load Control				
Residential Direct Load Control	X			
Small C&I Direct Load Control		X		
Dynamic Pricing Programs				
Residential Dynamic Pricing	S			
C&I Dynamic Pricing		X	X	X
Other C&I Programs				
Demand Bidding			X	X
Curtailable				X
DR Aggregator Contracts		X	X	X

The objective of these programs is to achieve demand reductions from eligible customers in AmerenUE territory during the highest load hours of each summer season. Pricing programs offer customers the opportunity to save money on their energy bills by shifting usage away from high load hours while a DLC program offers a fixed payment in return for utility control of specific end-uses. Curtailment and DLC programs may also provide AmerenUE with emergency demand response that could be called at any time in the event of a system emergency.

In order to avoid double counting of impacts the program eligibility criteria have been defined to ensure that customers cannot participate in multiple programs. For example, residential customers cannot participate in both an air conditioning DLC program and a pricing program, which both target the same load on the same days. Eligibility details for each program are discussed in the program descriptions below.

All new DR programs, including the DR Aggregator Contracts, follow the same initial ramp-up strategy as existing programs. Global assigned a specific percentage of total participants to be added to each program over a four-year ramp-up period. The percentages reflect what Global believes to be a reasonable number of customers per year based on our experience with other utilities. Program participant recruitment activity for the new programs begins in 4^{th} quarter of PY 2009, even though, without a summer season, program impacts are not realized in that year. Impacts are realized beginning in PY 2010. New programs ramp-up to full deployment over four years beginning in PY 2009 and ending in PY 2013. The ramp rate is illustrated below. In PY 2009 5% of the total participants are recruited, in PY 2010 an additional 20% are recruited and so on, until full participation is reached in 2013. The ramp rates represented in Table 4-2 are based on industry experience and reflect the fact that target marketing efforts will tend to focus on certain markets or segments each year and thus it takes time to reach the full deployment rates represented for the program.

Table 4-2 DR Program Participation Ramp Up Strategy

	2009	2010	2011	2012	2013
Program Ramp Rate	5%	20%	30%	25%	20%
Cumulative Recruitment	5%	25%	55%	80%	100%

AmerenUE's two existing programs, Curtailable and Demand Bidding (*AmerenUE "Peak Power Rebate"*), are currently being implemented and thus did not require a ramping strategy.

After the initial program ramp-up period, pricing programs are further expanded during PY 2015-2019. This expansion is facilitated by and coincident with an assumed AMI installation that replaces AmerenUE's current AMR system with an AMI system. The new AMI system has the two way communication necessary to send pricing signals and retrieve interval data for customers participating in dynamic pricing programs on a very large scale. Table 4-3 presents the assumed deployment rate for AmerenUE. In PY 2015, 15% of the total number of meters is expected to be installed; in PY 2016 an additional 20% and so on until the meters are fully deployed. Similar to the initial participation ramp-rate, the installation rates are based on industry experience and reflect the fact that AMI installations are generally rolled-out by geographic area and therefore take time to reach full deployment.

Table 4-3 AMI Deployment Schedule Assumed for this Analysis

	2015	2016	2017	2018	2019
AMI Deployment Rate	15%	20%	25%	20%	20%
Cumulative AMI Deployment	15%	35%	60%	80%	100%

The following sections include the program descriptions which provide information regarding the program design, implementation, and possible risks associated with each program.

The associated analysis details that were developed to support the build-up of DR potential estimates are provided in Appendix B. It should be noted that the BAU case from AmerenUE's 2008 IRP assumed a mix of programs and associated impacts that were based on secondary data. As a result, the impacts and cost-effectiveness of the programs are significantly different in the RAP and MAP cases, relative to the BAU case.

4.1 PROGRAM 1 – RESIDENTIAL DIRECT LOAD CONTROL

This program is targeted at eligible residential customers with central air conditioners (CAC), room air conditioners (RAC), or electric water heaters. Participants with both a CAC or RAC unit and an electric water heater may participate with both end-uses. Participants of the DLC program will not be eligible to participate in the Residential Dynamic Pricing program.

In this program, the AmerenUE program management team or system operator remotely shuts down or cycles a customer's AC unit or water heater without notice. In exchange, the customer receives an incentive payment or bill credit. Operation of DLC typically occurs during times of high peak demand or supply-side constraints. However, it can also be operated for economic reasons to avoid high on-peak electricity purchases.

During an event, participants' appliances are controlled either by a one-way remote switch or by a programmable communicating thermostat (PCT). The one-way remote switch is connected to the condensing unit of the CAC or RAC, and to the immersion element in a water heater. When activated by a control signal, the switch will not allow the equipment to operate for some predetermined portion of each hour. For the AC program, the compressor is shut down during an event while the fan continues to operate. This allows cool air to be circulated throughout the home while the compressor is disabled. The operation of the switch is usually controlled through a digital paging network. The Central AC and room AC units are typically controlled during the 4 summer months (June, July, August, and September). The water heating units are controlled all 12 months in the year. The load cycling strategy encompasses a trade-off between customer comfort and program cost-effectiveness. Air conditioner cycling strategies at other utilities range from 33% to 100% of each hour; the national average is a 50% cycling strategy. The water heater direct load control component is less complex and less likely to cause discomfort than the air conditioner cycling component since the temperature of the water in the tank is unlikely to be greatly affected by an interruption in the middle of the day. Participating customers' water heaters will be turned off for a predetermined time period, and are subject to this shut-down at any time during the summer season. Most switches also contain multiple relays so that multiple end-uses can be controlled by the same switch with independent control strategies for each relay.

More recent DLC programs involve installation of a PCT or "smart thermostat" for customers. PCTs allow remote adjustment of temperature settings, so AmerenUE can remotely adjust the temperature to reduce demand from CAC units. After an event, load control is released, allowing the thermostat to revert back to the original customer settings for temperature and schedule. Various re-set strategies are used across the country ranging from 2° F to 8° F. Again, like the cycling strategy, the strategy chosen will involve a trade-off between customer comfort and program cost-effectiveness.[10]

4.2 PROGRAM 2 – RESIDENTIAL DYNAMIC PRICING

This program will be targeted to all residential customers within the AmerenUE service territory. Dynamic pricing requires interval meter data for billing purposes. AmerenUE will be able to utilize its existing Automated Meter Reading (AMR) system to provide the data necessary to support the rate during initial program years, and is assumed for this analysis to install AMI meters beginning in 2015 to facilitate additional participants.

Rather than use a generic "dynamic pricing program" for this analysis, Global screened the various possibilities, critical peak pricing (CPP), peak time rebate (PTR), and real-time pricing (RTP), for the program that provided the best overall customer acceptance and peak impacts. Because a PTR program is a credit only program, customer acceptance rates in an opt-in, or voluntary, scenario tend to be higher than other penalty and credit programs such as CPP. Southern California Edison estimated a maximum take rate of 20% on a voluntary CPP program using the Momentum Market Intelligence tool created for the California State-Wide Pricing Pilot. [11] Considering that this take rate was estimated based on market research performed in CA, on customers that are experienced with DR programs, a translation of this take rate to AmerenUE would necessarily be lower, perhaps in the 10 – 15% maximum range. PTR, on the other hand due to its "no loser" nature, would likely be able to achieve the 20% participation on a voluntary basis; or much higher participation rates, in the 50-75% range on an opt-out or default basis. Both the FERC National assessment of demand response and the two CA utilities offering dynamic pricing on a default basis have estimated an upper bound for customer participation rates at 75%. Additionally, it has been demonstrated in industry pilots that the impacts that can be obtained through PTR and CPP programs are equivalent[12] meaning that the program with the higher participation rate will generate the higher impacts for AmerenUE. We therefore chose to model an opt-out PTR program for the residential class, recommending it because of both increased customer satisfaction and increased total potential impacts. This is an important point,

[10] Marrin, Kelly and Williamson, Craig, "Putting the Control in Direct Load Control", IDC Energy Insights Load Analysis Strategies Report, May 2009.
[11] Southern California Edison SmartConnect Business Case Filing with the CPUC, July 2007, available at: http://www3.sce.com/sscc/law/dis/dbattach1e.nsf/0/DA51DA091ECD4DAA88257329007E0AB3/$FILE/A.07-07-XXX+SCE+AMI+Phase+III+SCE-4.pdf
[12] Faruqui, Ahmad and Sanem Sergigi, "BGE's Smart Energy Pricing Pilot – Summer 2008 Impact Evaluation," Filed by BGE with the Maryland Public Service Commission, April, 2009.

as actual implementation of such a DR program would constitute a sweeping change in AmerenUE's relationship with all of its residential customers.

A PTR option uses price signals in the form of customer credits to encourage customers to reduce their usage during critical time periods on specific event days. Credits, or rebates, are calculated based on reduction in usage below a customer specific baseline. Event days are dispatched on relatively short notice for a limited number of days during the year. Usually their timing is unknown. However, trigger criteria are well-established so that customers can expect events based on the weather or other factors. Events can be called during times of system contingencies or when faced with high costs in procuring wholesale power. Notification of an event can either be a day in advance or on the day of the event.

For participation in this option, customers must have advanced meters, such as the AMR system currently in place with AmerenUE's residential customers. While the AMR system will support a dynamic rate to some extent, significant changes would be needed to both the system itself and the data collection, storage, and validation processes for the current AMR system to support a default dynamic rate with very high participation rates. To that end, we assume an AMI implementation and deployment beginning in 2015 to better facilitate the adoption of dynamic pricing for AmerenUE. Enabling technologies such as residential PCTs allow automatic responses to events for both the AMR and AMI system; therefore, the PTR program will offer both a technology enabled and non-enabled option.

4.3 PROGRAM 3 – SMALL C&I DIRECT LOAD CONTROL

This program will be targeted to eligible Small C&I [2M] customers with air conditioning systems that can be controlled with a PCT. Participants in the DLC program will not be eligible to participate in the C&I Dynamic Peak Pricing program.

In this program, the AmerenUE program management team or system operator remotely re-sets a customer's AC unit without notice. In exchange, the customer receives an incentive payment or bill credit. Operation of DLC typically occurs during times of high peak demand or supply-side constraints. However, it can also be operated when economic to avoid high on-peak electricity purchases.

During an event, participants' appliances are controlled by a PCT. A PCT is used exclusively in this program due to more complicated customer AC systems. C&I customers tend to have a wider variety of AC systems or may have multiple central AC units. This makes the PCT the most feasible and economic choice for a DLC program offered to the C&I class. PCTs allow AmerenUE to remotely adjust the temperature settings and reduce demand from any type of AC system. After an event, load control is released, allowing the thermostat to revert back to the original customer settings for temperature and schedule. Various re-set strategies are used across the country ranging from 2°F to 8° F, the strategy chosen will involve a trade-off between customer comfort and program cost-effectiveness.

4.4 PROGRAM 4 – C&I DYNAMIC PRICING

This program will be targeted to all C&I customers [2M, 3M, 4M, 11M] within AmerenUE service territory. Dynamic pricing requires interval meter data for billing purposes. Fortunately AmerenUE will be able to utilize its existing Automated Meter Reading (AMR) system to provide the data necessary to support the rate during initial program years, and is assumed for this analysis to install AMI meters beginning in 2015 to facilitate additional participants.

Rather than use a generic "dynamic pricing program" for this analysis Global screened the various possibilities, CPP, PTR, and RTP for the program that provided the best overall customer acceptance and peak impacts. The Critical Peak Pricing (CPP) style program was chosen as most realistic program for AmerenUE C&I customers based on these criteria. In our experience we find that, PTR is generally not offered to C&I customers, and real-time pricing (RTP) is difficult for customers to understand and difficult for utilities to design, communicate, and administer. CPP is a combination of strong price signals and simplicity that yields good impacts and customer take rates. The program would be on an opt-in or voluntary basis. Without the "no loser" aspects of the PTR, it would not be recommended to make this program opt-out like the Residential Dynamic Pricing program above.

A critical peak pricing (CPP) program uses price signals in the form of high prices during relatively short critical peak periods to encourage customers to reduce their usage during critical time periods on specific event days. The customer incentive is generally a discount on off-peak hours throughout the year. Event days are dispatched on relatively short notice for a limited number of days during the year. Usually their timing is unknown. However, trigger criteria are well-established so that customers can expect events based on the weather or other factors. Events can be called during times of system contingencies or when faced with high prices in procuring wholesale power. Notification of an event can either be a day in advance or on the day of the event.

For participation in this option, customers must have advanced meters, such as the AMR system currently in place with AmerenUE's customers. While the AMR system will support a dynamic rate to some extent, significant changes would be needed to both the system itself and the data collection, storage, and validation processes for the current AMR system to support a default dynamic rate with very high participation rates. To that end, we assume an AMI implementation and deployment beginning in 2015 to better facilitate the adoption of dynamic pricing for AmerenUE.

Enabling technologies such as C&I Automated Demand Response (Auto-DR) and PCTs allow automatic responses to critical peak prices. In fact, Auto-DR can be used in any pricing program by enabling automatic response to pricing signals through pre-programming of customer choice and preferences in the response strategy.

4.5 PROGRAM 5 – C&I DEMAND BIDDING

This program will be targeted to Medium & Large C&I customers [3M, 4M, 11M] within AmerenUE service territory. Participants in the C&I Dynamic Pricing and Curtailable programs are not eligible to participate in the demand bidding program.

A Demand Bidding Program offers participants the opportunity to receive a credit for voluntarily reducing load when an event is called. Customers do not pay a penalty if they are unable to meet their energy reduction bid. Participants will generally place a bid online for the amount of power they are willing to reduce. Events may be called on a day-of or day-ahead basis as conditions warrant. Many utilities allow customers to enter a standing bid that is automatically entered for each event. Participants are paid a credit for each kWh they reduce during the event and they are not penalized if they do not meet their reduction bid.

AmerenUE's existing Demand Bidding Program is called the *Peak Power Rebate* Program and is designed to pay credits to customer who, when called upon, voluntarily reduce electricity usage. The program operates as follows:

- Customers must be able to reduce a minimum of 200 kW at a single premise during a price response event. Additionally, individual customers are limited to a maximum reduction of 10,000 kW.
- Events may be called during times of system contingencies or when faced with high prices in procuring wholesale power. A single event will last a minimum of 4 hours and the total number of event hours will not exceed 60 hours per year.
- Customers will be notified of an event either the day before or the day of the event. Customers who wish to participate must confirm their intent and nominate their anticipated load reduction with AmerenUE within a specified time limit following the notification.[13]
- Participants are paid an hourly credit equal to the least of the estimated reduction, or the enrolled reduction, or the actual hourly reduction, times the hourly credit. The hourly credit

[13] For day-ahead events, the allowed bid time window is typically 4 hours from the time of the event call. For day of events, the allowed bid time window is typically 1 hour from the time of the event call.

is based on the day-of or day-ahead risk adjusted MISO market energy prices, plus a risk adjusted capacity price of $0.20 /kWh. Participants are paid credits on a monthly basis netting positive and negative events against each other.

Based on program experiences from other utilities, predefined and/or preprogrammed responses are likely to enhance customer response to peak power rebate events. Therefore our analysis introduces an automated enablement element (Auto-DR technology) in the Demand Bidding (Peak Power Rebate) program.

4.6 PROGRAM 6 – CURTAILMENT PROGRAM

This program will be targeted to Large C&I customers [4M, 11M] within AmerenUE service territory. Customers who are participating in Dynamic Pricing or Demand Bidding programs are not eligible to participate in the Curtailment program.

