VOLUME 3:

LOAD ANALYSIS AND LOAD FORECASTING

KANSAS CITY POWER & LIGHT COMPANY (KCP&L)

INTEGRATED RESOURCE PLAN

4 CSR 240-22.030

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PURPOSE: This rule sets minimum standards for the maintenance and updating of historical data, the level of detail required in analyzing loads, and the purposes to be accomplished by load analysis and by load forecast models. The load analysis discussed in this rule is intended to support both demand-side management efforts of 4 CSR 240-22.050 and the load forecast models of this rule. This rule also sets the minimum standards for the documentation of the inputs, components, and methods used to derive the load forecasts.

SECTION 1: SELECTING LOAD ANALYSIS METHODS

The utility may choose multiple methods of load analysis if it deems doing so is necessary to achieve all of the purposes of load analysis and if the methods are consistent with, and calibrated to, one another. The utility shall describe and document its intended purposes for load analysis methods, why the selected load analysis methods best fulfill those purposes, and how the load analysis methods are consistent with one another and with the endues consumption data used in the demand-side analysis as described in 4 CSR 240-22.050. At a minimum, the load analysis methods shall be selected to achieve the following purposes:

1.1 PURPOSE: IDENTIFICATION OF END-USE MEASURES

(A) To identify end-use measures that may be potential demand-side resources, generally, those end-use measures with an opportunity for energy and/or demand savings;

1.2 PURPOSE: DERIVATION OF DATA SET OF HISTORICAL VALUES

(B) To derive a data set of historical values from load research data that can be used as dependent and independent variables in the load forecasts;

1.3 PURPOSE: ANALYSIS OF IMPACTS OF IMPLEMENTED DSM AND DEMAND-SIDE RATES ON LOAD FORECASTS

(C) To facilitate the analysis of impacts of implemented demand-side programs and demand-side rates on the load forecasts and to augment measurement of the effectiveness of demand-side resources necessary for 4 CSR 240-22.070(8) in the evaluation of the performance of the demand-side programs or rates after they are implemented; and

1.4 PURPOSE: PRESERVATION OF LOAD ANALYSIS IN HISTORICAL DATABASE

(D) To preserve, in a historical database, the results of the load analysis used to perform the demand-side analysis as described in 4 CSR 240-22.050, and the load forecasting described in 4 CSR 240-22.030.

SECTION 2: HISTORICAL DATABASE FOR LOAD ANALYSIS

The utility shall develop and maintain data on the actual historical patterns of energy usage within its service territory. The following information shall be maintained and updated on an ongoing basis and described and documented in the triennial compliance filings:

2.1 CUSTOMER CLASS DETAIL

(A) Customer Class Detail. At a minimum, the historical database shall be maintained for each of the major classes;

Beginning with this IRP filing, KCP&L forecasts its loads for each major class, which are Residential, Small General Service (SGS), Medium General Service (MGS), Large General Service (LGS), Large Power (LP), Lighting and Sales for Resale (SFR). In addition, SGS, MGS, LGS and LP are split into the subclasses commercial and industrial. This data begins in May 2005 for KCP&L and will be maintained with at least 10 years of history going forward.

2.2 LOAD DATA DETAIL

(B) The historical load database shall contain the following data:

2.2.1 ACTUAL AND WEATHER NORMALIZED ENERGY, AND NUMBER OF CUSTOMERS

1. For each jurisdiction for which it prepares customer and energy and demand forecasts, for each major class, to the actual monthly energy usage and number of customers and weather-normalized monthly energy usage;

MetrixND files are used to maintain this data for each subclass listed in 22.030 (2) (A). These files also contain the models used to forecast the number of customers and weather-normalize and forecast monthly energy sales.

2.2.2 <u>ACTUAL AND WEATHER NORMALIZED DEMANDS</u>

2. For each jurisdiction and major class, estimated actual and weather-normalized demands at the time of monthly system peaks; and

Actual and weather-normalized coincident demands are provided in the *load research* folder of the workpapers. This data is available beginning in May 2004 at which time the load research sample converted from revenue class to CCOS. The loads are currently weather normalized when a rate case is prepared.

2.2.3 <u>ACTUAL AND WEATHER NORMALIZED SYSTEM PEAK DEMANDS</u>

3. For the system, actual and weather normalized hourly net system load;

Actual and weather-normalized Net System Input (NSI) is contained in the MetrixLT files.

2.3 <u>LOAD COMPONENT DETAIL</u>

(C) The historical database for major class monthly energy usage and demands at time of monthly peaks shall be disaggregated into a number-of-units component and a use-per-unit component, for both actual and weather-normalized loads.

2.3.1 <u>UNITS COMPONENT</u>

1. The number-of-units component shall be the number of customers, square feet, devices, or other units as appropriate to the customer class and the load analysis method selected by the utility. The utility shall select the units component with the intent of providing meaningful load analysis for demand-side analysis and maintaining the integrity of the database over time.

The number-of-units is the number of customers for residential, SGS commercial and MGS commercial. For the other subclasses, mWh sales are modeled because it is more stable than kWh sales per customer and the model fit statistics are higher. In the large customer classes, the size of customers varies more than in the smaller classes and use per customer can vary substantially as customers enter or exit the class.

2.3.2 UPDATE PROCEDURE

2. The utility shall develop and implement a procedure to routinely measure and regularly update estimates of the effect of departures from normal weather on class and system electric loads. The estimates of the effect of weather on historical major class and system loads shall incorporate the nonlinear response of loads to daily weather and seasonal variations in loads.

KCP&L has developed a MetrixND model for each subclass of kWh sales that both forecasts and weather normalizes sales or sales per unit. These models will update weather normalized sales at the subclass level whenever these models are updated. This procedure is automatic. Major class level demands are currently weather normalized only for a rate case and this process is not automatic as it requires a large number of manual steps. Heating and cooling degree days calculated with different base temperatures were tested and kept in the models if statistically significant so that nonlinear weather response functions could be represented.

2.3.3 WEATHER MEASURES AND ESTIMATION OF WEATHER EFFECTS DESCRIPTION AND DOCUMENTATION

3. The utility shall describe and document the methods used to develop weather measures and the methods used to estimate the effect of weather on electric loads. If statistical models are used, the documentation shall include at least: the functional form of the models; the estimation techniques employed; and the relevant statistical results of the models, including parameter estimates and tests of statistical significance. The data used to estimate the models, including the development of model input data from basic data, shall be included in the workpapers supplied at the time the compliance report is filed;

In this IRP filing, KCP&L used different methods to model the effects of weather for normalization and for forecasting. One reason for using different methods is that the sample period for WN needed to cover the entire period that historical data was available so that data could be WN. On the other hand, the forecasting models often need a more recent shorter sample period since the focus is on calibrating an end-use forecast to recent data. The method of WN used in this IRP filing is different than that used in the rate cases because it is designed to WN many years of data whereas the rate case models are based on only two years of data. Also the method used here is much less labor intensive and can be updated more routinely.

Degree days computed at different base temperatures were tested in explaining the effects of weather on sales and system load. Degree days computed with more than one base temperature were tested in the same model to determine if the load response is nonlinear. The statistical results of model estimation in the weather normalization models of monthly sales are presented in this section. Additional information is available in the MetrixND model files that are included in the electronic workpapers. This additional information includes formulas that define the explanatory variables, plots and tables of residuals, plots and tables of actual, weather-normalized and predicted values, plots and tables of explanatory variables and model statistics and coefficients. The model coefficients were estimated using ordinary least squares regression in MetrixND. The estimation period generally includes May 2005 to July 2011.

Table 1 WN Model for MO Residential Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	532.6	13.1	40.7	0.00%
BinaryVars.trend1	10.5	8.6	1.2	22.47%
BinaryVars.trend2	271.8	407.0	0.7	50.68%
BinaryVars.trend3	-1173.0	767.4	-1.5	13.15%
WthrIndex_RES.CDD65	2391.5	53.3	44.9	0.00%
WthrIndex_RES.HDD55	1674.8	82.9	20.2	0.00%
BinaryVars.Jan	86.6	15.4	5.6	0.00%
BinaryVars.Dec	95.7	14.0	6.9	0.00%
WthrTrans.cddTrend1_CCOS	-93.5	42.3	-2.2	3.06%
WthrTrans.cddTrend2_CCOS	1917.0	1295.6	1.5	14.40%
WthrTrans.hddTrend1_CCOS	-21.9	65.0	-0.3	73.76%
WthrTrans.hddTrend2_CCOS	799.8	1714.0	0.5	64.24%
WthrTrans.cdd65shoulder_CCOS	-263.5	153.3	-1.7	9.06%

Table 2 WN Model for MO Small GS Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	1058.6	24.8	42.7	0.00%
BinaryVars.trend1	-39.2	18.9	-2.1	4.25%
BinaryVars.trend2	769.3	854.1	0.9	37.11%
BinaryVars.trend3	-843.0	1511.2	-0.6	57.89%
WthrTrans.Cdd60trend1_SML	-192.1	102.1	-1.9	6.43%
WthrTrans.Cdd60trend2_SML	2669.2	3118.2	0.9	39.52%
WthrTrans.Hdd55trend1_SML	-61.1	133.9	-0.5	64.96%
WthrTrans.Hdd55trend2_SML	1438.9	3564.0	0.4	68.78%
WthrIndex_SML.CDD60	2488.6	121.9	20.4	0.00%
WthrIndex_SML.HDD55	1714.7	145.1	11.8	0.00%
SML_WNAvgUse.Dec06	208.8	59.6	3.5	0.08%

Table 3 WN Model for MO Medium GS Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	13,867	268	51.8	0.00%
BinaryVars.trend1	434	239	1.8	7.45%
BinaryVars.trend2	-16,321	9,263	-1.8	8.29%
BinaryVars.trend3	-66,259	54,867	-1.2	23.17%
BinaryVars.trend4	171,347	91,660	1.9	6.62%
WthrTrans.Cdd55trend1_MED	-1,625	1,183	-1.4	17.47%
WthrTrans.Cdd55trend2_MED	28,820	35,711	0.8	42.27%
WthrTrans.Hdd55trend1_MED	-2,431	1,421	-1.7	9.21%
WthrTrans.Hdd55trend2_MED	45,656	37,860	1.2	23.24%
WthrIndex_MED.CDD55	31,347	1,407	22.3	0.00%
WthrIndex_MED.HDD55	17,919	1,499	12.0	0.00%
MED_WNAvgUse.Jan09	-2,391	590	-4.1	0.01%

Table 4 WN Model for MO Large GS Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	138,760,209	2,425,834	57.2	0.00%
BinaryVars.trend1	4,569,750	1,904,021	2.4	1.94%
BinaryVars.trend2	-286,556,447	79,659,255	-3.6	0.06%
BinaryVars.trend3	425,443,428	132,331,932	3.2	0.21%
WthrTrans.Cdd55trend1_LRG	-10,621,991	10,970,508	-1.0	33.66%
WthrTrans.Cdd55trend2_LRG	209,061,080	331,503,926	0.6	53.06%
WthrTrans.Hdd55trend1_LRG	-15,882,551	12,946,437	-1.2	22.45%
WthrTrans.Hdd55trend2_LRG	331,741,690	344,711,622	1.0	33.95%
WthrIndex_LRG.CDD55	203,947,518	13,043,234	15.6	0.00%
WthrIndex_LRG.HDD55	170,024,075	13,858,774	12.3	0.00%
LRG_WNSales.Jan09	18,880,838	5,505,726	3.4	0.11%
LRG_WNSales.Dec09	18,202,460	5,205,430	3.5	0.09%

Table 5 WN Model for MO Large Power Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	61,254,939	1,546,486	39.6	0.00%
BinaryVars.trend1	4,455,312	1,401,137	3.2	0.23%
BinaryVars.trend2	169,322,084	53,544,776	3.2	0.24%
BinaryVars.trend3	-1,195,898,476	321,543,917	-3.7	0.04%
BinaryVars.trend4	1,508,070,776	537,062,083	2.8	0.66%
WthrTrans.Cdd55trend1_LP	2,508,489	6,839,604	0.4	71.50%
WthrTrans.Cdd55trend2_LP	-247,372,219	206,384,570	-1.2	23.52%
WthrTrans.Hdd55trend1_LP	-16,673,521	8,043,466	-2.1	4.23%
WthrTrans.Hdd55trend2_LP	277,848,482	214,502,954	1.3	19.99%
WthrIndex_LP.CDD55	127,905,262	8,145,130	15.7	0.00%
WthrIndex_LP.HDD55	42,958,375	8,626,118	5.0	0.00%
LP_WNSales.Oct08	17,002,987	3,272,816	5.2	0.00%

