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NAVIGANT

Demand-Side Resource Potential Study Report

Prepared for:
Kansas City Power and Light

KCP&L℠
energizing *life*

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ES Executive Summary

ES.1. Introduction and Background

Kansas City Power and Light (KCP&L) and KCP&L Greater Missouri Operations (KCP&L GMO), referred to herein as the "Companies," selected Navigant to conduct a Demand Side Management ("DSM") Resource Potential Study in January, 2012. The Study objective was to assess the potential for energy and peak demand savings from energy efficiency, combined heat and power, and demand response in the residential, commercial, and industrial sectors from 2014 to 2033.

This report summarizes the methodology and results for the energy-efficiency (EE) and combined heat and power (CHP) portion of the study. Details regarding the demand response (DR) portion of this study are provided in a separate report entitled "Demand-Side Resource Potential Study Report – Demand Response," dated August 2013. However, we provide aggregate potential results for the combination of EE, CHP, and DR in this document for ease of reference. As required per the statement of work, this study is deemed to be in compliance with Missouri protocols, as outlined in Missouri Public Service Commission (4 CSR 240)[1], for conducting a demand side resource potential study. For comparison with the results of this study, the targets for cumulative energy and demand savings in 4 CSR 240.094 are provided below. Comparisons, however, are subject to the caveats offered in Section ES-4. As a result, we provide this table once in the report as opposed to providing "side by side" comparisons of potential versus the targets below.

Table ES-1. Cumulative Energy and Demand Savings Targets per MO 4 CSR 240.094

Year	Energy (% of Baseline)	Demand (% of Baseline)
2012	0.30%	1.00%
2013	0.80%	2.00%
2014	1.50%	3.00%
2015	2.40%	4.00%
2016	3.50%	5.00%
2017	4.80%	6.00%
2018	6.30%	7.00%
2019	8.00%	8.00%
2020	9.90%	9.00%
beyond 2021	+1.9%/year	+1.0%/year

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[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

ES.2. Approach

This section provides a high-level summary of the approach detailed in section 2 of this report.

Baseline Market Characterization and Historical Load Analysis:
Navigant conducted extensive primary data collection as part of this study. We collected detailed measure-level detail and building characteristics from 208 buildings (69 residential and 139 commercial & industrial). Additionally, we conducted SIC code analysis of the Companies' databases to permit historical load analysis and to allow segmenting our model into 11 commercial, 7 industrial, and 4 residential customer segments. These data were used to forecast building stock by customer segment, to estimate market penetration of efficient measures, and to develop measure-level savings estimates specific to the Companies. These data, in combination with the measure characterization of the next task, were also used to estimate the forecast energy breakdown by end use category.

Measure Identification and Characterization:
Navigant identified nearly 500 possible measures to consider as part of this study and ultimately characterized 298 of the measures considered most likely to contribute to savings. Input from the baseline market characterization task was used to develop measure-level savings estimates and initial technology "densities" (e.g., measures/home for residential, or measures/1000 square feet for C&I). Navigant used a number of techniques to estimate measure-level savings, including calibrated building simulation and standard engineering algorithms. Navigant also estimated measure costs, accounting for regional cost differences using standard adjustment techniques (e.g., RSMeans City Cost Indices). Of the 298 measures characterized, 192 of the measures passed the TRC test and contributed to Economic potential.

Estimation of Technical, Economic, Realistic and Maximum Achievable Potential for Energy Efficiency Measures:
Navigant estimated the technical, economic, realistic achievable (RAP), and maximum achievable potential (MAP) for energy and peak demand savings for this study using its proprietary Demand Side Management Simulator (DSMSim™) model. DSMSim is a bottom-up technology diffusion and stock tracking model implemented using a System Dynamics[2] framework. As part of this analysis, Navigant developed payback acceptance curves specific to the Companies using online and telephone surveys of residential and C&I customers. Navigant also developed a suite of 20 EE, DR, and CHP programs and allocated savings potential to each program, resulting in a program forecast that is consistent with the RAP scenario. Navigant estimated administrative costs at the program level and calculated total program and portfolio costs and cost-effectiveness. Additionally, Navigant developed traditional EE supply curves and also ran scenario analysis between the RAP and MAP to understand how increasing savings targets would likely increase total costs.

Estimation of Combined Heat and Power Potential:
In addition to estimating EE potential, Navigant estimated the potential energy and peak demand savings from combined heat and power (CHP) measures. Navigant considered a wide range of CHP technologies, fuel types and system sizes (e.g., fuel cells, micro-turbines, reciprocating engines, gas

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

turbines, steam turbines), screened them for cost effectiveness, and estimated adoption of CHP technologies using a separate in-house CHP potential spreadsheet model.

Estimation of Demand Response Potential:
Navigant estimated DR potential using its Demand Response Simulator (DRSim™) model, which follows the approach used in the FERC National Assessment of Demand Response Potential[3]. Consistent with the FERC approach, Navigant estimated DR potential for five DR categories, including interruptible/curtailable tariffs, direct load control, pricing without enabling technology, pricing with enabling technology, and "other" DR.

ES.3. Results

This executive summary provides the aggregate energy and peak demand savings results for the realistic achievable potential (RAP) scenario. Results for additional scenarios (e.g., technical, economic, and maximum achievable potential (MAP) scenarios as well as scenarios between RAP and MAP) are detailed in the remainder of this report.

Opt Out Customers – The potential results of this study does not exclude opt-out customers.
At the time of this report development, the list of opt-out customers was very much in flux due to changes in customer decision-making regarding opt-out. As such, we collectively agreed with the Companies that we would not reduce the potential results of this study to exclude opt-out customers. However, we note that the latest data available indicated that, for GMO, approximately 19% (on an energy consumption basis) of GMO's large C&I customers were likely to opt out[4]. Data were not available for KCP&L MO and KCP&L KS.

Net-to-Gross Assumptions
Due to the inherent uncertainty in forecasting net-to-gross (NTG) ratios, we agreed with stakeholders to use a NTG value of 1.0 for all measures except appliance recycling (where 0.52 was used). As such, the potential estimates herein are, for the most part, estimates of "gross" savings. Using a default net-to-gross factor of 0.8 rather than 1.0 results in roughly a 20% reduction in savings relative to that shown in this report[5]. Consideration of this caveat is important for comparing the results of this study with future achievements and for setting compliance targets.

Cumulative Realistic Achievable Potential (RAP) for Energy Savings
Cumulative realistic achievable potential energy savings for energy efficiency (EE), combined heat and power (CHP), and demand response (DR) for KCP&L GMO, KCP&L MO, and KCP&L KS are provided below in Table ES-2 through Table ES-4, which illustrate results for the RAP scenario, and which does not exclude opt-out customers. Cumulative realistic achievable potential as a percentage of baseline forecast energy sales at the end of the 20-year forecast horizon ranges from 17.6% to 22.5%, with the largest value in KCP&L GMO's service territory. This difference is primarily attributable to GMO's higher forecast annual growth rate, lending additional opportunities for savings in new buildings. Over a nearer-term time horizon, 10 years, cumulative realistic achievable potential is 14.5% (or 1.45%/year)

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[3] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

[4] kWh for KCP&L-GMO customers exercising the opt-out option. Data taken from MO Public Commission Staff opt-out list provided to the KCP&L-GMO for verification on January 10, 2013.

[5] Most measures still passed the TRC.

for KCP&L GMO, 13.8% (or 1.38%/year), and 11.8% (or 1.18%/year) for KCP&L KS. As noted in these figures, for DR we conservatively assume there are no significant energy savings, which is consistent with typical industry assumptions for dispatch-able DR programs, as well as some of Navigant's recent findings for utilities with time-based rates, including TOU.

Table ES-2. Cumulative EE/DR/CHP Energy RAP (MWh) -- KCP&L GMO

KCP&L GMO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	90,895	0	0	90,895	1.1%
2015	191,727	0	2,300	194,027	2.2%
2016	302,033	0	4,600	306,633	3.5%
2017	427,785	0	11,501	439,286	4.9%
2018	569,884	0	20,702	590,586	6.5%
2019	722,942	0	32,203	755,146	8.2%
2020	881,328	0	46,169	927,497	9.9%
2021	1,037,947	0	62,271	1,100,218	11.5%
2022	1,187,910	0	79,522	1,267,433	13.1%
2023	1,330,940	0	96,938	1,427,878	14.5%
2024	1,467,700	0	113,040	1,580,739	15.7%
2025	1,599,381	0	126,677	1,726,058	16.9%
2026	1,727,665	0	137,685	1,865,350	17.9%
2027	1,851,215	0	146,065	1,997,280	18.8%
2028	1,973,566	0	151,979	2,125,545	19.6%
2029	2,093,452	0	156,087	2,249,539	20.3%
2030	2,208,148	0	158,716	2,366,863	20.9%
2031	2,321,418	0	160,359	2,481,777	21.5%
2032	2,434,251	0	161,345	2,595,596	22.0%
2033	2,548,082	0	162,002	2,710,084	22.5%

Table ES-3. Cumulative EE/DR/CHP Energy RAP (MWh) -- KCP&L MO

KCP&L MO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	83,217	0	0	83,217	0.9%
2015	175,255	0	3,162	178,417	2.0%
2016	277,039	0	6,325	283,364	3.2%
2017	392,661	0	15,811	408,472	4.5%
2018	522,323	0	28,461	550,783	6.1%
2019	660,805	0	44,272	705,077	7.7%
2020	801,979	0	63,472	865,450	9.4%
2021	938,370	0	85,608	1,023,978	11.0%
2022	1,064,988	0	109,325	1,174,312	12.5%
2023	1,180,430	0	133,268	1,313,697	13.8%
2024	1,284,982	0	155,404	1,440,386	15.0%
2025	1,379,080	0	174,151	1,553,232	16.0%
2026	1,467,237	0	189,285	1,656,522	16.9%
2027	1,550,686	0	200,805	1,751,491	17.7%
2028	1,629,698	0	208,937	1,838,635	18.3%
2029	1,704,979	0	214,584	1,919,563	18.9%
2030	1,775,261	0	218,198	1,993,459	19.4%
2031	1,843,326	0	220,456	2,063,783	19.8%
2032	1,909,732	0	221,812	2,131,544	20.2%
2033	1,975,390	0	222,715	2,198,106	20.6%

Table ES-4. Cumulative EE/DR/CHP Energy RAP (MWh) -- KCP&L KS

KCP&L KS	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	60,804	0	0	60,804	0.9%
2015	128,797	0	556	129,353	1.9%
2016	201,858	0	1,112	202,970	3.0%
2017	283,429	0	2,780	286,209	4.2%
2018	374,060	0	5,003	379,063	5.5%
2019	470,598	0	7,783	478,381	6.8%
2020	569,032	0	11,158	580,190	8.2%
2021	664,736	0	15,050	679,786	9.5%
2022	754,392	0	19,219	773,611	10.7%
2023	837,423	0	23,428	860,851	11.8%
2024	913,897	0	27,320	941,217	12.7%
2025	983,873	0	30,615	1,014,488	13.5%
2026	1,050,099	0	33,276	1,083,375	14.3%
2027	1,112,106	0	35,301	1,147,407	14.9%
2028	1,171,573	0	36,731	1,208,303	15.5%
2029	1,228,577	0	37,723	1,266,300	16.0%
2030	1,282,500	0	38,359	1,320,858	16.5%
2031	1,335,151	0	38,756	1,373,907	16.9%
2032	1,386,789	0	38,994	1,425,783	17.2%
2033	1,437,728	0	39,153	1,476,880	17.6%

Cumulative Realistic Achievable Potential (RAP) for Peak Demand Savings

Cumulative realistic achievable potential peak demand savings for EE, CHP, and DR for KCP&L GMO, KCP&L MO, and KCP&L KS are provided below in Table ES-5 through Table ES-7, which illustrate results for the RAP scenario. Cumulative realistic achievable potential as a percentage of baseline forecast peak demand at the end of the 20-year forecast horizon ranges from about 24% to 40%, with the largest value in KCP&L GMO's service territory. These percentage differences are driven by the potential for DR, which varies considerably among utilities. DR differences are driven largely by observed differences in the response of large C&I customers (i.e., GMO observes much greater response from large C&I customers in interruptible tariff programs than KS). These assumptions are based on observed results from the Companies' MPower program and are also reasonably consistent with assumptions in the FERC National Assessment of Demand Response Potential[6].

Finally, we note that the EE and DR realistic achievable potential estimates were estimated independently with separate models. If EE and DR programs are simultaneously pursued with adoption as forecast below, there would likely be some interaction between the two, whereby DR potential could be reduced due to aggressive adoption of EE. The estimates below do not adjust for such possible

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[6] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

overlap. The extent of this possible reduction in DR realistic achievable potential when combined with an aggressive EE portfolio would depend on a number of factors, including the extent to which the customers participating in EE and DR overlap (as well as the extent to which measures overlap). Though, as an upper bound, one could postulate that the percentage reduction in DR realistic achievable potential when combined with the EE savings achieved below would be roughly 22%, which is the fraction of baseline peak demand accounted for by EE measures alone in the GMO service territory (assuming 100% overlap of EE and DR customers and measures). Such overlap could therefore potentially reduce the combined percentages below (for GMO, for instance), by up to a relative value of 9.4% (or 4 absolute percentage points, from 40% of peak in 2033 to 36%)[7]. In reality, the reduction due to overlap is likely to be lower than this upper bound.

Table ES-5. Cumulative EE/DR/CHP Energy RAP (MW) -- KCP&L GMO

KCP&L GMO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	20	36	0.0	56	2.8%
2015	44	66	0.3	110	5.4%
2016	71	98	0.6	169	8.2%
2017	102	130	1.6	233	11.2%
2018	137	162	2.8	302	14.4%
2019	176	195	4.4	375	17.6%
2020	217	229	6.3	452	20.8%
2021	257	262	8.5	527	23.9%
2022	295	296	10.9	602	26.9%
2023	331	330	13.2	674	29.7%
2024	364	365	15.4	745	32.3%
2025	395	375	17.3	787	33.6%
2026	424	384	18.8	827	34.7%
2027	452	394	19.9	866	35.7%
2028	479	404	20.7	904	36.6%
2029	506	415	21.3	942	37.4%
2030	530	425	21.7	977	38.1%
2031	555	435	21.9	1,011	38.7%
2032	579	445	22.0	1,046	39.3%
2033	603	455	22.1	1,080	39.9%

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[7] 22.25% of 455 MW of DR is 101 MW, which is ~9.4% of the 1080 MW total forecast in 2033.

Table ES-6. Cumulative EE/DR/CHP Energy RAP (MW) -- KCP&L MO

KCP&L MO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	19	78	0.0	97	4.9%
2015	41	91	0.4	132	6.7%
2016	65	110	0.9	176	8.9%
2017	94	125	2.2	221	11.1%
2018	127	141	3.9	271	13.5%
2019	162	156	6.0	325	16.1%
2020	198	172	8.7	379	18.6%
2021	233	187	11.7	432	21.1%
2022	266	201	14.9	482	23.4%
2023	295	215	18.2	528	25.5%
2024	320	230	21.2	571	27.4%
2025	343	233	23.8	600	28.5%
2026	364	237	25.8	626	29.5%
2027	382	241	27.4	650	30.3%
2028	400	243	28.5	672	31.0%
2029	416	246	29.3	692	31.6%
2030	432	249	29.8	711	32.2%
2031	447	252	30.1	729	32.6%
2032	461	255	30.3	746	33.1%
2033	475	258	30.4	763	33.5%

Table ES-7. Cumulative EE/DR/CHP Energy RAP (MW) -- KCP&L KS

KCP&L KS	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	14	54	0.0	67	3.9%
2015	30	66	0.1	95	5.4%
2016	47	77	0.2	125	7.0%
2017	67	88	0.4	156	8.7%
2018	90	99	0.7	190	10.5%
2019	115	108	1.1	224	12.4%
2020	140	117	1.5	259	14.1%
2021	165	124	2.1	292	15.7%
2022	189	130	2.6	322	17.2%
2023	210	137	3.2	350	18.5%
2024	229	143	3.7	375	19.7%
2025	246	146	4.2	396	20.5%
2026	262	148	4.5	415	21.3%
2027	276	151	4.8	432	21.9%
2028	289	153	5.0	448	22.4%
2029	302	155	5.1	463	22.9%
2030	314	157	5.2	477	23.2%
2031	326	159	5.3	490	23.6%
2032	337	161	5.3	504	24.0%
2033	348	164	5.3	517	24.3%

Cumulative Maximum Achievable Potential (MAP) for Energy Savings

Cumulative maximum achievable potential energy savings for energy efficiency (EE), combined heat and power (CHP), and demand response (DR) for KCP&L GMO, KCP&L MO, and KCP&L KS are provided below in Table ES-8 through Table ES-10, which do not exclude opt-out customers. Cumulative maximum achievable potential as a percentage of baseline forecast energy sales at the end of the 20-year forecast horizon ranges from 24.5% to 29.2%, with the largest value in KCP&L GMO's service territory. As with RAP, this difference is primarily attributable to GMO's higher forecast annual growth rate, lending additional opportunities for savings in new buildings. Over a nearer-term time horizon, 10 years, cumulative maximum achievable potential is 18.4% (or 1.84%/year) for KCP&L GMO, 18.9% (or 1.89%/year) for KCP&L MO, and 16.2% (or 1.62%/year) for KCP&L KS. As noted in these figures, for DR we conservatively assume there are no significant energy savings, which is consistent with typical industry assumptions for dispatch-able DR programs, as well as some of Navigant's recent findings for utilities with time-based rates, including TOU. Cumulative MAP for peak demand savings is outlined in Appendix L.

Table ES-8. Cumulative EE/DR/CHP Energy MAP (MWh) – KCP&L GMO

KCP&L GMO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	106,150	0	0	106,150	1.2%
2015	227,510	0	3,485	230,995	2.7%
2016	364,356	0	6,970	371,327	4.2%
2017	523,176	0	17,426	540,602	6.1%
2018	703,168	0	31,367	734,535	8.1%
2019	897,225	0	48,793	946,018	10.3%
2020	1,098,957	0	69,953	1,168,909	12.5%
2021	1,298,414	0	94,349	1,392,764	14.6%
2022	1,490,214	0	120,488	1,610,702	16.6%
2023	1,672,037	0	146,876	1,818,913	18.4%
2024	1,847,554	0	171,273	2,018,827	20.1%
2025	2,018,670	0	191,935	2,210,605	21.6%
2026	2,187,097	0	208,614	2,395,711	23.0%
2027	2,350,357	0	221,310	2,571,667	24.2%
2028	2,513,766	0	230,272	2,744,038	25.3%
2029	2,673,904	0	236,495	2,910,400	26.3%
2030	2,826,627	0	240,479	3,067,106	27.1%
2031	2,976,165	0	242,968	3,219,132	27.9%
2032	3,123,259	0	244,462	3,367,721	28.6%
2033	3,270,051	0	245,457	3,515,509	29.2%

Table ES-9. Cumulative EE/DR/CHP Energy MAP (MWh) – KCP&L MO

KCP&L MO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	103,809	0	0	103,809	1.2%
2015	222,681	0	4,791	227,472	2.6%
2016	358,190	0	9,583	367,772	4.1%
2017	515,413	0	23,957	539,370	6.0%
2018	692,514	0	43,122	735,636	8.1%
2019	881,699	0	67,079	948,778	10.4%
2020	1,075,116	0	96,169	1,171,285	12.7%
2021	1,261,494	0	129,708	1,391,202	14.9%
2022	1,435,067	0	165,643	1,600,710	17.0%
2023	1,591,901	0	201,921	1,793,822	18.9%
2024	1,733,479	0	235,460	1,968,939	20.6%
2025	1,860,562	0	263,866	2,124,428	21.9%
2026	1,980,594	0	286,796	2,267,390	23.2%
2027	2,096,715	0	304,250	2,400,965	24.2%
2028	2,208,109	0	316,571	2,524,680	25.2%
2029	2,315,369	0	325,127	2,640,496	26.0%
2030	2,416,230	0	330,602	2,746,832	26.7%
2031	2,513,709	0	334,025	2,847,734	27.4%
2032	2,607,909	0	336,078	2,943,987	28.0%
2033	2,699,565	0	337,447	3,037,012	28.5%

Table ES-10. Cumulative EE/DR/CHP Energy MAP (MWh) – KCP&L KS

KCP&L KS	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	75,079	0	0	75,079	1.1%
2015	162,511	0	842	163,353	2.4%
2016	260,583	0	1,685	262,267	3.9%
2017	373,070	0	4,212	377,282	5.5%
2018	499,032	0	7,581	506,613	7.3%
2019	633,542	0	11,792	645,334	9.2%
2020	771,503	0	16,906	788,410	11.2%
2021	905,533	0	22,802	928,335	13.0%
2022	1,030,013	0	29,120	1,059,133	14.7%
2023	1,145,041	0	35,497	1,180,539	16.2%
2024	1,250,737	0	41,393	1,292,130	17.5%
2025	1,347,196	0	46,387	1,393,583	18.6%
2026	1,439,352	0	50,418	1,489,770	19.6%
2027	1,526,001	0	53,486	1,579,488	20.5%
2028	1,610,665	0	55,652	1,666,317	21.4%
2029	1,692,504	0	57,157	1,749,660	22.1%
2030	1,770,291	0	58,119	1,828,411	22.8%
2031	1,846,247	0	58,721	1,904,968	23.4%
2032	1,920,151	0	59,082	1,979,233	23.9%
2033	1,992,450	0	59,322	2,051,772	24.5%

ES.4. Caveats and Limitations

Opt Out Customers

At the time of this report, the list of opt-out customers was very much in flux due to changes in customer decision-making regarding opt-out. As such, we collectively agreed with the Companies that we would not reduce the potential results of this study to exclude opt-out customers. However, we note that the latest data available indicated that, for GMO, approximately 19% (on an energy consumption basis) of GMO's large C&I customers were likely to opt out[8]. Data were not available for KCP&L MO and KCP&L KS.

Net-to-Gross Assumptions

Due to the inherent uncertainty in forecasting net-to-gross (NTG) ratios, we agreed with stakeholders to use a NTG value of 1.0 for all measures except appliance recycling (where 0.52 was used). As such, the potential estimates herein are, for the most part, estimates of "gross" savings. Using a default net-to-gross factor of 0.8 rather than 1.0 results in roughly a 20% reduction in savings relative to that shown in this report[9]. Consideration of this caveat is important for comparing the results of this study with future achievements and for setting compliance targets.

Scenario Analysis versus Forecasts/Predictions

Estimation of market potential for energy efficiency savings is inherently uncertain. As such, the estimates provided herein are *scenario* based, and should not be considered to be forecasts or predictions of what *will* happen. Savings that will actually be achieved over the next 10-20 years depend on a large variety of factors, including incentive levels for each measure, effectiveness of program design, execution and marketing efforts, degree of success of emerging technologies, future fuel/electricity prices, measure costs, and economic factors, among many others.

Market Uncertainties

A number of uncertainties exist regarding the market acceptance of energy-efficiency measures. For instance, the primary method employed in this study for calculating equilibrium market share of efficient technologies is use of "payback acceptance curves," which are commonly used in potential studies as a reasonable and tractable approach to estimate market share for dozens or even hundreds of technologies. However, this approach is limited in its ability to account for non-monetary product purchase considerations. When combined with the other market dynamics considered in Navigant's DSMSim model, this approach should provide directionally reasonable estimates. However, it is subject to limitations and uncertainty that would likely be cost-prohibitive to mitigate (e.g., via detailed discrete choice analysis studies for each measure). Additionally, while Navigant's DSMSim model employs advanced technology diffusion theory, diffusion parameters are also uncertain (e.g., marketing effectiveness).

Data Uncertainties

Navigant drew upon many data sources, both primary (e.g., from the baseline study) and secondary (refer to Section 2.2.3), for estimation of measure energy consumption, incremental cost, and market saturation. However, uncertainty in these estimates inevitably exists, which can affect estimates of

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[8] kWh for KCP&L-GMO customers exercising the opt-out option. Data taken from MO Public Commission Staff opt-out list provided to the KCP&L-GMO for verification on January 10, 2013.

[9] Most measures still passed the TRC.

potential. Navigant did not conduct parametric or other uncertainty analysis on the unit-energy-savings, cost estimates, or initial market saturation estimates as part of this study.

1. Introduction

1.1 Background and Study Goals

Kansas City Power and Light (KCP&L) and KCP&L Greater Missouri Operations (KCP&L GMO), referred to herein as the "Companies," selected Navigant to conduct a Demand Side Management ("DSM") Resource Potential Study in January, 2012. The Study objective was to assess the various categories of electrical energy efficiency and demand response potential in the residential, commercial, and industrial sectors for the Companies' service areas from 2014 to 2033. Portions of the Study may be used by the Companies to satisfy some of the demand-side analysis requirements of the Missouri Public Service Commission Regulations for Electric Utility Resource Planning ("MO Planning Regulations"). Results of this Study will be used in the Companies' Integrated Resource Planning ("IRP") 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 in support of the Companies' effort to design highly effective potential demand-side programs that broadly cover the full spectrum of cost-effective end use measures for all customer market segments with the ultimate goal of achieving all cost-effective demand-side savings. As part of this study, Navigant also developed a suite of energy efficiency and demand response programs that were designed to achieve the savings deemed per this study to be "realistically achievable." As required per the statement of work, this study is deemed to be in compliance with Missouri protocols, as outlined in Missouri Public Service Commission (4 CSR 240)[10], for conducting a demand side resource potential study.

1.2 Stakeholder Involvement

Navigant involved a broad range of stakeholders throughout the study to ensure opportunity for review and comment of key study assumptions and methods was provided to those where were interested. Navigant invited the following organizations to each meeting and copied each of these stakeholders on correspondence providing key assumption and methodology files. Navigant reviewed and responded to stakeholder comments and distributed final documents to all stakeholders.

Stakeholders:

- KCP&L, KCP&L Greater Missouri Operations
- Missouri Public Service Commission
- Missouri Office of Public Counsel
- Missouri Department of Natural Resources
- National Resources Defense Council
- Empire Electric District
- Renew Missouri
- Ameren

Table 1-1 provides a summary of key stakeholder review meetings and relevant files pertaining to the review process.

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[10] 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

Table 1-1. List of Stakeholder Meetings and Relevant Review and Response Files

Review Item or Milestone	Review Type	Meeting Date (s)	Final File Date(s)	Relevant File Name(s)
Sample Design for On-Site Surveys	Webinar	3/22/2012	3/22/2012	Proposed KCPL Sample Design; Measure List Discussion 012_03_22.ppt
EE Measure List	Webinar	4/3/2012	4/26/2012	KCPL Measure List -- Final.xlsx
C&I Onsite Survey Instruments	File for review	N/A	4/26/2012	KCPL_CI_Onsite_Instrument_FINAL_040612_Clean.docx
Res Onsite Survey Instruments	File for review	N/A	5/25/2012	KCPL Res OnSite Instrument 2012 05 22.docx
Measure Characterization Approach	File for review	N/A	7/17/2012	KCPL Measure Characterization Approaches - 2012_07_17_R2
Online Survey (Payback Acceptance) Sample Design/ Approach	2 Webinars	7/24/2012, 8/13/2012	7/24/2012, 8/9/2012	KCPL Online Telephone Survey Approach 2012_07_24; Navigant notes from KCPL Online, Telephone Survey Approach Webinar, August 7, 2012_R2.docx; Navigant response to July 31 Memorandum Regarding Online, Telephone Surveys, August 9 2012.docx
Online Survey Instruments	File for review	8/28/2012	8/23/2012	CI Survey DRAFT Aug 23 2012 - BVG.docx; Landlord Survey DRAFT Aug 23 2012 - BVG; Residential Survey DRAFT Aug 23 2012 - BVG
Measure Characterization Results	File for review	N/A	9/30/2012	KCPL Measure Characterization Summary - 20130109
DR Measures/ Approach	File for review	N/A	12/3/2012	KCPL_DR Measures-Approach Memo_07-17-12.docx
List of EE and DR Programs	File for review	N/A	12/3/2012	KCPL GMO Final Programs Matrix Dec 3 2012.docx
CHP Measures/ Approach	File for review	N/A	8/1/2012	Proposed KCPL CHP Modeling Approach 2012_08_01.ppt

Review Item or Milestone	Review Type	Meeting Date (s)	Final File Date(s)	Relevant File Name(s)
EE/DR Modeling Approach	Webinar	12/13/2012	12/13/2012, 01/03/2013, 01/14/2013	KCPL EEDR Demand Side Resource Potential Modeling Methodology 2012_12_13_R2.pdf; Response to KCPL and GMO StakeholderComments_2013_January_03 v4.docx; Response to KCPL and GMO StakeholderComments_2013_January_14; Response to KCPL and GMO StakeholderComments_2013_March_5;
DRAFT Report – Review and Comment Period	3 Webinars	4/15/2013, 5/13/2013, 5/15/2013	4/17/2013, 5/22/2013, 5/10/2013, 5/13/2013	EO-2012-0323 MDNR Navigant Potential Study Comments 04 17_Navigant Response.docx; EO-2012-0323 MDNR Navigant Potential Study MDNRComments 05222013_Navigant Response.docx; KCPL potential study NRDC comments_Navigant_Response_2013_05_10.docx; PSC CHP Comments_Navigant Response 05_13_13

1.3 *Organization of Report*

This report is organized as follows:

Section 2 describes the study approach to estimating potential for energy efficiency savings, including discussion of baseline market characterization; measure identification and characterization; approach to modeling technical, economic, realistic achievable and maximum achievable potential; and calculation of payback acceptance curves.

Section 3 offers the results of the potential study analysis for energy efficiency measures, including a summary of aggregate savings potential for each utility; disaggregated savings results by customer segment, end use, and program; discussion of the top measures contributing toward potential; program costs and cost effectiveness; and energy efficiency potential supply curves.

Section 4 discuss the approach, assumptions, and results for Navigant's estimate of the potential for Combined Heat and Power (CHP) savings, as this portion of the study was conducted separately from the efficiency potential analysis.

Section 5 summarizes the combined savings from energy efficiency, CHP, and Demand Response (DR), as the DR study is a stand-alone report delivered to the Companies in parallel with this report.

2. Approach to Electric Energy and Demand Savings

2.1 *Baseline Market Characterization*

This section provides a high-level overview of the data sources and methods used to develop the baseline market characterization. Additional detail regarding the process, including sampling and site surveys used, can be found in Appendix K and Appendix J. The baseline market characterization involved extensive primary data collection from 208 customer sites in Kansas and Missouri. These customer data, combined with SIC code analysis of KCP&L and GMO's customer database, were used to estimate baseline measure characteristics (e.g., savings and initial market shares – see Section 2.2) and the initial breakdown of KCP&L and GMO's historic load by customer segment and by end use.

2.1.1 Breakdown by Customer Segment

The first step in the baseline market characterization was to break down historic energy usage by customer segment by mapping customer SIC codes (provided by KCP&L) to each customer segment. Consistent with MO 4 CSR 240-22.030(4), we segmented the study into the following residential, commercial, and industrial segments.

Residential: Single Family, Single-Family Low Income, Multifamily, Multifamily Low Income

Commercial: Grocery, Healthcare, Lodging, Office-Large, Office-Small, Restaurants, Retail, Schools, Warehouses, Other Commercial

Industrial: Chemicals, Electronics, Food, Rubber-Plastics, Stone-Clay-Glass, Motor Freight Transportation[11], Other Industrial[12]

Table 2-1 and Figure 2-1 provide the calculated breakdown of energy consumption, by customer segment, for the first year of the study (2014).

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[11] The original breakdown per MO 4 CSR 240 did not specify a Motor Freight segment. However, SIC code analysis indicated this was a large customer segment. As such, we specifically targeted this segment as part of the onsite sample design and Industrial customer segmentation.

[12] The original breakdown included a number of additional Industrial customer segments. However, our SIC code analysis indicated that these customer segments were a very small percentage of the energy consumption in the KCP&L GMO service territories. If a customer segment fell below a threshold of 1% of energy sales, it was aggregated into the "Other Industrial" customer segment. Though the Agriculture segment was not specifically included in the MO 4 CSR 240 breakdown, stakeholders did express some interest in this segment. After further analyzing this segment, Navigant chose not to specifically include it in the customer segmentation breakdown due to its very small calculated contribution toward total energy consumption (~0.4% of the three utility's combined energy consumption and ~0.75% of combined C&I energy consumption – well below the 1% threshold we applied for purposes of customer segmentation and sample design).

Table 2-1. Forecast Energy Consumption Breakdown (2014), in MWh

	KCPL-KS	KCPL-MO	KCPL-GMO
Industrial-Chemicals	109,750	451,450	161,806
Industrial-Electronics	7,517	10,702	238,731
Industrial-Food	79,681	383,343	308,581
Industrial-Motor Freight	127,791	65,188	80,461
Industrial-Other Industrial	369,841	510,800	705,581
Industrial-Rubber-Plastics	118,770	80,755	101,682
Industrial-Stone-Clay-Glass	7,517	185,834	90,187
Commercial-College	51,868	82,701	82,229
Commercial-Grocery	172,142	106,052	186,563
Commercial-Healthcare	247,313	393,073	284,708
Commercial-Lodging	67,654	142,051	76,924
Commercial-Office - Large	695,332	1,724,071	580,911
Commercial-Office - Small	361,572	403,775	363,401
Commercial-Other Commercial	284,146	638,256	366,053
Commercial-Restaurant	130,046	166,375	209,552
Commercial-Retail	400,661	360,965	404,073
Commercial-School	275,878	221,833	388,158
Commercial-Warehouse	101,481	254,913	159,154
Residential-Single Family	1,882,013	1,602,132	2,438,300
Residential-SF Low Income[13]	806,577	686,628	1,044,986
Residential-Multi-Family	188,799	223,868	122,334
Residential-MF Low Income	80,914	95,943	52,429
Totals	**6,567,261**	**8,790,707**	**8,446,806**

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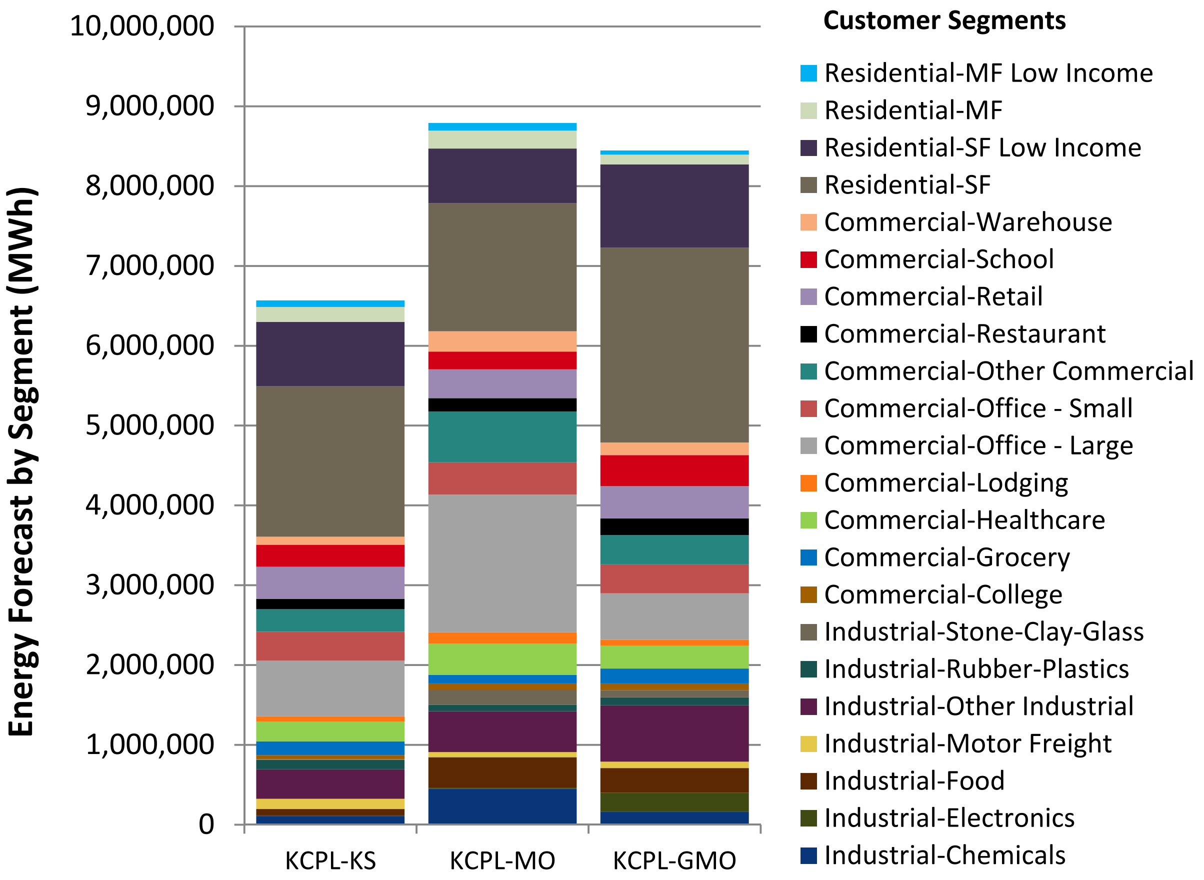
[13] Split by low-income households assumes that 32.2% of households are low-income. Assumptions & Sources (all specific to Kansas City Metro Area): Average HH size = 2.54 people (Census DP02). 2011 Federal poverty threshold for HH with 3 people = $17,916 (Census Poverty Thresholds). 2x federal poverty threshold = $35,832. % of HH with income < $35k = 32.2% (Census S1909).

Figure 2-1. Forecast Energy Consumption Breakdown (2014), in MWh



The above breakdown of energy consumption by customer segment is particularly relevant in this study, as measure potential is estimated by customer segment, with in some cases unique measure-level savings estimates that are dependent on the relevant customer segment. Additionally, the breakdown above is used in conjunction with a calculation of energy intensity by building type (derived from the baseline study's primary data collection activities – see Table 2-2) and a customer count forecast to determine the forecast building stock (in 1000 square feet) for C&I customers. For residential homes, the customer count forecast is used directly and does not require the estimation of energy intensity for forecasting building stock. The forecast building stock is then used in conjunction with measure-level "densities" (see section 2.2.2) to determine the quantity of measures (and the quantity that are "inefficient" and therefore offer savings potential) in each utility service territory.

Table 2-2. Customer Segment Energy Intensity

Customer Segment	kWh/ square foot
Industrial-Chemicals	231.9
Industrial-Electronics	30.4
Industrial-Food	106
Industrial-Motor Freight	7.6
Industrial-Other Industrial	22
Industrial-Rubber-Plastics	68.1
Industrial-Stone-Clay-Glass	796.6
Commercial-College	12.5
Commercial-Grocery	58.4
Commercial-Healthcare	21.3
Commercial-Lodging	13.1
Commercial-Office - Large	24.4
Commercial-Office - Small	17.4
Commercial-Other Commercial	15.8
Commercial-Restaurant	28.8
Commercial-Retail	21.1
Commercial-School	12.8
Commercial-Warehouse	7.7

Navigant notes that MO 4 CSR 240-20.094 provides provisions for customer to “opt-out” of energy efficiency programs. For this study, Navigant incorporated the ability to consider opt-out customers in its model, which would therefore reduce the potential savings since some customers are therefore guaranteed not to participate in any program. Early results provided to the Companies included such reduction in overall potential. However, at the time of this report, the list of opt-out customers was very much in flux due to changes in customer decision-making regarding opt-out. As such, we collectively agreed with the Companies that we would not reduce the potential results of this study to exclude opt-out customers. However, we note that the latest data available indicated that, for GMO, approximately 19% (on an energy consumption basis) of GMO’s large C&I customers were likely to opt out[14]. Data were not available for KCP&L MO and KCP&L KS.

2.1.2 Onsite Sample Design

Using the customer breakdown calculated in the first step, Navigant developed a stratified sample to target onsite data collection in each customer segment. The sample was designed to target 10% relative precision with 90% confidence at the sector level (i.e., Residential, Commercial, Industrial) across KS and MO. Additional detail, including the further stratification by customer energy consumption, is provided in Appendix B.

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[14] kWh for KCP&L-GMO customers exercising the opt-out option. Data taken from MO Public Commission Staff opt-out list provided to the KCP&L-GMO for verification on January 10, 2013.

Table 2-3. Target vs. Actual Onsite Surveys

Sector	Segment	Target/Actual Total
Commercial	College	6/6
	Grocery	6/8
	Healthcare	9/9
	Lodging	6/6
	Office - Large	9/7
	Office - Small	23/21
	Other Commercial	9/9
	Restaurant	6/7
	Retail	9/9
	School	9/9
	Warehouse	6/6
	Commercial Total	**98/97**
Industrial	Chemicals	7/3
	Electronics	5/3
	Food	7/9
	Motor Freight Transportation	5/2
	Other Industrial	8/13
	Rubber-Plastics	5/9
	Stone-Clay-Glass	5/3
	Industrial Total	**42/42**
TOTAL C&I		**140/139**
Residential	Multifamily	14/14
	Single Family	56/55
	Residential Total	**70/69**
TOTAL (C&I and Residential)		**210/208**

2.1.3 Onsite Data Collection

Commercial/Industrial

Professionally trained surveyors surveyed the sites of 139 C&I customers across the Companies' service territories (97 commercial and 42 industrial sites), which were randomly recruited by telephone according to the stratified sample design. The surveyors collected detailed inventories of energy-using equipment and building characteristics by inspection and, at some of the larger sites, by customer-provided schedules of equipment. Surveyors also collected operation and power management behavior by interview including specifics on combined heat and power, if present.

Data collected were extensive; on average, 8 hours were spent per C&I site. Data collected covered all relevant energy aspects of customer facilities and businesses, including:

- Building size and orientation
- Building envelope information, such as insulation levels and wall and window sizes
- Complete inventories of energy-using equipment covering all end uses, including lighting, HVAC, motors, water heating, commercial refrigeration, cooking, office equipment, air compressors, and other types of process equipment
- Equipment and operation schedules and controls

The survey used to collected onsite data for C&I customers can be explored further in Appendix K.

Residential

Professionally trained surveyors surveyed the sites of 69 KCP&L and GMO residential customers that were randomly recruited by telephone according to the stratified sample design. Surveyors conducted a brief interview with the customer regarding occupancy information and age of the home. The surveyors collected detailed inventories of energy-using equipment and building characteristics by inspection.

The inspection covered all relevant energy aspects of the home:

- Home size and orientation
- Building envelope information, such as insulation levels and wall and window sizes
- Complete inventories of energy-using equipment covering all end uses, including lighting, HVAC, motors, water heating, refrigeration, cooking, and electronic equipment

Surveyors used various tools for their inventory, including hot water thermometer, metered water container, and measuring tape. In addition, surveyors collected information on household characteristics, equipment usage, and maintenance from the resident.

The survey used to collected onsite data for residential customers can be explored further in Appendix J.

2.1.4 Energy Consumption Breakdown and Forecast

Navigant's potential study analysis is conducted at the measure level and is disaggregated by customer segment. As a result, the breakdown of energy consumption at the customer segment level combined with measure-level savings characteristics (which in some cases vary by customer segment) are the key drivers of potential study output. As a result, the potential study approach does not rely on a forecast that is broken down by customer end-use category. Some potential study approaches rely heavily on the end-use category breakdown, as they estimate savings as a fraction of the end-use category consumption. However, since this model is more granular and uses a bottom-up approach aggregating the savings of each measure, the end-use breakdown assumptions provided in this section are for information purposes only.

The Companies provided Navigant with a baseline energy forecast for each of the three utilities and was further disaggregated by sector (Residential, C&I). Navigant reviewed this forecast and did not suggest any adjustments, though we understand that an updated forecast is under development by the Companies. The baseline energy forecast data were used to estimate a breakdown of the forecast into eight end-use categories over the 20-year forecast horizon. To estimate a baseline energy consumption breakdown by end-use categories, the Navigant team used a combination of building simulation modeling (for the residential sector) and a bottom-up summation of energy consumption at the measure level (for the C&I sector), as described below.

For the residential sector, the 2014 residential sector energy consumption forecast was split into end-use categories using calibrated building simulation modeling. A description of the building simulation modeling that was conducted is expanded upon in section 2.2.3. The output of this modeling effort generated hourly load profiles (24 hours x 365 days) for residential homes and 3 HVAC configurations (Electric Resistance/AC, Gas Furnace/AC, Heat Pump) broken down by different end-use categories. Weighted average annual load consumption estimates were then calculated using the weightings by HVAC type calculated from the onsite data. These weighted-average load profiles were then used to estimate the base year percentage split by residential end-use categories (Lighting, Hot Water, HVAC, and Appliances/Electric/Other). The base year split among the end-use categories was assumed to be constant over the forecast horizon for simplicity. Though again, since this forecast breakdown by end use does not drive model results, the simplification does not impact the overall study results.

To estimate a percentage breakdown for C&I end-use categories, the Navigant team used the building stock forecast (disaggregated by customer segment) discussed in section 2.1.1 combined with measure characterization results such as base consumption, efficient measure consumption, and technology 'density' (see section 2.2) to estimate total energy consumption of all measures characterized in the study. The measure level usage data was then aggregated into C&I end-use categories (HVAC, Lightings, Motors/Process/Other, Hot Water/Refrigeration/Cooking) to estimate the base year percentage split by C&I end-use categories. The residential and C&I percentage breakdowns calculated as described were applied to the KCP&L baseline energy forecast to estimate the energy consumption by end-use categories over the modeling horizon, as shown below.

As can be seen in Figure 2-4, KCP&L GMO's energy forecast grows at a faster rate than does the KCP&L MO and KCP&L KS forecast. The compound annual growth rates of energy for these three utilities are 1.84%, 1.01%, and 1.25% per year for KCP&L GMO, KCP&L MO, and KCP&L KS, respectively. This difference is a key driver of differences in the calculated savings potential (as a percentage of baseline sales) among the three utilities.

Figure 2-2. End-Use Energy Consumption Forecast, in MWh - KCP&L GMO

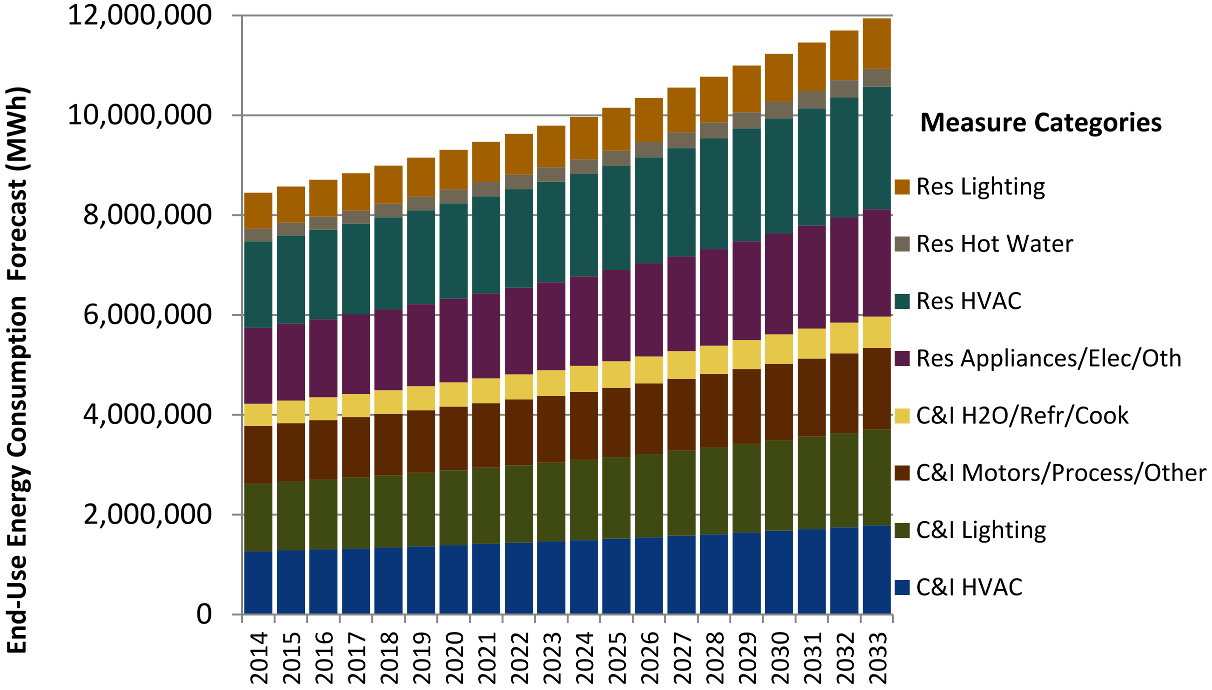


Figure 2-3. End-Use Energy Consumption Forecast, in MWh - KCP&L MO

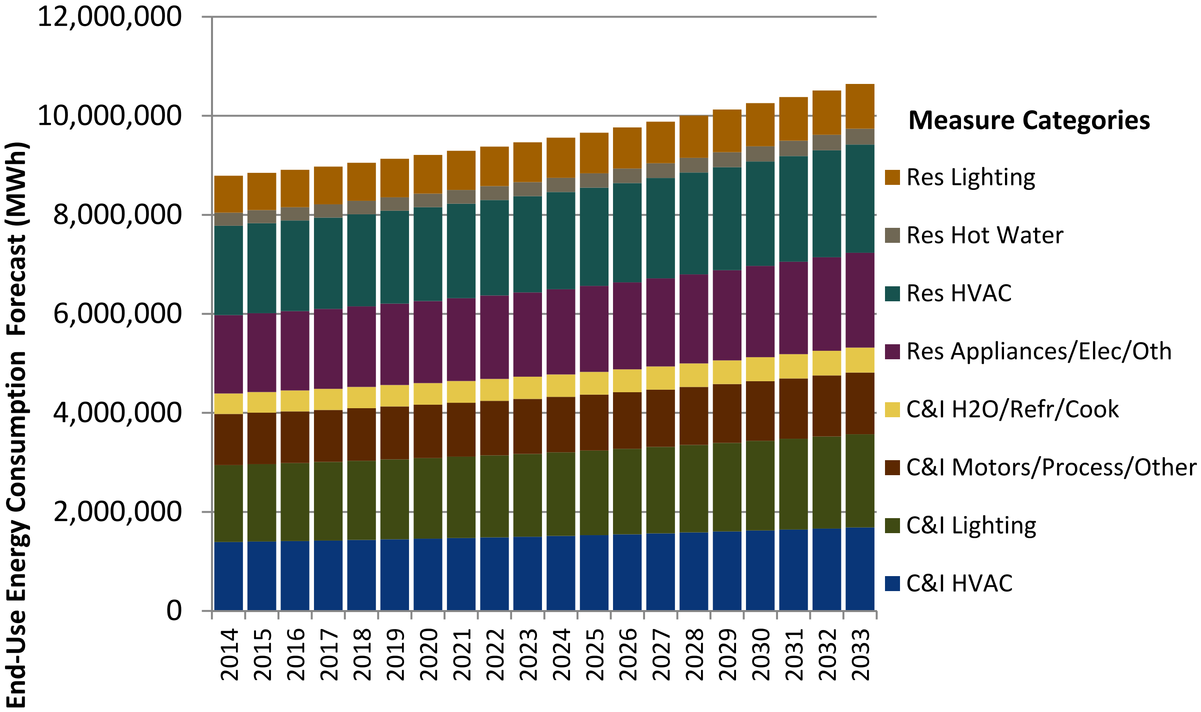
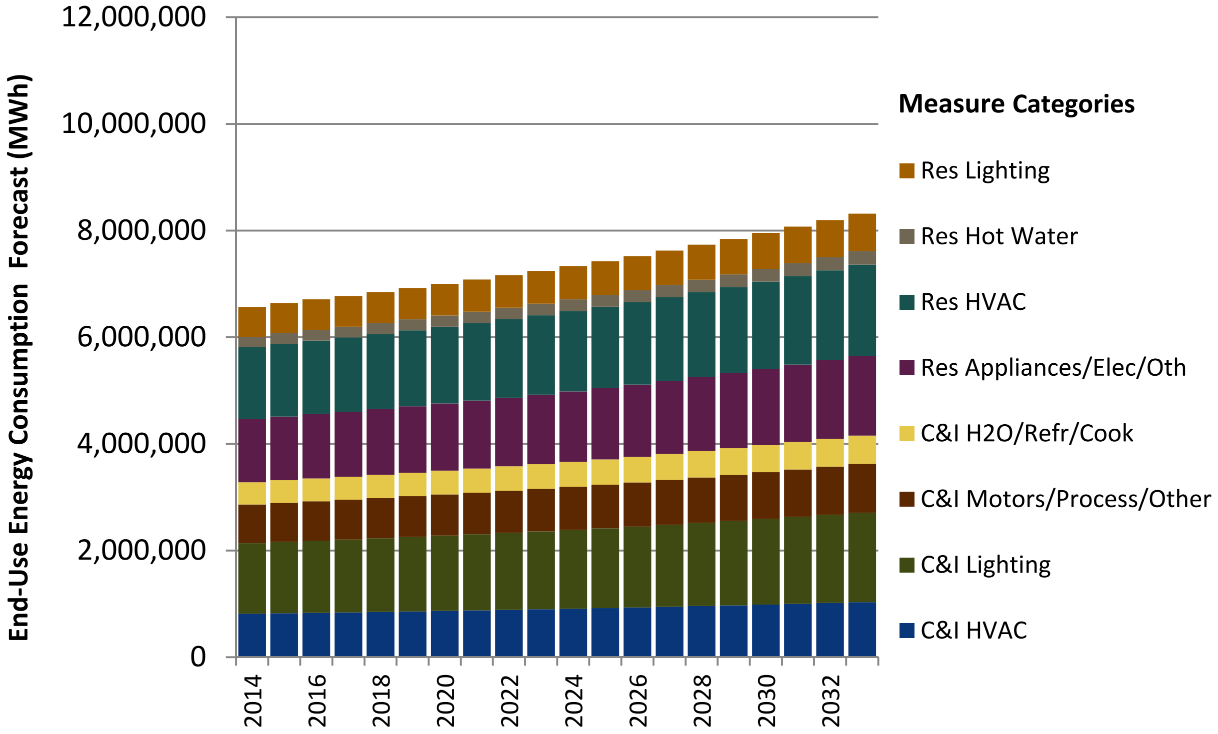


Figure 2-4. End-Use Energy Consumption Forecast, in MWh - KCP&L KS



2.2 *Measure Identification and Characterization*

2.2.1 Measure List Development

Navigant developed a comprehensive measure list of conventional and emerging technologies as the first step in the measure characterization process. The initial measure list was identified through a review of a) previous DSM potential studies conducted for the state of Missouri and other Missouri utilities[15,16], b) other Navigant potential, evaluation and program design work, and c) existing KCP&L program descriptions and custom applications. Navigant then modified the measure list – both adding and deleting measures - to incorporate feedback from KCP&L and Missouri stakeholders. Overall, 500 total measures were considered across the sectors and end-uses listed below, with 300[17] characterized for the final model. The final list of measures, including detailed measure characterization results, can be found in Appendix A.

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[15] Missouri Statewide DSM Potential Study – Final Report – Appendix J (i.e. MO DSM Study), published by KEMA consulting on March 04, 2011.

[16] AmerenUE Demand-side Management (DSM) Market Potential Study Volume 3: Analysis of Energy-Efficiency Potential (i.e. AmerenUE DSM Study), prepared by Global Energy Partners, January 2010.

[17] Measures that were not characterized either had low or no density per the baseline data collection effort, or were accounted for by other measures. For example, rather than characterizing "Best Practices", "Improved Operations", and "State of the Art" measures for Data Centers, potential savings from these measures are all captured in "Best Practices."

- **Residential :** Lighting, Space Cooling, Space Heating, Ventilation, Water Heating, Refrigerators, Freezers, Cooking, Clothes Washers, Clothes Dryers, Television, Personal Computers, Fans, Plug Loads, Behavioral
- **Commercial :** Heating, Space Cooling, Ventilation, Water Heating, Refrigeration, Lighting, Office Equipment, Cooking Equipment, Combined Heat and Power (CHP), Data Centers, Behavioral
- **Industrial:** Machine Drives, Space Heating, Space Cooling, Ventilation, Lighting, Process Heating, CHP, Compressed Air, Fans, Pumps, Refrigeration, Transformers

2.2.2 Measure Characterization Inputs

The measure characterization consisted of estimating/defining 22 key parameters across the 11 commercial, seven industrial, and two residential customer segments, all of which are input to the potential model and used in the calculation of technical, economic, and market potential. These parameters are listed and defined as follows:

1. ***Measure Definition (four parameters)*** – The following variables are used to qualitatively define each measure that is characterized.
    a. **<u>Measure Application–</u>** characterizes the measure as a retrofit (RET), replace-on-burnout (ROB), and/or new (NEW) application. The baseline definition and cost basis for each application is as follows:
        i. *RET* – The baseline is considered the existing equipment and the measure cost is considered the full installed cost of the efficient equipment.
        ii. *ROB* – The baseline is considered the least cost, code-compliant option and the measure cost is considered the incremental cost between the efficient and code-compliant equipment.
        iii. *NEW* - The baseline is considered the least cost, code-compliant option and the measure cost is considered the incremental cost between the efficient and code-compliant equipment.
    b. **<u>Baseline Definition –</u>** describes the baseline technology being characterized. For RET measures, the baseline is defined by characteristics sourced from the on-site data collection effort, when applicable.
    c. **<u>EE Definition –</u>** describes the efficient technology being characterized per the resources mentioned above, or Navigant’s professional judgment.
    d. **<u>Unit Basis –</u>** the normalizing unit for energy, demand, cost, and density estimates.
2. ***Annual Energy Consumption (three parameters)*** – the annual energy consumption in kilowatt-hours (kWh) for each of the base, code-compliant and energy efficient technologies. Base consumption is equivalent to Code consumption for ROB and NEW measures.
3. ***Coincident Electric Demand (three parameters)*** – the peak coincident demand in kilowatts (kW) for each of the base, code-compliant and energy efficient technologies. The coincident peak demand period is assumed to be 3pm-5pm weekdays in August, as recommended by KCP&L. The Base and Code demand are equivalent for ROB and NEW measures.

4. ***Annual Natural Gas Consumption (three parameters)*** – Given that KCP&L is an electric utility, technologies focused primarily on natural gas savings were not evaluated. However, for those measures which result in both significant electric and gas savings – such as shell and envelope measures - the annual gas consumption is estimated in therms for the base, code-compliant, and energy efficient cases, to support benefit cost calculations. Base consumption is equivalent to Code consumption for ROB and NEW measures.
5. ***Measure Lifetime (two parameters)*** – the lifetime in years for the base/code and energy efficient technologies. The Base/Code and EE lifetime only vary in instances where the two cases represent inherently different technologies, such as LED or CFL bulbs compared to a baseline incandescent.
6. ***Incremental Costs (three parameters)*** – the following variables are used as inputs to estimate measure costs.
    a. **Base/Code Material Costs –** the cost of the base or code compliant equipment. Only applicable for ROB and NEW applications.
    b. **EE Material Costs –** the cost of the energy efficient equipment.
    c. **Labor Costs –** the cost of installing the technology. Labor costs are only applied for RET measures. The analysis assumes no variation in labor costs between the base/code and efficient cases.
7. ***Net-to-Gross Ratio (one parameter)*** – adjusts savings and costs in the benefit cost tests to account for free-ridership and spillover. This analysis assumes a Net-to-Gross Ratio of 1.0 for all measures, except for appliance turn-ins, which assumed a NTG ratio of 0.52, consistent with discussion among stakeholders and a study performed by JACO for the Companies. A NTG of 1.0 is assumed for the base case analysis for simplicity due to inherent uncertainty in forecasting NTG ratios for new measures and programs. However, we also ran a scenario on total realistic achievable potential assuming instead a NTG ratio of 0.8 for all measures except appliance turn-ins, where 0.52 is assumed.
8. ***Technology Densities (two parameters)*** – the following variables define the saturation of the baseline and energy efficient technologies in KCP&L territory. The values are on a "per home" basis for the Residential sector, and on a "per 1000 square feet of building space" for the Commercial and Industrial sectors. All values are calculated from customer segment-specific information sourced from the baseline data collection effort. When customer segment data was under-sampled or unavailable, secondary literature and professional judgment was used to derive an appropriate value.
    a. **Base Density –** the saturation of the baseline equipment in KCP&L territory for a given customer segment.
    b. **Total Maximum Density –** the total number of both the baseline and efficient case for a given technology.
9. ***Technology Applicability (one parameter)*** – The percentage of the base technology that can be reasonably and practically replaced with the specified efficient technology. For instance, occupancy sensors are only practical for certain interior lighting fixtures (an applicability less than 1.0), while all existing incandescent exit signs can be replaced with efficient LED signs (an applicability of 1.0).

2.2.3 Measure Characterization Approaches

The characterization team employed a variety of analytical approaches to estimate annual energy savings and coincident peak demand savings for each measure including: engineering algorithms, building energy computer simulation models, and secondary resources.

The majority of measures employed engineering algorithms and appropriate inputs from different Technical Reference Manuals. When possible, the team sourced estimates from TRMs for mid-western states and utilities to capture effects of climate and regional similarities. These include the TRM submitted by Ameren Missouri[18], as well as the statewide TRM for Illinois[19]. TRMs also served as good resources for estimating costs and measure lifetimes.

Most building envelope measures were characterized through the use of building simulation models. For residential envelope measures, six models were constructed using BEopt™ software and calibrated to customer billing data. The six models were based on characteristics sourced from the baseline data collection effort and represent two customer segments (Single Family and Multi-Family) and three HVAC configurations (Electric Resistance/AC, Gas Furnace/AC, Heat Pump).

Energy and demand for commercial envelope measures were derived from simulations leveraging the *U.S. Department of Energy Commercial Reference Building Models of the National Building Stock* with a Kansas City, MO weather file. These models covered three vintages (Pre-1980, Post-1980, and New Construction) and 14 building types (Large Office, Small Office, Warehouse, Stand-alone Retail, Strip Mall, Primary School, Secondary School, Supermarket, Quick Service Restaurant, Full Service Restaurant, Hospital, Outpatient Health Care, Small Hotel, and Large Hotel).

Simulation models were also used to estimate the percent of annual energy consumption by end use occurring in each Month, On/Off Peak Period, and day type (i.e. weekday, weekend/holiday). Allocation of energy savings is necessary for calculating monetary benefits of each measure. Load shapes used for this allocation can be found in Appendix C.

Material and labor costs were derived from a variety of resources including TRMs, online research, the California Database for Energy Efficiency Resources (DEER), potential peak reductions are relatively small and RS Means cost work. When sourcing data from DEER or RSMeans, costs were adjusted using RSMeans City Cost Indices for material and labor as indicated in Table 2-4.

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[18] *Appendix A, Technical Resource Manual, 2012 Energy Efficiency Filing.* Comments provided by the Missouri Department of Natural Resources (MDNR) were considered and accounted for in the measure characterization.

[19] *State of Illinois Energy Efficiency Technical Reference Manual*

Table 2-4. Cost Adjustment Factors based on RS Means City Cost Indices

	Adjustment from DEER			Adjustment from RSMeans		
	Material	Installation	Total	Material	Installation	Total
Other	1.00	0.85	0.96	1.00	1.03	1.01
HVAC	1.03	0.84	0.94	1.01	1.02	1.01
Electrical	1.03	0.80	0.90	1.02	0.94	0.98
Weighted Average	1.00	0.86	0.93	1.02	1.03	1.02

2.2.4 Code Adjustments

The measure characterization values are aligned with national codes and standards assumptions for 2013. To accurately assess future impacts and cost effectiveness from these measures, both the energy/demand and costs of certain measures must be adjusted to account for codes and standards changes. Navigant identified the following measures as affected by future codes and standards:

- Residential Central Air Conditioners and Heat Pumps
- Residential Room Air Conditioners and Heat Pumps
- Residential Hot Water Heaters
- Residential Refrigerators and Freezers
- Residential Dishwashers
- Residential Clothes Washers and Dryers
- Residential and Commercial Screw In Bulbs
- Commercial Linear Fluorescents

The adjustments to the baseline and efficient annual energy consumption and demand can be found on the “Energy Adjustments” tab in Appendix A. Cost adjustments can be found on the “Cost Adjustments” tab in the same file.

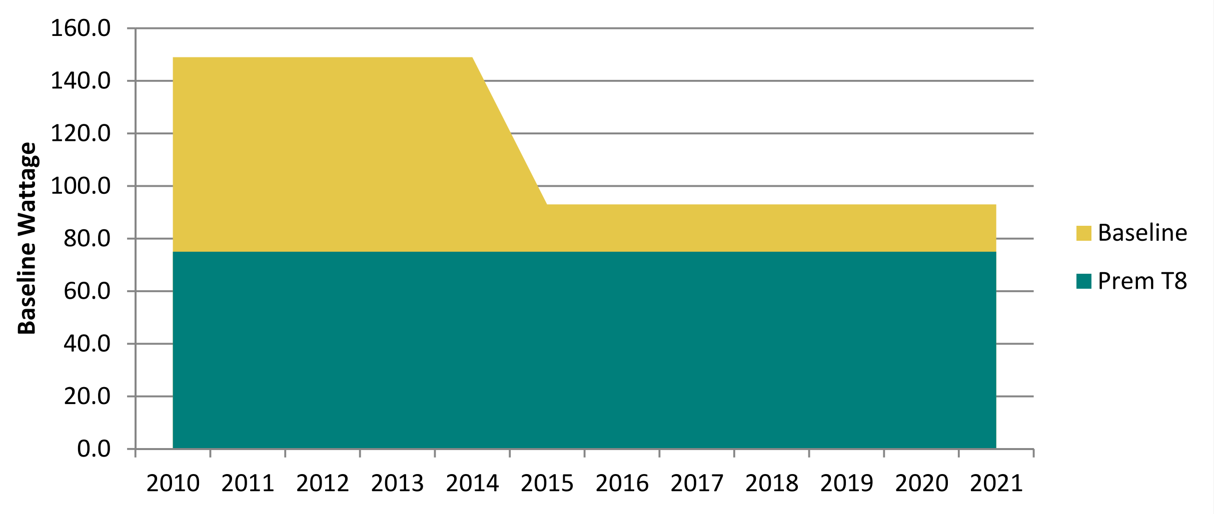
2.2.5 Treatment of T12 Retrofits

A key consideration for this analysis is the savings attributable to retrofitting T12 linear fluorescent lamp systems with T8 systems. These retrofits have been integral to successful and productive EE programs, and code changes – including the Energy Policy Act of 2005 (EPAct 2005) and Energy Independence and Security Act of 2007 (EISA 2007) - introduced increased efficacy requirements that temper the impact of these measures. These acts included specific requirements with respect to fluorescent lighting systems. EPAct 2005 laid out a timeline for phase out of magnetic ballasts. EISA 2007 included requirements for increased efficacy of fluorescent lighting.

Although magnetic ballasts have a fairly long EUL and code changes do affect the baseline for new construction, the critical date for most energy efficiency programs is July 14, 2012. This is the date specified by EISA 2007 that essentially bans the manufacture or importing of virtually all 4’ T12 lamps and 700-series T8 lamps (known as commodity F32T8, standard F32T8, or SP F32T8) by setting new efficacy standards for general purpose fluorescent lamps. Most T12 lamps and 700-series T8’s cannot pass these standards. Therefore, after July 14, 2012, if a T12 lamp or 700-series T8 lamp burns out, a customer will only be able to purchase a replacement lamp while existing stocks last, after which the fixture ballast and lamps will need to be upgraded.

As recommended by KCP&L and Missouri Stakeholders, savings for measures with a baseline of "Linear Fluorescent - T12" assume a T12 baseline for 2013 and 2014, and a standard T8 baseline (800 series) from 2015 on. To account for the baseline shift to T8, the model adjusts baseline kWh and kW for these measures to 63%[20] of their 2013 value (as listed in the "C&I Measures" tab in Appendix A) for 2015 on. In addition, for measures with an efficient description of "Linear Fluorescent - T8", starting in 2015, the efficient case is shifted to a "Premium T8" to address the remaining potential for linear fluorescent retrofits. As a result, the EE kWh and kW are adjusted to 81%[21] of their 2013 value for 2015 on. The baseline shift is depicted in Figure 2-5, where savings is represented by the yellow shaded area.

Figure 2-5. Baseline shift for T12 Retrofits.



2.3 *Approach to Estimation of Technical, Economic, and Market (Achievable) Potential for Energy/Demand*

Navigant estimated the technical, economic, and market Potential for this study using its proprietary Demand Side Management Simulator (DSMSim™) model. DSMSim is a bottom-up technology diffusion and stock tracking model implemented using a System Dynamics[22] framework. Figure 2-6 provides a high-level summary of the key input and output of DSMSim.

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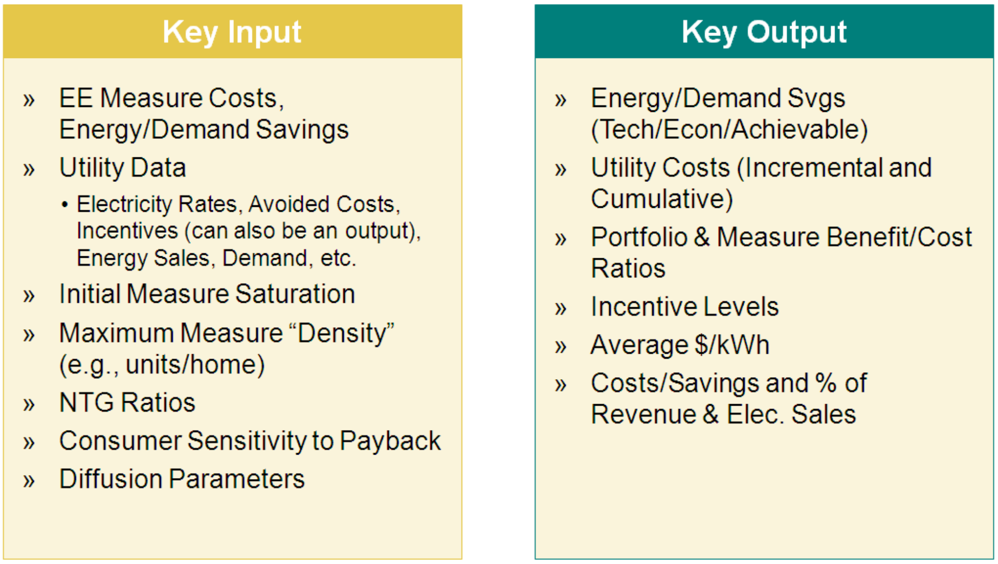
[20] A standard T8 system consumes approximately 63% of that consumed by a T12 system.