Under a curtailable rate option, eligible customers agree to reduce demand by a specific amount or curtail their consumption to a pre-specified level. In return, they receive a fixed incentive payment in the form of capacity credits or reservation payments (typically expressed as $/kW-month or $/kW-year) and are paid to be on call even though actual load curtailments may not occur. The amount of the capacity payment typically varies with the load commitment level. In addition to the fixed capacity payment, participants receive a payment for energy reduction. Enrolled loads represent a firm resource and can be counted toward installed capacity (ICAP) requirements. Since load reductions must be of firm resource quality, curtailment is mandatory and penalties are assessed for under-performance or non-performance.

Based on program experiences from other utilities, predefined and/or preprogrammed responses are likely to enhance customer response to peak power rebate events. Therefore, in our analysis, we propose that AmerenUE introduce an automated enablement (Auto DR technology) in its Option Based Curtailment program.

4.7 PROGRAM 7 – DR AGGREGATOR CONTRACTS

This program will be targeted toward all eligible C&I customers in AmerenUE service territory, who are not participating in any other AmerenUE DR program.

In this program, AmerenUE establishes performance contracts with one or more Curtailment Service Providers (CSP) who will recruit AmerenUE customers and deliver the demand reduction target set in the program. This program is primarily implemented by the CSPs who undertake all activities associated with program implementation. AmerenUE’s overall responsibility is to ensure that the goals of the program are accomplished.

CHAPTER | 5

ENERGY EFFICIENCY PROGRAM RESULTS

This chapter presents the achievable potential estimates, total program spend and cost-effectiveness results for the EE program portfolio assessed in this study.

5.1 EE ACHIEVABLE POTENTIAL ESTIMATES

The following sections present the estimates of the three levels of EE achievable potential described in the analysis framework. It is important to keep in mind that these are projections of what is likely to happen under a specific set of assumptions. MAP represents the upper bound of customer take rates for the proposed set of EE programs. RAP represents EE potential that might be achieved through the proposed set of EE programs and a more realistic set of customer take rates. It is important to note that both the MAP and RAP cases are grounded in the primary market research conducted as part of this project (and reported in Volume 2 of this study). The BAU represents AmerenUE's 2008 IRP estimate of EE program potential, drawing upon secondary data to support customer take rates and measure cost-effectiveness.

We first present the potential estimated for MAP, RAP and BAU by program, the associated cost-effectiveness of the programs and then present the overall results for AmerenUE.

5.1.1 EE MAP Estimates by Program

Figure 5-1 illustrates the estimated MAP energy reductions for key programs at select years over the 20-year time horizon. As can be seen, the program yielding the largest savings is C&I Standard Incentives. This is a predictable result given as this is a C&I prescriptive measure program. Industry experience has proven that a significant amount of savings potential typically comes in the C&I markets, particularly for prescriptive measures in the lighting and cooling end-uses. Other programs with significant savings include Residential Lighting and Appliances. This occurs even though new standards affecting residential appliances are coming into play in the baseline forecast; various measures that now are not cost-effective will become cost-effective in the 20-year time horizon (e.g., heat pump water heaters).

Table 5-1 presents the MAP energy savings for each program by select year in the 20-year forecast period. Table 5-2 presents the MAP peak demand reductions for each program by selected year.

Figure 5-1 MAP Savings by EE Program

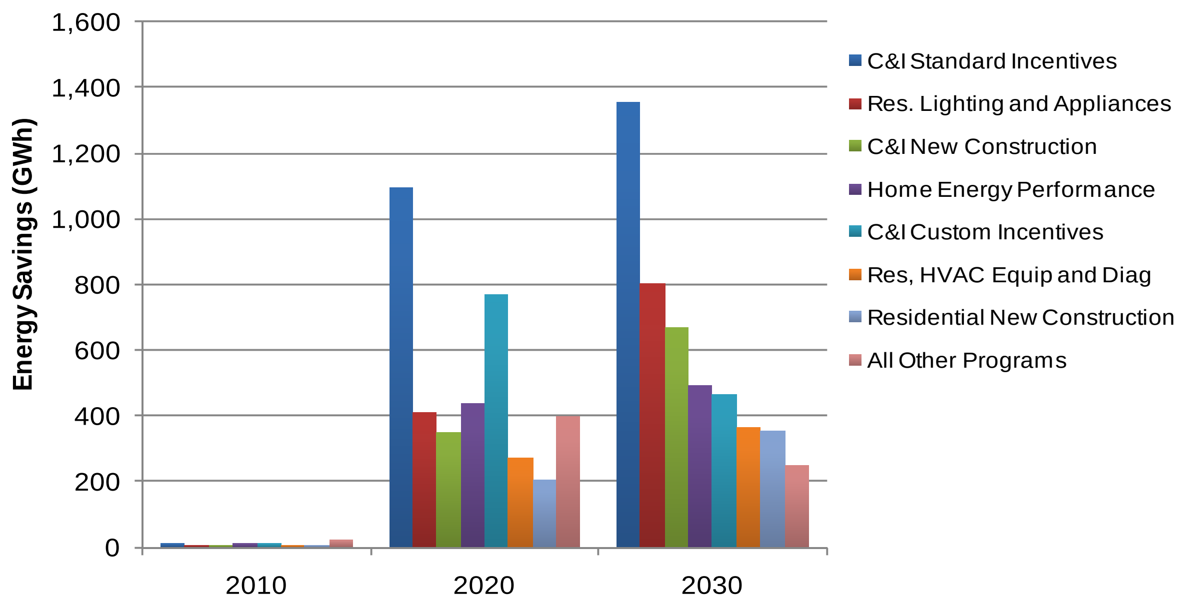


Table 5-1 MAP Energy Savings by EE Program

Program		Energy Savings (MWh)		
		2010	**2020**	**2030**
1	Residential Lighting & Appliances	4,749	408,289	803,560
2	Multi-Family Common Area	1,071	132,696	180,730
3	Residential New Construction	1,042	206,980	356,987
4	Residential HVAC Equipment & Diagnostics	5,506	273,452	365,563
5	Home Energy Performance	9,290	439,380	494,008
6	Residential Low Income	1,596	66,194	15,616
7	Residential Appliance Recycling	17,141	131,229	49,310
8	Residential Information/Feedback	0	0	0
9	C&I Standard Incentives	9,293	1,094,795	1,354,198
10	C&I Custom Incentives[14]	12,640	769,818	463,519
11	C&I New Construction	1,121	349,344	668,500
12	C&I Retro-Commissioning[15]	2,341	71,323	5,964
13	C&I Information/Feedback	0	0	0
Total MWh		**65,789**	**3,943,499**	**4,757,954**
Baseline Forecast		**38,846,347**	**40,248,500**	**43,180,986**
Program Savings as % of Baseline		**0.17%**	**9.80%**	**11.02%**

[14] Note that this program experiences a drop-off in energy savings during the last 10 years of the forecast. This is due to the fact that many of the measures that were specified for this program were deployed from the beginning of the forecast period because they passed the economic screen at that time. Unlike other programs in the portfolio, very few measures were added in future years under this program. Because we assumed that savings would no longer be counted in the program once the measure lifetime expired, overall savings began to erode after 2020, when many of the initial measures' lifetimes expired.
[15] See Footnote 14.

Table 5-2 MAP Peak Demand Savings by EE Program

Program		Peak Demand Savings (MW)		
		2010	**2020**	**2030**
1	Residential Lighting & Appliances	0.3	67.0	166.0
2	Multi-Family Common Area	0.2	30.0	44.7
3	Residential New Construction	0.2	48.4	93.9
4	Residential HVAC Equipment & Diagnostics	2.6	129.3	171.8
5	Home Energy Performance	3.9	175.9	164.9
6	Residential Low Income	0.3	14.1	4.1
7	Residential Appliance Recycling	5.1	39.0	14.7
8	Residential Information/Feedback	0.0	0.0	0.0
9	C&I Standard Incentives	2.1	239.5	314.5
10	C&I Custom Incentives	5.0	238.3	128.1
11	C&I New Construction	0.2	77.5	149.6
12	C&I Retro-Commissioning	0.4	12.6	1.1
13	C&I Information/Feedback	0.0	0.0	0.0
Total MW		**20.5**	**1,071.8**	**1,253.2**
Baseline Forecast		**7,749**	**8,356**	**9,127**
Program Savings as % of Baseline Forecast		**0.27%**	**12.83%**	**13.73%**

The estimates of energy savings yield the following observations:

- In 2010, the first full program year (2009 is a partial year), MAP program savings are estimated to reach 66 GWh. This represents less than 1% of the baseline forecast.
- By 2020, MAP program savings are estimated to reach 3,943 GWh, which represents a significant 9.8% of the baseline forecast.
- By 2030, MAP program savings are estimated to reach 4,758 GWh, which represents over 11% of the baseline forecast.

With respect to peak demand, the energy-efficiency programs contribute the following savings:

- In 2010, peak-demand savings are 20.5 MW. This represents less than 1% of the baseline forecast.
- By 2020, peak-demand savings from EE programs are expected to reach 1,072 MW, which represents almost 13% of the baseline forecast.
- By 2030, savings are expected to reach 1,253 MW, which represents nearly 14% of the baseline peak-demand forecast.

It is clear that these savings figures are significant. When benchmarked relative to what other studies are reporting, these MAP savings appear to be in line with expectations. For example, the EPRI National Potential Study assessed maximum achievable potential at the Midwest regional level. That study reports an estimated MAP savings of 10.1% after 20 years. The ACEEE conducted a study for the Energy Center of Wisconsin (ECW) of Wisconsin's statewide energy efficiency potential, which reported a significantly higher 13% after 10 years (compared with the AmerenUE estimate of just under 10%. It is not surprising that the ECW estimates are considerably higher since Wisconsin has had an energy efficiency mindset for many years and has implemented programs through a public goods funding mechanism.

5.1.2 EE RAP Estimates by Program

Figure 5-2 and Table 5-3 present the estimated RAP energy reductions for key programs at select years over the 20-year time horizon. RAP reflects lower participation rates than MAP, and a ramping up period with respect to program awareness. For example, lower incentives to customers result in reduced participation rates. Reduced program spending in RAP (relative to MAP) also comes about because of budget limitations and resource constraints, both within the implementation organizations and with the vendor communities. Table 5-4 presents the RAP peak demand reductions for each program by selected year.

Figure 5-2 RAP Savings by EE Program

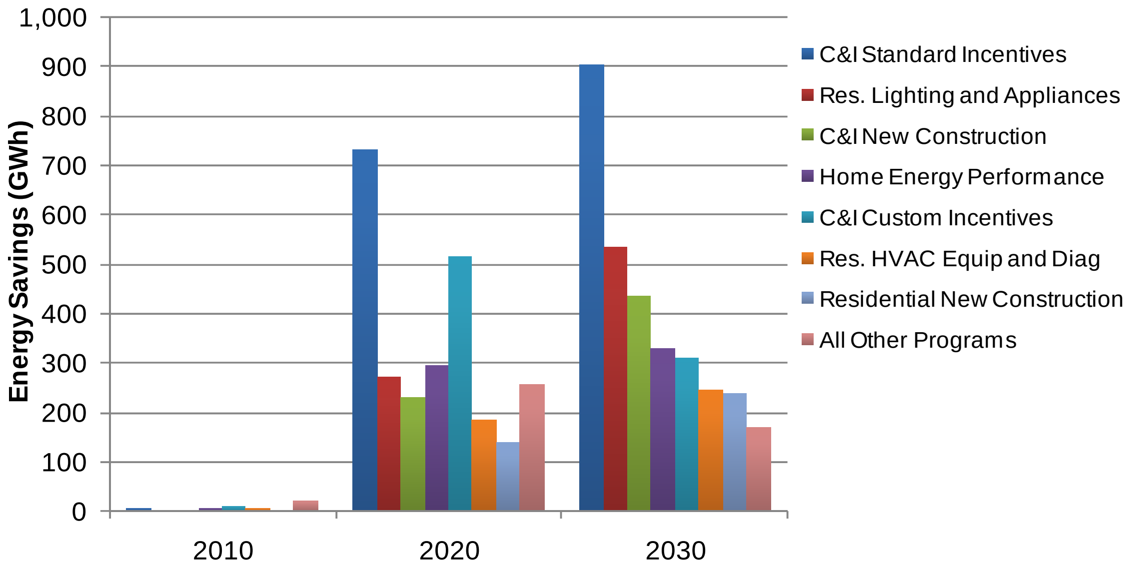


Table 5-3 RAP Energy Savings by EE Program

Program		Energy Savings (MWh)		
		2010	2020	2030
1	Residential Lighting & Appliances	4,085	272,396	535,706
2	Multi-Family Common Area	929	88,578	120,487
3	Residential New Construction	880	138,428	238,126
4	Residential HVAC Equipment & Diagnostics	4,682	184,430	243,708
5	Home Energy Performance	7,901	295,767	330,318
6	Residential Low Income	1,365	44,412	10,445
7	Residential Appliance Recycling	14,376	87,486	32,873
8	Residential Information/Feedback	0	0	0
9	C&I Standard Incentives	7,949	731,698	903,074
10	C&I Custom Incentives	10,722	516,093	309,232
11	C&I New Construction	1,558	230,075	435,819
12	C&I Retro-Commissioning	2,885	37,755	5,246
13	C&I Information/Feedback	0	0	0
Total MWh		**57,331**	**2,627,118**	**3,165,034**
Baseline Forecast		**38,846,347**	**40,248,500**	**43,180,986**
Program Savings as % of Baseline		**0.15%**	**6.53%**	**7.33%**

Table 5-4 RAP Peak Demand Savings by EE Program

Program		Peak Demand Savings (MW)		
		2010	**2020**	**2030**
1	Residential Lighting & Appliances	0.3	44.7	110.6
2	Multi-Family Common Area	0.2	20.1	29.8
3	Residential New Construction	0.2	32.4	62.6
4	Residential HVAC Equipment & Diagnostics	2.2	87.2	114.5
5	Home Energy Performance	3.3	118.6	110.1
6	Residential Low Income	0.3	9.5	2.7
7	Residential Appliance Recycling	4.3	26.0	9.8
8	Residential Information/Feedback	0.0	0.0	0.0
9	C&I Standard Incentives	1.8	160.2	209.8
10	C&I Custom Incentives	4.2	159.8	85.4
11	C&I New Construction	0.4	51.1	97.6
12	C&I Retro-Commissioning	0.5	6.7	1.2
13	C&I Information/Feedback	0.0	0.0	0.0
Total MW		**17.7**	**716.3**	**834.2**
Baseline Forecast		**7,749**	**8,356**	**9,127**
Program Savings as % of Baseline		**0.23%**	**8.57%**	**9.14%**

The estimates of energy savings yield the following observations:

- In 2010, the first full program year (2009 is a partial year), RAP program savings are estimated to reach 57 GWh. This represents less than 1% of the baseline forecast.
- By 2020, RAP program savings are estimated to reach 2,627 GWh, which represents a significant 6.5% of the baseline forecast.
- By 2030, RAP program savings are estimated to reach 3,165 GWh, which represents over 7% of the baseline forecast.

With respect to peak demand, the energy-efficiency programs contribute the following savings:

- In 2010, peak-demand savings are 17.7 MW, less than 1% of the baseline forecast.
- By 2020, peak-demand savings from EE programs are expected to reach 716 MW, which represents 8.6% of the baseline forecast.
- By 2030, savings are expected to reach 834 MW, which represents over 9% of the baseline peak-demand forecast.

It is evident that even for the RAP case, the estimated savings figures are quite significant. It is difficult to find other studies that one can make comparisons in an apples-to-apples context. However, when benchmarked relative to some of the other studies referenced in the MAP section above, these savings estimates appear to be in line with expectations. For example, the EPRI National Potential Study yields Midwest-specific RAP savings of 7.5% after 20 years (compared to 7.3% in this study). The ECW referenced above did not report RAP estimates.