Table 6 WN Model for MO Small GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	829,594	19,321	42.9	0.00%
WthrIndex_SML.CDD65	1,969,832	114,703	17.2	0.00%
WthrIndex_SML.HDD50	1,508,417	145,965	10.3	0.00%
SML_WNSales.Dec08	-749,951	86,668	-8.7	0.00%
SML_WNSales.Nov10	-352,493	85,360	-4.1	0.01%
WthrTrans.Cdd65trend1_SML	-215,425	65,932	-3.3	0.17%
WthrTrans.Cdd65trend2_SML	-1,794,848	2,083,133	-0.9	39.20%
WthrTrans.Hdd50trend1_SML	-579,081	113,718	-5.1	0.00%
WthrTrans.Hdd50trend2_SML	7,218,921	2,967,161	2.4	1.77%

Table 7 WN Model for MO Medium GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	4,716,896	62,759	75.2	0.00%
WthrTrans.Hdd50trend1_MED	330,831	146,396	2.3	2.70%
WthrTrans.Cdd65trend1_MED	126,396	107,643	1.2	24.43%
WthrIndex_MED.HDD50	457,771	475,406	1.0	33.90%
WthrIndex_MED.CDD65	4,750,472	348,146	13.6	0.00%
MED_WNSales.Dec08	1,113,574	286,156	3.9	0.02%

Table 8 WN Model for MO Large GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	19,567,839	203,651	96.1	0.00%
WthrIndex_LRG.CDD65	10,923,453	1,610,292	6.8	0.00%
WthrTrans.Cdd65trend1_LRG	-2,247,512	1,082,917	-2.1	4.16%
WthrTrans.Cdd65trend2_LRG	23,849,819	33,952,048	0.7	48.47%

Table 9 WN Model for MO Large Power Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	104,776,066	946,068	110.7	0.00%
WthrIndex_LP.CDD55	89,324,328	7,859,218	11.4	0.00%
WthrTrans.Cdd55trend1_LP	-12,608,789	2,588,823	-4.9	0.00%
LP_WNSales.nov2005dec	-55,615,219	4,099,808	-13.6	0.00%
LP_WNSales.feb2009mar	-43,507,320	4,098,799	-10.6	0.00%
LP_WNSales.feb2010mar	-44,526,118	4,098,393	-10.9	0.00%
LP_WNSales.jun2009jul	-25,723,771	4,099,441	-6.3	0.00%

Table 10 WN Model for KS Residential Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	687.4	15.8	43.6	0.00%
WthrIndex_RES.CDD65	3,235.3	119.8	27.0	0.00%
WthrIndex_RES.CDD75	-191.0	62.6	-3.1	0.34%
WthrIndex_RES.HDD55	1,906.6	99.4	19.2	0.00%
BinaryVars.trend1	9.3	9.4	1.0	32.64%
BinaryVars.trend2	-125.8	440.9	-0.3	77.64%
BinaryVars.trend3	-572.6	832.9	-0.7	49.43%
WNAvgUse_CCOS.Jan	115.6	17.0	6.8	0.00%
WNAvgUse_CCOS.Dec	98.2	15.5	6.4	0.00%
WthrTrans.cddTrend1_CCOS	-72.4	46.3	-1.6	12.34%
WthrTrans.cddTrend2_CCOS	2,173.5	1,381.5	1.6	12.08%
WthrTrans.hddTrend1_CCOS	-40.2	70.2	-0.6	56.88%
WthrTrans.hddTrend2_CCOS	1,006.6	1,849.3	0.5	58.82%
WthrTrans.cddShoulder_CCOS	-263.6	194.9	-1.353	18.11%

Table 11 WN Model for KS Small GS Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	946	13	73.7	0.00%
WthrTrans.Hdd55trend2_SML	-91,900	154,262	-0.6	55.35%
WthrTrans.Hdd55trend1_SML	-1,374	1,621	-0.8	39.98%
WthrTrans.Cdd60trend1_SML	-226	596	-0.4	70.64%
WthrTrans.Cdd60trend2_SML	5,053	46,842	0.1	91.44%
WthrIndex_SML.HDD55	1,352	69	19.6	0.00%
WthrIndex_SML.CDD60	2,040	74	27.6	0.00%
BinaryVars.trend1	-801	262	-3.1	0.32%
BinaryVars.trend2	-190,033	74,885	-2.5	1.36%
BinaryVars.trend3	-1,490,651	745,806	-2.0	4.99%
BinaryVars.trend4	-3,671,953	2,312,670	-1.6	11.73%

Table 12 WN Model for KS Medium GS Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	11,863	154	76.8	0.00%
BinaryVars.trend1	-5,696	2,936	-1.9	5.68%
BinaryVars.trend2	-1,896,567	801,966	-2.4	2.11%
BinaryVars.trend3	-18,697,575	7,969,356	-2.3	2.21%
BinaryVars.trend4	-55,219,032	24,719,659	-2.2	2.90%
WthrTrans.Cdd55trend1_MED	-1,349	8,157	-0.2	86.92%
WthrTrans.Cdd55trend2_MED	-157,865	644,060	-0.2	80.72%
WthrTrans.Hdd55trend1_MED	-20,098	18,607	-1.1	28.41%
WthrTrans.Hdd55trend2_MED	-1,599,323	1,760,986	-0.9	36.72%
WthrIndex_MED.CDD55	28,929	948	30.5	0.00%
WthrIndex_MED.HDD55	12,516	793	15.8	0.00%

Table 13 WN Model for KS Large GS Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	147,731,454	1,526,681	96.8	0.00%
BinaryVars.trend1	11,501,828	21,088,220	0.5	58.74%
BinaryVars.trend2	469,636,609	2,966,433,012	0.2	87.47%
BinaryVars.trend3	368,510,107	10,565,146,585	0.0	97.23%
WthrTrans.Hdd50trend1_LRG	-29,140,531	195,310,444	-0.1	88.19%
WthrTrans.Hdd50trend2_LRG	-1,801,005,671	18,341,660,895	-0.1	92.21%
WthrTrans.Cdd55trend1_LRG	55,314,776	79,371,164	0.7	48.84%
WthrTrans.Cdd55trend2_LRG	3,537,482,306	5,965,673,681	0.6	55.53%
WthrIndex_LRG.HDD50	97,928,174	7,027,548	13.9	0.00%
WthrIndex_LRG.CDD55	185,959,366	9,352,596	19.9	0.00%
LRG_WNSales.May08	95,474,123	4,578,350	20.9	0.00%
LRG_WNSales.lt2008may	-31,044,648	1,312,314	-23.7	0.00%

Table 14 WN Model for KS Large Power Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	6,088,951	498,949	12.2	0.00%
BinaryVars.trend1	13,095,183	10,336,570	1.3	20.99%
BinaryVars.trend2	835,600,759	2,963,411,137	0.3	77.89%
BinaryVars.trend3	-724,612,149	29,364,385,901	0.0	98.04%
BinaryVars.trend4	-19,134,032,618	90,634,584,525	-0.2	83.35%
WthrTrans.Cdd60trend1_LP	-37,297,986	21,590,942	-1.7	8.91%
WthrTrans.Cdd60trend2_LP	-896,920,435	1,684,954,362	-0.5	59.64%
WthrTrans.Hdd55trend1_LP	104,544,300	59,559,607	1.8	8.42%
WthrTrans.Hdd55trend2_LP	12,461,749,233	5,606,527,896	2.2	2.99%
WthrIndex_LP.CDD60	13,124,277	2,771,652	4.7	0.00%
WthrIndex_LP.HDD55	8,351,674	2,585,446	3.2	0.20%
LP_WNSales.May08	-95,261,396	1,594,668	-59.7	0.00%
LP_WNSales.lt2008may	30,024,703	461,224	65.1	0.00%

Table 15 WN Model for KS Small GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	1,218,982	22,695	53.7	0.00%
WthrTrans.Cdd65trend1_SML	18,336	40,195	0.5	64.98%
WthrTrans.Hdd50trend1_SML	36,760	50,950	0.7	47.32%
WthrIndex_SML.CDD65	610,692	94,660	6.5	0.00%
WthrIndex_SML.HDD50	541,389	129,834	4.2	0.01%
BinaryVars.trend1	-48,408	16,344	-3.0	0.43%
BinaryVars.trend2	-893,827	845,721	-1.1	29.45%
BinaryVars.trend3	14,126,170	6,079,405	2.3	2.33%
BinaryVars.trend4	-22,829,842	10,314,382	-2.2	3.04%
SML_WNSales.Nov10	-208,224	68,523	-3.0	0.34%

Table 16 WN Model for KS Medium GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	2,094,370	35,308	59.3	0.00%
WthrTrans.Cdd65trend1_MED	-79,556	131,069	-0.6	54.60%
WthrTrans.Cdd65trend2_MED	-818,791	3,929,340	-0.2	83.56%
WthrTrans.Hdd50trend1_MED	-613,440	187,189	-3.3	0.17%
WthrTrans.Hdd50trend2_MED	14,799,017	4,930,985	3.0	0.39%
WthrIndex_MED.CDD65	2,422,304	165,784	14.6	0.00%
WthrIndex_MED.HDD50	788,494	197,943	4.0	0.02%
BinaryVars.trend1	171,543	32,431	5.3	0.00%
BinaryVars.trend2	381,951	1,455,436	0.3	79.38%
BinaryVars.trend3	-53,438,288	9,724,651	-5.5	0.00%
BinaryVars.trend4	102,774,848	16,176,847	6.4	0.00%
MED_WNSales.Aug06	-2,126,321	106,860	-19.9	0.00%

Table 17 WN Model for KS Large GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	19,607,162	593,259	33.1	0.00%
WthrTrans.Cdd65trend1_LRG	2,349,574	887,590	2.6	1.02%
WthrTrans.Cdd65trend2_LRG	-14,187,533	26,715,901	-0.5	59.72%
WthrIndex_LRG.CDD65	8,762,971	1,021,637	8.6	0.00%
BinaryVars.trend1	-64,538	188,298	-0.3	73.29%
BinaryVars.trend2	16,438,424	13,039,436	1.3	21.19%
BinaryVars.trend3	-58,243,568	28,014,803	-2.1	4.16%
LRG_WNSales.May08	63,310,086	852,637	74.3	0.00%
LRG_WNSales.Jun08	-30,241,254	835,155	-36.2	0.00%
LRG_WNSales.lt2008may	-9,503,133	538,037	-17.7	0.00%

Table 18 WN Model for KS Large Power Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	20,128,567	601,344	33.5	0.00%
WthrTrans.Cdd65trend1_LP	-3,386,656	2,784,426	-1.2	22.83%
WthrTrans.Cdd65trend2_LP	35,580,371	81,018,726	0.4	66.20%
WthrIndex_LP.CDD65	9,745,053	3,021,221	3.2	0.20%
BinaryVars.trend1	-4,910,522	612,511	-8.0	0.00%
BinaryVars.trend2	-203,368,334	36,019,134	-5.6	0.00%
BinaryVars.trend3	934,310,682	247,212,475	3.8	0.03%
BinaryVars.trend4	-874,656,869	419,794,384	-2.1	4.11%
LP_WNSales.May08	-67,527,076	2,452,439	-27.5	0.00%
LP_WNSales.Jun08	26,379,850	2,502,473	10.5	0.00%

2.4 ASSESSMENTS

(D) For each major class specified pursuant to subsection (2)(A), the utility shall provide, on a seasonal and annual basis for each year of the historical period—

For the current KCP&L filing, historical sales and customers broken out by class cost of service and commercial and industrial customers was available beginning in May 2005. Going forward, KCP&L will maintain this data for at least the previous 10 years.

2.4.1 HISTORIC END-USE DRIVERS OF ENERGY USAGE AND PEAK DEMAND

1. Its assessment of the historical end-use drivers of energy usage and peak demand, including trends in numbers of units and energy consumption per unit;

Historical plots of customers and kwh/customer for energy usage and peak demand can be found in *Appendix 3A.*

2.4.2 WEATHER SENSITIVITY OF ENERGY AND PEAK DEMAND

2. Its assessment of the weather sensitivity of energy and peak demand.

The following plots illustrate the weather response function of daily energy and peak demand for each major class. This data is weather normalized in the rate case process during which the weather response function is represented with an equation estimated with statistical regression analysis. The blue symbols in the plot represent weekdays and the red symbols represent weekends.