[21] A premium T8 system consumes approximately 81% of that consumed by a standard T8 system.

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

Figure 2-6. DSMSim Key Input and Output



Key Input

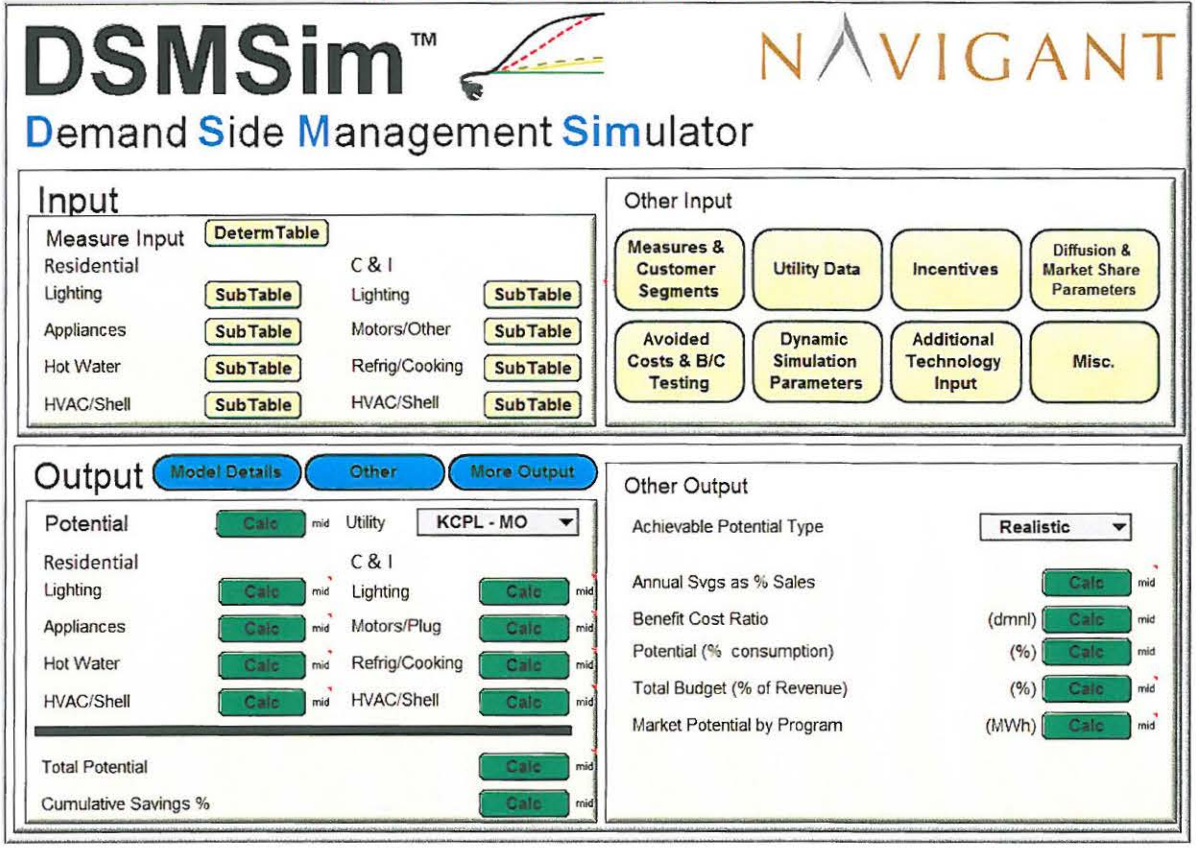
- EE Measure Costs, Energy/Demand Savings
- Utility Data
  - Electricity Rates, Avoided Costs, Incentives (can also be an output), Energy Sales, Demand, etc.
- Initial Measure Saturation
- Maximum Measure “Density” (e.g., units/home)
- NTG Ratios
- Consumer Sensitivity to Payback
- Diffusion Parameters

Key Output

- Energy/Demand Svgs (Tech/Econ/Achievable)
- Utility Costs (Incremental and Cumulative)
- Portfolio & Measure Benefit/Cost Ratios
- Incentive Levels
- Average $/kWh
- Costs/Savings and % of Revenue & Elec. Sales

All data developed as part of the measure characterization and baseline study tasks were auto-imported into DSMSim using the graphical user interface displayed below. This interface also facilitates detailed inspection (graphical or tabular) and quality control of all model output and intermediate variables, at the measure level, across customer segments, utilities, measure end uses, and simulation scenarios.

Figure 2-7. DSMSim Graphical User Interface



Utility: KCPL - MO

Achievable Potential Type: Realistic

2.3.1 Types of Potential

Consistent with the requirements of MO 4 CSR 240, four types of savings potential are calculated in this study – technical, economic, realistic achievable potential and maximum achievable potential. These different potential types are defined as follows:

Technical Potential: Technical potential is calculated assuming that all installed measures can *immediately* be replaced with the "efficient" technology, wherever technically feasible, regardless of the cost or market acceptance of the measure. This calculation of potential also does not take into consideration whether a measure has failed and is in need of being replaced.

Economic Potential: Economic potential is a subset of technical potential, using the same assumptions regarding immediate replacement, but limiting the calculation only to those measures that have passed the benefit/cost test chosen for measure screening. For this analysis, the total resource cost test[23] was used for measure screening and calculation of economic potential, using the utility after-tax weighted average cost of capital for the discount rate (**[redacted]** for KCP&L and **[redacted]** for GMO). The total resource test includes avoided energy, demand, and therm costs as the "benefits" in the ratio, whereas incremental measure costs are included as "costs" in the ratio. Consistent with industry practice,

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[23] See California Standard Practice Manual, Economic Analysis of Demand-Side Programs and Projects. October, 2001, available at http://www.energy.ca.gov/greenbuilding/documents/background/07-J_CPUC_STANDARD_PRACTICE_MANUAL.PDF

administrative costs are not included for screening at the measure level – they are considered only when estimating program level cost-effectiveness.

Maximum Achievable Potential (MAP) and Realistic Achievable Potential (RAP): Achievable potential is the most difficult and uncertain of the potentials calculated, as it estimates the energy savings that is achievable considering the following factors:

1. Market acceptance of the measure (often a function of the economics, or payback, of the measure – but other non-economic factors are also sometimes considered in market acceptance);
2. Dynamics of turning over long-lived technology stocks, since technologies with longer useful lifetimes turn over more slowly than technologies with short lifetimes, affecting the likely timing of technology adoption.
3. Diffusion of technology awareness and product adoption.

In this study, the only difference between the maximum and realistic achievable potential scenarios is the assumed level of measure incentives. Refer to section 2.3.3 for a description of how incentive levels are set for RAP and MAP.

2.3.2 Approach to Simulating Achievable Potential

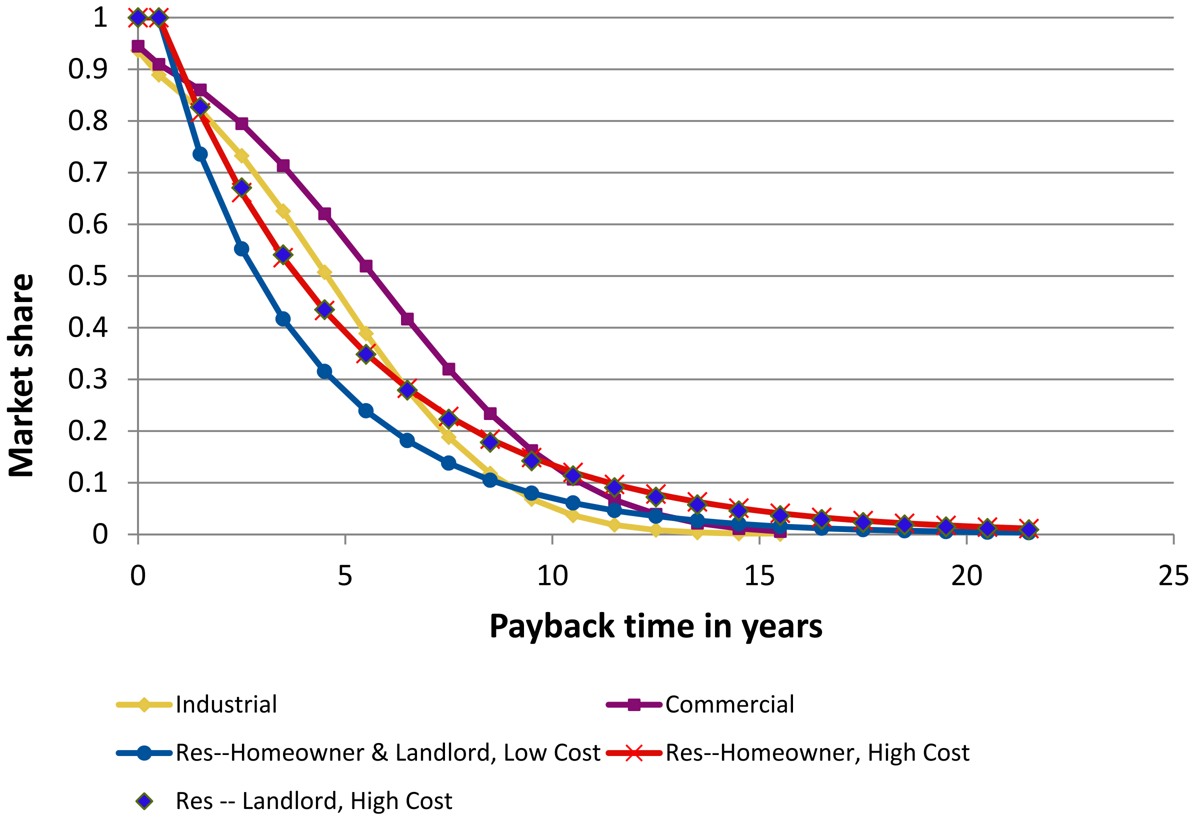
This section provides a high-level summary of the approach to calculating achievable potential, which is fundamentally more complex than calculation of technical or economic potential. The adoption of energy-efficient technologies can be broken down into calculation of the "equilibrium" market share and calculation of the dynamic approach to equilibrium market share.

Calculation of "Equilibrium" Market Share:

The equilibrium market share can be thought of as the percentage of individuals choosing to purchase a technology provided those individuals are fully aware of the technology and its relative merits (e.g., the energy- and cost-saving features of the technology). For energy-efficient technologies, a key differentiating factor between the base technology and the efficient technology is the energy and cost savings associated with the efficient technology. Of course, that additional efficiency often comes at a premium in initial cost. In efficiency potential studies, equilibrium market share is thus often calculated as a function of the payback time of the efficient technology relative to the inefficient technology. While such approaches certainly have limitations, they are nonetheless directionally reasonable and simple enough to permit estimation of market share for the dozens or even hundreds of technologies that are often considered in potential studies.

In this study, Navigant used equilibrium "payback acceptance" curves that were developed using primary research conducted in the KS and MO service areas. The final curves used in the model are illustrated below in Figure 2-8; details regarding their estimation are provided in Section 2.4.

Figure 2-8. Payback Acceptance Curves



Since the payback time of a technology can change over time, as technology costs and/or energy costs change over time, the "equilibrium" market share can also change over time. The equilibrium market share is therefore recalculated for every time step within the market simulation to ensure the dynamics of technology adoption take this effect into consideration. As such, "equilibrium" market share is a bit of an oversimplification and a misnomer, as it can itself change over time and is therefore never truly in equilibrium, but it is used nonetheless to facilitate understanding of the approach. The above curves were used for all technologies except residential lighting and appliance turn-ins (which have no calculable payback time), where a multinomial logit model[24] was employed.

Calculation of the approach to equilibrium market share:

Two approaches are used for calculating the approach to equilibrium market share, one for new technologies or those being modeled as a "retrofit" measures, and one for technologies simulated as "replace-on-burnout" (ROB) measures. Each of these approaches can be better understood by visiting Navigant's technology diffusion simulator, available at:
http://forio.com/simulate/navigantsimulations/technology-diffusion-simulation.
A high-level overview of each approach is also provided below.

Retrofit/New Technology Adoption Approach

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[24] See Ben-Akiva, Moshe and Lerman, Steven R. *Discrete Choice Analysis: Theory and Application to Travel Demand*, MIT Press 1985.

Retrofit and new technologies employ an enhanced version of the classic Bass diffusion model[25,26] to simulate the S-shaped approach to equilibrium that is observed again and again for technology adoption. Figure 2-9 provides a stock/flow diagram illustrating the causal influences underlying the Bass model. In this model, market potential adopters "flow" to adopters by two primary mechanisms – adoption from external influences, such as marketing and advertising, and adoption from internal influences, or "word-of-mouth." The "fraction willing to adopt" was estimated using the payback acceptance curves illustrated in Figure 2-10.

The marketing effectiveness and word-of-mouth parameters for this diffusion model were estimated drawing upon case studies where these parameters were estimated for dozens of technologies[27]. Recognition of the positive, or self-reinforcing, feedback generated by the "word-of-mouth" mechanism is evidenced by increasing discussion of the concepts such as social marketing as well as the term "viral," which has been popularized and strengthened most recently by social networking sites such as Facebook and YouTube. However, the underlying positive feedback associated with this mechanism has been ever present and a part of the Bass diffusion model of product adoption since its inception in 1969.

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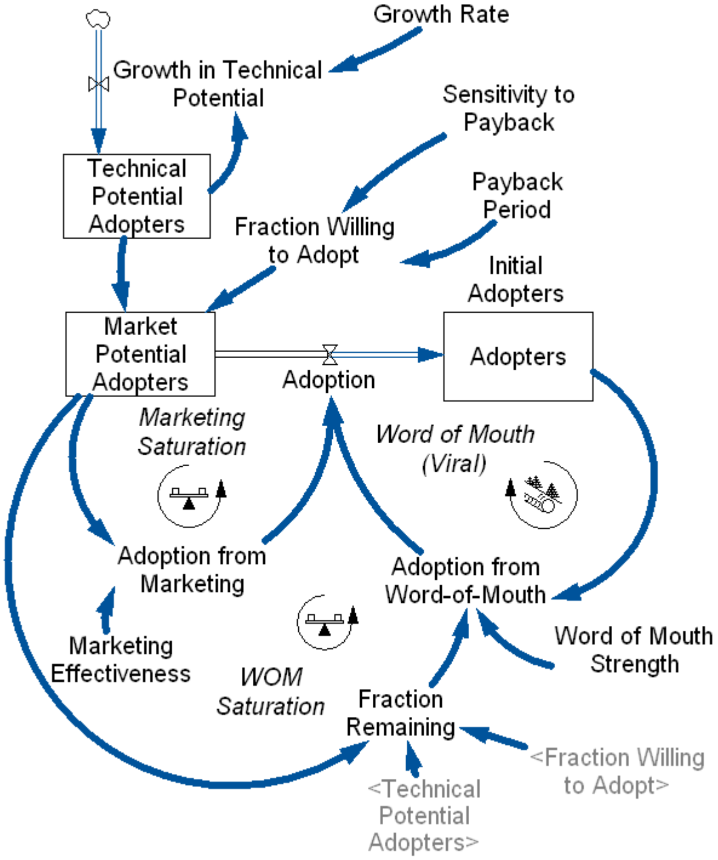
[25] Bass, Frank (1969). "A new product growth model for consumer durables". Management Science 15 (5): p215–227.

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

[27] See Mahajan, V., Muller, E., and Wind, Y. (2000). New Product Diffusion Models. Springer. Chapter 12 for estimation of the Bass diffusion parameters for dozens of technologies. This model uses the median value of 0.365 for the word-of-mouth strength in the base case scenario. The Marketing Effectiveness parameter was assumed to be 0.04, representing a somewhat aggressive value that exceeds the most likely value of 0.021 (75th percentile value is 0.055) per Mahajan 2000.

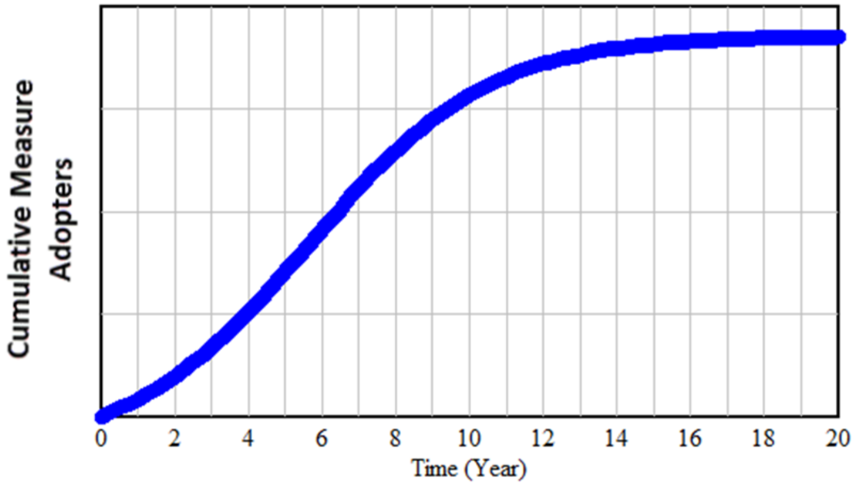
Figure 2-9. Stock/Flow Diagram of Diffusion Model for New Products and Retrofits



Source: Navigant Consulting, Inc.

The model illustrated above generates the commonly seen S-shaped growth of product adoption and is a simplified representation of that employed in DSMSim. The characteristic S-shaped growth for the parameters assumed in this model is provided below in Figure 2-10 (for retrofit measures – for replace-on-burnout measures, the dynamics can be slowed due to stock turnover).

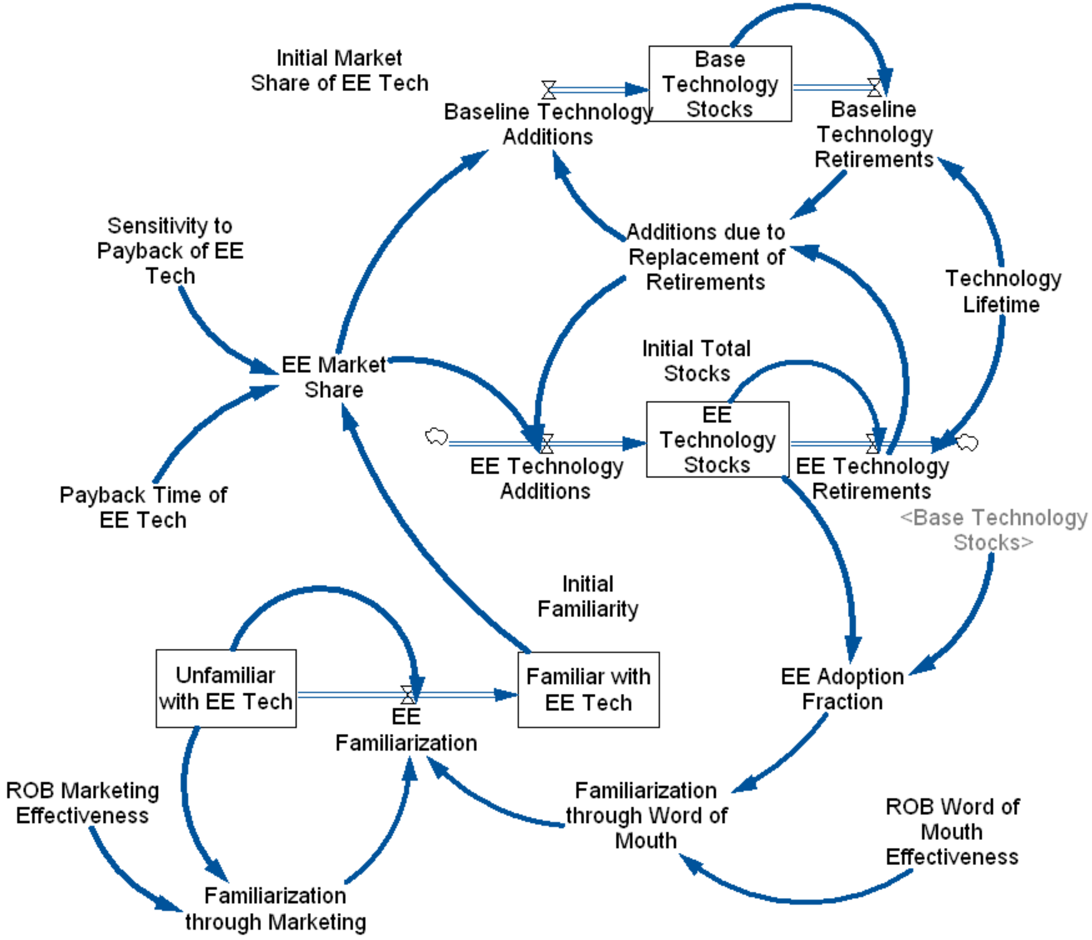
Figure 2-10. Characteristic Technology Diffusion for New/Retrofit Measures



Replace on Burnout Technology Adoption Approach

The dynamics of adoption for replace-on-burnout technologies is somewhat more complicated than for new/retrofit technologies since it requires simulating the turnover of long-lived technology stocks. The DSMSim model tracks the stock of all technologies, both base and efficient, and explicitly calculates technology retirements and additions consistent with the lifetime of the technologies. Such an approach ensures that technology “churn” is considered in the estimation of market potential, since only a fraction of the total stock of technologies are replaced each year, which affects how quickly technologies can be replaced. A model that endogenously generates growth in the familiarity of a technology, analogous to the Bass approach described above, is overlaid on the stock tracking model to capture the dynamics associated with the diffusion of technology familiarity. A simplified version of the model employed in DSMSim is illustrated graphically in Figure 2-11

Figure 2-11. Stock/Flow Diagram of Diffusion Model for Replace on Burnout Measures



Source: Navigant Consulting, Inc.

2.3.3 Achievable Potential Scenarios and Incentive Levels

A key component of any potential study is determining the appropriate level at which to set measure incentives for each scenario. Often, potential studies will set incentive levels by using a constant percentage of incremental cost across all measures (e.g., 33%, 50%, 75%, etc.). However, this methodology, while common in potential studies, will result in a portfolio that is more expensive than if the incentive levels are allowed to vary by measure using methods that come down the EE supply curve more efficiently[28], as we have done in this study. In this study, we follow the approach described in detail in Welch, Richerson-Smith (2012), which is summarized briefly below.

Maximum Achievable Potential (MAP):
For the MAP scenario, incentive levels are set at 100% of the incremental cost of the measure. This scenario will maximize savings achieved, but will also result in a portfolio cost that far exceeds that typically encountered in efficiency programs for a given level of energy saved (as will be illustrated in

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[28] See Welch, Richerson-Smith (2012). "Incentive Scenarios in Potential Studies: A Smarter Approach" Presented at the ACEEE Summer Study on Energy Efficiency in Buildings. Monterey, CA. August 2012. Available at http://www.aceee.org/files/proceedings/2012/data/papers/0193-000050.pdf.

section 3.8). Some exceptions apply, however. For instance, in the case of CFLs and ultra-high efficiency incandescent lightbulbs, the incremental cost can actually become negative upon full implementation of the new EISA lighting standards, due to increasing costs of the baseline code-compliant bulb. However, savings opportunities still exist for these measures, since the code-compliant incandescent bulbs still consume considerably more than an efficient CFL and since some consumers will still purchase code-compliant bulbs due to issues such as lighting quality and dim-ability. As such, we still suggest offering incentives for these measures, but rather than using the incremental cost to calculate the incentive level, we have selected an incentive level of $1/bulb for CFLs and ultra-high efficiency incandescents. Additionally, appliance turn-in programs typically cover the full recycling cost of the refrigerator or freezer and further provide an incentive for a customer to participate beyond that cost. In this study, we have selected an additional incentive level of $50/appliance for refrigerator and freezer recycling.

Realistic Achievable Potential (RAP):
For the RAP scenario, we come down the efficiency supply curve by limiting the maximum $/kWh paid (calculated on a levelized cost basis) for any given measure. This methodology, as described by Welch and Richerson-Smith (2012)[29], will first reduce the incentive levels (from a starting point of 100%) of those measures that are most expensive on a levelized $/kWh basis. For instance, at a maximum threshold payment of $0.015/kWh levelized, any measure with a levelized cost below this value will still offer an incentive of 100% of incremental cost (to maximize adoption of the measures that are least expensive on a levelized $/kWh basis). Measures that exceed this levelized cost will have incentives lower than 100% in proportion to their levelized cost. For instance, a measure that has a levelized cost of $0.03/kWh would receive an incentive that is 50% of the incremental cost of that measure (or $0.015/$0.030). The threshold value of $0.015 was determined iteratively to achieve an average incentive payment (across all measures) of 50% of the incremental costs (incentive fractions were weighted by the economic potential). The value of 50%, on average, was deemed to be reasonable by the stakeholder group and is consistent with levels often seen in efficiency program design.

As with MAP incentives, exceptions do apply. CFLs and ultra-high efficiency incandescents provide incentives of $1/bulb, and appliance turn-ins offer an additional incentive of $50/appliance beyond the full recycling cost (see discussion in the MAP scenario above). Additionally, as this study also developed a set of efficiency programs designed to achieve the realistic achievable potential, certain programs deviated from the algorithm described above. For instance, measures passing through the limited income program do not follow this algorithm. Rather, the full measure cost (materials and labor) are assumed to be covered for participants in this program. In similar fashion, incentive levels in the Small Business Direct Install program were set to an average of 70%, as higher incentive levels are often used in these types of programs to get adequate program participation. Finally, as very low incentive levels can result in high free ridership, we have set a minimum percentage of incremental cost covered of 25% for all cost-effective measures.

Other Scenarios:
In section 3.8.1 we provide high-level output (cumulative savings and cumulative program costs) for additional incentive scenarios between the RAP and MAP scenarios. These scenarios help to define a type of "market potential supply curve" for energy efficiency. These intermediate scenarios follow the same algorithm set forth above for the RAP scenario, but using different thresholds for the maximum

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[29] Welch, Richerson-Smith (2012). "Incentive Scenarios in Potential Studies: A Smarter Approach" Presented at the ACEEE Summer Study on Energy Efficiency in Buildings. Monterey, CA. August 2012. Available at http://www.aceee.org/files/proceedings/2012/data/papers/0193-000050.pdf.

levelized $/kWh payment (values of $0.03/kWh, $0.06/kWh, and $0.015/kWh), respectively, were used for Scenarios 1, 2, and 3 in this curve).

2.3.4 Model Calibration

Any model simulating *future* product adoption faces challenges with 'calibration,' as there is no future world against which one can compare simulated with actual results. Engineering models, on the other hand, can often be calibrated to a high degree of accuracy since simulated performance can be compared directly with performance of actual hardware. Unfortunately, DSM potential models do not have this luxury, and therefore must rely on other techniques to provide both the developer and the recipient of model results with a level of comfort that simulated results are reasonable. For this potential study, Navigant took a number of steps to ensure that forecast model results were reasonable, including:

- Comparing 2014 forecast values, by program, against claimed savings in 2011 and 2012. Although some studies indicate that DSM potential models are 'calibrated' to ensure first-year simulated savings precisely equal prior-year reported savings, we have found that forcing such precise agreement has the potential to introduce errors into the modeling process by effectively masking the explanation for differences – particularly when the measures included may be different. Additionally, there may be sound reasons for first-year simulated savings to differ from prior year reported savings (e.g., a program is rapidly ramping up, or savings estimates have changed). Thus, while we endeavored to achieve agreement to a degree believed to be reasonable between past results and forecast first-year results, we did not force the model to do so -- providing, we believe, a degree of confidence that the model is internally consistent.
- Identifying and ensuring an explanation existed for significant discrepancies between 2014 forecast savings and prior year savings, recognizing that some ramp-up is expected. For example, we noted in this process discrepancies in some programs (e.g., cool homes) due to our exclusion of some measures (e.g., early retirement HVAC) from the program due to failure to pass the TRC.
- Calculating $/first-year kWh costs for each program and comparing them with past results.
- Calculating portfolio-level $/first-year kWh costs and comparing them with values we researched through benchmarking of other utilities, which was conducted as part of this study.
- Comparing cost-effectiveness results with results from other programs Navigant has designed and/or evaluated and with values we researched through benchmarking we conducted of other utilities.

2.4 *Estimation of Payback Acceptance Curves*

This section describes calculation of payback acceptance curves, which, as discussed in section 2.3.3, are used to estimate the long-run, or equilibrium, market share of energy efficiency measures.

2.4.1 Objective and general approach

The objective of the analysis was to generate payback curves for each of three sectors: residential, commercial, and industrial. The approach chosen was to survey customers in the KCP&L/GMO service territory about the payback times required for the adoption of energy efficient technologies and to use these survey data to statistically estimate payback curves.

2.4.2 Sample Design for Customer Payback Acceptance Surveys

To generate separate payback curves for all three sectors, Navigant surveyed 400 commercial customers, 150 industrial customers, and 400 residential customers. All surveyed customers were in the KCP&L and GMO service territories.

Sample Stratification

The residential sector was stratified in three dimensions. First, the sample was split between 360 single-family homeowners and 40 landlords. The decision to include a small sample of landlords reflected the understanding that because landlords do not always pay for utilities, the rate of adoption of energy efficient appliances by landlords could be quite different than that for homeowners. The small sample of landlords allowed us to investigate this issue. Second, among homeowners the sample was split evenly between KCP&L respondents and GMO respondents –180 each. Third, the homeowner sample in each service territory was further stratified across three income classes: 60 with annual incomes less than $50K, 60 with incomes in the range $50K-$75K, and 60 with incomes greater than $75K. The decision to stratify by income reflected the concern that for high-cost electrical devices like refrigerators and central air conditioning units, income might be a factor in the decision to purchase the more expensive energy-efficient version of the device.

The sample of landlords was not stratified by location because of its small size and because landlords would be expected to have properties across the service territory boundaries. The commercial and industrial samples were not stratified due to expected high costs per completed survey and the reasonable hypothesis that the distribution of payback times was unlikely to vary much across sectors.

Implementation Strategy

The task of fielding the surveys was subcontracted to Ipsos Observer, a national survey firm. Web-based panels were used for the survey of residential homeowners. The advantage of such panels is that, because panel respondents choose to respond to a survey without knowing the survey topic, they eliminate the problem of issue-oriented selection bias. There is of course the possibility that an individual who agrees to sign up for such panels is different than the average individual, but it seems unlikely that this difference, if it exists, is related to the decision to purchase energy efficient technologies. Either way, this avenue for selection bias would seem far less problematic than a telephone survey in which the respondent is told the purpose of the survey at the start.

Ipsos Observer provided a census weight for each completed survey in the sample of residential homeowners. Weights were designed to match the sample distribution as closely as possible to the local census distribution of five demographic variables in each service area (KCP&L or GMO). The variables were age, income, education, gender, and race. The survey of residential landlords involved a telephone survey drawing on a client-supplied list of landlords in the service areas who previously completed a random survey for KCP&L. The survey of commercial and industrial customers involved a telephone survey drawing on a list of non-residential accounts previously provided by the client. Assignment of these accounts to the commercial and industrial sectors was based on SIC codes.

The surveys were fielded in late September 2012 and were completed by mid-October 2012. Because panel surveys are based on a first-come, first-served basis, in which panel members can opt into the survey as long as it is "open", with the survey closing when the desired sample size is reached, there is no response rate for the residential homeowner survey. For the landlord survey the response rate, defined as the ratio of the number of completed surveys to the number of customers who either completed the survey or refused to participate, was 44%. For the survey of industrial and commercial customers the response rate was 36%.

Three survey instruments were developed: one for homeowners, one for landlords, and one for commercial/industrial. The survey instruments are in Appendix E-Appendix I. Highlights of the surveys include the following:

- The survey of commercial and industrial customers was administered only to a respondent indicating that he/she was the person "most familiar" with the management of the company's lighting, heating, and cooling technology.
- In the survey of commercial and industrial customers, respondents were asked if they had a required payback time, or an established rule of thumb concerning payback time, for the purchase of energy efficient technologies. If not, they were asked a set of questions to get at the firm's typical payback time for energy efficient technologies.
- In the residential surveys—homeowner and landlord—respondents were not asked directly about payback times. Instead, they were given a decision scenario involving the purchase of an energy efficient technology, and then asked a set of questions concerning whether they would be willing to pay $X more for the technology if it saved them $Y per year. From their responses a payback time was calculated. For instance, if the respondent was told that savings from an energy efficient refrigerator is $25/year compared to a standard version, and the respondent indicated they would buy it if it cost $75 more than the standard version, but not if it cost $100 more, then their payback time for the energy efficient technology was revealed to be greater than $75/$25/year =3 years, but less than $100/$25/year =4 years, yielding an estimated payback time of 3.5 years.
- Homeowners were asked two such willingness-to-pay questions, one from a set of low-cost devices (light bulb, power strip, DVD player), and one from a set of high-cost devices (dishwasher, large-screen TV, refrigerator, central air conditioner). This created the opportunity to investigate whether the payback curves for low-cost devices are different than for high cost devices.
- Distinguishing payback curves for high-cost and low-cost devices for rental housing is confounded by the fact that landlords are typically responsible for high-cost appliances, while tenants are the purchasers of most low-cost devices and high-cost consumer devices –that is, devices that stay with the tenant. To simplify, we assumed that the payback curves for low-cost devices estimated for homeowners are generally applicable, and focused the survey of landlords on high-cost appliances only (dishwasher, refrigerator, central air conditioner).

2.4.3 Estimating Payback Functions

The survey data generates payback times in whole years –1 year, 2 years, 3 years, etc. These data were used to estimate payback functions $F(t)$ that indicate the proportion of respondents adopting an energy efficient technology if the payback time is t. We used two approaches for estimating $F(t)$. With t measured in years, the first simply plots the proportion of respondents adopting a technology with a payback time equal to t=0, 1, 2, 3, etc., and interpolates linearly between each point. This approach is called a "semi-parametric" approach because it makes no parametric assumptions about the shape of the payback curve except as expressed in linear interpolation between the market shares calculated from the data at each whole year. The advantage of the semi-parametric approach is that it imposes no assumptions about the functional form of the payback function. It's disadvantage, though, is that hypothesis testing, such as whether the payback function for the KCP&L and GMO service territories are different, or whether the payback functions for landlords and homeowners are different, is cumbersome and conceptually nuanced.[30]

In the alternative approach –parametric estimation of payback functions –hypothesis testing is straightforward. The analyst specifies and estimates a functional form for the payback function that includes both t and other variables expected to affect payback times, and tests whether these other variables do indeed have a statistically significant effect on payback. Formally, the payback function is specified as $F(t,X)$, where X is the set of additional variables.

After a review of histograms of the payback times reported in the survey data, we settled on a gamma-distributed specification for the residential version of $F(t,X)$, and a normal-distributed specification for the commercial and industrial versions of $F(t,X)$. The functions were estimated using maximum likelihood estimation, as described in Appendix A.

2.4.4 Payback Acceptance Results

Detailed results of the statistical analysis are reported in Appendix A. As discussed in Appendix A, the parametric estimates of the payback functions are very similar to the nonparametric estimates. Figure 2-12 below compares the parametric payback curves across sectors. It bears repeating that the analysis assumed that the payback curve for low-cost devices estimated for homeowners is generally applicable, whereas the analysis tests whether homeowners and landlords differ in the payback curve for high-cost devices. The figure indicates the following:

- In general, residential payback curves fall below the curves for the commercial and industrial sectors, indicating that residential customers require a shorter payback time to adopt new technology.
- The residential payback curve for high cost (>$300) devices lies above the curve for low-cost devices, indicating that in the residential sector, low-cost devices typically must have shorter payback times to capture the same market share as high-cost devices. This difference is statistically significant at the 95% confidence level.
- The residential payback curve for high-cost devices is virtually the same for homeowners and landlords. In statistical terms, it is not possible to reject at any reasonable confidence level the null hypothesis that there is no difference between these two curves.[31] While the results of this study did not reveal a difference between homeowners and landlords, Navigant notes that

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[30] For instance, it's conceivable that a comparison of two non-parametric payback functions generates the result that they are statistically different at Year 1, not statistically different at Year 2, statistically different at Year 3, and so on.

[31] One possible explanation for this result is that landlords systematically misinterpreted the question to be asking about how they would behave in a hypothetical situation in which they were responsible for the rental property's utilities. This is very unlikely to be the case. First, landlords were asked to think about a *particular* property if they owned more than one, and were asked whether they or their tenants paid the electric bill. Then, just before the payback questions were asked, the following script was read to the respondent:

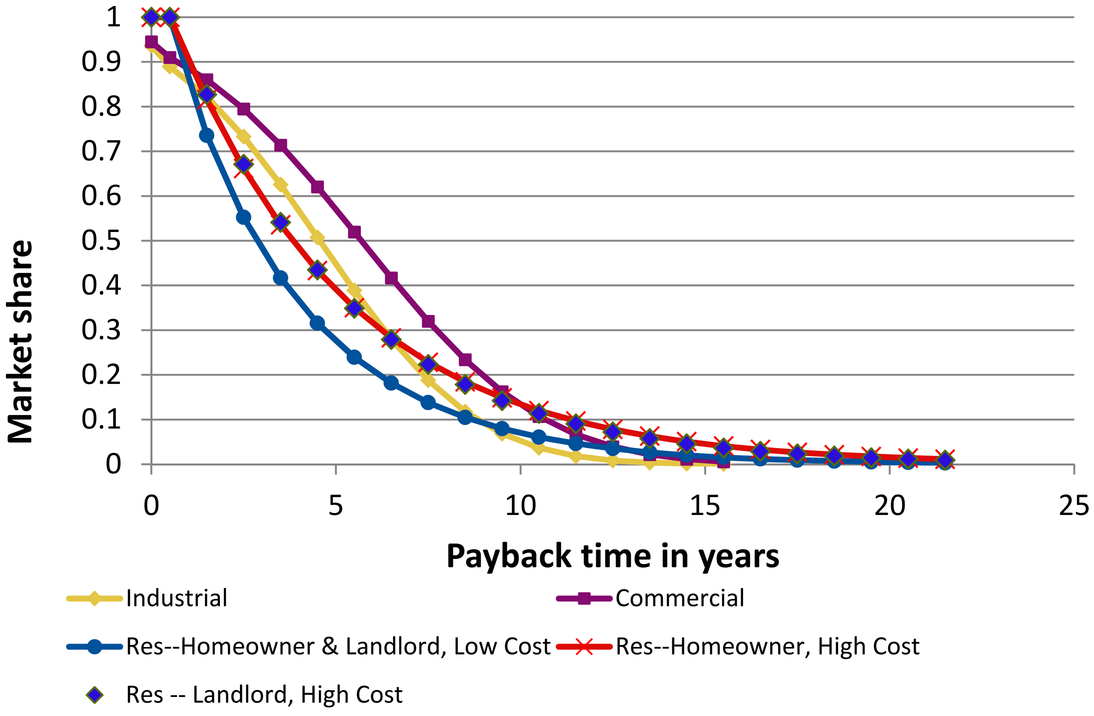
> *"The next set of questions asks about your likely purchase behavior when buying a new energy efficient appliance for your rental property. Imagine that you really are in the process of making the purchase decisions presented below, and anticipate how you would truly behave if the situation were real. Thanks for your help."*

future studies might focus in on the "landlord/tenant" issue to further explore whether forecast results might be impacted.

Two other results of interest, with details in Appendix A:

- For the residential sector there is no statistical difference in payback curves for KCPL and GMO;
- For the residential sector, demographic variables generally do not have a statistically significant effect on the payback curves.

Figure 2-12. Summary of Parametric Payback Curves



2.5 *Caveats and Limitations*

There are a number of important caveats and limitations associated with the results of this DSM potential study, as detailed below.

Opt Out Customers

At the time of this report, the list of opt-out customers was very much in flux due to changes in customer decision-making regarding opt-out. As such, we collectively agreed with the Companies that we would not reduce the potential results of this study to exclude opt-out customers. However, we note that the latest data available indicated that, for GMO, approximately 19% (on an energy consumption basis) of GMO's large C&I customers were likely to opt out[32]. Data were not available for KCP&L MO and KCP&L KS.

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[32] kWh for KCP&L-GMO customers exercising the opt-out option. Data taken from MO Public Commission Staff opt-out list provided to the KCP&L-GMO for verification on January 10, 2013.

Net-to-Gross Assumptions

Due to the inherent uncertainty in forecasting net-to-gross (NTG) ratios, we agreed with stakeholders to use a NTG value of 1.0 for all measures except appliance recycling (where 0.52 was used). As such, the potential estimates herein are, for the most part, estimates of "gross" savings. Using a default net-to-gross factor of 0.8 rather than 1.0 results in roughly a 20% reduction in savings relative to that shown in this report[33]. Consideration of this caveat is important for comparing the results of this study with future achievements and for setting compliance targets.

Scenario Analysis versus Forecasts/Predictions

Estimation of market potential for energy efficiency savings is inherently uncertain. As such, the estimates provided herein are *scenario* based, and should not be considered to be forecasts or predictions of what *will* happen. Savings that will actually be achieved over the next 10-20 years depend on a large variety of factors, including incentive levels for each measure, effectiveness of program design, execution and marketing efforts, degree of success of emerging technologies, future fuel/electricity prices, measure costs, and economic factors, among many others.

Market Uncertainties

A number of uncertainties exist regarding the market acceptance of energy-efficiency measures. For instance, the primary method employed in this study for calculating equilibrium market share of efficient technologies is use of "payback acceptance curves," which are commonly used in potential studies as a reasonable and tractable approach to estimate market share for dozens or even hundreds of technologies. However, this approach is limited in its ability to account for non-monetary product purchase considerations. When combined with the other market dynamics considered in Navigant's DSMSim model, this approach should provide directionally reasonable estimates. However, it is subject to limitations and uncertainty that would likely be cost-prohibitive to mitigate (e.g., via detailed discrete choice analysis studies for each measure). Additionally, while Navigant's DSMSim model employs advanced technology diffusion theory, diffusion parameters are also uncertain (e.g., marketing effectiveness).

Data Uncertainties

Navigant drew upon many data sources, both primary (e.g., from the baseline study) and secondary, for estimation of measure energy consumption, incremental cost, and market saturation. However, uncertainty in these estimates inevitably exists, which can affect estimates of potential. Navigant did not conduct parametric or other uncertainty analysis on the unit-energy-savings, cost estimates, or initial market saturation estimates as part of this study.

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[33] Most measures still passed the TRC.

3. KCP&L and GMO Energy Efficiency Potential Results

In this section, we summarize the potential for energy and peak demand savings from energy efficiency measures. The potential for combined heat and power savings is described in section 4. The potential for demand response program savings is detailed in a separate stand-alone report entitled "Demand-Side Resource Potential Study Report – Demand Response," dated June 2013.

We first describe in section 3.1 the technical, economic, maximum achievable (MAP) and realistic achievable (RAP) savings potential (energy and peak demand) in aggregate for KCP&L KS, KCP&L MO and KCP&L GMO. Subsequent sections (0 through 3.5) disaggregate the savings potential by customer segment, end use category, and program. We provide these disaggregated results for the realistic achievable potential scenario only. In section 3.6, we provide estimated costs, by program, to achieve the realistic potential savings. Finally, we provide in section 3.8 two types of supply curves that illustrate 1) the cost to achieve savings at levels higher than the RAP scenario (up to the MAP scenario), and 2) the levelized cost of electricity saved as a function of cumulative savings for both RAP and MAP.

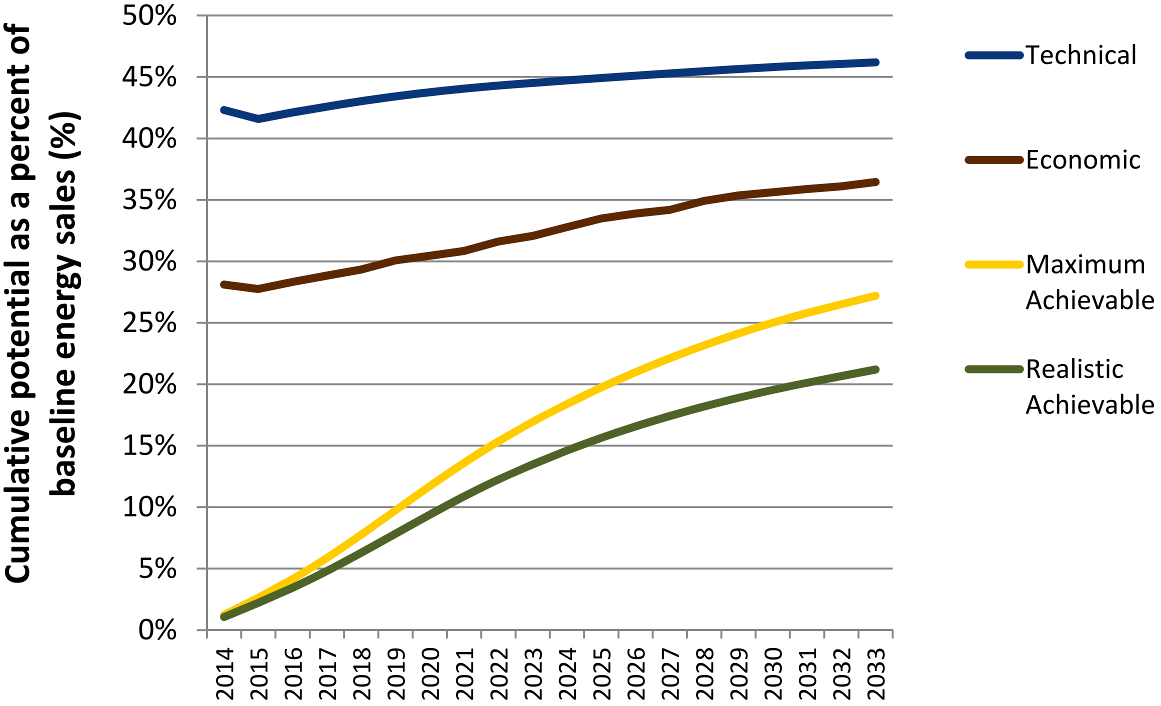
3.1 Aggregate Savings Potential

This section summarizes the aggregate savings potential for energy and peak demand, including technical, economic, MAP, and RAP scenario results for KCP&L KS, KCP&L MO, and KCP&L GMO. For energy savings potential, in addition to providing absolute values (in MWh), we also illustrate the potential as a percentage of baseline forecast energy sales (exclusive of EE savings), as stakeholders are often interested in this metric. Looking at the cumulative savings as a percentage of baseline forecast sales offers a way to compare results with other potential studies as well as with achieved savings from past programs in other service territories.

3.1.1 Aggregate Savings Potential – KCP&L GMO

Figure 3-1 illustrates the potential for energy savings as a percentage of KCP&L GMO's baseline energy forecast. As seen in this figure, technical potential represents between 41-46% of baseline energy sales over the 20-year forecast horizon, whereas economic potential ranges from about 27%-36% over the forecast horizon. There are sometimes "kinks" in the technical and economic potential curves (e.g., in 2015 and 2028) due to two factors. First, code and standard changes result in adjustment to baseline energy consumption assumptions (e.g., for residential lighting, T12's, etc. – see section 2.2.4). This factor is the primary contributor to the drop in technical and economic potential in 2015. Second, TRC screening is performed in every year of the simulation. As such, some measures (e.g., AC/HP evaporative pre-cooling, HPS induction lighting) that don't initially pass the TRC in the early years eventually pass the TRC in later years as avoided costs escalate. As a result, one can see an uptick in economic potential as those measures are introduced into the assumed portfolio of cost-effective measures.

Figure 3-1. Cumulative Energy Savings as % of Sales - KCP&L GMO



One can also see in Figure 3-1 that maximum achievable potential reaches 16.9% after 10 years (an average of 1.69%/year over the first 10 years of the forecast) and 27.2% by the year 2033, or about 75% of economic potential in that year. When comparing this result with the payback acceptance curves discussed in section 2.4, one may expect a higher value as a percentage of economic potential (e.g., closer to 90-95% of economic potential), since 100% of incremental costs are covered by incentives in the MAP scenario. The reason that MAP is somewhat lower is two-fold. First, the dynamics of stock turnover and growth in familiarity are such that some measures have not yet reached their "equilibrium" market share by 2033 (especially in the case of residential LEDs, which are not projected to gain significant market share until later in the simulation). Additionally, as noted in the previous paragraph, some measures don't pass the TRC until later in the simulation, meaning that they have also not yet reached their equilibrium market share values by 2033.

Figure 3-1 also shows that realistic achievable potential is 13.5% of baseline energy sales by 2023 (or 1.35%/year for the first 10 years of the forecast) and 21.2% by 2033, which is roughly 58% the economic potential in that year. Table 3-1 provides the same information shown in Figure 3-1, but in tabular format.

Table 3-1. Cumulative Energy Savings as % of Sales – KCP&L GMO

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2014	42.3%	28.1%	1.1%	1.2%
2015	41.6%	27.7%	2.2%	2.6%
2016	42.1%	28.3%	3.4%	4.2%
2017	42.6%	28.8%	4.8%	5.9%
2018	43.0%	29.3%	6.3%	7.8%
2019	43.4%	30.1%	7.8%	9.7%
2020	43.7%	30.5%	9.4%	11.7%
2021	44.1%	30.8%	10.9%	13.6%
2022	44.3%	31.6%	12.2%	15.4%
2023	44.5%	32.1%	13.5%	16.9%
2024	44.7%	32.8%	14.6%	18.4%
2025	44.9%	33.5%	15.6%	19.7%
2026	45.1%	33.9%	16.6%	21.0%
2027	45.3%	34.2%	17.4%	22.1%
2028	45.5%	34.9%	18.2%	23.2%
2029	45.6%	35.4%	18.9%	24.1%
2030	45.8%	35.6%	19.5%	25.0%
2031	45.9%	35.9%	20.1%	25.8%
2032	46.1%	36.1%	20.7%	26.5%
2033	46.2%	36.5%	21.2%	27.2%

In addition to viewing the cumulative realistic achievable potential as a percentage of baseline energy sales, it is also informative to look at the incremental annual potential as a percentage of baseline sales. We provide this result in Figure 3-2. As can be seen in this figure, which is effectively the slope of the cumulative potential curve[34], potential ramps up over the first several years, peaks in about 2020, and tails off in later years as the market for energy savings saturates and approaches its equilibrium value. In a simple situation where all savings are harvested over a 20-year horizon, the annual value would approach zero as the market saturates. However, it does not in this instance for a number of reasons, mainly due to the continued addition of new building stock, which continues to offer savings potential as long as the stock is growing. Additionally, some measures are being added to the portfolio in the out-years as they become cost-effective later in the forecast due to escalating avoided costs. Finally, emerging technologies such as LEDs show market penetration later in the forecast horizon as their costs and performance come down an estimated learning curve, thereby improving their competitiveness with other measures such as CFLs.

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[34] This statement is true if the curves are plotted in terms of absolute magnitude of savings, but not if plotted as a percentage. While the summation of annual savings will result in the same value as the cumulative potential curve in absolute terms (e.g., in MWh), the summation of annual percentages will not add to the cumulative potential as a percentage of baseline sales.

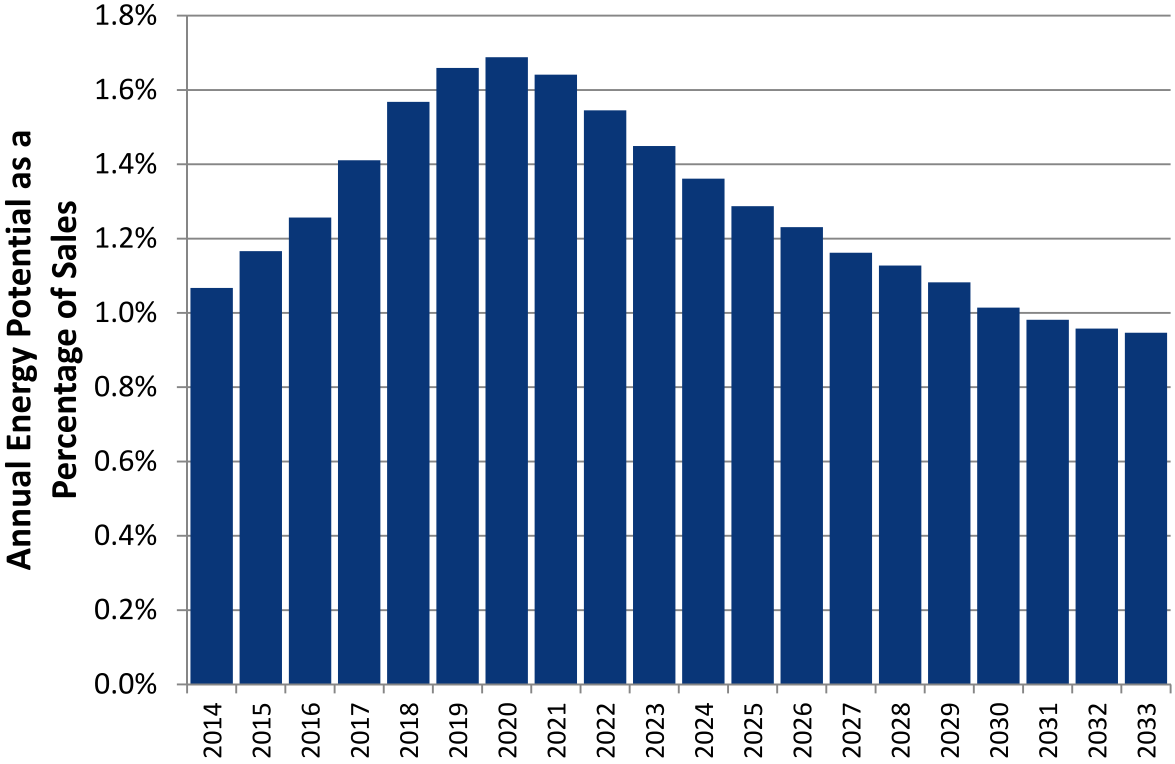


Figure 3-2. Incremental RAP as a % of Baseline Forecast Energy Sales – KCP&L GMO

Table 3-2 shows the results described expressed in absolute savings potential (in MWh), rather than as a percentage of baseline forecast energy sales.

Table 3-2. Cumulative Energy Savings (MWh) – KCP&L GMO

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2014	3,604,097	2,394,376	90,895	106,150
2015	3,595,117	2,398,790	191,727	227,510
2016	3,697,376	2,486,081	302,033	364,356
2017	3,796,243	2,570,081	427,785	523,176
2018	3,899,798	2,658,253	569,884	703,168
2019	4,005,157	2,773,474	722,942	897,225
2020	4,103,282	2,857,034	881,328	1,098,957
2021	4,203,193	2,942,518	1,037,947	1,298,414
2022	4,299,936	3,068,068	1,187,910	1,490,214
2023	4,393,587	3,164,818	1,330,940	1,672,037
2024	4,492,172	3,292,540	1,467,700	1,847,554
2025	4,594,538	3,425,606	1,599,381	2,018,670
2026	4,700,944	3,531,512	1,727,665	2,187,097
2027	4,816,489	3,635,284	1,851,215	2,350,357
2028	4,933,979	3,788,766	1,973,566	2,513,766
2029	5,055,552	3,915,775	2,093,452	2,673,904
2030	5,180,364	4,028,017	2,208,148	2,826,627
2031	5,300,992	4,140,064	2,321,418	2,976,165

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2032	5,425,181	4,251,923	2,434,251	3,123,259
2033	5,554,149	4,383,342	2,548,082	3,270,051

Navigant also calculated the potential for reduction in coincident peak demand from energy efficiency measures, the results of which are illustrated below in Table 3-3.

Table 3-3. Cumulative Peak Demand Potential (MW) – KCP&L GMO

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2014	1,018	602	20	26
2015	1,016	606	44	57
2016	1,039	624	71	93
2017	1,061	642	102	135
2018	1,085	661	137	183
2019	1,109	684	176	237
2020	1,133	703	217	292
2021	1,156	721	257	347
2022	1,179	771	295	400
2023	1,201	790	331	450
2024	1,224	821	364	498
2025	1,248	846	395	543
2026	1,273	872	424	587
2027	1,301	895	452	629
2028	1,328	922	479	670
2029	1,357	951	506	710
2030	1,386	976	530	748
2031	1,414	1,001	555	784
2032	1,443	1,026	579	819
2033	1,473	1,053	603	853

3.1.2 Aggregate Savings Potential – KCP&L MO

Figure 3-3 illustrates the potential for energy savings as a percentage of KCP&L MO's baseline energy forecast. As seen in this figure, technical potential represents roughly 41% of baseline energy sales over the 20-year forecast horizon, whereas economic potential ranges from about 27%-34% over the forecast horizon. Maximum achievable potential reaches 16.8% after 10 years (an average of 1.68%/year over the first 10 years of the forecast) and 25.3% by the year 2033. Realistic achievable potential is 12.4% of baseline energy sales by 2023 (or 1.24%/year for the first 10 years of the forecast) and 18.5% by 2033, which is roughly 55% the economic potential in that year. For additional discussion of the drivers of the shape of these curves, including "kinks" in the curve and the magnitude of achievable potential relative to economic potential, refer to the discussion in section 3.1.3, as the drivers are similar for each utility.

Figure 3-3. Cumulative Energy Savings as % of Sales – KCP&L MO

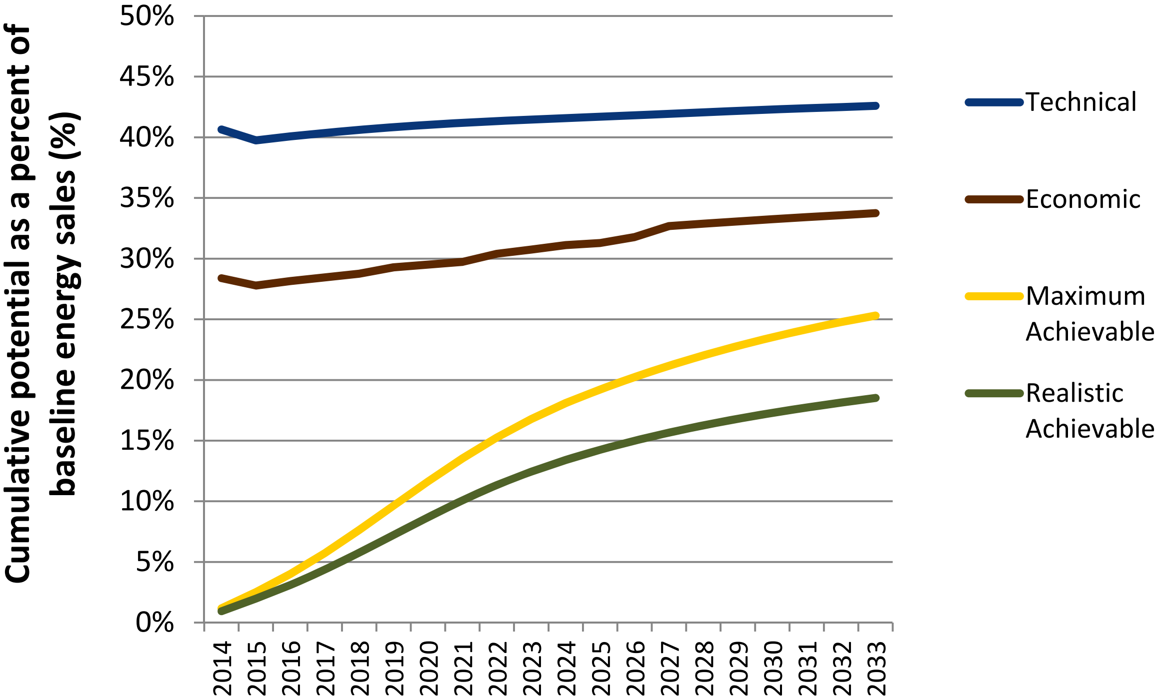


Table 3-4 provides the same information described in the figure above, but in tabular form.

Table 3-4. Cumulative Energy Savings as % of Sales – KCP&L MO

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2014	40.6%	28.4%	0.9%	1.2%
2015	39.7%	27.8%	2.0%	2.5%
2016	40.1%	28.1%	3.1%	4.0%
2017	40.4%	28.5%	4.4%	5.7%
2018	40.6%	28.8%	5.8%	7.6%
2019	40.8%	29.3%	7.2%	9.6%
2020	41.0%	29.5%	8.7%	11.6%
2021	41.2%	29.7%	10.1%	13.5%
2022	41.3%	30.4%	11.3%	15.3%
2023	41.5%	30.8%	12.4%	16.8%
2024	41.6%	31.1%	13.4%	18.1%
2025	41.7%	31.3%	14.2%	19.2%
2026	41.8%	31.8%	15.0%	20.2%
2027	41.9%	32.7%	15.7%	21.2%
2028	42.1%	32.9%	16.3%	22.0%
2029	42.2%	33.1%	16.8%	22.8%
2030	42.3%	33.3%	17.3%	23.5%
2031	42.4%	33.4%	17.7%	24.2%
2032	42.5%	33.6%	18.1%	24.8%
2033	42.6%	33.7%	18.5%	25.3%

As with KCP&L GMO, we provide for KCP&L MO the annual incremental realistic achievable potential as a percentage of baseline forecast energy sales in Figure 3-4. One will note that the annual percentage for KCP&L MO tails off more dramatically than for KCP&L GMO due to GMO's having a higher forecast customer growth rate, lending more opportunities for savings in new building stock in GMO's service area than in KCP&L MO's service area.

Figure 3-4. Incremental RAP as a % of Baseline Forecast Energy Sales – KCP&L MO

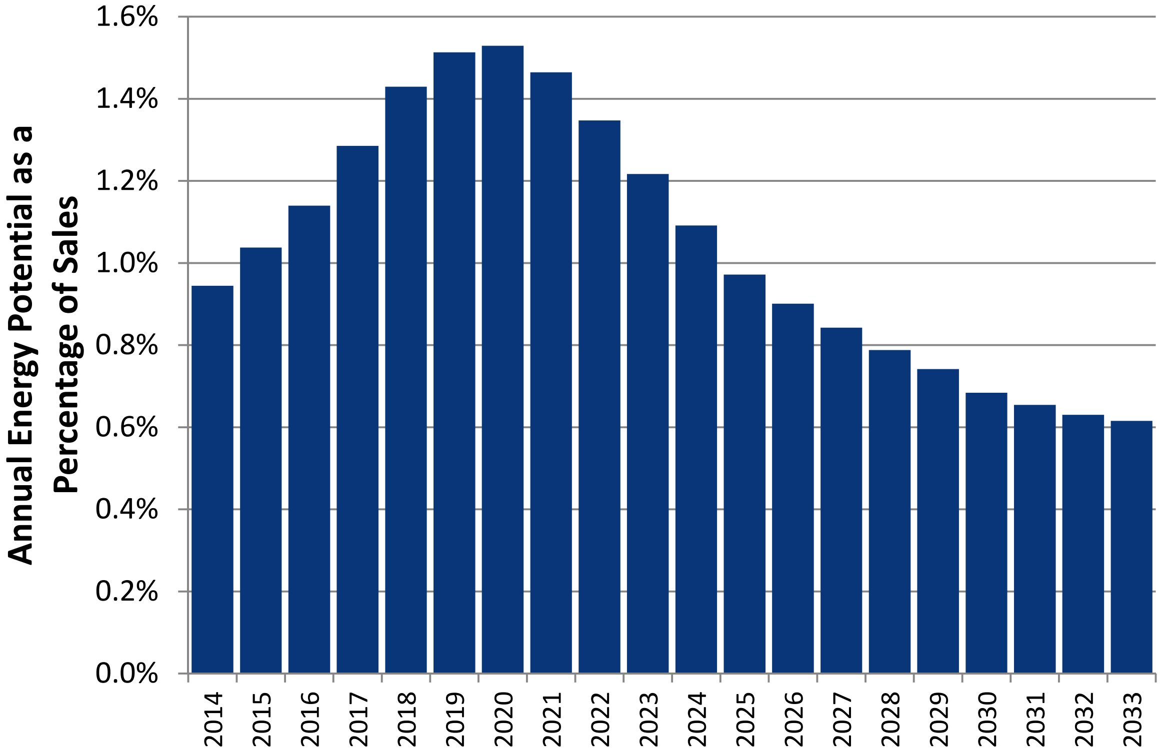


Table 3-5 shows the results described above expressed in absolute savings potential (in MWh), rather than as a percentage of baseline forecast energy sales.

Table 3-5. Cumulative Energy Savings (MWh) – KCP&L MO

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2014	3,581,027	2,501,491	83,217	103,809
2015	3,524,940	2,464,568	175,255	222,681
2016	3,579,226	2,514,060	277,039	358,190
2017	3,630,483	2,560,346	392,661	515,413
2018	3,684,404	2,608,862	522,323	692,514
2019	3,738,378	2,680,433	660,805	881,699
2020	3,786,858	2,723,815	801,979	1,075,116
2021	3,837,153	2,768,866	938,370	1,261,494
2022	3,885,410	2,857,765	1,064,988	1,435,067
2023	3,932,526	2,917,142	1,180,430	1,591,901
2024	3,983,472	2,980,930	1,284,982	1,733,479

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2025	4,036,927	3,029,471	1,379,080	1,860,562
2026	4,092,455	3,110,198	1,467,237	1,980,594
2027	4,153,604	3,236,336	1,550,686	2,096,715
2028	4,215,936	3,296,513	1,629,698	2,208,109
2029	4,280,483	3,356,160	1,704,979	2,315,369
2030	4,346,720	3,417,337	1,775,261	2,416,230
2031	4,409,916	3,476,352	1,843,326	2,513,709
2032	4,475,357	3,536,815	1,909,732	2,607,909
2033	4,543,031	3,599,358	1,975,390	2,699,565

Navigant also calculated the potential for reduction in coincident peak demand from energy efficiency measures, the results of which are illustrated below in Table 3-6.

Table 3-6. Cumulative Peak Demand Potential – KCP&L MO

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2014	976	615	19	26
2015	963	611	41	56
2016	974	621	65	92
2017	985	630	94	134
2018	997	640	127	181
2019	1,009	654	162	232
2020	1,020	664	198	285
2021	1,032	674	233	336
2022	1,043	716	266	384
2023	1,054	730	295	427
2024	1,066	741	320	466
2025	1,078	752	343	501
2026	1,091	773	364	534
2027	1,106	791	382	565
2028	1,120	805	400	594
2029	1,135	818	416	621
2030	1,151	832	432	647
2031	1,165	846	447	671
2032	1,181	860	461	693
2033	1,197	874	475	715

3.1.3 Aggregate Savings Potential – KCP&L KS

Figure 3-5 illustrates the potential for energy savings as a percentage of KCP&L KS's baseline energy forecast. As seen in this figure, technical potential represents roughly 42% of baseline energy sales over the 20-year forecast horizon, whereas economic potential ranges from about 26%-33% over the forecast horizon. Maximum achievable potential reaches 15.7% after 10 years (an average of 1.57%/year over the first 10 years of the forecast) and 23.8% by the year 2033. Realistic achievable potential is 11.5% of baseline energy sales by 2023 (or 1.15%/year for the first 10 years of the forecast) and 17.1% by 2033, which is roughly half the economic potential in that year. For additional discussion of the drivers of the shape of these curves, including "kinks" in the curve and the magnitude of achievable potential relative to economic potential, refer to the discussion in section 3.1.3, as the drivers are similar for each utility.

Figure 3-5. Cumulative Energy Savings as % of Baseline Forecast Sales - KCP&L KS

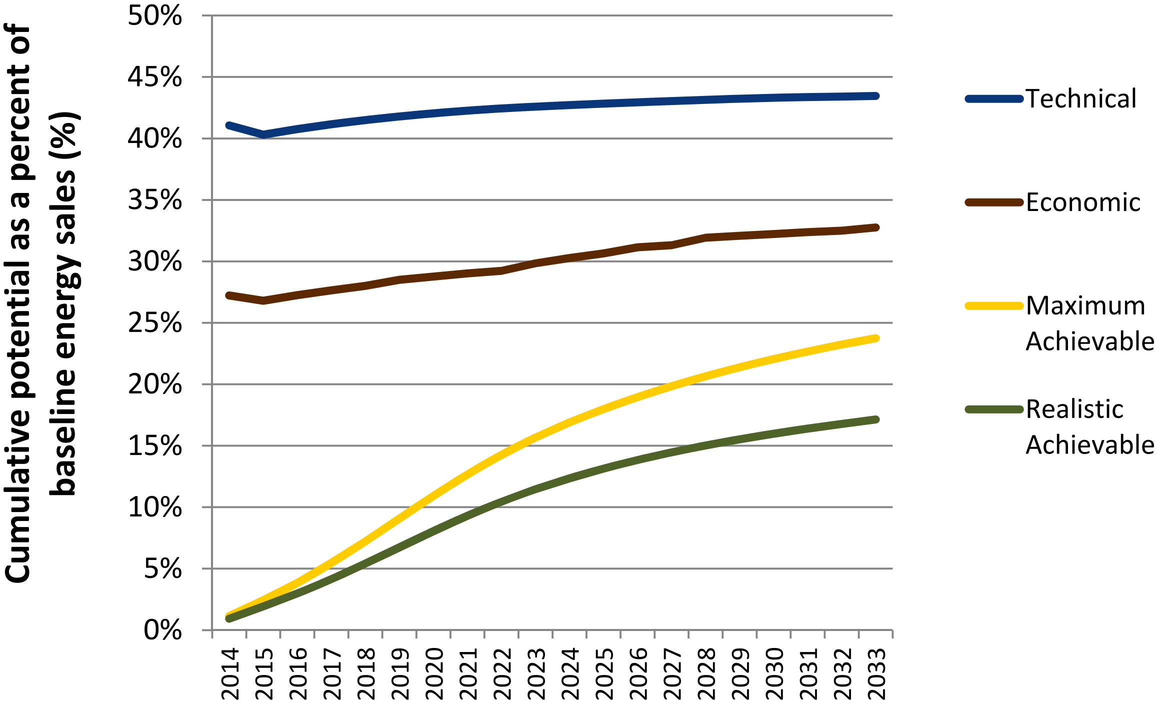


Table 3-7 provides the same information described in the figure above, but in tabular form.