5.1.3 EE BAU Estimates by Program

Figure 5-3 illustrates the estimated BAU energy reductions for key programs at select years over the 20-year time horizon. While this is not new information for this study (given that these data were provided to Global by AmerenUE for the purpose of benchmarking MAP and RAP estimates), it is useful to view the MAP and RAP results in the context of BAU. It is important to point out that in all cases, AmerenUE's current 3-year implementation plan is modeled as fully operational from 2010 to 2012. This is considered part of the BAU programs, but is not included in the RAP and MAP programs, which fully kick in after 2012. Beyond that time period, the impacts of MAP and RAP programs ramp in and essentially dominate the savings opportunities relative to the 2010-2012 BAU programs.

Figure 5-3 BAU Savings by EE Program

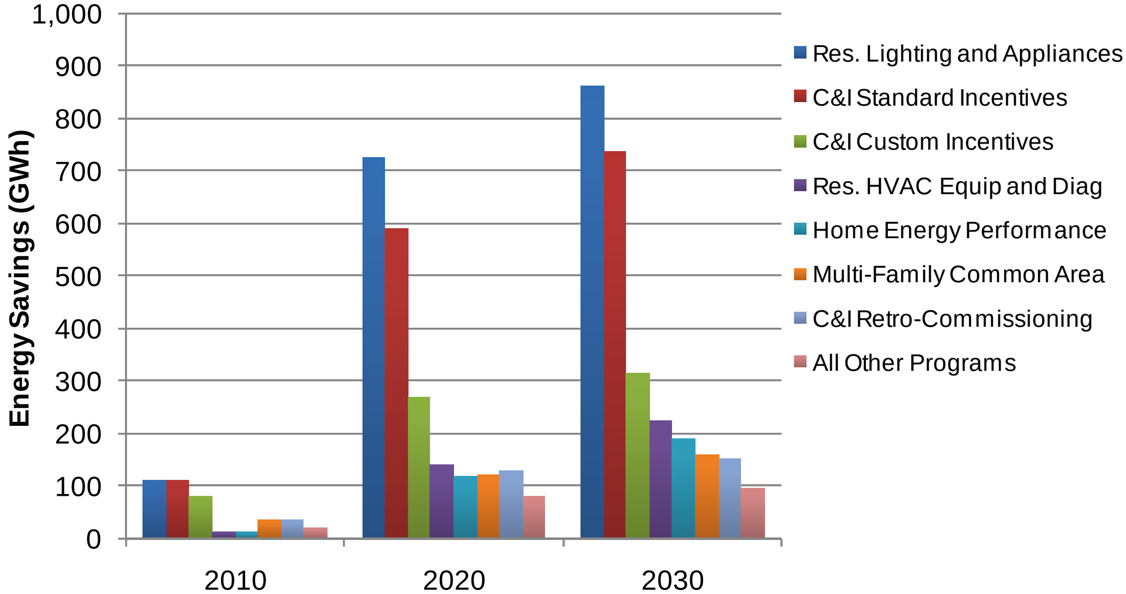


Table 5-5 presents the BAU energy savings for each program by select year in the 20-year forecast period. Table 5-6 presents the BAU peak demand reductions for each program by selected year.

Table 5-5 BAU Energy Savings by EE Program

Program		Energy Savings (MWh)		
		2010	2020	2030
1	Residential Lighting & Appliances	112,670	725,088	863,713
2	Multi-Family Common Area	34,026	124,393	159,930
3	Residential New Construction	4,012	13,898	6,111
4	Residential HVAC Equipment & Diagnostics	13,692	142,827	224,754
5	Home Energy Performance	14,463	119,287	189,773
6	Residential Low Income	13,742	57,146	74,301
7	Residential Appliance Recycling	0	0	0
8	Residential Information/Feedback	0	0	0
9	C&I Standard Incentives	109,738	592,019	735,627
10	C&I Custom Incentives	81,297	269,469	315,827
11	C&I New Construction	2,451	10,621	16,339
12	C&I Retro-Commissioning	37,357	129,660	153,997
13	C&I Information/Feedback	0	0	0
Total MWh		**423,447**	**2,184,408**	**2,740,372**
Baseline Forecast		**38,846,347**	**40,248,500**	**43,180,986**
Program Savings as % of Baseline		**1.09%**	**5.43%**	**6.35%**

Table 5-6 BAU Peak Demand Savings by EE Program

Program		Peak Demand Savings (MW)		
		2010	**2020**	**2030**
1	Residential Lighting & Appliances	9.6	61.7	73.8
2	Multi-Family Common Area	6.2	25.1	32.1
3	Residential New Construction	1.0	3.5	2.7
4	Residential HVAC Equipment & Diagnostics	2.8	27.8	37.5
5	Home Energy Performance	2.0	17.5	30.8
6	Residential Low Income	0.8	4.1	10.0
7	Residential Appliance Recycling	0.0	0.0	0.0
8	Residential Information/Feedback	0.0	0.0	0.0
9	C&I Standard Incentives	16.6	86.6	111.6
10	C&I Custom Incentives	10.6	35.0	41.1
11	C&I New Construction	0.8	3.4	5.2
12	C&I Retro-Commissioning	4.4	5.9	6.9
13	C&I Information/Feedback	0.0	0.0	0.0
Total MW		**54.9**	**270.6**	**351.8**
Baseline Forecast		**7,749**	**8,356**	**9,127**
Program Savings as % of Baseline		**0.71%**	**3.24%**	**3.85%**

The estimates of energy savings yield the following observations:

- In 2010, BAU program savings are estimated to reach 423 GWh. This represents less than 1% of the baseline forecast.
- By 2020, BAU program savings are estimated to reach 2,184 GWh, which represents a significant 5.4% of the baseline forecast.
- By 2030, MAP program savings are estimated to reach 2,740 GWh, which represents 6.4% of the baseline forecast.

With respect to peak demand, the energy-efficiency programs contribute the following savings:

- In 2010, peak-demand savings are 55 MW. This represents less than 1% of the baseline forecast.
- By 2020, peak-demand savings from EE programs are expected to reach 271 MW, which represents 3.2% of the baseline forecast.
- By 2030, savings are expected to reach 352 MW, which represents 3.9% of the baseline peak-demand forecast.

It is noteworthy that BAU program savings are in line with commonly-known experience of utilities achieving energy savings in the 0.5% to 1% range in the early years of the program. However, over time the savings only grow to 6.4% after 20 years. This translates to an annual savings of 0.34%, which is not among the industry-leading utilities. According to the EIA Form EIA-861 (Annual Electric Power Industry Report) survey data for 2006, utilities from two states in New England lead the nation with annual energy reductions greater than 1%. California's utilities, long known as major leaders in the energy efficiency industry, report 0.73% annual savings.[16]

[16] Source: ACEEE 2008 State Energy Efficiency Scorecard.

5.1.4 Overall EE Potential Estimates

Figure 5-4 illustrates the various level of EE potential, from business as usual through technical potential. The graph provides the percentage reduction relative to the baseline forecast in each year and for each level of potential.

Figure 5-4 Summary of all EE Potential Types

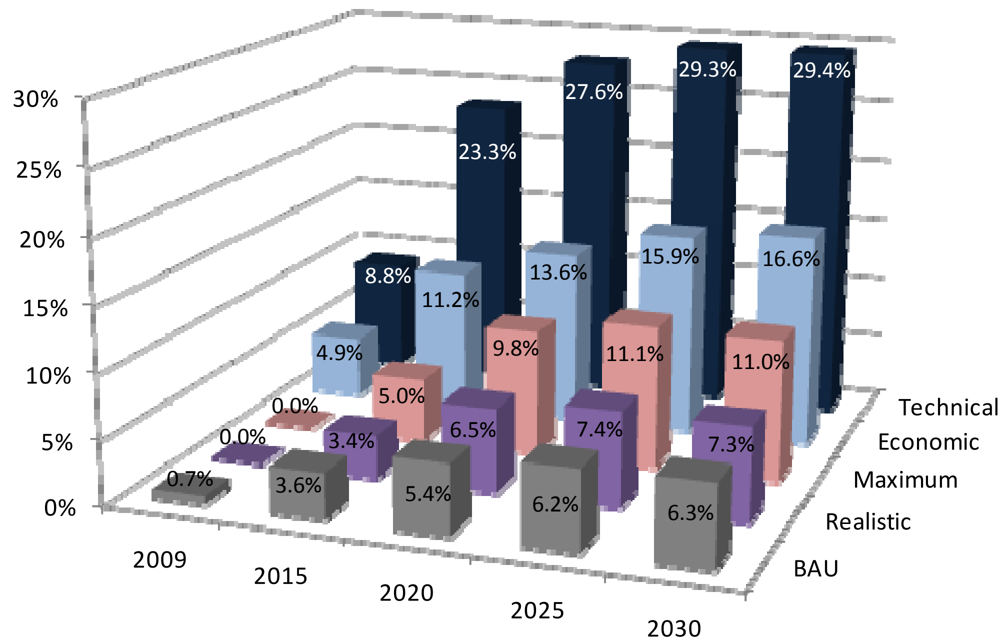


Table 5-7 displays the different levels of potential both as GWh per year and as a percentage of baseline forecast.

- MAP in 2030 is 4,758 GWh, about 11% of the total forecasted sales. This represents more than a third of technical potential and nearly two-thirds of economic potential.
- RAP in 2030 is 3,165 GWh, 7.3% of total forecasted sales. This represents 25% of technical potential and 44% of economic potential.
- BAU in 2030 is 2,740 GWh, 6.3% of total forecasted usage.

Table 5-7 AmerenUE EE Potential Estimates (GWh)

	2009	2015	2020	2025	2030
Baseline Electricity Forecast (GWh)	38,839	39,057	40,248	41,899	43,181
Energy Savings (GWh)					
Technical Potential	3,434	9,115	11,098	12,296	12,696
Economic Potential	1,895	4,392	5,475	6,657	7,181
Maximum Achievable	13	1,950	5,475	4,655	4,758
Realistic Achievable	12	1,316	3,943	3,098	3,165
Business as Usual	264	1,399	2,184	2,596	2,740
Energy Savings as % of Baseline					
Technical Potential	8.8%	23.3%	27.6%	29.3%	29.4%
Economic Potential	4.9%	11.2%	13.6%	15.9%	16.6%
Maximum Achievable	0.0%	5.0%	9.8%	11.1%	11.0%
Realistic Achievable	0.0%	3.4%	6.5%	7.4%	7.3%
Business as Usual	0.7%	3.6%	5.4%	6.2%	6.3%

5.2 EE PROGRAM SPENDING

An important result from this study is program spending, both from an annual perspective and cumulative. Figure 5-5 illustrates the year-by-year EE program spending over the entire 22-year time horizon (2009-2030). The figure illustrates that for BAU and RAP, the annual spend is roughly equivalent (yet the RAP savings are significantly higher than BAU in each year after about 2013). The figure also illustrates the fact that the MAP spend is significantly higher than RAP and BAU. Of course, MAP savings are substantially higher than BAU and RAP. The results lead to the obvious conclusion that it will cost significantly more to get additional savings.

Figure 5-5 Annual EE Program Spending[17]

[17] Note that annual spending for MAP and RAP was calibrated to the BAU for the purposes of creating this illustration. The calibration was done such that spending amounts in the first two years of the programs would be roughly comparable across the three levels (MAP, RAP and BAU). The actual analyses of MAP and RAP (in terms of savings and cost-effectiveness) were conducted independently of BAU.

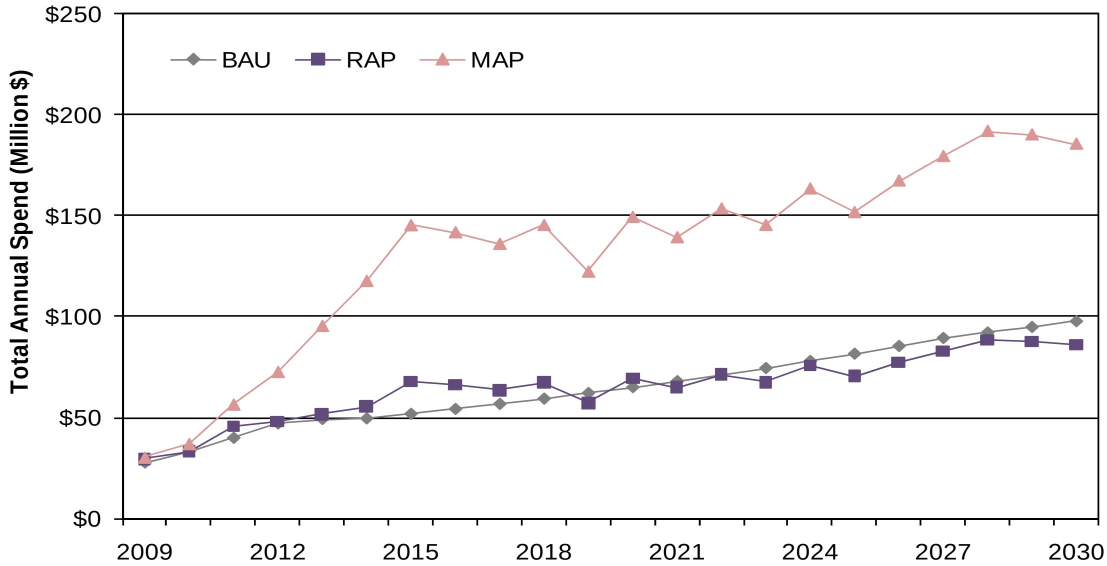


Table 5-8 reports annual program spending for three snapshot years – 2010, 2020 and 2030 – for MAP, RAP and BAU. The table also indicates the cumulative spending over the entire 22-year time horizon from 2009 to 2030 for MAP, RAP and BAU. While all three program levels appear to have roughly the same spending levels in 2010, there are significant variations in the program spending in the out years. By 2030, the cumulative spend for BAU and RAP are roughly the same at $1.4 billion. For MAP however, the cumulative spend is $2.9 billion. Again, it is interesting to note that the BAU and RAP spending levels for EE are not significantly different yet the estimated savings are significantly higher for RAP than they were projected under BAU.

Table 5-8 Annual and Cumulative EE Program Spending[18]

EE Program Level	Annual Program Spend (Million $)			Cumulative Spend to 2030 (Million $)
	2010	2020	2030	
Business-as-usual (BAU)	$33.3	$65.0	$97.7	$1,428.1
Realistic Achievable Potential (RAP)	$33.2	$69.5	$86.1	$1,428.6
Maximum Achievable Potential (MAP)	$37.1	$149.3	$185.5	$2,917.3

5.3 EE PROGRAM COST-EFFECTIVENESS ANALYSIS

The results of the TRC test analysis show that each of the proposed EE programs is cost effective. While nearly all programs passed the cost screening with benefit/cost (B/C) ratios greater than one, some programs are more cost effective than others. This conclusion can also be drawn by looking at the levelized cost for each program and for the portfolio as a whole. These two perspectives are explored below to highlight the program cost-effectiveness – B/C ratios and levelized cost.

5.3.1 Benefit/Cost Ratios

Table 5-9 presents the results of the TRC analysis by program for MAP. Table 5-10 presents these same results for RAP and Table 5-11 presents these same results for the BAU.[19] Detailed results that contain program-by-program cost-effectiveness figures are provided in Appendix C, first for MAP, then RAP and finally BAU. The tables in Appendix C also provide year-by-year

[18] See the previous footnote as to how the program costs were treated in the first few years of the program in order to calibrate spending between MAP, RAP and BAU.

[19] Note that the B/C ratios presented for BAU are directly from the AmerenUE IRP.

energy savings, peak demand reductions, administrative costs, incentive costs, and customer costs.