Figure 1: MO Residential Daily Energy vs Average Temp

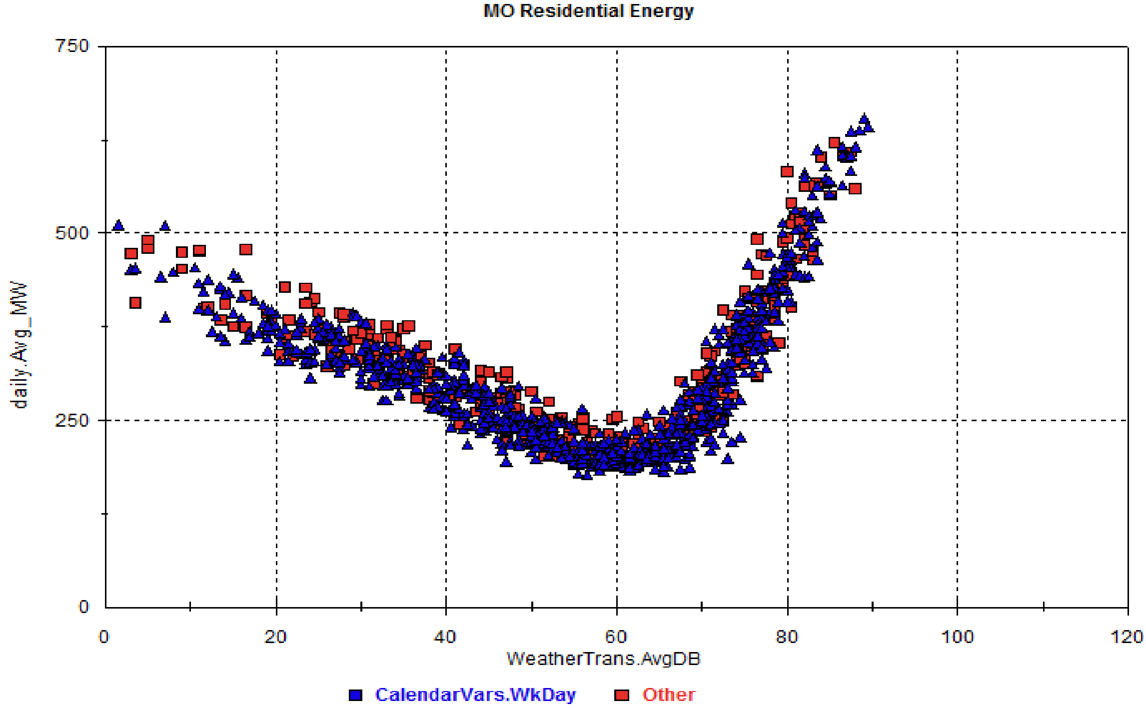


Figure 2: MO Residential Daily Peak Demand vs Average Temp

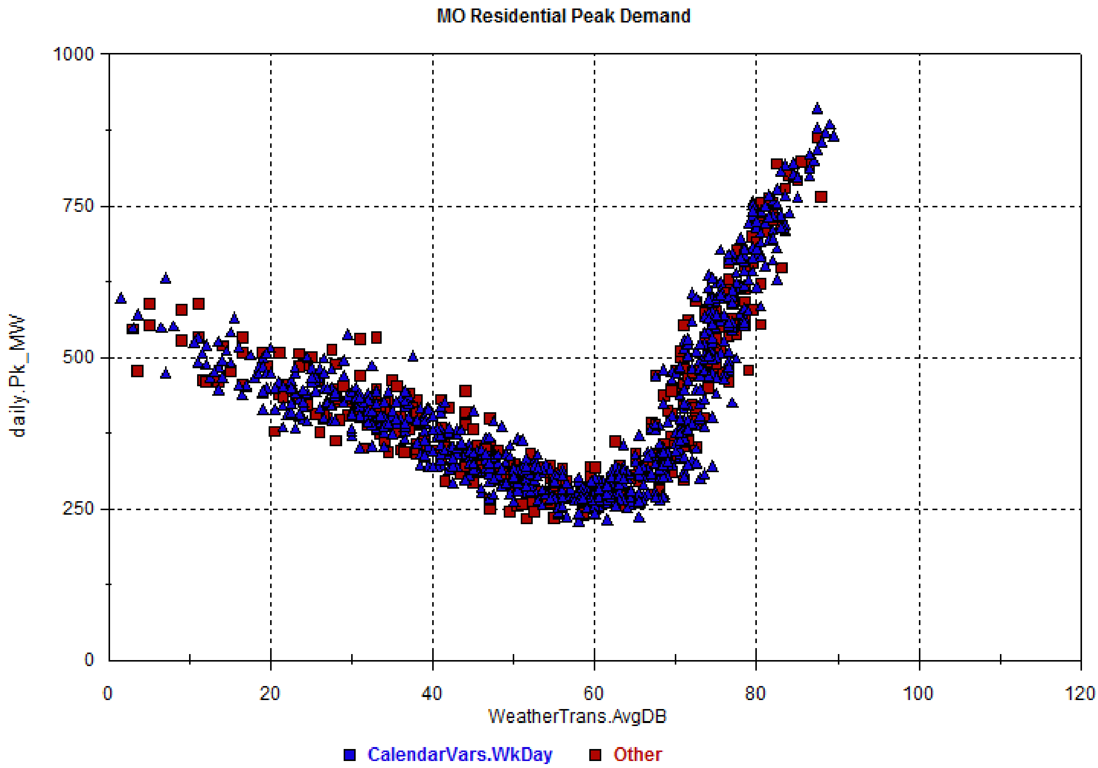


Figure 3: MO Small General Service Daily Energy vs Average Temp

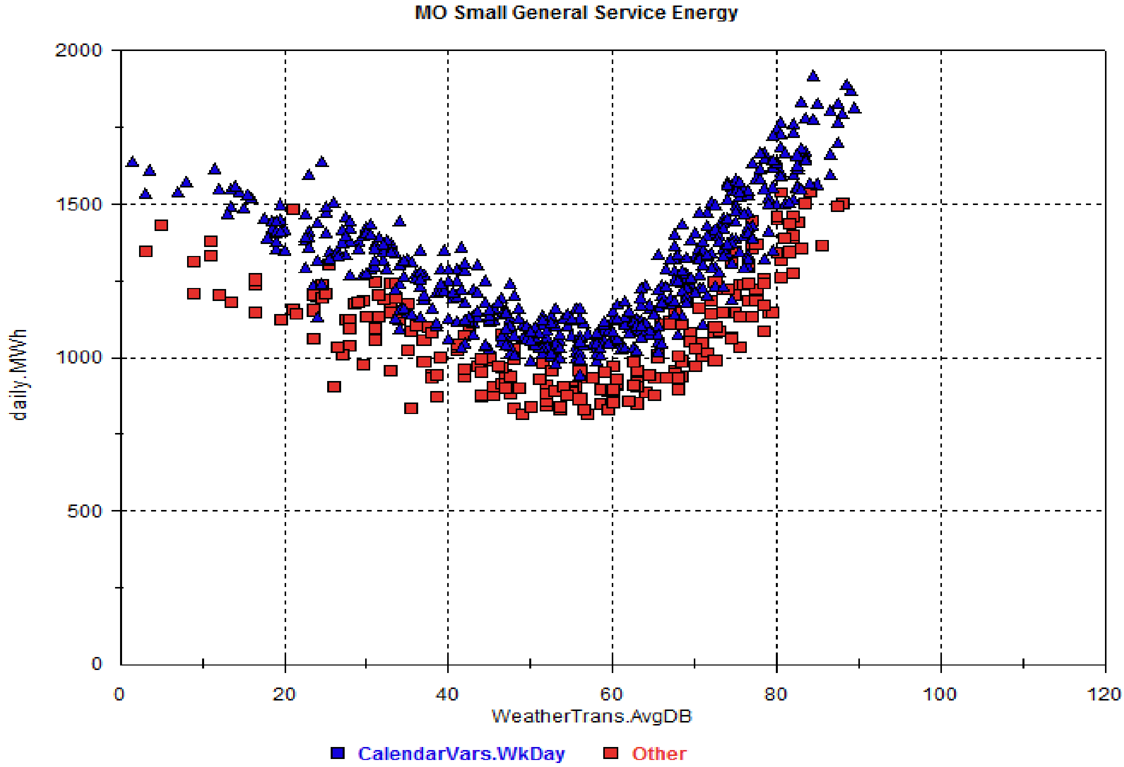


Figure 4: MO Small General Service Daily Peak vs Average Temp

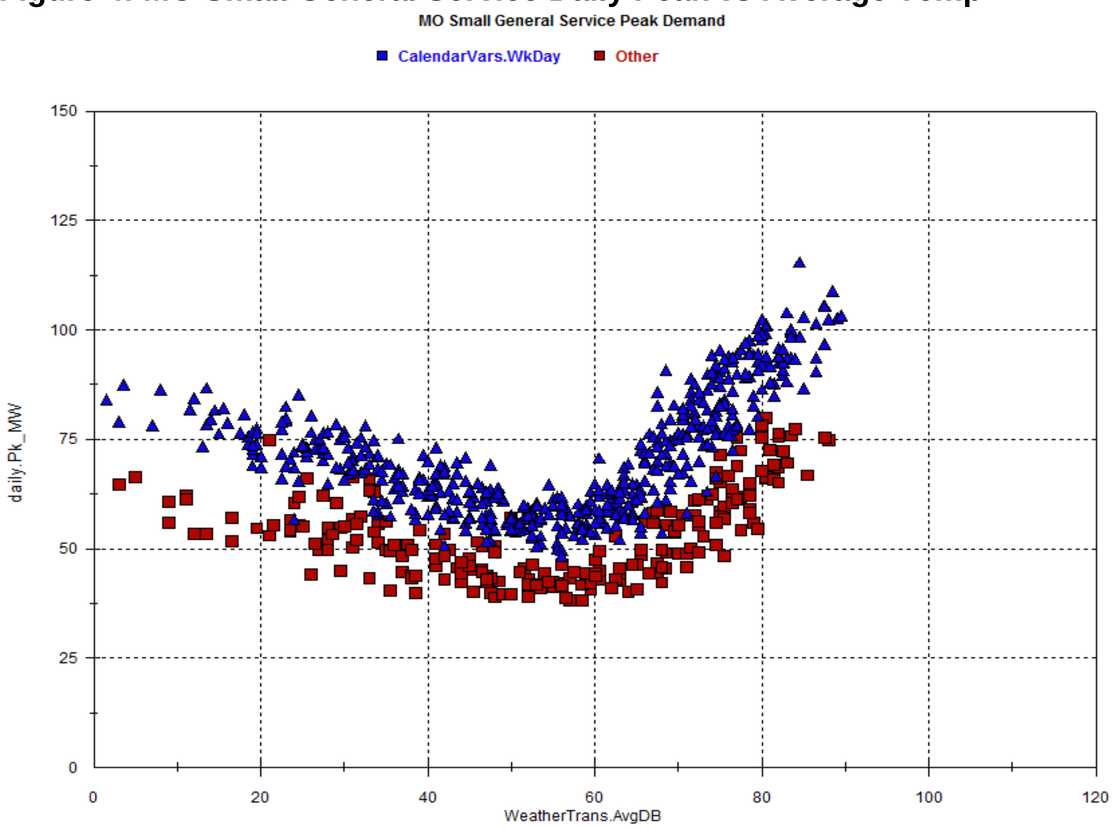


Figure 5: MO Medium General Service Daily Energy vs Average Temp

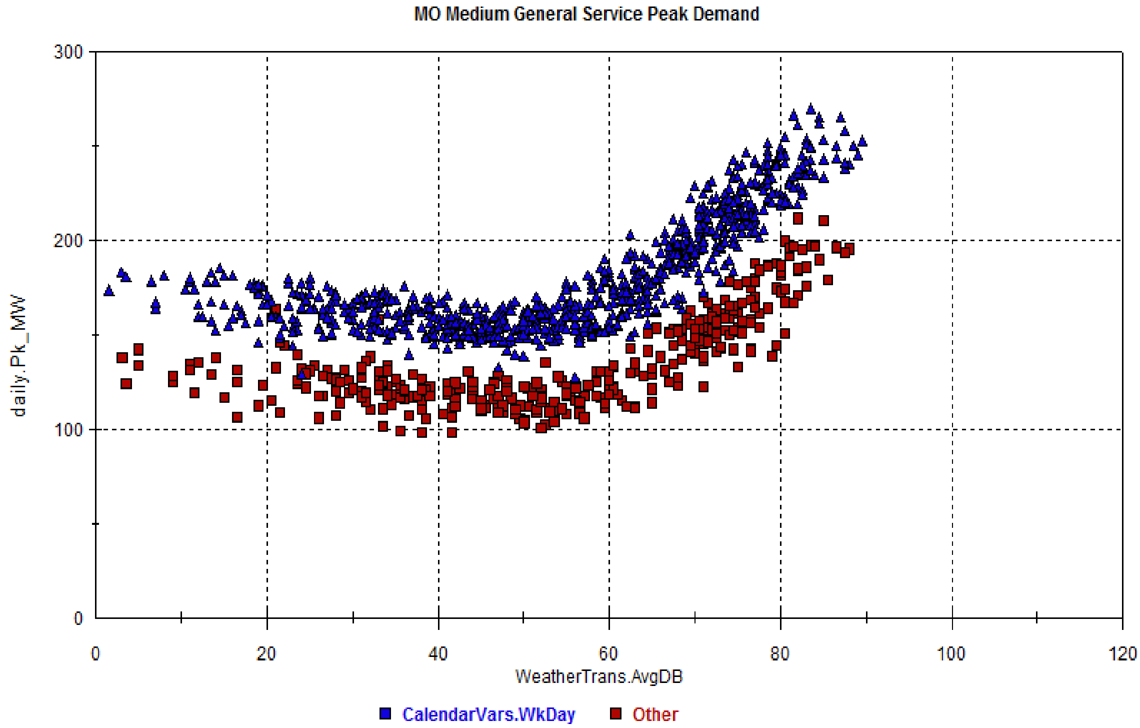