Table 3-7. Cumulative Energy Savings as % of Baseline Forecast Sales - KCP&L KS

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2014	41.1%	27.2%	0.9%	1.1%
2015	40.3%	26.8%	1.9%	2.4%
2016	40.8%	27.3%	3.0%	3.8%
2017	41.2%	27.6%	4.1%	5.5%
2018	41.5%	28.0%	5.4%	7.2%
2019	41.8%	28.5%	6.7%	9.1%
2020	42.0%	28.8%	8.1%	10.9%
2021	42.3%	29.0%	9.3%	12.7%
2022	42.4%	29.2%	10.4%	14.3%
2023	42.6%	29.8%	11.5%	15.7%
2024	42.7%	30.3%	12.4%	16.9%
2025	42.8%	30.6%	13.1%	18.0%
2026	42.9%	31.1%	13.8%	19.0%
2027	43.1%	31.3%	14.5%	19.8%
2028	43.1%	31.9%	15.0%	20.6%
2029	43.2%	32.1%	15.5%	21.4%
2030	43.3%	32.2%	16.0%	22.1%
2031	43.4%	32.4%	16.4%	22.7%
2032	43.4%	32.5%	16.8%	23.2%
2033	43.5%	32.8%	17.1%	23.8%

As with KCP&L GMO and KCP&L MO, we provide for KCP&L KS the annual incremental realistic achievable potential as a percentage of baseline forecast energy sales in Figure 3-6. One will note that the annual percentage for KCP&L KS tails off more dramatically than for KCP&L GMO due to GMO's having a higher forecast customer growth rate, lending more opportunities for savings in new building stock in GMO's service area than in KCP&L KS's service area.

Figure 3-6. Incremental RAP as a % of Baseline Forecast Energy Sales – KCP&L KS

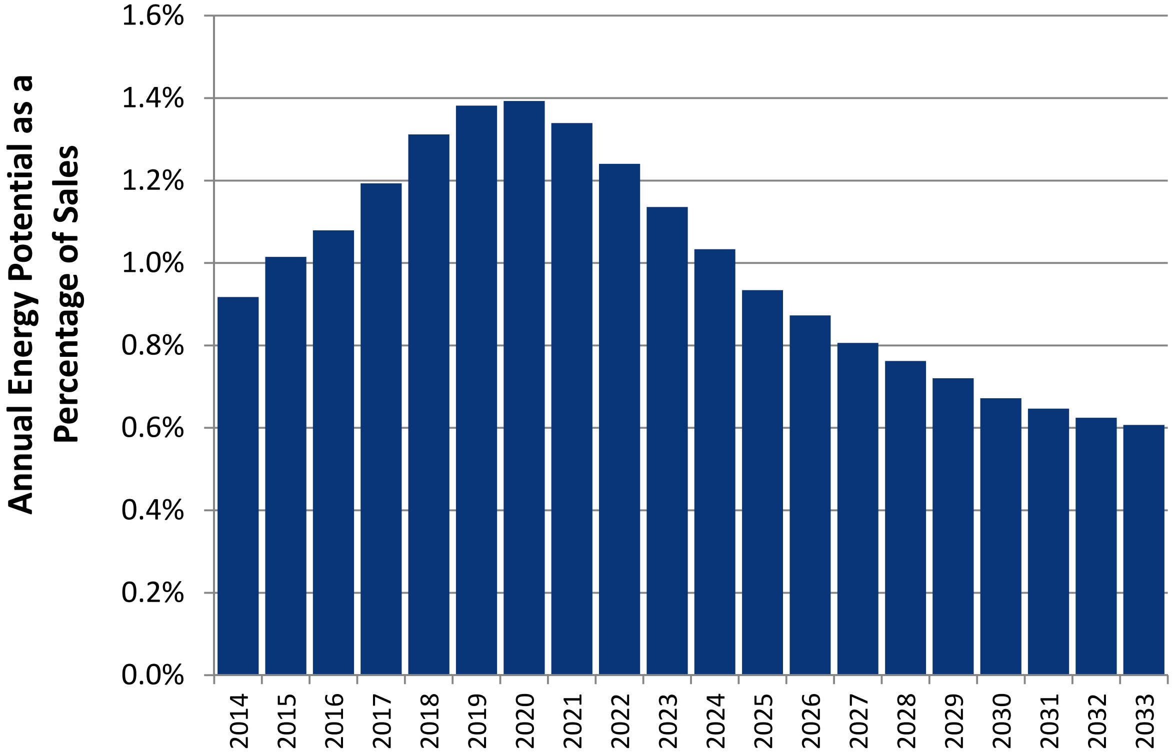


Table 3-8 shows the results described above expressed in absolute savings potential (in MWh), rather than as a percentage of baseline forecast energy sales.

Table 3-8. Cumulative Energy Savings (MWh) – KCP&L KS

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2014	2,721,410	1,804,180	60,804	75,079
2015	2,700,880	1,795,794	128,797	162,511
2016	2,759,519	1,845,102	201,858	260,583
2017	2,812,774	1,889,418	283,429	373,070
2018	2,866,972	1,934,541	374,060	499,032
2019	2,920,690	1,991,280	470,598	633,542
2020	2,969,861	2,031,782	569,032	771,503
2021	3,019,936	2,073,275	664,736	905,533
2022	3,067,602	2,112,647	754,392	1,030,013
2023	3,112,399	2,181,514	837,423	1,145,041
2024	3,159,916	2,239,795	913,897	1,250,737
2025	3,208,476	2,295,653	983,873	1,347,196
2026	3,258,312	2,362,886	1,050,099	1,439,352
2027	3,311,738	2,409,134	1,112,106	1,526,001
2028	3,365,596	2,491,169	1,171,573	1,610,665
2029	3,420,374	2,538,341	1,228,577	1,692,504
2030	3,476,409	2,586,670	1,282,500	1,770,291
2031	3,531,031	2,637,233	1,335,151	1,846,247

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2032	3,587,559	2,686,173	1,386,789	1,920,151
2033	3,645,948	2,747,654	1,437,728	1,992,450

Navigant also calculated the potential for reduction in coincident peak demand from energy efficiency measures, the results of which are illustrated below in Table 3-9.

Table 3-9. Cumulative Peak Demand Potential (MW) – KCP&L KS

Year	Technical	Economic	Realistic Achievable	Maximum Achievable
2014	764	450	14	19
2015	759	450	30	41
2016	772	460	47	67
2017	784	470	67	97
2018	796	479	90	131
2019	809	490	115	169
2020	821	499	140	207
2021	832	508	165	244
2022	844	517	189	279
2023	855	549	210	312
2024	866	558	229	341
2025	878	571	246	368
2026	890	589	262	393
2027	903	599	276	417
2028	915	612	289	439
2029	929	623	302	461
2030	942	634	314	481
2031	955	645	326	500
2032	968	656	337	518
2033	982	668	348	535

3.2 *Disaggregated Realistic Achievable Potential – Customer Segment*

Navigant modeled for each measure the savings potential by customer segment, as this was the level of aggregation of building stock calculations, as discussed in section 2.1.1. The savings by customer segment for the realistic achievable potential scenario is provided for each utility in Figure 3-7 through Figure 3-9. Residential single family homes offer the largest potential for energy savings for all three utilities. Including both limited income and non-limited income homes, residential single family homes account for 24%, 19%, and 30% of the realistic achievable potential by 2033 for KCP&L GMO, KCP&L MO, and KCP&L KS, respectively. We also note that to permit modeling incentive levels separately for customers in the limited income program, the limited income customer segment was further subdivided into those participating in the LI Weatherization program and those assumed to participate via other residential programs.

Figure 3-7. Cumulative RAP Energy Savings (MWh) by Customer Segment - KCP&L GMO

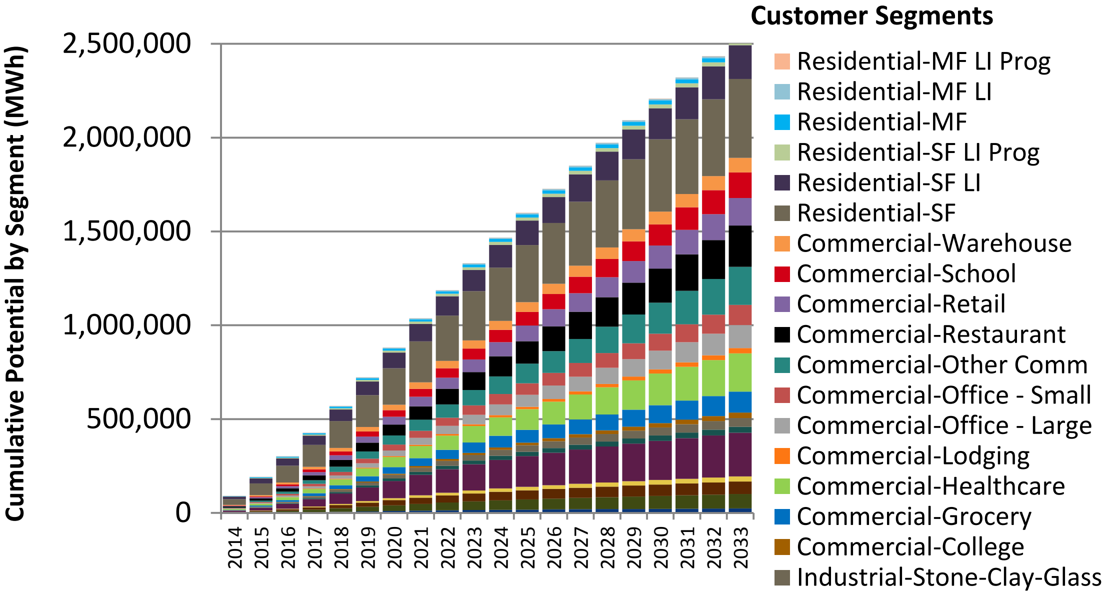


Figure 3-8. Cumulative RAP Energy Savings (MWh) by Customer Segment - KCP&L MO

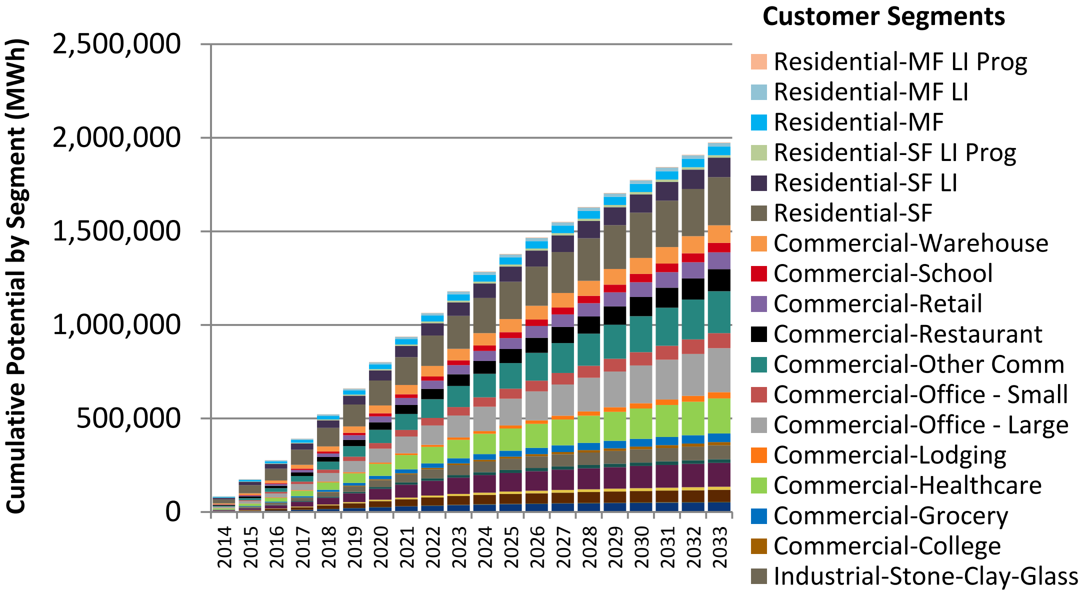
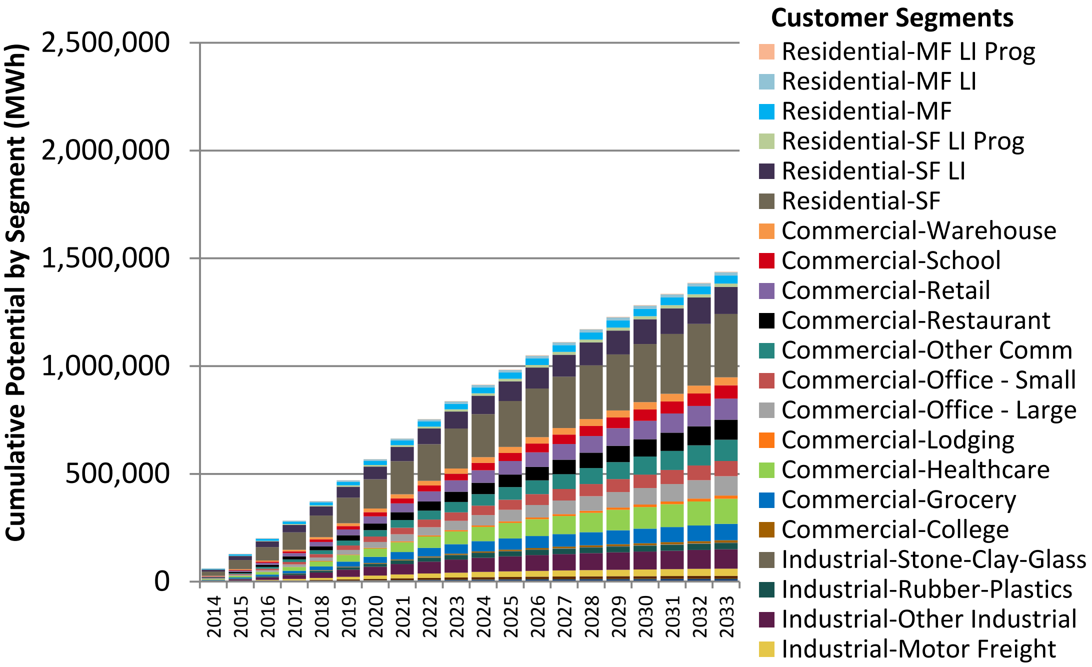


Figure 3-9. Cumulative RAP Energy Savings (MWh) by Customer Segment - KCP&L KS



3.3 Disaggregated Realistic Achievable Potential – End Use Category

Navigant aggregated savings potential, which is calculated at the measure and customer segment level, into eight end-use categories in Figure 3-10 through Figure 3-12. As seen in these figures, C&I HVAC/Shell/Whole Building measures provide the largest savings opportunity by 2033, driven largely by new construction measures that reduce savings greater than 30% relative to a baseline building. This end use category accounts for between 25% and 32% of total realistic achievable potential over the 20-year forecast horizon. Residential and C&I Lighting still account for substantial savings notwithstanding new federal lighting standards that reduce opportunity relative to past achievement. Residential and C&I lighting combined account for between 28% and 30% of realistic achievable savings over the 20-year forecast horizon. Additional detail regarding which measures drive the savings results can be found in section 3.4 and in Appendix L.

Figure 3-10. Cumulative RAP Energy Savings (MWh) by End Use Category - KCP&L GMO

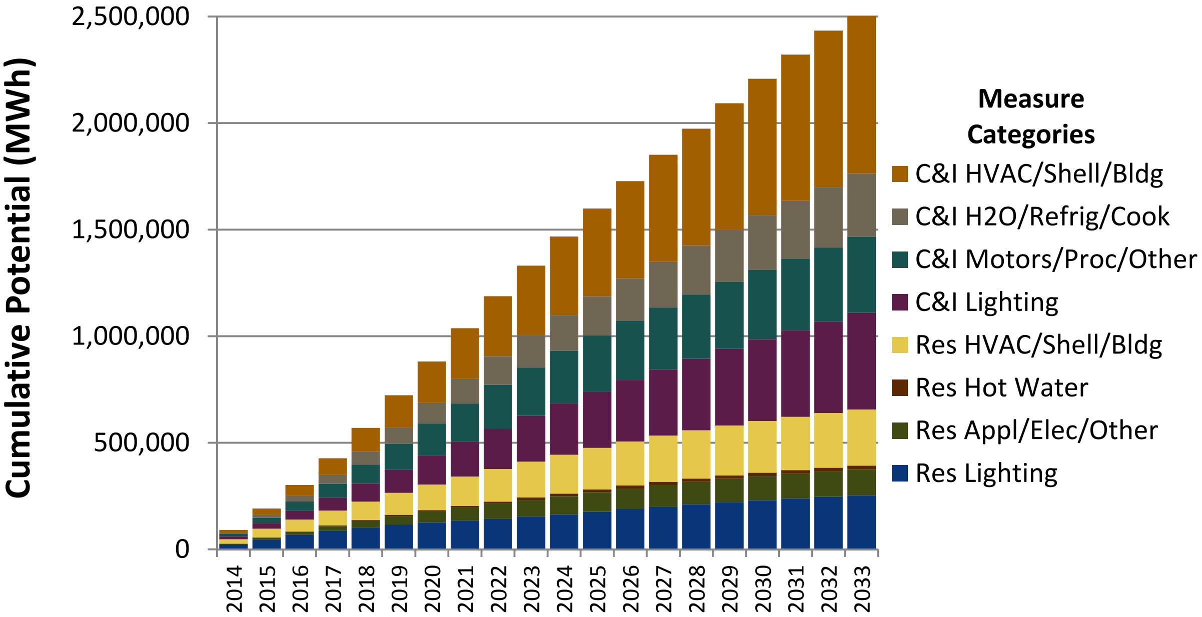


Figure 3-11. Cumulative RAP Energy Savings (MWh) by End Use Category - KCP&L MO

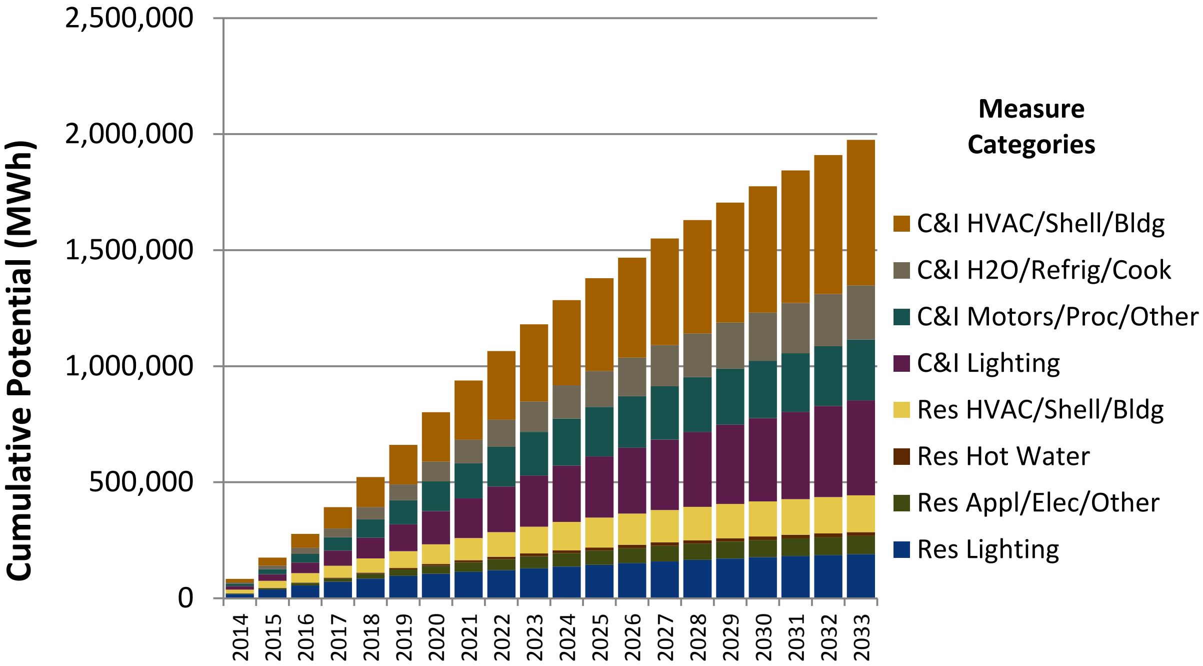
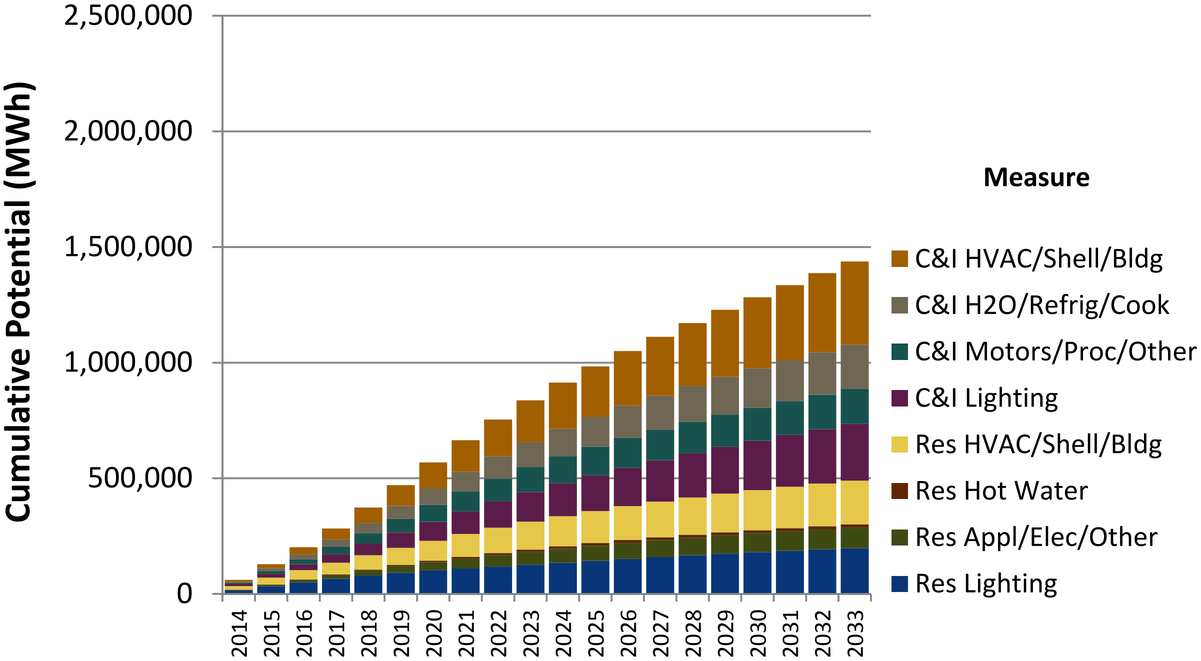


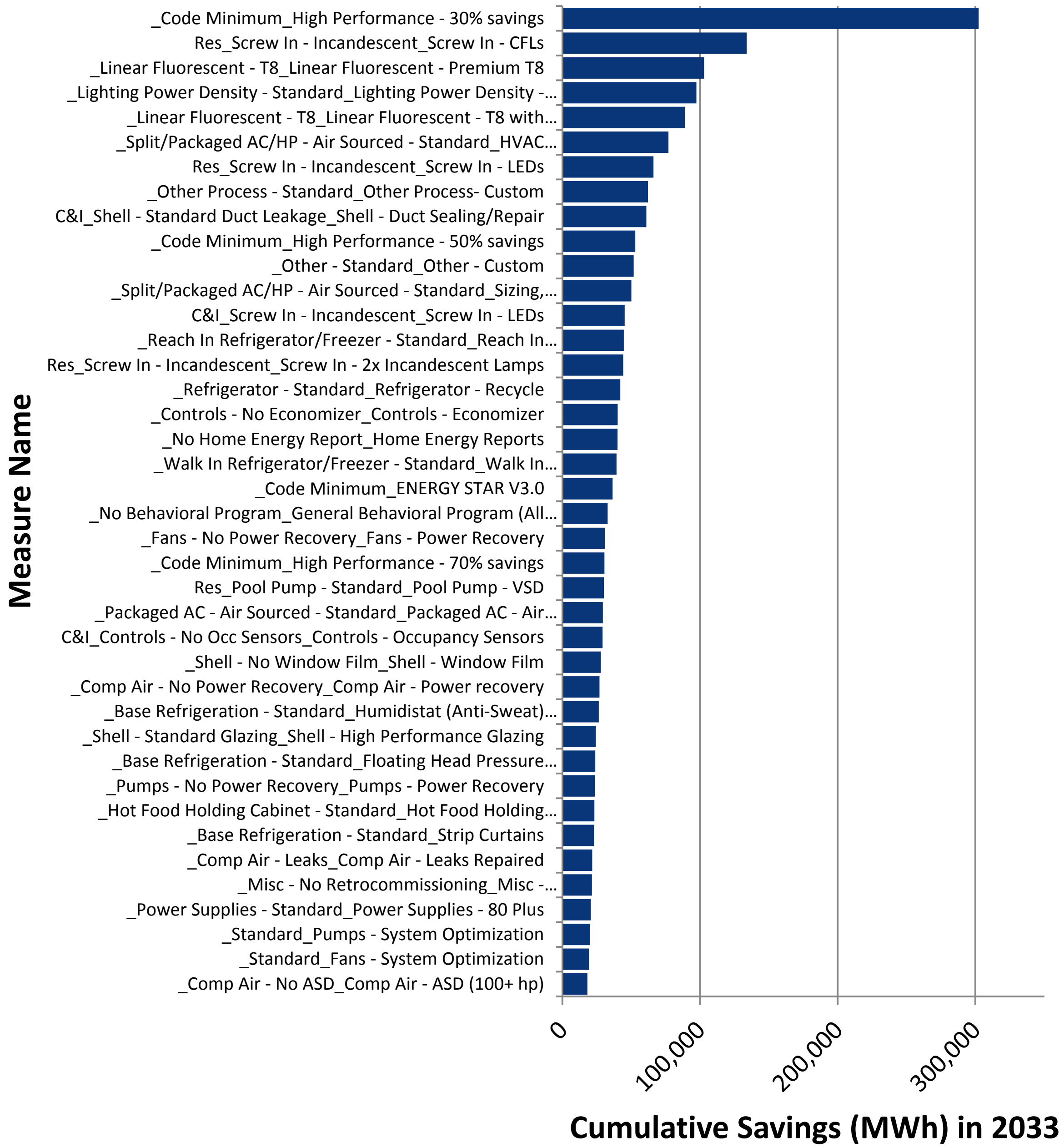
Figure 3-12. Cumulative RAP Energy Savings (MWh) by End Use Category - KCP&L KS



3.4 *Histograms of Top 40 Measures*

Often in potential studies, a small number of measures accounts for a larger percentage of total savings. We provide below in Figure 3-13 through Figure 3-15 a set of histograms for each utility showing the realistic achievable potential by 2033 of the top 40 measures in the portfolio. These measures represent 78%, 75%, and 79% of total achievable potential for KCP&L GMO, KCP&L MO, and KCP&L KS, respectively. For all utilities, the top 3 measures are a commercial new construction measure (30% savings relative to baseline), residential CFLs and Premium T8s (both of which continue to provide large savings at low cost notwithstanding EISA 2007 lighting standard changes). For GMO, the commercial new construction measure is larger on a relative basis than it is for KCP&L MO and KCP&L KS due to the larger forecast customer growth in that utility's service territory. Additional detail regarding measure-level output, including measure baseline and efficient technology assumptions, is provided in Appendix L and Appendix A.

Figure 3-13.Top 40 Measures[35] (Realistic Achievable Potential) by 2033 – KCP&L GMO



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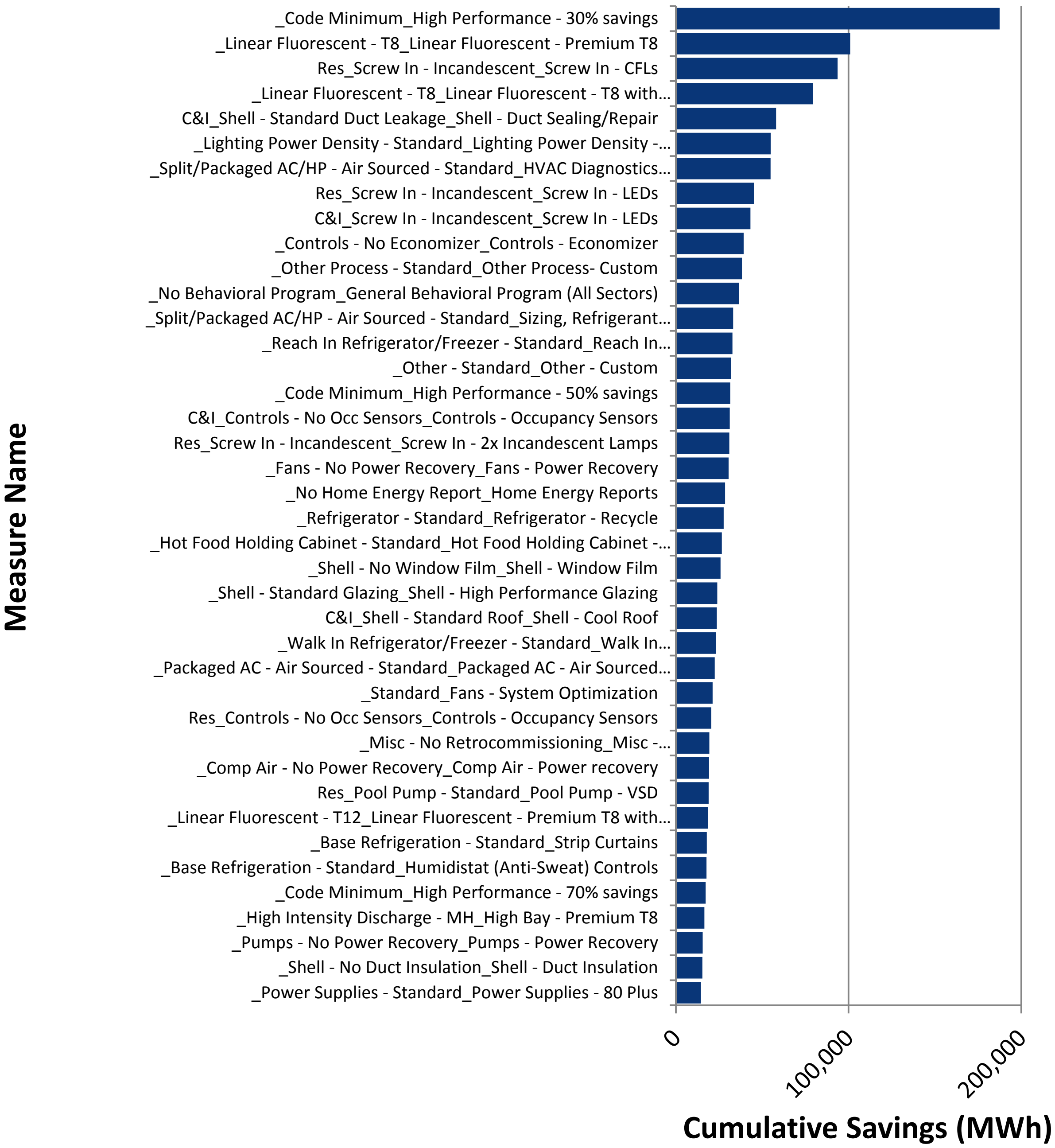
[35] Additional detail regarding measure-level output, including measure baseline and efficient technology assumptions, is provided in Appendix L and Appendix A.

Figure 3-14.Top 40 Measures[36] (Realistic Achievable Potential) by 2033 – KCP&L MO



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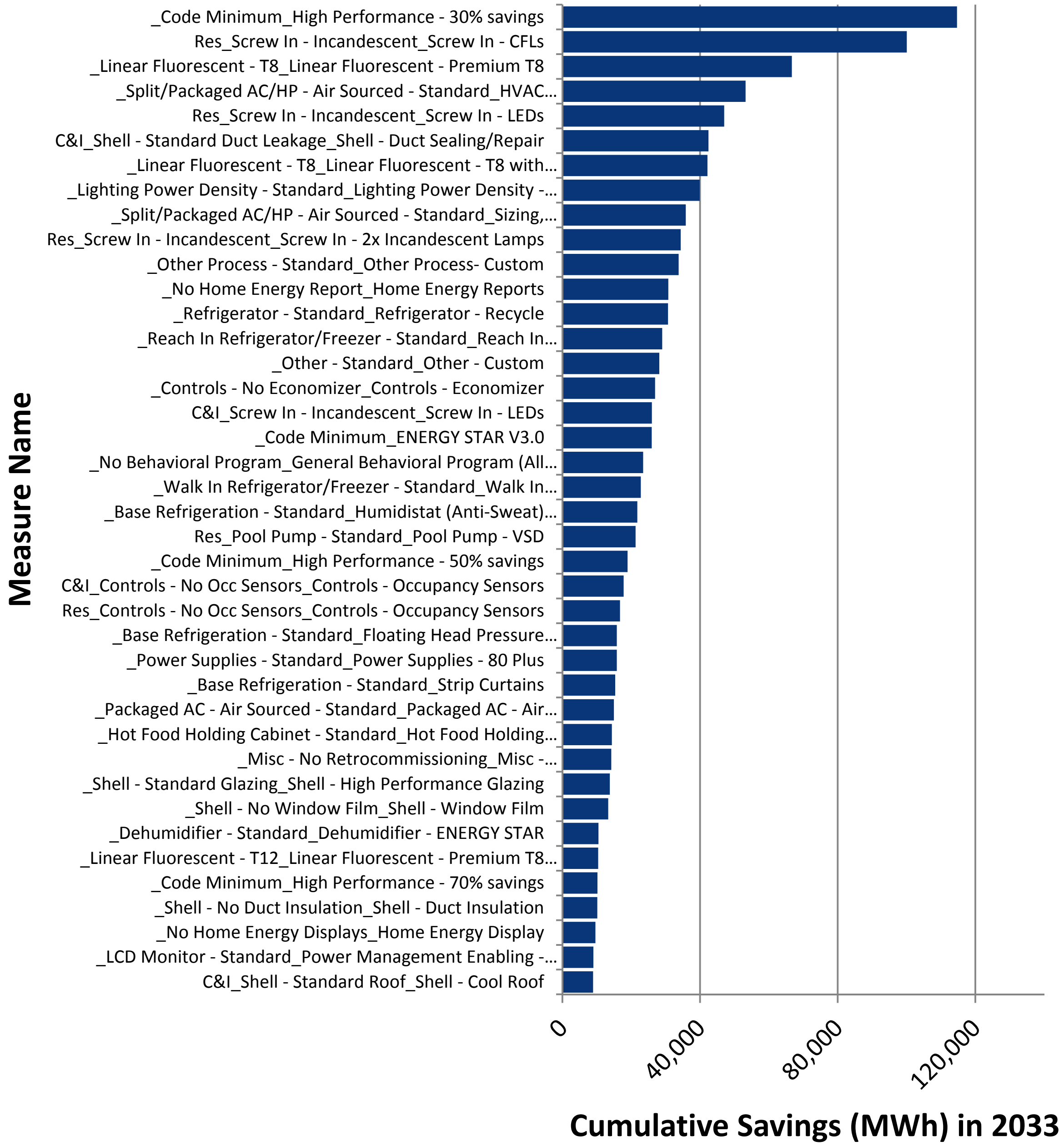
[36] Additional detail regarding measure-level output, including measure baseline and efficient technology assumptions, is provided in Appendix L and Appendix A.

Figure 3-15. Top 40 measures[37] (Realistic Achievable Potential) by 2033 – KCP&L KS



3.5 *Disaggregated Realistic Achievable Potential – Program*

As part of this study, Navigant also developed a set of efficiency programs that are designed to deliver the savings in the realistic achievable potential scenario[38]. While the potential model is run at the level of the measure and customer segment, Navigant mapped measures and customer segments to programs, thereby allocating the realistic achievable potential to a suite of efficiency programs. The potential model

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[37] Additional detail regarding measure-level output, including measure baseline and efficient technology assumptions, is provided in Appendix L and Appendix A.

[38] Demand Response and CHP program descriptions will be provided separately to stakeholders for review.

is therefore effectively an integrated potential and program design model, as the results are internally consistent. Separate from this report, Navigant will be providing to the Companies a set of program design documents that can be used to guide implementation contractors in program execution. However, we include in this report a high-level discussion of the programs under development and summary results by program for context and since we estimated administrative costs at the program level.

Table 3-10. List of Programs[39] and Brief Descriptions

Program Name	High Level Program Description
C&I Custom Rebates	The C&I Custom Rebates Program is designed to encourage and assist nonresidential customers to improve the energy efficiency of their existing facilities through a broad range of energy efficiency options that address all major end uses and processes. The program offers incentives to customers who install high-efficiency electric equipment and engages equipment suppliers and contractors to promote the incentive-eligible equipment. The program is designed for retrofit and replacement projects and offers financial incentives, paid on a fixed kWh basis, based on the project's first year energy savings.
C&I Prescriptive Rebates	The Prescriptive Rebates Program is designed to encourage and assist nonresidential customers to improve the energy efficiency of their existing facilities through the installation of a broad range of energy efficiency options that address all major end uses and processes. The program offers rebates to customers who install high-efficiency equipment and engages equipment suppliers and contractors to promote the rebate-eligible equipment. The program is designed for retrofit and replacement projects and offers fixed, per-unit financial rebates.
C&I New Construction	The New Construction Program is designed to capture energy efficiency opportunities through a comprehensive effort to influence building design and construction practices. The program will work with design professionals and construction contractors to influence prospective building owners and developers to construct high- performance buildings that provide improved energy efficiency, systems performance, and comfort. Energy saving targets will be accomplished by stimulating incremental improvements of efficiency in lighting, HVAC and other building systems. The program will seek to capture synergistic energy savings by encouraging the design and construction of buildings as integrated systems.

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[39] This list is for energy efficiency programs only. Five additional DR programs were also developed and are described at a high level in the Demand Response report, provided separately. Detailed program design information for EE, DR, and CHP is being promulgated separately.

Program Name	High Level Program Description
Small Business Direct Install (SBDI)	The SBDI program is designed to encourage and assist small business customers to improve the energy efficiency of their existing facilities through turn-key installation and rapid project completion. The program includes lighting, refrigeration, air-conditioning, water heating and control measures that are typically low-cost with reliable, prescriptive energy savings and costs per unit. The SBDI is designed to assist small business owners to overcome the barriers to achieving energy efficiency faced by small businesses. These include time constraints, capital constraints, lack of energy efficiency awareness, and lack of labor resources.
Building Operator Certification (BOC)	The BOC Program is a competency-based training and certification program for operations and maintenance staff working in commercial, institutional, or industrial buildings. Operators earn certification by attending training and completing project assignments in their facilities. BOC achieves energy savings by training individuals directly responsible for the maintenance of energy-using building equipment and day-to-day building operations.
Home Performance with ENERGY STAR	The HPwES Program will work to coordinate the development of a statewide network of independent contractors trained and mentored on the delivery of comprehensive energy analysis and measure installations under the Home Performance with ENERGY STAR model. The program will train contractors to Building Performance Institute (BPI) standards on building science and offer marketing and incentive packages to accelerate customer awareness and demand. Customers will pay a market-based fee for the analysis and will receive partial reimbursement when recommendations are implemented.
Low-Income Weatherization	The program will help facilitate the implementation of cost-effective electrical energy-savings measures in residential low-income households. In an ongoing effort, the utility company intends to work with the agencies responsible for implementing the federal LIHEAP program to leverage its funding, thereby increasing the number of homes served. If local weatherization agencies initially lack the resources to handle the additional workload, the implementation contractor will temporarily contract with private sector firms to address the overload.
Efficient Products	The Efficient Products Program promotes ENERGY STAR® appliances, lighting and home electronics. The program also promotes several products that are energy efficient, for which there are not yet ENERGY STAR labels, such as solid state lighting and light emitting diode technologies.
Multifamily Rebate	The Multifamily program offers property owners a comprehensive service for reducing energy use in the common areas of their building as well as helping residents reduce energy use in their living units. Property owners will be given the opportunity to participate in either or both components of the program.

Program Name	High Level Program Description
Cool Homes	The Cool Homes Program will influence the installation of high-efficiency heating, cooling and water heating technologies through a combination of market push and pull strategies that stimulate demand, while simultaneously increasing market provider investment in promoting high-efficiency products. The program will stimulate demand by educating customers about the energy and money-saving benefits associated with efficient equipment and providing financial incentives to overcome the first cost barrier. The program will stimulate market provider investment in stocking and promoting efficient products by offering HVAC contractors several services including training, educational materials, cooperative advertising and sales brochures.
Appliance Turn-In	The average household replaces a refrigerator (or freezer) every ten years. However, many of these refrigerators and freezers being replaced are still functioning and often end up as energy guzzling back-up appliances in basements and garages, or are sold in a used appliance market. The Appliance Turn-In Program will target these “second” refrigerators and freezers, providing the dual benefit of cutting energy consumption and keeping these appliances out of the used market. Units removed will be recycled and disabled through a certified recycling agency.
Home Energy Reports	The Home Energy Reports program provides residential customers with an energy report that provides an analysis of their household energy usage information along with comparison to similar customers or “neighbors.” The intention of the energy report is to provide information that will influence customers’ behavior in such a way that they lower their energy usage.
Energy Education	The Energy Education program provides curriculum, teacher training, and supplies for in-class instruction about how to use energy efficiently at home. The program will target students in the 5th through 8th grades, providing education and a “take-home” kit that raises awareness about how individual actions and low-cost measures can provide significant reductions in electricity and water consumption.
ENERGY STAR Homes	The ENERGY STAR Homes Program will recruit and educate selected builders and their trade allies on the benefits associated with building new homes to the ENERGY STAR standard. The program will provide education and rebates to inform and encourage architects, builders, and home buyers on the benefits of ENERGY STAR homes as well as requirements for gaining certification.

We provide the energy savings forecast for the realistic achievable potential scenario, disaggregated by program, in Table 3-11 through Table 3-13.

Table 3-11. Cumulative Realistic Achievable Potential (MWh) by Program[40] – KCP&L GMO

KCPL-GMO	C&I Custom Rebates	Prescriptive Rebates	New Construction	SBDI	BOC	Home Perf. with ENERGY STAR	LI Weatherization	Efficient Products	Multifamily Rebate	Cool Homes	Appliance Turn-In	Energy Reports	Energy Education	ENERGY STAR Homes	TOTALS
2014	17,945	18,838	1,122	4,617	634	1,456	483	21,734	959	3,309	1,068	15,781	1,940	1,010	**90,895**
2015	42,017	39,296	3,191	8,506	1,799	3,335	1,249	45,270	1,937	8,377	3,020	27,633	3,893	2,203	**191,727**
2016	73,157	65,321	6,654	13,208	3,381	5,348	2,200	67,458	2,876	14,931	5,657	32,609	5,604	3,626	**302,033**
2017	111,695	97,618	12,122	18,890	5,374	7,496	3,239	88,567	3,803	22,947	8,960	34,642	7,127	5,307	**427,785**
2018	156,872	135,949	19,837	25,595	7,761	9,772	4,308	108,519	4,726	32,328	12,887	35,608	8,484	7,239	**569,884**
2019	206,599	178,381	29,400	32,993	10,452	12,110	5,365	126,766	5,633	42,757	17,273	36,184	9,646	9,385	**722,942**
2020	257,712	223,457	41,571	40,661	13,285	14,436	6,366	142,981	6,495	53,694	21,834	36,611	10,541	11,683	**881,328**
2021	306,825	268,719	56,004	48,128	16,069	16,704	7,258	157,941	7,324	64,466	26,230	36,973	11,205	14,102	**1,037,947**
2022	351,343	312,628	72,825	55,055	18,634	18,900	8,033	172,293	8,134	74,479	30,167	37,298	11,629	16,492	**1,187,910**
2023	390,044	354,848	92,405	61,294	20,882	21,038	8,697	187,405	8,950	83,412	33,469	37,595	11,938	18,961	**1,330,940**
2024	423,399	395,370	115,208	66,879	22,796	23,906	9,259	202,271	9,719	91,169	36,102	37,878	12,190	21,554	**1,467,700**
2025	451,914	434,188	140,695	71,901	24,414	26,534	9,734	218,383	10,901	97,805	38,135	38,154	12,393	24,230	**1,599,381**
2026	476,743	472,460	169,856	76,540	25,802	28,896	10,163	233,893	11,947	103,695	39,681	38,428	12,557	27,005	**1,727,665**
2027	499,014	509,707	200,826	80,871	27,025	30,984	10,553	248,522	12,866	108,799	40,856	38,700	12,690	29,800	**1,851,215**
2028	520,561	546,668	234,353	85,047	28,135	32,793	10,908	262,102	13,671	113,228	41,762	38,968	12,802	32,567	**1,973,566**
2029	540,864	583,186	269,544	89,090	29,173	34,353	11,230	274,602	14,380	117,102	42,475	39,230	12,899	35,324	**2,093,452**
2030	560,259	618,228	304,123	92,976	30,163	35,704	11,523	286,034	15,009	120,527	43,052	39,486	12,988	38,075	**2,208,148**
2031	578,880	653,025	339,957	96,790	31,115	36,894	11,791	296,473	15,573	123,719	43,535	39,740	13,073	40,854	**2,321,418**
2032	597,000	687,864	377,219	100,571	32,044	37,966	12,036	306,024	16,083	126,649	43,954	39,993	13,160	43,688	**2,434,251**
2033	615,385	723,095	416,240	104,359	32,909	38,942	12,261	314,748	16,545	129,344	44,311	40,120	13,251	46,569	**2,548,082**

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[40] Data for CHP savings can be found in section 4 of the report. Data for DR can be found in the "Demand-Response" report, provided separately, a summary of which is provided in Section 5. Compiled data and tables for EE, DR and CHP can be found in Section 5, with additional disaggregation provided in Appendix L.

Table 3-12. Cumulative Realistic Achievable Potential (MWh) by Program[41] – KCP&L MO

KCPL-MO	C&I Custom Rebates	Prescriptive Rebates	New Construction	SBDI	BOC	Home Perf. with ENERGY STAR	LI Weatherization	Efficient Products	Multifamily Rebate	Cool Homes	Appliance Turn-In	Energy Reports	Energy Education	ENERGY STAR Homes	TOTALS
2014	18,656	20,139	2,001	4,570	834	987	355	14,904	2,212	2,438	788	12,651	2,453	229	**83,217**
2015	42,772	41,591	4,758	8,578	2,356	2,295	937	31,530	4,711	6,226	2,219	21,980	4,831	470	**175,255**
2016	73,143	68,816	8,628	13,556	4,409	3,694	1,660	47,247	7,301	11,121	4,138	25,734	6,861	729	**277,039**
2017	109,967	101,945	14,054	19,451	6,979	5,182	2,449	62,226	10,024	17,106	6,528	27,117	8,622	1,011	**392,661**
2018	152,431	140,744	20,914	26,341	10,034	6,752	3,258	76,399	12,884	24,105	9,353	27,644	10,153	1,313	**522,323**
2019	198,471	183,450	28,676	33,904	13,447	8,354	4,056	89,365	15,810	31,857	12,483	27,864	11,439	1,628	**660,805**
2020	245,040	228,138	37,939	41,662	16,995	9,935	4,809	100,846	18,664	39,931	15,703	27,972	12,394	1,951	**801,979**
2021	288,885	272,185	48,237	49,096	20,419	11,459	5,475	111,315	21,371	47,788	18,761	28,038	13,065	2,278	**938,370**
2022	327,538	313,846	59,665	55,828	23,492	12,917	6,048	121,229	23,887	54,963	21,439	28,088	13,458	2,589	**1,064,988**
2023	359,905	352,308	72,383	61,685	26,087	14,313	6,531	131,433	26,210	61,206	23,618	28,131	13,714	2,905	**1,180,430**
2024	386,173	388,058	86,819	66,702	28,186	15,548	6,928	141,268	28,233	66,465	25,285	28,171	13,912	3,235	**1,284,982**
2025	407,283	420,953	102,337	70,990	29,848	16,631	7,252	150,651	29,979	70,814	26,500	28,209	14,059	3,573	**1,379,080**
2026	424,605	452,064	119,736	74,743	31,168	18,258	7,536	159,530	31,492	74,407	27,358	28,248	14,167	3,923	**1,467,237**
2027	440,657	481,403	137,969	78,083	32,239	19,725	7,790	167,842	32,816	77,402	27,953	28,288	14,245	4,274	**1,550,686**
2028	454,704	509,550	157,082	81,156	33,138	21,004	8,016	175,542	33,982	79,915	28,362	28,326	14,301	4,619	**1,629,698**
2029	467,278	536,613	176,839	84,022	33,921	22,096	8,216	182,609	35,017	82,049	28,645	28,364	14,344	4,964	**1,704,979**
2030	478,733	562,110	195,889	86,700	34,627	23,016	8,395	189,036	35,939	83,887	28,844	28,402	14,378	5,307	**1,775,261**
2031	489,282	586,940	215,607	89,261	35,278	23,794	8,552	194,837	36,764	85,521	28,986	28,440	14,407	5,657	**1,843,326**
2032	499,184	611,255	235,974	91,741	35,893	24,463	8,692	200,030	37,502	86,983	29,093	28,477	14,432	6,013	**1,909,732**
2033	508,660	635,344	257,281	94,175	36,453	25,039	8,815	204,651	38,163	88,308	29,172	28,496	14,457	6,379	**1,975,390**

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[41] Data for CHP savings can be found in section 4 of the report. Data for DR can be found in the "Demand-Response" report, provided separately, a summary of which is provided in Section 5. Compiled data and tables for EE, DR and CHP can be found in Section 5, with additional disaggregation provided in Appendix L.

Table 3-13. Cumulative Realistic Achievable Potential (MWh) by Program[42] – KCP&L KS

KCPL-KS	C&I Custom Rebates	Prescriptive Rebates	New Construction	SBDI	BOC	Home Perf. with ENERGY STAR	LI Weatherization	Efficient Products	Multifamily Rebate	Cool Homes	Appliance Turn-In	Energy Reports	Energy Education	ENERGY STAR Homes	TOTALS
2014	9,775	12,580	749	2,916	530	924	309	13,920	1,518	2,252	774	12,034	1,840	682	**60,804**
2015	22,745	26,294	1,797	5,606	1,500	2,199	866	30,308	3,290	5,707	2,191	21,074	3,750	1,472	**128,797**
2016	39,377	43,697	3,365	9,044	2,808	3,590	1,580	46,243	5,160	10,174	4,103	24,869	5,447	2,401	**201,858**
2017	59,791	64,935	5,734	13,131	4,447	5,085	2,375	61,774	7,146	15,636	6,498	26,417	6,965	3,496	**283,429**
2018	83,519	89,814	8,938	17,908	6,396	6,673	3,203	76,739	9,249	22,049	9,346	27,151	8,318	4,757	**374,060**
2019	109,392	117,272	12,818	23,166	8,576	8,305	4,031	90,667	11,414	29,198	12,527	27,588	9,480	6,165	**470,598**
2020	135,678	146,156	17,716	28,577	10,846	9,926	4,823	103,235	13,546	36,716	15,834	27,912	10,375	7,693	**569,032**
2021	160,526	174,749	23,380	33,781	13,040	11,507	5,534	114,906	15,598	44,139	19,022	28,189	11,039	9,326	**664,736**
2022	182,520	201,939	29,849	38,513	15,015	13,035	6,154	126,044	17,539	51,048	21,877	28,440	11,469	10,950	**754,392**
2023	201,020	227,249	37,268	42,652	16,689	14,512	6,688	137,386	19,362	57,226	24,272	28,672	11,762	12,663	**837,423**
2024	216,301	250,861	45,830	46,217	18,049	15,852	7,142	148,456	20,997	62,608	26,185	28,896	12,005	14,498	**913,897**
2025	228,679	272,737	55,225	49,281	19,132	17,056	7,523	159,149	22,453	67,231	27,665	29,119	12,203	16,418	**983,873**
2026	238,811	293,537	65,852	51,973	19,995	18,727	7,864	169,428	23,758	71,211	28,794	29,344	12,368	18,437	**1,050,099**
2027	247,325	313,231	77,022	54,375	20,699	20,266	8,175	179,179	24,934	74,674	29,659	29,570	12,505	20,492	**1,112,106**
2028	255,093	332,280	88,889	56,603	21,291	21,644	8,457	188,326	25,997	77,702	30,332	29,794	12,621	22,541	**1,171,573**
2029	262,070	350,685	101,343	58,684	21,808	22,856	8,715	196,866	26,966	80,379	30,868	30,015	12,725	24,598	**1,228,577**
2030	268,487	368,145	113,629	60,631	22,274	23,912	8,951	204,813	27,852	82,778	31,307	30,233	12,822	26,666	**1,282,500**
2031	274,479	385,233	126,468	62,499	22,705	24,841	9,167	212,206	28,669	85,062	31,681	30,449	12,917	28,776	**1,335,151**
2032	280,189	402,039	139,821	64,312	23,114	25,670	9,366	219,044	29,427	87,189	32,010	30,667	13,011	30,930	**1,386,789**
2033	285,930	418,620	153,631	66,087	23,488	26,415	9,550	225,379	30,126	89,178	32,293	30,776	13,110	33,143	**1,437,728**

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[42] Data for CHP savings can be found in section 4 of the report. Data for DR can be found in the "Demand-Response" report, provided separately, a summary of which is provided in Section 5. Compiled data and tables for EE, DR and CHP can be found in Section 5, with additional disaggregation provided in Appendix L.

3.6 Estimated Energy Efficiency Program Costs

This section provides the cumulative budget, by program, for all three utilities for the realistic achievable potential (RAP) scenario. The cumulative budgets for the maximum achievable potential (MAP) scenario and for scenarios between RAP and MAP, are provided in section 3.8.1.

Table 3-14 through Table 3-16 provide a breakdown, by program, of the forecast cumulative budget from 2014 through 2033. The budget values include incentive costs, non-incentive costs (i.e., program administration), and evaluation, measurement and verification (EM&V) costs. Assumptions regarding non-incentive costs and EM&V costs are provided in section 3.7.1. Budgets over the 20-year forecast horizon range for $445 million to $806 million depending on the utility. The 10-year average annual budget for each utility is $34.4 million, $29.5 million, and $21.4 million for KCP&L GMO, KCP&L MO, and KCP&L KS, respectively.

The budgets below combined with the forecast savings shown previously results in a cost of savings that ranges from $0.19/first-year kWh to $0.20/first-year kWh over the first five years of the program, with roughly 53-55% of that cost coming from incentives, 40-42% from program administrative costs, and 5% from EM&V. Additional detail regarding the budget breakdown, by program, will be provided to the Companies in separate program design documents.

Table 3-14. Cumulative Budget – KCP&L GMO

KCPL-GMO	C&I Custom Rebates	Prescriptive Rebates	New Construction	SBDI	BOC	Home Perf. with ENERGY STAR	LI Weatherization	Efficient Products	Multifamily Rebate	Cool Homes	Appliance Turn-In	Energy Reports	Energy Education	ENERGY STAR Homes	TOTALS
2014	$ 3,687,097	$ 3,257,843	$ 352,091	$ 1,307,320	$ 81,988	$ 370,487	$ 559,678	$ 1,923,416	$ 164,628	$ 869,342	$ 447,448	$ 687,379	$ 286,864	$ 770,242	**$ 14,765,823**
2015	$ 8,752,869	$ 7,148,559	$ 1,016,606	$ 2,643,525	$ 236,063	$ 901,039	$ 1,466,258	$ 4,178,594	$ 353,677	$ 2,080,922	$ 1,284,099	$ 1,918,644	$ 606,621	$ 1,690,406	**$ 34,277,882**
2016	$ 15,463,804	$ 12,321,313	$ 2,154,568	$ 4,376,674	$ 449,993	$ 1,501,007	$ 2,644,335	$ 6,422,683	$ 544,164	$ 3,624,154	$ 2,439,479	$ 3,405,089	$ 895,090	$ 2,799,762	**$ 59,042,115**
2017	$ 23,968,464	$ 18,903,665	$ 3,992,541	$ 6,556,682	$ 725,733	$ 2,172,680	$ 4,052,839	$ 8,679,580	$ 739,798	$ 5,511,885	$ 3,919,941	$ 5,020,483	$ 1,159,310	$ 4,124,656	**$ 89,528,258**
2018	$ 34,184,255	$ 26,880,241	$ 6,644,918	$ 9,199,663	$ 1,063,586	$ 2,917,221	$ 5,658,016	$ 10,937,583	$ 941,985	$ 7,737,796	$ 5,720,718	$ 6,719,122	$ 1,401,969	$ 5,665,584	**$ 125,672,657**
2019	$ 45,720,482	$ 35,901,879	$ 10,009,353	$ 12,196,656	$ 1,453,198	$ 3,718,738	$ 7,401,966	$ 13,143,016	$ 1,148,263	$ 10,255,200	$ 7,778,090	$ 8,484,959	$ 1,616,207	$ 7,397,128	**$ 166,225,135**
2020	$ 57,907,363	$ 45,700,424	$ 14,393,477	$ 15,398,766	$ 1,872,919	$ 4,559,622	$ 9,192,598	$ 15,301,250	$ 1,355,776	$ 12,972,236	$ 9,966,538	$ 10,312,723	$ 1,787,264	$ 9,273,954	**$ 209,994,911**
2021	$ 69,946,516	$ 55,761,757	$ 19,716,852	$ 18,619,484	$ 2,294,741	$ 5,422,901	$ 10,917,463	$ 17,541,832	$ 1,568,098	$ 15,757,056	$ 12,124,363	$ 12,200,998	$ 1,918,794	$ 11,273,930	**$ 255,064,785**
2022	$ 81,178,183	$ 65,741,573	$ 26,073,792	$ 21,715,616	$ 2,692,377	$ 6,299,096	$ 12,490,837	$ 20,063,572	$ 1,792,351	$ 18,482,388	$ 14,100,603	$ 14,149,706	$ 2,006,821	$ 13,273,829	**$ 300,060,744**
2023	$ 91,241,281	$ 75,592,464	$ 33,658,028	$ 24,617,188	$ 3,048,913	$ 7,185,132	$ 13,864,516	$ 22,995,026	$ 2,032,335	$ 21,080,999	$ 15,796,397	$ 16,159,116	$ 2,073,272	$ 15,365,843	**$ 344,710,511**
2024	$ 100,192,298	$ 85,266,373	$ 42,714,811	$ 27,326,672	$ 3,359,347	$ 8,858,041	$ 15,024,776	$ 25,892,202	$ 2,262,585	$ 23,516,388	$ 17,180,055	$ 18,230,188	$ 2,128,691	$ 17,590,387	**$ 389,542,814**
2025	$ 108,079,363	$ 94,750,331	$ 53,096,640	$ 29,871,575	$ 3,627,934	$ 10,452,432	$ 15,987,242	$ 29,417,922	$ 2,572,542	$ 25,769,728	$ 18,272,617	$ 20,364,361	$ 2,174,021	$ 19,915,768	**$ 434,352,476**
2026	$ 115,156,503	$ 104,322,943	$ 65,278,767	$ 32,328,172	$ 3,863,452	$ 11,927,255	$ 16,798,106	$ 32,915,844	$ 2,860,356	$ 28,024,498	$ 19,122,252	$ 22,563,281	$ 2,211,376	$ 22,358,527	**$ 479,731,332**
2027	$ 121,696,209	$ 113,863,702	$ 78,550,249	$ 34,714,302	$ 4,075,914	$ 13,254,598	$ 17,485,876	$ 36,297,527	$ 3,125,317	$ 30,124,586	$ 19,783,506	$ 24,828,722	$ 2,242,350	$ 24,850,699	**$ 524,893,557**
2028	$ 128,228,644	$ 123,540,248	$ 93,295,495	$ 37,096,218	$ 4,273,228	$ 14,410,755	$ 18,074,303	$ 39,501,550	$ 3,368,109	$ 32,058,053	$ 20,304,627	$ 27,162,302	$ 2,268,618	$ 27,350,495	**$ 570,932,645**
2029	$ 134,525,627	$ 133,325,801	$ 109,164,883	$ 39,477,530	$ 4,461,875	$ 15,406,819	$ 18,584,446	$ 42,500,543	$ 3,591,010	$ 33,833,169	$ 20,724,177	$ 29,565,572	$ 2,291,898	$ 29,874,024	**$ 617,327,373**
2030	$ 140,680,096	$ 142,938,685	$ 125,153,684	$ 41,828,678	$ 4,645,901	$ 16,270,625	$ 19,032,153	$ 45,284,602	$ 3,796,231	$ 35,465,970	$ 21,071,759	$ 32,040,194	$ 2,313,462	$ 32,426,481	**$ 662,948,521**
2031	$ 146,737,281	$ 152,710,035	$ 142,135,958	$ 44,198,348	$ 4,826,930	$ 17,039,246	$ 19,430,536	$ 47,861,200	$ 3,986,209	$ 37,024,145	$ 21,369,412	$ 34,587,983	$ 2,334,463	$ 35,039,642	**$ 709,281,389**
2032	$ 152,794,935	$ 162,726,587	$ 160,232,433	$ 46,604,763	$ 5,007,787	$ 17,748,969	$ 19,789,659	$ 50,248,247	$ 4,163,006	$ 38,495,168	$ 21,633,677	$ 37,210,991	$ 2,356,294	$ 37,739,791	**$ 756,752,309**
2033	$ 159,130,356	$ 173,099,155	$ 179,648,526	$ 49,071,031	$ 5,180,049	$ 18,418,733	$ 20,115,326	$ 52,453,551	$ 4,326,833	$ 39,893,045	$ 21,863,611	$ 39,902,875	$ 2,379,378	$ 40,524,441	**$ 806,006,911**

Table 3-15. Cumulative Budget – KCP&L MO

KCPL-MO	C&I Custom Rebates	Prescriptive Rebates	New Construction	SBDI	BOC	Home Perf. with ENERGY STAR	LI Weatherization	Efficient Products	Multifamily Rebate	Cool Homes	Appliance Turn-In	Energy Reports	Energy Education	ENERGY STAR Homes	TOTALS
2014	$ 3,807,242	$ 3,477,480	$ 621,168	$ 1,315,101	$ 105,532	$ 243,323	$ 415,151	$ 1,373,991	$ 372,190	$ 612,190	$ 330,530	$ 581,526	$ 357,559	$ 176,801	**$ 13,789,783**
2015	$ 8,866,093	$ 7,495,576	$ 1,498,714	$ 2,703,622	$ 302,476	$ 602,782	$ 1,099,336	$ 3,063,941	$ 832,980	$ 1,478,595	$ 943,588	$ 1,615,131	$ 740,541	$ 365,180	**$ 31,608,553**
2016	$ 15,409,033	$ 12,806,361	$ 2,760,860	$ 4,534,736	$ 574,136	$ 1,008,753	$ 1,989,976	$ 4,786,069	$ 1,324,079	$ 2,582,628	$ 1,784,749	$ 2,853,091	$ 1,077,758	$ 570,117	**$ 54,062,346**
2017	$ 23,551,161	$ 19,443,075	$ 4,573,573	$ 6,801,421	$ 922,056	$ 1,461,060	$ 3,053,712	$ 6,556,972	$ 1,852,350	$ 3,935,813	$ 2,856,395	$ 4,187,550	$ 1,379,857	$ 795,499	**$ 81,370,496**
2018	$ 33,188,586	$ 27,374,643	$ 6,921,713	$ 9,523,336	$ 1,345,241	$ 1,959,271	$ 4,264,057	$ 8,364,444	$ 2,419,504	$ 5,535,579	$ 4,151,826	$ 5,579,279	$ 1,651,621	$ 1,038,971	**$ 113,318,072**
2019	$ 43,926,400	$ 36,286,333	$ 9,644,894	$ 12,590,574	$ 1,828,756	$ 2,491,866	$ 5,576,972	$ 10,159,592	$ 3,014,011	$ 7,343,139	$ 5,620,363	$ 7,014,333	$ 1,888,120	$ 1,296,789	**$ 148,682,142**
2020	$ 55,111,877	$ 45,816,474	$ 12,976,289	$ 15,829,026	$ 2,343,140	$ 3,046,462	$ 6,923,019	$ 11,923,032	$ 3,617,001	$ 9,286,795	$ 7,165,907	$ 8,488,072	$ 2,071,223	$ 1,563,723	**$ 186,162,040**
2021	$ 65,962,476	$ 55,420,783	$ 16,774,012	$ 19,032,479	$ 2,850,801	$ 3,610,028	$ 8,215,185	$ 13,714,008	$ 4,218,880	$ 11,260,893	$ 8,666,884	$ 9,999,289	$ 2,206,238	$ 1,837,885	**$ 223,769,842**
2022	$ 75,827,929	$ 64,710,389	$ 21,096,503	$ 22,039,291	$ 3,316,948	$ 4,177,096	$ 9,389,876	$ 15,649,307	$ 4,820,170	$ 13,168,090	$ 10,011,971	$ 11,548,027	$ 2,290,891	$ 2,101,853	**$ 260,148,340**
2023	$ 84,369,404	$ 73,490,077	$ 26,031,380	$ 24,765,608	$ 3,719,596	$ 4,742,421	$ 10,407,343	$ 17,791,321	$ 5,417,157	$ 14,951,498	$ 11,131,473	$ 13,134,782	$ 2,349,108	$ 2,373,865	**$ 294,675,034**
2024	$ 91,557,481	$ 81,888,800	$ 31,777,790	$ 27,211,380	$ 4,052,739	$ 5,256,675	$ 11,255,990	$ 19,841,175	$ 5,958,420	$ 16,588,052	$ 12,007,171	$ 14,760,318	$ 2,395,126	$ 2,661,346	**$ 327,212,462**
2025	$ 97,544,026	$ 89,813,331	$ 38,114,562	$ 29,409,146	$ 4,322,754	$ 5,719,992	$ 11,948,116	$ 21,811,532	$ 6,448,596	$ 18,069,962	$ 12,660,448	$ 16,425,538	$ 2,430,019	$ 2,959,150	**$ 357,677,173**
2026	$ 102,636,010	$ 97,504,616	$ 45,401,665	$ 31,436,137	$ 4,541,966	$ 6,783,085	$ 12,519,697	$ 23,723,454	$ 6,897,867	$ 19,411,222	$ 13,132,233	$ 18,131,405	$ 2,455,946	$ 3,272,353	**$ 387,847,657**
2027	$ 107,560,344	$ 104,944,100	$ 53,236,953	$ 33,331,281	$ 4,724,041	$ 7,775,848	$ 12,995,304	$ 25,560,767	$ 7,311,441	$ 20,630,329	$ 13,466,697	$ 19,878,926	$ 2,475,018	$ 3,590,151	**$ 417,481,200**
2028	$ 111,997,603	$ 112,250,073	$ 61,657,491	$ 35,153,860	$ 4,880,293	$ 8,658,089	$ 13,394,083	$ 27,308,535	$ 7,692,334	$ 21,732,548	$ 13,702,249	$ 21,669,093	$ 2,489,152	$ 3,907,191	**$ 446,492,594**
2029	$ 116,065,164	$ 119,443,587	$ 70,578,598	$ 36,924,101	$ 5,019,640	$ 9,415,013	$ 13,731,793	$ 28,954,893	$ 8,043,470	$ 22,730,875	$ 13,868,825	$ 23,502,900	$ 2,499,948	$ 4,227,784	**$ 475,006,592**
2030	$ 119,859,989	$ 126,381,245	$ 79,395,109	$ 38,634,984	$ 5,148,113	$ 10,053,208	$ 14,020,346	$ 30,490,806	$ 8,366,944	$ 23,639,347	$ 13,988,361	$ 25,381,376	$ 2,508,533	$ 4,550,930	**$ 502,419,291**
2031	$ 123,452,860	$ 133,301,428	$ 88,745,052	$ 40,325,546	$ 5,269,150	$ 10,594,725	$ 14,269,188	$ 31,911,483	$ 8,664,941	$ 24,482,014	$ 14,076,307	$ 27,305,589	$ 2,515,815	$ 4,885,230	**$ 529,799,330**
2032	$ 126,936,488	$ 140,244,756	$ 98,638,587	$ 42,008,046	$ 5,386,285	$ 11,065,628	$ 14,485,217	$ 33,213,192	$ 8,939,094	$ 25,265,942	$ 14,143,391	$ 29,276,665	$ 2,522,409	$ 5,229,967	**$ 557,355,666**
2033	$ 130,394,265	$ 147,294,190	$ 109,240,561	$ 43,699,312	$ 5,495,330	$ 11,478,786	$ 14,673,341	$ 34,397,451	$ 9,190,208	$ 26,004,591	$ 14,194,168	$ 31,294,415	$ 2,528,734	$ 5,589,417	**$ 585,474,768**

Table 3-16. Cumulative Budget -- KCP&L KS

KCPL-KS	C&I Custom Rebates	Prescriptive Rebates	New Construction	SBDI	BOC	Home Perf. with ENERGY STAR	LI Weatherization	Efficient Products	Multifamily Rebate	Cool Homes	Appliance Turn-In	Energy Reports	Energy Education	ENERGY STAR Homes	TOTALS
2014	$ 1,921,143	$ 2,171,776	$ 231,262	$ 838,727	$ 68,694	$ 233,412	$ 397,664	$ 1,290,286	$ 255,746	$ 587,709	$ 324,486	$ 542,076	$ 269,323	$ 522,474	**$ 9,654,778**
2015	$ 4,535,579	$ 4,720,413	$ 562,418	$ 1,755,853	$ 197,117	$ 586,470	$ 1,070,592	$ 2,948,010	$ 582,262	$ 1,409,214	$ 931,291	$ 1,513,168	$ 578,188	$ 1,134,375	**$ 22,524,951**
2016	$ 7,971,793	$ 8,079,707	$ 1,069,045	$ 2,994,837	$ 374,398	$ 991,116	$ 1,956,947	$ 4,672,270	$ 936,797	$ 2,456,513	$ 1,769,258	$ 2,685,520	$ 861,003	$ 1,862,242	**$ 38,681,446**
2017	$ 12,294,336	$ 12,289,374	$ 1,852,015	$ 4,534,968	$ 601,568	$ 1,445,679	$ 3,024,379	$ 6,473,221	$ 1,322,548	$ 3,736,838	$ 2,842,943	$ 3,959,487	$ 1,121,770	$ 2,729,244	**$ 58,228,372**
2018	$ 17,448,326	$ 17,325,987	$ 2,935,377	$ 6,387,172	$ 878,066	$ 1,949,231	$ 4,246,018	$ 8,333,689	$ 1,739,893	$ 5,254,568	$ 4,148,866	$ 5,298,977	$ 1,361,790	$ 3,738,990	**$ 81,046,951**
2019	$ 23,223,182	$ 23,002,508	$ 4,278,325	$ 8,480,669	$ 1,194,280	$ 2,490,641	$ 5,576,820	$ 10,201,846	$ 2,180,423	$ 6,980,372	$ 5,640,796	$ 6,691,326	$ 1,574,670	$ 4,880,909	**$ 106,396,767**
2020	$ 29,269,168	$ 29,106,459	$ 6,015,539	$ 10,700,466	$ 1,531,147	$ 3,058,217	$ 6,946,764	$ 12,058,592	$ 2,631,544	$ 8,853,093	$ 7,227,719	$ 8,132,425	$ 1,744,924	$ 6,133,626	**$ 133,409,682**
2021	$ 35,164,211	$ 35,285,040	$ 8,073,865	$ 12,906,177	$ 1,864,288	$ 3,641,523	$ 8,269,275	$ 13,968,534	$ 3,088,300	$ 10,781,228	$ 8,792,464	$ 9,621,275	$ 1,876,431	$ 7,489,870	**$ 160,822,478**
2022	$ 40,553,205	$ 41,293,735	$ 10,483,377	$ 14,988,221	$ 2,171,038	$ 4,234,417	$ 9,477,146	$ 16,040,402	$ 3,551,367	$ 12,672,072	$ 10,225,728	$ 11,157,950	$ 1,965,892	$ 8,855,102	**$ 187,669,652**
2023	$ 45,249,475	$ 47,019,080	$ 13,317,469	$ 16,890,182	$ 2,436,967	$ 4,834,009	$ 10,534,558	$ 18,331,986	$ 4,018,126	$ 14,480,247	$ 11,456,026	$ 12,742,782	$ 2,029,813	$ 10,313,739	**$ 213,654,458**
2024	$ 49,280,732	$ 52,502,385	$ 16,673,954	$ 18,609,474	$ 2,657,990	$ 5,397,124	$ 11,430,988	$ 20,561,864	$ 4,452,353	$ 16,181,208	$ 12,460,865	$ 14,376,745	$ 2,083,750	$ 11,896,522	**$ 238,565,953**
2025	$ 52,670,785	$ 57,709,653	$ 20,453,294	$ 20,165,630	$ 2,838,044	$ 5,922,710	$ 12,175,682	$ 22,738,894	$ 4,856,166	$ 17,761,482	$ 13,256,067	$ 16,061,209	$ 2,128,486	$ 13,573,524	**$ 262,311,627**
2026	$ 55,556,382	$ 62,788,526	$ 24,839,856	$ 21,608,776	$ 2,984,963	$ 6,970,263	$ 12,803,787	$ 24,887,269	$ 5,236,537	$ 19,230,267	$ 13,876,998	$ 17,797,691	$ 2,166,069	$ 15,359,910	**$ 286,107,291**
2027	$ 58,080,380	$ 67,720,856	$ 29,572,604	$ 22,962,203	$ 3,107,491	$ 7,973,676	$ 13,339,229	$ 26,980,497	$ 5,594,981	$ 20,602,098	$ 14,363,516	$ 19,587,801	$ 2,197,887	$ 17,203,143	**$ 309,286,362**
2028	$ 60,461,980	$ 72,599,294	$ 34,732,452	$ 24,273,650	$ 3,212,883	$ 8,891,545	$ 13,799,553	$ 28,996,746	$ 5,931,818	$ 21,875,074	$ 14,750,607	$ 21,432,982	$ 2,225,394	$ 19,064,976	**$ 332,248,956**
2029	$ 62,654,539	$ 77,427,991	$ 40,285,984	$ 25,549,158	$ 3,306,947	$ 9,706,545	$ 14,200,907	$ 30,926,241	$ 6,248,916	$ 23,059,061	$ 15,065,972	$ 23,334,579	$ 2,250,251	$ 20,958,967	**$ 354,976,057**
2030	$ 64,722,984	$ 82,118,924	$ 45,906,086	$ 26,785,042	$ 3,393,777	$ 10,420,698	$ 14,555,286	$ 32,764,073	$ 6,547,638	$ 24,166,270	$ 15,330,821	$ 25,294,023	$ 2,273,660	$ 22,888,208	**$ 377,167,489**
2031	$ 66,713,965	$ 86,821,716	$ 51,927,356	$ 28,009,292	$ 3,475,838	$ 11,052,907	$ 14,873,058	$ 34,509,536	$ 6,830,188	$ 25,248,796	$ 15,560,942	$ 27,312,883	$ 2,296,826	$ 24,883,934	**$ 399,517,238**
2032	$ 68,680,164	$ 91,560,966	$ 58,347,119	$ 29,230,877	$ 3,555,610	$ 11,626,469	$ 15,161,136	$ 36,154,874	$ 7,097,903	$ 26,288,556	$ 15,768,229	$ 29,392,932	$ 2,320,429	$ 26,949,848	**$ 422,135,114**
2033	$ 70,734,905	$ 96,352,561	$ 65,154,177	$ 30,456,040	$ 3,630,211	$ 12,153,822	$ 15,424,637	$ 37,704,634	$ 7,350,419	$ 27,296,757	$ 15,950,712	$ 31,528,419	$ 2,345,395	$ 29,102,280	**$ 445,184,970**

3.7 *Energy Efficiency Cost Effectiveness*

This section provides the results of cost-effectiveness analysis for the realistic achievable potential scenario. Section 3.7.1 provides key underlying assumptions, while section 3.7.2 provides cost-effectiveness results for energy efficiency programs. Results for CHP cost-effectiveness are provided in section 4, while demand response cost-effectiveness is provided in the stand-alone DR report entitled "Demand-Side Resource Potential Study Report – Demand Response," dated August 2013.