Table 5-9 TRC Cost Effectiveness Results by EE Program for MAP

Program		Total Resource Cost			
		Lifetime Benefits (Million$)	Lifetime Costs (Million $)	Net Benefits (Million $)	B/C Ratio
1	Residential Lighting & Appliances	$562.2	$510.5	$51.7	1.10
2	Multi-Family Common Area	$151.6	$108.0	$43.6	1.40
3	Residential New Construction	$271.6	$276.0	-$4.4	0.98
4	Residential HVAC Equipment & Diagnostics	$387.9	$207.6	$180.3	1.87
5	Home Energy Performance	$559.2	$368.7	$190.5	1.52
6	Residential Low Income	$64.3	$26.7	$37.6	2.41
7	Residential Appliance Recycling	$134.7	$30.3	$104.4	4.44
8	Residential Information/Feedback[20]	NA	NA	NA	NA
9	C&I Standard Incentives	$1,181.2	$738.0	$443.2	1.60
10	C&I Custom Incentives	$777.4	$279.7	$497.7	2.78
11	C&I New Construction	$453.8	$337.1	$116.7	1.35
12	C&I Retro-Commissioning	$54.9	$38.2	$16.6	1.43
13	C&I Information/Feedback[21]	NA	NA	NA	NA
Total		**$4,598.9**	**$2,921.1**	**$1,677.8**	**1.57**

Table 5-10 TRC Cost Effectiveness Results by EE Program for RAP

Program		Total Resource Cost			
		Lifetime Benefits (Million$)	Lifetime Costs (Million $)	Net Benefits (Million $)	B/C Ratio
1	Residential Lighting & Appliances	$375.4	$326.4	$49.0	1.15
2	Multi-Family Common Area	$101.3	$69.4	$31.9	1.46
3	Residential New Construction	$181.6	$179.4	$2.2	1.01
4	Residential HVAC Equipment & Diagnostics	$261.4	$135.9	$125.5	1.92
5	Home Energy Performance	$376.7	$243.3	$133.4	1.55
6	Residential Low Income	$43.3	$14.8	$28.5	2.93
7	Residential Appliance Recycling	$91.3	$24.7	$66.6	3.69
8	Residential Information/Feedback22	NA	NA	NA	NA
9	C&I Standard Incentives	$789.8	$460.9	$328.9	1.71
10	C&I Custom Incentives	$521.7	$170.4	$351.2	3.06
11	C&I New Construction	$298.5	$207.9	$90.7	1.44
12	C&I Retro-Commissioning	$31.1	$22.4	$8.7	1.39
13	Residential Information/Feedback23	NA	NA	NA	NA
Total		**$3,072.0**	**$1,855.5**	**$1,216.5**	**1.66**

[20] There are no benefits associated with this program since it is an information-only program aimed at changing customer behavior in their use of energy. The costs associated with the information campaigns are pro-rated to the other programs for the purpose of estimating the cost-effectiveness.
[21] See footnote 20 above.
[22] See footnote 20 above.
[23] See footnote 20 above.

Table 5-11 TRC Cost Effectiveness Results by EE Program for BAU

Program		B/C Ratio
1	Residential Lighting & Appliances	2.29
2	Multi-Family Common Area	2.63
3	Residential New Construction	1.00
4	Residential HVAC Equipment & Diagnostics	1.55
5	Home Energy Performance	2.39
6	Residential Low Income	0.88
7	Residential Appliance Recycling[24]	NA
8	Residential Information/Feedback[25]	NA
9	C&I Standard Incentives	1.89
10	C&I Custom Incentives	2.23
11	C&I New Construction	1.14
12	C&I Retro-Commissioning	3.17
13	C&I Information/Feedback[26]	NA
Total		**1.95**

5.3.2 Levelized Cost

Another indicator of program cost-effectiveness is the levelized cost of saved energy as a result of the EE programs. This computation is a common industry benchmark and is useful for comparison purposes. The levelized cost is calculated as the net present value of the total utility costs (administration and incentives) expended over the lifetime of the program divided by the lifetime energy savings resulting from the program. Levelized cost over the full 22-year time horizon (2009-2030) was developed using the utility cost (UC) test. Table 5-12 displays the program-specific and total portfolio levelized cost under each program level (MAP, RAP, and BAU).

Table 5-12 Levelized Cost by 2030 (based on the Utility Cost perspective)

Program	Levelized Cost ($/kWh)		
	MAP	RAP	BAU
Residential Lighting & Appliances	$0.040	$0.028	$0.013
Multi-Family Common Area	$0.028	$0.020	$0.019
Residential New Construction	$0.063	$0.043	$0.027
Residential HVAC Equipment & Diagnostics	$0.025	$0.018	$0.035
Home Energy Performance	$0.025	$0.017	$0.022
Residential Low Income	$0.031	$0.026	$0.057
Residential Appliance Recycling	$0.033	$0.031	NA
Residential Information/Feedback	NA	NA	NA
C&I Standard Incentives	$0.025	$0.017	$0.025
C&I Custom Incentives	$0.018	$0.012	$0.020
C&I New Construction	$0.023	$0.016	$0.065
C&I Retro-Commissioning	$0.036	$0.030	$0.007
C&I Information/Feedback	NA	NA	NA
Total	**$0.024**	**$0.017**	**$0.021**

[24] This program was not considered by AmerenUE in its IRP.
[25] See footnote 24 above.
[26] See footnote 24 above.

CHAPTER | 6

DEMAND RESPONSE PROGRAM RESULTS

This chapter presents demand-response potential estimates, total program spending, and cost-effectiveness results for the DR programs. Note that unlike energy efficiency potential, which is assessed at the measure level and then transitioned to the program level, DR must be assessed at a program level from the outset. That is, technical, economic, and achievable are program-level concepts for DR. This is due to the fact that DR programs are more or less representations of actions that participants take when asked to do so. Energy efficiency is initiated by measures that are installed at one time. Therefore, DR does not have any of the types of measures that can be assessed in a detailed measure-based framework. Savings from demand response only occur when a DR event is called by the utility. The results that are presented in this section outline the DR program potential at the technical, economic and achievable levels.

6.1 DR POTENTIAL ESTIMATES

The following sections present the estimates of the five levels of DR potential described in the analysis framework. It is important to keep in mind that these are estimates of potential DR savings under a specific set of assumptions. Technical potential represents a theoretical upper bound of potential assuming 100% participation in the proposed set of DR programs, without regard to cost. Economic potential assumes 100% participation in only those DR programs that are cost-effective. MAP represents the upper bound of potential and customer take rates on the proposed set of DR programs. RAP represents DR potential that might be achieved through the proposed set of DR programs and a more realistic set of customer take rates. And finally, BAU represents AmerenUE's 2008 IRP estimate of DR program potential, drawing upon secondary data.

Recall that the economic potential represents full participation in cost effective programs. Since each of the proposed DR programs passed the cost-effectiveness screening, estimates of technical and economic potential are identical.

Potential estimates for MAP, RAP and BAU by program are presented below, followed by overall results for AmerenUE.

6.1.1 DR MAP by Program

Figure 6-1 shows the MW reductions in key program years. Like the Achievable Scenario in the FERC National Study, the Residential Dynamic Pricing program is the largest single contributor to overall MAP, dominating the graph. The next largest programs are C&I Dynamic Pricing, and Residential Direct Load Control. The huge jump in both the residential and C&I dynamic pricing impacts that occurs between 2010 and 2020 result from the high participation rates enabled by the assumed AMI implementation. With 75% of the total residential customer base participating in dynamic pricing, the impacts increase to nearly 700 MW in PY 2020-2030.

Figure 6-1 MAP by DR Program

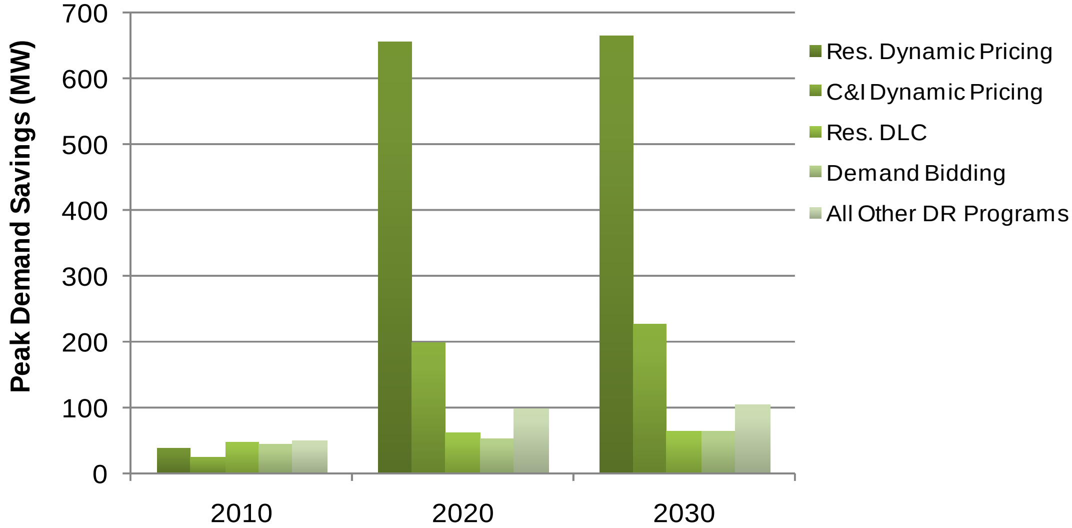


Table 6-1 presents peak demand savings estimates by program under MAP assumptions. Energy savings estimates (not presented in the table) assume sixty event hours per season.

Table 6-1 MAP MW Savings by Program

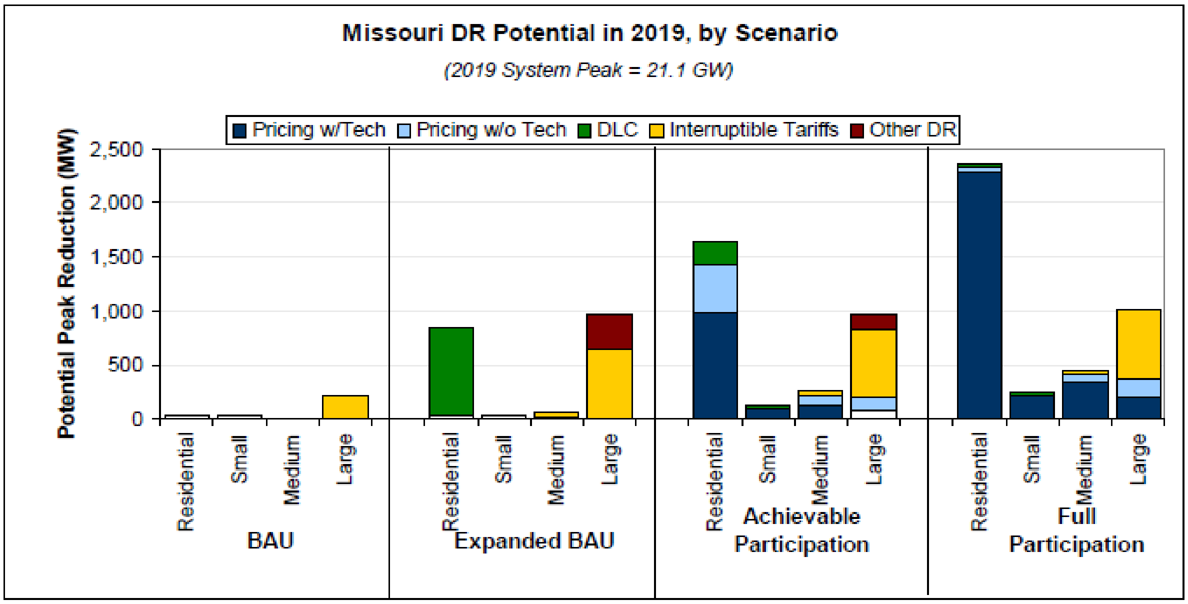
Program		Peak Demand Savings (MW)			
		2009	2010	2020	2030
1	Residential Direct Load Control	0.0	47.7	63.3	65.9
2	Residential Dynamic Pricing	0.0	39.9	656.0	664.4
3	C&I Direct Load Control	0.0	7.6	30.6	33.6
4	C&I Dynamic Pricing	0.0	23.9	200.4	226.7
5	Demand Bidding	0.0	45.1	54.5	64.4
6	Curtailable	0.0	36.1	37.5	41.1
7	DR Aggregator Contracts	1.5	7.5	30.0	30.0
Total MW		**1.5**	**207.9**	**1,072.3**	**1,126.0**
Baseline Forecast		**7,642**	**7,749**	**8,356**	**9,127**
Program Savings as % of Baseline		**0.02%**	**2.68%**	**12.83%**	**12.34%**

Again, the dominance of the dynamic pricing programs in the MAP scenario is obvious. Residential Dynamic Pricing accounts for 59% of the total impacts and C&I dynamic pricing accounts for 20% of the total impacts. The large dynamic pricing programs consequently reduce the potential for other types of DR programs such as DLC. The residential DLC program, for example, is quite small in the MAP scenario because of high dynamic pricing participation and a restriction on dual program participation. Within a class, programs are mutually exclusive to prevent double counting of benefits between programs that target the same load at the same time. Therefore, if 75% of the population is participating in dynamic pricing, only 25% of the population is eligible for DLC. Within that 25%, only the customers that have the appropriate end use (determined by appliance saturations) can actually participate in a DLC program, which further shrinks the pool of potential participants.

A similar phenomenon can be seen in the FERC study by comparing its Expanded BAU impacts, which assumes opt-in dynamic pricing and best practices participation in existing programs like

DLC, with its Achievable impacts, which assumes default dynamic pricing. Figure 6-2 presents the FERC Missouri DR potential peak reduction in 2019[27]. Looking at the residential class under the Expanded BAU, nearly 100% of the impacts are coming from DLC. Now, looking at the Achievable Scenario, close to 90% of total impacts attributable to the residential class are coming from dynamic pricing. This means that there is a trade-off between dynamic pricing and other DR programs: the higher the dynamic pricing participation and impacts become the fewer customers remain eligible to participate in other programs.

Figure 6-2 FERC Study Missouri DR Potential



Source: FERC, A National Assessment of Demand Response Potential

6.1.2 DR RAP by Program

Figure 6-3 shows the MW reductions in key program years. In the RAP analysis the potential attributable to dynamic pricing drops and the potential remaining for other DR programs increases. This is a result of the adjustments made to the pricing program participation rates, from 75% to 56% for residential dynamic pricing and from 20% to 15% for C&I dynamic pricing. Therefore, in RAP, residential dynamic pricing remains, by far, the largest contributor to overall savings, but is followed more closely by the other DR programs.

[27] FERC, "A National Assessment of Demand Response Potential".