Figure 6: MO Medium General Service Daily Peak Demand vs Average Temp

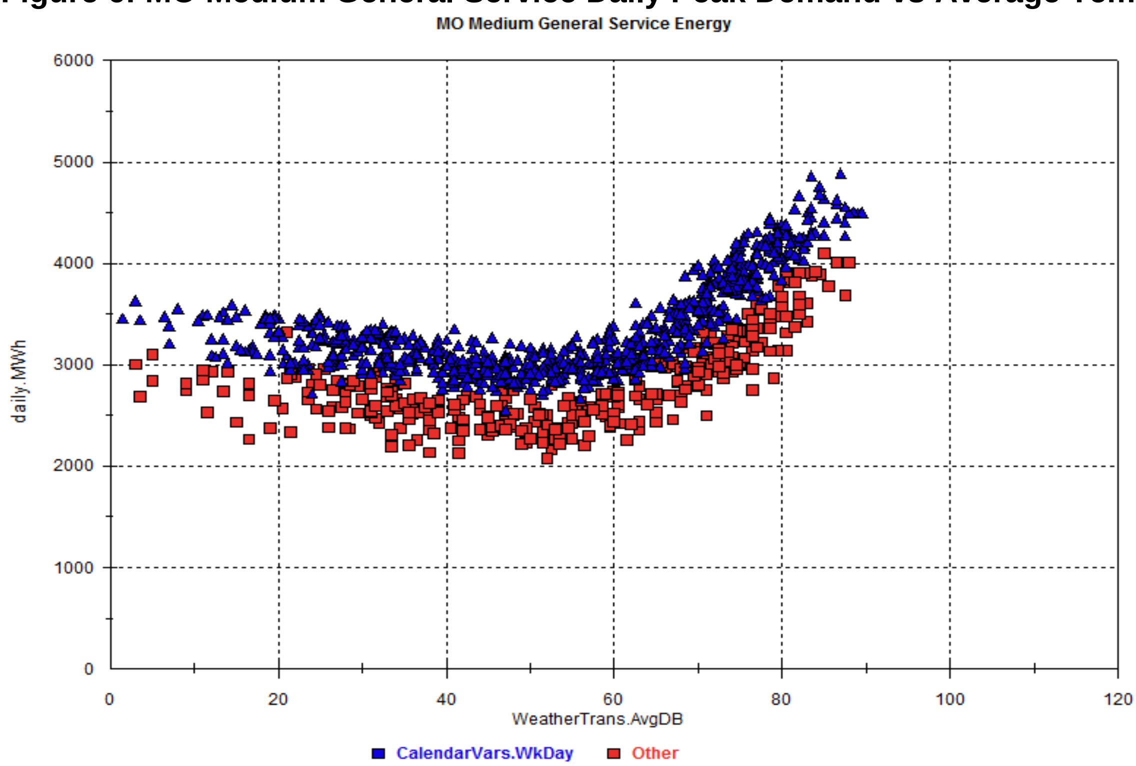


Figure 7: MO Large General Service Daily Energy vs Average Temp

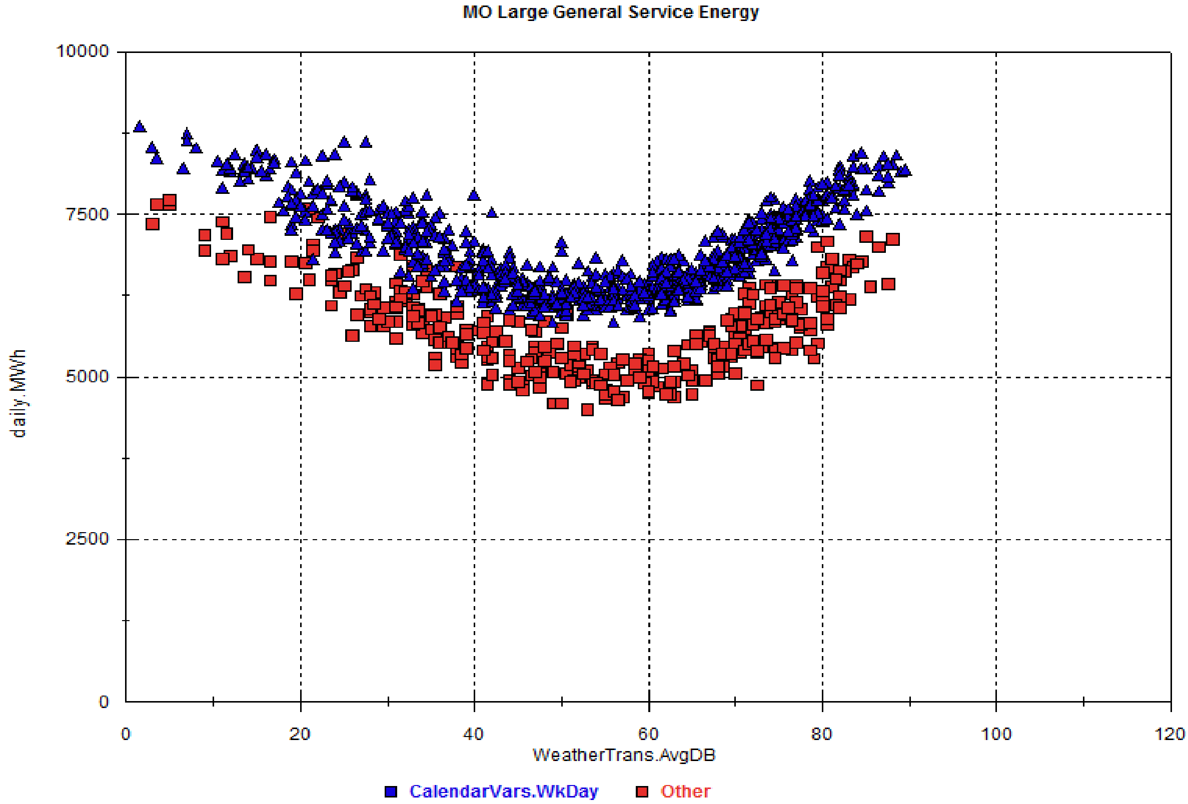


Figure 8: MO Large General Service Daily Peak Demand vs Average Temp

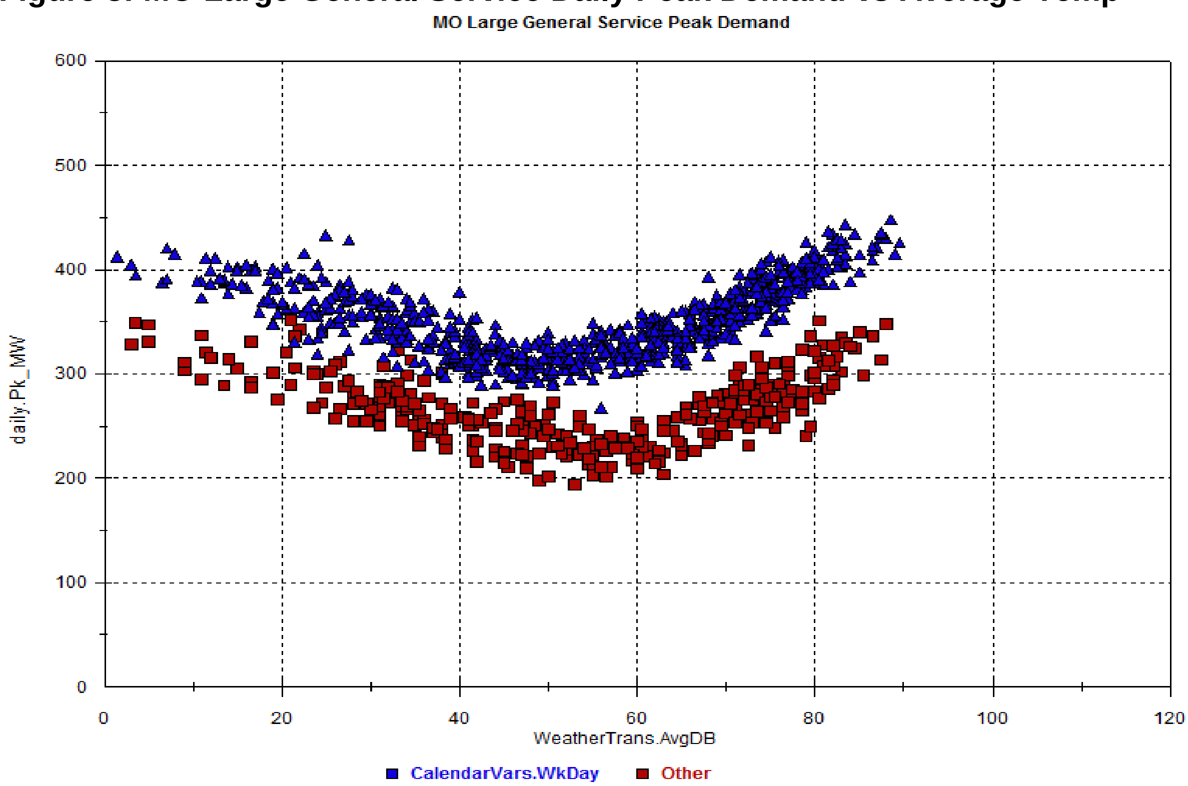


Figure 9: MO Large Power Daily Energy vs Average Temp

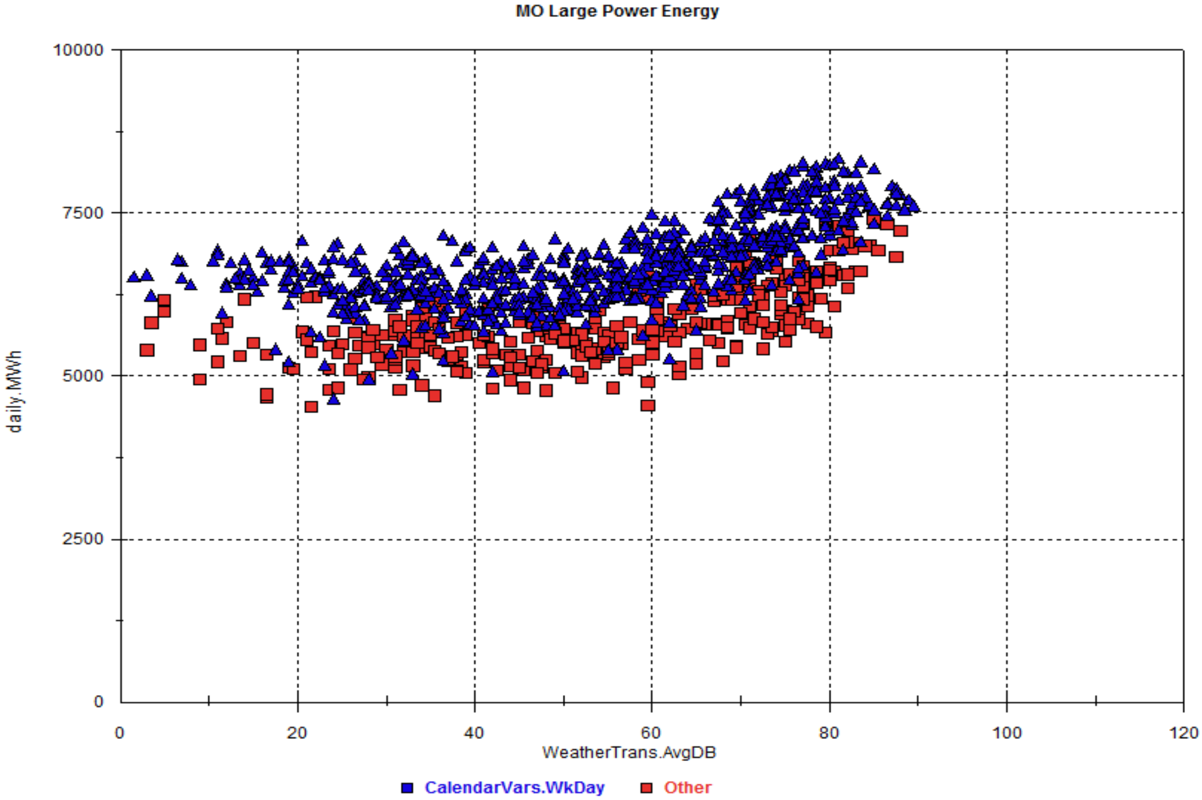


Figure 10: MO Large Power Daily Peak Demand vs Average Temp

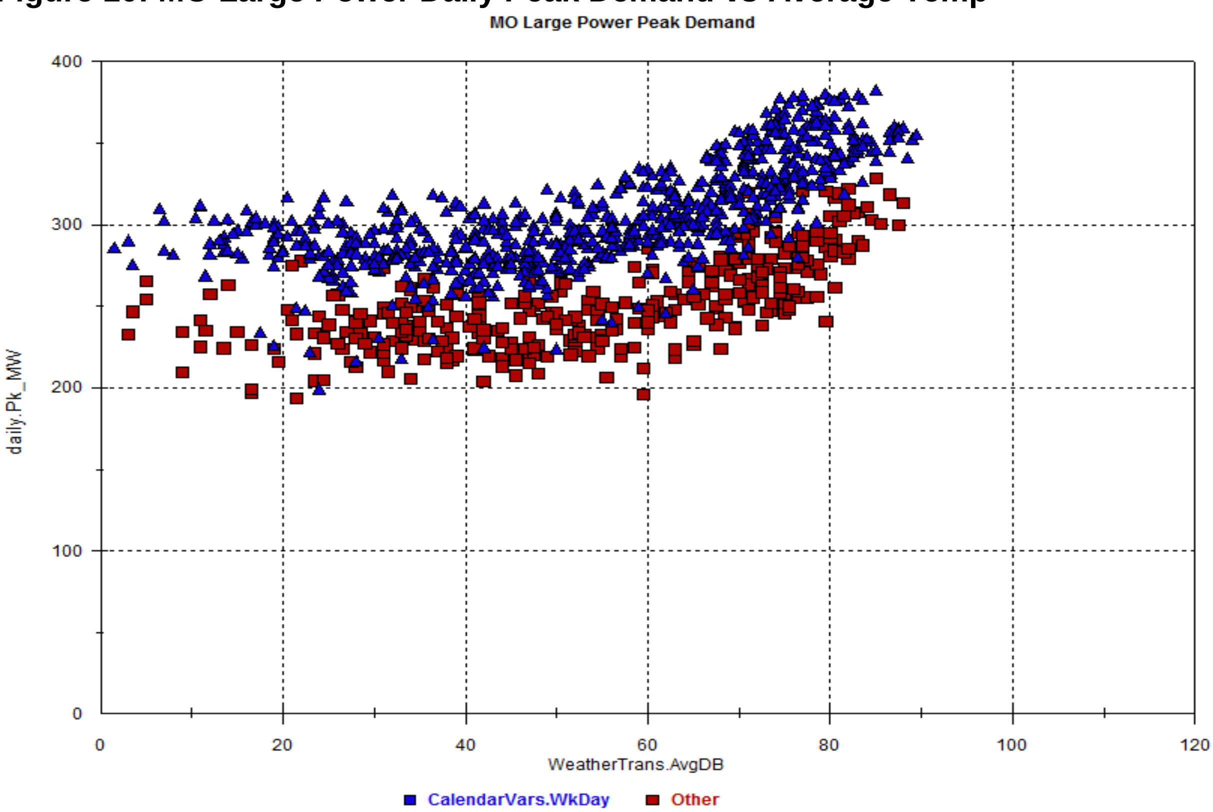


Figure 11: MO Sales for Resale Daily Energy vs Average Temp