3.7.1 Key Cost Effectiveness Assumptions

[redacted]

[redacted]

[redacted]

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[43]U.S. DOE EIA, website "Annual Energy Outlook 2011" http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2011&subject=8-AEO2011&table=72-AEO2011&region=0-0&cases=ref2011-d020911a. A 2.5% inflation rate was assumed.

Table 3-17. Avoided Cost Assumptions

Year	Avoided Energy Costs ($/kWh)				Avoided Demand Costs ($/kW-yr)	Avoided Therm Costs ($/therm)
	Summer On Peak	Summer Off Peak	Non Summer On Peak	Non Summer Off Peak		
2014	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2015	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2016	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2017	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2018	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2019	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2020	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2021	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2022	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2023	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2024	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2025	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2026	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2027	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2028	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2029	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2030	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2031	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2032	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**
2033	**[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]**

[redacted]

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Table 3-18. Administrative Cost Assumptions

Program Name	$/first-year kWh
Custom Retrofit	**[redacted]**
Prescriptive Rebates	**[redacted]**
Custom NC	**[redacted]**
SBDI	**[redacted]**
BOC	**[redacted]**
Home Perf. w/ENERGY STAR	**[redacted]**
Low-Income Weatherization	**[redacted]**
Efficient Products	**[redacted]**
Multi-Family Rebates	**[redacted]**
HVAC & DHW	**[redacted]**
Appliance Turn-In	**[redacted]**
Energy Reports	**[redacted]**
Energy Education	**[redacted]**
ENERGY STAR New Homes	**[redacted]**

Finally, Navigant assumed the following discount rates in its analysis. For the Total Resource Cost test, Utility Cost test, and Ratepayer Impact Measurement test, Navigant used the after-tax weighted average cost of capital provided by the Companies, consistent with standard industry practice, the EPA's National Action Plan for Energy Efficiency (NAPEE)[44] (see Table 4-3 in that document), and KS Commission ORDER FOLLOWING COLLABORATIVE ON BENEFIT-COST TESTING AND EVALUATION, MEASUREMENT, AND VERIFICATION (Docket No. 08 -GIMX-442), dated April 13, 2009, Section 2.56. A lower discount rate of 3% is assumed for the Societal Cost test, while a 10% discount rate is assumed for the Participant Cost[45].

Table 3-19. Assumed Discount Rates

	KCP&L - KS	KCPL - MO	KCPL – GMO
Societal Cost Test	3%	3%	3%
Total Resource Cost Test	**[redacted]	[redacted]	[redacted]**
Utility Cost Test	**[redacted]	[redacted]	[redacted]**
Participant Cost Test	10%	10%	10%
Rate Impact Measure Test	**[redacted]	[redacted]	[redacted]**

3.7.2 Cost Effectiveness Results

This section provides the results of the five standard cost-effectiveness tests, calculated in a manner consistent with MO 4 CSR 240 used in evaluation of energy efficiency programs. As noted in section 2.3.1, the Total Resource Cost (TRC) test is used at the measure level to determine whether a measure falls into the Economic Potential subset, though we provide the results of all five cost-effectiveness tests below for stakeholders' information.

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[44] Available at http://www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf

[45] Also consistent with guidance in the NAPEE report and KS Commission Order referenced previously.

Table 3-20. Portfolio Cost Effectiveness – KCP&L GMO

	2014	2015	2016	2017	2018
Societal Cost Test	2.1	2.2	2.3	2.4	2.5
Total Resource Cost Test	1.6	1.7	1.8	1.9	1.9
Utility Cost Test	2.4	2.5	2.7	2.9	3.1
Participant Cost Test	3.7	3.6	3.4	3.3	3.2
Rate Impact Measure Test	0.5	0.6	0.6	0.6	0.7

Table 3-21. Portfolio Cost Effectiveness -- KCP&L MO

	2014	2015	2016	2017	2018
Societal Cost Test	2.3	2.3	2.5	2.6	2.7
Total Resource Cost Test	1.7	1.7	1.8	1.9	2.0
Utility Cost Test	2.5	2.6	2.9	3.0	3.2
Participant Cost Test	3.3	3.2	3.1	3.0	2.9
Rate Impact Measure Test	0.6	0.6	0.7	0.7	0.8

Table 3-22. Portfolio Cost Effectiveness -- KCP&L KS

	2014	2015	2016	2017	2018
Societal Cost Test	2.1	2.2	2.3	2.4	2.5
Total Resource Cost Test	1.6	1.7	1.8	1.9	1.9
Utility Cost Test	2.3	2.4	2.6	2.8	2.9
Participant Cost Test	3.2	3.1	3.0	2.9	2.8
Rate Impact Measure Test	0.6	0.6	0.7	0.7	0.8

Additional cost-effectiveness results, by program, are offered to the Companies separately in the detailed program design documents and are also provided in Appendix L.

3.8 *Energy Efficiency Potential Supply Curves*

Navigant calculated two different types of supply curves as part of this study. The first set of supply curves illustrates how the cumulative budget increases as higher and higher levels of achievable potential are realized. These curves are provided in section 3.8.1. The second set of curves provide traditional supply curve results that plot the levelized cost of electric energy saved as a function of the cumulative MWh of energy saved.

3.8.1 Cumulative Budget versus Cumulative Achievable Potential

Although Navigant's statement of work and the MO 4 CSR 240 protocols call only for two scenarios of achievable potential (realistic and maximum), stakeholders indicated an interest in understanding how both costs and savings would vary between the RAP and MAP achievable potential scenarios. In an attempt to address this question at a high level, Navigant created what is effectively an achievable potential supply curve that shows the cumulative program budget (in 2033 and in 2023) as a function of the cumulative energy savings achieved (both in absolute MWh and as a percentage of baseline forecast energy sales). Navigant created this curve by adjusting incentive levels between RAP and MAP per the strategy outlined in section 2.3.3.

Figure 3-16 provides for all three utilities the cumulative program budget in 2033 as a function of the achievable energy savings potential (expressed as a percentage of baseline energy sales in 2033). The data point on the far left side of each curve represents the RAP scenario, whereas the far right data point on each curve represents the MAP scenario. As can be seen in these curves, costs begin to increase sharply at higher and higher levels of desired potential. For instance, targeting 25% savings by 2033 versus the RAP scenario of 18.5% for KCP&L MO increases the forecast cumulative budget by a factor of 3.9. Diminishing returns set in that require going after more costly measures at higher incentive levels for all measures, thereby resulting in a very expensive portfolio, especially in the case of the MAP scenario, where costs are up to 4-5 times greater than in the RAP scenario.

Figure 3-16. Cumulative Budget versus Cumulative Achievable Potential % of Sales – 2033

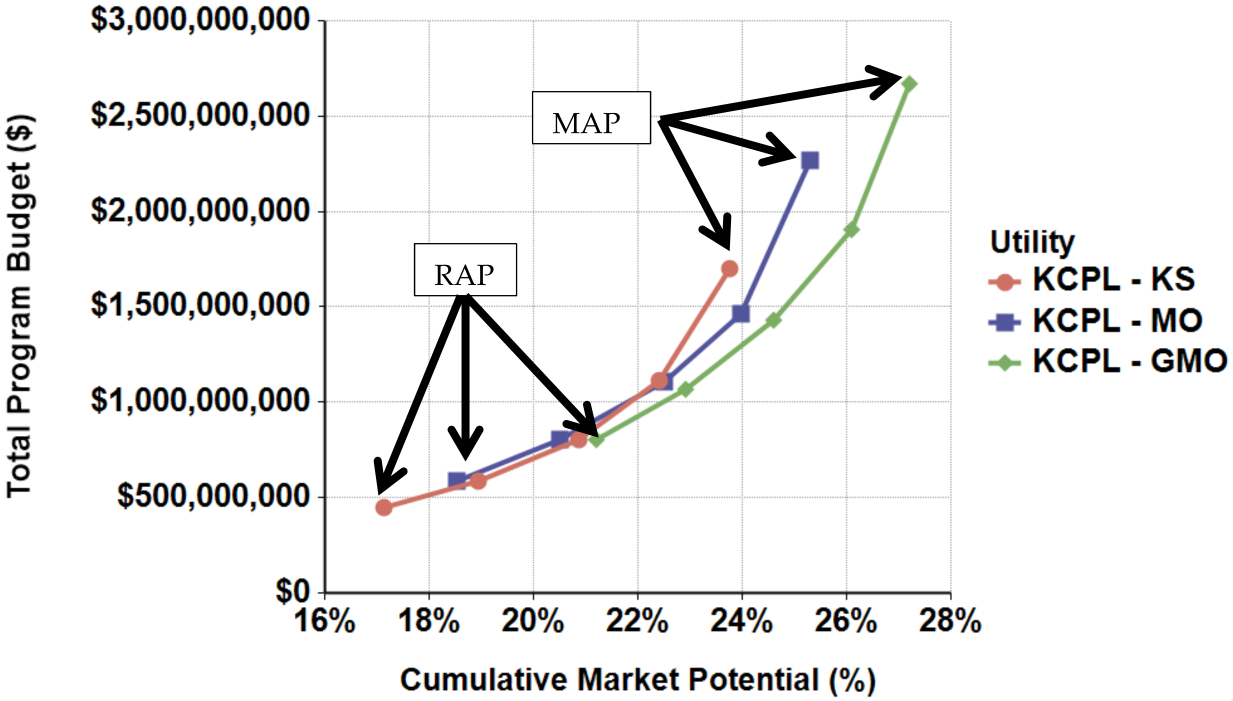
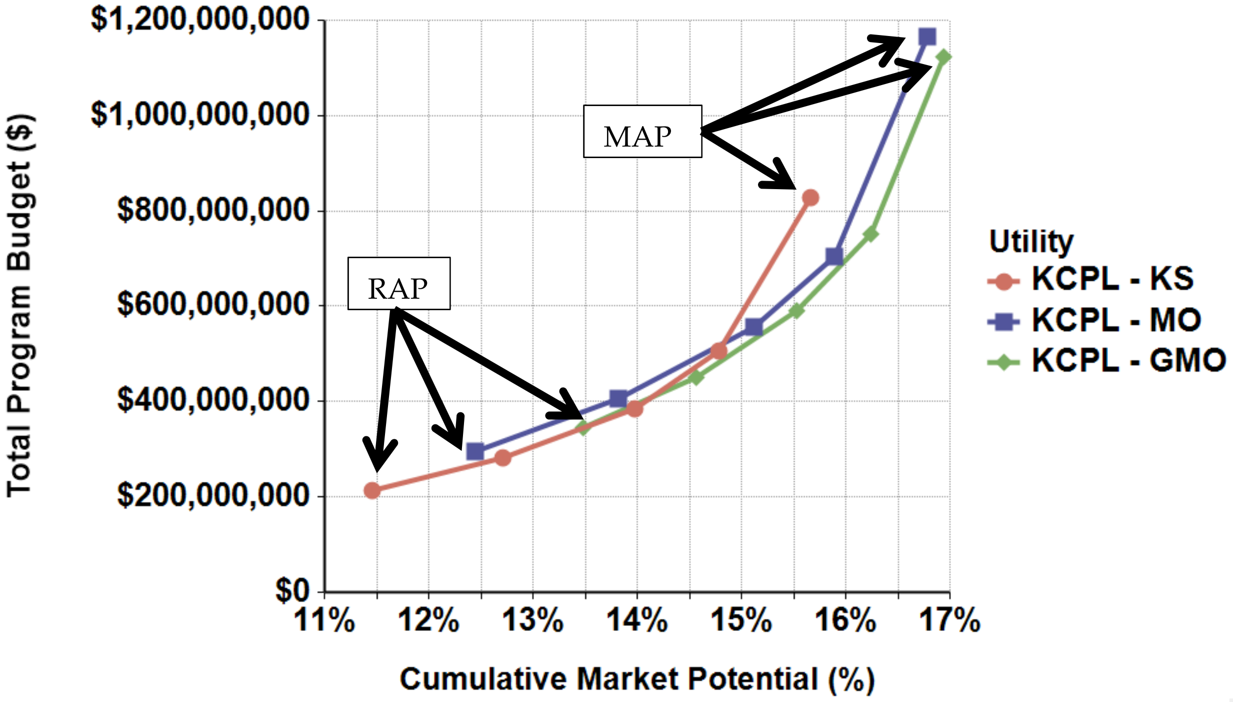


Figure 3-17 provides the same curve as that shown above except the 10-year potential is provided rather than the 20-year potential. The 10-year average potential (e.g., in %/year) is a useful metric for comparison with other studies and with savings achieved in other service territories. As can be seen in this figure, for instance, targeting an achievable savings potential of about 15.5% by 2023 (or 1.5%/year) for KCP&L MO is estimated to cost about $600,000,000 cumulative (or $60 million/year), which compares with an estimated cumulative cost of roughly $295,000,000 (or ~$29.5 million/year) for the RAP scenario of ~1.24%/yr.

Figure 3-17. Cumulative Budget versus Cumulative Achievable Potential % of Sales – 2023



3.8.2 Levelized Cost of Electricity versus Cumulative Energy Savings

Energy efficiency supply curves offer a useful way to illustrate the amount of energy savings per dollar spent. A supply curve typically consists of two axes – one that shows the cost per unit of saving (e.g., levelized cost per kWh saved) and one that captures the energy savings at each cost level. The curve is constructed using individual efficiency measures that are sorted on a least-cost basis, and savings are calculated on an incremental basis relative to the measures that precede them. The costs of the measures are levelized over the measure lifetime and include measure incentives as well as an allocation of program administration and M&V costs. Figure 3-18 through Figure 3-20 show the energy efficiency (EE) supply curves for 2033, for all three utilities, and for two achievable potential scenarios – Realistic Achievable Potential (RAP) and Maximum Achievable Potential (MAP).

Overall, we observe that a majority of the energy savings over the 20 year time horizon fall below $0.08/kWh. For RAP, most of the savings occur below $0.04/kWh. RAP holds roughly steady at a cost of about $0.02/kWh going from a cumulative potential of 400,000 to 1,200,000 MWh for KS, 500,000 to 1.6 million MWh for MO, and 600,000 to 2 million MWh for GMO, reflecting the low cost and high potential part of the supply curve. Beyond this cost level, the RAP curve reflects diminishing returns as costs increase rapidly with little increase in cumulative potential. Below the $0.10/kWh cost level, MAP offers the same amount of savings but at a higher marginal cost compared to RAP, which is to be expected as MAP assumes that incentives cover 100% of the incremental cost, while RAP enforces a maximum incentive limit on a levelized $/kWh basis (see section 2.3.3 for how incentives are set).

Figure 3-18. KCP&L - GMO EE Supply Curve – Potential by 2033

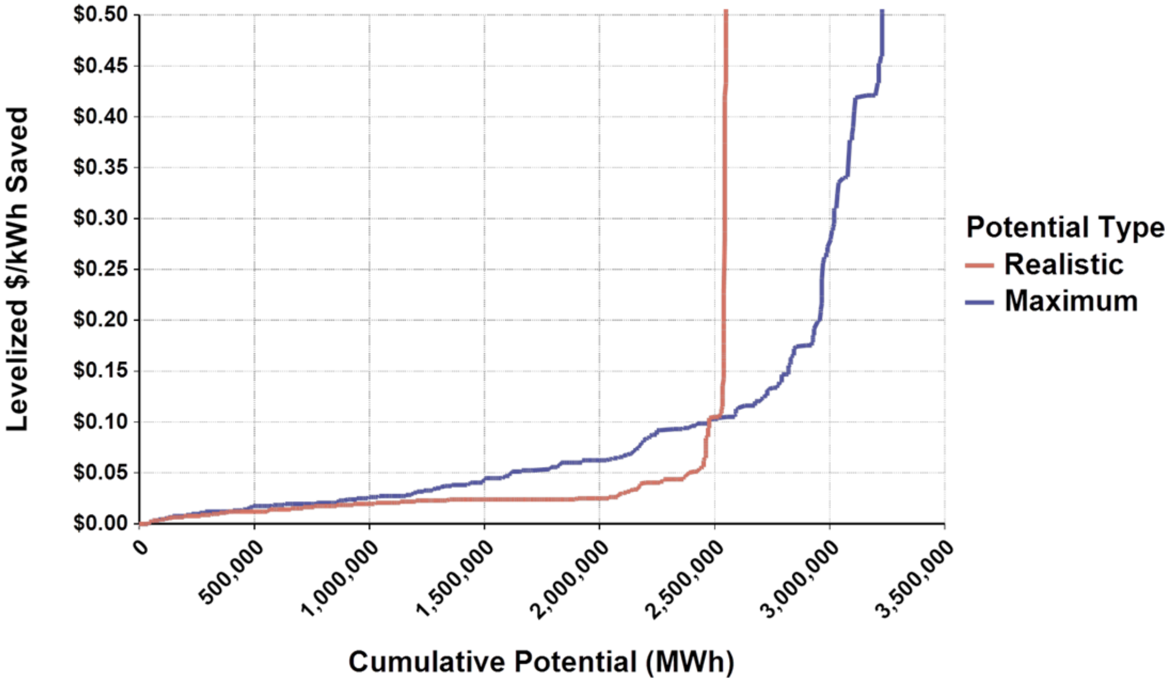


Figure 3-19. KCP&L - MO EE Supply Curve – Potential by 2033

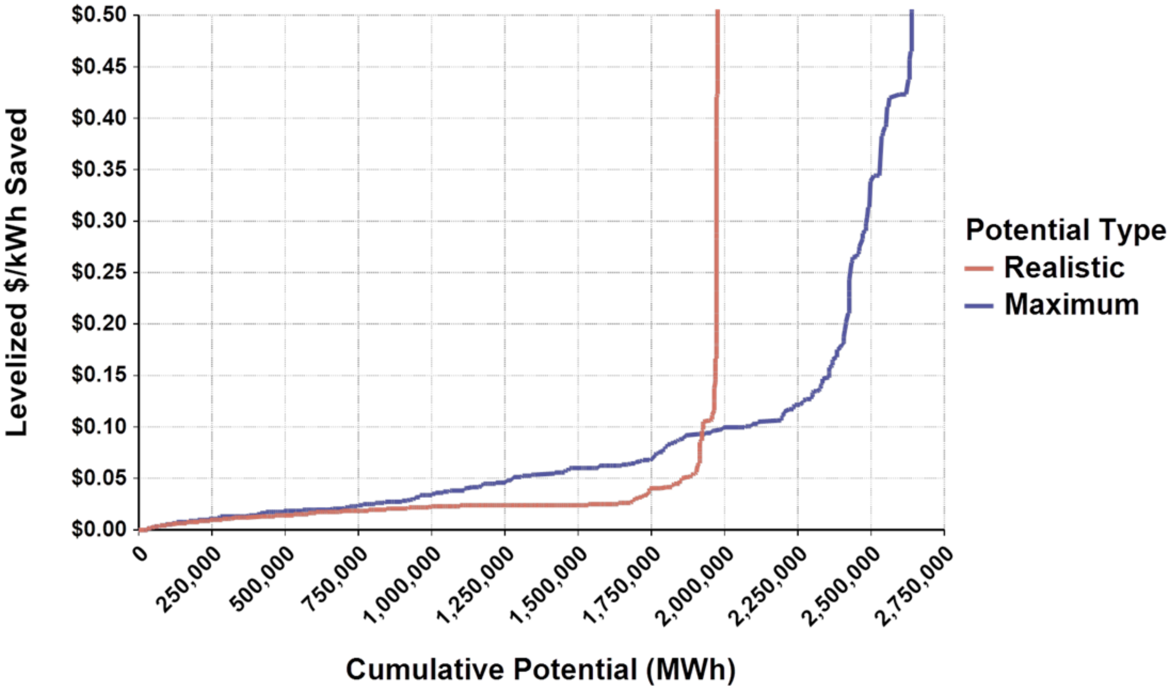
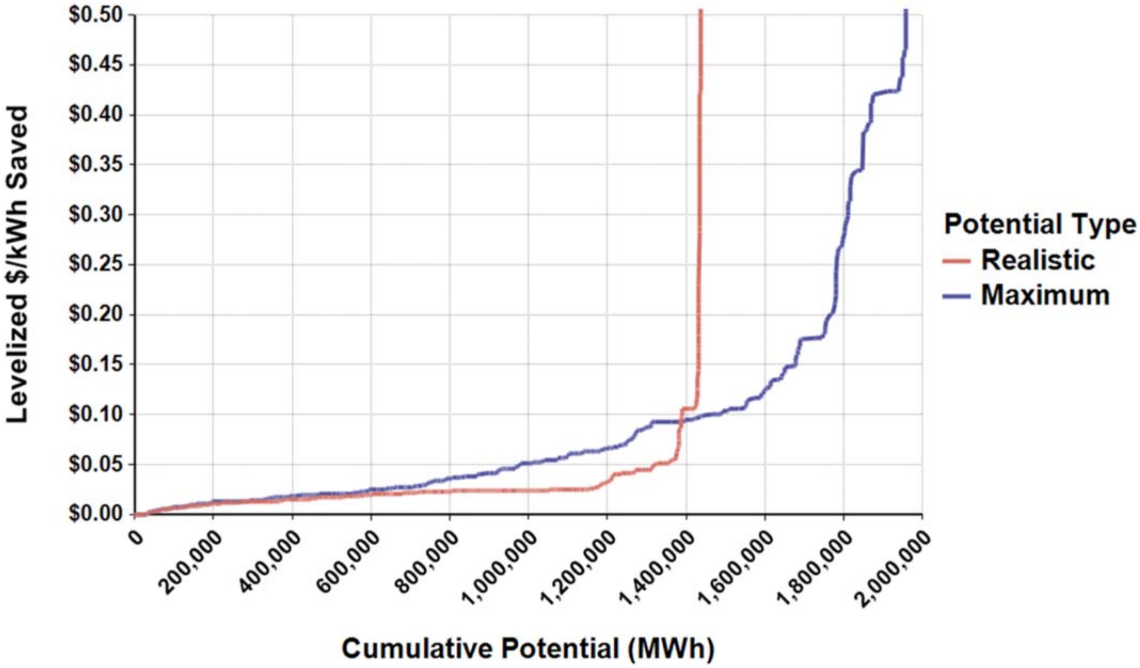


Figure 3-20. KCP&L-KS EE Supply Curve – Potential by 2033



4. Combined Heat and Power

Navigant conducted an analysis of combined heat and power (CHP) systems to identify DSM opportunities from this technology. Navigant developed a stand-alone model for this analysis because the approach varied considerably from the analysis of EE measures considered in this study and because the results from this analysis indicate a large, but uncertain potential from CHP systems. Using this tool, Navigant evaluated the cost-effectiveness of CHP systems driven by a range of prime-movers, system configurations, and usage levels and then identified individual customers that may be well suited to the systems that we found to be cost effective.

Navigant limited this analysis to large commercial and industrial customers and assumed that CHP systems would be fueled by natural gas. Although the model is capable of analyzing both natural gas-fired and opportunity fuel-fired systems, Navigant did not have the data available to determine the availability of opportunity fuels at or near sites. This type of analysis must be highly customized to individual sites and must include a valuation of opportunity fuel feed stocks currently used for other purposes (or disposed of). This type of analysis was beyond the scope of this study.

4.1 *CHP Methodology*

Navigant used the following approach to determine CHP potential:

1. Collect input data for measure characterization.
2. Screen available CHP technologies for TRC cost-effectiveness.
3. Screen TRC cost-effective technologies for participant test cost-effectiveness.
4. Identify customer base suited to cost-effective systems.
5. Estimate economic and achievable potential.
6. Model technology diffusion to estimate incremental and cumulative adoption over time.

4.1.1 CHP Input Data

Navigant collected the following data in order to determine measure cost-effectiveness

- <u>Avoided energy costs ($/kWh)</u> – avoided costs ($/MWh) provided for on-peak, off-peak, and weekend times of use, by month and year. See section 3.7.1 for avoided energy cost assumptions.
- <u>Avoided electric capacity costs ($/kW-yr)</u> – See section 3.7.1 for avoided capacity cost assumptions.
- <u>Avoided natural gas costs</u> – Natural gas costs (in $/1000 cubic feet) from the U.S. DOE EIA forecast of MidContinent wellhead gas prices[46].

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[46] U.S. DOE EIA, website "Annual Energy Outlook 2011" http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2011&subject=8-AEO2011&table=72-AEO2011&region=0-0&cases=ref2011-d020911a

- Retail electricity costs – Current large general service rates ($/kWh) in KCP&L territory, marginal rate (over 360 hours of use) used for 2012[47]. To forecast rates beyond 2012, an annual escalation of 2.3% of 2012 rates was assumed.
- Retail electric capacity costs - Current large general service rates ($/kW/month) in KCP&L territory, marginal rate (over 7,500 kW) used for 2012[48]. To forecast rates beyond 2012, an annual escalation of 2.3% of 2012 rates was assumed.
- Retail natural gas costs - Natural gas costs (in $/1000 cubic feet) from the U.S. DOE EIA forecast of industrial gas prices for the west-north-central census division[49].
- CHP prime-mover costs and performance - Capital cost ($/kW), operation and maintenance (O&M) Cost ($/kWh), heat rate (Btu/kWh), electric output to thermal output ratio (E/T) (kWh/kWh), lifetime (years), and availability (unitless) for CHP systems of a range of sizes driven by reciprocating engines, microturbines, fuel cells, steam turbines and gas turbines developed from data from several sources[50,51,52].
- Absorption chiller costs and performance – Coefficient of performance (COP), capital cost ($/ton), O&M cost ($/ton-year) from the Midwest Clean Energy Application Center[53]
- Discount rate – After tax discount rates for each utility provided by the Companies (see section 3.7.1).
- Technology diffusion rate - Assumed a bass diffusion model with a marketing effectiveness (p) of 0.03 and word-of-mouth strength (q) of 0.365[54]. A start year of 2014 was assumed, based on the time required to get projects of this magnitude implemented.

Additionally, Navigant made the following assumptions in the model

- System usage – high, medium, and low case scenarios were considered, each with different assumptions about the percentage of CHP system equivalent full load hours during each time of use:
  - High case: 95% of on-peak hours, 80% of off-peak hours, 80% of weekend hours

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[47] KCP&L, "Commercial and industrial electric service pricing." http://www.kcpl.com/brochures/CIPricing_KS.pdf

[48] KCP&L, "Commercial and industrial electric service pricing.", http://www.kcpl.com/brochures/CIPricing_KS.pdf

[49] U.S. DOE EIA, website "Annual Energy Outlook 2011" http://205.254.135.7/forecasts/archive/aeo11/source_natural_gas.cfm

[50] Combined Heat and Power: Policy Analysis and 2011-2030 Market Assessment (2012). Prepared for the California Energy Commission by ICF International. http://www.meede.org/wp-content/uploads/CHP-Policy-Analysis_Market-Assessment_California_Feb-20121.pdf

[51] US EPA Catalog of CHP Technologies. http://www.epa.gov/chp/basic/catalog.html

[52] Itron, Inc., "CPUC Self-Generation Incentive Program Tenth-Year Impact Evaluation, Final Report" http://www.cpuc.ca.gov/NR/rdonlyres/CF952F3B-0C3C-481D-968A-420F92FC2901/0/SGIP_2010_Impact_Eval_Report.pdf

[53] Midwest Clean Energy Application Center, Combined Heat and Power Resource Guide, http://www.midwestcleanenergy.org/Archive/pdfs/chp_resource_guide_2003sep.pdf

[54] See Mahajan, V., Muller, E., and Wind, Y. (2000). New Product Diffusion Models. Springer. Chapter 12 for estimation of the Bass diffusion parameters for dozens of technologies. This model uses the median value of 0.365 for the word-of-mouth strength in the base case scenario. The Marketing Effectiveness parameter was assumed to be 0.03, representing a somewhat aggressive value that exceeds the most likely value of 0.021 (75th percentile value is 0.055) per Mahajan 2000 but is slightly lower than the 0.04 value used for EE due to the higher complexity of CHP applications.

  - Medium case: 80% of on-peak hours, 25% of off-peak hours, 25% of weekend hours
  - Low case: 70% of on-peak hours, 0% of off-peak hours, 0% of weekend hours

- Thermal energy utilization – 85% of recovered heat from the CHP system was assumed to be utilized.
- Fuel for heat efficiency – a base case heating efficiency of 77% was assumed, the base case heating fuel was assumed to be natural gas
- Cooling coefficient of performance – a base case cooling COP of 5 was assumed, the base case cooling fuel was assumed to be electricity
- Project first year program administrative costs - $0.01/annual kWh reduction, modeled as a one-time cost applied at the start of the project.
- Project ongoing program administrative costs - $0.001/annual kWh reduction, modeled as an annual cost applied to the second through tenth years of the project.

4.1.2 CHP TRC Screening

Navigant began the analysis by determining what types of CHP systems would pass the TRC test. Navigant did not include administrative costs in this measure-level analysis. Navigant could then focus the remainder of the analysis on these specific systems and the sites that these CHP systems would likely be suited to.

For the TRC screening, systems defined by all possible combinations of the following parameters were considered:

- Prime mover – fuel cell, gas turbine, micro turbine, reciprocating engine, steam turbine,
- System size – a range of sizes appropriate to each technology was considered
- Heat utilization – heating, cooling, or both. Any system using heat for cooling included the costs of an absorption chiller sized to that CHP system.
- Usage - the low, medium, and high usage cases described above

Each possible system was analyzed using a detailed model of energy generation, net changes in electricity and natural gas consumption (relative to a base case of no on-site generation), and costs (capital, O&M, program administration, net electricity and natural gas costs). Navigant considered each time of use period in each month of the system's expected lifetime. From the usage case definitions, we determined the number of equivalent full load hours in each time of use period and the computed the fuel requirements, energy offsets, and O&M costs for that time of use period.

As discussed below in the Results subsection, Navigant found that some steam turbines and gas turbines with electrical capacity of 500 kW and larger passed the TRC screening, primarily systems which used recovered heat for heating or for heating and cooling. While Navigant found gas turbines under 5 MW to be not cost effective, this contradicts Navigant's observation that gas turbines in the 2.5 MW to 5 MW, 5 MW to 10 MW, and 10 MW to 50 MW ranges are adopted at higher rates than steam turbines[55]. We

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[55] Navigant reviewed all CHP installations reported in the ICF International CHP Installation database (http://www.eea-inc.com/chpdata/index.html) in Texas, Louisiana, Oklahoma, Arkansas, Kansas, Missouri, Illinois, Nebraska, and Iowa from 2004 to the present. We observed that gas turbines were three times as prevalent as steam

recognize the considerable uncertainty in our capital cost estimates and decided that combining technologies to define measures would reflect the CHP market most accurately. Navigant therefore developed measures by electrical capacity of systems, rather than prime-movers, and used a weighted average of results from steam turbines and gas turbine in each measure. We have identified in bold the considered systems in Table 4-1 and state the weightings used to define each measure in Table 4-5. Navigant only considered measures with a weighted average TRC of 1.0 or greater in our analysis of economic potential.

In addition to the measure level TRCs, which did not include program administrative costs, Navigant computed a program-level TRC, which *did* include administrative costs. To do this, Navigant first identified all measures with a measure-level TRC (excluding administrative costs) of one or greater. Navigant then took a weighted average of the TRCs of these measures, this time computed *inclusive* of administrative costs. The weighting of measures was proportional to each measure's annual kWh potential.

4.1.3 CHP Participant Test Screening

Navigant's next step was to determine the participant cost-effectiveness of systems passing the TRC screen. The same model used for TRC screening was used for the participant test. However, avoided costs were replaced by retail rates, and incentives were included.

Navigant found that no systems passed a participant test without incentives. This finding was corroborated by the current and historical lack of CHP adoption in the region. However, Navigant found that when incentives on par with those offered elsewhere in the U.S. were included, the systems that passed the TRC screen also passed the participant test. The incentive level used for the results provided in this report was a performance-based incentive of $0.03/kWh, for the first 10 years of the system operation.

A common problem with CHP systems is that they do not remain online as long as the expected lifetime assumed by the program incenting them[56]. To address this issue, Navigant modeled incentives as long-term, performance based incentives, rather than upfront rebates. While the logistics of implementing a 10 year period of monitoring and incentives may be challenging, this financial structure ensures that the ongoing economics of self-generation remain favorable for much of the expected lifetime of the system.

4.1.4 CHP Target Market Identification

After determining the systems that passed TRC and participant tests, Navigant identified customers that that would be candidates for adoption of the large CHP systems being considered. Customers were considered candidates if they had an onsite demand for heating and/or cooling on par with the thermal output of a given CHP system.

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turbines in the 2.5 MW to 5 MW capacity range, and twice as prevalent as steam turbines in the 5 MW to 50 MW capacity range. No gas turbines smaller than 2.5 MW were observed.

[56] For example, the California Self Generation Incentive Program found that capacity factors for fuel cells, reciprocating engines, and micro turbines fell to nearly half of their initial levels within six years.
Itron, Inc. 2011 "CPUC Self-Generation Incentive Program, Tenth-Year Impact Evaluation" for PG&E and the SGIP Working Group.

Navigant's analysis was limited by the information available on customers. The customer database provided to Navigant by KCP&L identified the annual electricity consumption and the building/business type of customers. Navigant assumed that these largest customers used natural gas to provide heating and that their heating and cooling loads – relative to their electric loads – followed patterns observed in other regions of the country for similar analyses. Navigant could not identify customers with access to opportunity fuels such as biogas or combustible agricultural waste: this would have required a detailed study of individual customers, their processes, and their existing valuation of the byproducts of their processes. Table 4-2 through Table 4-4 in the Results section summarize the number of customers, by building or industry type, identified as candidates for each size CHP system.

4.1.5 CHP Economic and Achievable Potential

Navigant defined economic potential as the summation of CHP potential at all sites identified as candidates for CHP systems. Table 4-6 through Table 4-9 in the Results subsection summarize the economic potential of CHP systems at each utility and collectively.

Navigant estimated achievable CHP potential based on their analysis of adoption of high cost ($100,000 and greater) energy efficiency measures in the U.S. Department of Energy's Industrial Assessment Center (IAC) database[57]. The IAC database documents EE measures recommended to industrial sites as part of a standardized energy audit conducted by IAC members. CHP is not considered in these audits. Auditors estimate the cost and simple payback period of each recommendation. Auditors revisit sites approximately one year after the audit and document which recommendations were implemented. From this data, Navigant was able to develop a payback acceptance curve for high-cost measures. There were only a few measures in the database as expensive (multi-million dollar) as MW-scale CHP systems. Navigant therefore examined all recommended measures that cost $100,000 or more.

At an incentive level of $0.03/kWh, the cost-effective CHP measures have a simple payback period of 1.6 to 6.5 years. For the IAC-based payback acceptance curve, measures in this payback range had an adoption rate of 27 to 34%. Navigant therefore assumed that one third of economic potential was realistically achievable. The large capital costs of these systems make them incomparable to other energy efficiency measures, so that the traditional payback acceptance curves used for other EE measures would not apply here. The relatively low ratio of achievable to economic potential reflects significant technical, financial, and institutional barriers to the adoption of large mechanical systems.

Measures with a payback period less than six months had an adoption rate of approximately 40% on the IAC-based payback acceptance curve. Navigant assumed a maximum achievable potential of 50% to account for this observed maximum adoption rate plus additional adoption facilitated by financing arrangements (e.g. third party ownership) that would be more likely to be available for CHP systems than for the EE measures in the IAC database. The maximum achievable potential scenario assumes the same $0.03/kWh incentive level as the realistic achievable potential scenario for CHP. Therefore these two scenarios are intended to reflect the uncertainty in the likely adoption of these expensive and complex measures.

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[57] http://iac.rutgers.edu/database/

4.1.6 Technology Diffusion

As discussed above, Navigant assumed CHP technology diffusion curve comparable to that used in the other portions of this potential study. However, the curve was shifted forward in time (first participants in 2015), based on the time required to get projects of this magnitude implemented.

This diffusion assumption results in a fractional number of participants per year. In reality, the total number of achievable participants is small (~24 per utility) and the incremental participation in a given year would be discrete and may be zero in some years.

4.2 *CHP Results*

Table 4-1 states the cost and performance parameters assumed for each considered CHP system, and the resulting TRC values for the high usage cases for each of the three thermal output utilization scenarios (heating, cooling, heating and cooling). Steam turbines and gas turbines are the only technologies to pass the TRC test. Table 4-2 through Table 4-4 summarize the number of candidate customers identified for each utility, by customer segment and size of system (in kW of electrical capacity). More than half of the candidate sites for systems 1 MW and larger are in the “Chemicals” segment. About 41% of the candidate sites for systems between 500 kW and 1 MW are in the “Food” segment. Candidates are distributed across all three utilities.

Navigant developed a measure for each of the five largest CHP system size categories. For each measure, a weighted average of costs and impacts for steam turbines and gas turbines was used. The weights, costs, impacts, and cost-effectiveness of each measure are shown in Table 4-5.

Table 4-6 through Table 4-9 show the economic and equilibrium achievable potential for each utility. Table 4-10 shows the cumulative achievable potential by year, from 2014 to 2034.

The program-level TRC for this collection of measures is 1.42, and the participant test value is 1.70.

Although we think including gas turbines with TRCs of less than 1.0 in some measures leads to the most accurate reflection of the CHP market, as discussed in section 4.1.2, we also executed our CHP model *without* this adjustment in order to examine the impact of this decision on the potential results. For this run of the model, Navigant excluded gas turbines in the 2.5 MW to 5 MW range, so that the measure defined by this range was solely based on steam turbines results. This resulted in no change in electrical potential (by design of the analysis) and an approximately 10% increase in natural gas impact of this measure.

Table 4-1. Modeled CHP Systems[58] and Resulting TRC For High Usage Cases

Generator Type	Range	Capital Cost ($/kW)	O&M Cost ($/kWh)	Heat Rate (Btu/kWh)	Electrical to Thermal Energy Output Ratio	Lifetime (years)	Availability	TRC - thermal output for heating	TRC - thermal output for cooling	TRC - thermal output for heating and cooling
Fuel Cell	100 to 500 kW	$5,875	0.037	9307	1.28	8	0.89	0.09	0.04	0.06
Fuel Cell	500 to 1,000 kW	$5,395	0.036	8279	1.72	8	0.89	0.1	0.06	0.08
Fuel Cell	1,000 to 2,500 kW	$5,258	0.033	8022	2.16	8	0.89	0.1	0.07	0.08
Gas Turbine	500 to 1,000 kW	$3,606	0.012	16047	0.47	20	0.95	0.37	0.16	0.29
Gas Turbine	1,000 to 2,500 kW	$2,632	0.01	15240	0.53	20	0.95	0.49	0.22	0.38
Gas Turbine	**2,500 to 5,000 kW**	**$1,938**	**0.009**	**13199**	**0.66**	**20**	**0.95**	**0.72**	**0.42**	**0.59**
Gas Turbine	**5,000 to 10,000 kW**	**$1,464**	**0.008**	**11883**	**0.71**	**20**	**0.95**	**1.07**	**0.67**	**0.86**
Gas Turbine	**10,000 to 50,000 kW**	**$1,138**	**0.005**	**9462**	**1**	**20**	**0.95**	**1.68**	**1.2**	**1.39**
Microturbine	100 to 500 kW	$3,000	0.022	12247	0.69	6	0.95	0.08	0	0.01

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[58] Systems identified in bold were included in our assessment of economic potential. The primary criterion for inclusion was a TRC for thermal output of heating of greater than ~1.0, though exceptions apply as discussed in section 4.1.2.

Generator Type	Range	Capital Cost ($/kW)	O&M Cost ($/kWh)	Heat Rate (Btu/kWh)	Electrical to Thermal Energy Output Ratio	Lifetime (years)	Availability	TRC - thermal output for heating	TRC - thermal output for cooling	TRC - thermal output for heating and cooling
Microturbine	500 to 1,000 kW	$2,900	0.02	12247	0.69	6	0.95	0.09	0	0.01
Reciprocating Engine	100 to 500 kW	$2,417	0.021	11501	0.68	7	0.95	0.18	0.04	0.11
Reciprocating Engine	500 to 1,000 kW	$1,840	0.015	9760	0.79	7	0.95	0.31	0.12	0.21
Reciprocating Engine	1,000 to 2,500 kW	$1,491	0.014	9616	0.88	7	0.95	0.34	0.14	0.24
Reciprocating Engine	2,500 to 5,000 kW	$1,338	0.013	9134	1.05	7	0.95	0.36	0.17	0.26
Reciprocating Engine	5,000 to 10,000 kW	$1,338	0.013	9134	1.05	7	0.95	0.36	0.18	0.26
Steam Turbine	**500 to 1,000 kW**	**$1,167**	**0.005**	**13661**	**0.5**	**15**	**0.89**	**1.15**	**0.47**	**0.73**
Steam Turbine	**1,000 to 2,500 kW**	**$950**	**0.005**	**13661**	**0.5**	**15**	**0.89**	**1.35**	**0.53**	**0.83**
Steam Turbine	**2,500 to 5,000 kW**	**$496**	**0.005**	**13661**	**0.48**	**15**	**0.89**	**2.21**	**0.78**	**1.21**
Steam Turbine	**5,000 to 10,000 kW**	**$496**	**0.005**	**13661**	**0.48**	**15**	**0.89**	**2.21**	**0.78**	**1.21**
Steam Turbine	**10,000 to 50,000 kW**	**$496**	**0.005**	**13661**	**0.48**	**15**	**0.89**	**2.21**	**0.78**	**1.21**

Table 4-2. Number of Candidate Customers by Segment and CHP Electrical Capacity - GMO

Segment	Application of Waste Heat	Usage Case	500 to 1,000 kW	1,000 to 2,500 kW	2,500 to 5,000 kW	5,000 to 10,000 kW	10,000 to 50,000 kW	Total
Chemicals	Heating	High		6			1	7
Fab Metals	Heating	High	4					4
Food	Heating	High	8	3				11
Healthcare	Heating and Cooling	Medium	1					1
Motor Freight Transportation	Heating	High	2					2
Office - Large	Heating and Cooling	Low	3	1				4
Other Industrial	Heating	High	1					1
Rubber-Plastics	Heating	High		1				1
Stone-Clay-Glass	Heating	High			2			2
Transportation Equipment	Heating	High	1					1
		Total	20	11	2	0	1	34

Table 4-3. Number of Candidate Customers by Segment and CHP Electrical Capacity – KCP&L MO

Segment	Application of Waste Heat	Usage Case	500 to 1,000 kW	1,000 to 2,500 kW	2,500 to 5,000 kW	5,000 to 10,000 kW	10,000 to 50,000 kW	Total
Chemicals	Heating	High		3			2	5
Food	Heating	High	4	2		1		3
Healthcare	Heating and Cooling	Medium	6					
Office - Large	Heating and Cooling	Low	2	1				1
Petroleum	Heating	High		2				2
Rubber-Plastics	Heating	High		1				1
Stone-Clay-Glass	Heating	High		1	1			2
		Total	12	10	1	1	2	26

Table 4-4. Number of Candidate Customers by Segment and CHP Electrical Capacity – KCP&L KS

Segment	Application of Waste Heat	Usage Case	500 to 1,000 kW	1,000 to 2,500 kW	2,500 to 5,000 kW	5,000 to 10,000 kW	10,000 to 50,000 kW	Total
Segment	Application of Waste Heat	Usage Case	500 to 1,000 kW	1,000 to 2,500 kW	2,500 to 5,000 kW	5,000 to 10,000 kW	10,000 to 50,000 kW	Total
Chemicals	Heating	High		6				6
Food	Heating	High	3					3
Healthcare	Heating and Cooling	Medium	1					1
Motor Freight Transportation	Heating	High	1					1
Office - Large	Heating and Cooling	Low		1				1
Rubber-Plastics	Heating	High		1				1
		Total	5	8	0	0	0	13

Table 4-5. Measure Level Results

CHP System Range	Measure % Steam Turbine	Measure % Gas Turbine	Capital Cost per CHP system (without incentive)	Annual O&M Costs	Annual NG Increase (therms)	Annual Electricity Reduction (kWh)	Annual Demand Reduction (kW)	Measure Life (years)	TRC	Participant Test	Number of Candidate Sites
500 to 1,000 kW	100%	0%	$875,250	$25,422	311,297	5,084,348	712	15	1.15	1.39	37
1,000 to 2,500 kW	100%	0%	$1,662,500	$59,317	726,360	11,863,478	1,662	15	1.35	1.62	29
2,500 to 5,000 kW	33%	67%	$5,483,025	$205,573	1,848,695	26,570,000	3,561	18	1.21	1.28	3
5,000 to 10,000 kW	33%	67%	$8,584,200	$374,785	3,365,108	53,140,001	7,121	18	1.45	1.51	1
10,000 to 50,000 kW	33%	67%	$27,784,200	$1,062,800	12,178,350	212,560,002	28,485	18	1.85	1.92	3

Table 4-6. Economic and Achievable Potential by CHP System Size for All Utilities

Measure	Economic Potential - kWh	Economic Potential - kW	Realistically Achievable Potential - kWh	Realistically Achievable Potential - kW	Maximum Achievable Potential - kWh	Maximum Achievable Potential - kW
500 to 1,000 kW	188,120,858	26,349	62,079,883	8,695	94,060,429	13,174
1,000 to 2,500 kW	344,040,848	48,187	113,533,480	15,902	172,020,424	24,094
2,500 to 5,000 kW	79,710,001	10,682	26,304,300	3,525	39,855,000	5,341
5,000 to 10,000 kW	53,140,001	7,121	17,536,200	2,350	26,570,000	3,561
10,000 to 50,000 kW	637,680,006	85,455	210,434,402	28,200	318,840,003	42,728
Total	1,302,691,712	177,794	429,888,265	58,672	651,345,856	88,897

Table 4-7. Economic and Achievable Potential by CHP System Size – GMO

Measure	Economic Potential - kWh	Economic Potential - kW	Realistically Achievable Potential - kWh	Realistically Achievable Potential - kW	Maximum Achievable Potential - kWh	Maximum Achievable Potential - kW
Measure	Economic Potential - kWh	Economic Potential - kW	Achievable Potential - kWh	Achievable Potential - kW	Maximum Achievable Potential - kWh	Maximum Achievable Potential - kW
500 to 1,000 kW	101,686,950	14,243	33,556,694	4,700	50,843,475	7,121
1,000 to 2,500 kW	130,498,253	18,278	43,064,423	6,032	65,249,126	9,139
2,500 to 5,000 kW	53,140,001	7,121	17,536,200	2,350	26,570,000	3,561
5,000 to 10,000 kW	-	-	-	-	-	-
10,000 to 50,000 kW	212,560,002	28,485	70,144,801	9,400	106,280,001	14,243

Table 4-8. Economic and Achievable Potential by CHP System Size – KCP&L MO

Measure	Economic Potential - kWh	Economic Potential - kW	Achievable Potential - kWh	Achievable Potential - kW	Maximum Achievable Potential - kWh	Maximum Achievable Potential - kW
500 to 1,000 kW	61,012,170	8,546	20,134,016	2,820	30,506,085	4,273
1,000 to 2,500 kW	118,634,775	16,616	39,149,476	5,483	59,317,388	8,308
2,500 to 5,000 kW	26,570,000	3,561	8,768,100	1,175	13,285,000	1,780
5,000 to 10,000 kW	53,140,001	7,121	17,536,200	2,350	26,570,000	3,561
10,000 to 50,000 kW	425,120,004	56,970	140,289,601	18,800	212,560,002	28,485
Total	684,476,950	92,814	225,877,393	30,628	342,238,475	46,407

Table 4-9. Economic and Achievable Potential by CHP System Size – KCP&L KS

Measure	Economic Potential - kWh	Economic Potential - kW	Achievable Potential - kWh	Achievable Potential - kW	Maximum Achievable Potential - kWh	Maximum Achievable Potential - kW
500 to 1,000 kW	25,421,738	3,561	8,389,173	1,175	12,710,869	1,780
1,000 to 2,500 kW	94,907,820	13,293	31,319,581	4,387	47,453,910	6,647
2,500 to 5,000 kW	-	-	-	-	-	-
5,000 to 10,000 kW	-	-	-	-	-	-
10,000 to 50,000 kW	-	-	-	-	-	-
Total	120,329,558	16,854	39,708,754	5,562	60,164,779	8,427

Table 4-10. Cumulative Realistic Achievable Potential by Year

Year	GMO - GWh	GMO - MW	KCP&L MO - GWh	KCP&L MO - MW	KCP&L KS - GWh	KCP&L KS - MW	All Utilities - GWh	All Utilities - MW
2014	-	-	-	-	-	-	-	-
2015	2.30	0.31	3.16	0.43	0.56	0.08	6.02	0.82
2016	4.60	0.63	6.32	0.86	1.11	0.15	12.04	1.64
2017	11.50	1.57	15.81	2.16	2.78	0.38	30.09	4.11
2018	20.70	2.83	28.46	3.88	5.00	0.68	54.17	7.39
2019	32.20	4.40	44.27	6.04	7.78	1.06	84.26	11.50
2020	46.17	6.30	63.47	8.66	11.16	1.52	120.80	16.49
2021	62.27	8.50	85.61	11.68	15.05	2.05	162.93	22.24
2022	79.52	10.85	109.32	14.92	19.22	2.62	208.07	28.40
2023	96.94	13.23	133.27	18.19	23.43	3.20	253.63	34.62
2024	113.04	15.43	155.40	21.21	27.32	3.73	295.76	40.37
2025	126.68	17.29	174.15	23.77	30.62	4.18	331.44	45.24
2026	137.69	18.79	189.29	25.83	33.28	4.54	360.25	49.17
2027	146.06	19.94	200.81	27.41	35.30	4.82	382.17	52.16
2028	151.98	20.74	208.94	28.52	36.73	5.01	397.65	54.27
2029	156.09	21.30	214.58	29.29	37.72	5.15	408.39	55.74
2030	158.72	21.66	218.20	29.78	38.36	5.24	415.27	56.68
2031	160.36	21.89	220.46	30.09	38.76	5.29	419.57	57.26
2032	161.34	22.02	221.81	30.27	38.99	5.32	422.15	57.62
2033	162.00	22.11	222.72	30.40	39.15	5.34	423.87	57.85
2034	162.17	22.13	222.94	30.43	39.19	5.35	424.30	57.91

Table 4-11. Cumulative Maximum Achievable Potential by Year

Year	GMO - GWh	GMO - MW	KCP&L MO - GWh	KCP&L MO - MW	KCP&L KS - GWh	KCP&L KS - MW	All Utilities - GWh	All Utilities - MW
2014	-	-	-	-	-	-	-	-
2015	3.49	0.48	4.79	0.65	0.84	0.11	9.12	1.24
2016	6.97	0.95	9.58	1.31	1.68	0.23	18.24	2.49
2017	17.43	2.38	23.96	3.27	4.21	0.57	45.59	6.22
2018	31.37	4.28	43.12	5.89	7.58	1.03	82.07	11.20
2019	48.79	6.66	67.08	9.16	11.79	1.61	127.66	17.42
2020	69.95	9.55	96.17	13.13	16.91	2.31	183.03	24.98
2021	94.35	12.88	129.71	17.70	22.80	3.11	246.86	33.69
2022	120.49	16.44	165.64	22.61	29.12	3.97	315.25	43.03
2023	146.88	20.05	201.92	27.56	35.50	4.84	384.29	52.45
2024	171.27	23.38	235.46	32.14	41.39	5.65	448.13	61.16
2025	191.93	26.20	263.87	36.01	46.39	6.33	502.19	68.54
2026	208.61	28.47	286.80	39.14	50.42	6.88	545.83	74.50
2027	221.31	30.20	304.25	41.52	53.49	7.30	579.05	79.03
2028	230.27	31.43	316.57	43.21	55.65	7.60	602.49	82.23
2029	236.50	32.28	325.13	44.37	57.16	7.80	618.78	84.45
2030	240.48	32.82	330.60	45.12	58.12	7.93	629.20	85.87
2031	242.97	33.16	334.02	45.59	58.72	8.01	635.71	86.76
2032	244.46	33.36	336.08	45.87	59.08	8.06	639.62	87.30
2033	245.46	33.50	337.45	46.06	59.32	8.10	642.23	87.65
2034	245.71	33.53	337.79	46.10	59.38	8.10	642.88	87.74

4.3 *CHP Conclusions*

MW-scale steam- and gas-turbine CHP systems appear to be cost-effective in the KCP&L territory. While the number of sites with achievable potential is small (~24 per utility), the equilibrium realistic achievable potential is approximately 58 MW. Candidate sites include both traditional CHP adopters (i.e, industrial and medical sites) and less typical CHP adopters that could utilize thermal energy for both heating and cooling (i.e., large offices).

Additional potential may exist at sites with access to opportunity fuels, such as waste water treatment facilities, agricultural sites, and wood processing sites. However, a custom analysis would be required of each site to address highly variable factors such as the quantity of available fuel, and the economics of using the opportunity fuel for power generation instead of its current use, and the need/ability to export generated power. Historically, CHP systems have been mothballed when natural gas prices rise; systems fueled by opportunity fuels do not bear this risk.

Regardless of the fuel, valuable services that can potentially be provided to customers are identifying candidate sites, providing preliminary cost-effectiveness analyses, and providing independent review of contractor proposals and savings claims.

Long term performance based incentives could help ensure that project economics remain favorable – and that systems remain in operation – for the expected lifetime of the systems.

Finally, it is important to recognize that there is an expected small number of participants, which will inevitably have discrete patterns of incremental participation -- likely be one or two new participants in some years and zero in others.

5. Combined Savings Estimates (EE/CHP/DR)

This section aggregates the energy savings, demand savings, and cumulative budget results for the realistic achievable potential (RAP) scenario described in sections 3 (for energy efficiency), section 4 (for CHP), and in the stand-alone report on Demand Response. For comparison with the results of this study, the targets for cumulative energy and demand savings in 4 CSR 240.094 are provided below. Comparisons, however, are subject to the caveats offered in Section 2.5. As a result, we provide this table once in the report as opposed to providing "side by side" comparisons of potential versus the targets below.

Table 5-1. Cumulative Energy and Demand Savings Targets per MO 4 CSR 240.094

Year	Energy (% of Baseline)	Demand (% of Baseline)
2012	0.30%	1.00%
2013	0.80%	2.00%
2014	1.50%	3.00%
2015	2.40%	4.00%
2016	3.50%	5.00%
2017	4.80%	6.00%
2018	6.30%	7.00%
2019	8.00%	8.00%
2020	9.90%	9.00%
beyond 2021	+1.9%/year	+1.0%/year

5.1 *Cumulative Realistic Achievable Potential (RAP) for Energy Savings*

Cumulative achievable potential energy savings for energy efficiency (EE), combined heat and power (CHP), and demand response (DR) for KCP&L GMO, KCP&L MO, and KCP&L KS are provided below in Table 5-1 through Table 5-4, which illustrate results for the RAP scenario. Cumulative potential as a percentage of baseline forecast energy sales at the end of the 20-year forecast horizon ranges from 17.6% to 22.5%, with the largest value in KCP&L GMO's service territory. This difference is primarily attributable to GMO's higher forecast annual growth rate, lending additional opportunities for savings in new buildings. Over a nearer-term time horizon of ten years, cumulative achievable potential is 14.5% (or 1.45%/year) for KCP&L GMO, 13.8% (or 1.38%/year) for KCP&L MO, and 11.8% (or 1.18%/year) for KCP&L KS. As noted in these figures, for DR we conservatively assume there are no significant energy savings, which is consistent with typical industry assumptions for dispatch-able DR programs, as well as some of Navigant's recent findings for utilities with time-based rates, including TOU.

Table 5-2. Cumulative EE/DR/CHP Energy RAP (MWh) – KCP&L GMO

KCP&L GMO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	90,895	0	0	90,895	1.1%
2015	191,727	0	2,300	194,027	2.2%
2016	302,033	0	4,600	306,633	3.5%
2017	427,785	0	11,501	439,286	4.9%
2018	569,884	0	20,702	590,586	6.5%
2019	722,942	0	32,203	755,146	8.2%
2020	881,328	0	46,169	927,497	9.9%
2021	1,037,947	0	62,271	1,100,218	11.5%
2022	1,187,910	0	79,522	1,267,433	13.1%
2023	1,330,940	0	96,938	1,427,878	14.5%
2024	1,467,700	0	113,040	1,580,739	15.7%
2025	1,599,381	0	126,677	1,726,058	16.9%
2026	1,727,665	0	137,685	1,865,350	17.9%
2027	1,851,215	0	146,065	1,997,280	18.8%
2028	1,973,566	0	151,979	2,125,545	19.6%
2029	2,093,452	0	156,087	2,249,539	20.3%
2030	2,208,148	0	158,716	2,366,863	20.9%
2031	2,321,418	0	160,359	2,481,777	21.5%
2032	2,434,251	0	161,345	2,595,596	22.0%
2033	2,548,082	0	162,002	2,710,084	22.5%

Table 5-3. Cumulative EE/DR/CHP Energy RAP (MWh) -- KCP&L MO

KCP&L MO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	83,217	0	0	83,217	0.9%
2015	175,255	0	3,162	178,417	2.0%
2016	277,039	0	6,325	283,364	3.2%
2017	392,661	0	15,811	408,472	4.5%
2018	522,323	0	28,461	550,783	6.1%
2019	660,805	0	44,272	705,077	7.7%
2020	801,979	0	63,472	865,450	9.4%
2021	938,370	0	85,608	1,023,978	11.0%
2022	1,064,988	0	109,325	1,174,312	12.5%
2023	1,180,430	0	133,268	1,313,697	13.8%
2024	1,284,982	0	155,404	1,440,386	15.0%
2025	1,379,080	0	174,151	1,553,232	16.0%
2026	1,467,237	0	189,285	1,656,522	16.9%
2027	1,550,686	0	200,805	1,751,491	17.7%

KCP&L MO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2028	1,629,698	0	208,937	1,838,635	18.3%
2029	1,704,979	0	214,584	1,919,563	18.9%
2030	1,775,261	0	218,198	1,993,459	19.4%
2031	1,843,326	0	220,456	2,063,783	19.8%
2032	1,909,732	0	221,812	2,131,544	20.2%
2033	1,975,390	0	222,715	2,198,106	20.6%

Table 5-4. Cumulative EE/DR/CHP Energy RAP (MWh) -- KCP&L KS

KCP&L KS	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	60,804	0	0	60,804	0.9%
2015	128,797	0	556	129,353	1.9%
2016	201,858	0	1,112	202,970	3.0%
2017	283,429	0	2,780	286,209	4.2%
2018	374,060	0	5,003	379,063	5.5%
2019	470,598	0	7,783	478,381	6.8%
2020	569,032	0	11,158	580,190	8.2%
2021	664,736	0	15,050	679,786	9.5%
2022	754,392	0	19,219	773,611	10.7%
2023	837,423	0	23,428	860,851	11.8%
2024	913,897	0	27,320	941,217	12.7%
2025	983,873	0	30,615	1,014,488	13.5%
2026	1,050,099	0	33,276	1,083,375	14.3%
2027	1,112,106	0	35,301	1,147,407	14.9%
2028	1,171,573	0	36,731	1,208,303	15.5%
2029	1,228,577	0	37,723	1,266,300	16.0%
2030	1,282,500	0	38,359	1,320,858	16.5%
2031	1,335,151	0	38,756	1,373,907	16.9%
2032	1,386,789	0	38,994	1,425,783	17.2%
2033	1,437,728	0	39,153	1,476,880	17.6%

5.2 *Cumulative Maximum Achievable Potential (MAP) for Energy Savings*

Cumulative maximum achievable potential energy savings for energy efficiency (EE), combined heat and power (CHP), and demand response (DR) for KCP&L GMO, KCP&L MO, and KCP&L KS are provided below in Table 5-5 through Table 5-7, which do not exclude opt-out customers. Cumulative maximum achievable potential as a percentage of baseline forecast energy sales at the end of the 20-year forecast horizon ranges from 24.5% to 29.2%, with the largest value in KCP&L GMO's service territory. As with RAP, this difference is primarily attributable to GMO's higher forecast annual growth rate, lending additional opportunities for savings in new buildings. Over a nearer-term time horizon, 10 years, cumulative maximum achievable potential is 18.4% (or 1.84%/year) for KCP&L GMO, 18.9% (or 1.89%/year) for KCP&L MO, and 16.2% (or 1.62%/year) for KCP&L KS. As noted in these figures, for DR we conservatively assume there are no significant energy savings, which is consistent with typical industry assumptions for dispatch-able DR programs, as well as some of Navigant's recent findings for utilities with time-based rates, including TOU.