Figure 6-3 RAP by DR Program

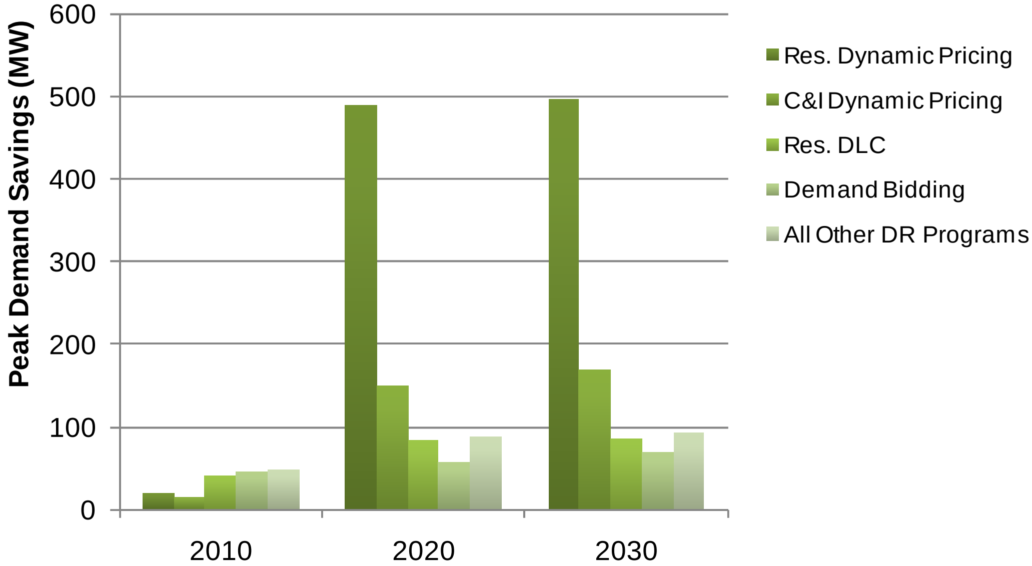


Table 6-2 presents the peak demand savings estimates under RAP assumptions. Energy savings estimates (not presented in the table) assume sixty event hours per season.

Table 6-2 RAP MW Savings by Program

Program		Peak Demand Savings (MW)			
		2009	**2010**	**2020**	**2030**
1	Residential Direct Load Control	0.0	40.3	83.8	87.1
2	Residential Dynamic Pricing	0.0	20.0	489.8	496.1
3	C&I Direct Load Control	0.0	5.4	21.7	23.8
4	C&I Dynamic Pricing	0.0	14.5	150.3	170.0
5	Demand Bidding	0.0	45.1	57.9	68.4
6	Curtailable	0.0	36.1	36.1	38.7
7	DR Aggregator Contracts	1.5	7.5	30.0	30.0
Total MW		**1.5**	**168.9**	**869.5**	**914.1**
Baseline Forecast		**7,642**	**7,749**	**8,356**	**9,127**
Program Savings as % of Baseline		**0.02%**	**2.18%**	**10.41%**	**10.01%**

In RAP, the dynamic pricing programs are still very dominant, but to a lesser degree. Here, residential dynamic pricing accounts for 54% of the total impact and C&I dynamic pricing accounts for 19% of the total impact in PY 2030. The slightly lower contributions and lower dynamic pricing participation rates in RAP have allowed the residential DLC program to grow in this scenario, from 66 MW under MAP to 87 MW under RAP.

6.1.3 DR BAU Estimates by Program

Figure 6-4 shows the MW reductions in key program years. In the BAU case, the majority of peak load reductions come from Direct Load Control and Interruptible programs.

Figure 6-4 BAU by DR Program

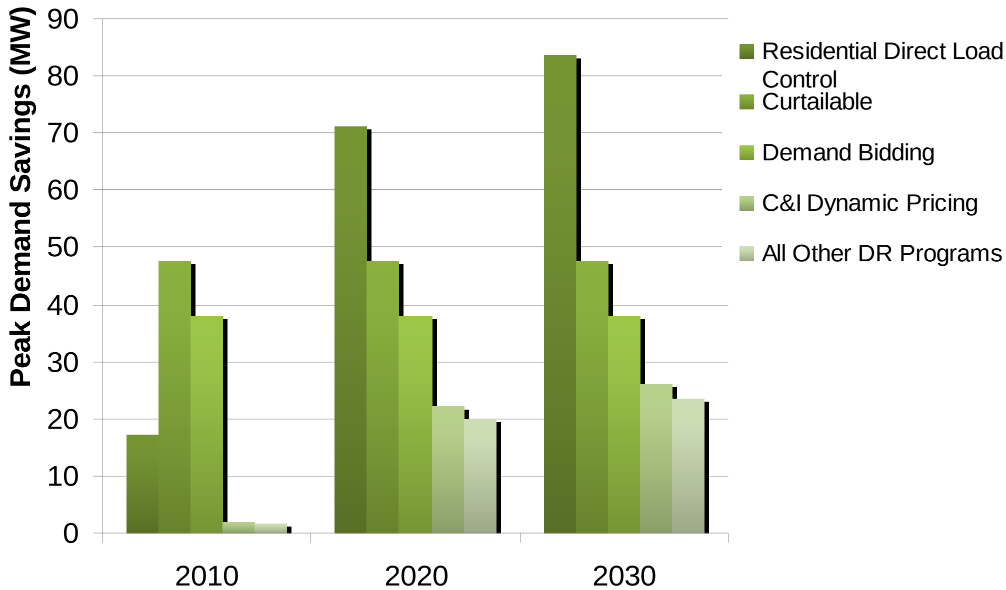


Table 6-3 presents the peak demand savings estimates under the BAU assumptions. Energy savings estimates (not reported in the table) are based on the assumptions developed by AmerenUE to support the BAU portfolio of programs.

Table 6-3 BAU MW Savings by Program

Program		Peak Demand Savings (MW)			
		2009	2010	2020	2030
1	Residential Direct Load Control	11.3	17.3	71.2	83.6
2	Residential Dynamic Pricing	0.0	1.8	20.0	23.4
3	C&I Direct Load Control	0.0	0.0	0.0	0.0
4	C&I Dynamic Pricing	0.0	2.0	22.3	26.1
5	Demand Bidding	38.0	38.0	38.0	38.0
6	Curtailable	47.5	47.5	47.5	47.5
7	DR Aggregator Contracts	0.0	0.0	0.0	0.0
Total MW		**96.8**	**106.5**	**198.9**	**218.6**
Baseline Forecast		**7,642**	**7,749**	**8,356**	**9,127**
Program Savings as % of Baseline		**1.27%**	**1.37%**	**2.38%**	**2.40%**

When the BAU program design was conducted, more of the traditional DR program types (Residential Direct Load Control and Curtailable) were very dominant. Here, these two programs alone make up for 60% of the total impact.

6.1.4 Overall DR Potential Estimates

Figure 6-5 illustrates the various level of DR potential, from Technical through to the three levels of achievable. The graph provides the percentage reduction relative to the baseline forecast at each level of potential.

Figure 6-5 Summary of all DR Potential Types

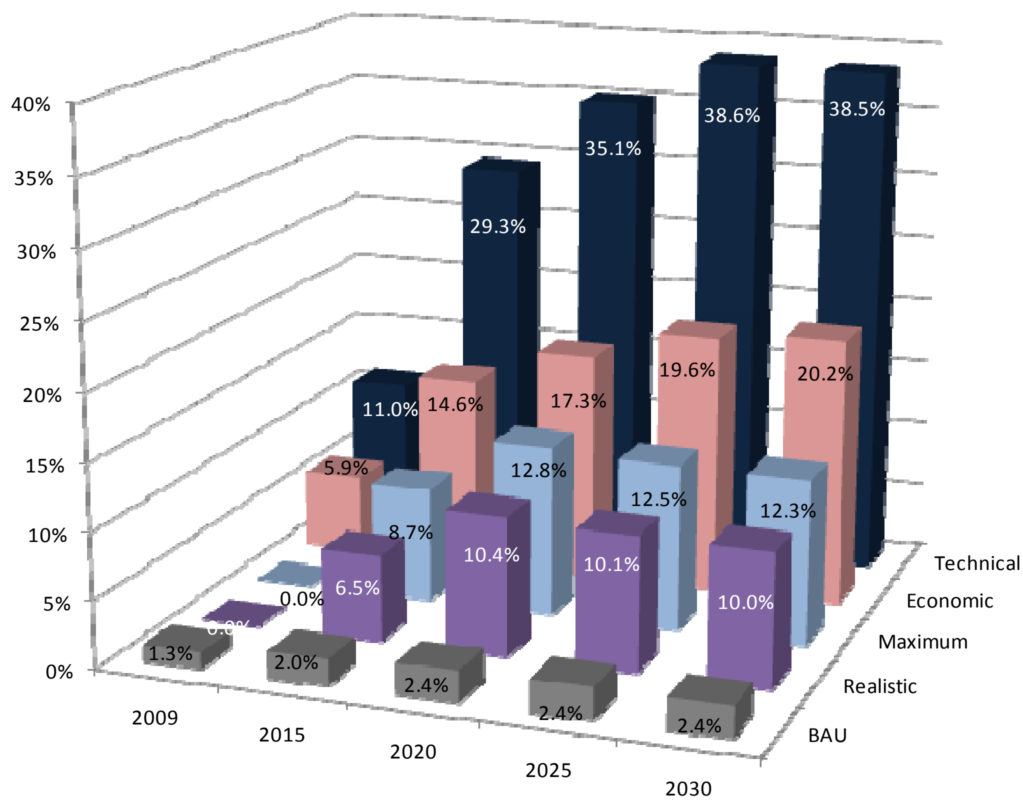


Table 6-4 displays the different levels of potential both as MW/year and as a percentage of baseline forecast.

- Total RAP comes to 914 MW in 2030 and about 10.6% of the total forecasted system load.
- Total MAP in 2030 totals 1,126 MW and 12.9% of total forecasted system load.
- Economic and technical potential reach 2,254 MW and 24.7% of total forecasted system load.

Table 6-4 AmerenUE DR Potential Estimates

	2009	2015	2020	2025	2030
Baseline Peak Demand Forecast (MW)	**7,642**	**8,003**	**8,356**	**8,752**	**9,127**
Peak Demand Savings (MW)					
Technical Potential	2	2,102	2,098	2,173	2,254
Economic Potential	2	2,102	2,098	2,173	2,254
Maximum Achievable Potential	2	694	1,072	1,090	1,126
Realistic Achievable Potential	2	520	870	885	914
Business as Usual	97	160	199	213	219
Peak Savings as % of Baseline					
Technical Potential	0.0%	26.3%	25.1%	24.8%	24.7%
Economic Potential	0.0%	26.3%	25.1%	24.8%	24.7%
Maximum Achievable Potential	0.0%	8.7%	12.8%	12.5%	12.3%
Realistic Achievable Potential	0.0%	6.5%	10.4%	10.1%	10.0%
Business as Usual	1.3%	2.0%	2.4%	2.4%	2.4%

In comparison with other recent studies, AmerenUE estimates are on par. The most recent comparable study is the FERC National Assessment of Demand Response.[28] The FERC study estimates cannot be used in a true apples-to-apples comparison because they are based on different definitions of potential and, therefore, are more pricing-centric. However, they are still useful for benchmarking the AmerenUE potentials estimated in this study. The FERC study estimated potential for the following four scenarios:

- Business as usual (BAU) assumed that current levels of DR were maintained.
- Expanded BAU assumed DR reached participation penetrations at a best practices level.[29]
- Achievable Participation assumed likely customer take rates on an opt-out default dynamic pricing rate structure. Assuming a default rate structure allowed the FERC study to analyze participation rates much higher than anything seen in currently in the industry, upward of 60 - 75%.
- Full Participation assumed 100% participation on dynamic pricing options for all classes.[30]

The Missouri-specific potential estimates in each scenario are as follows: BAU, 1.3%; Expanded BAU, 9%; Achievable Participation, 14.1%; Full Participation 19.2%.

The two scenarios, and underlying assumptions that are the easiest to compare across studies are the FERC Achievable Participation scenario, and the AmerenUE MAP scenario. The FERC Achievable scenario is a bit more aggressive than the AmerenUE MAP scenario in that default dynamic pricing is assumed for all classes. Still, the final estimates are fairly close, with an estimate of 14.1% for FERC and 12.9% for AmerenUE. Interestingly, while the underlying assumptions for the FERC Expanded BAU scenario and the AmerenUE RAP scenario are quite different, the estimates are remarkably close with an estimated 9% potential for FERC and 10.6% potential for AmerenUE.

The estimates presented here are reasonable and consistent with policies at AmerenUE and regulations in the state of Missouri. A demand reduction of 6.5% (RAP estimate) in six years is in

[28] FERC, "A National Assessment of Demand Response Potential".
[29] Best practices participation was defined as the 75th percentile of the distribution of achieved participation rates for current DR programs by type.
[30] Large C&I did maintain a 6.9% participation rate for interruptible/ curtailable programs.

line with goals set by other states and being estimated by other utilities. Pennsylvania just passed a peak load reduction requirement calling for a 4.5% reduction in peak load by 2013. Also, the California Energy Action Plan set a goal to achieve an initial peak load reduction of 5% in four years. Pacific Gas and Electric, with one of the most developed DR portfolios in the country, is looking at a current DR impact contribution of about 3.5% of system peak. Once their AMI system and new voluntary CPP style rates are fully deployed in 2012, they expect their DR impacts to almost double, for a 6-7% contribution to system peak.

Looking further into the future and beyond an AMI deployment, higher overall estimates can be expected. This is also consistent with what other utilities are predicting. One of the main benefits of an AMI system, aside from operational savings, is the ability to enable dynamic pricing programs on a much larger scale than previously possible. The use of residential PTR as a default dynamic pricing program significantly increases the potential impacts by maximizing the number of participants and minimizing negative impacts on customers. AMI and the additional marketing efforts that take place simultaneously with meter installs can also be used to significantly increase participation on voluntary dynamic pricing rates, like C&I CPP. In total, AmerenUE potential estimates show an increase in DR impacts from 6.8% in PY 2015 to 11% in PY 2020 at the end of the assumed AMI implementation.

6.2 DR PROGRAM SPENDING

An important result from this study was a look at the program spending, both from an annual perspective and cumulative. Figure 6-6[31] illustrates the year-by-year DR program spending over the entire 22-year time horizon (2009-2030). The figure illustrates significant fluctuations in the annual spending for all three cases. In the RAP case, it is assumed that AMI comes in around 2015 and that opt-in dynamic pricing is implemented afterwards. Since opt-in pricing assumes that participants are voluntary, the rates of growth in spending are what would typically be expected in a DR program.

However, for the MAP case, the spending grows dramatically in the first 5 years (2009-2013), reflecting a significant ramp-up of participation in traditional DR programs such as Direct Load Control and Curtailable as well as newer DR programs such as opt-in dynamic pricing tariffs. Beginning in 2014 the spending drops down for the one year, and then again rises dramatically until about 2020. This is occurring because it is assumed that customers are participating in the dynamic pricing programs on an opt-in or voluntary basis through 2013. In 2014, there is a transition in the pricing program designs from the opt-in style to a more mandatory opt-out style. That means that all customers not currently on a time-based pricing tariff would be defaulted to such a tariff. This transition occurs based on the assumption that the AMI meters begin to become deployed starting in 2015. As AMI deployment is initiated, pricing program expenditures rise to bring on the new participants until 2020 when it is assumed that all available participants are transitioned to the various dynamic pricing programs. While it is merely speculation as to whether opt-out dynamic pricing tariffs would actually be implemented in the AmerenUE service territory during this time, the differences in annual spend between MAP and RAP reveal some important insights about the tradeoffs between opt-out dynamic pricing vs. opt-in dynamic pricing. First, it is clear that there would be significant fluctuations in spending in the dynamic pricing case. Such fluctuations may not be feasible from an AmerenUE operational perspective. Second, as mandatory dynamic pricing tariffs take hold, there is a negative impact on program participation for other non-pricing programs. This situation is clearly revealed in the annual spend, where RAP spending in the last 10 years of the plan is actually higher than MAP spending.

[31] Note that annual spend for MAP and RAP were calibrated to the BAU for the purposes of creating this illustration. The calibration was done such that spending amounts in the first 2 years of the programs would be roughly comparable across the three levels (MAP, RAP and BAU). The actual analyses of MAP and RAP (in terms of savings and cost-effectiveness) were conducted independently of BAU.