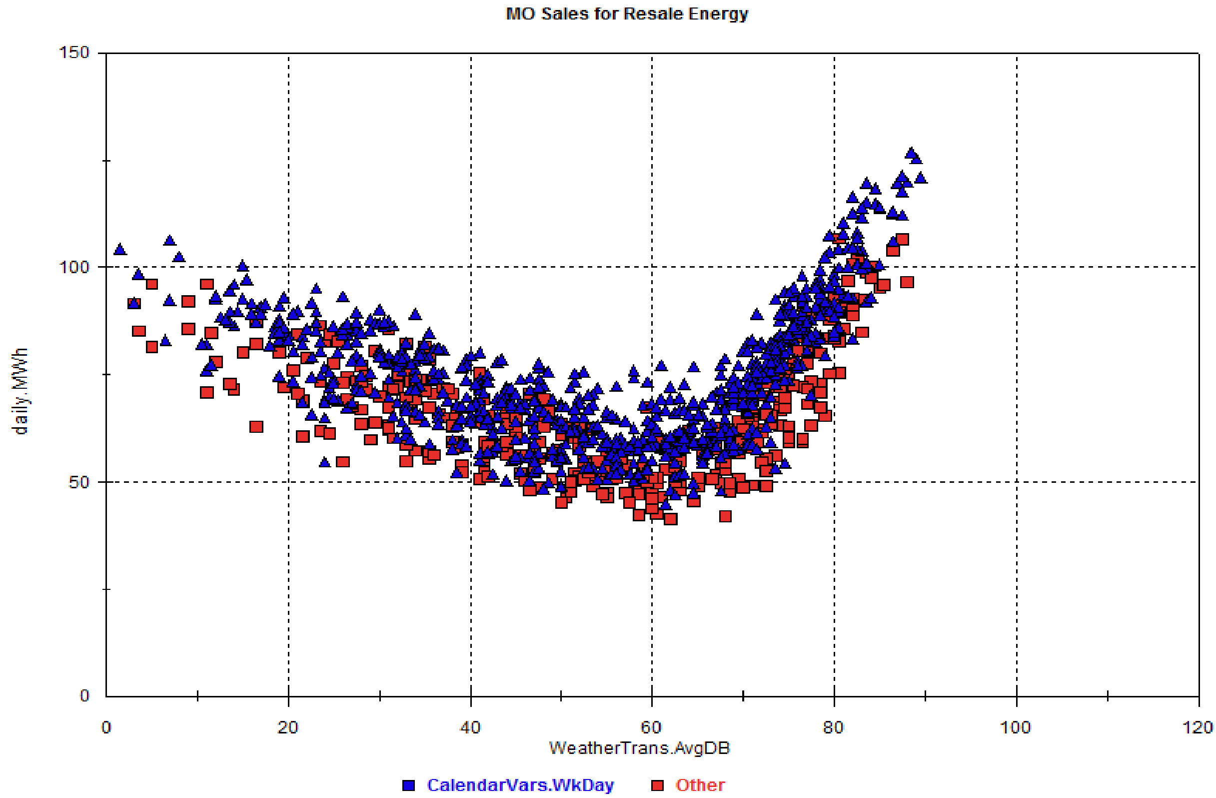


Figure 12: MO Sales for Resale Daily Peak Demand vs Average Temp

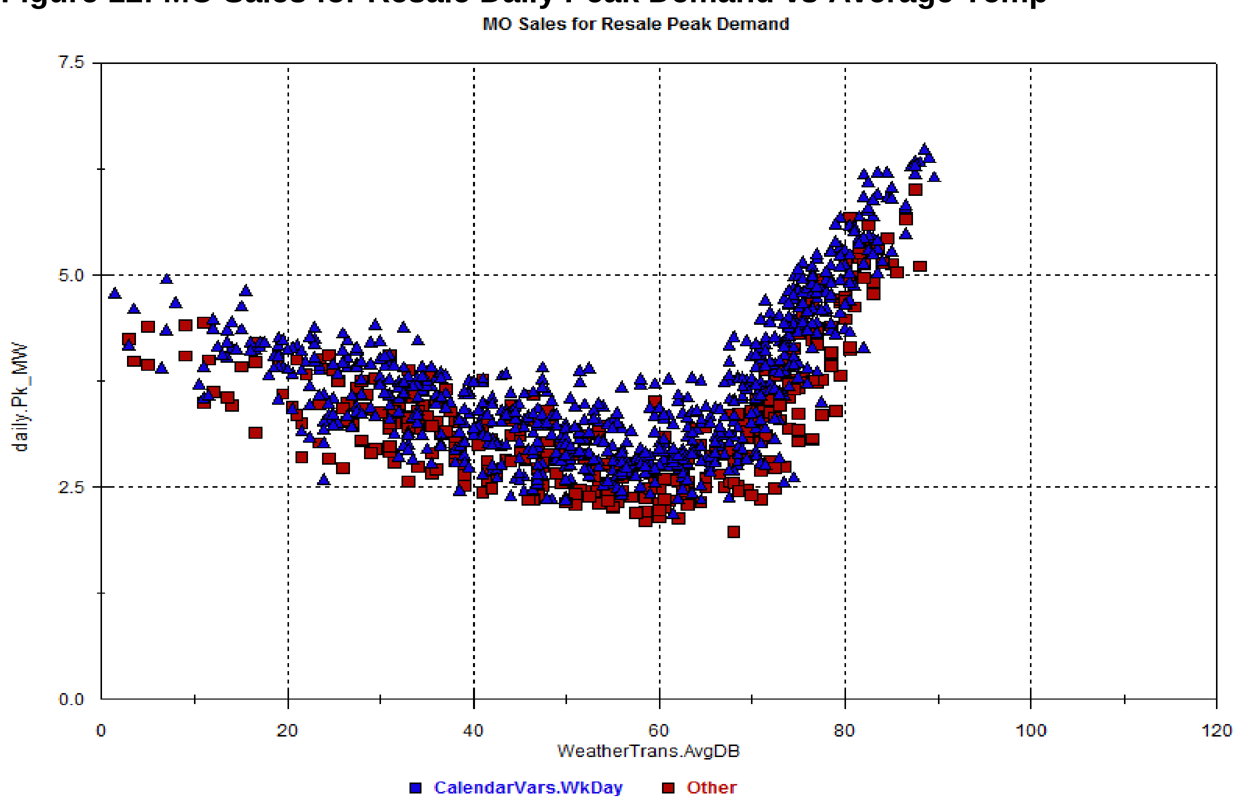


Figure 13: KS Residential Daily Energy vs Average Temp

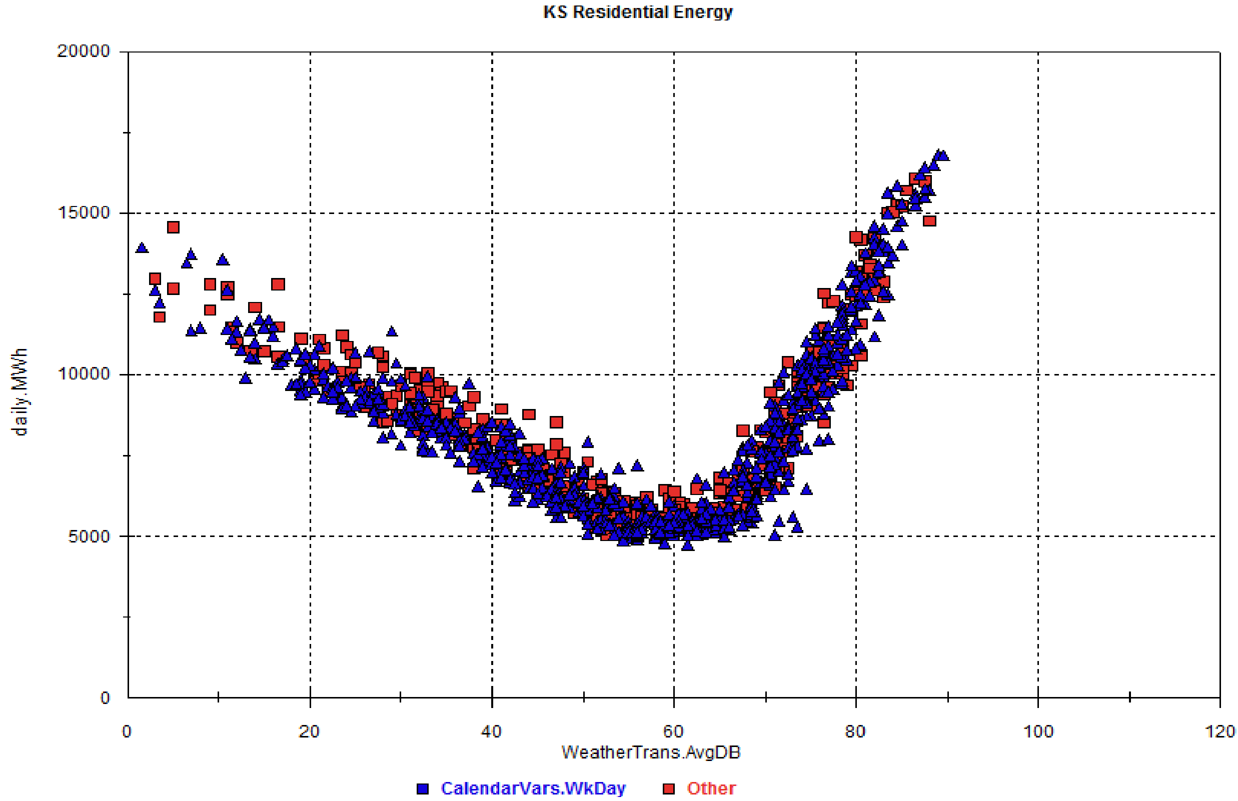


Figure 14: KS Residential Daily Peak Demand vs Average Temp

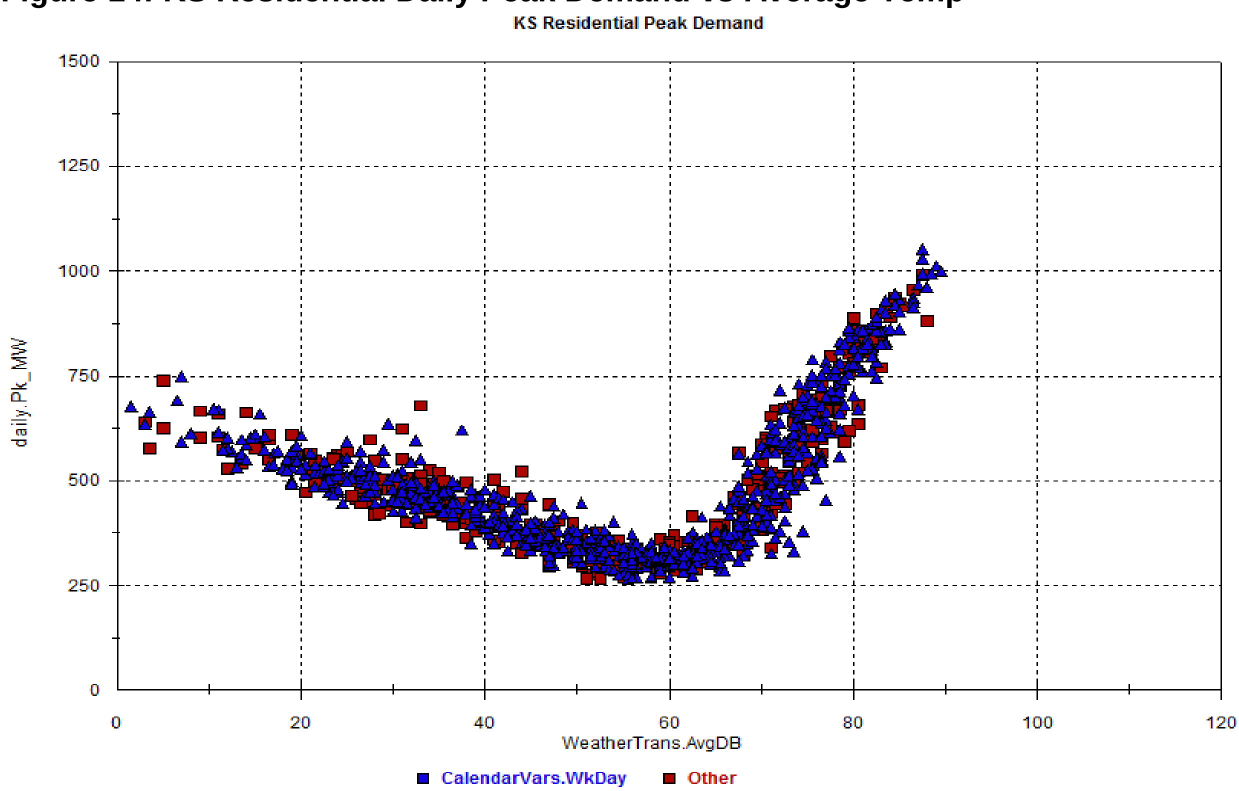


Figure 15: KS Small General Service Daily Energy vs Average Temp

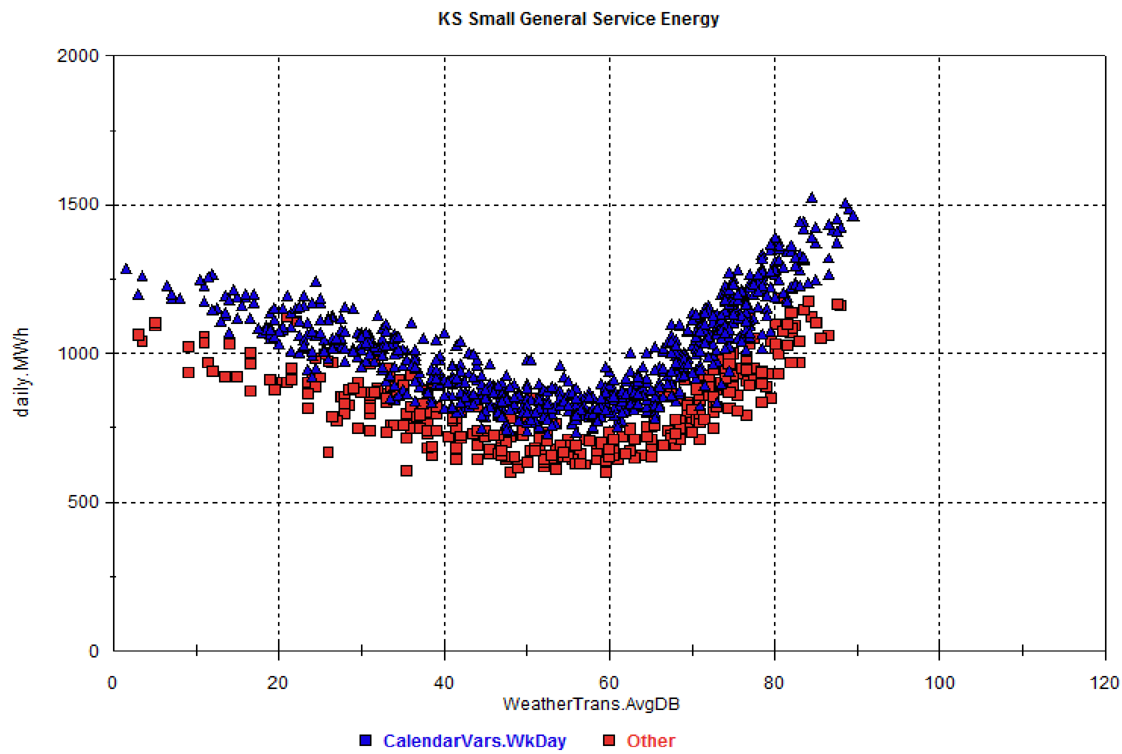


Figure 16: KS Small General Service Daily Peak Demand vs Average Temp