Table 5-5. Cumulative EE/DR/CHP Energy MAP (MWh) – KCP&L GMO

KCP&L GMO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	106,150	0	0	106,150	1.2%
2015	227,510	0	3,485	230,995	2.7%
2016	364,356	0	6,970	371,327	4.2%
2017	523,176	0	17,426	540,602	6.1%
2018	703,168	0	31,367	734,535	8.1%
2019	897,225	0	48,793	946,018	10.3%
2020	1,098,957	0	69,953	1,168,909	12.5%
2021	1,298,414	0	94,349	1,392,764	14.6%
2022	1,490,214	0	120,488	1,610,702	16.6%
2023	1,672,037	0	146,876	1,818,913	18.4%
2024	1,847,554	0	171,273	2,018,827	20.1%
2025	2,018,670	0	191,935	2,210,605	21.6%
2026	2,187,097	0	208,614	2,395,711	23.0%
2027	2,350,357	0	221,310	2,571,667	24.2%
2028	2,513,766	0	230,272	2,744,038	25.3%
2029	2,673,904	0	236,495	2,910,400	26.3%
2030	2,826,627	0	240,479	3,067,106	27.1%
2031	2,976,165	0	242,968	3,219,132	27.9%
2032	3,123,259	0	244,462	3,367,721	28.6%
2033	3,270,051	0	245,457	3,515,509	29.2%

Table 5-6. Cumulative EE/DR/CHP Energy MAP (MWh) – KCP&L MO

KCP&L MO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	103,809	0	0	103,809	1.2%
2015	222,681	0	4,791	227,472	2.6%
2016	358,190	0	9,583	367,772	4.1%
2017	515,413	0	23,957	539,370	6.0%
2018	692,514	0	43,122	735,636	8.1%
2019	881,699	0	67,079	948,778	10.4%
2020	1,075,116	0	96,169	1,171,285	12.7%
2021	1,261,494	0	129,708	1,391,202	14.9%
2022	1,435,067	0	165,643	1,600,710	17.0%

KCP&L MO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2023	1,591,901	0	201,921	1,793,822	18.9%
2024	1,733,479	0	235,460	1,968,939	20.6%
2025	1,860,562	0	263,866	2,124,428	21.9%
2026	1,980,594	0	286,796	2,267,390	23.2%
2027	2,096,715	0	304,250	2,400,965	24.2%
2028	2,208,109	0	316,571	2,524,680	25.2%
2029	2,315,369	0	325,127	2,640,496	26.0%
2030	2,416,230	0	330,602	2,746,832	26.7%
2031	2,513,709	0	334,025	2,847,734	27.4%
2032	2,607,909	0	336,078	2,943,987	28.0%
2033	2,699,565	0	337,447	3,037,012	28.5%

Table 5-7. Cumulative EE/DR/CHP Energy MAP (MWh) – KCP&L KS

KCP&L KS	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	75,079	0	0	75,079	1.1%
2015	162,511	0	842	163,353	2.4%
2016	260,583	0	1,685	262,267	3.9%
2017	373,070	0	4,212	377,282	5.5%
2018	499,032	0	7,581	506,613	7.3%
2019	633,542	0	11,792	645,334	9.2%
2020	771,503	0	16,906	788,410	11.2%
2021	905,533	0	22,802	928,335	13.0%
2022	1,030,013	0	29,120	1,059,133	14.7%
2023	1,145,041	0	35,497	1,180,539	16.2%
2024	1,250,737	0	41,393	1,292,130	17.5%
2025	1,347,196	0	46,387	1,393,583	18.6%
2026	1,439,352	0	50,418	1,489,770	19.6%
2027	1,526,001	0	53,486	1,579,488	20.5%
2028	1,610,665	0	55,652	1,666,317	21.4%
2029	1,692,504	0	57,157	1,749,660	22.1%
2030	1,770,291	0	58,119	1,828,411	22.8%
2031	1,846,247	0	58,721	1,904,968	23.4%
2032	1,920,151	0	59,082	1,979,233	23.9%
2033	1,992,450	0	59,322	2,051,772	24.5%

5.3 *Cumulative Realistic Achievable Potential (RAP) for Peak Demand Savings*

Cumulative achievable potential peak demand savings for EE, CHP, and DR for KCP&L GMO, KCP&L MO, and KCP&L KS are provided below in

Table 5-8 through Table 5-10, which illustrate results for the RAP scenario. Cumulative potential as a percentage of baseline forecast peak demand at the end of the 20-year forecast horizon ranges from 24% to 40%, with the largest value in KCP&L GMO's service territory. These percentage differences are driven by the potential for DR, which varies considerably among utilities. DR differences are driven largely by observed differences in the response of large C&I customers (i.e., GMO observes much greater response from large C&I customers in interruptible tariff programs than KS). These assumptions are based on observed results from the Companies' MPower program and are also reasonably consistent with assumptions in the FERC National Assessment of Demand Response Potential[59].

Finally, we note that the EE and DR potential estimates were estimated independently with separate models. If EE and DR programs are simultaneously pursued with adoption as forecast below, there would likely be some interaction between the two, whereby DR potential could be reduced due to aggressive adoption of EE. The estimates below do not adjust for such possible overlap. The extent of this possible reduction in DR potential when combined with an aggressive EE portfolio would depend on a number of factors, including the extent to which the customers participating in EE and DR overlap (as well as the extent to which measures overlap). Though, as an upper bound, one could postulate that the percentage reduction in DR potential when combined with the EE savings achieved below would be roughly 22%, which is the fraction of baseline peak demand accounted for by EE measures alone in the GMO service territory (assuming 100% overlap of EE and DR customers and measures). Such overlap could therefore potentially reduce the combined percentages below (for GMO, for instance), by up to a relative value of 9.4% (or 4 absolute percentage points, from 40% of peak in 2033 to 36%). In reality, the reduction due to overlap is likely to be lower than this upper bound. Additional scenarios for peak demand savings, including maximum achievable potential, are provided in Appendix L.

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[59] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

Table 5-8. Cumulative EE/DR/CHP Demand RAP (MW) -- KCP&L GMO

KCP&L GMO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	20	36	0.0	56	2.8%
2015	44	66	0.3	110	5.4%
2016	71	98	0.6	169	8.2%
2017	102	130	1.6	233	11.2%
2018	137	162	2.8	302	14.4%
2019	176	195	4.4	375	17.6%
2020	217	229	6.3	452	20.8%
2021	257	262	8.5	527	23.9%
2022	295	296	10.9	602	26.9%
2023	331	330	13.2	674	29.7%
2024	364	365	15.4	745	32.3%
2025	395	375	17.3	787	33.6%
2026	424	384	18.8	827	34.7%
2027	452	394	19.9	866	35.7%
2028	479	404	20.7	904	36.6%
2029	506	415	21.3	942	37.4%
2030	530	425	21.7	977	38.1%
2031	555	435	21.9	1,011	38.7%
2032	579	445	22.0	1,046	39.3%
2033	603	455	22.1	1,080	39.9%

Table 5-9. Cumulative EE/DR/CHP Demand RAP (MW) -- KCP&L MO

KCP&L MO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	19	78	0.0	97	4.9%
2015	41	91	0.4	132	6.7%
2016	65	110	0.9	176	8.9%
2017	94	125	2.2	221	11.1%
2018	127	141	3.9	271	13.5%
2019	162	156	6.0	325	16.1%
2020	198	172	8.7	379	18.6%
2021	233	187	11.7	432	21.1%
2022	266	201	14.9	482	23.4%
2023	295	215	18.2	528	25.5%
2024	320	230	21.2	571	27.4%
2025	343	233	23.8	600	28.5%
2026	364	237	25.8	626	29.5%
2027	382	241	27.4	650	30.3%
2028	400	243	28.5	672	31.0%

KCP&L MO	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2029	416	246	29.3	692	31.6%
2030	432	249	29.8	711	32.2%
2031	447	252	30.1	729	32.6%
2032	461	255	30.3	746	33.1%
2033	475	258	30.4	763	33.5%

Table 5-10. Cumulative EE/DR/CHP Demand RAP (MW) -- KCP&L KS

KCP&L KS	Energy Efficiency	Demand Response	CHP	Total	% of Baseline
2014	14	54	0.0	67	3.9%
2015	30	66	0.1	95	5.4%
2016	47	77	0.2	125	7.0%
2017	67	88	0.4	156	8.7%
2018	90	99	0.7	190	10.5%
2019	115	108	1.1	224	12.4%
2020	140	117	1.5	259	14.1%
2021	165	124	2.1	292	15.7%
2022	189	130	2.6	322	17.2%
2023	210	137	3.2	350	18.5%
2024	229	143	3.7	375	19.7%
2025	246	146	4.2	396	20.5%
2026	262	148	4.5	415	21.3%
2027	276	151	4.8	432	21.9%
2028	289	153	5.0	448	22.4%
2029	302	155	5.1	463	22.9%
2030	314	157	5.2	477	23.2%
2031	326	159	5.3	490	23.6%
2032	337	161	5.3	504	24.0%
2033	348	164	5.3	517	24.3%

5.4 *Cumulative Budget for Realistic Achievable Potential*

Table 5-11 through Table 5-13 provide the combined EE/DR/CHP cumulative budget through 2033 for the realistic achievable potential scenario. Additional budget scenarios, including those for maximum achievable potential, are provided in Appendix L.

Table 5-11. Cumulative RAP Budget ($) -- KCP&L GMO

KCP&L GMO	Energy Efficiency	Demand Response	CHP	Total
2014	$14,765,823	$2,976,743	$23,002	$17,765,568
2015	$34,277,882	$9,653,744	$117,312	$44,048,937
2016	$59,042,115	$17,403,516	$213,921	$76,659,552
2017	$89,528,258	$26,983,893	$501,450	$117,013,602
2018	$125,672,657	$38,716,017	$890,189	$165,278,863
2019	$166,225,135	$54,126,156	$1,382,438	$221,733,729
2020	$209,994,911	$70,944,741	$1,987,234	$282,926,886
2021	$255,064,785	$90,015,937	$2,693,569	$347,774,291
2022	$300,060,744	$111,994,080	$3,463,160	$415,517,984
2023	$344,710,511	$137,001,267	$4,256,739	$485,968,518
2024	$389,542,814	$165,291,988	$5,011,543	$559,846,346
2025	$434,352,476	$193,732,844	$5,679,103	$633,764,423
2026	$479,731,332	$223,532,953	$6,245,616	$709,509,902
2027	$524,893,557	$254,850,429	$6,706,155	$786,450,141
2028	$570,932,645	$287,733,003	$7,062,527	$865,728,175
2029	$617,327,373	$322,345,390	$7,336,747	$947,009,510
2030	$662,948,521	$358,153,771	$7,538,345	$1,028,640,638
2031	$709,281,389	$395,700,274	$7,684,903	$1,112,666,567
2032	$756,752,309	$435,119,322	$7,788,742	$1,199,660,373
2033	$806,006,911	$476,418,473	$7,863,992	$1,290,289,377

Table 5-12. Cumulative RAP Budget ($) -- KCP&L MO

KCP&L MO	Energy Efficiency	Demand Response	CHP	Total
2014	$13,789,783	$4,114,225	$31,623	$17,935,631
2015	$31,608,553	$10,541,321	$161,276	$42,311,151
2016	$54,062,346	$17,915,406	$294,092	$72,271,844
2017	$81,370,496	$26,858,809	$689,378	$108,918,683
2018	$113,318,072	$36,575,376	$1,223,804	$151,117,251
2019	$148,682,142	$47,494,740	$1,900,532	$198,077,414
2020	$186,162,040	$59,647,161	$2,731,987	$248,541,188
2021	$223,769,842	$73,069,301	$3,703,034	$300,542,177
2022	$260,148,340	$87,790,210	$4,761,044	$352,699,593
2023	$294,675,034	$103,860,589	$5,852,032	$404,387,654
2024	$327,212,462	$121,317,514	$6,889,712	$455,419,688
2025	$357,677,173	$138,103,840	$7,807,452	$503,588,466
2026	$387,847,657	$155,555,730	$8,586,277	$551,989,665
2027	$417,481,200	$173,709,466	$9,219,412	$600,410,077
2028	$446,492,594	$192,172,113	$9,709,340	$648,374,046

2029	$475,006,592	$211,325,815	$10,086,329	$696,418,737
2030	$502,419,291	$231,196,651	$10,363,481	$743,979,422
2031	$529,799,330	$251,804,672	$10,564,963	$792,168,966
2032	$557,355,666	$273,152,757	$10,707,718	$841,216,141
2033	$585,474,768	$295,311,650	$10,811,170	$891,597,587

Table 5-13. Cumulative RAP Budget ($) -- KCP&L KS

KCP&L KS	Energy Efficiency	Demand Response	CHP	Total
2014	$9,654,778	$5,672,052	$5,559	$15,332,389
2015	$22,524,951	$12,082,050	$28,352	$34,635,353
2016	$38,681,446	$17,988,131	$51,701	$56,721,277
2017	$58,228,372	$24,891,860	$121,191	$83,241,423
2018	$81,046,951	$31,758,078	$215,142	$113,020,171
2019	$106,396,767	$39,017,432	$334,109	$145,748,308
2020	$133,409,682	$46,643,152	$480,277	$180,533,112
2021	$160,822,478	$54,165,962	$650,985	$215,639,426
2022	$187,669,652	$62,371,338	$836,981	$250,877,971
2023	$213,654,458	$71,259,800	$1,028,774	$285,943,033
2024	$238,565,953	$80,841,373	$1,211,196	$320,618,523
2025	$262,311,627	$91,488,360	$1,372,533	$355,172,520
2026	$286,107,291	$102,546,428	$1,509,449	$390,163,168
2027	$309,286,362	$114,077,010	$1,620,753	$424,984,125
2028	$332,248,956	$125,698,721	$1,706,881	$459,654,558
2029	$354,976,057	$137,749,161	$1,773,155	$494,498,373
2030	$377,167,489	$150,261,042	$1,821,877	$529,250,408
2031	$399,517,238	$163,250,254	$1,857,298	$564,624,789
2032	$422,135,114	$176,730,718	$1,882,393	$600,748,226
2033	$445,184,970	$190,740,954	$1,900,580	$637,826,503

Appendix A. Measure Characterization Data

This appendix is provided as a separate Excel spreadsheet and contains all characterization data listed in Section 2.2.2 (i.e. energy, demand, costs, and densities) for every measure at the customer segment level.

Appendix B. Onsite Data Collection

B.1 Data Sources

The on-site surveys collected primary data from KCP&L residential, commercial and industrial facilities in designated regions. The on-site surveys focused principally on in-depth and accurate data collection of equipment and building envelope by inspection of professionally trained surveyors. Together these sources reflect the 2012 baseline efficiency of KCP&L customers. The on-site survey participants were recruited randomly from a stratified sample of KCP&L customers.

B.2 Sampling Approach

The on-site survey sample was designed to represent a broad cross section of KCP&L customers and to achieve a reasonable confidence interval and margin of error. For the residential sector, Navigant considered energy usage as well as single family and multi-family segmentation. For the C&I sector, Navigant considered energy usage and business type as the primary sampling dimensions. Customer data from all residential and C&I customers was collected from KCP&L and GMO. The following sections show the resulting stratified sample design.

C&I On-Site Survey Samples

A stratified ratio estimation method was used for the C&I sample design. Both stratification and ratio estimation take advantage of available information per account, in this case, energy use per account. Thus the sample design is determined by building type/industry and account usage. Unlike the residential sector, accounts in the commercial and industrial sectors range widely in terms of energy use: most accounts have low energy use and few accounts have high energy use. Here, simple random sampling methods by account would not be representative.

Rather, stratifying by energy use reduces the coefficient of variation of energy use in each stratum and thus improves statistical precision. Additionally, for this sample design, Navigant determined a relatively small sample of low energy use accounts and a relatively large sample of high energy use accounts. For the commercial and industrial sample, sites were stratified by energy usage into two groups: strata 1 and strata 2. C&I sites were placed into strata 1 if their average monthly kWh was 50,000 or higher. Strata 2 consisted of sites with an average monthly kWh of less than 50,000. Both strata included the selected building types for both commercial and industrial segments. The Navigant team targeted a total of 102 sites in Strata 1 and 38 in Strata 2 leading to an overall sample goal of 140 completed C&I sites. This number of surveys was targeted to provide statistical confidence of 90% and +/- 10% precision or margin of error (90/10) for the C&I sector as a whole.

Then, the sample was segmented by commercial and industrial designations using SIC code mapping. This consists of SIC code descriptions lining up with commercial or industrial sector descriptions as well as market sector building types. This segmentation resulted in a sample of 98 total commercial sites and 42 total industrial sites.

The following tables show the targeted segmentation for the C&I sample:

Table B- 1. Original Targeted C&I Sample Draw

KCP&L DSM Potential Study CnI On-site Sample Plan											
		Strata I					Strata II					Planned Size
		Sites	kwh %	Approachable Sites	Selected	Target Size	Sites	kwh %	Approachable Sites	Selected	Target Size	
Commercial	College	62	90%	56	19	4	83	10%	77	8	2	6
	Grocery	107	77%	95	55	4	412	23%	299	160	2	6
	Healthcare	257	92%	216	149	7	476	8%	311	144	2	9
	Lodging	115	90%	99	75	4	136	10%	108	64	2	6
	Office - Large	98	67%	84	63	6	368	33%	314	146	3	9
	Office - Small	1114	65%	829	157	15	2,859	35%	1995	104	8	23
	Other Commercial	617	75%	496	172	6	2,271	25%	1386	142	3	9
	Restaurant	671	74%	508	138	4	1,045	26%	637	142	2	6
	Retail	629	80%	536	138	7	1,633	20%	1059	151	2	9
	School	452	88%	423	71	7	500	12%	427	75	2	9
	Warehouse	281	79%	213	166	4	797	21%	380	146	2	6
Industrial	Chemicals	29	95%	26	20	7	87	5%	60	35	0	7
	Electronics	10	94%	10	9	3	64	6%	41	20	2	5
	Food	32	95%	31	25	7	92	5%	63	46	0	7
	Motor Freight Transportation	76	89%	63	42	3	209	11%	136	83	2	5
	Other Industrial	441	86%	399	164	6	1,388	14%	924	140	2	8
	Rubber-Plastics	15	94%	14	12	3	36	6%	27	16	2	5
	Stone-Clay-Glass	6	97%	6	6	5	42	3%	25	21	0	5
Total		5,012	81%	4,104	1,481	102	12,498	19%	8,269	1,643	38	140

Table B- 2. Targeted C&I Sample Summary

Sector	Strata 1	Strata 2	Total
Commercial	68	30	98
Industrial	34	8	42
Total	**102**	**38**	**140**

The following tables summarize the results of the on-site data collection efforts for the commercial and industrial site visits. Table B- 3 compares the targeted to actual sample sizes by sector, building type and stratum. Navigant surveyed 139 C&I buildings across 18 building types and two strata.

Table B- 3. Comparison of Targeted to Actual C&I Site Visits

		On-Site Surveys (Target / Actual)		
Sector	**Building Type**	**Target/Actual Strata 1**	**Target/Actual Strata 2**	**Target/Actual Total**
Commercial	College	4/4	2/2	6/6
	Grocery	4/4	2/4	6/8
	Healthcare	7/7	2/2	9/9
	Lodging	4/4	2/2	6/6
	Office - Large	6/5	3/2	9/7
	Office - Small	15/13	8/8	23/21
	Other Commercial	6/6	3/4	9/9
	Restaurant	4/4	2/3	6/7
	Retail	7/7	2/2	9/9
	School	7/7	2/2	9/9
	Warehouse	4/4	2/2	6/6
	Commercial Total	**68/65**	**30/33**	**98/97**
Industrial	Chemicals	7/3	0/0	7/3
	Electronics	3/1	2/2	5/3
	Food	7/5	0/4	7/9
	Motor Freight Transportation	3/2	2/0	5/2
	Other Industrial	6/9	2/4	8/13
	Rubber-Plastics	3/4	2/5	5/9
	Stone-Clay-Glass	5/1	0/2	5/3
	Industrial Total	**34/25**	**8/17**	**42/42**
TOTAL		**102/90**	**38/50**	**140/139**

Table B- 4 shows the distribution of targeted and completed sites across the building types.

Table B- 4. Summary of Total C&I Site Visits by Building Type

Sector	Building Type	Number of Targeted Sites	Number of Completed Sites	Percent of Total Sample (Completed Sites)
Commercial	College	6	6	4%
	Grocery	6	8	6%
	Healthcare	9	9	6%
	Lodging	6	6	4%
	Office - Large	9	7	5%
	Office - Small	23	21	15%
	Other Commercial	9	9	6%
	Restaurant	6	7	5%
	Retail	9	9	6%
	School	9	9	6%
	Warehouse	6	6	4%
	Commercial Total	**98**	**97**	**67%**
Industrial	Chemicals	7	3	2%
	Electronics	5	3	2%
	Food	7	9	6%
	Motor Freight Transportation	5	2	1%
	Other Industrial	8	13	9%
	Rubber-Plastics	5	9	6%
	Stone-Clay-Glass	5	3	2%
	Industrial Total	**42**	**42**	**28%**
TOTAL		**140**	**139**	**95%**

Table B- 5 summarizes the completed on-site visits across the two consumption strata.

Table B- 5. Summary of Completed Site Visits by Consumption Stratum

Consumption Stratum	Consumption Stratum	Number of Completed Sites in Stratum	Percent of Total Sample
1	Large Commercial	68	49%
	Large Industrial	34	24%
2	Small Commercial	30	21%
	Small Industrial	8	6%
Total		**140**	**100%**
Source: Navigant on-site surveys			

Table B- 6 and Table B- 7 show the final on-site sample results by sector, building type and strata, as well as weightings used to extrapolate the results of the on-site surveys to the population. Weighting Factors are defined as *Population Size/Sample Size* for the number of sites.

Table B- 6. Final Commercial On-Site Sample Results and Weightings

	Area	Strata	Population Size	Target Sample Size	Final Sample Size	Weighting factor
Commercial	College	1	62	4	4	15.5
	College	2	83	2	2	41.5
	Grocery	1	107	4	4	26.8
	Grocery	2	412	2	4	103.0
	Healthcare	1	257	7	7	36.1
	Healthcare	2	476	2	2	239.0
	Lodging	1	115	4	4	28.8
	Lodging	2	136	2	2	68.0
	Office - Large	1	98	6	5	19.6
	Office - Large	2	368	3	2	184.0
	Office - Small	1	1,114	15	13	85.69
	Office - Small	2	2,859	8	8	357.4
	Other Commercial	1	617	6	6	102.8
	Other Commercial	2	2,271	3	3	567.8
	Restaurant	1	671	4	4	167.8
	Restaurant	2	1,045	2	3	348.3
	Retail	1	629	7	7	89.9
	Retail	2	1,633	2	2	816.5
	School	1	452	7	4	64.57
	School	2	500	2	2	250.0
	Warehouse	1	281	4	4	70.3
	Warehouse	2	797	2	2	398.5
	Total		**14,983**	**98**	**97**	

Table B- 7. Final Industrial On-Site Sample Results and Weightings

	Area	Strata	Population Size	Target Sample Size	Final Sample Size	Weighting factor
Industrial	Chemicals	1	29	7	3	9.67
	Chemicals	2	87	0	0	NA
	Electronics	1	10	3	1	10.0
	Electronics	2	644	2	2	32.0
	Food	1	32	7	5	6.4
	Food	2	92	0	4	23.0
	Motor Freight Transportation	1	76	3	2	38.0
	Motor Freight Transportation	2	209	2	0	NA
	Other Industrial	1	441	6	9	49.0
	Other Industrial	2	1,388	2	4	347.0
	Rubber-Plastics	1	15	3	4	3.8
	Rubber-Plastics	2	36	2	5	7.2
	Stone-Clay-Glass	1	6	5	1	6.0
	Stone-Clay-Glass	2	42	0	2	21.0
	Total		3107	42	42	

Final C&I Reporting Segments

Navigant presents the results of this baseline study according to designated reporting segments, illustrated in Table B- 8.

Table B- 8. C&I Reporting Segments for Building Type

Sector	Building Type	On-Site Survey Count	Total Weighted (sq. ft.)	Sq. ft. % of Overall Population
Commercial	College	6	10,360,238.5	0.02
	Grocery	8	5,162,894.5	0.01
	Healthcare	9	9,719,175.6	0.02
	Lodging	6	9,791,255	0.02
	Office - Large	7	53,425,365.2	0.12
	Office - Small	21	40,007,351.2	0.09
	Other Commercial	9	42,819,822.8	0.10
	Restaurant	7	6,533,482.1	0.01
	Retail	9	23,608,059.9	0.05
	School	9	45,909,581.4	0.10
	Warehouse	6	25,074,850	0.06
Industrial	Chemicals	3	2,421,500	0.01
	Electronics	3	10,077,000	0.02
	Food	9	7,361,064.8	0.02
	Motor Freight Transportation	2	9,500,000	0.02
	Other Industrial	13	136,789,496	0.31
	Rubber-Plastics	9	5,344,848	0.01
	Stone-Clay-Glass	3	284,256	0.00
	Total	**139**	**444,190,241**	**0.97**

Residential On-Site Survey Samples

The Navigant team targeted 70 residences and completed on-site surveys at 69 residences consisting of 14 multi-family sites and 55 single family sites. This number of surveys was targeted to provide statistical confidence of 90% and +/- 10% precision or margin of error (90/10) for the residential sector across KS and MO.

Table B- 9. Original Targeted Residential Sample Draw

KCPL Potential Residential Sample Design										
	kWh (%)	Strata 1				Strata 2				Planned Size
		Sites	kWh %	Selected	Target	Sites	kWh %	Selected	Target	
Multi-Family	14%	29,558	50%	700	7	56,610	50%	700	7	14
Sing-Family	86%	136,333	55%	700	31	235,453	45%	700	25	56
Total	100%	165,891	54%	1,400	38	292,063	46%	1,200	32	70

The following tables summarize the results of the on-site data collection efforts for the residential site visits. Table B- 10 compares the targeted to actual sample sizes by area and stratum. Navigant surveyed 69 existing buildings across two sample sectors and two strata. Navigant defined the sample areas as single family and multi-family homes. These designations were constructed from premise type mapping to family home type. Multi-family homes were defined as homes included in a structure of three or more units, such as an apartment or duplex. Navigant divided the two strata based on annual electric energy use, where Strata 1 is the higher energy users and Strata 2 is the lower energy users.

Table B- 10. Comparison of Targeted to Actual Residential Site Visits

Building Type	On-Site Surveys (Target / Actual)		
	Target/Actual Strata 1	Target/Actual Strata 2	Target/Actual Total
Multi-family	7/6	7/ 8	14/14
Single family	31/31	25/24	56/55
Total	**38/37**	**32/32**	**70/69**

Table B- 11 shows the distribution of targeted and completed sites across the building types.

Table B- 11. Summary of Site Visits by Sample Area

Building Type	Number of Targeted Sites	Number of Completed Sites	Percent of Total Sample (Completed Sites)
Multi-family	14	13	20%
Single family	56	56	80%
Total	**70**	**69**	**100%**

Table B- 12 shows the final on-site sample results by sample area and strata, as well as weightings used to extrapolate the results of the on-site surveys to the population. Weighting factors are defined as *Population Size/Sample Size* for the number of sites.

Table B- 12. Final Residential On-Site Sample Results and Weightings

Sector	Strata	Population Size	Target Sample Size	Final Sample Size	Weighting Factor
Single family	1	136,333	31	31	4,398
Single family	2	235,453	25	24	9,811
Multi-family	1	29,558	7	6	4,926
Multi-family	2	56,610	7	8	7,076
Total		**457,954**	**70**	**69**	**13,611**

Final Residential Reporting Segments

Navigant presents the results of this baseline study according to designated reporting segments, illustrated in Table B- 13.

Table B- 13. Reporting Segments for Residential On-sites

Building Type	On-Site Survey Count	Total Weighted (count of homes)
Single family	55	371,786
Multi-family	14	86,168
Total	**69**	**457,954**

B.3 Data Collection Approach

All survey participants were recruited at random according to the stratified sample designs. Forms for all surveys are included in the appendices.

C&I On-Site Surveys

Professionally trained surveyors surveyed the sites of 139 C&I customers, 97 commercial and 42 industrial, which were randomly recruited by telephone according to the stratified sample design. The surveyors collected detailed inventories of energy-using equipment and building characteristics by inspection and, at some of the larger sites, by customer-provided schedules of equipment. Surveyors also collected operation and power management behavior by interview including specifics on combined heat and power, if present.

The site inspection covered all relevant energy aspects of customer facilities and businesses:

- Building size and orientation
- Building envelope information, such as insulation levels and wall and window sizes
- Complete inventories of energy-using equipment covering all end uses, including lighting, HVAC, motors, water heating, commercial refrigeration, cooking, office equipment, air compressors, and other types of process equipment

- Equipment and operation schedules and controls

Table B- 14 shows the response rate for scheduling the C&I on-site surveys. The scheduling team successfully contacted 53% of the sample, with 83% refusing to participate and 17% successfully scheduling a site visit.

Table B- 14. C&I On-Site Survey Response Rates

	Total Counts	Percentage
Total Sample	3123	
Total Customers Dialed	1515	49%
Total Customers Reached	797	53%
Refused	658	83%
Completed	139	17%
Source: On-site survey scheduling disposition		

Residential On-Site Surveys

Professionally trained surveyors surveyed the sites of 69 KCP&L residential customers that were randomly recruited by telephone according to the stratified sample design. Surveyors conducted a brief interview with the customer regarding occupancy information and age of the home. The surveyors collected detailed inventories of energy-using equipment and building characteristics by inspection.

The inspection covered all relevant energy aspects of the home:

- Home size and orientation
- Building envelope information, such as insulation levels and wall and window sizes
- Complete inventories of energy-using equipment covering all end uses, including lighting, HVAC, motors, water heating, refrigeration, cooking, and electronic equipment

Surveyors used various tools for their inventory, including hot water thermometer, metered water container, and measuring tape. In addition, surveyors collected information on household characteristics, equipment usage, and maintenance from the resident.

Table B- 15 shows the response rate for scheduling the residential on-site surveys. The scheduling team successfully contacted 50% of the sample, with 34% refusing to participate and 24% successfully scheduling a site visit.

Table B- 15. Residential On-Site Survey Response Rates

	Total Counts	Percentage
Total Sample	2598	
Total Customers Dialed	583	22%
Total Customers Reached	293	50%
Refused	101	34%
Completed	70	24%
Source: On-site survey scheduling disposition		

Appendix C. Loadshape Data

This appendix is provided as two separate Excel files (one for residential and one for commercial/industrial) that contain loadshapes used to allocate energy savings across months, on/off peak periods, and weekend/weekday for each end-use and sector.

Appendix D. Statistical Estimation of the Parametric Payback Functions

The payback data obtained from the surveys of the residential, commercial, and industrial sectors were used to develop payback functions that express the share of the market that can be captured by an energy efficient technology with a payback time of t. We call these functions "payback curves" and express them as $F(t;b)$, where b is the set of parameters defining *F*. Denoting by $C(t;b)$ the cumulative distribution function expressing the share of the market that would *not* purchase an energy efficient device if the payback period were t, $F(t;b) = 1 - C(t;b)$. In other words, the payback curve is a mirror of a cumulative distribution function; it starts along the vertical axis at 1 and falls to 0.[60]

We use two approaches for estimating the payback function *F*(t). With t measured in years, the first simply plots the proportion of respondents adopting a technology with a payback time equal to t=0,1,2,3, etc., and interpolates linearly between each point. This approach is called "semi-parametric" because it makes no parametric assumptions about the shape of the payback curve except as expressed in linear interpolation between the market shares calculated from the data for each whole year. So, for instance, for the commercial sector about 45% of survey respondents indicate a payback period ≥5 years, and about 35% indicate a payback period ≥6 years, and so the semi-parametric version of *F(t)* includes the data points .45(5) and .35(6) and the line between these points.

The advantage of the semi-parametric approach is that it imposes minimal assumptions about the functional form of the payback function. Its disadvantage, though, is that hypothesis testing, such as whether the payback functions for KCPL and GMO are different, or whether the payback functions for owner-occupied and landlord-owned residential units are different, is cumbersome and conceptually nuanced.[61]

In the alternative approach –parametric estimation of payback functions—a parametric functional form of the payback function is assumed and the function parameters are econometrically estimated. Hypothesis testing is straightforward under the maintained assumption that the functional form is correct.

It is possible that the payback function depends on a set of variables *X*, such as demographic variables, in which case the parametric payback function is expressed as $F(t, X; b)$. For instance, household income might affect the payback function in the residential sector. As described below, it is possible to statistically test whether *F* does indeed depend on a given *X*. Regardless, ultimately we are interested in the value of $F(t, X; b)$ averaged over X in the population: $F(t;b) = \int_X F(t, X; b) g(X) dX$, where g is the population density function for X. In other words, we are interested in the population-weighted average payback curve.

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[60] If the payback curve intersects the vertical axis at less than 1, the difference between 1 and the intercept indicates the proportion of the market that would never purchase the technology.

[61] For instance, it's conceivable that a comparison of two non-parametric payback functions generates the result that they are statistically different at year 1, not statistically different at Year 2, statistically different at Year 3, and so on.

With respect to statistically identifying a parametric form of the function $F(t, X; b)$, we address the question, "within a particular class of parametric distribution functions, what is the distribution function $C(t, X; b) = 1 - F(t, X; b)$ *most likely* to have generated the observed data {t,X} obtained from the survey data?" This is the question addressed by maximum likelihood estimation (MLE). For instance, if we assume that $C(t, X; b)$ takes the form of a cumulative normal distribution with mean $m = aX$ and variance s, standard OLS (with t as the dependent variable) generates the estimate of $F(t, X; b = \{a, s\})$ most likely to have generated the observed data. In other words, OLS generates MLE estimates under the assumption of normality.

After reviewing histograms of the survey data, Navigant decided to fit payback functions based on the gamma distribution to the payback data for the residential sector, and to fit payback functions based on the normal distribution to the payback data for the commercial and residential sectors. Figure D- 1 through Figure D-4 compare the payback curves generated by these models to their non-parametric counterparts. The figures indicate that parametric and non-parametric payback curves are generally quite similar.

Table D- 1and Table D- 2 provide results for parametric models for homeowner payback functions in which the payback function is extended to include a set of demographic variables X, $F(t, X; b)$.[62] Variables include the following:

Age = age of respondent;

Education = years of schooling by respondent;

Income = respondent annual income;

Female = indicator for respondent gender, with Female=1 indicating female and Female=0 indicating male.

GMO = indicator variable taking a value of 1 if the observation is in the GMO service territory, and 0 if it is in the KCP&L service territory.

Summarizing the results from these extended models:

- For low-cost devices, none of the demographic variables examined has a statistically significant effect on the homeowner payback function;
- For high-cost devices, education *increases* the required payback time for homeowners. None of the other demographic variables affect the payback time.[63]
- In none of the extended models does location in GMO vs. KCP&L have a statistically significant effect on the payback function.

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[62] All parametric models were estimated using the SAS GENMOD procedure.

[63] Note that the homeowner payback curves account for the effect of education by virtue of the census weighting of the data.

Table D- 1. Effect of demographic variables on the payback function, homeowners, low-cost devices

Parameter	Estimate	Standard Error	95% Confidence Limits	
Intercept	1.250	0.055	1.142	1.358
Age	-0.002	0.004	-0.009	0.005
Education	0.087	0.129	-0.166	0.340
Income	0.008	0.017	-0.024	0.041
Female	-0.065	0.111	-0.281	0.152
GMO	0.103	0.110	-0.113	0.319

Table D- 2. Effect of demographic variables on the payback function, homeowners, high-cost devices

Parameter	Estimate	Standard Error	95% Confidence Limits	
Intercept	1.530	0.207	1.124	1.936
Age	-0.001	0.004	-0.008	0.006
Education	0.268	0.125	0.024	0.513
Income	-0.007	0.016	-0.038	0.024
Female	-0.021	0.106	-0.229	0.188
GMO	0.134	0.105	-0.072	0.341

Figure D- 1. Residential sector payback curves for high-cost devices

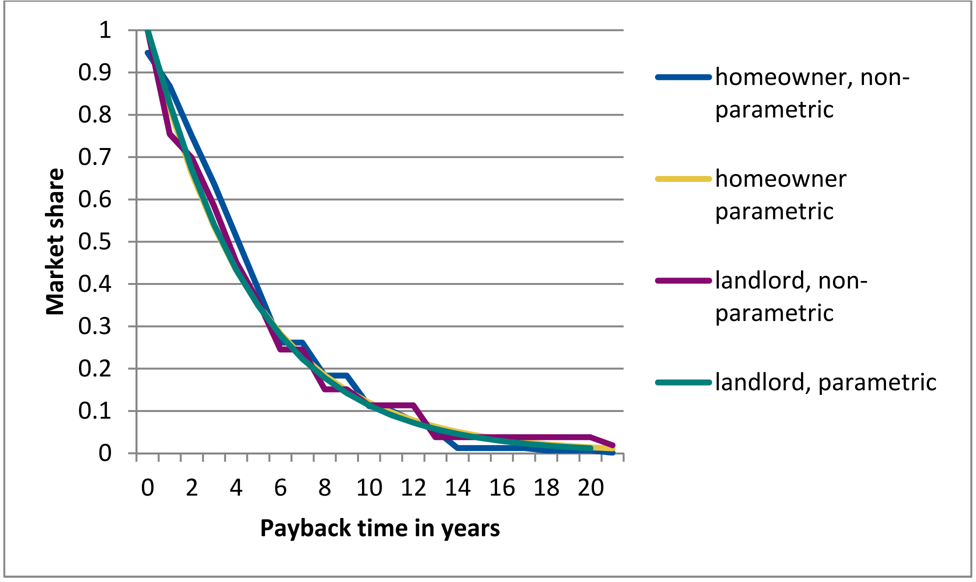


Figure D- 2. Residential sector payback curves for low-cost devices

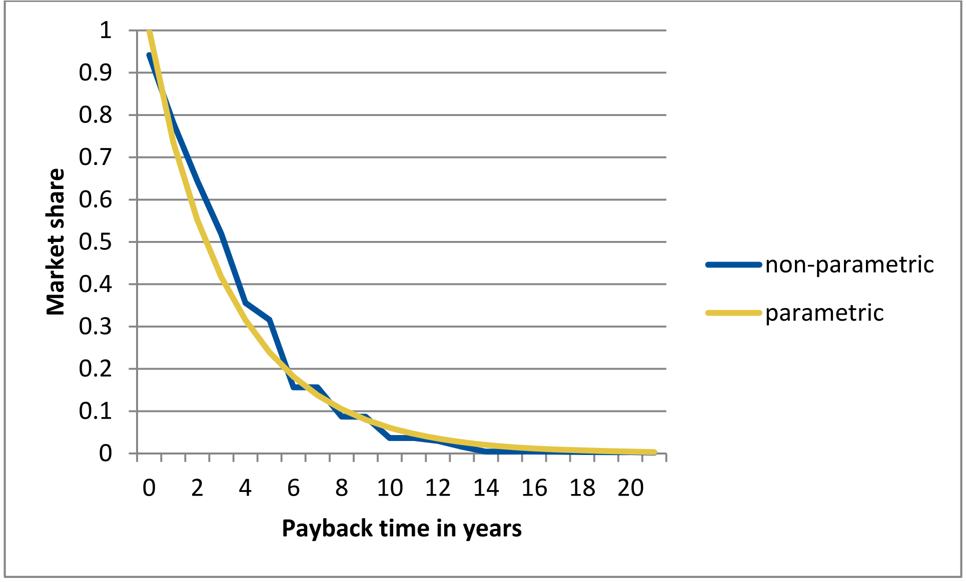


Figure D- 3. Commercial sector payback curves

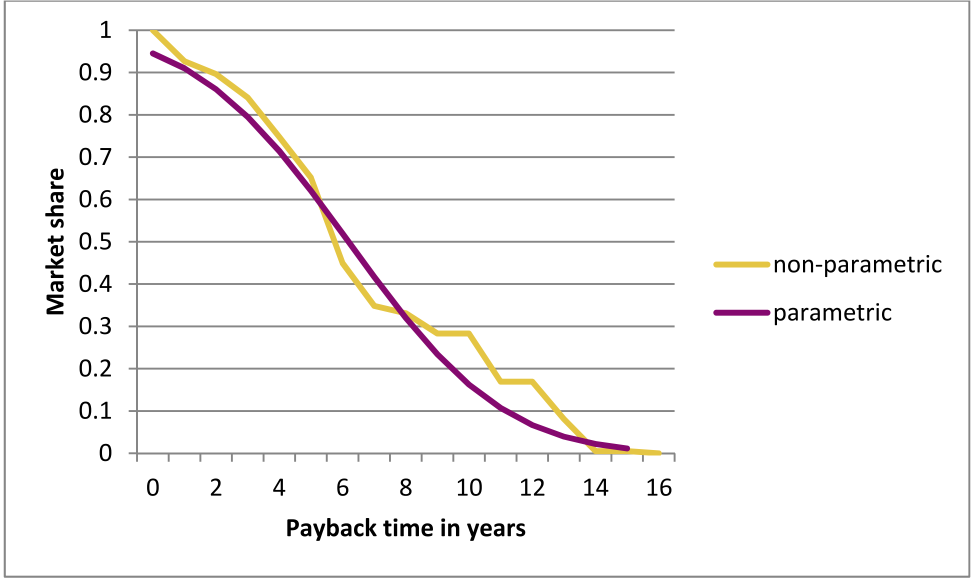
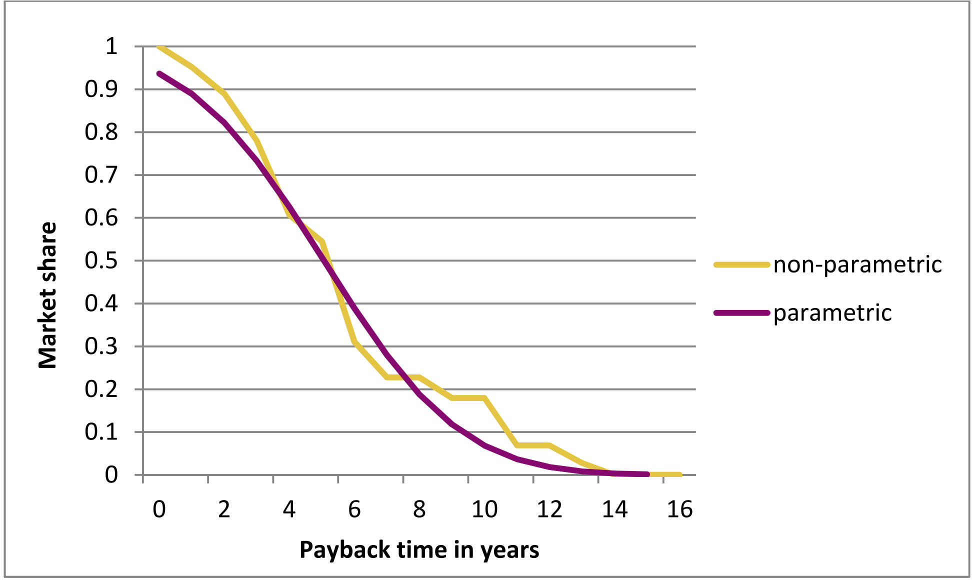


Figure D- 4. Industrial sector payback curves



Appendix E. Owner-Occupied Payback Acceptance Survey – Low Cost

I. Introduction to the Study

A local electric utility is interested in determining whether residential customers believe that the energy savings from energy efficient appliances are worth the additional cost of the appliance. The utility wants this information to help it design future energy efficiency programs in its service territory.

The questions will take about 10 minutes to answer. Thank you for your time on this survey.

II. Initial Questions

1. Which of the following devices and appliances do you own? (All answers: Y/N/DK/NR)
   a. Power strip for computer and other electronic equipment
   b. DVD or Blu-Ray player
   c. Dishwasher
   d. Refrigerator
   e. Central air conditioning
   f. Large TV (greater than 40")

2. Is your water heater electric or natural gas?
   a. Electric
   b. Natural gas
   c. Don't know

III. WTP Question 1 . *Randomly choose from the set of questions in Appendix A based on responses to questions 1a-b of part II. The feasible set for the random draw is defined as follows:*

- *Questions A1(a,b) concerning lighting are always feasible.*
- *Questions A2(a,b) are feasible if question II.1a is "Yes".*
- *Questions A3(a,b) are feasible if question II.1b is "Yes".*

IV. WTP Question 2 . *Randomly choose from the set of questions in Appendix B based on responses to questions 1c-f and question 2 of part II. The feasible set for the random draw is defined as follows:*

- *Questions B1(a,b) are feasible if question II.1c is "Yes"* ***and question II.2 is "Electric"****.*
- *Questions B2(a,b) are feasible if question II.1d is "Yes".*
- *Questions B3(a,b) are feasible if question II.1e is "Yes"*
- *Questions B4(a,b) are feasible if question II.1f is "Yes"*

V. Demographics

We now want to ask you some demographic questions about your household. We ask these questions to check that we have a representative sample for our study. [Standard demographic questions here].

Owner-Occupied Survey, Appendix A

EVERY RESPONDENT GETS ONE QUESTION FROM THIS APPENDIX—that is one question from the set [Lighting 1, Lighting 2, Power strip 1, Power strip 2, DVD 1, DVD 2] –BASED ON THE RESPONSES TO QUESTION II.1(a,b) IN SECTION 1. THAT IS, RESPONSES TO QUESTION II.1(a,b)

ARE THE BASIS FOR THE SET OF FEASIBLE QUESTIONS IN THIS APPENDIX FROM WHICH A RANDOM DRAW IS MADE.

A1(a). Lighting question I

Now we want to ask you about your likely decision in the event you need to buy a new light bulb. Please think about a particular socket in your living space that you use fairly often.

Suppose the bulb burns out and you're at the store shopping for a new one. You have in mind a particular type of bulb, a particular wattage, etc. You find the bulb you need, and there is a standard version and anenergy efficient version. Assume there is no difference in the quality of lighting between the two versions. In other words, the energy efficient version looks just like the standard version of the light bulb, and has the exact same quality of light. It's just more energy efficient.

*The energy efficient version would save you **$1 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $3, you are saying that you would not pay $3 more for the energy efficient version.*

$0 (the energy efficient light bulb is no more expensive than the standard bulb)	*☐Yes*	*☐ No*
$1	*☐Yes*	*☐ No*
$2	*☐Yes*	*☐ No*
$3	*☐Yes*	*☐ No*
$4	*☐Yes*	*☐ No*
$5	*☐Yes*	*☐ No*
$6	*☐Yes*	*☐ No*
$8	*☐Yes*	*☐ No*
$10	*☐Yes*	*☐ No*
$12	*☐Yes*	*☐ No*
More than $12	*☐Yes*	*☐ No*

If this question is the second of the two questions asked:

On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient light bulb:
It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

A1(b). Lighting question 2

Now we want to ask you about your likely decision in the event you need to buy a new light bulb. Please think about a particular socket in your living space that you use fairly often.

Suppose the bulb burns out and you're at the store shopping for a new one. You have in mind a particular type of bulb, a particular wattage, etc. You find the bulb you need, and there is a standard version and an energy efficient version. Assume there is no difference in the quality of lighting between the two versions. In other words, the *energy efficient version looks just like the standard version of the light bulb, and has the exact same quality of light. It's just more energy efficient.*

*The energy efficient version would save you **$3 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $12, you are saying that you would not pay $12 more for the energy efficient version.*

$0 (the energy efficient charger is no more expensive than the standard one)	*☐Yes*	*☐ No*
$3	*☐Yes*	*☐ No*
$6	*☐Yes*	*☐ No*
$9	*☐Yes*	*☐ No*
$12	*☐Yes*	*☐ No*
$18	*☐Yes*	*☐ No*
$24	*☐Yes*	*☐ No*
$30	*☐Yes*	*☐ No*
$45	*☐Yes*	*☐ No*
$60	*☐Yes*	*☐ No*
More than $60	*☐Yes*	*☐ No*

If this question is the second of the two questions asked:

On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient light bulb:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

A2(a). Power strip question 1

Now we want to ask you about your likely decision in the event you need to buy a new power strip because the old one breaks and can't be repaired.

Power strips typically cost in the neighborhood of $5-$40, depending on the number outlets and styling (shape, color).

Suppose that you've found the power strip that suits your needs.

*There are **two versions of the power strip:** A standard version and a "smart" version that reduces the electricity draw from an outlet when the devices plugged into it are not being used, and allows electricity to flow again when the devices are turned on. Generally there is no noticeable difference in the quality of the standard and "smart" versions. In other words, the smart version is just like the standard version. It's just more energy efficient.*

*The energy efficient version would save you **$1 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $3, you are saying that you would not pay $3 more for the energy efficient version.*

$0 (the energy efficient charger is no more expensive than the standard version)	☐*Yes*	☐ *No*
$1	☐*Yes*	☐ *No*
$2	☐*Yes*	☐ *No*
$3	☐*Yes*	☐ *No*
$4	☐*Yes*	☐ *No*
$5	☐*Yes*	☐ *No*
$6	☐*Yes*	☐ *No*
$8	☐*Yes*	☐ *No*
$10	☐*Yes*	☐ *No*
$12	☐*Yes*	☐ *No*
More than $12	☐*Yes*	☐ *No*

If this question is the second of the two questions asked:
On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase a "smart" power strip:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I don't plan on keeping my current phone long enough to make the investment in an energy efficient charger worthwhile
I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

A2(b). Power strip question 2

Now we want to ask you about your likely decision in the event you need to buy a new power strip because the old one breaks and can't be repaired.

Power strips typically cost in the neighborhood of $5-$40, depending on the number outlets and styling (shape, color).

Suppose that you've found the power strip that suits your needs.

*There are **two versions of the power strip:** A standard version and a "smart" version that reduces the electricity draw from an outlet when the devices plugged into it are not being used, and allows electricity to flow again when the devices are turned on. Generally there is no noticeable difference in the quality of the standard and "smart" versions. In other words, the smart version is just like the standard version. It's just more energy efficient.*

*The energy efficient version would save you **$3 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $3, you are saying that you would not pay $3 more for the energy efficient version.*

$0 (the energy efficient charger is no more expensive than the standard one) ☐*Yes* ☐ *No*

$3	☐*Yes*	☐ *No*
$6	☐*Yes*	☐ *No*
$9	☐*Yes*	☐ *No*
$12	☐*Yes*	☐ *No*
$18	☐*Yes*	☐ *No*
$24	☐*Yes*	☐ *No*
$30	☐*Yes*	☐ *No*
$45	☐*Yes*	☐ *No*
$60	☐*Yes*	☐ *No*
More than $60	☐*Yes*	☐ *No*

If this question is the second of the two questions asked:
On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase a "smart" power strip:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I don't plan on keeping my current phone long enough to make the investment in an energy efficient charger worthwhile
I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

A3(a). DVD and Blu-Ray question 1

Now we want to ask you about your likely decision in the event you needed to buy a new DVD or Blu Ray player because your current one breaks down and can't be repaired.

DVD players typically cost in the neighborhood of $50-$300, though there is wide variation in cost, depending on styling, whether it plays Blu-Ray discs, and features such as.

Suppose that you've identified the DVD or Blu-Ray player that you prefer and that you can afford.

*There are **two versions of the player:** A standard version and a more energy efficient version. Assume there is no difference in the quality of the two versions. In other words, the energy efficient version is just like the standard version. It's just more energy efficient.*

*The energy efficient version would save you **$3 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $18, you are saying that you would not pay $18 more for the energy efficient version.*

$0 (the energy efficient charger is no more expensive than the standard one)	☐*Yes*	☐ *No*
$3	☐*Yes*	☐ *No*
$6	☐*Yes*	☐ *No*
$9	☐*Yes*	☐ *No*
$12	☐*Yes*	☐ *No*
$15	☐*Yes*	☐ *No*
$18	☐*Yes*	☐ *No*

$24	*☐Yes*	*☐ No*
$30	*☐Yes*	*☐ No*
$36	*☐Yes*	*☐ No*
More than $36	*☐Yes*	*☐ No*

If this question is the second of the two questions asked, ask the following questions:
On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient DVD player:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

A3(b). DVD and DVD/Blu-Ray question 2

Now we want to ask you about your likely decision in the event you needed to buy a new DVD or Blu Ray player because your current one breaks down and can't be repaired.

DVD players typically cost in the neighborhood of $50-$300, though there is wide variation in cost, depending on styling, whether it plays Blu-Ray discs, and features such as.

Suppose that you've identified the DVD or Blu-Ray player that you prefer and that you can afford.

There are ***two versions of the player:*** *A standard version and a more energy efficient version. Assume there is no difference in the quality of the two versions. In other words, the energy efficient version is just like the standard version. It's just more energy efficient.*

The energy efficient version would save you ***$6 per year*** *in electricity costs compared to a standard version,* ***but is more expensive to buy****.*

Would you be willing to pay the following ***additional*** *amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $12, you are saying that you would not pay $12 more for the energy efficient version.*

$0 (the energy efficient microwave is no more expensive than the standard version) ☐Yes ☐ No

$6	*☐Yes*	*☐ No*
$12	*☐Yes*	*☐ No*
$18	*☐Yes*	*☐ No*
$24	*☐Yes*	*☐ No*
$36	*☐Yes*	*☐ No*
$48	*☐Yes*	*☐ No*
$60	*☐Yes*	*☐ No*
$90	*☐Yes*	*☐ No*
$120	*☐Yes*	*☐ No*
More than $120	*☐Yes*	*☐ No*

If this question is the second of the two questions asked, ask the following questions:
On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient DVD player:

It doesn’t make financial sense for me to pay more than I indicated for the energy efficient version.
I don’t think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don’t think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We’re all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it’s a good thing to use energy efficient products to reduce global climate change.

Appendix F. Owner-Occupied Payback Acceptance Survey – High Cost

EVERY RESPONDENT GETS ONE QUESTION FROM THIS APPENDIX, BASED ON THE RESPONSES TO QUESTIONS II.1(c-e) and question II.2 IN SECTION 1. THOSE RESPONSES ARE THE BASIS FOR THE SET OF FEASIBLE QUESTIONS IN THIS APPENDIX FROM WHICH A RANDOM DRAW IS MADE.

B1(a). Dishwasher question 1

Now we want to ask you about your likely decision in the event you needed to buy a new dishwasher because your current one breaks down and can't be repaired.

Dishwashers typically cost in the neighborhood of $700-$800, though there is a wide variation in cost, depending on features such as size, noisiness, style (portable vs. undercounter, brushed steel vs. plastic, etc.), and the availability of features such as delayed-start and hard food disposer.

Suppose that you've identified the dishwasher you prefer and that you can afford.

*There are **two versions of the dishwasher:** A standard version and a more energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version. It's just more energy efficient.*

*The energy efficient version would save you **$6 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $12, you are saying that you would not pay $12 more for the energy efficient version.*

$0 (the energy efficient microwave is no more expensive than the standard version)	☐*Yes*	☐ *No*
$6	☐*Yes*	☐ *No*
$12	☐*Yes*	☐ *No*
$18	☐*Yes*	☐ *No*
$24	☐*Yes*	☐ *No*
$30	☐*Yes*	☐ *No*
$36	☐*Yes*	☐ *No*
$48	☐*Yes*	☐ *No*
$60	☐*Yes*	☐ *No*
$72	☐*Yes*	☐ *No*
More than $72	☐*Yes*	☐ *No*

[If this question is the second of the two questions asked, ask the following questions:]
On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient dishwasher:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

B1(b). Dishwasher question 2

Now we want to ask you about your likely decision in the event you needed to buy a new dishwasher because your current one breaks down and can't be repaired.

Dishwashers typically cost in the neighborhood of $700-$800, though there is a wide variation in cost, depending on features such as size, noisiness, style (portable vs. undercounter, brushed steel vs. plastic, etc.), and the availability of features such as delayed-start and hard food disposer.

Suppose that you've identified the dishwasher you prefer and that you can afford.

*There are **two versions of the dishwasher:** A standard version and a more energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version. It's just more energy efficient.*

*The energy efficient version would save you **$12 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $72, you are saying that you would not pay $72 more for the energy efficient version.*

$0 (the energy efficient microwave is no more expensive than the standard version)	*☐Yes*	*☐ No*
$6	*☐Yes*	*☐ No*
$12	*☐Yes*	*☐ No*
$24	*☐Yes*	*☐ No*
$36	*☐Yes*	*☐ No*
$48	*☐Yes*	*☐ No*
$60	*☐Yes*	*☐ No*
$72	*☐Yes*	*☐ No*
$96	*☐Yes*	*☐ No*
$120	*☐Yes*	*☐ No*
$144	*☐Yes*	*☐ No*
More than $144	*☐Yes*	*☐ No*

[If this question is the second of the two questions asked, ask the following questions:]
On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient dishwasher:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version;
It makes me feel good to buy energy efficient devices;
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

B2(a). Refrigerator question 1

Now we want to ask you about your likely decision in the event you needed to buy a new refrigerator because your current one breaks down and can't be repaired.

Refrigerators typically cost in the neighborhood of $900-$1100, though there is a wide variation in cost, depending on features such as size, style (the freezer compartment is at the bottom vs. the top, brushed steel vs. painted, etc.), and the availability of features such ice maker, chilled water dispenser, and so forth.

Suppose that you've identified the refrigerator that you prefer and that you can afford.

*There are **two versions of the refrigerator:** A standard version and an energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version. It's just more energy efficient.*

*The energy efficient version would save you **$12 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $24, you are saying that you would not pay $24 more for the energy efficient version.*

$0 (the energy efficient microwave is no more expensive than the standard version) ☐Yes ☐ No
$12 ☐Yes ☐ No
$24 ☐Yes ☐ No
$36 ☐Yes ☐ No
$48 ☐Yes ☐ No
$60 ☐Yes ☐ No
$72 ☐Yes ☐ No
$96 ☐Yes ☐ No
$120 ☐Yes ☐ No
$144 ☐Yes ☐ No
More than $144 ☐Yes ☐ No

[If this question is the second of the two questions asked, ask the following questions:]
On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient refrigerator:
It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices;.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

B2(b). Refrigerator question 2

Now we want to ask you about your likely decision in the event you needed to buy a new refrigerator because your current one breaks down and can't be repaired.

Refrigerators typically cost in the neighborhood of $900-$1100, though there is a wide variation in cost, depending on features such as size, style (the freezer compartment is at the bottom vs. the top, brushed steel vs. painted, etc.), and the availability of features such ice maker, chilled water dispenser, and so forth.

Suppose that you've identified the refrigerator that you prefer and that you can afford.

*There are **two versions of the refrigerator:** A standard version and an energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version. It's just more energy efficient.*

*The energy efficient version would save you **$25 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $200, you are saying that you would not pay $200 more for the energy efficient version.*

$0 (the energy efficient microwave is no more expensive than the standard version) ☐Yes ☐ No

$25	*☐Yes*	*☐ No*
$50	*☐Yes*	*☐ No*
$75	*☐Yes*	*☐ No*
$100	*☐Yes*	*☐ No*
$150	*☐Yes*	*☐ No*
$200	*☐Yes*	*☐ No*
$250	*☐Yes*	*☐ No*
$375	*☐Yes*	*☐ No*
$500	*☐Yes*	*☐ No*
More than $500	*☐Yes*	*☐ No*

[If this question is the second of the two questions asked, ask the following questions:]
On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient refrigerator:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

B3(a). CAC question 1

Now we want to ask you about your likely decision in the event you needed to buy a new central air conditioning unit because your current one breaks down and can't be repaired.

Including the cost of installation, central air conditioning units typically cost in the neighborhood of $3000-$4000, though there is a wide variation in cost, depending on the size of the unit, the warrantee, and any difficulty arising in the installation of the unit.

Suppose that you've identified the model that suits your needs and that you can afford.

*There are **two versions of the model you've chosen:** A standard version and a more energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version. It's just more energy efficient.*

*The energy efficient version would save you **$25 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $100, you are saying that you would not pay $100 more for the energy efficient version.*

$0 (the energy efficient microwave is no more expensive than the standard version) ☐Yes ☐ No

$25	*☐Yes*	*☐ No*
$50	*☐Yes*	*☐ No*
$75	*☐Yes*	*☐ No*
$100	*☐Yes*	*☐ No*
$125	*☐Yes*	*☐ No*
$150	*☐Yes*	*☐ No*
$200	*☐Yes*	*☐ No*
$250	*☐Yes*	*☐ No*
$300	*☐Yes*	*☐ No*
More than $300	*☐Yes*	*☐ No*

[If this question is the second of the two questions asked, ask the following questions:]
On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient central air conditioning unit:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

B3(b). CAC question 2

Now we want to ask you about your likely decision in the event you needed to buy a new central air conditioning unit because your current one breaks down and can't be repaired.

Including the cost of installation, central air conditioning units typically cost in the neighborhood of $3000-$4000, though there is a wide variation in cost, depending on the size of the unit, the warrantee, and any difficulty arising in the installation of the unit.

Suppose that you've identified the model that suits your needs and that you can afford.

*There are **two versions of the model you've chosen:** A standard version and a more energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version. It's just more energy efficient.*

*The energy efficient version would save you **$50 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $100, you are saying that you would not pay $100 more for the energy efficient version.*

$0 (the energy efficient microwave is no more expensive than the standard version) ☐Yes ☐ No

$50	*☐Yes*	*☐ No*

$100	*☐Yes*	*☐ No*
$150	*☐Yes*	*☐ No*
$200	*☐Yes*	*☐ No*
$300	*☐Yes*	*☐ No*
$400	*☐Yes*	*☐ No*
$500	*☐Yes*	*☐ No*
$750	*☐Yes*	*☐ No*
$1000	*☐Yes*	*☐ No*
More than $1000	*☐Yes*	*☐ No*

[If this question is the second of the two questions asked, ask the following questions:]
On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient central air conditioning unit:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

B4(a). Large TV question 1

Now we want to ask you about your likely decision in the event you needed to buy a new large TV because your current one malfunctions and can't be repaired.

Large TVs typically cost in the neighborhood of $300-$1000, though there is a wide variation in cost, depending on size and style, and features such sound quality, number of USB ports, and so forth.

Suppose that you've identified the large TV that you prefer and that you can afford.

*There are **two versions of the TV:** A standard version and an energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version. It's just more energy efficient.*

*The energy efficient version would save you **$10 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $60, you are saying that you would not pay $60 more for the energy efficient version.*

$0 (the energy efficient TV is no more expensive than the standard version)	*☐Yes*	*☐ No*
$10	*☐Yes*	*☐ No*
$20	*☐Yes*	*☐ No*
$30	*☐Yes*	*☐ No*
$40	*☐Yes*	*☐ No*
$50	*☐Yes*	*☐ No*
$60	*☐Yes*	*☐ No*
$80	*☐Yes*	*☐ No*
$100	*☐Yes*	*☐ No*

$120	☐*Yes*	☐ *No*
More than $120	☐*Yes*	☐ *No*

[If this question is the second of the two questions asked, ask the following questions:]

On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient TV:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

B4(b). Large TV question 2

Now we want to ask you about your likely decision in the event you needed to buy a new large TV because your current one malfunctions and can't be repaired.

Large TVs typically cost in the neighborhood of $300-$1000, though there is a wide variation in cost, depending on size and style, and features such sound quality, number of USB ports, and so forth.

Suppose that you've identified the large TV that you prefer and that you can afford.

*There are **two versions of the TV:** A standard version and an energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version. It's just more energy efficient.*

*The energy efficient version would save you **$15 per year** in electricity costs compared to a standard version, **but is more expensive to buy**.*

*Would you be willing to pay the following **additional** amount for the energy efficient version? Please indicate "Yes" or "No" for each amount. For instance, if you say "no" for $60, you are saying that you would not pay $60 more for the energy efficient version.*

$0 (the energy efficient TV is no more expensive than the standard version)	☐*Yes*	☐ *No*
$15	☐*Yes*	☐ *No*
$30	☐*Yes*	☐ *No*
$45	☐*Yes*	☐ *No*
$60	☐*Yes*	☐ *No*
$90	☐*Yes*	☐ *No*
$120	☐*Yes*	☐ *No*
$150	☐*Yes*	☐ *No*
$225	☐*Yes*	☐ *No*
$300	☐*Yes*	☐ *No*
More than $300	☐*Yes*	☐ *No*

[If this question is the second of the two questions asked, ask the following questions:]

On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of the following factors in your response concerning the decision to purchase an energy efficient TV:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.

I just don't think the energy efficient version would be as good as the standard version.
It makes me feel good to buy energy efficient devices.
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change.

Appendix G. Residential Payback Acceptance Survey, Landlord Intro Script

VI. Introduction to the Study [use this script if the contact list names an individual]

Hello. My name is _____ and I am calling on behalf of KCP&L, a local electric utility. KCP&L is trying to determine how to improve its energy efficiency programs and it believes that customer feedback is an important part of making these improvements. We had previously received valuable information from (Name of business indicated in the KEMA list), and we were hoping that you or another individual at your company could help us out again by answering a few questions. It would take 5-10 minutes. It is important that I talk to the decision-maker in charge of furnishing the rental units. Is he/she available?

- *Yes ➔ respondent is not the person who answered the telephone. Go to section II when the respondent is on the phone*
- *Yes ➔ respondent is the person who answered the telephone. Go to section III.*

- *No. ➔ Do I have the correct number to reach him/her?*
  - *Yes ➔ Can you tell me when would be a good time to reach him/her?*
    - *Yes ➔ OK, thanks, I'll try back then. (record the contact time)*
    - *No, but OK to call back ➔ OK, I'll try another time.*
    - *No, please don't call back ➔OK, thanks for your time.*
  - *No ➔ Can you tell me where I can reach him/her? (record number if available).*

VII. Introduction to the Study [use this script if the contact list names an organization]

Hello. My name is _____ and I am calling on behalf of KCP&L, a local electric utility. We are conducting a study to understand how KCP&L customers make decisions concerning the purchase of electric appliances so we can design programs to help customers save on their energy bills. We had previously received valuable information from (Name of the organization), and we were hoping that you could help us out again by answering a few questions. Are you the decision-maker in charge of furnishing the rental units?

- *Yes ➔ The survey will take 5-10 minutes. Individual responses are strictly confidential; we will provide the data to the utility in a way that does not tie your responses to you. We think you will find the questions interesting. Do you have the time now to help us out?*

  - *Yes → Go to section IV.*
  - *No → May I try back another time?*
    - *Yes ➔ Obtain alternative time.*
    - *No ➔ Thank and terminate.*

- *No → Is he/she available?*
  - *Yes → Repeat section II when decision-maker is on the phone.*
  - *No. ➔ Do I have the correct number to reach him/her?*
    - *Yes ➔ Can you tell me when would be a good time to reach him/her?*
      - *Yes ➔ OK, thanks, I'll try back then. (record the contact time)*
      - *No, but OK to call back ➔ OK, I'll try another time.*
      - *No, please don't call back ➔OK, thanks for your time.*
    - *No ➔ Can you tell me where I can reach him/her? (record number if available).*

VIII. Initial script

KCP&L is interested in the decisions their customers make to replace electric appliances, and in particular how their customers make the decision about whether or not to purchase an energy efficient appliance. Our information indicates that you own or manage rental property in KCP&L's service territory. The information we *obtain will allow them to develop programs to help their customers –hopefully including you and your tenants –to save energy.*

The survey will take 5-10 minutes. Individual responses are strictly confidential; we will provide the data to the utility in a way that does not tie your responses to you. We think you will find the questions interesting. Do you have the time now to help us out?

Yes ➔ Thanks. (Go to section IV).
No ➔ May I try back another time?
  Yes ➔ Obtain alternative time.
  No ➔ Thank and terminate.

IX. Landlord identification and initial questions

One of the issues that KCP&L is most interested in is the decision that landlords and property managers make with regard to the use of energy efficient appliances in rental housing.

Do you own or manage at least one residential property that is not your place of residence, and that is currently occupied by paying tenants?

a. Yes, one property➔

Qa1. For your rental property, who pays the electric bill?
  a. Landlord
  b. Tenant
  c. Management Company
  d. Other
  e. Don't Know

Qa2. What type of property is it?
  a. single family home
  b. duplex
  c. apartment
  e. other

Qa3. (If Qa2 = c or d) How many units are in the building?_______

b. Yes, more than one property➔

Qb1. How many properties do you own?

Qb2. For the remainder of this survey, please consider your rental property ***with the most units*** *when answering the questions. For this rental property, who pays the electric bill?*

  a. Landlord
  b. Tenant
  c. Management Company
  d. Varies by the unit
  e. Other
  f. Don't Know

Qb3. What type of property is it?
  a. single family home
  b. duplex

c. apartment
e. other

Qb4. (If Qb3= c or d) How many units are in the building? ______

c. *No ➔ OK. That's all the questions we have then. Thanks for being willing to help us out. Terminate.*

X. *Which of the following appliances are provided in this rental property? (All answers: Y/N/DK/NR)*

a. Dishwasher
b. Refrigerator
c. Central air conditioning

XI. Cheap talk script

The next set of questions asks about your likely purchase behavior when buying a new energy efficient appliance for your rental property.

Imagine that you really are in the process of making the purchase decisions presented below, and anticipate how you would truly behave if the situation were real. Thanks for your help.

XII. WTP Question 1 . *Randomly choose from the set of questions in Appendix A based on responses to questions Va-c. The feasible set for the random draw is defined as follows:*

- *Questions A1(a,b) concerning lighting are always feasible.*
- *Questions A2(a,b) are feasible if question Va is "Yes".*
- *Questions A3(a,b) are feasible if question Vb is "Yes"*
- *Questions A4(a,b) are feasible if question Vc is "Yes"*

XIII. WTP Question 2. *Randomly choose from the set of questions in Appendix A based on responses to questions IVa-c of part II. The feasible set for the random draw excludes the question asked in the first WTP question above, and otherwise is the same as for WTP Question 1.*

XIV. Other Questions

We now want to ask you some demographic questions about your company.

1. What is your title in the organization? ___________________

2. How long have you currently held this position? ___________ years

3. To the best of your knowledge, has (Name of organization) participated in any KCP&L energy efficiency programs within the last year?
   a. Yes → go to Q4 and Q5
   b. No
   c. Don't know
   d. Refused

4. (Ask if yes in Q3) Which measures did you install or actions did you take as a result of the energy efficiency program? (do not read list; mark all that apply)
   a. Attic Insulation
   b. Wall Insulation

   c. Install Windows
   d. Replace air conditioner (or heat pump)
   e. Air conditioner tune-up
   f. Install ceiling fan
   g. Install programmable thermostat
   h. Install CFLs in indoor public areas
   i. Install high efficiency lighting in exterior areas
   j. Install Refrigerator
   k. Other

5. (Ask if yes in Q3) On a scale of 0 to 10, with 0 being “extremely dissatisfied” and 10 being “extremely satisfied,” how satisfied were you with this program? You may use any number from 0 to 10.
   _______ (0-10, DN, NR)

X. Termination script

OK, that’s all the questions I have. Thanks a lot for your time.

Appendix H. Landlord Payback Acceptance Survey

EVERY RESPONDENT GETS UP TO TWO QUESTIONS FROM THIS APPENDIX, PER RESPONSES TO QUESTION IV. THESE QUESTIONS ARE RANDOMIZED AND THEN ASKED IN ORDER UNTIL A MAXIMUM OF TWO ARE COMPLETED.