Figure 6-6 Annual DR Program Spending

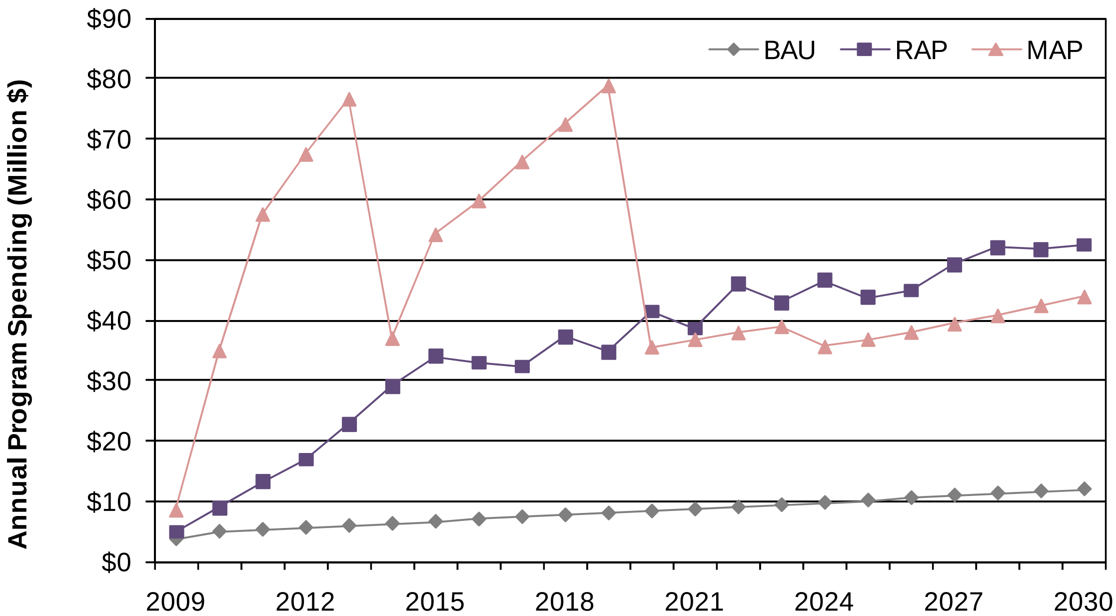


Table 6-5 reports the annual DR spending for three snapshot years – 2010, 2020 and 2030 for MAP, RAP and BAU. The table also indicates the cumulative spend over the entire 22-year time horizon from 2009 to 2030 for MAP, RAP and BAU. While all three program levels appear to have roughly the same spending levels in 2009, by 2030 there are significant variations in the program spending in the out years. By 2030, the cumulative spend for BAU is only $181 million. For RAP it is $777 million, and for MAP it is over $1 billion. Much of the higher cumulative spend for MAP relates to the years when opt-out dynamic pricing tariffs are being phased in, with significant numbers of participants being brought into the tariffs, along with the associated implementation costs.

Table 6-5 Annual and Cumulative DR Program Spending[32]

DR Program Level	Annual Program Spend (Million $)			Cumulative Spend to 2030 (Million $)
	2010	2020	2030	
Business-as-usual (BAU)	$5.0	$8.3	$12.0	$180.6
Realistic Achievable Potential (RAP)	$8.9	$41.5	$52.5	$776.6
Maximum Achievable Potential (MAP)	$35.0	$35.6	$43.9	$1,040.3

6.3 DR PROGRAM COST-EFFECTIVENESS ANALYSIS

The results of the TRC test analysis show that each of the proposed DR programs is cost effective. While nearly all programs passed the cost screening with benefit/cost (B/C) ratios greater than one, some programs are more cost effective than others. This conclusion can also be drawn by looking at the levelized cost for each program and for the portfolio as a whole. These two perspectives are explored below to highlight the program cost-effectiveness – B/C ratios and levelized cost.

[32] See the previous footnote as to how the program costs were treated in the first few years of the program in order to calibrate spending between MAP, RAP and BAU.

6.3.1 Benefit/Cost Ratios

Table 6-6 presents the results of the TRC analysis by program for the MAP analysis. Table 6-7 presents these same results for the RAP.

Table 6-8 presents these same results for the BAU. Detailed results that contain program-by-program cost-effectiveness figures are provided in Appendix D, first for MAP, then RAP and finally BAU. The tables in Appendix D also provide year-by-year energy savings, peak demand reductions, administrative costs, incentive costs, and customer costs.

Table 6-6 TRC Cost Effectiveness Results by DR Program for MAP

Program		Total Resource Cost			
		Lifetime Benefits (Million$)	Lifetime Costs (Million $)	Net Benefits (Million $)	B/C Ratio
1	Residential Direct Load Control	$115.8	$92.8	$23.0	1.25
2	Residential Dynamic Pricing	$604.9	$242.0	$362.9	2.50
3	C&I Direct Load Control	$36.9	$15.3	$21.6	2.42
4	C&I Dynamic Pricing	$214.5	$90.0	$124.5	2.38
5	Demand Bidding	$69.5	$33.8	$35.7	2.06
6	Curtailable	$47.1	$8.3	$38.7	5.64
7	DR Aggregator Contracts	$35.0	$31.9	$3.1	1.10
Total		**$1,123.7**	**$514.1**	**$609.5**	**2.19**

Table 6-7 TRC Cost Effectiveness Results by DR Program for RAP

Program		Total Resource Cost			
		Lifetime Benefits (Million$)	Lifetime Costs (Million $)	Net Benefits (Million $)	B/C Ratio
1	Residential Direct Load Control	$124.2	$85.0	$39.1	1.46
2	Residential Dynamic Pricing	$439.0	$171.0	$268.0	2.57
3	C&I Direct Load Control	$26.2	$11.3	$14.9	2.32
4	C&I Dynamic Pricing	$155.5	$63.8	$91.7	2.44
5	Demand Bidding	$73.2	$34.9	$38.2	2.09
6	Curtailable	$45.0	$8.1	$36.8	5.53
7	DR Aggregator Contracts	$35.0	$31.9	$3.1	1.10
Total		**$898.0**	**$406.0**	**$491.8**	**2.21**

Table 6-8 TRC Cost Effectiveness Results by DR Program for BAU

Program		B/C Ratio
1	Residential Direct Load Control	1.93
2	Residential Dynamic Pricing	1.37
3	C&I Direct Load Control	NA
4	C&I Dynamic Pricing	1.60
5	Demand Bidding	1.56
6	Curtailable	1.59
7	DR Aggregator Contracts	NA
Total		**1.68**

The Curtailable program under MAP and RAP appears to be the most cost effective with B/C ratios that are over 5.0 in both cases. This is a reflection of the low implementation costs and high impacts. Curtailable programs are considered very reliable by utilities because the customers are under contract; the only problem is that these types of programs only have good participation rates because they are rarely called. If a utility needed to call curtailable customers often, say 10-12 times a season, participation and enrolled load would likely suffer significantly.

Dynamic pricing programs are the next most cost-effective option, simply because the incentives are not counted as a pure program cost but rather are part of, and recovered through, the rate design process. Dynamic pricing also tends to have lower administrative costs, due to the lack of a communication system required by the DLC programs. Unfortunately, dynamic pricing is currently viewed as less reliable than DLC programs because it relies on a voluntary customer response rather than "the push of a button."

The two DLC programs and Demand Bidding are the least cost effective of the AmerenUE administered group, although with a TRC ratio of 1.79 the Residential DLC program is still significantly more cost effective than new generation.

Finally, DR Aggregator contracts are the least cost effective program. However, aggregator programs have many benefits for the utility because they are run by Curtailment Service Providers who are responsible for the entire program including achieving the MW goals.

6.3.2 Levelized Cost

Another indicator of program cost-effectiveness is the levelized cost of reduced peak demand as a result of the DR programs. Although levelized cost is a common industry benchmark for energy efficiency programs, there is very little comparable information about DR programs so it is more challenging to use levelized cost of DR programs for comparison purposes. For this study, levelized cost has been calculated over the full 22-year time horizon (2009-2030) using the TRC test as the basis for the assessment. Table 6-9 displays the program-specific and total portfolio levelized cost under each program level (MAP, RAP, and BAU).

Table 6-9 Levelized Cost by 2030 (based on the Utility Cost perspective)

Program	**Levelized Cost ($/kW-year)**		
	MAP	**RAP**	**BAU**
Residential Direct Load Control	$111.10	$104.12	$32.71
Residential Dynamic Pricing	$22.52	$22.01	$29.84
C&I Direct Load Control	$65.43	$66.39	NA
C&I Dynamic Pricing	$21.46	$20.96	$25.78
Demand Bidding	$39.18	$38.75	$9.08
Curtailable	$9.48	$9.65	$35.42
DR Aggregator Contracts	$50.00	$50.00	NA
Total	**$37.45**	**$39.69**	**$27.50**

As the table indicates, the program portfolio is cost-effective from a levelized cost perspective. This conclusion is drawn based on the fact that the avoided cost of new capacity is typically well over $75/kW-year.[33] With any of the three portfolios, the levelized cost is well under half of that average.

[33] This was the figure used as a proxy avoided capacity cost for the FERC National DR Potential study.

CHAPTER 7

POTENTIAL SUPPLY CURVES

The results from the cost-effectiveness screening analysis and the program potential were used to construct a family of supply curves that depict the various energy efficiency and demand response potential levels in AmerenUE's service territory.

7.1 ANALYSIS APPROACH

Supply curves consist of two axes – an x-axis that shows the cumulative potential energy savings (GWh) or peak demand savings (MW) and a y-axis that depicts the levelized cost per unit of the saved energy ($/kWh) or reduced peak demand ($/kW-year), respectively. The represented costs are based on a Utility Cost (UC) test perspective, which includes the portion of the EE or DR equipment cost (paid by the utility) plus the cost of program administration (also paid by the utility).[34]

It is useful to present different levels of program implementation in the same supply curve since nobody truly knows a priori which approach to program implementation is ideal. It may be appropriate to represent different possible implementation approaches and to model each of those portfolios during the IRP stages to determine the most optimal portfolio. Thus, the supply curves for this study provide the range of portfolios (BAU, RAP and MAP).

Each program implementation strategy is represented as program implementation levels (BAU, RAP, and MAP). Each level represents a more aggressive pursuit of the DSM resources.

To develop the supply curves, the following approach was taken.

- First, values representing the y-axis of the curves were constructed. The y-axis represents these aggregate costs divided by the program's lifetime savings to effectively yield a levelized $/kWh or $/kW-year. From the cost-effectiveness screening analysis, incentive costs, administration costs, annual energy savings, and equipment lives for all of the EE and DR programs considered in this study were obtained.
- Then values representing the x-axis of the curves were constructed. The x-axis values represent the cumulative potential energy savings and demand reductions (on the basis of percentage of baseline forecast) by individual EE and DR program for the years 2009 through 2030.[35] To develop these data, the programs were sorted from the lowest to highest cost of reduced energy and demand. Then cumulative savings were calculated based upon the ascending order of the programs' levelized cost.

7.2 EE PROGRAM POTENTIAL SUPPLY CURVES

Figure 7-1 shows the supply curve for the assumed EE programs, at the various implementation levels as described above for the year 2030. Data to support each of the supply curves can be found in Appendix E.

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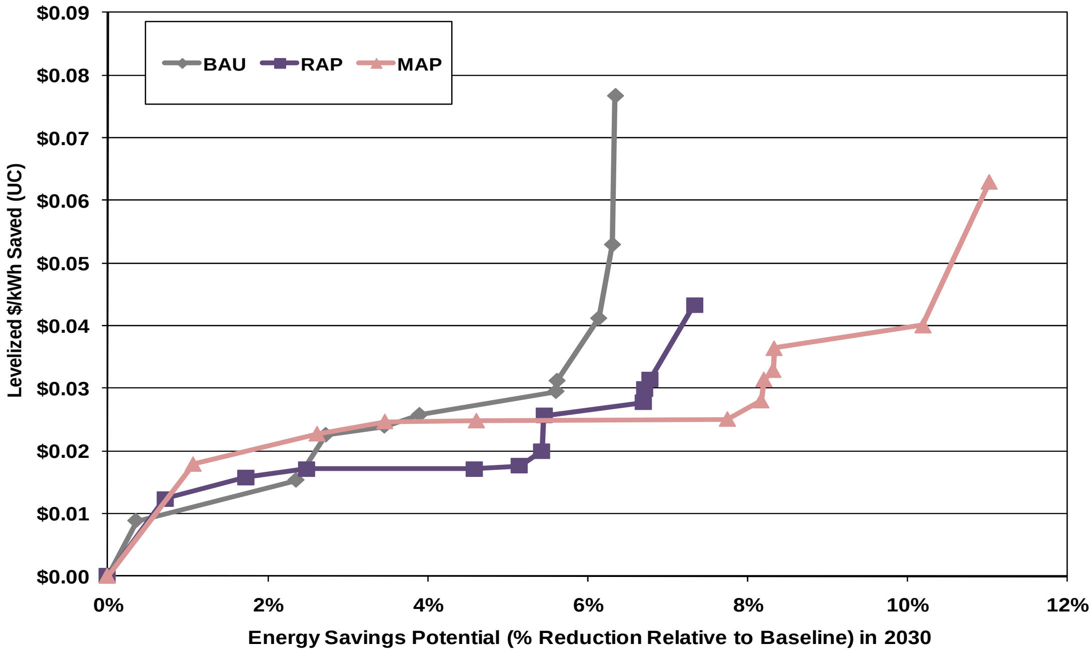
[34] Note that an original set of supply curves was generated based on a TRC test perspective. After reviewing the interim results, the project team (with AmerenUE support) that looking at supply curves from a TRC levelized cost perspective was not as meaningful for AmerenUE management to draw conclusions about which portfolio (BAU, RAP or MAP) would be most cost-effective. Therefore, the analysis was switched to a Utility Cost test perspective.

[35] Note that while the original work plan called for year-by-year supply curves, the project team recommended (with AmerenUE support) that this high volume of data would not be particularly useful. Therefore, the end year 2030 was selected for display purposes. This was based on the fact that 2030 captures the full effects of AmerenUE's EE and DR initiatives.