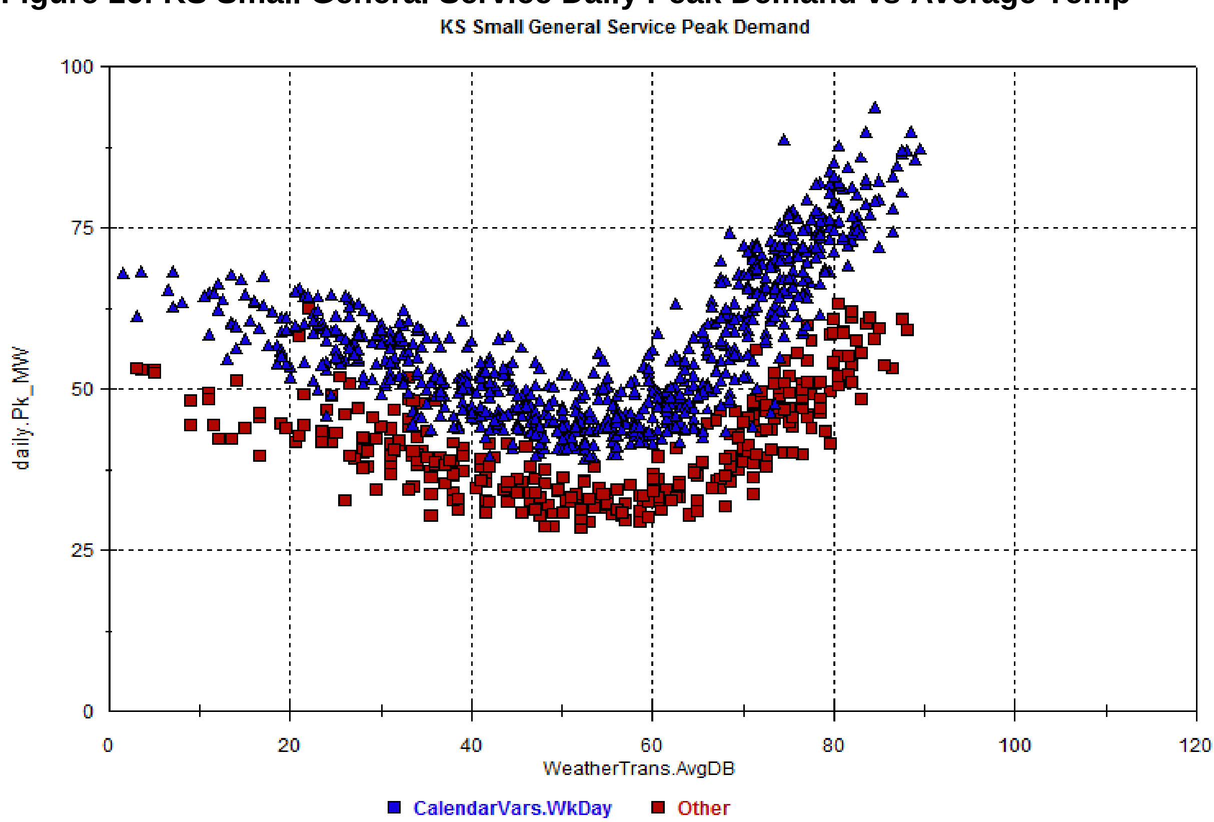


Figure 17: KS Medium General Service Daily Energy vs Average Temp

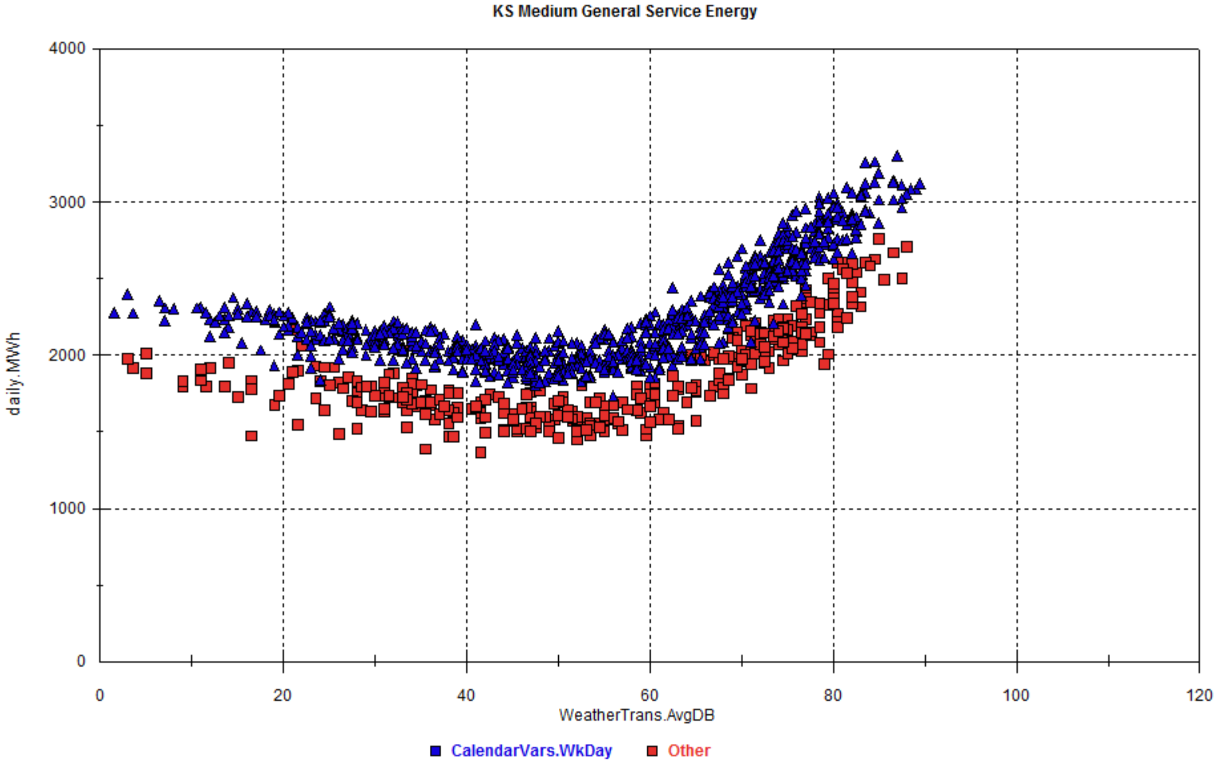


Figure 18: KS Medium General Service Daily Peak Demand vs Average Temp

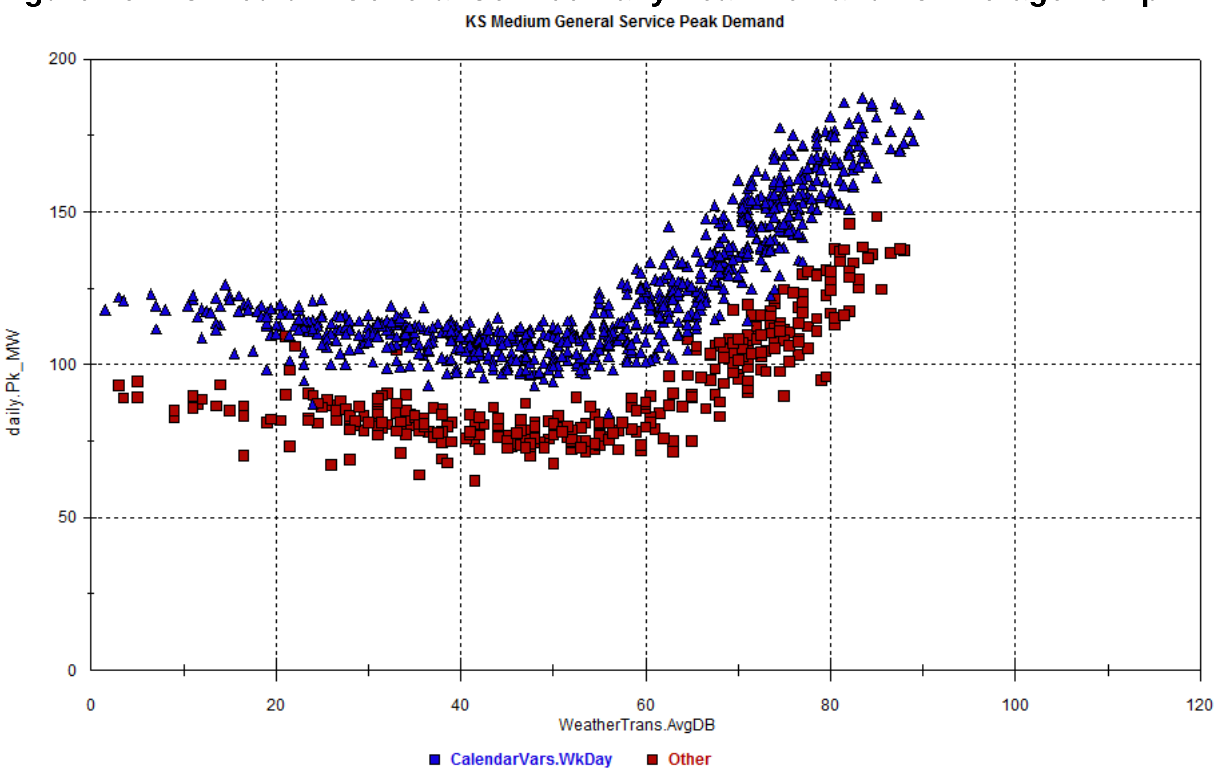


Figure 19: KS Large General Service Daily Energy vs Average Temp

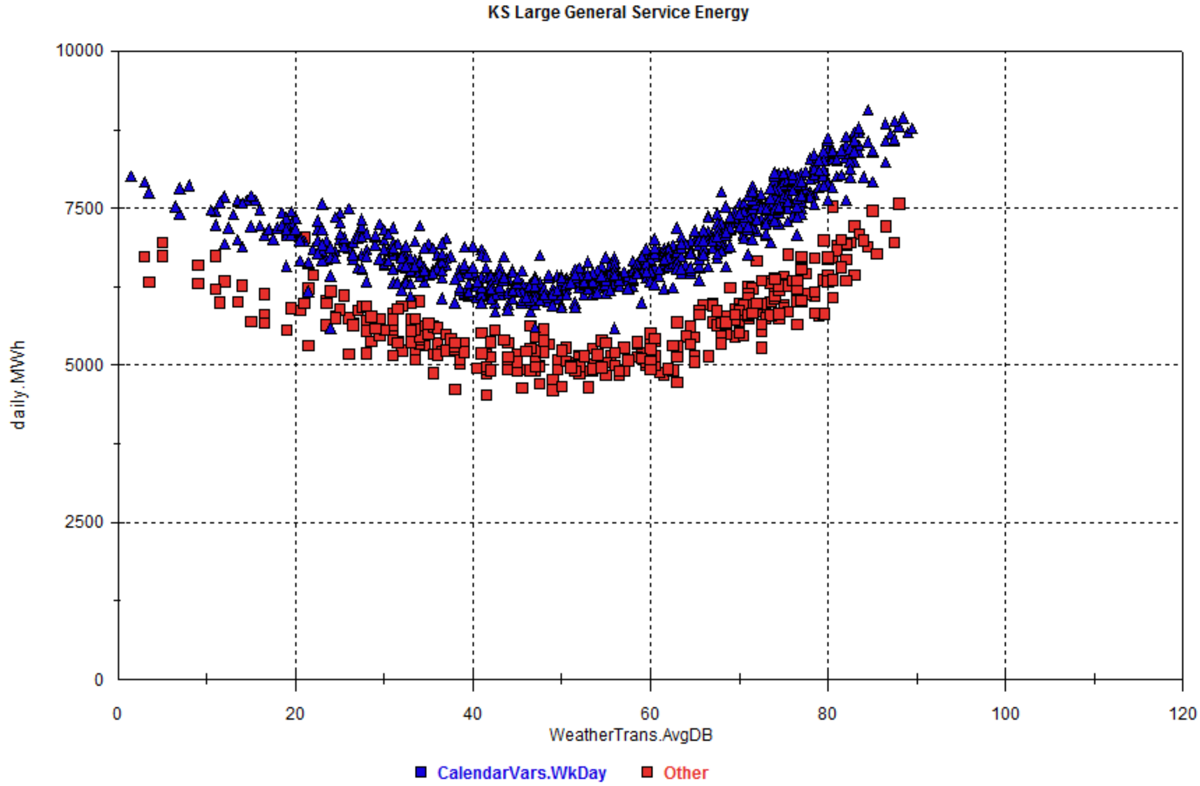


Figure 20: KS Large General Service Daily Peak Demand vs Average Temp

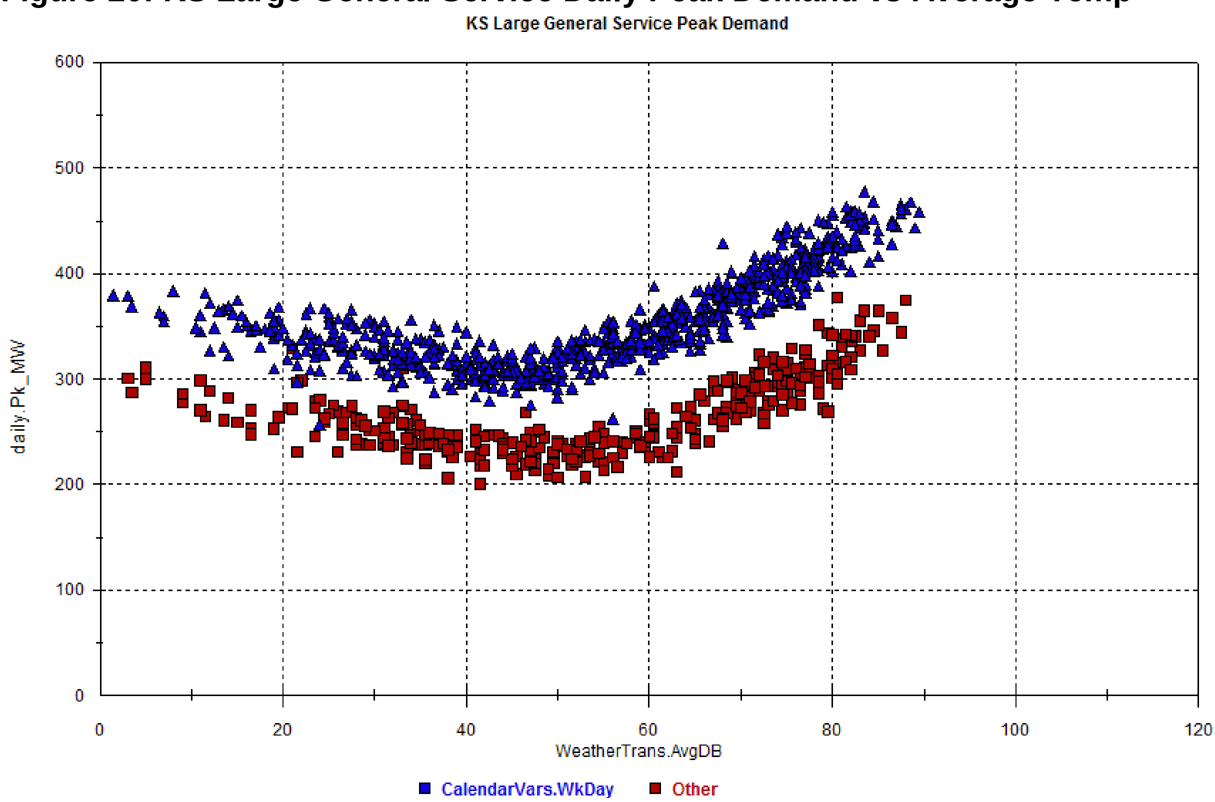


Figure 21: KS Large Power Daily Energy vs Average Temp