NOTE THAT THERE ARE TWO VERSIONS OF EVERY QUESTION, WITH THE VERSIONS DIFFERING ONLY BY THE DOLLAR AMOUNTS USED IN THE QUESTION, SO ONCE THE FEASIBILE SET OF DEVICES IS DEFINED AND A DEVICE IS CHOSEN FOR A WTP QUESTION, WHICH OF THE TWO QUESTIONS IS CHOSEN IS BY RANDOM ASSIGNMENT.

A1(a). Lighting questions I

Usually tenants are responsible for replacing bulbs in a rental property, but often when tenants vacate a property landlords find that they must replace burned out bulbs that the tenant did not replace. We want to ask you about your likely decision in the event you need to buy a new light bulb for your rental property.

Please think about a particular socket in the living space of this rental property.

Assume you have in mind a particular type of bulb and a particular wattage. You find the bulb you need, and there is a standard version and an energy efficient version. Assume there is ***no difference*** *in the quality of lighting between the two versions. In other words, the energy efficient version looks just like the standard version of the light bulb, and has the exact same quality of light, except that it's more energy efficient.*

I'm now going to ask you how much more –if anything more –you would be willing to pay for the energy efficient version of the bulb if it ***reduces electricity costs by $1 per year****.*

The amounts below are the categories that match the residential internet survey. We want to randomly start at a-l, and then follow the algorithm indicated in the first dishwasher question (see below).

$0 (the energy efficient light bulb is no more expensive than the standard bulb)	*☐Yes*	*☐ No*
$1	*☐Yes*	*☐ No*
$2	*☐Yes*	*☐ No*
$3	*☐Yes*	*☐ No*
$4	*☐Yes*	*☐ No*
$5	*☐Yes*	*☐ No*
$6	*☐Yes*	*☐ No*
$8	*☐Yes*	*☐ No*
$10	*☐Yes*	*☐ No*
$12	*☐Yes*	*☐ No*
More than $12	*☐Yes*	*☐ No*

If this question is the second of the two questions asked:
I'm now going to read to you a set of 7 statements. On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of each statement in your response concerning the decision to purchase an energy efficient light bulb:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version;
It makes me feel good to buy energy efficient devices;

We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.

I think it's a good thing to use energy efficient products to reduce global climate change;

A1(B). Lighting questions 2

Usually tenants are responsible for replacing bulbs in a rental property, but often when tenants vacate a property landlords find that they must replace burned out bulbs that the tenant did not replace. We want to ask you about your likely decision in the event you need to buy a new light bulb.

Please think about a particular socket in the living space of one of this rental property

Assume you have in mind a particular type of bulb and a particular wattage. You find the bulb you need, and there is a standard version and an energy efficient version. Assume there is ***no difference*** *in the quality of lighting between the two versions. In other words, the energy efficient version looks just like the standard version of the light bulb, and has the exact same quality of light, except that it's more energy efficient.*

I'm now going to ask you how much more –if anything more –you would be willing to pay for the energy efficient version of the bulb if it ***reduces electricity costs by $3 per year****.*

The amounts below are the categories that match the residential internet survey. We want to randomly start at a-l, and then follow the algorithm indicated in the first dishwasher question (see below).

$0 (the energy efficient light bulb is no more expensive than the standard bulb)	*☐Yes*	*☐ No*
$3	*☐Yes*	*☐ No*
$6	*☐Yes*	*☐ No*
$9	*☐Yes*	*☐ No*
$12	*☐Yes*	*☐ No*
$18	*☐Yes*	*☐ No*
$24	*☐Yes*	*☐ No*
$30	*☐Yes*	*☐ No*
$45	*☐Yes*	*☐ No*
$60	*☐Yes*	*☐ No*
More than $60	*☐Yes*	*☐ No*

If this question is the second of the two questions asked:

I'm now going to read to you a set of 7 statements. On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of each statement in your response concerning the decision to purchase an energy efficient light bulb:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.

I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.

I just don't think the energy efficient version would be as good as the standard version;

It makes me feel good to buy energy efficient devices;

We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.

I think it's a good thing to use energy efficient products to reduce global climate change;

Q2a. Dishwasher questions 1

Now we want to ask you about your likely decision in the event you needed to buy a new dishwasher because one at your rental property breaks down and can't be repaired.

Dishwashers typically cost in the neighborhood of $700-$800, though there is a wide variation in cost, depending on features such as size, noisiness, style, and the availability of features such as delayed-start and hard food disposer.

Suppose that you've identified the dishwasher you prefer given the cost.

*There are **two versions of the dishwasher:** A standard version and a more energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version except that it's more energy efficient.*

*I'm now going to ask you how much more –if anything more –you would be willing to pay for the energy efficient dishwasher if it **reduces electricity costs by $6 per year**.*

The amounts below are the categories that match the residential internet survey. We want to randomly start at a-k, and then follow the following algorithm (Ipsos: hopefully this is clear enough to develop the proper programming algorithm. I can work with your team to clarify as necessary. The idea here is to minimize the number of questions necessary to complete the WTP data without making the algorithm overly complicated):

Step 1. Random draw from choices a-l below.
Step2. Ask about the amount indicated.

- ➔ *If answer is "no", fill in "no" for that value and all values higher, and do the following:*
  - ➔ *If on (a) go to the next question.*
  - ➔ *If at (b), go to (a):*
    - ➔ *if (a) is already filled in, go to the next question; otherwise return to the start of Step 2.*
  - ➔ *If above (b), reduce value by two increments and:*
    - ➔ *if the choice is already filled in, increase the value by one increment:*
      - ➔ *if the choice is filled in, go to the next question; otherwise return to the start of Step 2.*
    - ➔ *if the choice is not filled in, return to the start of Step 2.*

- ➔ *If answer is "yes", fill in "yes" for that value and all values lower, and do the following:*
  - ➔ *If at (k), go to the next question*
  - ➔ *If at (j), go to (k) :*
    - ➔ *if (k) is already filled in, go to the next question; otherwise return to the start of Step 2.*
  - ➔ *If below (j), increase value by two increments and :*
    - ➔ *if the choice is already filled in, reduce the value by one increment:*
      - ➔ *if the choice is filled in, go to the next question; otherwise return to the start of Step 2.*
    - ➔ *if the choice is not filled in, return to the start of Step 2.*

a)	*$0 (the energy efficient dishwasher is no more expensive than the standard version)*	*☐Yes*	*☐ No*
b)	*$6*	*☐Yes*	*☐ No*
c)	*$12*	*☐Yes*	*☐ No*
d)	*$18*	*☐Yes*	*☐ No*
e)	*$24*	*☐Yes*	*☐ No*
f)	*$36*	*☐Yes*	*☐ No*
g)	*$48*	*☐Yes*	*☐ No*

h) $60 ☐*Yes* ☐ *No*
i) $90 ☐*Yes* ☐ *No*
j) $120 ☐*Yes* ☐ *No*
k) More than $120 ☐*Yes* ☐ *No*

[If this question is the second of the two WTP questions, ask the following questions:]

I'm now going to read to you a set of 7 statements. On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of each statement in your response concerning the decision to purchase an energy efficient dishwasher:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version;
It makes me feel good to buy energy efficient devices;
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change;

Q2b. Dishwasher questions 2

Now we want to ask you about your likely decision in the event you needed to buy a new dishwasher because one at your rental property breaks down and can't be repaired.

Dishwashers typically cost in the neighborhood of $700-$800, though there is a wide variation in cost, depending on features such as size, noisiness, style, and the availability of features such as delayed-start and hard food disposer.

Suppose that you've identified the dishwasher you prefer given the cost.

*There are **two versions of the dishwasher:** A standard version and a more energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version, except it's more energy efficient.*

I'm now going to ask you how much more –if anything more –you would be willing to pay for the energy efficient dishwasher if it ***reduces electricity costs by $12 per year****.*

The amounts below are the categories that match the residential internet survey. We want to randomly start at a-l, and then follow the algorithm indicated in the first dishwasher question.

$0. (the energy efficient dishwasher is no more expensive than the standard version) ☐*Yes* ☐ *No*
$12 ☐*Yes* ☐ *No*
$24 ☐*Yes* ☐ *No*
$36 ☐*Yes* ☐ *No*
$48 ☐*Yes* ☐ *No*
$72 ☐*Yes* ☐ *No*
$96 ☐*Yes* ☐ *No*
$120 ☐*Yes* ☐ *No*
$180 ☐*Yes* ☐ *No*
$240 ☐*Yes* ☐ *No*
More than $240 ☐*Yes* ☐ *No*

[If this question is the second of the two WTP questions, ask the following questions:]

I'm now going to read to you a set of 7 statements. On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of each statement in your response concerning the decision to purchase an energy efficient dishwasher:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.

I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.

I just don't think the energy efficient version would be as good as the standard version;

It makes me feel good to buy energy efficient devices;

We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.

I think it's a good thing to use energy efficient products to reduce global climate change;

Q3a. Refrigerator question 1

Now we want to ask you about your likely decision in the event you needed to buy a new refrigerator because one at your rental property breaks down and can't be repaired.

Refrigerators typically cost in the neighborhood of $900-$1100, though there is a wide variation in cost, depending on features such as size, style, and the availability of features such ice maker, chilled water dispenser, and so forth.

Suppose that you've identified the refrigerator you prefer given the cost.

*There are **two versions of the refrigerator:** A standard version and a more energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version, except that it's more energy efficient.*

I'm now going to ask you how much more –if anything more –you would be willing to pay for the energy efficient refrigerator if it ***reduces electricity costs by $12 per year****.*

The amounts below are the categories that match the residential internet survey. We want to randomly start at a-l, and then follow the algorithm indicated in the first dishwasher question.

$0 (the energy efficient refrigerator is no more expensive than the standard version)	*☐Yes*	*☐ No*
$12	*☐Yes*	*☐ No*
$24	*☐Yes*	*☐ No*
$36	*☐Yes*	*☐ No*
$48	*☐Yes*	*☐ No*
$72	*☐Yes*	*☐ No*
$96	*☐Yes*	*☐ No*
$120	*☐Yes*	*☐ No*
$180	*☐Yes*	*☐ No*
$240	*☐Yes*	*☐ No*
More than $240	*☐Yes*	*☐ No*

[If this question is the second of the two WTP questions, ask the following questions:]

I'm now going to read to you a set of 7 statements. On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of each statement in your response concerning the decision to purchase an energy efficient refrigerator:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.

I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.

I just don't think the energy efficient version would be as good as the standard version;

It makes me feel good to buy energy efficient devices;

We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change;

Q3b. Refrigerator question 2

Now we want to ask you about your likely decision in the event you needed to buy a new refrigerator because one at your rental property breaks down and can't be repaired.

Refrigerators typically cost in the neighborhood of $900-$1100, though there is a wide variation in cost, depending on features such as size, style, and the availability of features such ice maker, chilled water dispenser, and so forth.

Suppose that you've identified the refrigerator you prefer given the cost.

There are ***two versions of the refrigerator:*** *A standard version and a more energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version, except that it's more energy efficient.*

I'm now going to ask you how much more –if anything more –you would be willing to pay for the energy efficient refrigerator if it ***reduces electricity costs by $25 per year****.*

The amounts below are the categories that match the residential internet survey. We want to randomly start at a-l, and then follow the algorithm indicated in the first dishwasher question.

$0 (the energy efficient refrigerator is no more expensive than the standard version)	*☐Yes*	*☐ No*
$25	*☐Yes*	*☐ No*
$50	*☐Yes*	*☐ No*
$75	*☐Yes*	*☐ No*
$100	*☐Yes*	*☐ No*
$150	*☐Yes*	*☐ No*
$200	*☐Yes*	*☐ No*
$250	*☐Yes*	*☐ No*
$375	*☐Yes*	*☐ No*
$500	*☐Yes*	*☐ No*
More than $500	*☐Yes*	*☐ No*

[If this question is the second of the two WTP questions, ask the following questions:]
I'm now going to read to you a set of 7 statements. On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of each statement in your response concerning the decision to purchase an energy efficient refrigerator:
It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version;
It makes me feel good to buy energy efficient devices;
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change;

Q4a. CAC questions 1

Now we want to ask you about your likely decision in the event you needed to buy a new central air conditioning unit because one at your rental property breaks down and can't be repaired.

Including the cost of installation, central air conditioning units typically cost in the neighborhood of $3000-$4000, though there is a wide variation in cost, depending on the size of the unit, the warrantee, and any difficulty arising in the installation of the unit.

Suppose that you've identified the unit you prefer given the cost.

*There are **two versions of the model:** A standard version and a more energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version, except that it's more energy efficient.*

I'm now going to ask you how much more –if anything more –you would be willing to pay for the energy efficient refrigerator if it ***reduces electricity costs by $25 per year***.

The amounts below are the categories that match the residential internet survey. We want to randomly start at a-l, and then follow the algorithm indicated in the first dishwasher question.

$0 (the energy efficient central air conditioning unit is no more expensive than the standard version)	☐*Yes*	☐ *No*
$25	☐*Yes*	☐ *No*
$50	☐*Yes*	☐ *No*
$75	☐*Yes*	☐ *No*
$100	☐*Yes*	☐ *No*
$150	☐*Yes*	☐ *No*
$200	☐*Yes*	☐ *No*
$250	☐*Yes*	☐ *No*
$375	☐*Yes*	☐ *No*
$500	☐*Yes*	☐ *No*
More than $500	☐*Yes*	☐ *No*

[If this question is the second of the two WTP questions, ask the following questions:]
I'm now going to read to you a set of 7 statements. On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of each statement in your response concerning the decision to purchase an energy efficient central air conditioning unit:

It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.
I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.
I just don't think the energy efficient version would be as good as the standard version;
It makes me feel good to buy energy efficient devices;
We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.
I think it's a good thing to use energy efficient products to reduce global climate change;

Q4b. CAC questions 2

Now we want to ask you about your likely decision in the event you needed to buy a new central air conditioning unit because one at your rental property breaks down and can't be repaired.

Including the cost of installation, central air conditioning units typically cost in the neighborhood of $3000-$4000, though there is a wide variation in cost, depending on the size of the unit, the warrantee, and any difficulty arising in the installation of the unit.

Suppose that you've identified the unit you prefer given the cost.

There are ***two versions of the model:*** *A standard version and a more energy efficient version. Assume there is no other difference in the two versions. In other words, the energy efficient version is just like the standard version, except that it's more energy efficient.*

I'm now going to ask you how much more –if anything more –you would be willing to pay for the energy efficient refrigerator if it ***reduces electricity costs by $50 per year****.*

The amounts below are the categories that match the residential internet survey. We want to randomly start at a-l, and then follow the algorithm indicated in the first dishwasher question.

$0 (the energy efficient central air conditioning unit is no more expensive than the standard version)	*☐Yes*	*☐ No*
$50	*☐Yes*	*☐ No*
$100	*☐Yes*	*☐ No*
$150	*☐Yes*	*☐ No*
$200	*☐Yes*	*☐ No*
$300	*☐Yes*	*☐ No*
$400	*☐Yes*	*☐ No*
$500	*☐Yes*	*☐ No*
$750	*☐Yes*	*☐ No*
$1000	*☐Yes*	*☐ No*
More than $1000	*☐Yes*	*☐ No*

[If this question is the second of the two WTP questions, ask the following questions:]

I'm now going to read to you a set of 7 statements. On a scale of 1-5, where 1 is "strongly disagree" and 5 is "strongly agree", please indicate the importance of each statement in your response concerning the decision to purchase an energy efficient central air conditioning unit:

> *It doesn't make financial sense for me to pay more than I indicated for the energy efficient version.*
> *I don't think the energy efficient version will last long enough to justify paying more for it than I indicated.*
> *I just don't think the energy efficient version would be as good as the standard version;*
> *It makes me feel good to buy energy efficient devices;*
> *We're all influenced somewhat by our friends and family, and my social group tends to look favorably on energy efficient purchases.*
> *I think it's a good thing to use energy efficient products to reduce global climate change;*

Appendix I. Commercial and Industrial Payback Acceptance Survey

Intro_1

Hello. My name is _____ and I am calling on behalf of your electric utility, KCP&L. KCP&L is trying to determine how to improve its energy efficiency programs, and it believes that customer feedback is an important part of making these improvements. It would be a big help if we could get feedback from your organization. It's important that I talk to the facilities manager, energy manager, or another person who is ***most familiar*** *with the management of your company's lighting, heating, and cooling technology.*

Are you that person?

1. Yes **(go to Intro_2)**
2. No - *Could you please give me the name and phone number of the person I should speak to, or someone who would know the proper person to speak to?*
NAME: ____ PHONE: ____

8. Don't know
9. Refused - *Thank you very much for your time. Goodbye.*

Intro_2

Great! I'd like to ask you a few questions. This will take about 5-10 minutes and will greatly help KCP&L tailor its energy efficiency programs to better serve its customers. Your responses will be completely confidential; your name and organization will be separated from the responses before results are communicated to KCP&L. Can we start?

1. Yes (go to Background)
2. No (*When is a good time to callback?*)
____)
9. Refused - Thank *you very much for your time. Goodbye.*

INT NOTE: If the 'NO" feels like a refusal - state the following*: "KCP&L is trying to determine how to improve its energy efficiency programs, and it believes that customer feedback is an important part of making these improvements. It would be a big help if we could get feedback from your organization. May we continue?"*

I. Background

Great – thank you so much. First, I have a few background questions about your position and your facility.

Q1. What is your title in the organization?

8. Don't know
9. Refused

Q2. How many years have you been in your current position in the organization? ___ Years

Q3. How many buildings do you manage? _____ buildings

(If Q3 greater than 1) For the remainder of this survey, please consider the **largest** building that you manage when answering the questions.

Q4. What is the primary use of this building that you manage? Would you say…? (Select One)

a. Office space
b. School/Educational
c. Church/Place of worship
d. Health care
e. Retail
f. Warehouse
g. Industrial
h. Other ____
8. Don't know
9. Refused

Q5. Does your organization own, or lease this building?

a. Own
b. Lease
c. Other
8. Don't know
9. Refused

Q6. (Ask for respondents in the client-supplied contact list) Has your organization participated in any KCP&L energy efficiency programs in the last year?

a. Yes → Continue to Q7, Q8
b. No
c. Don't know
d. Refused

Q7. (If yes to Q6) Did you participate in the following programs? (Y/N/DN/R for all programs)

a. On-site or online energy audit
b. Building operator certification
c. Rebates for lighting, HVAC, or motors
d. Rebates for equipment besides lighting, HVAC, or motors
e. New Construction
f. Small Business direct install of lighting, HVAC, or refrigeration
g. Retro commissioning
h. Continuous Energy Improvement

Q8. (If yes to Q6) On a scale of 0 to 10, with 0 being "extremely dissatisfied" and 10 being "extremely satisfied," how satisfied were you with these programs in general? You may use any number from 0 to 10.

_______ (0-10, DN, NR)

II. Questions about the decision to install

We want to ask you about decisions you make concerning the purchase of energy efficient technologies in lighting, heating, and cooling. We're asking this because KCP&L wants to get a better idea of the typical behavior of its customers with respect to purchases so that it can better design its future offerings of energy efficient programs. The next question concerns what energy experts call "payback time". This is the time it takes for the total accumulated energy savings of an energy efficiency technology to equal the original cost of the technology. For instance, if the technology costs $100, and saves $10 per year, then the payback time is 10 years, because it takes 10 years for savings of $10 per year to equal the $100 initial cost of the technology.

Q5. Have you heard the term "payback time" or "payback period" before, or are you familiar with the concept?

No ➔ *OK. So it gets at the idea that if a new energy-saving technology, like a new kind of boiler for heating water, costs more than the standard technology, it takes a certain amount of time for the energy savings to "pay off" the extra cost of the new technology. Does this make sense?*

Yes ➔ *Good. So now to our first question* [drop down to below, "Consider the purchase…."]

No ➔ [Try to probe and explain. If respondent does not seem to understand after a brief interaction, terminate].

Yes➔ *Good. So now to our first question:*

Consider the purchase of a technology that affects the energy efficiency of lighting, heating, or cooling for your business. Suppose the technology has NO impact on the QUALITY of lighting, heating, and cooling, it just changes the amount of energy consumed. An example might be a variable frequency drive in an HVAC system, or replacing a lighting system with a lighting system that is exactly the same in all ways except its energy use.

Q6. Does your business have either an established rule, or a general rule-of-thumb, requiring that an energy-efficient technology meet a threshold for the payback time? In other words, must the technology pay itself off in energy savings in no more than a certain number years?

Yes ➔ **Q6a. What is the TYPICAL required payback time? ___Yrs [go to Q7].**

No ➔ **Q6b. Based on your experience, would your firm generally purchase an energy efficient technology if the payback time were… [after getting answers, go to terminal script].**

We want to randomly start at a-k, and then follow the following algorithm.

Step 1. Random draw from choices a-l below.

Step2. Ask about the amount indicated.

➔ *If answer is "no", fill in "no" for that value and all values higher, and do the following:*

➔ *If on (a) go to the next question.*

➔ *If at (b), go to (a):*

➔*if (a) is already filled in, go to the next question; otherwise return to the start of Step 2.*

➔ *If above (b), reduce value by two increments and:*

➔ *if the choice is already filled in, increase the value by one increment:*

➔ *if the choice is filled in, go to the next question; otherwise return to the start of Step 2.*

➔ *if the choice is not filled in, return to the start of Step 2.*

➔ *If answer is "yes", fill in "yes" for that value and all values lower, and do the following:*

➔*If at (l), go to the next question*

➔*If at (k), go to (l) :*

➔ *if (l) is already filled in, go to the next question; otherwise return to the start of Step 2.*

➔ *If below (k), increase value by two increments and :*

➔ *if the choice is already filled in, reduce the value by one increment:*

➔ *if the choice is filled in, go to the next question; otherwise return to the start of Step 2.*

➔ *if the choice is not filled in, return to the start of Step 2.*

(The verbiage in parentheses is to be used if the respondent is unclear what the question is asking. Use this explanation for one or two of the responses as the question sequence is worked through, then use it only if it seems necessary to help the respondent)

a) *Less than a year (that is, it would take less than 1 year for the energy savings to exceed the cost of the technology).* ☐*Yes* ☐ *No* ☐ *Don't know/not sure*
b) *1 year (that is, it would take about 1 year for the energy savings to exceed the cost of the technology)* ☐*Yes* ☐ *No* ☐ *Don't know/not sure*
c) *2 years (that is, it would take about 2 years for the energy savings to exceed the cost of the technology)* ☐*Yes* ☐ *No* ☐ *Don't know/not sure*
d) *3 years(that is, it would take about 3 years for the energy savings to exceed the cost of the technology)* ☐*Yes* ☐ *No* ☐ *Don't know/not sure*
e) *4 years (that is, it would take about 4 years for the energy savings to exceed the cost of the technology)* ☐*Yes* ☐ *No* ☐ *Don't know/not sure*
f) *5 years (that is, it would take about 5 years for the energy savings to exceed the cost of the technology)* ☐*Yes* ☐ *No* ☐ *Don't know/not sure*
g) *6 years (that is, it would take about 6 years for the energy savings to exceed the cost of the technology)* ☐*Yes* ☐ *No* ☐ *Don't know/not sure*
h) *8 years (that is, it would take about 8 years for the energy savings to exceed the cost of the technology)* ☐*Yes* ☐ *No* ☐ *Don't know/not sure*
i) *10 years (that is, it would take about 10 years for the energy savings to exceed the cost of the technology)* ☐*Yes* ☐ *No* ☐ *Don't know/not sure*
j) *12 years(that is, it would take about 12 years for the energy savings to exceed the cost of the technology)* ☐*Yes* ☐ *No* ☐ *Don't know/not sure*
k) *More than 12 years (that is, it would take more than 12 years for the energy savings to exceed the cost of the technology)* ☐*Yes* ☐ *No* ☐ *Don't know/not sure*

OK, that's all we have. Thanks for your time!

Appendix J. 2012 Residential On-Site Survey Form

Site ID #

2012 Residential
On-Site Survey Form
For

KCPL

05/22/2012

Customer Information: (Please Print)

Customer			
Phone	**( )**		
Street Address:			
City:		Zip	
Mailing			
City:		Zip	
County:			

Survey Tracking Information:

	Date:	Performed by, Initials
Field Survey Performed:	__ / __ / __	__ __ __
Completeness and Quality Check	__ / __ / __	__ __ __
Data Entry Complete:	__ / __ / __	__ __ __

HOME CHARACTERISTICS - BY INTERVIEW

INTRODUCTION TO SURVEY

Thank you again for participating in the survey. To start, I'm going to ask you a few questions about your home and your home's equipment. After this brief interview, I will walk through your home and so that I can inventory your energy using equipment to record all the specific information about the equipment. I will be recording information on the following items: lighting, heating and cooling systems, water heating system, cooking equipment, home electronics, laundry equipment, refrigerators and freezers, fans and miscellaneous equipment. I will have some questions for you about the equipment and how you use it, so it's best if we walk through the survey together.

1. Which of the following best describes the home/residence (based on **surveyor** judgment):
   ☐ Single-family construction
   ☐ Single-family factory manufactured/modular
   ☐ Single-family mobile home
   ☐ Two family residence (duplex)—traditional structure
   ☐ Apartment (3 + families) --- traditional structure
   ☐ Condominium---traditional structure
   ☐ Row House or any "Other": (describe________________________________)

2. Do the occupants own or rent the residence?
   ☐ Own
   ☐☐ Rent

3. What year was this residence built?
   ________ Year Built Interviewer Estimate? ☐
   If estimate, OK to estimate by decade up to 2000, then estimate to year.

4. How many square feet is the above-grade conditioned living space? ____________

5. How many square feet of conditioned living space is below-grade? ___________

6. Total square footage of home (Add 4 & 5) _________________________

7. Is this the main, weekend, or seasonal/vacation residence? (CHECK ONLY ONE)
   ☐ Main Residence
   ☐ Weekend Residence
   ☐ Seasonal/Vacation Residence

8. In each season, how many people live in this household?
   _______ Summer
   _______ Winter

9. How many stories tall is the home? (check one, based on **surveyor** judgment)
   ☐ One Story
   ☐ Split Foyer
   ☐ Split Level
   ☐ Two Stories

- ☐ Three or More Stories

For the remainder of the survey, answer questions based on YOUR OBSERVATION, whenever possible. Otherwise, ask the homeowner.

HOME CHARACTERISTICS – BY OBSERVATION

10. Estimate square feet of conditioned floor space: (other than garage, basement, and porch)

______________sq.ft.

11. Are any of the following areas used as conditioned living space? (ENTER ALL THAT APPLY)

____________ Garage (sq. ft).

____________ Basement (sq. ft).

____________ Porch (sq. ft).

12. Does this residence have an accessible attic?
    - ☐ Yes/Vented
    - ☐ Yes/Unvented
    - ☐ No

13. Does this residence have an accessible crawl space?
    - ☐ Yes Access/Vents Open
    - ☐ Yes Access/Vents Closed
    - ☐ No

LIGHTING

14. Fill out the following information about the indoor and outdoor lighting of the home using the following codes.

Fixture Number	Number of identical fixtures	Room Type	Socket Type	Bulb Type (existing)	No. of bulbs per fixture	Watts per Bulb	Watts per Fixture	Hours of use Code	(1) standard, (2) dimmable, (3) 3-way	Hardwire? [Yes=1 No=2]	(1) Exposed flood (2) recessed can (99) other	(1) Control (2) Manual, (3) Timer, (4)Photocell, (5)occupancy sensor
1												
2												
3												
4												
5												
6												
7												
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30												

Lighting Room Codes		Socket Type Codes	Bulb Type Codes		Hours of Use Code	
1. Living Room	8. Office	1. Edison Base	1. Incandescent	8. LED	1. Infrequent Use - < 1hr	5. Security Lighting
2. Kitchen	9. Closet	2. Candelabra	2. T12 Fluorescent	9. No Bulb	2. Low Use - 1 to 2 hrs	6. Dusk-to-Dawn
3. Dining Room	10. Utility Room	3. Pin Base	3. T8 Fluorescent	88. Don't Know	3. Med. Use - 2-5hrs	7. Not Applicable
4. Hall/Foyer	11. Basement	4. Nightlight	4. High Performance T8	99. Other	4. High Use - > 5hrs	99. Other
5. Bedroom	12. Exterior	88. Don't know	5. CFL			
6. Bathroom	88. Don't know	99. Other	6. Halogen			
7. Garage	99. Other		7. Xenon			

SPACE HEATING

15. Is the heating system accessible?
    - ☐ Yes (note (1) ton = 12,000 btu's)
    - ☐ No

16. When was the heating system last serviced or repaired by a qualified HVAC technician?
    - ☐ less than 6 months
    - ☐ 6 - 12 months
    - ☐ 1 to 2 years
    - ☐ more than 2 years
    - ☐ Never
    - ☐ Not Sure

17. If there is a secondary or backup heating system, how often is it used during winter?
    - ☐ Don't have one
    - ☐ Never or Rarely
    - ☐ Often
    - ☐ Always

(*IF RESIDENCE TYPE: multifamily (4or more attached units*) ASK THE NEXT QUESTION:

18. Does the heating system serve more than one residence?
    - ☐ Yes
    - ☐ No
    - ☐ Not Sure

SPACE HEATING

19. Fill out the following information about the heating system of the home using the following codes:
(Note: Record the make and model number on the supplemental data sheet.)

(*a*) Type of System
(1) Central furnace
(2) Central heat pump - air
(3) Central heat pump - water
(4) Central heat pump - ground
(5) Built-in electric room units with indiv. rm. controls (incl. baseboards)
(6) Boiler/Steam/Hot Water
(7) Dual fuel heat pump (electric & gas)
(8) Wall or floor furnace
(9) Portable electric heater
(10) Portable kerosene heater
(11) Wood burning stove
(12) Coal burning stove
(13) Fireplace
(14) Solar
(15) None
(16) Electric Thermal Storage
(17) Other
____

(*b*) Fuel Type
(1) Electricity
(2) Natural Gas
(3) Propane or Bottled Gas
(4) Fuel Oil
(5) Wood
(6) Kerosene
(7) Coal
(8) Solar
(9) Biomass Pellets
(10) Other

(*d*) Air Handler Location
(1) Conditioned space
(2) Unconditioned space
(3) Unconditioned attic
(4) Outdoors
(5) No air handler
(6) Not sure

(*e*) Location of Majority of Duct Work
(1) Conditioned space
(2) Unconditioned space
(3) Unconditioned attic
(4) Outdoors
(5) No ducts

	Primary System	**Second System**	**Third System**
1. Type of system (*a*)			
2. Fuel type (*b*)			
3. Input capacity *kW*			
3a. Input capacity *kBtuh*			
4. Output capacity (*Btuh/hr*)			
5. Make			
6. Model			
7. Year of Manufacture			
8. Fan HP			
9. Fan Watts (if HP unavailable)			
10. Fan Speed (Constant, Variable)			
11. Is fan ECM?			
12. Energy Star? *(yes = 1,no = 2)*			
13. Air handler location (*d*)			
14. Duct work location(*e*)			
15. Duct work insulated *(yes = 1,no = 2)*			
16. Programmable thermostat *(yes = 1, no = 2)*			
17.Energy Recovery (yes. no)			

SPACE COOLING

20. Is the cooling system accessible?
    - ☐ Yes (note (1) ton = 12,000 btu’s)
    - ☐ No

21. When was the cooling system last serviced or repaired by an HVAC technician?
    - ☐ less than 6 months
    - ☐ 6 - 12 months
    - ☐ 1 to 2 years
    - ☐ More than 2 years
    - ☐ Never
    - ☐ Not Sure

22. If there is a secondary or backup cooling system, how often is it used during summer?
    - ☐ Don't have one
    - ☐ Never or Rarely
    - ☐ Often
    - ☐ Always

(*IF RESIDENCE TYPE: multifamily (4or more attached units*) ASK THE NEXT QUESTION

23. Does the air conditioning system serve more than one residence?
    - ☐ Yes
    - ☐ No
    - ☐ Not Sure

SPACE COOLING

24. Fill out the following information about the central air conditioning system using the following codes:
(Note: Record the make and model number on the supplemental data sheet.)

(*a*) Type of System
(1) Central electric, straight cool/packaged
(2) Central electric, straight cool/split
(3) Central heat pump/air-packaged
(4) Central heat pump/air-split
(5) Central heat pump/water or ground source
(6) Central Gas
(7) Room air conditioning only
(8) Room air conditioning with heat pump
(9) Room air conditioning with strip heat
(10) Whole house AC with window/wall mounted
(11) None
(12) Other: ___________________________

(*c*) Air Handler Location
(1) Conditioned space
(2) Unconditioned space
(3) Unconditioned attic
(4) Outdoors
(5) No air handler
(6) Not sure

(*d*) Location of Majority of Duct Work
(1) Conditioned space

(2) Unconditioned space
(3) Unconditioned attic
(4) Outdoors
(5) No ducts

	Primary System	**Second System**	**Third System**
1. Type of system (*a*)			
2. Output Capacity (kBtu/hr)			
3. Output Capacity (tons)			
4. Make			
5. Model			
6. Year of Manufacture			
7. Fan HP			
8. Fan Speed (Variable, Constant)			
9. Is Fan ECM?			
10. SEER			
11. EER			
12. Energy Star? *(yes=1,no=2)*			
13. Air handler location (*c*)			
14. Duct work location (*d*)			
15. If in conditioned space, are ducts in need of repair?			
16. Duct work insulated *(yes=1,no=2)*			
17. Programmable thermostat *(yes=1, no=2)*			

Water Heating

25. Is the water heating system accessible?
    - ☐ Yes
    - ☐ No

26. Where are the hot water lines located?
    - ☐ In Slab
    - ☐ Un-Conditioned Area (Crawl space, attic, basement)
    - ☐ Conditioned Area (including finished basement and/or attic)
    - ☐ Other _______________

(*IF RESIDENCE TYPE: multifamily (4or more attached units*) ASK THE NEXT QUESTION:

27. Is there a separate water heater serving only this residence?
    - ☐ Yes
    - ☐ No
    - ☐ Not Sure

28. Fill out the following information about the water heating system using the following codes:

(Note: Record the make and model number on the supplemental data sheet.)

(*a*) System Type
(1) Electric Resistance
(2) Heat Pump
(3) Natural Gas
(4) Propane or Bottled gas
(5) Fuel oil
(6) Instantaneous Electric
(7) Instantaneous Gas
(8) Solar
(9) Fossil Fuel , Unknown

	Unit 1	**Unit 2**
1. Primary fuel type (*a*)		
2. Back-up fuel type (*a*)		
3. Input Rating (kW)		
3a. Input Rating (kBtu/hr)		
4. Capacity in gallons		
5. Tank Insulation R-Value (if labeled)		
8. Location *(cond = 1, uncond = 2)*		
9. Tank Wrap (*yes = 1, no = 2*)		
10. Timer (*yes = 1, no = 2*)		
11. Add-on heat pump (*yes = 1, no = 2*)		
12. Pipe wrap near the water heater (*yes = 1, no = 2*)		
13. Heat Recovery from Heat Pump?		
14. Drain Water Heat Recovery?		
15. Tank temperature setting*(Lo, Med, Hi)*		

BRAND NAME MODEL NUMBER ENERGY STAR

Primary Heater ______________________ _____________________ ☐
Second Heater ______________________ _____________________ ☐

WATER HEATING

29. Are there **low-flow showerheads (< 2.5 gpm)** installed in the showers? (Low flow takes 24 seconds or more to fill a gallon jug.)

Number with __________ Number without __________

30. Are there **faucet aerators** installed on the faucets? (Usually < 2 gpm) (Low flow takes 30 seconds or more to fill a gallon jug or 15+ seconds to fill ½ gallon.)

Number with __________ Number without __________

Refrigerators

31. Fill out the following information about the refrigerators of the home using the following codes:

(*a*) Type
(1) Side by side
(2) Top mount freezer
(3) Bottom mount freezer
(4) Single door with freezer
(5) Single door w/o freezer
(6) Compact (<5 cubic feet)

	Unit 1	**Unit 2**	**Unit 3**
1. Type (*a*)			
2. Size (cubic feet)			
3. Year of manufacture			
4. Make			
5. Model			
6. Ice Maker? (*yes* = *1*, *no* = *2*)			
7. Energy Star Logo (*yes* = *1*, *no* = *2*)			
8. Unit Plugged In? (*yes* = *1*, *no* = *2*)			
9. Location *(cond=1, uncond=2)*			

Freezers

32. Fill out the following information about the freezers of the home using the following codes:

(*a*) Type	**(*b*) Seal Condition**	**(*c*) Coil Condition**
(1) Chest	(1) Complete	(1) Clean
(2) Upright FF	(2) Cracked	(2) Dirty
(3) Upright Manual	(3) Missing Sections	(3) Inaccessible
(4) None		

	Unit 1	**Unit 2**	**Unit 3**
1. Type (*a*)			
2. Size (cubic feet)			
3. Make			
4. Model			
5. Year of manufacture			
6. Energy Star (*yes* = 1, *no* = 2)			
7. Location *(cond=1, uncond=2)*			

Cooking

33. Is there a range/cooktop in the residence?
☐ Yes
☐ No (SKIP TO OVEN)

34. What type of range/cooktop do you primarily use in this home?(CHECK ONLY ONE)
☐ Electric Range/Cooktop
☐ Gas Range/Cooktop [SKIP TO OVEN]
☐ Propane Range/Cooktop [SKIP TO OVEN]
☐ Other (*Describe:*__________________________) [SKIP TO OVEN]
☐ None [SKIP TO OVEN]

35. Is the electric range/cooktop Energy Star?
☐ Yes
☐ No

36. Is the electric range/cooktop induction?
☐ Yes
☐ No

37. How old is the electric range/cooktop?
________ (Age in years) ☐☐Estimate?☐
(If estimate, estimate to increments of 5 years or less)

38. Is there an oven in the residence?
☐ Yes
☐ No (SKIP TO DISHWASHER)

39. What type of oven do you primarily use in this residence? (CHECK ONLY ONE)
- ☐ Electric Oven
- ☐ Gas Oven [SKIP TO DISHWASHER]
- ☐ Propane Oven [SKIP TO DISHWASHER]
- ☐ Other (*Describe:*_________________ __________) [SKIP TO DISHWASHER]
- ☐ None [SKIP TO DISHWASHER]

40. Is the electric oven:
- ☐☐standard
- ☐☐convection
- ☐☐combination

41. How old is the electric oven?

_______ (Age in years)☐☐☐ Estimate?

(If estimate, estimate to increments of 5 years or less)

Dishwashers

42. Is there a dishwasher in this residence?
- ☐ Yes
- ☐ No

43. How many dish loads are washed per week?

__________loads per week

44. How often is the energy saver option used during the drying cycle?
- ☐ All the time
- ☐ Sometimes
- ☐ Never

45. Is the dishwasher Energy Star?
- ☐ Yes
- ☐ No
- ☐ Don't Know

46. How old is the dishwasher?

_______ (Age in years) ☐☐Estimate?☐

(If estimate, estimate to increments of 5 years or less)

47. If there is a dishwasher, does it have a heat booster?
- ☐ Yes
- ☐ No
- ☐ None

	BRAND NAME	MODEL NUMBER
DISHWASHER	_______________________	______________________

Laundry

48. Is there a clothes washer in this residence for private use?
    - ☐ Yes
    - ☐ No

49. Is the clothes washer Energy Star?
    - ☐ Yes
    - ☐ No

50. How old is the clothes washer?

    _______ (Age in years) ☐☐Estimate?☐

    (If estimate, estimate to increments of 5 years or less)

51. How many loads of laundry are washed per week? _______

52. If there is a clothes washer, what is the orientation?
    - ☐ Horizontal (front loading)
    - ☐ Vertical (top loading)
    - ☐ None

Laundry

53. Is there a **clothes dryer** in this residence?
    - ☐ Yes
    - ☐ No

54. If there is a clothes dryer, what type of fuel does it use *for heat*?
    - ☐ Electric
    - ☐ Natural Gas [SKIP TO HOME ELECTRONICS]
    - ☐ LP Gas [SKIP TO HOME ELECTRONICS]
    - ☐ Other (*Describe:*_____________________) [SKIP TO HOME ELECTRONICS]
    - ☐ None

55. Is the clothes dryer Energy Star?
    - ☐ Yes
    - ☐ No

56. How many loads of laundry are dried with the clothes dryer per week?

    ____

57. How old is the clothes dryer?

    _______ (Age in years) ☐☐Estimate?☐

    (If estimate, estimate to increments of 5 years or less)

	BRAND NAME	MODEL NUMBER
CLOTHES WASHER	_____________________	____________________
CLOTHES DRYER	_____________________	____________________

Home Electronics & Other

TELEVISIONS

	Display (CRT/LCD/Plasma/Other)	Format Std/Wide	Size (Diag. inches)	Energy Star? (Y/N)	EMS	Avg. Hours of Daily Use
Unit 1						
Unit 2						
Unit 3						
Unit 4						
Unit 5						
Unit 6						

Video Game Systems and DVRs

	Type (DVR OR Video Game System)	EMS	Avg. Hours of Daily Use
Unit 1			
Unit 2			
Unit 3			
Unit 4			
Unit 5			
Unit 6			

Energy Management System	
EMS Type	**EMS Code**
Manual Power Strip (user turns off PS after each use)	**MPS**
Always On Power Strip	**AOPS**
Timer Strip	**TM**
Occupancy Sensor	**OSS**
Smart Strip	**SMS**
Other	**OT**

Computers & Peripherals

Computers	Type (Desktop OR Laptop)	Screen Size (diag. inch)	IF Desktop, Display: CRT OR LCD	Additional Display: CRT OR LCD	Energy Star? (Y/N)	EMS	Auto power down enabled? (Y/N)	Avg. Hours On per Day
Unit 1								
Unit 2								
Unit 3								
Unit 4								
Unit 5								
Unit 6								

Computer Peripherals	Type (Printer, scanner, external hard drive, modem, router)	Energy Star? (Y/N)	Energy Management System- (MPS, AOPS, TM, OSS, SMS, OT)	Average Hours On per Day
Unit 1				
Unit 2				
Unit 3				
Unit 4				
Unit 5				

PUMPS

Type (pool, spa, fountain, pond, sump, well)	Years Since Installation	Horsepower (HP)	Efficiency Rating? (s) Standard, (h) high, (p) premium	Motor Speed? (s) Single, (d) double, (v) variable	Timer?	Months of Use	Avg. Hours of Daily Use during months of use

FANS

Type (Attic, Whole house, Ceiling, Ventilation)	Years Since Installation	Horsepower (HP)	Energy Star?	Efficiency Rating? (s) Standard, (h) high, (p) premium	Months of Use	Avg. Hours of Daily Use during months of use

MISCELLANEOUS

Type (Water bed heater, humidifiers, dehumidifiers)	Years Since Installation	Energy Star?	Gallons per hour	Months of Use	Avg. Hours of Daily Use during months of use

WALL, ROOF, AND FLOOR INSULATION

58. Fill out the following information about the insulation of the home using the following codes:

(*a*) Roof Material	**(*b*) Roof Color**	**(*c*) Attic Type**
(T) Tile/Slate/Concrete (A) Asphalt Shingles (M) Metal or Membrane (W) Wood Shake	(D) Dark (L) Light (W) White	(N) None (Cathedral Ceiling) (V) Vented Attic (U) Unvented Attic

Reference Number	Roof Material (*a*)	Roof Color (*b*)	Attic Type (*c*)	Insulation Depth *(in)*	Radiant Barrier?	% Roof Area
1	T A M W	D L W	N V U		Y N	
2	T A M W	D L W	N V U		Y N	
3	T A M W	D L W	N V U		Y N	

Notes:	

(*b*) Construction
(2x4) 2x4 Stick Built
(2x6) 2x6 Stick Built
(BW) Block Wall

(*c*) Exterior Finish
(B) Brick/Block
(ST) Stucco
(SI) Siding

(d) Insulation Type
(B) Batts
(L) Loose Fill
(F) Expanded foam
(O) Other

Wall Ref. Number	% of Total Above Grade Wall Area	Construction (*b*)	Ext. Finish (*c*)	Rigid Foam Insulation?	Insulation Type (d)
1A		2x4 2x6 BW	B ST SI	Y N	
2A		2x4 2x6 BW	B ST SI	Y N	
3A		2x4 2x6 BW	B ST SI	Y N	

Wall Ref. Number	% of Total Below Grade Wall Area	Insulation Thickness (in)	Rigid Foam Insulation?	Insulation Type (d)
1B				
2B				
3B				

Wall Ref. Number	% of Total Floor Area	Insulation Thickness (in)	Insulation Type (d)
1T			
2T			
3T			

Notes:	

WINDOWS

59. Fill out the following information about the windows of the home using the following codes:

(*a*) Type
(O) Operable Window
(F) Fixed Window
(B) Bay Window
(G) Garden Window
(FD) French Door
(SD) Sliding Door
(SK) Skylight

(*b*) Orientation
(N) North
(NE) Northeast
(S) South
(NW) Northwest
(E) East
(SE) Southeast
(W) West
(SW) Southwest
(H) Horizontal (skylights only)

(*c*) Shading
(D) Drapes
(B) Blinds
(SS) Solar Screen
(WF) Window Film
(N) None

(*d*) Panes
(1) Single Pane
(2) Double Pane
(3) Triple Pane

(*e*) Frame
(A) Aluminum/metal
(W) Wood/ Vinyl

(*f*) Tinting
(C) Clear
(T) Tinted
(L) Low-e

Ref #	**Type (*a*)**	**Orient (*b*)**	**Shade (*c*)**	**Panes (*d*)**	**Frame (*e*)**	**Tint (*f*)**	**Total Sq Feet**	**Overhang (Y/N)**	**Storm Window (Y/N?)**
1				1 2 3	A W	C T L			
2				1 2 3	A W	C T L			
3				1 2 3	A W	C T L			
4				1 2 3	A W	C T L			
5				1 2 3	A W	C T L			
6				1 2 3	A W	C T L			
7				1 2 3	A W	C T L			
8				1 2 3	A W	C T L			
9				1 2 3	A W	C T L			
10				1 2 3	A W	C T L			
11				1 2 3	A W	C T L			
12				1 2 3	A W	C T L			
13				1 2 3	A W	C T L			
14				1 2 3	A W	C T L			
15				1 2 3	A W	C T L			
16				1 2 3	A W	C T L			
17				1 2 3	A W	C T L			
18				1 2 3	A W	C T L			
19				1 2 3	A W	C T L			
20				1 2 3	A W	C T L			
Notes:									

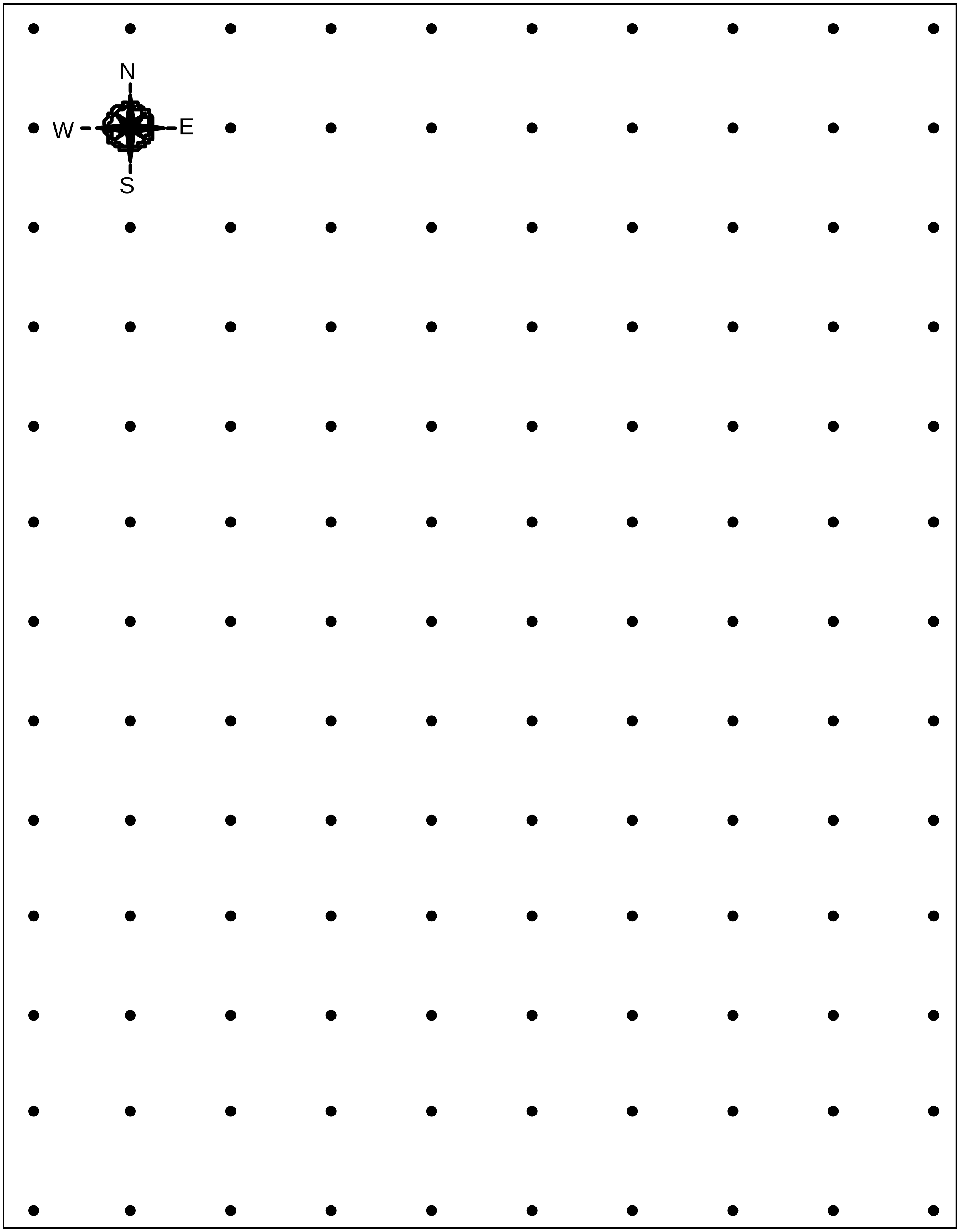
DOORS

60. Fill out the following information about the doors of the home using the following codes:

(*a*) **Door Type**	(*b*) **Orientation**	(*c*) **Quality of Caulking/ Weather Stripping**
(1) Hollow Wood	(1) North	(1) Good
(2) Solid Wood	(2) South	(2) Fair
(3) Sliding Glass Door	(3) East/West	(3) Poor or None
(4) French Doors	(4) SE	
(5) Other	(5) SW	
(6) Steel	(6) NE	
	(7) NW	
	(8) unconditioned indoors	

Reference Number	**Type (*a*)**	**Orientation (*b*)**	**Quality (c)**	**Number of Doors**	**Total Area**	**Storm Door?**
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

X. Sketch out the general outline of the residence floor plan and note the dimensions in feet.



Comments and Notes:

Question #	Comments/Explanations/Notes

Appendix K. 2012 C&I On-Site Survey Form

This appendix is provided in a separate file entitled "Appendix K – C and I Onsite Survey Form."

Appendix L. Detailed Potential Output

This appendix is provided in a separate Excel file entitled “Appendix L – Detailed Potential Output.xlsm”

DEMAND-SIDE RESOURCE POTENTIAL STUDY REPORT – DEMAND RESPONSE

Prepared for:
Kansas City Power and Light

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1 Executive Summary

This section provides a high-level executive summary of the contents of this report.

1.1 *Introduction and Background*

Kansas City Power and Light (KCP&L) and KCP&L Greater Missouri Operations (KCP&L GMO) ("the Companies") selected Navigant to conduct a Demand Side Management ("DSM") Resource Potential Study in January, 2012. The Study objective was to assess the various categories of electrical energy efficiency and demand response potential in the residential, commercial, and industrial sectors for the Companies' service areas from 2014 to 2033. Portions of the study may be used by the Companies to satisfy some of the demand-side analysis requirements of the Missouri Public Service Commission Regulations for Electric Utility Resource Planning ("MO Planning Regulations").[1] Results of this Study will be used in the Companies' Integrated Resource Planning ("IRP") processes 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 in support of the Companies' efforts to design highly effective potential demand-side programs that broadly cover the full spectrum of cost-effective end use measures for all customer market segments with the ultimate goal of achieving all cost-effective demand-side savings. As part of this study, Navigant also developed a suite of energy efficiency and demand response programs that were designed to achieve the savings deemed per this study to be "realistically achievable."

This document represents the Demand Response (DR) portion of the Demand Side Management ("DSM") Resource Potential Study and specifically presents the potential for peak demand savings attributable to demand response initiatives.

1.2 *Approach*

Navigant conducted the analysis for this study using its Demand Response Simulator (DRSim™) model. This model is designed to identify the critical component variables of peak demand impact, avoided cost estimates, program administration and evaluation costs, one-time startup costs, any incentive costs, and the appropriate population of potential participants. Navigant mirrored the model's approach after the methodology that the Federal Energy Regulatory Commission (FERC) used in its *National Assessment of Demand Response Potential*[2] (NADR), with a number of customizations added to specifically tailor the framework and inputs to the Companies.

Where possible, the analysis used inputs specific to the Companies, gathered through personal communications with the Companies, program documentation from the Companies, and KCP&L-GMO filings with the Missouri Public Service Commission (MO PSC).[3] Other resources referenced or

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[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

[2] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

[3] Including Kansas City Power & Light Company. *2012 Integrated Resource Plan.* Case No. EO-2012-0323. April 2012.

incorporated included the Missouri DSM potential study,[4] the Ameren UE DSM potential study,[5] Electric Power Research Institute (EPRI) research,[6] FERC's 2012 DR survey results,[7] and FERC's NADR.[8] In addition to leveraging NADR to inform the model approach, Navigant also used FERC's study as a benchmark for the model's output and to provide model participation, peak demand reduction, and equipment cost inputs that were unavailable through other data sources.

To capture a range of potential DR impacts, Navigant assumed Realistic Achievable Potential and Maximum Achievable Potential DR scenarios. The significance of these scenarios is presented briefly below:

- **Realistic Achievable Potential** means demand savings relative to a utility's baseline demand forecast resulting from expected program participation and realistic implementation conditions. This scenario mirrors FERC's Expanded BAU scenario and represents the approximate peak load reductions that the Companies may achieve through expansion of their current DR initiatives and implementation of some new DR initiatives with "best practice" participation levels[9] and medium-term backend integration with the Companies' AMI to support opt-in time-based rates.
- **Maximum Achievable Potential** means demand savings relative to a utility's baseline demand forecast resulting from expected program participation and ideal implementation conditions. It is considered the hypothetical upper-boundary of achievable demand-side savings potential. This scenario mirrors FERC's Achievable Potential scenario and represents an estimate of the maximum achievable potential for reliability-based DR penetration, based on full-scale deployment of DR programs under ideal implementation conditions, default dynamic pricing tariffs, and accelerated backend integration with the Companies' AMI to support opt-out time-based rates.

1.3 Results

This section provides a high-level summary of Navigant's estimates of DR potential for KCP&L and KCP&L GMO that the Companies could achieve during reliability-based events. Navigant estimates up to 453 MW in peak load reduction potential for KCP&L-KS, 642 MW for KCP&L-MO, and 840 MW for KCP&L-GMO by 2033 in the Max Achievable scenario, which represents about 21.3, 28.2, and 31.0

---

[4] "Missouri Statewide DSM Potential Study – Final Report." Published by KEMA Consulting. March 04, 2011.

[5] AmerenUE Demand-side Management (DSM) market Potential Study, Volume 3, prepared by Global Energy Partners, January 2010.

[6] Electric Power Research Institute. *Understanding Electric Utility Customers – Summary Report.* Report #1025856, Final Report, October 2012.

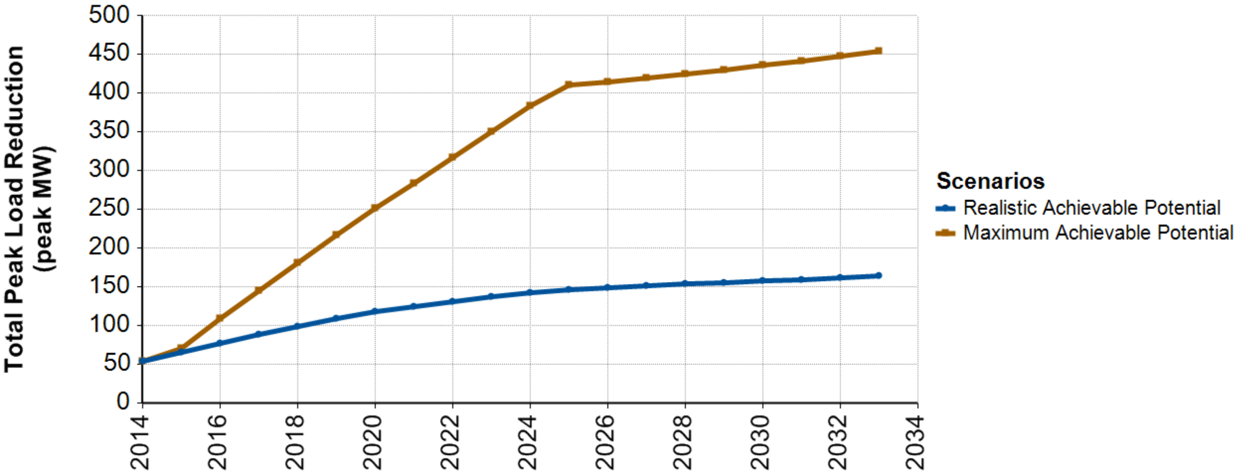
[7] Federal Energy Regulatory Commission, *2012 Survey on Demand Response and Advanced Metering*. Demand Response Survey Data, December 2012.

[8] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009. "National Demand Response Potential Model Guide", prepared for FERC, June 2009.

[9] This analysis uses FERC's interpretation of "best practices," where it refers only to "high rates of participation in demand response programs, not to a specific demand response goal nor the endorsement of a particular program design or implementation. The best practice participation rate is equal to the 75th percentile of ranked participation rates of existing programs of the same type and customer class." Source: Federal Energy Regulatory Commission. *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

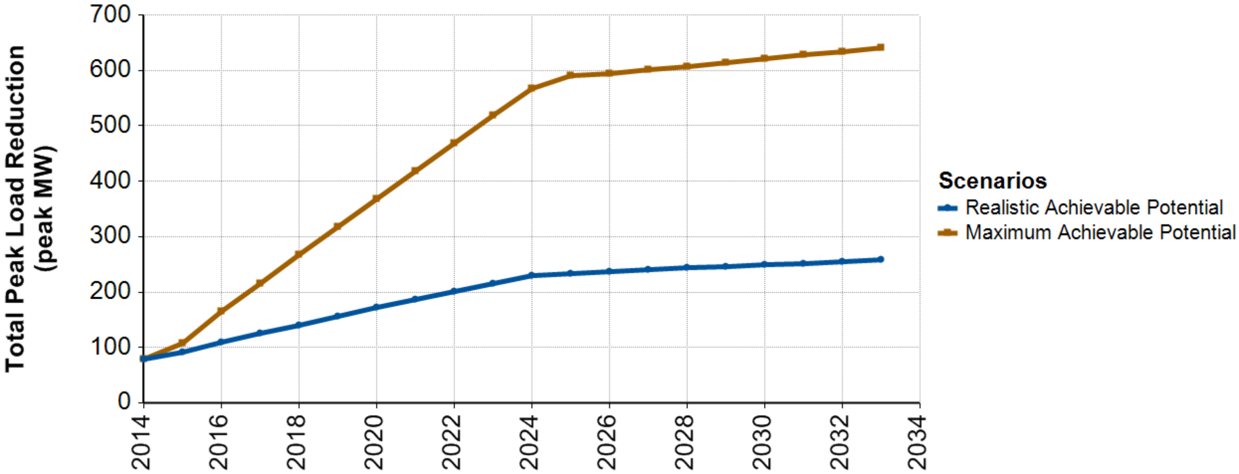
percent of each utility's forecasted peak load for 2033, respectively. The potential in the Max Achievable scenario reflects the peak load reductions that *could* be possible if the Companies were to drive new DR customer participation through targeted program marketing and investment in new infrastructure deployment and integration. These findings are benchmarked against the Realistic Achievable findings in Figure 1-1 through Figure 1-3 and Table 1-1, which show the total peak load reduction potential estimated for KCP&L-KS, KCP&L-MO, and KCP&L-GMO in each scenario.

Figure 1-1. Total Peak Load Reduction Potential by Scenario for KCP&L-KS (peak MW)



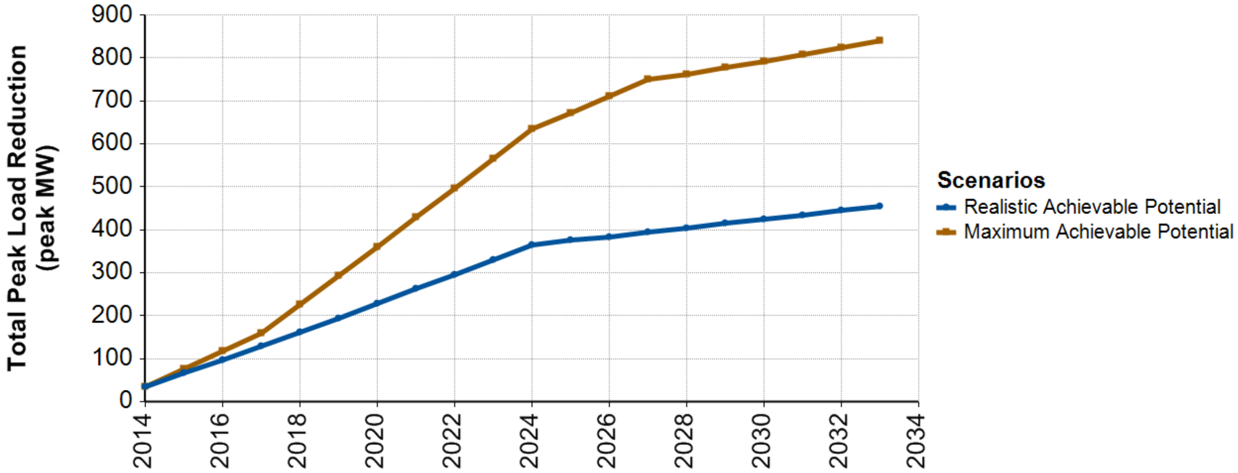
Source: Navigant analysis

Figure 1-2. Total Peak Load Reduction Potential by Scenario for KCP&L-MO (peak MW)



Source: Navigant analysis

Figure 1-3. Total Peak Load Reduction Potential by Scenario for KCP&L-GMO (peak MW)



Source: Navigant analysis

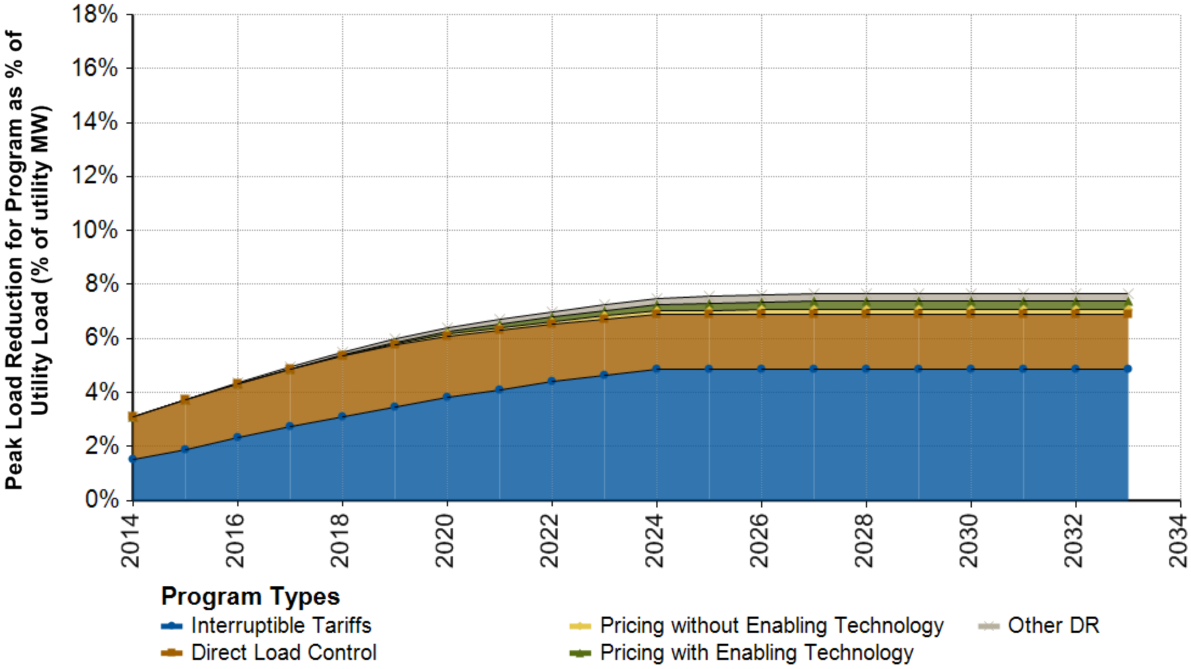
Table 1-1. Total Peak Load Reduction Potential by Scenario for the Companies (peak MW)

Utility	KCP&L-KS		KCP&L-MO		KCP&L-GMO	
Scenario	Realistic Achievable	Max Achievable	Realistic Achievable	Max Achievable	Realistic Achievable	Max Achievable
2014	54	54	78	78	36	36
2015	66	70	91	108	66	75
2016	77	109	110	164	98	117
2017	88	145	125	216	130	158
2018	99	181	141	267	162	226
2019	108	216	156	318	195	294
2020	117	251	172	368	229	361
2021	124	284	187	418	262	428
2022	130	317	201	468	296	497
2023	137	350	215	518	330	565
2024	143	383	230	568	365	636
2025	146	410	233	591	375	672
2026	148	413	237	594	384	710
2027	151	419	241	601	394	750
2028	153	424	243	607	404	760
2029	155	430	246	614	415	777
2030	157	436	249	621	425	792
2031	159	441	252	627	435	808
2032	161	447	255	634	445	824
2033	164	453	258	642	455	840

Source: Navigant analysis

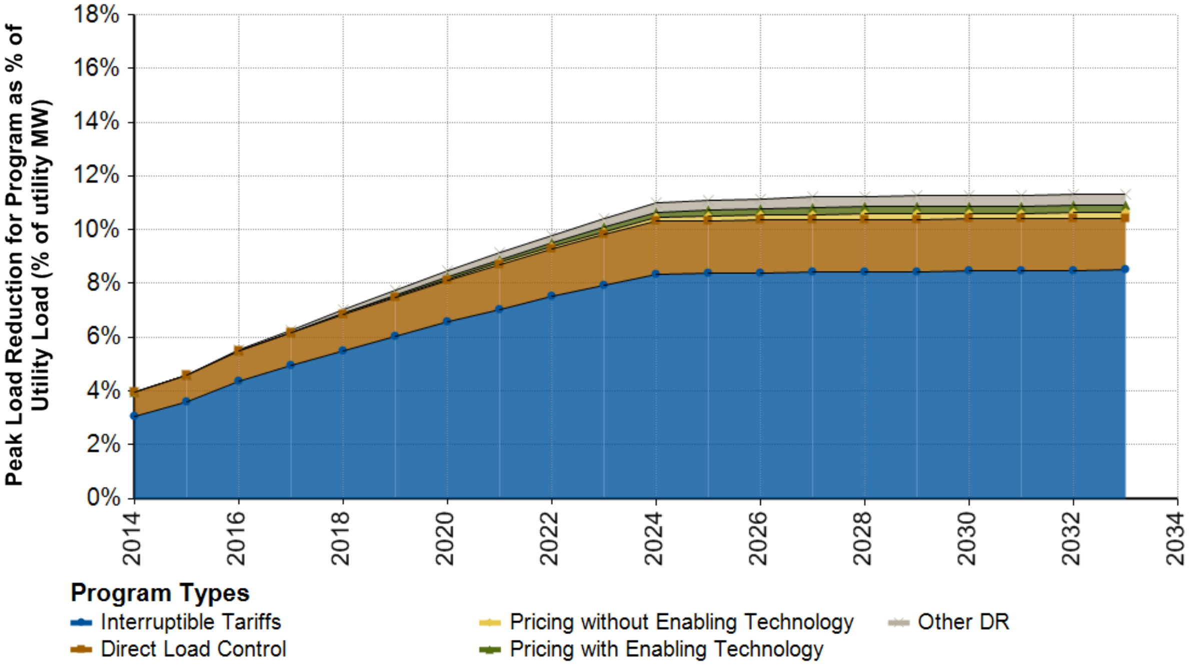
Variations between the three utilities are largely due to differences in total peak load, the mix of customers by rate class, and assumptions about customer load sizes and end uses that impact the amount of load a customer can reduce (e.g., large versus small industrials, higher versus lower air conditioning penetrations, etc.). Figure 1-4 through Figure 1-6 show the peak load reductions estimated in the Realistic Achievable scenarios for each of the Companies as the percentage of system load that could be reduced through different DR program types. This information is shown as tabular results for both the Realistic and Max Achievable scenarios in Appendix C – DR Demand Savings and Costs by Program Type.