Figure 7-1 Energy Efficiency Program Supply Curve – Potential by 2030



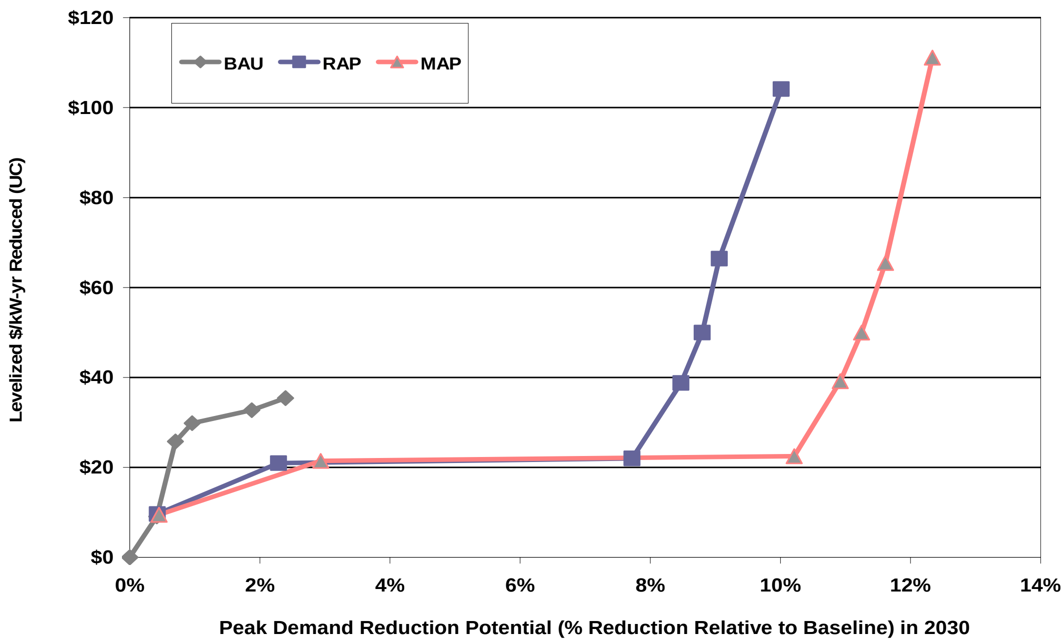
In general, several observations can be made from the results of the 20-year supply curve analysis for the EE programs:

- Overall, the 20-year analysis shows a significant majority of the EE program savings fall under $0.04/kWh. For the BAU portfolio, a total savings of over 5% falls under a very attractive cost-effective cut-off of $0.02/kWh.
- For the RAP portfolio, close to 8% total savings falls under a $0.03/kWh levelized cost.
- The MAP portfolio appears to become very costly when reaching beyond the 10% savings level, as the levelized cost to add additional savings beyond a cumulative savings of 10% reaches well over $0.05/kWh.
- Another interesting observation to draw from the results is that RAP appears to hold steady at a levelized cost under $0.02/kWh, going from a cumulative savings of just over 2% to over 5%. Program costs do not appear to substantially increase under RAP until the portfolio reaches over 7% savings.
- While most of the programs are considered cost-effective, there are some higher cost programs which include: HVAC, Lighting and Appliance and Residential New Construction. Residential New Construction costs are significantly higher than the second most expensive program.
- When comparing the three different curves (BAU, RAP and MAP), it is worth noting that there is a clustering of programs that cost roughly the same (on a levelized $/kWh basis), yet these programs bring about substantial increases in the energy savings potential. For MAP, bringing on the last two most expensive programs brings about measureable increases in savings potential. Thus the slope of the supply curve does not turn in a vertical direction, as is clearly demonstrated in the BAU and to some extent in the RAP cases. This suggests that while MAP is the most expensive portfolio, a bump-up in the expenditures even for the high cost programs yields significantly greater returns in terms of energy savings.

7.3 DR PROGRAM POTENTIAL SUPPLY CURVES

Figure 7-2 shows the supply curve for the assumed DR programs, at the various implementation levels as described above for the year 2030. Data to support each of the supply curves can be found in Appendix E.

Figure 7-2 Demand Response Program Supply Curve – Potential by 2030



In general, several observations can be made from the results of the 20-year supply curve analysis for the demand response programs:

- In RAP and MAP, the programs as a whole appear to deliver significant peak demand reductions at a cost that is well below $30/kW-year. By any measure, this would also be judged very cost effective when compared to supply-side resources and their associated costs.
- For the BAU portfolio, savings do not go much above the 2% mark, with associated costs jumping up to above $30/kW-year.
- The RAP portfolio brings about savings at over 7% for a cost that is well under $30/kW-year.
- The MAP portfolio yields a higher savings of over 10% for essentially the same cost that is experienced in the RAP case. The reason these costs are comparable relates to the fact that the main differences between RAP and MAP relate to scale-up of DR programs under scenarios of higher incentives and assumptions about greater levels of opt-out pricing in the MAP case, which bring about significantly greater savings for very little extra cost.
- Again, most of the DR programs in each portfolio have a lower levelized cost than the projected avoided capacity costs used in the FERC National Assessment of Demand Response of approximately $75/kW-year in year 2030 indicating that all three portfolios are cost-effective as a whole.
- Direct load control programs tend to have significantly higher costs than the other DR programs. This result is driven by the assumption that these programs have a large amount of automated technologies such as PCTs for residential and small commercial and Auto-DR for large commercial and industrial customers who tend to drive up the costs.

7.4 ANALYSIS AND RECOMMENDATIONS

Based on the results presented above, it is clear that each implementation level presents certain risks and rewards for AmerenUE. For the BAU Portfolio, there is less risk posed by adopting the current programmatic approach over the full 20-year time horizon. However the risk is that AmerenUE shouldn't expect to see significant reductions in the electricity usage and peak demands as a result of the BAU EE and DR efforts. On the other hand, the MAP portfolio brings about the largest amount of savings of any level but those savings are realized at a very high cost in absolute terms. Budgets would need to be significantly increased to accommodate the higher program activities and resulting savings associated with those activities.

The RAP portfolio offers what we believe is the best opportunity for AmerenUE to significantly increase its visibility as a market leader in the energy efficiency and demand response industry. AmerenUE can adopt the RAP portfolio cost-effectively and with a greater level of resulting savings (relative to the BAU Portfolio) and with a higher degree of certainty (relative to the MAP Portfolio). The drivers behind the figures for the RAP Portfolio are grounded by solid primary market research. The program participation assumptions are in line with that market research and with industry best practices.

CHAPTER 8

SCENARIO ANALYSIS

Scenario development is a critical part of any planning exercise. While the "reference" case for EE and DR program potential represents the best or most-likely estimate of what the future will look like, it is important to understand the sensitivity of the reference case estimate to key assumptions and to evaluate alternative worlds or scenarios. This chapter identifies a number of plausible scenarios that may occur in the future and assesses how each scenario would affect the impacts and costs associated with AmerenUE's EE and DR program portfolio. The scenarios reviewed for this exercise are assumed to be outside of the sphere of influence of AmerenUE's corporate planners or its external stakeholders. Thus, should any of the circumstances conveyed in the scenarios become reality, the EE and DR programs are likely to be influenced.

8.1 APPROACH

As part of the supply curve analysis in the previous chapter, the results from the cost-effectiveness screening and the program potential were used to construct a family of supply curves that depicted the various energy efficiency and demand response potential levels in AmerenUE's service territory. Based on the results of the analysis, the RAP portfolio was chosen as a representative reference case for further study in the scenario analysis.

During the various stakeholder meetings convened over the course of this project, a number of potential future scenarios was outlined and reviewed. Over the course of those discussions, it was clear that a whole host of external factors might occur in the future, all potentially influencing the outcome of AmerenUE's EE and DR programs. Based on discussions with AmerenUE staff, its stakeholders, and independent studies,[36] a total of three scenarios were considered:

- **Scenario 1 – Aggressive Codes and Standards**: This scenario represents the implementation of aggressive state building codes which will capture lost opportunities in new construction that might currently be captured (at least in part) in the various DSM new construction programs. Further, the scenario represents aggressive appliance standards that are currently being contemplated at the federal level. As recent increased national attention is being given to the role of energy efficiency in the economic recovery and the Smart Grid, it is conceivable that this attention will lead policymakers to increase laws and regulations governing codes and standards beyond existing and planned levels. The anticipated effect of an increased role for codes and standards in the short run is that it might lead to a slight decrease in the EE and DR program level savings because more measures would be captured through the codes and standards. Over the longer term (still within the 20-year planning horizon of this study), programs could be modified to accommodate the more aggressive codes and standards as they come on line.
- **Scenario 2 – High Infrastructure Costs**: This scenario anticipates greater levels of utility spending due to higher than anticipated costs associated with new generation, compliance with environmental regulations and carbon legislation,[37] widespread implementation of the Smart Grid, and the like. The general effect of these factors will be an increase in electricity

[36] AmerenUE supplied results from a recently-completed scenario and avoided cost study conducted for AmerenUE by Charles River Associates (CRA).

[37] The Reference scenario assumes passage of legislation similar to the 2009 proposed Waxman-Markey Bill. A carbon cost is included in the forecasts beginning in 2014 that reflects the targets and assumptions therein. These carbon costs are thus included in each scenario unless modified as noted.

rates beyond the levels contemplated in the reference case. The effect of this scenario will be that participation rates in the EE and DR programs will increase since the customer paybacks will be shorter due to the higher rates, leading to higher savings levels than what is anticipated in the reference scenario.

- **Scenario 3 – Prolonged Recession Beyond 2 Years**: This scenario assumes that the economy does not recover in the next two years, but rather that the recession lasts up to five years. As a result, there would be a delayed and weakened carbon legislation passed by the Congress and rate hikes would be kept to a minimum. Electricity consumption would continue to decrease or stay flat, leading to smaller EE and DR measure savings potential. Consumers would have less ability to make investments in EE and DR measures, which would also lead to a decrease in the program participation rates.

The general approach for conducting the scenarios analysis is to make adjustments to the key drivers that determine the program potential. Figure 8-1 provides the framework from which these adjustments were made.

Figure 8-1 EE and DR Program Potential Elements and Associated Drivers

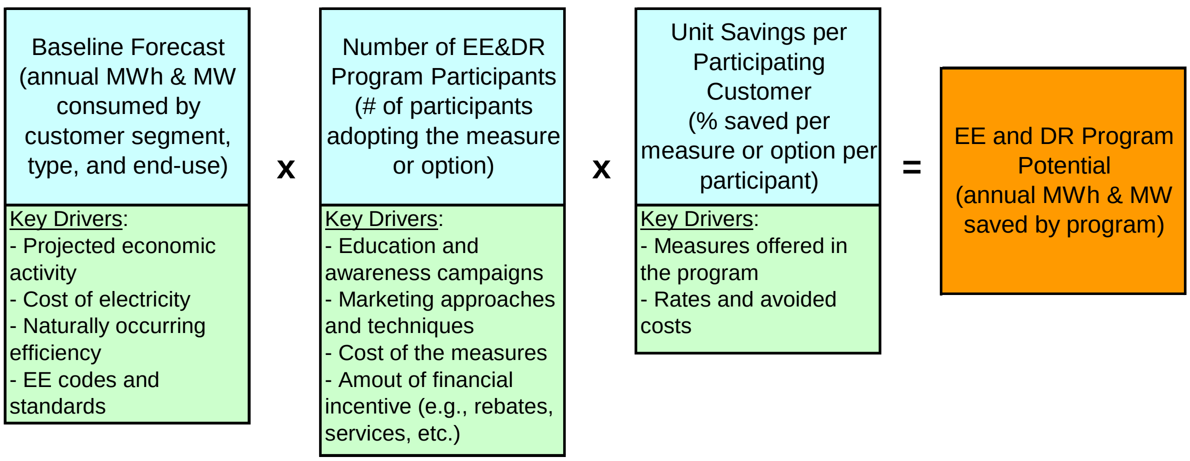


Figure 8-1 identifies three main elements that make up the computation of EE and DR program potential. They include:

- The baseline forecast of energy and peak demand: This element represents how much energy and peak demand customers will consume if there were no programs or measures in place.
- The number of EE and DR program participants: This element represents how many customers will adopt the measures or options offered in the various EE and DR programs.
- The unit savings per participating customer: This element represents the magnitude of savings that could be realized when various measures or options offered in the program are adopted by participating customers.

When these three elements are multiplied together, the result is the EE and DR program potential. There are a variety of drivers that typically determine the magnitude of these elements. While it is the intent of the program planners to design the EE and DR programs to ensure maximum participation, a significant amount of uncertainty influences the accuracy of the estimates that represent each of the three elements. Introducing the possibility that of any one of the three scenarios could potentially be realized would most certainly change the estimated EE and DR potential, and as well influence the cost-effectiveness of the EE and DR program portfolio.

Figure 8-2 maps the key drivers for each of the three elements comprising the EE and DR program potential to the three scenarios being addressed as part of this analysis.

Figure 8-2 Mapping of EE and DR Program Key Drivers to Scenarios

Key Driver	**Scenario 1: Aggressive Codes & Standards**	**Scenario 2: High Infrastructure Costs**	**Scenario 3: Prolonged Recession**
Baseline Forecast:			
Projected economic activity			X
Cost of electricity		X	X
Naturally occurring efficiency	X	X	
Assumed new codes and standards	X		
Number of EE and DR Program Participants			
Education and awareness	X	X	X
Marketing efforts	X	X	X
Cost of the measures	X		
Amount of the incentive		X	X
Unit savings per Participating Customer			
Measures offered	X	X	X
Rates and avoided costs		X	X

Under Scenario 1, several factors are likely to influence the EE and DR potential should more aggressive codes and standards be adopted:

- It is likely that with more aggressive codes and standards would come greater awareness and education for consumers about how they can use energy more efficiently. Compliance of existing energy codes would likely improve. More customers would likely increase their adoption of the energy efficient appliances covered under the existing standards. Lower baseline energy consumption and peak demand would result. The net result of these effects would be lower baseline energy consumption and peak demand for those market segments and end-uses affected by the codes and standards.
- It is likely that the measures and options that comprise more aggressive codes and standards would be many of the same measures and options offered under utility EE and DR programs. Programs will likely be scaled back. Program-specific education and awareness budgets would be reduced. Marketing efforts would be scaled back. Conversely, a higher volume of EE and DR measures in the marketplace suggests that overall prices for energy efficiency products would come down. The net result of these effects would be lower program participation rates for all EE and DR programs.
- Because baseline energy consumption and peak demand would be reduced as a result of more aggressive codes and standards, unit-level savings would be reduced because fewer measures would be offered in the programs. The net result of these effects would be lower unit savings per participating customer.

Under Scenario 2, several factors are likely to influence the EE and DR potential should there be higher than anticipated infrastructure costs:

- Electric rates would increase. Because of the rate increases, customers would figure out ways to use electricity more efficiently, either through self-adoption of energy efficiency measures, adoption of distributed generation technologies, or through pure conservation. The net result of these effects would be lower baseline energy consumption and peak demand across the board.

- Because of the higher electric rates, utilities would be under greater pressure to increase their EE and DR programming and outreach efforts. Education and awareness campaigns would increase, marketing campaigns would be expanded. Rebates and other incentives would be increased. The net result of these effects would be higher program participation rates for all EE and DR programs.
- Because of the higher electric rates, utilities would be under pressure by consumers to offer more measures as part of their EE and DR programs. Furthermore, higher rates would be complemented by higher avoided costs, which in turn means that more EE and DR programs would be cost-effective, thus leading to further expansions of the programs. The net result of these effects would be higher unit savings per participating customer.

Under Scenario 3, several factors are likely to influence the EE and DR potential should there be a prolonged recession:

- Electric rates would remain steady, and possibly fall. Utility capital projects would be put on hold thus keeping costs down. Utility revenue would fall because consumers would be limiting their use of electricity to keep their overall costs to a minimum. The net result of these effects would be lower baseline energy consumption and peak demand across the board.
- Because of decreased utility revenue due to lower baselines, utility programs would likely be scaled back. Program-specific education and awareness budgets would be reduced. Marketing efforts would be scaled back. Program incentive budgets would be reduced. The net result of these effects would be lower program participation rates for all EE and DR programs.
- Because baseline energy consumption and peak demand would be reduced as a result of the prolonged recession, unit-level savings would be reduced because fewer measures would be offered in the programs. The net result of these effects would be lower unit savings per participating customer. Avoided costs would be flat or declining as utilities postpone capital projects.

The key assumptions that were made for each scenario in the EE program analysis are described in Table 8-1. The key assumptions that were made for each scenario in the DR program analysis are described in Table 8-2.