Figure 1-4. Peak Load Reduction Potential for KCP&L-KS – Realistic Achievable Scenario (% of utility MW)



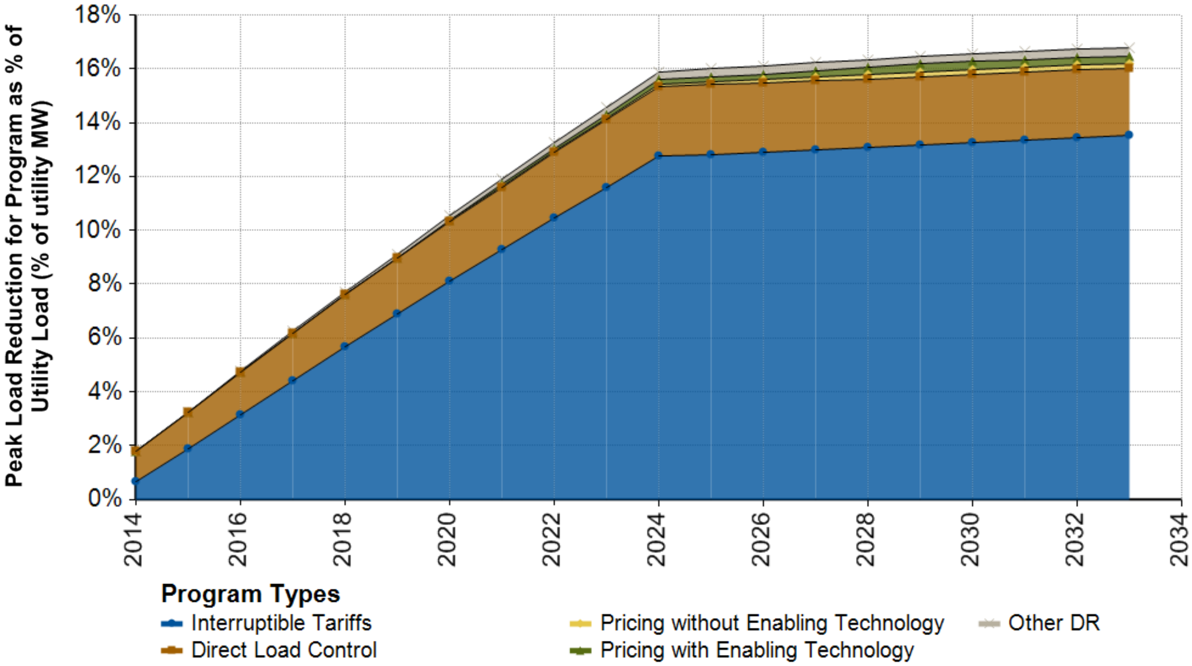
Source: Navigant analysis

Figure 1-5. KCP&L-MO Peak Load Reduction Potential – Realistic Achievable Scenario (% of utility MW)



Source: Navigant analysis

Figure 1-6. KCP&L-GMO Peak Load Reduction Potential – Realistic Achievable Scenario (% of utility MW)



Source: Navigant analysis

All of the scenarios show that significant potential growth still exists for the Companies' MPower Interruptible/Curtailable Tariff programs in the Medium and Large C&I customer segments, particularly in the KCP&L-MO and GMO territories. In contrast, participation rates in the Companies' Energy Optimizer Direct Load Control programs are already close to "best practice," though some additional potential exists. In the case of the pricing programs, the Max Achievable impacts are significantly higher than the Realistic Achievable impacts, which is due to the assumption that the pricing programs are opt-in in the Realistic scenario and opt-out in the Max Achievable scenario. Finally, while the cost effectiveness results suggest that the Other DR program may be cost effective, the potential peak reductions are relatively small.

- **Deployment of pricing programs is predicated on the backend integration of the Companies' AMI systems. While the Companies plan to deploy AMI across most of their service territories before 2020, the Companies do not have explicit plans to invest in the backend integration required to support time-based rates, such as installation of a Meter Data Management System (MDMS), which can add significant upfront costs to the program's deployment.**

- **The analysis includes the estimated costs of installing a MDMS[10] as a one-time startup cost for the pricing programs and finds that the pricing programs are cost effective when analyzed over a long-term horizon (i.e., the 20-year analysis period). However, we note that with relatively low near-term avoided capacity costs projected for the Companies, there is a significant time lag (10-15 years) before the cumulative program benefits surpass the cumulative program costs.**

- **This suggests that the timing of deployment for the pricing programs may warrant monitoring of capacity price forecasts and possibly aligning deployment with capacity price increases (which could shorten the effective payback time).**

Overall, this analysis finds significant potential for cost-effective DR program growth, with as much as 21-31 percent of each utility's peak demand in 2033 met by DR, as compared to less than 5 percent met by the Companies' existing programs. Furthermore, Navigant's cost-effectiveness analysis found that all of the program types are likely to be cost-effective over a 20-year horizon using the Total Resource Cost (TRC) benefit-cost test as a screen for all three of the utilities. These results reflect the estimated benefits from the continued promotion of the Companies' existing MPower and Optimizer programs, as well as investing in the infrastructure needed for backend integration of the Companies' AMI systems to support time-based rate programs.

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[10] The MDMS installed cost assumed in this analysis of $1,000,000 is a reasonable initial estimate based on MDMS costs for other independently owned utilities; however, this cost can vary widely depending on the utility's system and functionality requirements, so the actual cost may be relatively uncertain.

2 Introduction

This section provides a brief introduction to the contents of this report, including a background discussion and summary of the study goals. This section also provides a summary of the report organization to facilitate reader navigation of its contents.

2.1 *Background and Study Goals*

Kansas City Power and Light (KCP&L) and KCP&L Greater Missouri Operations (KCP&L GMO) ("the Companies") selected Navigant to conduct a Demand Side Management ("DSM") Resource Potential Study in January, 2012. The Study objective was to assess the various categories of electrical energy efficiency and demand response potential in the residential, commercial, and industrial sectors for the Companies' service areas from 2014 to 2033. Portions of the study may be used by the Companies to satisfy some of the demand-side analysis requirements of the Missouri Public Service Commission Regulations for Electric Utility Resource Planning ("MO Planning Regulations").[11] Results of this Study will be used in the Companies' Integrated Resource Planning ("IRP") processes 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 in support of the Companies' efforts to design highly effective potential demand-side programs that broadly cover the full spectrum of cost-effective end use measures for all customer market segments with the ultimate goal of achieving all cost-effective demand-side savings. As part of this study, Navigant also developed a suite of energy efficiency and demand response programs that were designed to achieve the savings deemed per this study to be "realistically achievable."

This document represents the Demand Response (DR) portion of the Demand Side Management ("DSM") Resource Potential Study and specifically presents the potential for peak demand savings attributable to DR initiatives.

In addition to these efforts, the Companies are currently engaged in DR research with the Electric Power Research Institute (EPRI) and KCP&L-MO's SmartGrid Demonstration Project. This research is also expected to meet some of the MO Planning Regulations. Navigant has collaborated throughout this project with EPRI and the SmartGrid Project and intends for this study to complement those efforts.

2.2 *Stakeholder Involvement*

Navigant involved a broad range of stakeholders throughout the study to ensure opportunity for review and comment of key study assumptions and methods was provided to those where were interested. Navigant invited the following organizations to each meeting and copied each of these stakeholders on correspondence providing key assumption and methodology files. Navigant reviewed and responded to stakeholder comments and distributed final documents to all stakeholders.

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[11] 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

Stakeholders:

- KCP&L, KCP&L Greater Missouri Operations
- Missouri Public Service Commission
- Missouri Office of Public Counsel
- Missouri Department of Natural Resources
- National Resources Defense Council
- Empire Electric District
- Renew Missouri
- Ameren

Table 2-1 provides a summary of key stakeholder review meetings and relevant files pertaining to the review process.

Table 2-1. List of Stakeholder Meetings and Relevant Review and Response Files

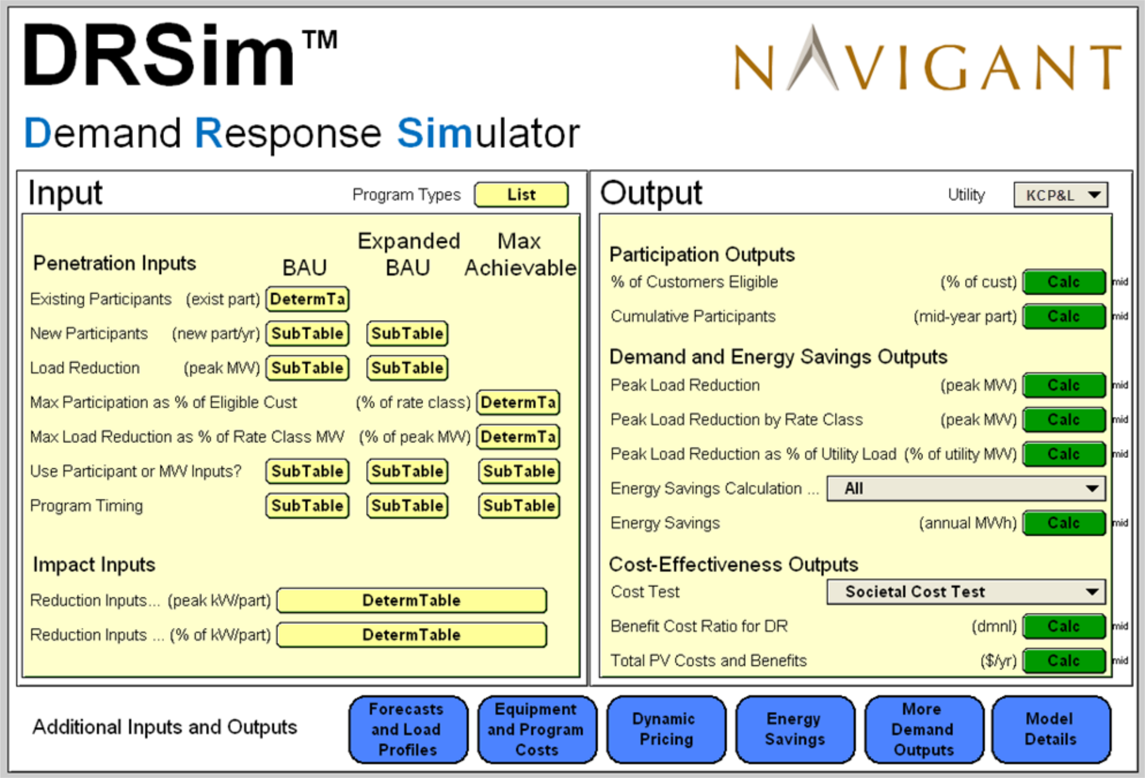
Review Item or Milestone	Review Type	Meeting Date (s)	Final File Date(s)	Relevant File Name(s)
DR Measures/ Approach	File for review	N/A	12/3/2012	KCPL_DR Measures-Approach Memo_07-17-12.docx
List of EE and DR Programs	File for review	N/A	12/3/2012	KCPL GMO Final Programs Matrix Dec 3 2012.docx
EE/DR Modeling Approach	Webinar	12/13/2012	12/13/2012, 01/03/2013, 01/14/2013	KCPL EEDR Demand Side Resource Potential Modeling Methodology 2012_12_13_R2.pdf; Response to KCPL and GMO StakeholderComments_2013_January_03 v4.docx; Response to KCPL and GMO StakeholderComments_2013_January_14;

2.3 *Demand Response Potential Model Description*

Navigant conducted the analysis for this study using its Demand Response Simulator (DRSim™) model. This model is designed to identify the critical component variables of peak demand impact, avoided cost estimates, program administration and evaluation costs, one-time startup costs, any incentive costs, and the appropriate population of potential participants. Navigant mirrored the model's approach after the methodology that the Federal Energy Regulatory Commission (FERC) used in its *National Assessment of Demand Response Potential*[12] (NADR), with a number of customizations added to specifically tailor the framework and inputs to the Companies. Although some DR programs included in this model could be deployed for economic considerations, the model output is intended to reflect the potential for peak load reduction that the Companies could achieve during reliability-based events. Figure 2-1 provides a screen capture of DRSim's graphical user interface.

[12] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

Figure 2-1. DRSim™ Graphical User Interface



Where possible, the analysis used inputs specific to the Companies, gathered through personal communications with the Companies, program documentation from the Companies, and KCP&L-GMO filings with the Missouri Public Service Commission (MO PSC).[13] Other resources referenced or incorporated included the Missouri DSM potential study,[14] the Ameren UE DSM potential study,[15] Electric Power Research Institute (EPRI) research,[16] FERC's 2012 DR survey results,[17] and FERC's NADR.[18] In addition to leveraging NADR to inform the model approach, Navigant also used FERC's study to provide model inputs that were unavailable through other data sources and as a benchmark for the model's output.

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[13] Including Kansas City Power & Light Company. *2012 Integrated Resource Plan*. Case No. EO-2012-0323. April 2012.

[14] "Missouri Statewide DSM Potential Study – Final Report." Published by KEMA Consulting. March 04, 2011.

[15] AmerenUE Demand-side Management (DSM) market Potential Study, Volume 3, prepared by Global Energy Partners, January 2010.

[16] Electric Power Research Institute. *Understanding Electric Utility Customers – Summary Report*. Report #1025856, Final Report, October 2012.

[17] Federal Energy Regulatory Commission, *2012 Survey on Demand Response and Advanced Metering*. Demand Response Survey Data, December 2012.

[18] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009. "National Demand Response Potential Model Guide", prepared for FERC, June 2009.

3 Methodology and Key Assumptions

This study leveraged assumptions and inputs from a variety of sources, including several different resources specific to the Companies and FERC's NADR, as discussed below.

3.1 *Demand Response Program Types*

This section provides brief overviews of five different DR program types included in the analysis. These program types are based on those referenced in NADR, as well as on specific initiatives that the Companies are currently considering or implementing. At a high-level, the results for these different program types inform the DR program design efforts Navigant is conducting in parallel with this potential study. These program types are briefly described more below.

Some DR program types, including most time-based rates, require interval data collection and often require two-way communications between the utility and the customer's meter. These functionalities are inherent in advanced metering infrastructure (AMI) meters, but typically require investment in systems like a Meter Data Management System (MDMS) and integration with the utility's billing system. While the Companies plan to deploy AMI across most of their service territories before 2020, the Companies do not have explicit plans to install a MDMS or integrate the AMI with the systems required to support time-based rates. An important assumption within both the Realistic and Maximum Achievable scenarios is that the Companies invest in the additional infrastructure needed to integrate the AMI with the Companies' DR programs and offer time-based rates.

Interruptible/Curtailable Tariffs

FERC defines an interruptible (or curtailable) tariff as a rate structure in which customers agree to reduce consumption to a pre-specified level, or by a pre-specified amount, during system reliability events in exchange for an incentive payment.[19] The analysis limits participation in this program type to Medium and Large C&I customers and assumes that participants do not require additional investments in AMI or other equipment for participation.

This program type represents the Companies' existing MPower peak load reduction programs for commercial and industrial customers, in which the Companies collaborates with customers to curtail (or reduce) their energy use during times of peak electric demand. Events may be called for reliability or economic reasons. Reductions are commonly achieved by reducing lighting and HVAC load, shutting down equipment, or switching facility load to an onsite generator. MPower provides customers with two forms of financial incentives: 1) a monthly "participation payment" for being "on call" to reduce power consumption at the Companies' request, and 2) an additional "event payment" for successfully reducing demand each time they are called upon to do so. Participants must be current electric customers on a non-residential rate, who are able to provide a minimum reduction of 25kW during the specified curtailment season and curtailment hours.

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[19] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

Direct Load Control (DLC)

This program type is modeled after the Companies' existing Energy Optimizer programs for Residential and Small Commercial (R&SC) customers. In the Energy Optimizer program, the Companies provide a free programmable thermostat to residential and small commercial customers with peak demand less than 25 kW. The Companies then remotely raise the customer's thermostat setpoint or cycles the A/C equipment without notification to reduce system load on peak summer days.

Because the scope of this analysis is limited, we did not look at the potential for DLC in other end uses, such as water heating or pool pumps, due to the relatively low expected impact. These end uses may provide additional opportunity for peak load reduction beyond that presented here.

Pricing without Enabling Technology

Dynamic pricing refers to the family of rates that offer customers time-varying electricity prices on a day-ahead or real-time basis.[20] Examples of dynamic rates include time of use (TOU),[21] critical peak pricing (CPP), peak time rebates (PTR), and real-time pricing (RTP). Customers without enabling technology are assumed to manually curtail load in response to these dynamic time-varying pricing signals. Pricing signals can be communicated to customers via delivery mechanisms such as text messages, which avoid the need for additional investment in technologies such as in-home displays.

This analysis assumes that integrated AMI must be in place for a customer to be eligible for dynamic pricing. For residential customers, the analysis reflects the program impacts from a TOU rate in the Realistic Achievable scenario and a TOU with CPP rate in the Maximum Achievable scenario. The Companies are particularly interested in assessing TOU potential, given KCP&L-MO's current TOU pilot through the SmartGrid Demonstration Project, so it is specifically explored as part of this study. The program impacts for C&I customers are consistent with those assumed in the FERC NADR study, which does not assume a specific type of pricing.

Pricing with Enabling Technology

In this program type, customers are on a dynamic pricing rate, but also have enabling technology for automatic load curtailment. This analysis defines enabling technology as devices that automatically control load and reduce consumption during high-priced hours. Examples of enabling technology include Programmable Communication Thermostats (PCT), load switches, and Automated Demand Response (Auto-DR).[22] This analysis assumes that:

- The Residential, Small C&I, and Medium C&I customers with enabling technology have a PCT, whereas Large C&I customers have Auto-DR;
- Customer participation requires AMI; and

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[20] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

[21] While FERC's 2009 NADR study does not consider TOU a form of dynamic pricing, other industry definitions of dynamic pricing in more recent reports from EPRI and The Brattle Group include TOU as dynamic pricing. Sources: Electric Power Research Institute, *Understanding Electric Utility Customers – Summary Report.* Report #1025856, Final Report, October 2012. Faruqui, Ahmad, "Dynamic Pricing for Residential and Small C&I Customers", The Brattle Group, Presented to Ohio Public Utilities Commission, March 28, 2012.

[22] Automated Demand Response uses a customer's automated load control systems, such as an energy management system, to participate in DR events without manual intervention.

- Customers are offered the same pricing program types as in pricing without enabling technology.

Other DR

The assumed costs and impacts associated with this program type align with a curtailable load program targeted towards increased Small and Medium C&I customer participation. This new program would be an expansion of the Companies' existing MPower programs to Small and Medium C&I customers and may be a subset within the MPower program. No AMI would be needed to participate. Load curtailment through this program could be used for both economic and reliability-based dispatch.

3.2 Model Scenarios

To capture a range of potential DR impacts, Navigant assumed two DR potential scenarios: Realistic Achievable Potential and Maximum Achievable Potential. The primary differences between these scenarios relate to the assumed program participation levels, participant peak load reductions, and expected timing for AMI deployment and backend integration. Key inputs and assumptions for each scenario are discussed further in Sections 3.3 through 3.7.

3.2.1 Realistic Achievable Potential Assumptions

Realistic achievable potential means demand savings relative to a utility's baseline demand forecast, resulting from expected program participation and **realistic** implementation conditions. This scenario mirrors FERC's Expanded BAU scenario and represents the approximate peak load reductions that the Companies may achieve through expansion of their current DR initiatives and implementation of some new DR initiatives with "best practice" participation levels.[23] This scenario assumes that the Companies fully deploy AMI across KCP&L's and KCP&L GMO's territories according to their currently planned deployment schedule (i.e., by 2016 in KCP&L and 2020 in GMO) with at least partial backend integration by 2017 and 2019, respectively, to support opt-in time-based rates (see Table 3-4).

3.2.2 Maximum Achievable Potential Assumptions

Maximum achievable potential means demand savings relative to a utility's baseline demand forecast, resulting from expected program participation and **ideal** implementation conditions. Maximum achievable potential establishes a maximum target for demand-side savings that a utility can expect to achieve through its demand-side programs and may involve incentive or deployment costs that represent a very high portion of total programs costs. Maximum achievable potential is considered the hypothetical upper-boundary of achievable demand-side savings potential, because it presumes conditions that are ideal and not typically observed.

This scenario mirrors FERC's Achievable Potential scenario and represents an estimate of the maximum achievable potential for reliability-based DR penetration, based on full-scale deployment of DR

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[23] This analysis uses FERC's interpretation of "best practices," where it refers only to "high rates of participation in demand response programs, not to a specific demand response goal nor the endorsement of a particular program design or implementation. The best practice participation rate is equal to the 75th percentile of ranked participation rates of existing programs of the same type and customer class." Source: Federal Energy Regulatory Commission. *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

programs under ideal implementation conditions and default dynamic pricing tariffs. This scenario assumes backend integration with the Companies' AMI is accelerated to support opt-out time-based rates (see Table 3-4).

3.3 Market Characterization

This section discusses the analysis inputs that Navigant collected to define the DR potential market for the Companies. The inputs discussed below include the peak demand forecasts, number of customers forecast, customer load profiles, portion of customers with load suitable for automated control, and AMI deployment forecasts for the Companies.

3.3.1 Peak Demand and Customer Forecasts

This study uses FERC's definition of *peak* and assumes that DR occurs for 4 hours a day during the 15 highest load days of the year. As a result, the DR presented in this analysis reduces peak demand, but not necessarily demand during non-peak times.[24]

To tailor the DR potential estimate to the Companies' service territory, the team collected the peak load[25] and customer forecasts[26] for KCP&L-KS, KCP&L-MO, and KCP&L-GMO through 2033. The peak load forecasts provided by the Companies are without demand-side management (DSM) [27] and serve as the baseline for the analysis. The number of customers informs the maximum penetration of DR programs in the Max Achievable scenario (see Section 3.4.2).

3.3.2 Customer Rate Classes and Load Profiles

Because the potential for DR varies depending on the size and type of customer, the analysis divided the Companies' customers into the following rate classes:

- Residential[28]
- Small C&I (<25 kW)
- Medium C&I (25–200 kW)
- Large C&I (>200 kW)

These rate classes were chosen to maintain consistency with the rate classes used in NADR[29] and with KCP&L's General Service tariffs, which require a minimum demand of 25 kW for Medium General Service and 200 kW for Large General Service. Table 3-1 shows the average customer load profile for each rate class, based on the average peak load per customer under each tariff.

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[24] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009, p. 28.

[25] Maximum monthly load in each year from Coincident Peak Demand By Class (MW) from KCPL Energy Peak Customers.xls and GMO Energy Peak Customers.xls.

[26] Maximum monthly number of customers in each year from "KCPL Energy Peak Customers.xls" and "GMO Energy Peak Customers.xls". Excludes Street Lighting and Sales-for-resale.

[27] Confirmed via phone communications with Joe O'Donnell, GPES, December 17, 2012.

[28] Includes multi-family, as included in GPES's residential tariffs.

[29] FERC's DR potential study actually divides Small and Medium C&I at 20 kW; however, the distinction between 20 kW and 25 kW likely has no significant impact on the analysis.

Table 3-1. Average Customer Load Profiles (peak kW/customer)

Rate Class	Utility		
	KCP&L-KS	KCP&L-MO	KCP&L-GMO [30]
Residential	4.6	3.3	4.0
Small C&I (<25 kW)	3.0	3.9	2.0
Medium C&I (25-200 kW)	39.4	43.0	29.5
Large C&I (>200 kW)	408.7	685.5	456.8

Source: Navigant analysis, based on the Companies' peak demand and number of customer forecasts by rate class.

Table 3-2 shows the portion of customers with load (e.g., cooling load) suitable for participation in programs that require automated load control, such as DLC and pricing with enabling technology.

Table 3-2. Proportion of Customers with Suitable Load

	Percentage of Customers with Suitable Load	
Rate Class	Missouri	Kansas
Residential	87.5%	83.7%
Small C&I (<25 kW)	74%	74%
Medium C&I (25-200 kW)	77%	77%
Large C&I (>200 kW)	40%	40%

Source: Federal Energy Regulatory Commission, A National Assessment of Demand Response Potential. Prepared by The Brattle Group, June 2009.

Finally, Table 3-3 shows the program types that are considered in the DR potential model for each of these rate classes.

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[30] Since KCP&L-GMO does not have a Medium General Service tariff, KCP&L-GMO's Small and Large General Service customers and load were divided into these rate classes by using the same proportion of customers and load in each rate class as in KCP&L.

Table 3-3. Overview of DR Program Types and Rate Classes Assessed

	Rate Classes			
Demand Response Programs	**R**	**S**	**M**	**L**
Interruptible/Curtailable Tariffs			X	X
Direct Load Control	X	X		
Pricing without Enabling Technology	X	X	X	X
Pricing with Enabling Technology	X	X	X	X
Other DR		X	X	

R = Residential, S = Small C&I, M = Medium C&I, L = Large C&I

3.3.3 AMI Deployment Forecast

As discussed in Section 3.1, the analysis assumes that a customer must have access to an AMI meter integrated with the Companies' backend systems to participate in a pricing program. Through discussions with the Companies, Navigant has developed forecasts for when AMI will be deployed across each service territory, as well as a rough estimate of when the Companies might install MDM systems and integrate the AMI to support pricing programs. This forecast appears in Table 3-4 below for both scenarios and is an important driver in the deployment of time-based rates.

Table 3-4. Assumed Timing for AMI Deployment and Backend Integration to Support Time-Based Rates (% of customers)

Scenario	Utility	Year Backend Integration Occurs	AMI Deployment Forecast							
			2013	2014	2015	2016	2017	2018	2019	2020
Realistic Potential	KCP&L-KS	2017	0%	50%	80%	100%	100%	100%	100%	100%
	KCP&L-MO	2017	*	50%	80%	100%	100%	100%	100%	100%
	KCP&L-GMO	2019	0%	0%	0%	0%	0%	50%	80%	100%
Maximum Potential	KCP&L-KS	2015	0%	50%	80%	100%	100%	100%	100%	100%
	KCP&L-MO	2015	*	50%	80%	100%	100%	100%	100%	100%
	KCP&L-GMO	2017	0%	0%	50%	80%	100%	100%	100%	100%

*Commercial = 0.5%, Residential = 3%

Note: Assumes one MDMS is installed in KCP&L and one is installed in KCP&L GMO.

Source: Based on email and phone communications with Joe O'Donnell, KCP&L, December 2012 and Navigant analysis.

The key differences between the two scenarios are the accelerated meter deployment for KCP&L-GMO and the accelerated backend integration for both utilities in the Maximum scenario, which allow time-based rates to be offered sooner in the Maximum scenario. For comparison, the Achievable Potential scenario in FERC's NADR study, which corresponds to the Maximum Achievable Potential scenario here, assumes full AMI deployment in Kansas and Missouri by 2019.

3.3.4 Customer Program Eligibility

The percentage of customers eligible for each program type is an important constraint on program participation, as described below in Section 3.4. Navigant estimated this percentage using the proportion of customers with load suitable for automated load control from Table 3-2 and customers with integrated AMI meters from Table 3-4. Table 3-5 shows how these constraints are applied to each program type.

Table 3-5. Requirements for DR Program Eligibility

Program Type	Requires Load Suitable for Automated Load Control?	Requires Integrated AMI?
Interruptible/Curtailable Tariffs		
Direct Load Control	Yes	
Dynamic Pricing w/o Enabling Technology		Yes
Dynamic Pricing w/ Enabling Technology	Yes	Yes
Other DR		
Time of Use		Yes

3.4 *Participation Assumptions*

The program participation inputs use a base case participation forecast provided by the Companies as the initial DR penetration in 2014 (see Table 3-6), then assume a maximum penetration of DR program deployment (see Table 3-7) and a number of years it takes to reach that maximum penetration for each scenario.[31] This approach is consistent with the methodology used in NADR.

3.4.1 Base Case Participation Inputs

Table 3-6 shows the participation in each program type at the start of the analysis in 2014, based on the Companies' currently planned DR program forecasts. MPower and Energy Optimizer are the only programs assumed to be available.

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[31] The analysis assumes ten years for all program types and scenarios. Source: Oak Ridge National Laboratory, "Eastern Interconnection Demand Response Potential", ORNL/TM-2012/303, DRAFT, October 2012, "NADR-XL7v2s_S_20120710.xlsx." Based on high-case numbers from Faruqui, A. and D. Mitarotonda (2011). "Energy efficiency and demand response in 2020- a survey of expert opinion". Available at http://www.brattle.com/_documents/UploadLibrary/Upload990.pdf.

Table 3-6. Base Case Participation Inputs in 2014 (in kW)

Utility	Interruptible Tariffs	Direct Load Control	All Other Program Types
KCP&L-MO	59,997	18,000	0
KCP&L-KS	26,630	27,000	0
GMO	13,648	22,000	0

Sources:
Interruptible Tariffs: MPower forecast provided by Joe O'Donnell, KCP&L, "KCPL_GMO MPower forecast.xlsx", December 5, 2012.
Direct Load Control: Energy Optimizer forecast provided in National Association of Regulatory Utility Commissioners, Assessment of Demand-Side Resources Survey, Submitted by KCP&L on December 10, 2012.

KCP&L-MO is also currently offering a TOU rate and other residential smart grid DR strategies through its SmartGrid Demonstration Project (the "pilot") for residential customers in its Green Impact Zone. This pilot began in 2012 and will run through 2014. Since the Companies expect program participation to be limited to a few hundred customers, this program is not included in the potential analysis. However, the Companies expect that the pilot will help inform future program deployments, such as the potential deployment of a more widespread residential TOU rate.

3.4.2 Maximum Participation Inputs for Realistic and Maximum Achievable Scenarios

Table 3-7 shows the maximum penetration of DR program deployment, which is estimated as either a percentage of the total peak demand or a percentage of the eligible customers for each rate class, depending on the information available for each program and utility. These estimates are based on the "Expanded BAU" and "Achievable Participation" scenarios in Kansas and Missouri from either FERC's NADR or ORNL's recent update to NADR for the Eastern Interconnection.

Table 3-7. Maximum Participation Inputs for Realistic and Maximum Achievable Potential Scenarios (% of Rate Class MW or Eligible Customers)

Program Type	Participation Input	Scenario	Residential	Small C&I (<25 kW)	Medium C&I (25-200 kW)	Large C&I (>200 kW)
Interruptible Tariffs	% of rate class MW	Both	0%	0%	40%	40%
Direct Load Control	% of customers w/suitable load	Both	21%	20%	20%	20%
Pricing w/o Enabling Technology	% of customers w/AMI	Realistic	5%	5%	5%	5%
		Maximum	75%	75%	60%	60%
Pricing w/ Enabling Technology	% of customers w/suitable load & AMI	Realistic	2.9%	2.9%	2.9%	2.9%
		Maximum	42.7%	42.7%	34.2%	34.2%
Other DR	% of rate class MW	Realistic	0%	1.2%	7.2%	23.4%
		Maximum		20%	20%	

Source for Interruptible, Direct Load Control, and Other DR (Maximum): Oak Ridge National Laboratory, "Eastern Interconnection Demand Response Potential", ORNL/TM-2012/303, DRAFT, October 2012, "NADR-XL7v2s_S_20120710.xlsx." Based on high-case numbers from Faruqui, A. and D. Mitarotonda (2011). "Energy efficiency and demand response in 2020- a survey of expert opinion." Available at http://www.brattle.com/_documents/UploadLibrary/Upload990.pdf.
Source for Dynamic Pricing and Other DR (Realistic): Federal Energy Regulatory Commission. *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.
* All inputs are the same for Kansas and Missouri.
** Estimates presented here do not account for potential overlaps in program participation. Overlap is accounted for in final model output.

The maximum penetrations for the dynamic pricing programs shown in Table 3-7 depend on a variety of inputs, including the percentage of customers that 1) enroll in the programs, 2) are offered an automated load control device (e.g., PCT or load switch), 3) accept the automated load control device, and 4) in the case of pricing without enabling technology, are already enrolled in pricing with enabling technology. This approach leverages the methodology and inputs used in NADR. The relationship between these inputs is shown here for the Maximum Achievable scenario:

Maximum Achievable penetration for pricing with enabling technology:

60–75 percent of eligible customers enroll in dynamic pricing
× 95 percent of eligible customers are offered automated load control device
× 60 percent of eligible customers accept automated load control device
34–43 percent of eligible* customers enroll in dynamic pricing with enabling technology

**Eligible customers must have AMI and load suitable for auto load control.*

Maximum Achievable penetration for pricing without enabling technology:

60–75 percent of eligible customers enroll in dynamic pricing
\- 34–43 percent of eligible customers enrolled in dynamic pricing with enabling technology
26–32 percent of eligible* customers enroll in dynamic pricing without enabling technology

**Eligible customers must have AMI.*

Source: Navigant analysis and Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential.* "FERC_NADR-model.xls." Prepared by The Brattle Group, June 2009.

FERC's assumption that 60–75 percent of eligible customers enroll in dynamic pricing reflects an opt-out enrollment strategy and is based on market research and recent experience in California. The percentages of customers that are offered and accept an automated load control device reflect FERC's assumptions on the likelihood of the average utility and customer to make these decisions.[32]

3.4.3 Adjusting for Overlap in Participation

Although the maximum penetration rates shown in Table 3-7 do not account for the potential overlap in program participation across program types and customer segments, the final peak demand reductions are adjusted to account for participant overlap. Figure 3-1 through Figure 3-4 show the hierarchy for determining which program a customer participates in.

In the Realistic scenario, participation in MPower (i.e., Interruptible/Curtailable Tariffs) is the default customer choice for Medium and Large C&I participants and Optimizer (i.e., Direct Load Control) is the default customer choice for Residential Small C&I participants. Participants not enrolled in Interruptible/Curtailable Tariffs or Direct Load Control may choose to participate in either and opt-in Dynamic Pricing program or Other DR, depending on whether or not they have integrated AMI.

In the Maximum scenario, an opt-out pricing program is the default option for participation, assuming the customer has integrated AMI.

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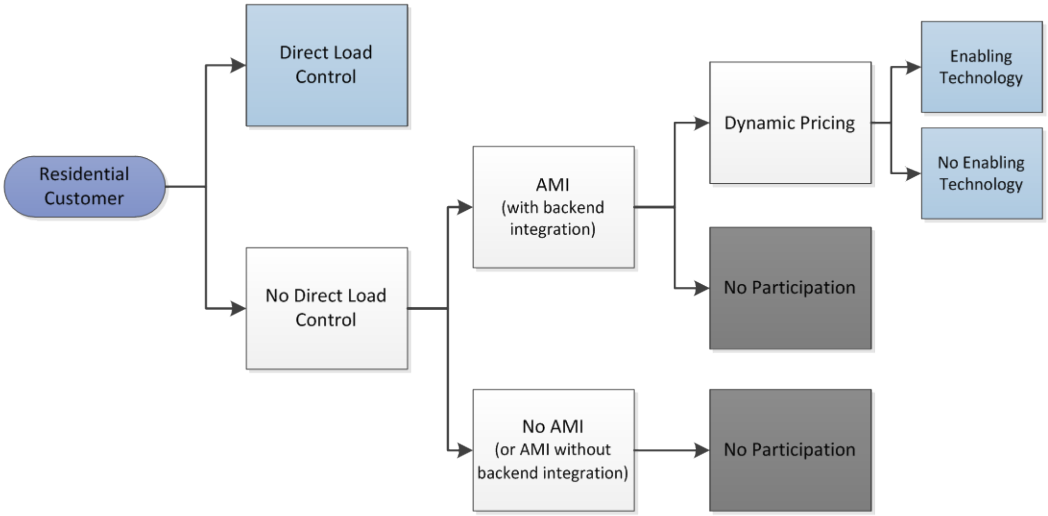
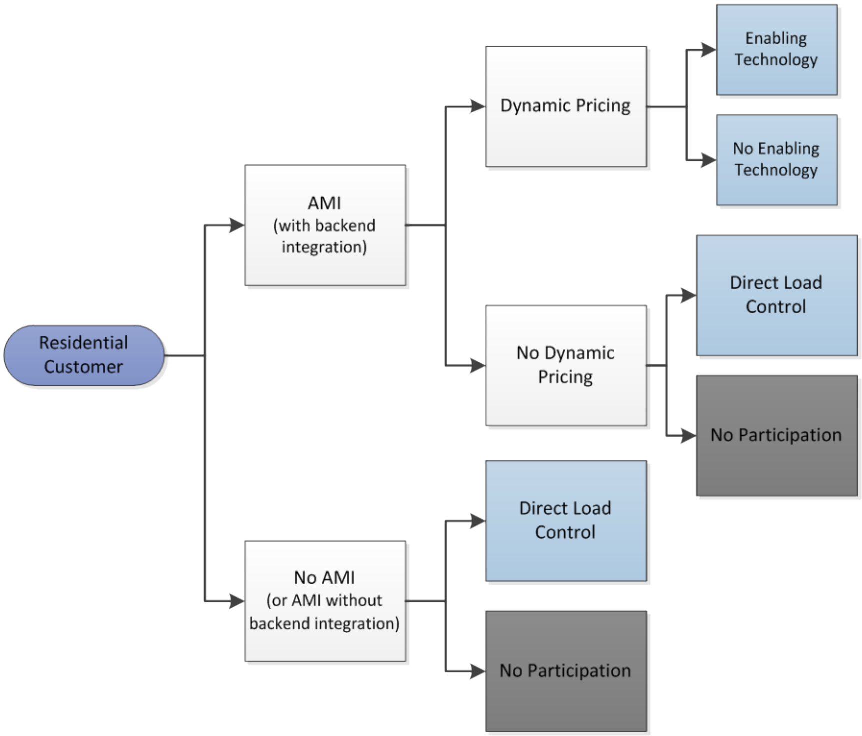
[32] Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009, p. 62.

Figure 3-1. Participation Hierarchy for Residential Realistic Achievable Scenario



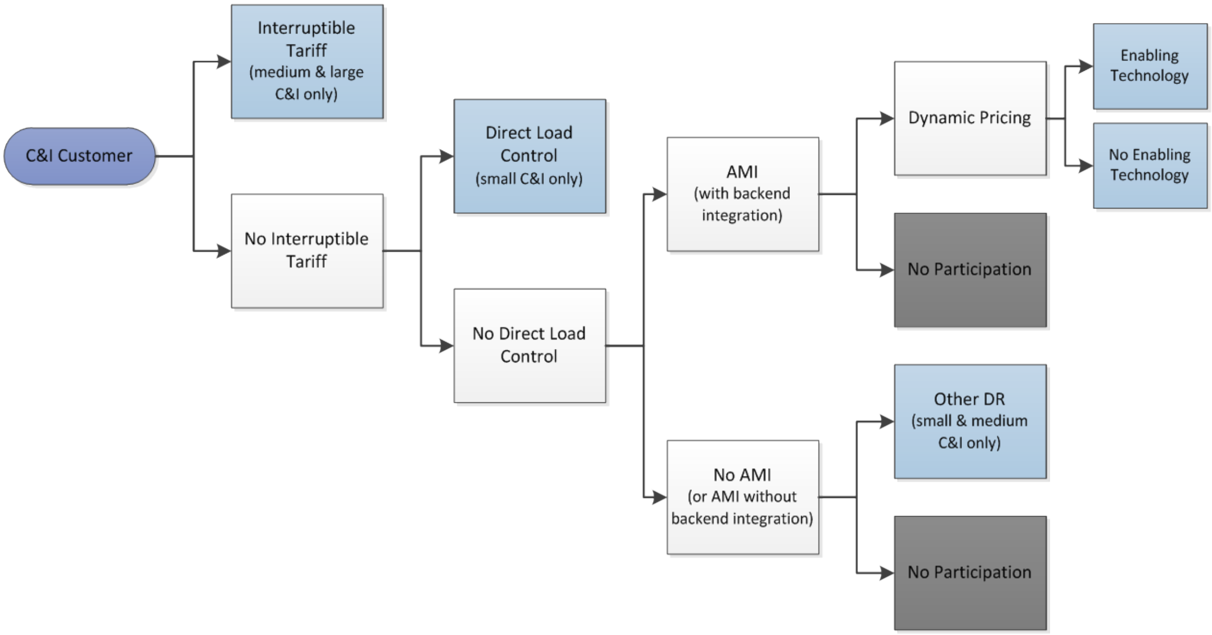
Source: Navigant analysis

Figure 3-2. Participation Hierarchy for Residential Maximum Achievable Scenario



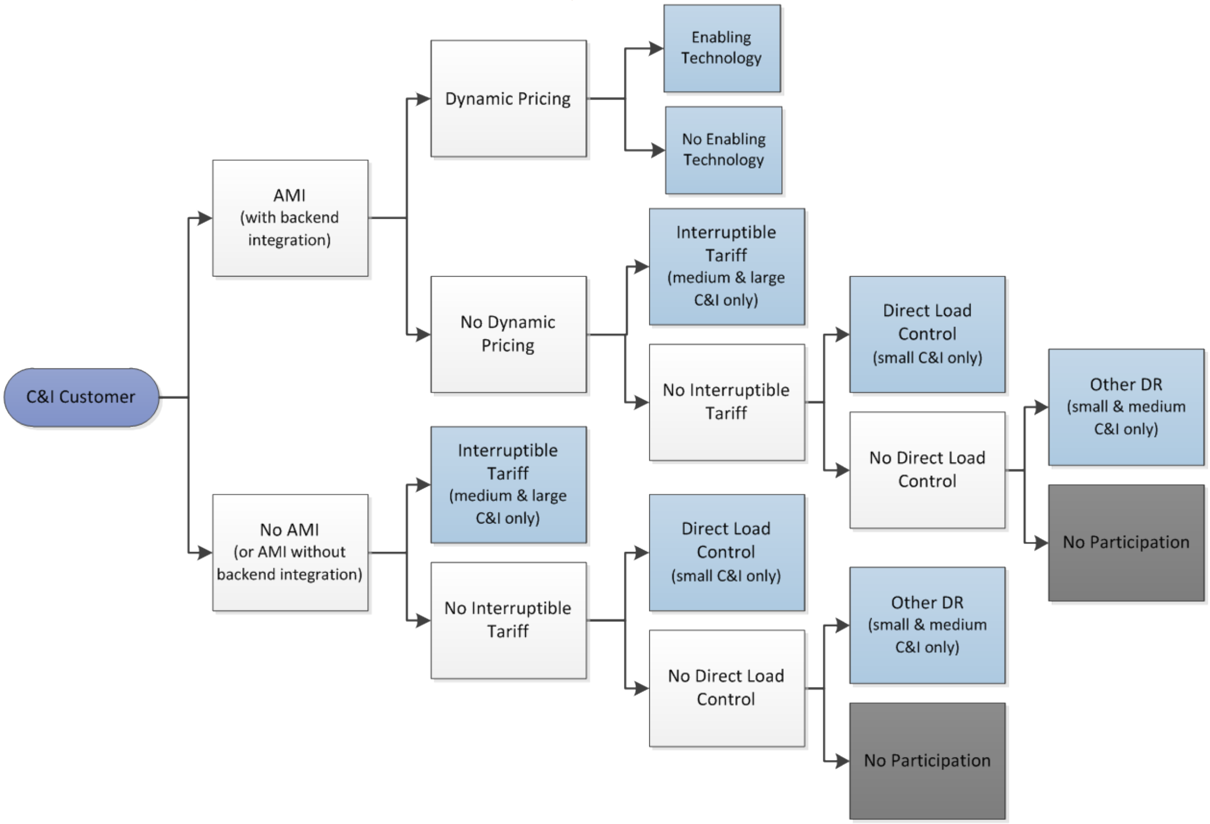
Source: Navigant analysis

Figure 3-3. Participation Hierarchy for C&I Realistic Achievable Scenario



Source: Navigant analysis

Figure 3-4. Participation Hierarchy for C&I Maximum Achievable Scenario



Source: Navigant analysis

3.5 *Peak Demand Reduction Assumptions*

The amount of peak demand reduced by each participant was calculated as a percentage of the average load profile for that participant's rate class (see Table 3-1). For residential pricing with and without enabling technology, Navigant assumes that the peak demand reductions in the Realistic Achievable scenario are roughly equivalent to the peak demand reductions for a customer on a TOU rate, while the peak demand reductions in the Maximum Achievable scenario are roughly equivalent to that of a TOU with CPP rate. The pricing programs with enabling technology assume peak demand reductions for the same rate types, but with the incremental benefit provided by enabling technologies. Table 3-8 shows the specific rate and demand reduction for each program and scenario, based on the impacts of various residential pricing pilots from EPRI.

Table 3-8. Assumed Peak Demand Reduction and Pricing Type for Each Scenario and Program Type

Program Type	Realistic Achievable	Maximum Achievable
Pricing without Enabling Technology	TOU 7%	TOU with CPP 18%
Pricing with Enabling Technology	TOU + Technology 18%	TOU with CPP + Technology 30%

Source: Based on the averaged load reductions for Residential pricing pilots with and without enabling technology. Electric Power Research Institute, Understanding Electric Utility Customers - Summary Report. Report #1025856, Final Report, October 2012.

For Interruptible Tariffs and Direct Load Control in the Realistic Achievable scenario, Navigant used actual 2012 peak demand reduction values from the Companies' MPower and Optimizer programs by utility. Unless the MPower and Optimizer values were higher than what FERC assumed,[33] Navigant used FERC's NADR assumptions for all other demand reduction inputs in the Realistic and Maximum Achievable scenarios.[34]

3.6 *Energy Savings from Demand Response*

Navigant conservatively assumes there are no significant energy savings from the Companies' DR programs in any scenario. While some studies have found conservation from DR, this assumption is consistent with typical industry assumptions for dispatchable programs like Direct Load Control and Interruptible Tariffs, as well as some of Navigant's recent findings for utilities with time-based rates, including TOU.[35]

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[33] The Companies' actual reductions were slightly higher than FERC's estimated reductions for Large C&I MPower participants in KCP&L-KS and Optimizer participants in KCP&L.

[34] Navigant used FERC's default average participant load reductions from the Achievable scenario, including the price ratio assumptions for dynamic pricing, with minor exceptions.

[35] Email communications with David Walls, Navigant Consulting, Inc., January 2013 regarding energy use with TOU for some DOE Smart Grid Investment Grant recipients.

3.7 Program Costs and Benefits

The cost-effectiveness analysis looked at the utility program administration costs; vendor program administration costs; evaluation, measurement, and verification (EM&V) costs; incentive costs; and avoided costs for each DR program type. These costs were included as the following:

- **Ongoing program costs:** An estimated cost per kilowatt of savings ($/kW-year) for each cost category and program type that applies to new and existing program participants.
- **New participant costs:** A cost per new participant ($/new participant), which includes the incremental costs for new participants associated with equipment installation and marketing.
- **One-time costs:** A one-time annual cost ($/yr) for a limited number of startup or capital costs applied within the utility administration cost category.

To distinguish the Companies' in-house administrative costs from outsourced costs, the program administration costs are divided into the utility and vendor administration cost categories. The utility administration costs assumed in this model reflect the up-front costs for program development and MDMS installation; the ongoing in-house costs for implementation and delivery, such as program delivery, marketing, and administration costs; and the marketing for new participants. The vendor administration costs reflect all outsourced costs and include ongoing costs for implementation and delivery, as well as any incremental equipment costs associated with new participants. For the purposes of this analysis, the capital and installation costs associated with equipment installed at the customer site are included in the vendor administration category and treated as costs to the utility and ratepayer, rather than the participant. This assumption is consistent with the current design of the Energy Optimizer program, as well as many other utility DR programs within the industry.

Since the cost structures in the Realistic and Maximum Achievable scenarios for MPower are not expected to change significantly from the base case cost forecasts provided by the Companies, Navigant used the cost estimates provided by the Companies for MPower as the Interruptible Tariffs costs for both scenarios.

This section describes the inputs and assumptions driving the various cost inputs, and how they are applied in more detail below.

<u>Ongoing Program Costs</u>

Table 3-9 below summarizes the ongoing program costs assumed for each cost category and program type.

Table 3-9. Summary of Ongoing Program Costs by Cost Category ($/kW-yr)[1,2]

Program Type	Utility Admin	Vendor Admin	EM&V	Incentive
Interruptible Tariffs	** $6	$3	$3	$46-50
Direct Load Control	$2	$30	$3	$0
Pricing w/o Enabling Technology	$5	$30	$3	$0
Pricing w/ Enabling Technology	$5	$30	$3	$0
Other DR	$15	$45	$5	$57 **

1. These are the estimated costs from 2014-2017, with an assumed escalation rate of 2.5 percent per year applied starting in 2018 to be consistent with the cost assumptions in the MPower forecast provided by the Companies.
2. Actual costs in the model vary slightly by utility based on forecasts provided by the Companies.

Interruptible Tariffs: "KCPL_GMO MPower forecast.xlsx" provided by Joe O'Donnell, KCP&L, August 2012.
Direct Load Control and Pricing: Estimated from benchmarking of similar programs.
Pricing and Other DR: Navigant analysis. Global Energy Partners, *Tennessee Valley Authority Potential Study*, Report Number 1360, December 21, 2011.

The assumptions for Direct Load Control *vendor* administration costs were also applied to the pricing programs, since they are assumed to have similar vendor requirements. However, Navigant assumed a slightly higher *utility* administration cost for the pricing programs than for Direct Load Control programs, based on cost estimates from Global Energy Partners (GEP).[36] For Other DR, the vendor administration costs are assumed to be 50 percent higher than the Direct Load Control costs, based on the additional communications and control technologies that would likely be needed for small and medium C&I customers to participate effectively. Finally, the Other DR program's utility administration costs reference GEP's administrative cost estimate for a C&I capacity reduction program of $15/kW-yr.

The EM&V costs are based on KCP&L and KCP&L GMO's MPower and Energy Optimizer costs forecasts, and are assumed to be roughly equivalent for all programs except the Other DR program. A slightly higher EM&V cost is assumed for the Other DR program, since it is a less commonly implemented program type within the industry.

Finally, incentive costs are only assumed for Interruptible Tariffs and the Other DR program. The Interruptible Tariffs program uses the forecasted MPower incentive costs provided by the Companies and Other DR references GEP's cost estimates for a C&I capacity reduction program.

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[36] Global Energy Partners, *Tennessee Valley Authority Potential Study*, Report Number 1360, December 21, 2011.

New Participant Costs

New participant costs are assumed for all program types except Interruptible Tariffs. The number of new participants each year is based on the annual program growth minus participants that dropped out of the program. The latter is captured through an assumed rate of attrition, which varies between one and five percent each year in this analysis, based on program type and standard industry assumptions.

Under the utility administration cost category, a $50 marketing cost is assumed for each new participant in all program types except for Interruptible Tariffs.[37]

Table 3-9 below shows the assumed vendor administration costs for new participants, which largely reflect the installed costs of the equipment required for participation in each program type. No incremental equipment costs are assumed for participation in Interruptible Tariffs or Pricing without Enabling Technology. The Residential and Small C&I costs are based on the estimated installed cost of a controllable thermostat in the Companies' Energy Optimizer programs. These costs are higher than many other assumptions for installed thermostat costs, particularly for Residential, and are thought to be conservative. The Medium and Large C&I costs are reasonable average assumptions, but could be much higher for very large C&I customers.

Table 3-10. Vendor Administration Costs for New Participants by Cost Category and Rate Class ($/new participant)*

Program Type	Residential	Small C&I	Medium C&I	Large C&I
Interruptible Tariffs	-	-	$0	$0
Direct Load Control	$380	$380	-	-
Pricing w/o Enabling Technology	$0	$0	$0	$0
Pricing w/ Enabling Technology	$380	$380	$1050	$2000
Other DR	-	$380	$1050	-

* These are the estimated costs from 2014-2017, with an assumed escalation rate of 2.5 percent per year applied starting in 2018 to be consistent with the cost assumptions in the MPower forecast provided by the Companies.

Residential and Small C&I: Based on benchmarking of typical installed cost of controllable thermostats.

Medium C&I: Based on vendor estimates and utility program cost data for the installed cost of programmable communicating thermostats and remotely-controlled switches from programs with similar DR options. Federal Energy Regulatory Commission, *A National Assessment of Demand Response Potential*. Prepared by The Brattle Group, June 2009.

Large C&I: Based on estimated installed cost of automated demand response (Auto-DR) for large C&I customers. Global Energy Partners, *Tennessee Valley Authority Potential Study*, Report Number 1360, December 21, 2011.

One-Time Costs

The analysis includes one-time program development costs for the startup of new programs, as well as the cost of a new MDMS to fully integrate the Companies' AMI meters and support time-based rates. The cost of the AMI meters is not included in the DR cost effectiveness analysis, since it is assumed these meters are deployed independently of the DR programs to provide meter reading benefits.

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[37] Navigant analysis for Tucson Electric Power on cost effectiveness of mass market Direct Load Control, 2009. Global Energy Partners, *Tennessee Valley Authority Potential Study*, Report Number 1360, December 21, 2011.

These costs are each incurred once for KCP&L and once for KCP&L-GMO. The model then apportions the costs for KCP&L by state based on the number of KCP&L participants in each state.
The assumed program development costs include $400,000[38] for the Other DR program and a single $400,000 cost shared across both Pricing programs in the year the programs begin. No program development cost is applied to the Interruptible Tariff and Direct Load Control programs.

The installed cost of an MDMS is estimated to be around $1,000,000, based on the estimated cost of Ameren's MDMS,[39] although this cost may vary significantly depending on the selected vendor and choice of options.

Total Program Costs

Table 3-11 through Table 3-13 provide a breakdown, by program, of the forecast cumulative budget from 2014 through 2033. The budget values include the incentive costs, non-incentive costs (i.e., program administration and on-time costs), and EM&V costs presented above. Budgets over the 20-year forecast horizon range from $191 million to $476 million depending on the utility. The 10-year average annual budget for each utility is $7.1 million, $10.4 million, and $13.7 million for KCP&L-KS, KCP&L-MO, and KCP&L-GMO, respectively. The budgets for the Maximum Achievable Potential scenario are also presented in Appendix C.

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[38] Global Energy Partners, *Tennessee Valley Authority Potential Study*, Report Number 1360, December 21, 2011.

[39] Navigant Consulting, Inc. *Advanced Metering Infrastructure (AMI) Future Program Study.* Prepared for FortisBC. March 2011.

Table 3-11. Cumulative Realistic Achievable DR Budget – KCP&L-KS

Year	Interruptible Tariffs	Direct Load Control	Pricing without Enabling Technology	Pricing with Enabling Technology	Other DR	Total
2014	$1,549,067	$4,122,985	$0	$0	$0	**$5,672,052**
2015	$3,491,026	$8,411,081	$0	$0	$179,943	**$12,082,050**
2016	$5,889,817	$11,810,172	$0	$0	$288,141	**$17,988,131**
2017	$8,726,582	$14,983,312	$381,474	$339,618	$460,874	**$24,891,860**
2018	$12,070,918	$17,965,630	$424,926	$591,819	$704,784	**$31,758,078**
2019	$15,923,140	$20,709,160	$484,813	$877,991	$1,022,328	**$39,017,432**
2020	$20,294,450	$23,165,387	$562,433	$1,202,531	$1,418,352	**$46,643,152**
2021	$25,177,009	$24,864,815	$659,098	$1,570,261	$1,894,779	**$54,165,962**
2022	$30,569,599	$26,574,576	$777,172	$1,993,311	$2,456,680	**$62,371,338**
2023	$36,475,916	$28,291,242	$916,980	$2,467,111	$3,108,551	**$71,259,800**
2024	$42,890,438	$30,024,685	$1,079,919	$2,994,933	$3,851,398	**$80,841,373**
2025	$49,540,734	$32,408,813	$1,267,350	$3,579,215	$4,692,248	**$91,488,360**
2026	$56,434,583	$34,879,529	$1,479,344	$4,211,486	$5,541,486	**$102,546,428**
2027	$63,589,239	$37,437,496	$1,719,322	$4,906,362	$6,424,591	**$114,077,010**
2028	$71,024,731	$40,081,466	$1,928,790	$5,317,219	$7,346,515	**$125,698,721**
2029	$78,739,050	$42,816,534	$2,146,021	$5,742,675	$8,304,880	**$137,749,161**
2030	$86,753,359	$45,647,766	$2,371,408	$6,183,546	$9,304,964	**$150,261,042**
2031	$95,077,834	$48,579,701	$2,605,261	$6,640,547	$10,346,911	**$163,250,254**
2032	$103,712,529	$51,621,418	$2,847,954	$7,114,948	$11,433,869	**$176,730,718**
2033	$112,689,168	$54,777,102	$3,100,068	$7,607,441	$12,567,175	**$190,740,954**

Source: Navigant analysis

Table 3-12. Cumulative Realistic Achievable DR Budget – KCP&L-MO

Year	Interruptible Tariffs	Direct Load Control	Pricing without Enabling Technology	Pricing with Enabling Technology	Other DR	Total
2014	$3,477,426	$636,799	$0	$0	$0	**$4,114,225**
2015	$7,591,966	$2,729,299	$0	$0	$220,057	**$10,541,321**
2016	$12,617,933	$4,928,403	$0	$0	$369,070	**$17,915,406**
2017	$18,335,814	$7,231,666	$346,690	$332,218	$612,421	**$26,858,809**
2018	$24,898,453	$9,692,706	$395,364	$628,903	$959,949	**$36,575,376**
2019	$32,326,148	$12,331,548	$462,131	$956,215	$1,418,697	**$47,494,740**
2020	$40,632,047	$15,159,395	$547,757	$1,315,108	$1,992,854	**$59,647,161**
2021	$49,841,088	$18,180,108	$653,129	$1,706,737	$2,688,239	**$73,069,301**
2022	$59,962,270	$21,405,269	$779,117	$2,132,208	$3,511,345	**$87,790,210**
2023	$71,017,500	$24,852,911	$926,718	$2,592,825	$4,470,635	**$103,860,589**
2024	$83,022,805	$28,536,683	$1,097,005	$3,090,045	$5,570,975	**$121,317,514**
2025	$95,451,967	$30,913,721	$1,291,125	$3,625,197	$6,821,831	**$138,103,840**
2026	$108,339,521	$33,363,128	$1,515,915	$4,240,162	$8,097,003	**$155,555,730**
2027	$121,712,194	$35,886,224	$1,770,192	$4,911,313	$9,429,542	**$173,709,466**
2028	$135,586,186	$38,484,837	$1,995,775	$5,286,093	$10,819,222	**$192,172,113**
2029	$149,988,495	$41,160,772	$2,229,322	$5,673,246	$12,273,980	**$211,325,815**
2030	$164,936,865	$43,919,299	$2,471,184	$6,073,328	$13,795,976	**$231,196,651**
2031	$180,449,598	$46,761,572	$2,721,616	$6,486,467	$15,385,420	**$251,804,672**
2032	$196,521,394	$49,694,115	$2,980,772	$6,913,556	$17,042,920	**$273,152,757**
2033	$213,206,648	$52,720,073	$3,249,310	$7,355,491	$18,780,128	**$295,311,650**

Source: Navigant analysis

Table 3-13. Cumulative Realistic Achievable DR Budget – KCP&L-GMO

Year	Interruptible Tariffs	Direct Load Control	Pricing without Enabling Technology	Pricing with Enabling Technology	Other DR	Total
2014	$855,866	$2,120,877	$0	$0	$0	**$2,976,743**
2015	$3,220,864	$6,032,880	$0	$0	$400,000	**$9,653,744**
2016	$7,253,894	$9,601,568	$0	$0	$548,055	**$17,403,516**
2017	$12,984,682	$13,221,707	$0	$0	$777,505	**$26,983,893**
2018	$20,640,870	$16,977,142	$0	$0	$1,098,005	**$38,716,017**
2019	$30,345,273	$20,866,198	$715,592	$684,408	$1,514,685	**$54,126,156**
2020	$42,205,351	$24,875,235	$773,417	$1,057,969	$2,032,768	**$70,944,741**
2021	$56,362,567	$28,669,406	$850,790	$1,474,788	$2,658,386	**$90,015,937**
2022	$72,966,431	$32,741,589	$948,860	$1,939,501	$3,397,699	**$111,994,080**
2023	$92,106,086	$37,120,052	$1,068,195	$2,452,476	$4,254,458	**$137,001,267**
2024	$113,991,661	$41,836,470	$1,209,770	$3,015,944	$5,238,143	**$165,291,988**
2025	$136,963,457	$45,406,291	$1,374,631	$3,631,880	$6,356,586	**$193,732,844**
2026	$161,033,069	$49,105,253	$1,569,612	$4,336,141	$7,488,879	**$223,532,953**
2027	$186,330,540	$52,936,278	$1,794,976	$5,114,138	$8,674,497	**$254,850,429**
2028	$212,901,993	$56,897,123	$2,052,792	$5,968,366	$9,912,729	**$287,733,003**
2029	$240,889,355	$60,996,259	$2,345,768	$6,903,969	$11,210,038	**$322,345,390**
2030	$270,314,526	$65,238,224	$2,599,276	$7,436,372	$12,565,374	**$358,153,771**
2031	$301,231,904	$69,634,047	$2,863,905	$7,989,447	$13,980,971	**$395,700,274**
2032	$333,765,056	$74,189,239	$3,140,322	$8,564,291	$15,460,415	**$435,119,322**
2033	$367,906,672	$78,913,705	$3,428,753	$9,161,892	$17,007,451	**$476,418,473**

Source: Navigant analysis

Other Cost-Effectiveness Inputs

In addition to the cost inputs described above, Navigant tailored FERC's assumptions for avoided costs and discount rate to the Companies to determine the cost-effectiveness of each DR program. For consistency, the DR model uses the same discount rate[40] and avoided demand costs[41] as the Demand Side Management Simulator (DSMSim™) model that Navigant created to estimate the Demand Side Management (DSM) potential for the Companies.

Note that the cost-effectiveness analysis does not consider bill reductions or lost revenues because the model does not assume any energy savings and, therefore, does not assume any bill savings to the customer. Externalities are also not considered.

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[40] Discount rates assumed to be 3 percent for Societal, 10 percent for Participant, and an After-Tax Weighted Average Cost of Capital ** of [redacted] **** and [redacted] ** percent for KCP&L and KCP&L-GMO in all other tests.

[41] Provided by email communications with Joe O'Donnell, GPES, July 2012. Avoided capacity costs are based on the cost of new entry in the Midwest ISO.

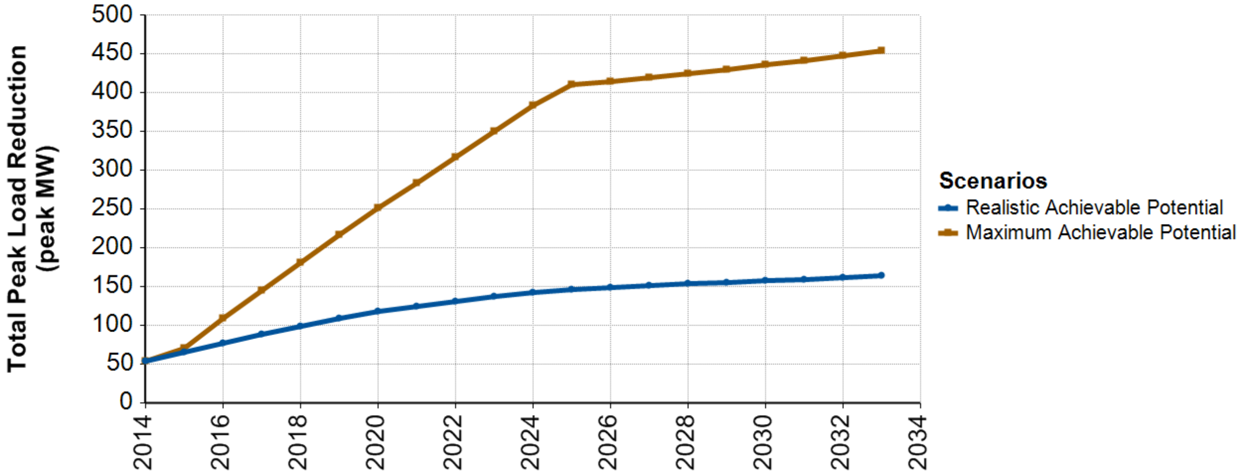
4 Findings

This section presents the results of Navigant's DR potential model for the Companies. This section also compares the Kansas- and Missouri-specific results from NADR with the peak demand reduction potential and cost effectiveness findings of this analysis, and discusses the likely drivers behind major differences in findings.

4.1 Peak Load Reduction Potential

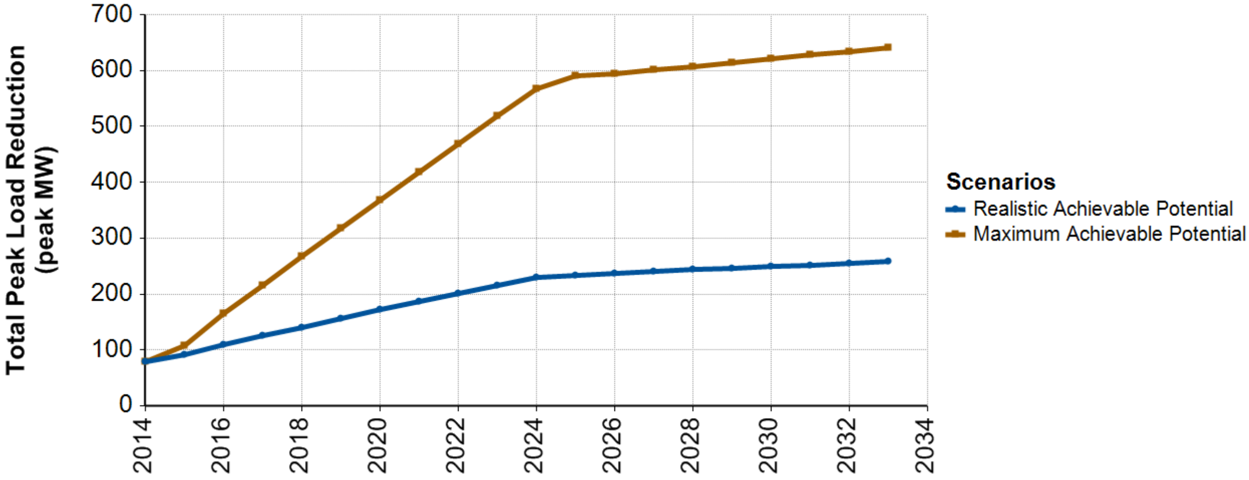
Navigant estimates up to 453 MW in peak load reduction potential for KCP&L-KS, 642 MW for KCP&L-MO, and 840 MW for KCP&L-GMO by 2033 in the Max Achievable scenario, which represents about 21.3, 28.2, and 31.0 percent of each utility's forecasted peak load for 2033, respectively. The potential in the Max Achievable scenario reflects the peak load reductions that *could* be possible if the Companies were to drive new DR customer participation through targeted program marketing and investment in new infrastructure deployment and integration. These findings are benchmarked against the Realistic Achievable findings in Figure 4-1 through Figure 4-3 and Table 4-1, which show the total peak load reduction potential estimated for KCP&L-KS, KCP&L-MO, and KCP&L-GMO in each scenario. Tabular results are shown in Appendix A and Appendix C.

Figure 4-1. Total Peak Load Reduction Potential by Scenario for KCP&L-KS (peak MW)



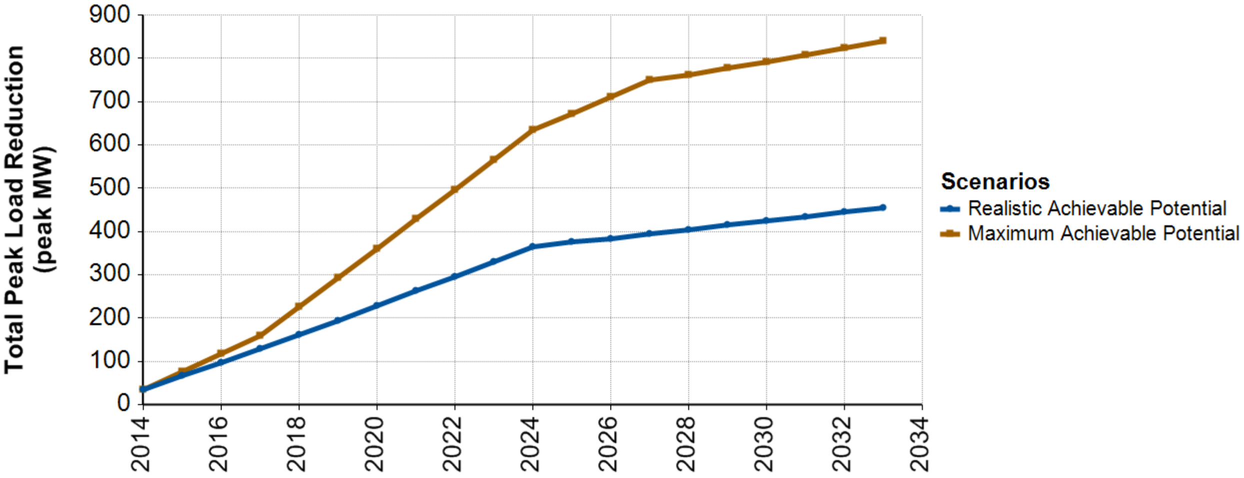
Source: Navigant analysis

Figure 4-2. Total Peak Load Reduction Potential by Scenario for KCP&L-MO (peak MW)



Source: Navigant analysis

Figure 4-3. Total Peak Load Reduction Potential by Scenario for KCP&L-GMO (peak MW)



Source: Navigant analysis

Table 4-1. Total Peak Load Reduction Potential by Scenario for the Companies (peak MW)

Utility	KCP&L-KS		KCP&L-MO		KCP&L-GMO	
Scenario	Realistic Achievable	Max Achievable	Realistic Achievable	Max Achievable	Realistic Achievable	Max Achievable
2014	54	54	78	78	36	36
2015	66	70	91	108	66	75
2016	77	109	110	164	98	117
2017	88	145	125	216	130	158
2018	99	181	141	267	162	226
2019	108	216	156	318	195	294
2020	117	251	172	368	229	361
2021	124	284	187	418	262	428
2022	130	317	201	468	296	497
2023	137	350	215	518	330	565
2024	143	383	230	568	365	636
2025	146	410	233	591	375	672
2026	148	413	237	594	384	710
2027	151	419	241	601	394	750
2028	153	424	243	607	404	760
2029	155	430	246	614	415	777
2030	157	436	249	621	425	792
2031	159	441	252	627	435	808
2032	161	447	255	634	445	824
2033	164	453	258	642	455	840

Source: Navigant analysis

For all of the Companies, these figures show significant contrast between the Realistic Achievable scenarios and the Max Achievable scenarios, and suggest that there is significant potential for additional demand reductions through strategic program deployment. Figure 4-4 through Figure 4-9 help identify *which* programs would be most beneficial to target, by showing the peak load reduction potential for each DR program type and scenario as an aggregate percentage of the utility's peak load. In general, KCP&L-KS has lower DR potential than the other utilities, which is primarily due to significantly lower peak load reduction from KCP&L-KS's Interruptible Tariffs program. This is based on current participation in KCP&L's MPower program, where the average peak load reduction for customers in KCP&L-KS is about a third of the average customer's reduction in KCP&L GMO.[42] This also aligns with FERC's assumption that the average Industrial Tariff participant's peak demand reduction in KS (i.e., around 30 percent per participant, on average) is less than a third of the peak demand reduction in MO (i.e., over 90 percent per participant, on average). Additionally, the percentage of peak load from the

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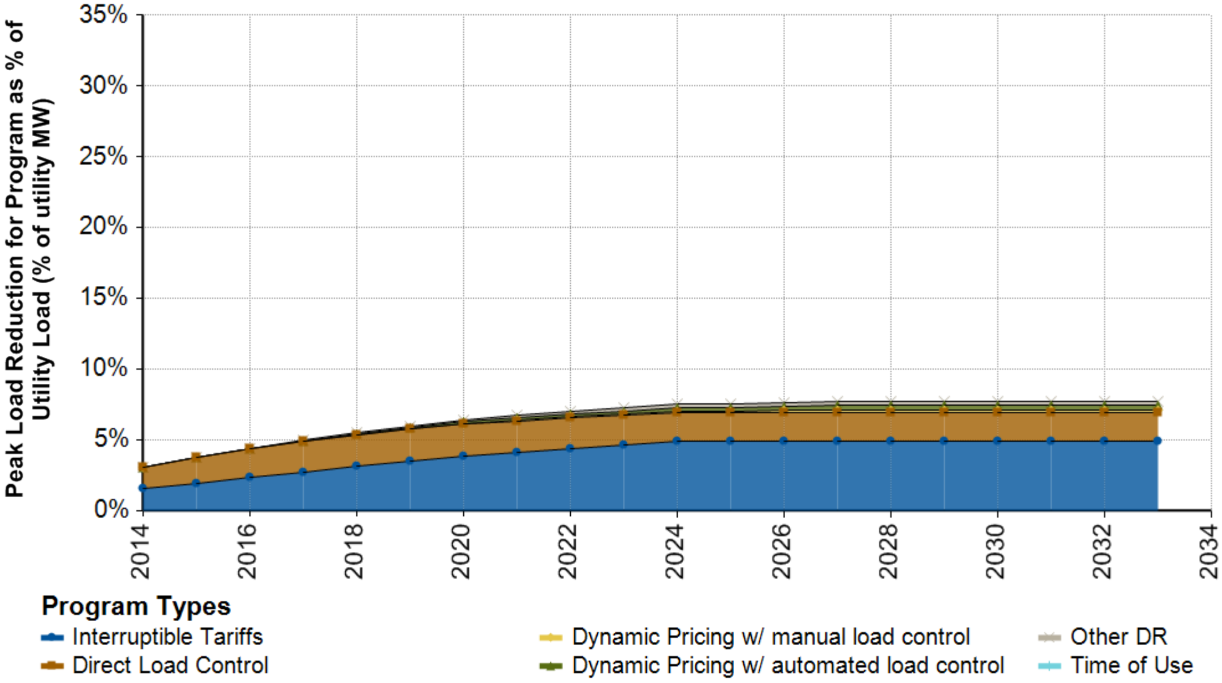
[42] Average peak load reductions (i.e., average % load reduced per participant) estimated for 2012 MPower program are around 31 percent in KCP&L-KS, 39 percent in KCP&L-MO, and 92 percent in KCP&L-GMO. Based on 2012 MPower data provided by Joe O'Donnell, GPES, "2012 MPower Active Contracts_12-09-12.xlsx", December 2012.

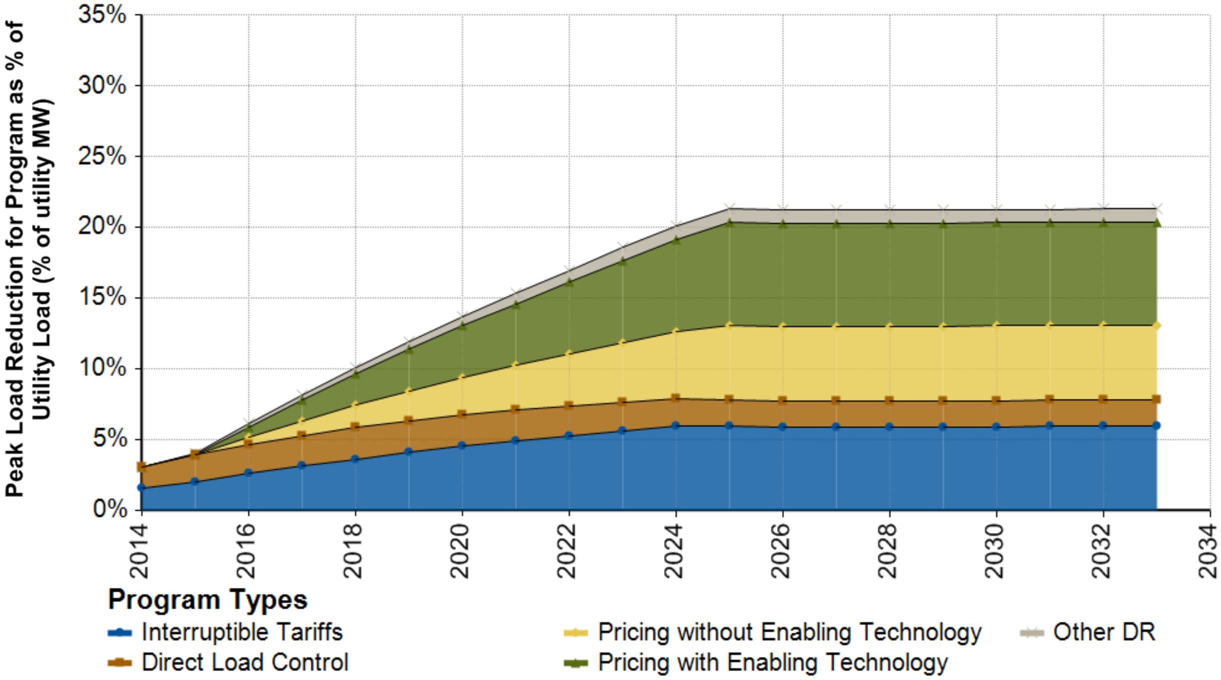
Large C&I customer class is lower in KCP&L-KS relative to the other utilities, which further contributes to the decreased impacts from Interruptible Tariffs.

Figure 4-4. KCP&L-KS Peak Load Reduction Potential – Realistic Achievable (% of utility MW)



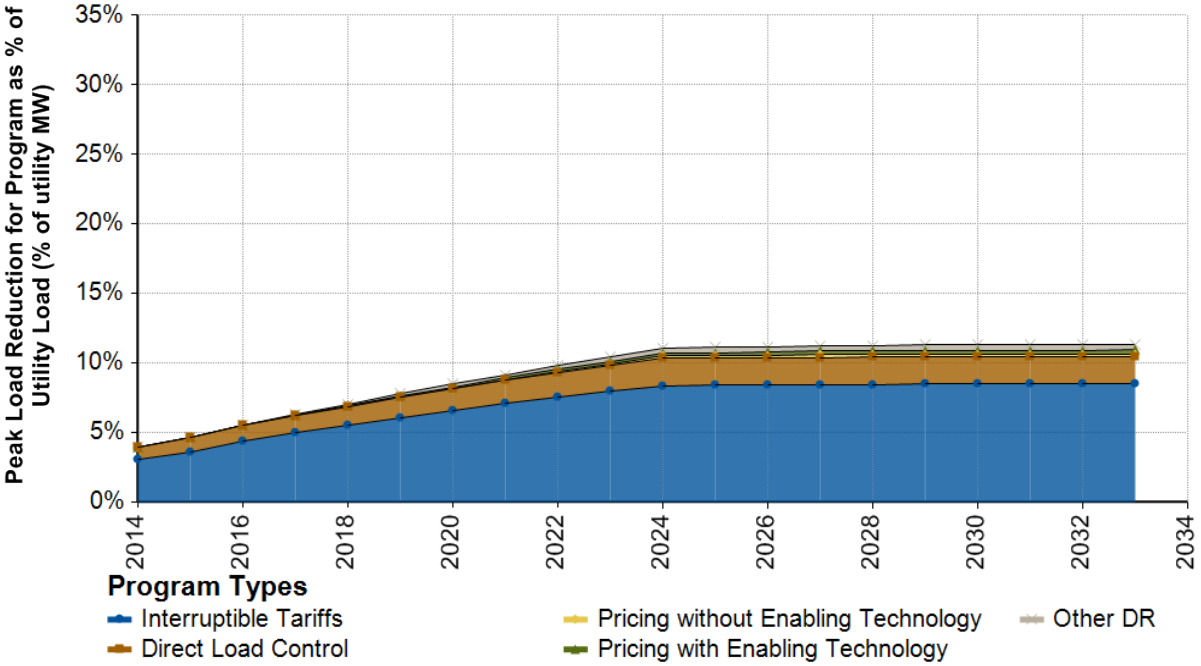
Source: Navigant analysis

Figure 4-5. KCP&L-KS Peak Load Reduction Potential – Max Achievable Scenario (% of utility MW)



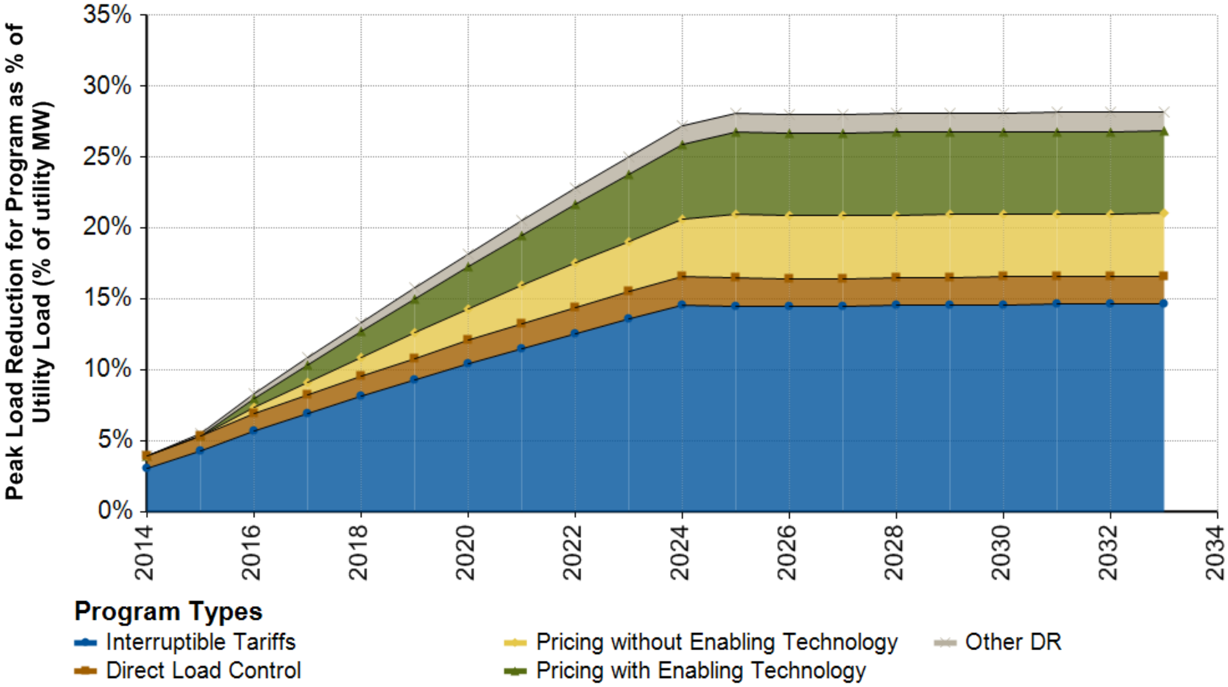
Source: Navigant analysis

Figure 4-6. KCP&L-MO Peak Load Reduction Potential – Realistic Achievable (% of utility MW)



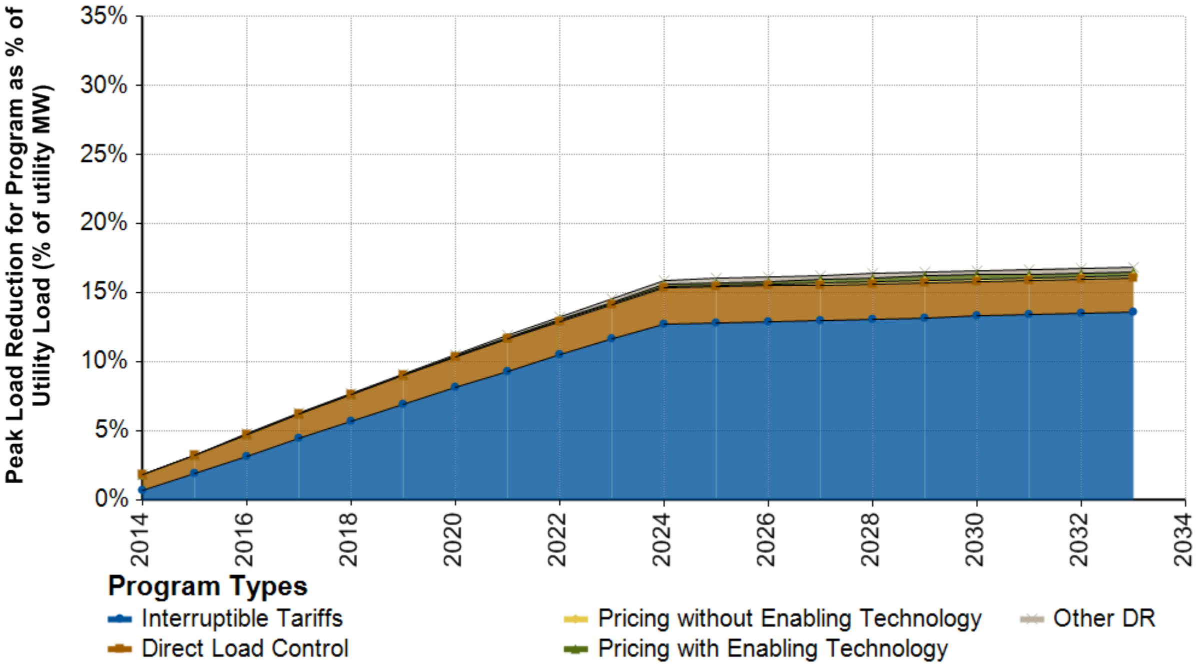
Source: Navigant analysis

Figure 4-7. KCP&L-MO Peak Load Reduction Potential – Max Achievable Scenario (% of utility MW)



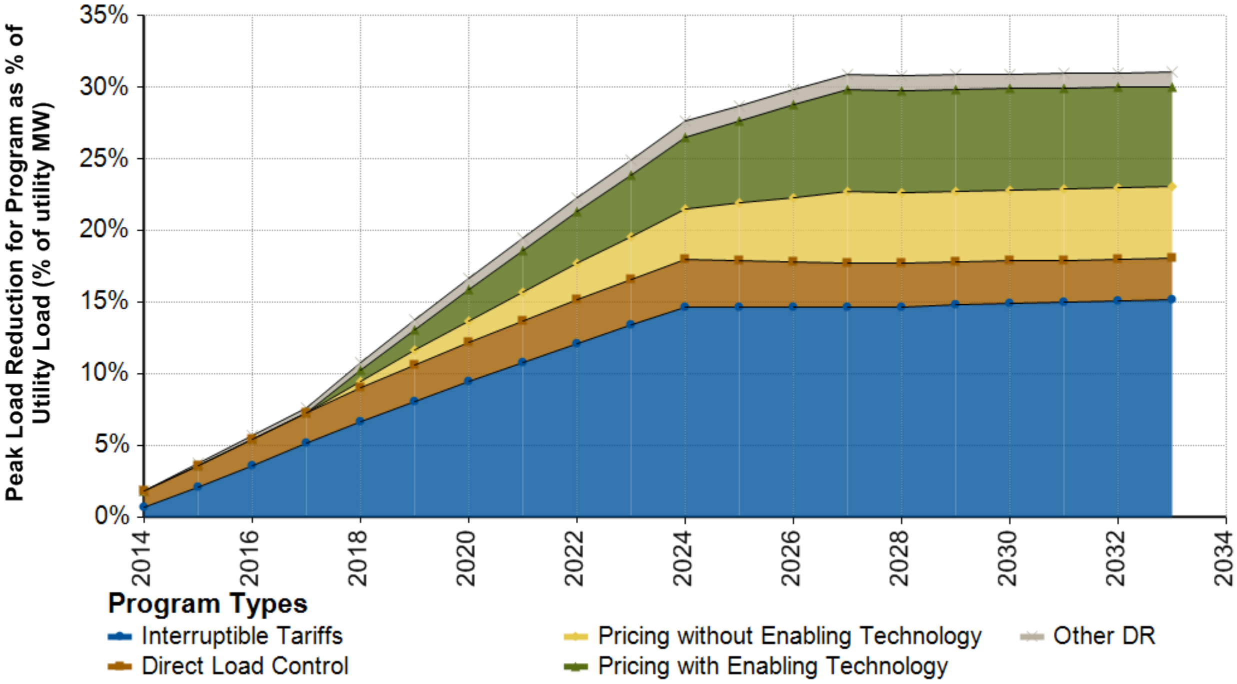
Source: Navigant analysis

Figure 4-8. KCP&L-GMO Peak Load Reduction Potential – Realistic Achievable (% of utility MW)



Source: Navigant analysis

Figure 4-9. KCP&L-GMO Peak Load Reduction Potential – Max Achievable Scenario (% utility MW)



Source: Navigant analysis

4.2 *Energy Savings from Demand Response Potential*

As discussed in Section 3.6, Navigant conservatively assumes there are no significant energy savings from the Companies' DR programs in any scenario.

4.3 *Cost-Effectiveness*

This analysis finds almost all DR program types to be cost effective for both scenarios using the Total Resource Cost (TRC), Societal cost, Utility Cost, and Rate Impact Measure benefit-cost tests, as defined in the MO Planning Regulations.[43] The only exception is the Other DR program, where the Utility and RIM test ratios are very close to one. These results represent more cost categories and a more complex methodology than the cost effectiveness analyses in FERC's DR potential study and the Missouri DSM potential study. As such, the benefit-cost ratios in this study are lower, but are likely a better portrayal of actual cost effectiveness.

Figure 4-10 through Figure 4-12 show the results for the TRC test, with all results provided in tabular format in Appendix B – Benefit-Cost Test Ratio Results. As shown in the results, the benefit-cost ratios for the Pricing without Enabling Technology are relatively high, which can be attributed to the lack of equipment and incentive costs needed to participate. However, the potential impacts from this program are also more limited, since participants do not have access to an enabling technology. Similarly, a Direct Load Control program is likely to be more cost effective than Pricing with Enabling Technology, but customer participation rates may ultimately be higher for the Pricing program. Note that incentives are treated as a transfer in the TRC test, which results in a high benefit-cost test ratio for programs where the primary costs are incentives, like the Interruptible Tariffs program.

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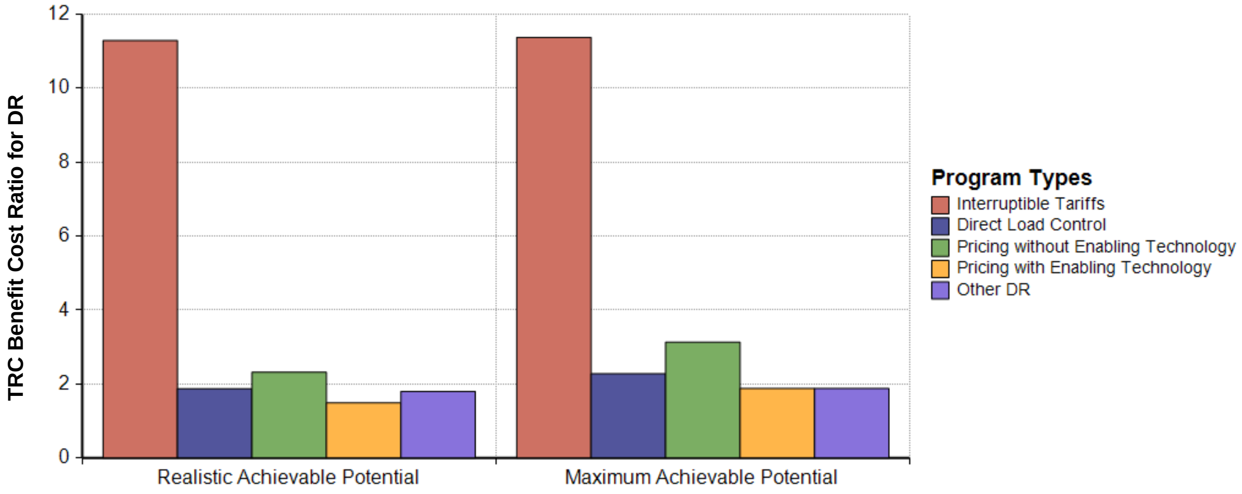
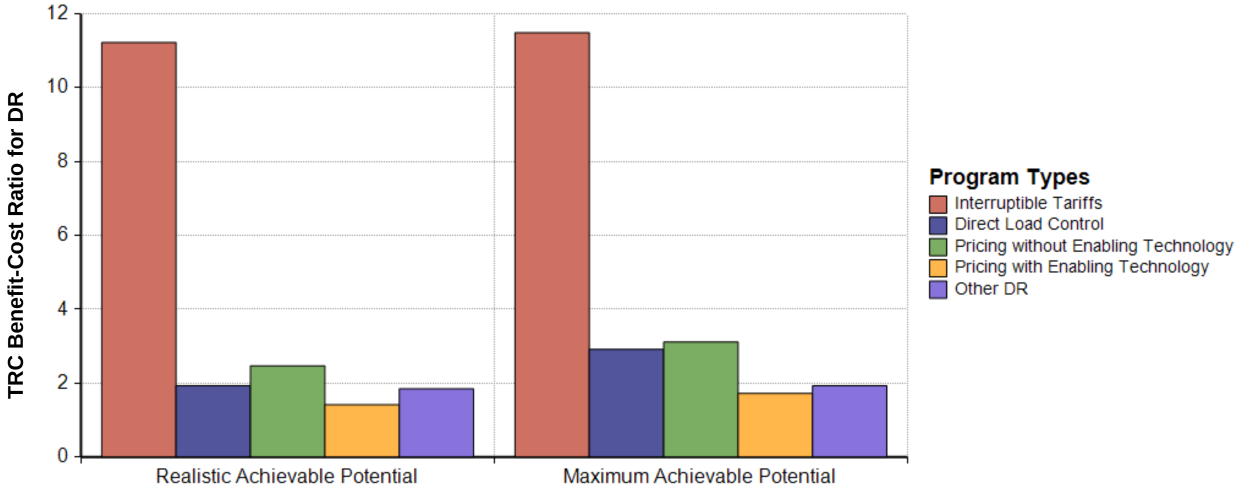
[43] Rules of Department of Economic Development Division 240—Public Service Commission Chapter 22—Electric Utility Resource Planning (4 CSR 240-22.010) – http://sos.mo.gov/adrules/csr/current/4csr/4c240-22.pdf

Figure 4-10. TRC Benefit-Cost Test Results – KCP&L-KS



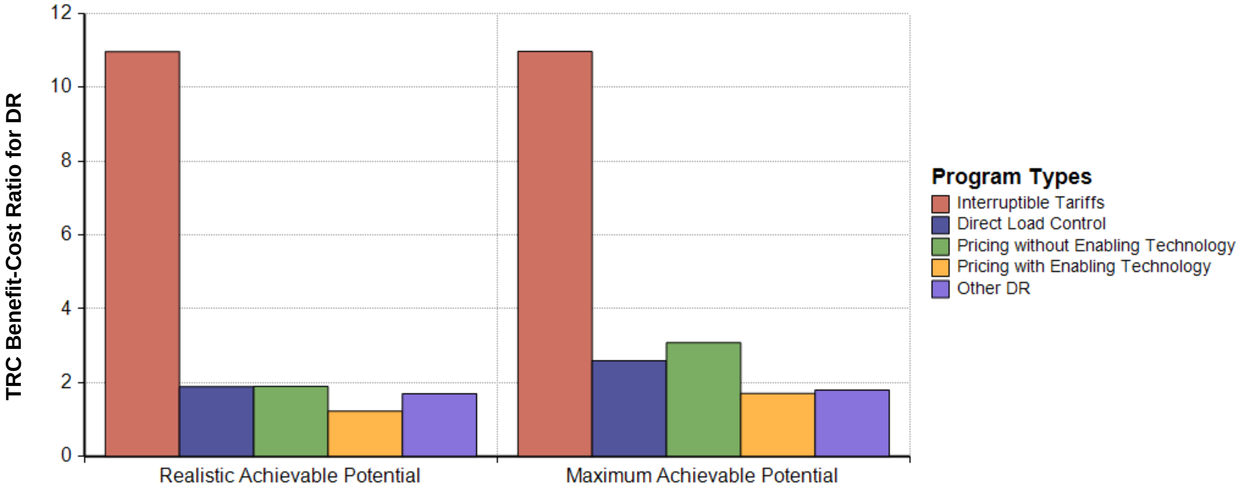
Source: Navigant analysis

Figure 4-11. TRC Benefit-Cost Test Results – KCP&L-MO



Source: Navigant analysis

Figure 4-12. TRC Benefit-Cost Test Results – KCP&L-GMO



Source: Navigant analysis

4.4 Comparison with Findings in FERC's NADR Model

Table 4-2 compares the "Achievable Penetration" scenario findings for Kansas and Missouri from FERC's NADR model with the Maximum Achievable scenario potential estimated in this analysis. The model outputs for 2019 are used to be consistent with the final year of the FERC analysis.

Table 4-2. Comparison of the Companies' Potential Peak Load Reduction from DR in 2019 (% of utility MW)

	KCP&L-KS	KCP&L-MO	KCP&L-GMO
Navigant's Maximum Achievable Scenario	11.9%	15.7%	13.7%
FERC's Achievable Potential Scenario	14.3%*	12.6%**	12.6%**

* For the state of Kansas
** For the state of Missouri

4.5 Summary

All of the scenarios show that significant potential growth still exists for the Companies' MPower Interruptible/Curtailable Tariff programs targeting the Medium and Large C&I customer segments, particularly in the KCP&L-MO and GMO territories. In contrast, participation rates in the Companies' Energy Optimizer Direct Load Control programs are already close to "best practice," though some additional potential exists. While the Other DR program may be cost effective, the potential peak reductions are estimated to be relatively small.

For all utilities in the Max Achievable scenario, the most substantial reductions in 2033 are projected to occur through the Companies' existing MPower programs and pricing with enabling technology. However, in the Realistic Achievable scenario, pricing programs contribute minimal peak load reduction. The Max Achievable impacts from pricing programs are significantly higher than the Realistic

Achievable impacts, which is due to the assumption that the pricing programs are opt-in in the Realistic scenario and opt-out in the Max Achievable scenario. As assumed in FERC's NADR, the pricing program impacts shown in the Max Achievable scenario assumes that the Companies enroll 60 to 75 percent of customers in a pricing program, while the Realistic scenario only assumes that the Companies enroll 5 percent. Even without an opt-out tariff, Navigant expects that a 5 percent enrollment is conservative and impacts under realistic implementation conditions could be higher.

- **Deployment of pricing programs is predicated on the backend integration of the Companies' AMI systems. While the Companies plan to deploy AMI across most of their service territories before 2020, the Companies do not have explicit plans to invest in the backend integration required to support time-based rates, such as installation of a MDMS, which can add significant upfront costs to the program's deployment.**

- **As discussed in Section 3.7, the analysis includes the estimated costs of installing a MDMS as a one-time startup cost for the pricing programs and finds that the pricing programs are cost effective when analyzed over a long-term horizon (i.e., the 20-year analysis period). However, we note that with relatively low near-term avoided capacity costs projected for the Companies, there is a significant time lag (10-15 years) before the cumulative program benefits surpass the cumulative program costs.**

- **This suggests that the timing of deployment for the pricing programs may warrant monitoring of capacity price forecasts and possibly aligning deployment with capacity price increases (which could shorten the effective payback time).**

Overall, this analysis finds significant potential for cost-effective DR program growth, with as much as 21-31 percent of each utility's peak demand in 2033 met by DR, as compared to less than 5 percent met by the Companies' existing programs. Furthermore, Navigant's cost-effectiveness analysis found that all of the program types are likely to be cost-effective over a 20-year horizon using the Total Resource Cost (TRC) benefit-cost test as a screen for all three of the utilities. Navigant also found that almost all program types are cost-effective in the long-term under the Societal, Utility Cost, and Rate Impact Measure benefit-cost tests. These results reflect the estimated benefits from the continued promotion of the Companies' existing MPower and Optimizer programs, as well as investing in the infrastructure needed for backend integration of the Companies' AMI systems to support time-based rate programs.

5 Appendix A – Cumulative Potential Savings and Budget Results

Table 5-1. Cumulative Potential Savings and Budget for KCP&L-KS

	Realistic Achievable Potential			Maximum Achievable Potential		
Year	Cumulative Energy Savings Potential (MWh)	Cumulative Peak Demand Savings Potential (MW)	Cumulative Budget ($)	Cumulative Energy Savings Potential (MWh)	Cumulative Peak Demand Savings Potential (MW)	Cumulative Budget ($)
2014	0	54	$5,672,052	0	54	$5,785,509
2015	0	66	$12,082,050	0	70	$13,382,649
2016	0	77	$17,988,131	0	109	$25,630,670
2017	0	88	$24,891,860	0	145	$37,944,138
2018	0	99	$31,758,078	0	181	$52,231,206
2019	0	108	$39,017,432	0	216	$68,763,745
2020	0	117	$46,643,152	0	251	$87,618,847
2021	0	124	$54,165,962	0	284	$108,793,029
2022	0	130	$62,371,338	0	317	$132,384,029
2023	0	137	$71,259,800	0	350	$158,578,709
2024	0	143	$80,841,373	0	383	$187,496,317
2025	0	146	$91,488,360	0	410	$218,590,543
2026	0	148	$102,546,428	0	413	$244,760,685
2027	0	151	$114,077,010	0	419	$272,123,834
2028	0	153	$125,698,721	0	424	$300,534,804
2029	0	155	$137,749,161	0	430	$330,004,403
2030	0	157	$150,261,042	0	436	$360,605,725
2031	0	159	$163,250,254	0	441	$392,361,269
2032	0	161	$176,730,718	0	447	$425,347,967
2033	0	164	$190,740,954	0	453	$459,632,639

Note: Conservatively assumes there are no significant energy savings from the Companies' DR programs, which is consistent with typical industry assumptions for dispatchable programs, as well as some of Navigant's recent findings for utilities with time-based rates, including TOU. Results represent both net and gross impacts. Costs are inclusive of incentives, program admin, and EM&V.

Source: Navigant analysis

Table 5-2. Cumulative Potential Savings and Budget for KCP&L-MO

	Realistic Achievable Potential			Maximum Achievable Potential		
	Cumulative Energy Savings Potential	Cumulative Peak Demand Savings Potential	Cumulative Budget	Cumulative Energy Savings Potential	Cumulative Peak Demand Savings Potential	Cumulative Budget
Year	(MWh)	(MW)	($)	(MWh)	(MW)	($)
2014	0	78	$4,114,225	0	78	$4,330,698
2015	0	91	$10,541,321	0	108	$12,769,124
2016	0	110	$17,915,406	0	164	$28,534,152
2017	0	125	$26,858,809	0	216	$46,143,182
2018	0	141	$36,575,376	0	267	$66,843,462
2019	0	156	$47,494,740	0	318	$90,769,524
2020	0	172	$59,647,161	0	368	$118,104,732
2021	0	187	$73,069,301	0	418	$149,048,455
2022	0	201	$87,790,210	0	468	$183,745,477
2023	0	215	$103,860,589	0	518	$222,388,189
2024	0	230	$121,317,514	0	568	$265,160,472
2025	0	233	$138,103,840	0	591	$310,209,754
2026	0	237	$155,555,730	0	594	$350,429,108
2027	0	241	$173,709,466	0	601	$392,293,951
2028	0	243	$192,172,113	0	607	$435,657,944
2029	0	246	$211,325,815	0	614	$480,622,055
2030	0	249	$231,196,651	0	621	$527,249,167
2031	0	252	$251,804,672	0	627	$575,563,789
2032	0	255	$273,152,757	0	634	$625,609,219
2033	0	258	$295,311,650	0	642	$677,540,222

Note: Conservatively assumes there are no significant energy savings from the Companies' DR programs, which is consistent with typical industry assumptions for dispatchable programs, as well as some of Navigant's recent findings for utilities with time-based rates, including TOU. Results represent both net and gross impacts. Costs are inclusive of incentives, program admin, and EM&V.

Source: Navigant analysis

Table 5-3. Cumulative Potential Savings and Budget for KCP&L-GMO

	Realistic Achievable Potential			Maximum Achievable Potential		
Year	Cumulative Energy Savings Potential (MWh)	Cumulative Peak Demand Savings Potential (MW)	Cumulative Budget ($)	Cumulative Energy Savings Potential (MWh)	Cumulative Peak Demand Savings Potential (MW)	Cumulative Budget ($)
2014	0	36	$2,976,743	0	36	$3,018,282
2015	0	66	$9,653,744	0	75	$10,316,604
2016	0	98	$17,403,516	0	117	$19,845,843
2017	0	130	$26,983,893	0	158	$33,331,438
2018	0	162	$38,716,017	0	226	$55,692,474
2019	0	195	$54,126,156	0	294	$80,986,346
2020	0	229	$70,944,741	0	361	$110,572,407
2021	0	262	$90,015,937	0	428	$144,515,297
2022	0	296	$111,994,080	0	497	$183,546,257
2023	0	330	$137,001,267	0	565	$227,885,121
2024	0	365	$165,291,988	0	636	$277,946,214
2025	0	375	$193,732,844	0	672	$331,347,851
2026	0	384	$223,532,953	0	710	$388,374,633
2027	0	394	$254,850,429	0	750	$449,342,965
2028	0	404	$287,733,003	0	760	$504,198,063
2029	0	415	$322,345,390	0	777	$561,918,720
2030	0	425	$358,153,771	0	792	$622,241,989
2031	0	435	$395,700,274	0	808	$685,284,466
2032	0	445	$435,119,322	0	824	$751,222,486
2033	0	455	$476,418,473	0	840	$820,131,160

Note: Conservatively assumes there are no significant energy savings from the Companies' DR programs, which is consistent with typical industry assumptions for dispatchable programs, as well as some of Navigant's recent findings for utilities with time-based rates, including TOU. Results represent both net and gross impacts. Costs are inclusive of incentives, program admin, and EM&V.

Source: Navigant analysis.

6 Appendix B – Benefit-Cost Test Ratio Results

The benefit-cost test ratio results are shown below for all DR program types and both scenarios using the Total Resource Cost (TRC), Societal cost, Utility Cost, and Rate Impact Measure benefit-cost tests, as defined in the MO Planning Regulations. Note that incentives are treated as a transfer in the TRC test, which results in a high benefit-cost test ratio for programs where the primary costs are incentives, like the Interruptible Tariffs program.

Table 6-1. Benefit-Cost Test Ratio Results for All Program Types and Scenarios

State	Utility	Benefit-Cost Test	Program Type	Realistic Scenario	Maximum Scenario
KS	KCP&L	Societal Cost Test	Interruptible Tariffs	11.6	11.6
			Direct Load Control	2.1	2.6
			Pricing without Enabling Technology	2.6	3.2
			Pricing with Enabling Technology	1.7	2.0
			Other DR	1.9	2.0
		Total Resource Cost Test	Interruptible Tariffs	11.3	11.4
			Direct Load Control	1.9	2.3
			Pricing without Enabling Technology	2.3	3.1
			Pricing with Enabling Technology	1.5	1.9
			Other DR	1.8	1.9
		Utility Cost Test	Interruptible Tariffs	2.3	2.3
			Direct Load Control	1.9	2.3
			Pricing without Enabling Technology	2.3	3.1
			Pricing with Enabling Technology	1.5	1.9
			Other DR	1.0	1.1
		Participant Cost Test	Interruptible Tariffs	-	-
			Direct Load Control	-	-
			Pricing without Enabling Technology	-	-
			Pricing with Enabling Technology	-	-
			Other DR	-	-
		Rate Impact Measure Test	Interruptible Tariffs	2.3	2.3
			Direct Load Control	1.9	2.3
			Pricing without Enabling Technology	2.3	3.1
			Pricing with Enabling Technology	1.5	1.9
			Other DR	1.0	1.1
MO	KCP&L	Societal Cost Test	Interruptible Tariffs	11.6	11.7
			Direct Load Control	2.1	3.1
			Pricing without Enabling Technology	2.7	3.2
			Pricing with Enabling Technology	1.6	1.9
			Other DR	1.9	2.0
		Total Resource	Interruptible Tariffs	11.2	11.5
			Direct Load Control	1.9	2.9

State	Utility	Benefit-Cost Test	Program Type	Realistic Scenario	Maximum Scenario
		Cost Test	Pricing without Enabling Technology	2.5	3.1
			Pricing with Enabling Technology	1.4	1.7
			Other DR	1.8	1.9
		Utility Cost Test	Interruptible Tariffs	2.2	2.3
			Direct Load Control	1.9	2.9
			Pricing without Enabling Technology	2.5	3.1
			Pricing with Enabling Technology	1.4	1.7
			Other DR	1.1	1.1
		Participant Cost Test	Interruptible Tariffs	-	-
			Direct Load Control	-	-
			Pricing without Enabling Technology	-	-
			Pricing with Enabling Technology	-	-
			Other DR	-	-
		Rate Impact Measure Test	Interruptible Tariffs	2.2	2.3
			Direct Load Control	1.9	2.9
			Pricing without Enabling Technology	2.5	3.1
			Pricing with Enabling Technology	1.4	1.7
			Other DR	1.1	1.1
MO	KCP&L GMO	Societal Cost Test	Interruptible Tariffs	11.1	11.1
			Direct Load Control	2.1	2.9
			Pricing without Enabling Technology	2.2	3.2
			Pricing with Enabling Technology	1.4	1.9
			Other DR	1.8	1.9
		Total Resource Cost Test	Interruptible Tariffs	11.0	11.0
			Direct Load Control	1.9	2.6
			Pricing without Enabling Technology	1.9	3.1
			Pricing with Enabling Technology	1.2	1.7
			Other DR	1.7	1.8
		Utility Cost Test	Interruptible Tariffs	2.2	2.2
			Direct Load Control	1.9	2.6
			Pricing without Enabling Technology	1.9	3.1
			Pricing with Enabling Technology	1.2	1.7
			Other DR	1.0	1.0
		Participant Cost Test	Interruptible Tariffs	-	-
			Direct Load Control	-	-
			Pricing without Enabling Technology	-	-
			Pricing with Enabling Technology	-	-
			Other DR	-	-
		Rate Impact Measure Test	Interruptible Tariffs	2.2	2.2
			Direct Load Control	1.9	2.6
			Pricing without Enabling Technology	1.9	3.1
			Pricing with Enabling Technology	1.2	1.7

State	Utility	Benefit-Cost Test	Program Type	Realistic Scenario	Maximum Scenario
			Other DR	1.0	1.0

Note: The Participant Cost Test is undefined because no costs are assumed on the part of participants.
Source: Navigant analysis

7 Appendix C – DR Demand Savings and Costs by Program Type

The following tables show the demand savings for each DR program type in MW and as a percent of each utility’s annual peak demand, as well as the cumulative costs for each program type.

Table 7-1. Peak Load Reduction Potential for the Companies – Realistic Scenario (peak MW)

Utility	KCP&L-KS						KCP&L-MO						KCP&L-GMO					
Prog Type	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total
2014	26.6	27.0	0.0	0.0	0.0	**53.6**	60.0	18.0	0.0	0.0	0.0	**78.0**	13.6	22.0	0.0	0.0	0.0	**35.6**
2015	33.4	32.3	0.0	0.0	0.0	**65.7**	71.0	20.3	0.0	0.0	0.0	**91.2**	37.7	27.9	0.0	0.0	0.0	**65.7**
2016	41.2	35.6	0.0	0.0	0.5	**77.4**	86.7	22.5	0.0	0.0	0.8	**110.0**	64.3	32.6	0.0	0.0	0.7	**97.5**
2017	48.8	38.2	0.0	0.0	1.1	**88.0**	98.7	24.7	0.0	0.0	1.6	**124.9**	91.4	36.9	0.0	0.0	1.3	**129.6**
2018	56.1	40.1	0.4	0.6	1.6	**98.8**	110.5	27.0	0.4	0.6	2.3	**140.8**	119.1	41.0	0.0	0.0	2.0	**162.1**
2019	63.0	41.4	0.7	1.2	2.1	**108.5**	122.0	29.3	0.8	1.1	3.1	**156.4**	147.3	44.9	0.0	0.0	2.7	**194.8**
2020	69.8	42.1	1.1	1.7	2.7	**117.4**	133.1	31.6	1.3	1.7	3.9	**171.5**	175.6	48.4	0.4	0.7	3.4	**228.5**
2021	76.0	41.0	1.5	2.3	3.2	**124.1**	143.9	33.9	1.7	2.3	4.7	**186.5**	204.5	51.1	0.8	1.4	4.1	**261.9**
2022	81.9	40.0	1.9	3.0	3.7	**130.5**	154.3	36.3	2.1	2.8	5.5	**201.1**	234.0	53.9	1.2	2.1	4.8	**296.1**
2023	87.6	39.1	2.3	3.6	4.3	**136.8**	164.5	38.7	2.5	3.4	6.4	**215.5**	263.2	56.9	1.7	2.8	5.5	**330.0**
2024	92.8	38.3	2.6	4.2	4.8	**142.7**	174.3	41.2	2.9	4.0	7.2	**229.6**	293.6	60.0	2.1	3.5	6.3	**365.4**
2025	93.8	38.7	3.1	4.9	5.3	**145.8**	176.0	41.4	3.4	4.6	8.0	**233.4**	300.7	60.7	2.5	4.2	7.0	**375.1**
2026	94.9	39.2	3.5	5.5	5.4	**148.5**	178.0	41.7	3.8	5.2	8.2	**236.9**	307.3	61.5	2.9	5.0	7.2	**383.9**
2027	96.1	39.6	3.9	6.2	5.5	**151.4**	180.2	42.0	4.3	5.8	8.3	**240.6**	315.1	62.3	3.4	5.8	7.3	**393.9**
2028	97.4	40.2	4.0	6.3	5.6	**153.4**	182.4	42.2	4.3	5.9	8.5	**243.3**	322.9	63.1	3.9	6.6	7.5	**404.0**
2029	98.6	40.7	4.0	6.4	5.7	**155.3**	184.8	42.5	4.4	5.9	8.6	**246.2**	331.8	63.9	4.4	7.4	7.6	**415.3**
2030	99.9	41.2	4.1	6.5	5.8	**157.4**	187.1	42.8	4.4	6.0	8.8	**249.1**	340.4	64.7	4.5	7.6	7.8	**425.0**
2031	101.3	41.6	4.1	6.5	5.9	**159.5**	189.4	43.1	4.5	6.0	9.0	**252.0**	348.9	65.5	4.6	7.7	7.9	**434.7**
2032	102.5	42.2	4.2	6.6	6.0	**161.5**	191.5	43.4	4.5	6.1	9.2	**254.7**	358.2	66.3	4.7	7.8	8.1	**445.1**
2033	104.0	42.8	4.2	6.7	6.1	**163.8**	193.9	43.8	4.6	6.2	9.4	**257.8**	366.7	67.2	4.8	7.9	8.3	**454.9**

IT = Interruptible Tariffs, DLC = Direct Load Control, Pricing w/o ET = Pricing without Enabling Technology, Pricing w/ ET = Pricing with Enabling Technology
Source: Navigant analysis

Table 7-2. Peak Load Reduction Potential for the Companies – Maximum Scenario (peak MW)

Utility	KCP&L-KS						KCP&L-MO						KCP&L-GMO					
Prog Type	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total
2014	26.6	27.0	0.0	0.0	0.0	**53.6**	60.0	18.0	0.0	0.0	0.0	**78.0**	13.6	22.0	0.0	0.0	0.0	**35.6**
2015	35.7	32.6	0.0	0.0	2.1	**70.4**	84.1	20.9	0.0	0.0	3.3	**108.4**	42.4	30.1	0.0	0.0	2.9	**75.4**
2016	45.9	36.2	9.4	12.9	4.2	**108.6**	113.2	23.9	8.9	11.9	6.5	**164.4**	73.8	37.0	0.0	0.0	5.7	**116.6**
2017	55.5	38.4	18.9	26.0	6.2	**145.0**	137.9	26.4	17.9	23.8	9.7	**215.7**	106.0	43.6	0.0	0.0	8.6	**158.1**
2018	64.9	40.0	28.5	39.3	8.2	**180.9**	162.6	28.9	26.9	35.8	12.6	**266.8**	139.0	50.1	10.6	15.3	11.4	**226.4**
2019	73.8	40.8	38.4	52.9	10.1	**216.0**	187.0	31.3	36.1	47.9	15.6	**317.8**	171.7	55.3	21.5	31.0	14.1	**293.6**
2020	82.6	41.1	48.4	66.8	11.9	**250.8**	210.8	33.6	45.3	60.0	18.4	**368.1**	204.3	60.2	32.7	47.1	16.6	**361.0**
2021	90.7	39.7	58.7	80.9	13.7	**283.7**	234.5	35.9	54.7	72.3	21.0	**418.4**	237.4	64.2	44.2	63.6	19.1	**428.5**
2022	98.5	38.4	69.1	95.2	15.3	**316.6**	257.6	38.2	64.2	84.8	23.5	**468.3**	270.9	68.1	56.1	80.5	21.4	**497.0**
2023	106.1	37.3	79.7	110.0	16.9	**350.0**	280.5	40.4	73.8	97.4	25.9	**518.1**	303.7	72.0	68.2	97.8	23.5	**565.3**
2024	113.1	36.3	90.6	125.0	18.4	**383.5**	303.1	42.7	83.5	110.3	28.2	**567.8**	337.7	76.0	80.8	115.7	25.6	**635.7**
2025	113.7	36.1	101.8	140.4	18.1	**410.1**	304.4	42.1	93.5	123.3	27.6	**590.9**	343.8	75.5	93.8	134.1	25.0	**672.2**
2026	114.4	35.8	102.9	142.1	18.2	**413.5**	306.2	41.7	94.3	124.3	27.8	**594.2**	349.3	75.0	107.2	153.0	25.1	**709.6**
2027	115.9	36.3	104.2	143.8	18.5	**418.6**	310.1	42.0	95.1	125.3	28.2	**600.6**	356.0	74.6	121.2	172.6	25.3	**749.7**
2028	117.6	36.8	105.6	145.7	18.8	**424.4**	314.0	42.2	96.0	126.3	28.5	**607.0**	362.6	74.1	123.3	175.3	25.3	**760.5**
2029	119.1	37.2	106.9	147.6	19.0	**429.8**	318.1	42.5	96.8	127.4	29.0	**613.8**	372.5	75.0	125.5	178.1	25.6	**776.6**
2030	120.9	37.7	108.2	149.4	19.3	**435.6**	322.2	42.8	97.7	128.5	29.5	**620.7**	382.0	75.8	127.6	180.8	25.9	**792.0**
2031	122.6	38.1	109.6	151.3	19.5	**441.1**	326.4	43.1	98.6	129.6	29.8	**627.5**	391.5	76.6	129.9	183.6	26.1	**807.6**
2032	124.3	38.6	111.1	153.4	19.8	**447.1**	330.0	43.4	99.6	130.8	30.2	**634.0**	401.7	77.5	132.2	186.4	26.3	**824.1**
2033	126.1	39.1	112.6	155.5	20.1	**453.5**	334.4	43.8	100.6	132.1	30.8	**641.6**	411.3	78.4	134.4	189.3	26.6	**840.0**

IT = Interruptible Tariffs, DLC = Direct Load Control, Pricing w/o ET = Pricing without Enabling Technology, Pricing w/ ET = Pricing with Enabling Technology
Source: Navigant analysis

The following tables show the demand savings for each DR program type and in total as a percent of each utility's annual peak demand. These results are also shown graphically in Figure 1-4 through Figure 1-6 and Figure 4-4 through Figure 4-9.

Table 7-3. Peak Load Reduction Potential for the Companies – Realistic Scenario (% of utility MW)

Utility	KCP&L-KS						KCP&L-MO						KCP&L-GMO					
Prog Type	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total
2014	1.53%	1.55%	0%	0%	0%	**3.08%**	3.04%	0.91%	0%	0%	0%	**3.95%**	0.68%	1.10%	0%	0%	0%	**1.79%**
2015	1.90%	1.84%	0%	0%	0%	**3.74%**	3.59%	1.02%	0%	0%	0%	**4.61%**	1.87%	1.38%	0%	0%	0%	**3.25%**
2016	2.33%	2.01%	0%	0%	0.03%	**4.37%**	4.37%	1.13%	0%	0%	0.04%	**5.54%**	3.14%	1.59%	0%	0%	0.03%	**4.77%**
2017	2.73%	2.14%	0%	0%	0.06%	**4.93%**	4.95%	1.24%	0%	0%	0.08%	**6.27%**	4.41%	1.78%	0%	0%	0.06%	**6.25%**
2018	3.12%	2.23%	0%	0%	0.09%	**5.49%**	5.51%	1.35%	0%	0%	0.12%	**7.02%**	5.66%	1.95%	0%	0%	0.10%	**7.70%**
2019	3.47%	2.28%	0%	0%	0.12%	**5.97%**	6.04%	1.45%	0%	0%	0.16%	**7.75%**	6.89%	2.10%	0%	0%	0.13%	**9.11%**
2020	3.80%	2.29%	0.06%	0.10%	0.15%	**6.40%**	6.56%	1.56%	0.06%	0.08%	0.19%	**8.45%**	8.10%	2.23%	0.02%	0.03%	0.16%	**10.54%**
2021	4.11%	2.22%	0.08%	0.13%	0.17%	**6.70%**	7.05%	1.66%	0.08%	0.11%	0.23%	**9.13%**	9.29%	2.32%	0.04%	0.06%	0.19%	**11.89%**
2022	4.39%	2.14%	0.10%	0.16%	0.20%	**6.99%**	7.50%	1.77%	0.10%	0.14%	0.27%	**9.78%**	10.47%	2.41%	0.06%	0.09%	0.22%	**13.24%**
2023	4.64%	2.07%	0.12%	0.19%	0.23%	**7.25%**	7.94%	1.87%	0.12%	0.16%	0.31%	**10.41%**	11.60%	2.51%	0.07%	0.12%	0.24%	**14.55%**
2024	4.86%	2.01%	0.14%	0.22%	0.25%	**7.48%**	8.35%	1.98%	0.14%	0.19%	0.34%	**11.00%**	12.74%	2.60%	0.09%	0.15%	0.27%	**15.86%**
2025	4.87%	2.01%	0.16%	0.25%	0.28%	**7.56%**	8.37%	1.97%	0.16%	0.22%	0.38%	**11.10%**	12.83%	2.59%	0.11%	0.18%	0.30%	**16.00%**
2026	4.87%	2.01%	0.18%	0.28%	0.28%	**7.61%**	8.39%	1.96%	0.18%	0.24%	0.38%	**11.16%**	12.90%	2.58%	0.12%	0.21%	0.30%	**16.11%**
2027	4.87%	2.01%	0.20%	0.32%	0.28%	**7.67%**	8.41%	1.96%	0.20%	0.27%	0.39%	**11.22%**	12.98%	2.57%	0.14%	0.24%	0.30%	**16.23%**
2028	4.87%	2.01%	0.20%	0.32%	0.28%	**7.67%**	8.43%	1.95%	0.20%	0.27%	0.39%	**11.24%**	13.07%	2.55%	0.16%	0.27%	0.30%	**16.35%**
2029	4.87%	2.01%	0.20%	0.32%	0.28%	**7.67%**	8.45%	1.94%	0.20%	0.27%	0.40%	**11.26%**	13.17%	2.54%	0.18%	0.30%	0.30%	**16.49%**
2030	4.87%	2.01%	0.20%	0.32%	0.28%	**7.68%**	8.47%	1.94%	0.20%	0.27%	0.40%	**11.27%**	13.27%	2.52%	0.18%	0.29%	0.30%	**16.57%**
2031	4.88%	2.01%	0.20%	0.32%	0.28%	**7.68%**	8.49%	1.93%	0.20%	0.27%	0.40%	**11.29%**	13.36%	2.51%	0.18%	0.29%	0.30%	**16.64%**
2032	4.87%	2.01%	0.20%	0.32%	0.28%	**7.68%**	8.49%	1.93%	0.20%	0.27%	0.41%	**11.30%**	13.46%	2.49%	0.18%	0.29%	0.30%	**16.73%**
2033	4.88%	2.01%	0.20%	0.32%	0.29%	**7.68%**	8.51%	1.92%	0.20%	0.27%	0.41%	**11.31%**	13.54%	2.48%	0.18%	0.29%	0.31%	**16.79%**

IT = Interruptible Tariffs, DLC = Direct Load Control, Pricing w/o ET = Pricing without Enabling Technology, Pricing w/ ET = Pricing with Enabling Technology

Source: Navigant analysis

Table 7-4. Peak Load Reduction Potential for the Companies – Maximum Scenario (% of utility MW)

Utility	KCP&L-KS						KCP&L-MO						KCP&L-GMO					
Prog Type	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total
2014	1.53%	1.55%	0%	0%	0%	**3.08%**	3.04%	0.91%	0%	0%	0%	**3.95%**	0.68%	1.10%	0%	0%	0%	**1.79%**
2015	2.03%	1.86%	0%	0%	0%	**4.01%**	4.25%	1.06%	0%	0%	0%	**5.48%**	2.10%	1.49%	0%	0%	0%	**3.73%**
2016	2.59%	2.04%	1%	1%	0.24%	**6.13%**	5.70%	1.20%	0%	1%	0.33%	**8.28%**	3.61%	1.81%	0%	0%	0.28%	**5.70%**
2017	3.11%	2.15%	1%	1%	0.35%	**8.13%**	6.92%	1.32%	1%	1%	0.48%	**10.82%**	5.11%	2.10%	0%	0%	0.41%	**7.63%**
2018	3.61%	2.22%	2%	2%	0.45%	**10.05%**	8.11%	1.44%	1%	2%	0.63%	**13.30%**	6.60%	2.38%	1%	1%	0.54%	**10.75%**
2019	4.07%	2.25%	2%	3%	0.55%	**11.90%**	9.26%	1.55%	2%	2%	0.77%	**15.74%**	8.03%	2.59%	1%	1%	0.66%	**13.73%**
2020	4.50%	2.24%	2.64%	3.64%	0.65%	**13.67%**	10.39%	1.66%	2.23%	2.96%	0.90%	**18.14%**	9.42%	2.78%	1.51%	2.17%	0.77%	**16.64%**
2021	4.90%	2.15%	3.17%	4.37%	0.74%	**15.32%**	11.48%	1.76%	2.68%	3.54%	1.03%	**20.48%**	10.78%	2.91%	2.01%	2.89%	0.87%	**19.46%**
2022	5.28%	2.06%	3.70%	5.10%	0.82%	**16.95%**	12.52%	1.86%	3.12%	4.12%	1.14%	**22.77%**	12.11%	3.05%	2.51%	3.60%	0.96%	**22.23%**
2023	5.62%	1.98%	4.22%	5.83%	0.90%	**18.55%**	13.55%	1.95%	3.56%	4.70%	1.25%	**25.02%**	13.39%	3.18%	3.01%	4.31%	1.04%	**24.93%**
2024	5.93%	1.90%	4.75%	6.56%	0.97%	**20.11%**	14.52%	2.05%	4.00%	5.29%	1.35%	**27.21%**	14.66%	3.30%	3.51%	5.02%	1.11%	**27.59%**
2025	5.90%	1.87%	5.28%	7.28%	0.94%	**21.27%**	14.47%	2.00%	4.45%	5.86%	1.31%	**28.10%**	14.67%	3.22%	4.00%	5.72%	1.07%	**28.68%**
2026	5.87%	1.84%	5.28%	7.29%	0.93%	**21.20%**	14.42%	1.96%	4.44%	5.85%	1.31%	**27.99%**	14.66%	3.15%	4.50%	6.42%	1.05%	**29.78%**
2027	5.87%	1.84%	5.28%	7.29%	0.93%	**21.21%**	14.46%	1.96%	4.43%	5.84%	1.32%	**28.01%**	14.67%	3.07%	4.99%	7.11%	1.04%	**30.89%**
2028	5.88%	1.84%	5.28%	7.29%	0.94%	**21.22%**	14.50%	1.95%	4.43%	5.84%	1.32%	**28.04%**	14.67%	3.00%	4.99%	7.09%	1.02%	**30.78%**
2029	5.88%	1.84%	5.28%	7.29%	0.94%	**21.23%**	14.54%	1.94%	4.43%	5.82%	1.33%	**28.06%**	14.79%	2.98%	4.98%	7.07%	1.02%	**30.83%**
2030	5.89%	1.84%	5.28%	7.29%	0.94%	**21.24%**	14.58%	1.94%	4.42%	5.81%	1.33%	**28.09%**	14.89%	2.95%	4.98%	7.05%	1.01%	**30.88%**
2031	5.91%	1.83%	5.28%	7.29%	0.94%	**21.25%**	14.62%	1.93%	4.42%	5.81%	1.34%	**28.11%**	14.99%	2.93%	4.97%	7.03%	1.00%	**30.92%**
2032	5.91%	1.84%	5.28%	7.29%	0.94%	**21.26%**	14.64%	1.93%	4.42%	5.80%	1.34%	**28.13%**	15.10%	2.91%	4.97%	7.01%	0.99%	**30.97%**
2033	5.92%	1.83%	5.28%	7.29%	0.94%	**21.27%**	14.67%	1.92%	4.41%	5.79%	1.35%	**28.15%**	15.18%	2.90%	4.96%	6.99%	0.98%	**31.01%**

IT = Interruptible Tariffs, DLC = Direct Load Control, Pricing w/o ET = Pricing without Enabling Technology, Pricing w/ ET = Pricing with Enabling Technology

Source: Navigant analysis

Table 7-5. Cumulative DR Budget by Program for the Companies – Realistic Scenario (million $/year)

Utility	KCP&L-KS						KCP&L-MO						KCP&L-GMO					
Prog Type	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total
2014	$1.5	$4.1	$0.0	$0.0	$0.0	**$5.7**	$3.5	$0.6	$0.0	$0.0	$0.0	**$4.1**	$0.9	$2.1	$0.0	$0.0	$0.0	**$3.0**
2015	$3.5	$8.4	$0.0	$0.0	$0.2	**$12.1**	$7.6	$2.7	$0.0	$0.0	$0.2	**$10.5**	$3.2	$6.0	$0.0	$0.0	$0.4	**$9.7**
2016	$5.9	$11.8	$0.0	$0.0	$0.3	**$18.0**	$12.6	$4.9	$0.0	$0.0	$0.4	**$17.9**	$7.3	$9.6	$0.0	$0.0	$0.5	**$17.4**
2017	$8.7	$15.0	$0.4	$0.3	$0.5	**$24.9**	$18.3	$7.2	$0.3	$0.3	$0.6	**$26.9**	$13.0	$13.2	$0.0	$0.0	$0.8	**$27.0**
2018	$12.1	$18.0	$0.4	$0.6	$0.7	**$31.8**	$24.9	$9.7	$0.4	$0.6	$1.0	**$36.6**	$20.6	$17.0	$0.0	$0.0	$1.1	**$38.7**
2019	$15.9	$20.7	$0.5	$0.9	$1.0	**$39.0**	$32.3	$12.3	$0.5	$1.0	$1.4	**$47.5**	$30.3	$20.9	$0.7	$0.7	$1.5	**$54.1**
2020	$20.3	$23.2	$0.6	$1.2	$1.4	**$46.6**	$40.6	$15.2	$0.5	$1.3	$2.0	**$59.6**	$42.2	$24.9	$0.8	$1.1	$2.0	**$70.9**
2021	$25.2	$24.9	$0.7	$1.6	$1.9	**$54.2**	$49.8	$18.2	$0.7	$1.7	$2.7	**$73.1**	$56.4	$28.7	$0.9	$1.5	$2.7	**$90.0**
2022	$30.6	$26.6	$0.8	$2.0	$2.5	**$62.4**	$60.0	$21.4	$0.8	$2.1	$3.5	**$87.8**	$73.0	$32.7	$0.9	$1.9	$3.4	**$112.0**
2023	$36.5	$28.3	$0.9	$2.5	$3.1	**$71.3**	$71.0	$24.9	$0.9	$2.6	$4.5	**$103.9**	$92.1	$37.1	$1.1	$2.5	$4.3	**$137.0**
2024	$42.9	$30.0	$1.1	$3.0	$3.9	**$80.8**	$83.0	$28.5	$1.1	$3.1	$5.6	**$121.3**	$114.0	$41.8	$1.2	$3.0	$5.2	**$165.3**
2025	$49.5	$32.4	$1.3	$3.6	$4.7	**$91.5**	$95.5	$30.9	$1.3	$3.6	$6.8	**$138.1**	$137.0	$45.4	$1.4	$3.6	$6.4	**$193.7**
2026	$56.4	$34.9	$1.5	$4.2	$5.5	**$102.5**	$108.3	$33.4	$1.5	$4.2	$8.1	**$155.6**	$161.0	$49.1	$1.6	$4.3	$7.5	**$223.5**
2027	$63.6	$37.4	$1.7	$4.9	$6.4	**$114.1**	$121.7	$35.9	$1.8	$4.9	$9.4	**$173.7**	$186.3	$52.9	$1.8	$5.1	$8.7	**$254.9**
2028	$71.0	$40.1	$1.9	$5.3	$7.3	**$125.7**	$135.6	$38.5	$2.0	$5.3	$10.8	**$192.2**	$212.9	$56.9	$2.1	$6.0	$9.9	**$287.7**
2029	$78.7	$42.8	$2.1	$5.7	$8.3	**$137.7**	$150.0	$41.2	$2.2	$5.7	$12.3	**$211.3**	$240.9	$61.0	$2.3	$6.9	$11.2	**$322.3**
2030	$86.8	$45.6	$2.4	$6.2	$9.3	**$150.3**	$164.9	$43.9	$2.5	$6.1	$13.8	**$231.2**	$270.3	$65.2	$2.6	$7.4	$12.6	**$358.2**
2031	$95.1	$48.6	$2.6	$6.6	$10.3	**$163.3**	$180.4	$46.8	$2.7	$6.5	$15.4	**$251.8**	$301.2	$69.6	$2.9	$8.0	$14.0	**$395.7**
2032	$103.7	$51.6	$2.8	$7.1	$11.4	**$176.7**	$196.5	$49.7	$3.0	$6.9	$17.0	**$273.2**	$333.8	$74.2	$3.1	$8.6	$15.5	**$435.1**
2033	$112.7	$54.8	$3.1	$7.6	$12.6	**$190.7**	$213.2	$52.7	$3.2	$7.4	$18.8	**$295.3**	$367.9	$78.9	$3.4	$9.2	$17.0	**$476.4**

IT = Interruptible Tariffs, DLC = Direct Load Control, Pricing w/o ET = Pricing without Enabling Technology, Pricing w/ ET = Pricing with Enabling Technology

Source: Navigant analysis

Table 7-6. Cumulative DR Budget by Program for the Companies – Maximum Scenario (million $/year)

Utility	KCP&L-KS						KCP&L-MO						KCP&L-GMO					
Prog Type	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total	IT	DLC	Pricing w/o ET	Pricing w/ ET	Other DR	Total
2014	$1.5	$4.1	$0.0	$0.0	$0.2	**$5.8**	$3.5	$0.6	$0.0	$0.0	$0.2	**$4.3**	$0.9	$1.8	$0.0	$0.0	$0.4	**$3.0**
2015	$3.6	$8.3	$0.4	$0.3	$0.7	**$13.4**	$8.4	$2.8	$0.3	$0.3	$1.0	**$12.8**	$3.5	$5.6	$0.0	$0.0	$1.2	**$10.3**
2016	$6.3	$11.7	$1.2	$4.8	$1.5	**$25.6**	$14.9	$5.0	$1.2	$5.3	$2.1	**$28.5**	$8.1	$9.4	$0.0	$0.0	$2.3	**$19.8**
2017	$9.5	$13.4	$2.5	$10.0	$2.5	**$37.9**	$22.9	$6.5	$2.4	$10.8	$3.6	**$46.1**	$14.8	$13.3	$0.7	$0.7	$3.8	**$33.3**
2018	$13.4	$14.9	$4.2	$16.0	$3.7	**$52.2**	$32.6	$7.8	$4.1	$17.0	$5.4	**$66.8**	$23.7	$17.6	$1.8	$6.9	$5.7	**$55.7**
2019	$17.9	$16.5	$6.3	$22.9	$5.2	**$68.8**	$44.0	$9.2	$6.1	$24.0	$7.6	**$90.8**	$35.0	$20.6	$3.4	$14.2	$7.8	**$81.0**
2020	$23.1	$18.1	$8.9	$30.7	$6.8	**$87.6**	$57.1	$10.5	$8.6	$31.8	$10.1	**$118.1**	$48.8	$23.5	$5.5	$22.5	$10.3	**$110.6**
2021	$28.9	$19.6	$12.1	$39.4	$8.7	**$108.8**	$72.1	$11.9	$11.5	$40.5	$13.0	**$149.0**	$65.3	$26.1	$8.1	$32.0	$13.0	**$144.5**
2022	$35.4	$21.2	$15.8	$49.2	$10.8	**$132.4**	$89.0	$13.5	$15.0	$50.0	$16.2	**$183.7**	$84.5	$28.9	$11.4	$42.7	$16.1	**$183.5**
2023	$42.5	$22.7	$20.1	$60.1	$13.2	**$158.6**	$107.9	$15.1	$19.0	$60.5	$19.9	**$222.4**	$106.6	$31.9	$15.3	$54.7	$19.4	**$227.9**
2024	$50.4	$24.2	$25.0	$72.1	$15.9	**$187.5**	$128.7	$16.9	$23.5	$72.0	$24.0	**$265.2**	$131.7	$35.1	$19.9	$68.1	$23.1	**$277.9**
2025	$58.4	$25.7	$30.5	$85.3	$18.6	**$218.6**	$150.2	$18.7	$28.6	$84.5	$28.1	**$310.2**	$158.0	$38.3	$25.3	$82.9	$26.8	**$331.3**
2026	$66.7	$27.3	$35.6	$93.7	$21.4	**$244.8**	$172.4	$20.5	$33.3	$91.9	$32.3	**$350.4**	$185.4	$41.6	$31.4	$99.3	$30.7	**$388.4**
2027	$75.4	$29.1	$40.9	$102.5	$24.3	**$272.1**	$195.4	$22.6	$38.1	$99.5	$36.7	**$392.3**	$213.9	$44.9	$38.5	$117.4	$34.6	**$449.3**
2028	$84.3	$31.0	$46.4	$111.5	$27.3	**$300.5**	$219.3	$24.7	$43.0	$107.3	$41.3	**$435.7**	$243.8	$48.3	$44.9	$128.5	$38.6	**$504.2**
2029	$93.7	$33.0	$52.1	$120.9	$30.4	**$330.0**	$244.1	$26.9	$48.2	$115.4	$46.1	**$480.6**	$275.2	$52.1	$51.6	$140.1	$42.9	**$561.9**
2030	$103.4	$35.0	$58.0	$130.6	$33.7	**$360.6**	$269.8	$29.1	$53.5	$123.8	$51.1	**$527.2**	$308.2	$56.1	$58.6	$152.1	$47.3	**$622.2**
2031	$113.4	$37.1	$64.1	$140.6	$37.1	**$392.4**	$296.6	$31.4	$59.0	$132.4	$56.2	**$575.6**	$342.9	$60.1	$65.9	$164.6	$51.8	**$685.3**
2032	$123.9	$39.3	$70.5	$151.1	$40.6	**$425.3**	$324.3	$33.8	$64.7	$141.3	$61.6	**$625.6**	$379.4	$64.4	$73.5	$177.5	$56.4	**$751.2**
2033	$134.8	$41.5	$77.1	$161.9	$44.3	**$459.6**	$353.0	$36.3	$70.5	$150.6	$67.2	**$677.5**	$417.7	$68.8	$81.4	$191.0	$61.3	**$820.1**

IT = Interruptible Tariffs, DLC = Direct Load Control, Pricing w/o ET = Pricing without Enabling Technology, Pricing w/ ET = Pricing with Enabling Technology

Source: Navigant analysis