Table 8-1 Key Assumptions for EE Program Scenarios

Scenario	Description of Action(s) Taken
1: Aggressive Codes & Standards	1. Decreased per-participant impacts for measures expected to be directly affected by the expanded codes and standards. Measures affected were limited to ENERGY STAR appliances. Amount of reduction was 50%. 2. Decreased per-participant impacts for all other measures since the baseline forecast is reduced due to the affects of aggressive C&S. Amount of reduction was 7%. Source: Extracted from "Assessment of Energy Efficiency Achievable in the U.S. by New Codes and Standards (2010 - 2020)" for the Edison Institute for Electric Efficiency."
2: High Infrastructure Costs	1. Increase rebate amounts to levels that will bring about increases in the participation rates. Bump up incentive amounts by 25% relative to RAP, as applicable. For Program 7 (Appliance Recycling), the per-participant incentive is increased from $50/yr to $65/yr. 2. Increase participation rates to levels well above RAP (but still below MAP). Gradual increase in participation rates above RAP case for all programs as follows: 2009: 10% 2010: 15% 2011: 20% 2012-2030: 25% 3. Higher program spending to accommodate more aggressive marketing of the programs, greater levels of education and awareness campaigns. Increase program implementation costs as follows: EE Programs 1-5,10-12: $0.05/kWh to $0.06/kWh EE Program 6: $0.10/kWh to $0.12/kWh EE Program 7: $100/participant to $115/participant EE Program 9: $0.04/kWh to $0.05/kWh EE Programs 8 and 13: No changes made In addition, Program 6 (Low Income) has more internal program staff dedicated to the program to manage and operate an expanded program. In 2009, 1 FTE and for 2010-2030, 2 FTE are designated to the program. 4. Change avoided energy costs to represent high infrastructure costs. 5. Reduce per-participant impacts for all measures in all programs to reflect the fact that with increased penetration of solar and other distributed renewable technologies that the aggregate baselines forecasts would come in lower because of this situation. Per-participant reductions for residential programs: 1%. Per-participant reductions for C&I programs: 0.5%.
3: Prolonged Recession	1. Rebate amounts left unchanged relative to RAP case. Programs will still need to offer incentives to attract participants during difficult economic times. 2. Decreased participation rates to levels below RAP. Gradual erosion of participation rates below RAP case for all programs as follows: 2009: 5% 2010: 10% 2011: 15% 2012-2030: 20% 3. Program spending left unchanged relative to RAP case. Programs will still need to provide the services to attract participants during difficult economic times. 4. Change avoided energy costs to represent a prolonged recession.

Table 8-2 Key Assumptions for DR Program Scenarios

Scenario	Description of Action(s) Taken
1: Aggressive Codes & Standards	1. Decreased per-participant impacts for all DR programs (except Program 7 DR Aggregator) since the baseline forecast is reduced due to the affects of aggressive C&S. Amount of reduction was 7%. Source: Extracted from "Assessment of Energy Efficiency Achievable in the U.S. by New Codes and Standards (2010 - 2020)" for the Edison Institute for Electric Efficiency."
2: High Infrastructure Costs	1. Increased incentive amounts to levels that will bring about increases in the participation rates. Bumped up incentive amounts by 25% relative to RAP, as applicable. For DR Programs 2 and 4 (Pricing) and Program 6 (Curtailable), incentives are part of tariff so no changes were made here. No changes were made to Program 7 (DR Aggregator) since the program is based on a contracted MW reduction with third party vendors. 2. Increased participation rates to levels well above RAP (but still below MAP) for all programs (except Program 7). Gradual increases in participation rates above RAP case as follows: 2009: 10% 2010: 15% 2011: 20% 2012-2030: 25% 3. Higher program spending to accommodate more aggressive marketing of the programs, greater levels of education and awareness campaigns. Increased program implementation costs as follows: DR Programs 1-4: $50/kW-yr to $60/kW-yr DR Program 5: $75/kW-yr to $90/kW-yr DR Program 6: $25/kW-yr to $35/kW-yr DR Program 7: no change. 4. Change avoided energy costs to represent high infrastructure costs. Note that this change had very little influence on the outcome since the DR program benefits are driven largely by capacity savings, which did not vary from scenario to scenario. 5. Reduce per-participant impacts for all measures in all programs to reflect the fact that with increased penetration of solar and other distributed renewable technologies that the aggregate baselines forecasts would come in lower because of this situation. Per-participant reductions for residential programs: 1%. Per-participant reductions for C&I programs: 0.5%.
3: Prolonged Recession	1. Incentive amounts left unchanged relative to RAP case. Programs will still need to offer incentives to attract participants during difficult economic times. 2. Decreased participation rates to levels below RAP. Gradual erosion of participation rates below RAP case for all programs (except Program 7) as follows: 2009: 5% 2010: 10% 2011: 15% 2012-2030: 20% 3. Program spending left unchanged relative to RAP case. Programs will still need to provide the services to attract participants during difficult economic times. 4. Change avoided energy costs to represent a prolonged recession. Note that this change had very little influence on the outcome since the DR program benefits are driven largely by capacity savings, which did not vary from scenario to scenario.

8.2 IMPACT ON EE AND DR POTENTIAL

This section specifies how the EE and DR potential estimates change as the effects of each scenario are put into place for each of the programs. A variety of important EE and DR program parameters are specified for the reference case (RAP) and each scenario. These include:

- Program Total Expenditure: This is the net present value of aggregate 22-year program-based expenditures based on the TRC costs.
- Portfolio Levelized Cost: This is the levelized cost of saved energy and capacity for 2030 based on the TRC test (expressed in $/kWh for EE programs and $/kW-year for DR programs).
- Portfolio Percent Reduction Relative to Baseline: This is the percentage reduction resulting from the 2030 energy savings and peak demand reductions relative to the AmerenUE baseline forecast.

Table 8-3 provides a summary comparison of the impact of each scenario on a variety of key EE and DR program-related parameters.

Table 8-3 Scenario Impacts on EE and DR Potential

Parameter	Reference Case (RAP)	Scenario 1: Aggressive Codes and Standards		Scenario 2: High Infrastructure Costs		Scenario 3: Prolonged Recession	
		Value	Percent Change	Value	Percent Change	Value	Percent Change
EE Program Total Expenditure (Million $)	$1,856	$1,555	-16%	$2,394	29%	$1,522	-18%
EE Portfolio Levelized Cost ($/kWh-saved)	$0.017	$0.018	8%	$0.021	23%	$0.018	4%
EE Portfolio % Reduction Relative to Baseline	7.3%	5.18%	-29%	9.1%	24%	5.9%	-20%
DR Program Total Expenditure (Million $)	$406	$370	-9%	$657	62%	$406	0%
DR Portfolio Levelized Cost ($/kW-yr saved)	$39.69	$39.923	1%	$38.87	-2%	$38.88	-2%
DR Portfolio % Reduction Relative to Baseline	10.0%	9.32%	-7%	15.2%	52%	9.9%	-1%

In general, several observations can be made from the results of the scenario analysis:

- As we move from the Reference Case (RAP) to the various scenarios, most of the typical parameters are moving in the direction that is expected. Aggressive codes and standards and a prolonged recession bring about lower expenditure for programs, lower savings relative to the baseline and higher levelized costs. High infrastructure costs bring about higher expenditure for programs, higher savings relative to the baseline and higher levelized cost.
- For Scenario 1 (Aggressive Codes and Standards), total EE expenditures are reduced by 16% and DR expenditures reduced by 9% due mainly to the fact that lower impacts mean that less is being expended for program administration and incentives. Levelized costs for the EE portfolio increase by 8% and for the DR portfolio by 1% indicating that the reduction in expenditures is not leading to a proportional reduction in impacts. Finally, the EE portfolio percentage reduction drops by 29% and the DR reduction drops by 7%, which is largely a function of the aggressive codes and standards taking over nearly a third of the savings projected in the reference case.
- For Scenario 2 (High Infrastructure Costs), total EE expenditures increase by 29% and DR expenditures increased by 62% due mainly to the fact more programmatic activities due to lower avoided costs, more aggressive marketing of programs, and the like. Levelized costs for the EE portfolio increase by 23% and for the DR portfolio drops by a slight 2% indicating

that the increase in expenditures is bringing about a proportional increase in impacts (at least for the EE programs) . Finally, the EE portfolio percentage reduction increases by 24% and the DR reduction drops by 52%, This again is mainly driven by the fact that the EE and DR programs are operated at higher budget levels thus bringing about a larger number of participants relative to the Reference Case which in turn leads to greater impacts.

- For Scenario 3 (Prolonged Recession), total EE expenditures decrease by 18% and DR expenditures remaining relatively unchanged. The decrease in EE expenditures is due mainly to the fact few program participants is leading to less in incentives being paid out. DR appears to be relatively unchanged by these exogenous factors. Levelized costs for the EE portfolio increase by 4% and for the DR portfolio decrease by 2% indicating that (like Scenario 1) the reduction in EE expenditures is leading to a proportional reduction in impacts which has very little impact on the levelized cost. Finally, the EE portfolio percentage reduction decreases by 20% and the DR reduction increases drops by less than 1%. This again is mainly driven by the fact that the EE programs are not attracting as many participants because the economic situation is inhibiting the ability of participants to make capital investments. Thus, the resulting impacts are depressed relative to the Reference Case. This situation was not as affected in the DR case.

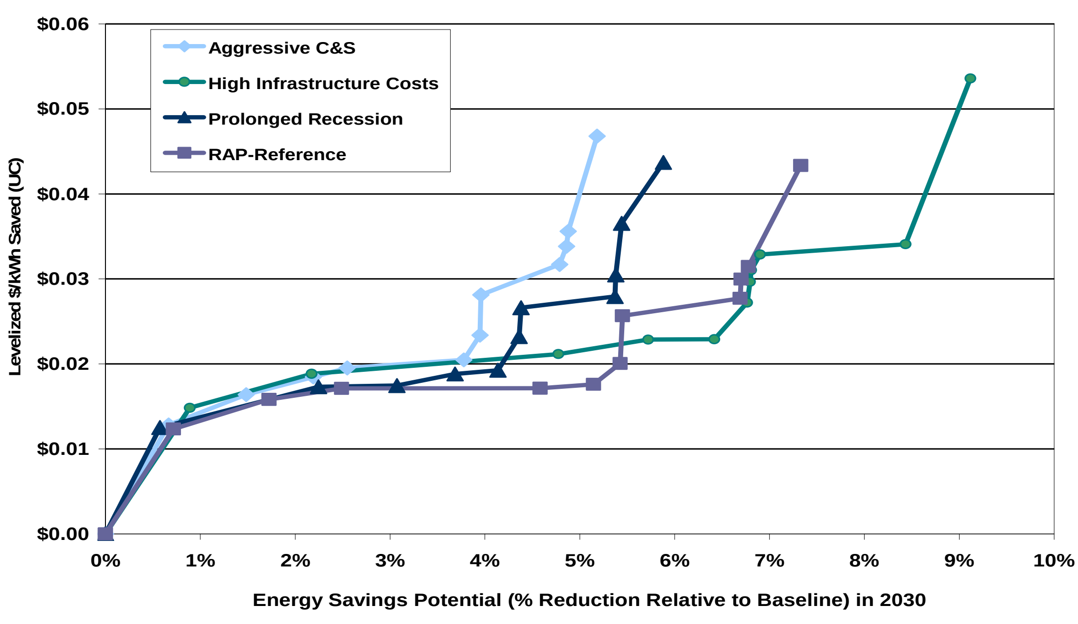
8.3 SUPPLY CURVE ASSESSMENT FOR SCENARIOS

This section specifies the effects of each scenario on the EE and DR program supply curves. The reference case (RAP) and each of the three scenarios are represented as separate supply curves on the same graph, in much the same manner as was presented for the various program implementation levels reported in the previous chapter.

8.3.1 EE Supply Curves

Figure 8-3 shows the supply curve for AmerenUE's potential EE programs, as reflected by each of the three scenarios for the year 2030. The supply curve from the Reference case is provided for comparison purposes. Data to support the EE supply curves for each scenario can be found in Appendix F.

Figure 8-3 EE Program Supply Curve – by Scenario, Year 2030



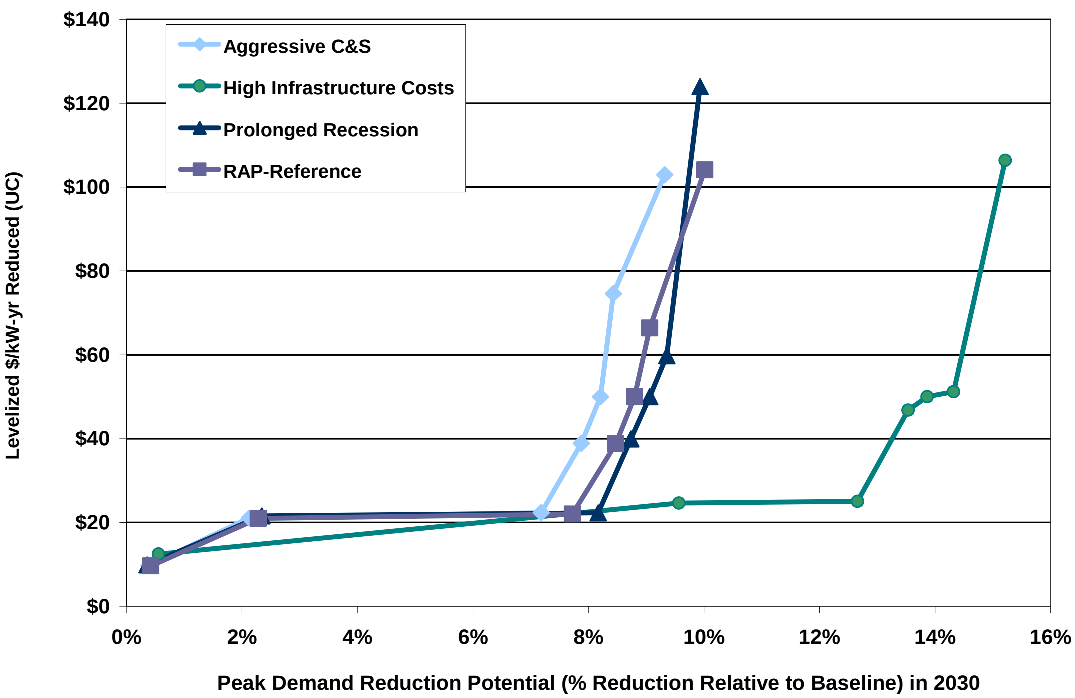
In general, several observations can be made from the results of the 20-year supply curve analysis for the various scenario assessments of the EE programs:

- Up to about 4% energy savings potential, all of the scenarios deliver about the same level of savings at the same level of cost (around $0.02/kWh or less). However, going above that levelized cost threshold, significant variances occur.
- Neither Scenario 1 (Aggressive C&S) nor Scenario 3 (Prolonged Recession) would be favorable from the perspective of an AmerenUE EE program portfolio. Both cases show significantly higher costs for a relatively minimal increase in savings potential.
- Scenario 2 (High Infrastructure Costs) appears to be most favorable from the perspective of bringing about 6.5% in energy savings potential at the lowest level of cost. However, for every extra kWh saved beyond that level, the costs rise dramatically.

8.3.2 DR Supply Curves

Figure 8-4 shows the supply curve for AmerenUE's potential DR programs, as reflected by each of the three scenarios for the year 2030. The supply curve from the Reference case is provided for comparison purposes. Data to support the DR supply curves for each scenario can be found in Appendix F.

Figure 8-4 DR Program Supply Curve – by Scenario, Year 2030



In general, several observations can be made from the results of the 20-year supply curve analysis for the various scenario assessments of the DR programs:

- There is very little difference between the Reference Case and Scenario 1 (Aggressive Codes and Standards) and Scenario 3 (Prolonged Recession). This has mainly to do with the fact that in both instances these external factors have very little influence on the DR program portfolios.
- For Scenario 2 (High Infrastructure Costs) there is a pronounced improvement in the cost of delivered demand relative to the Reference Case. In other words, it does not appear to cost much more on a $/kW-year basis but the savings are significantly greater.

ABOUT GLOBAL

Established in 1998, Global Energy Partners, LLC is a premier provider of energy and environmental engineering and technical services to utilities, energy companies, research organizations, government/regulatory agencies and private industry.

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