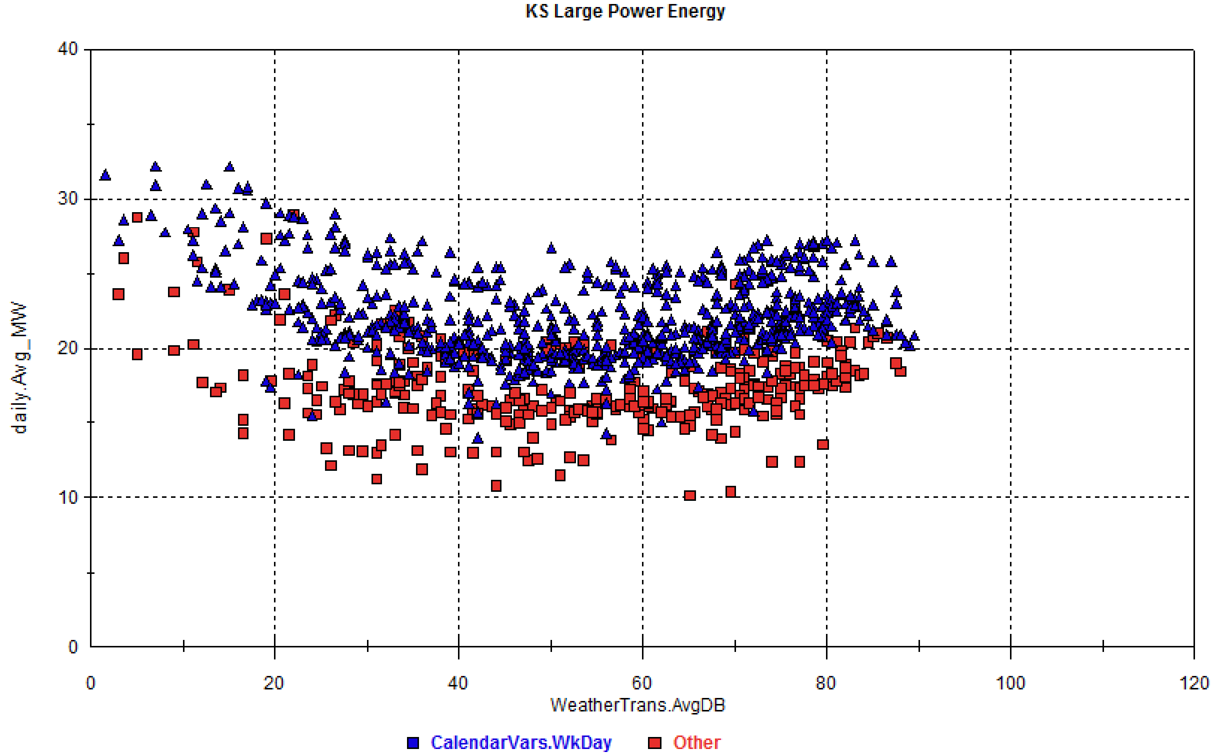


Figure 22: KS Large Power Daily Peak Demand vs Average Temp

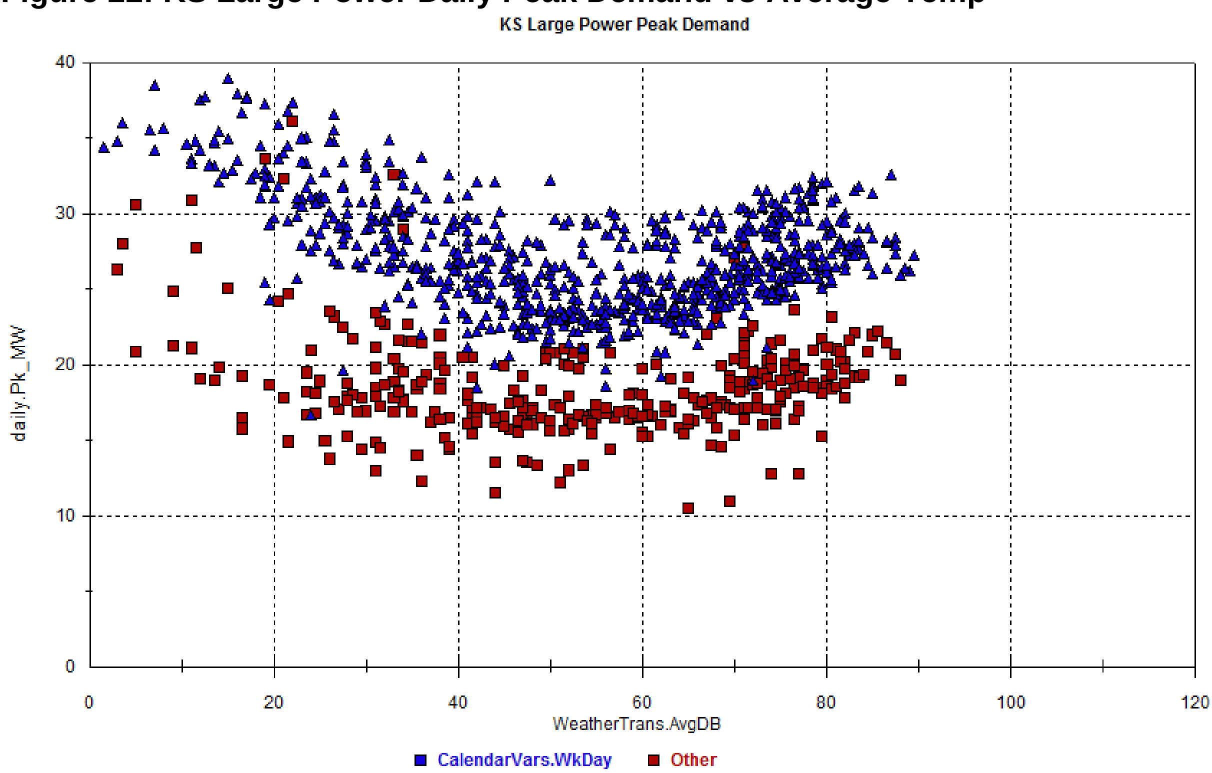


Figure 23: KS Sales for Resale Daily Energy vs Average Temp

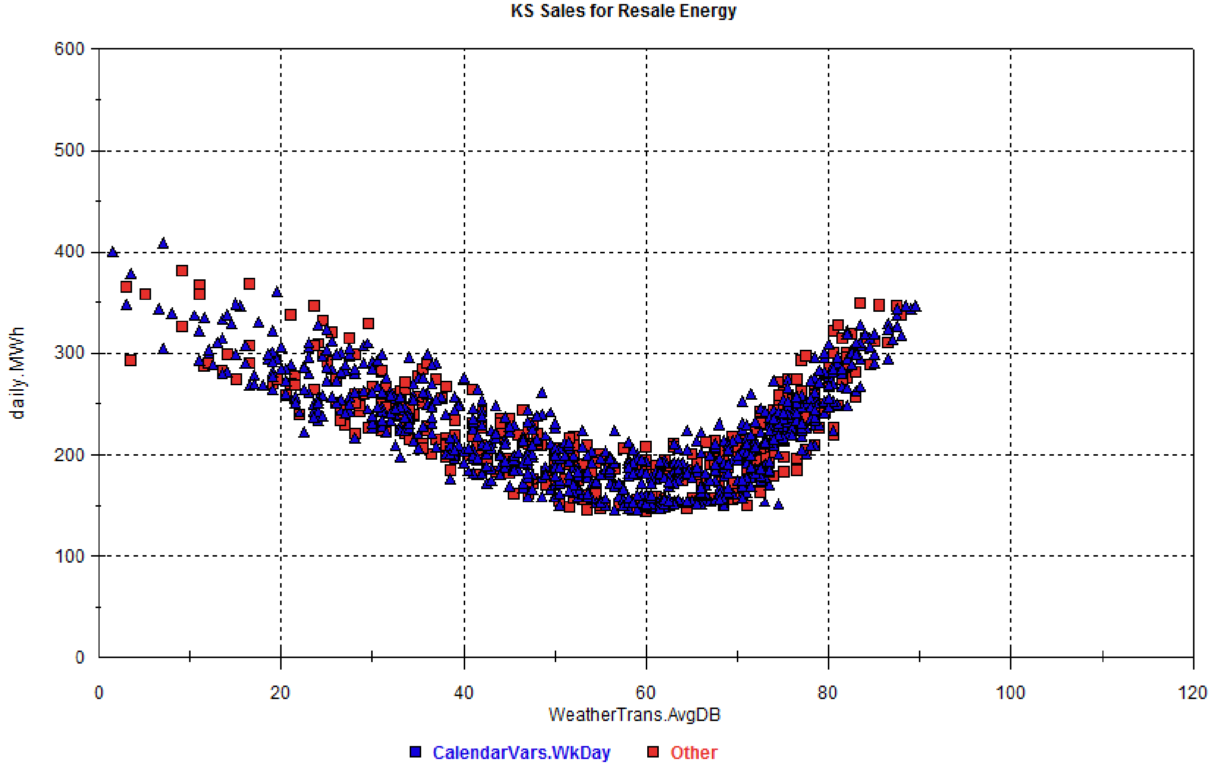
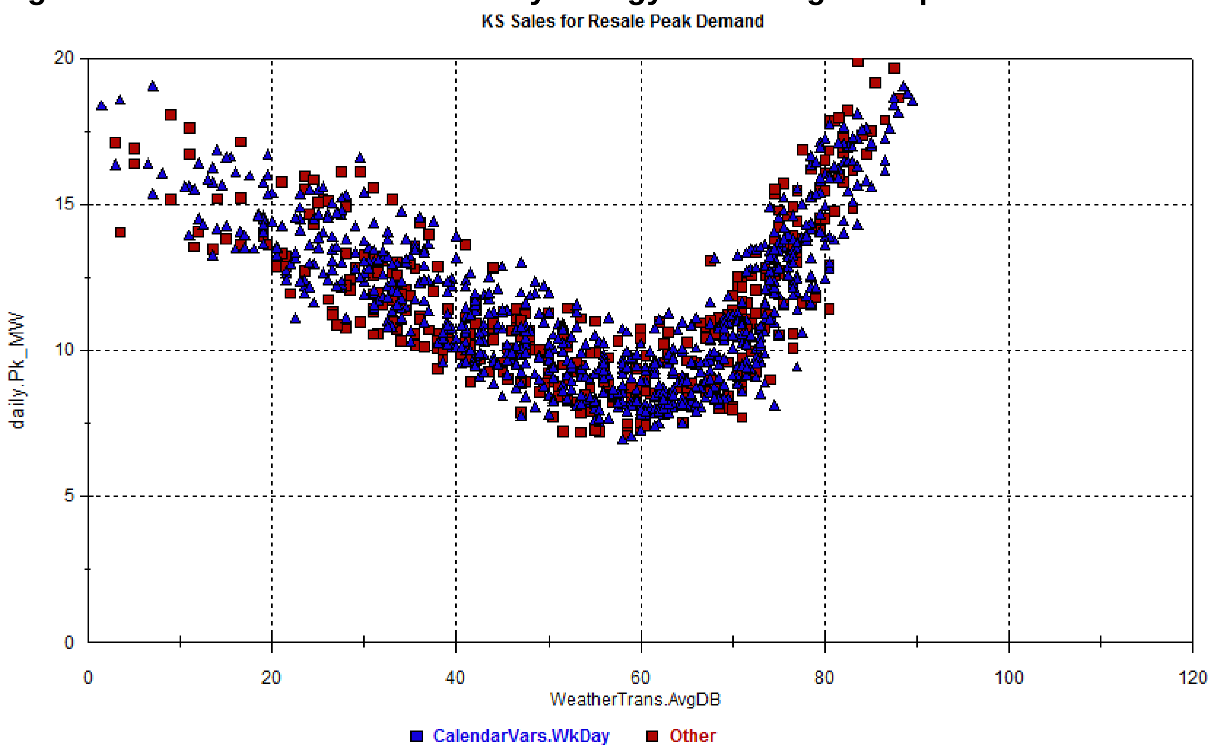


Figure 24: KS Sales for Resale Daily Energy vs Average Temp



and 3. Plots illustrating trends materially affecting electricity consumption over the historical period.

Historical class plots of customers, kwh, average use and peak are provided in *Appendix3A1.*

2.5 ADJUSTMENTS TO HISTORICAL DATA DESCRIPTION AND DOCUMENTATION

(E) The utility shall describe and document any adjustments that it made to historical data prior to using it in its development or interpretation of the forecasting models; and

KCP&L used binary variables in regression models to explain outliers rather than make adjustments to the data.

2.6 LENGTH OF HISTORICAL DATABASE

(F) Length of Historical Database. The utility shall develop and retain the historical database over the historical period.

For KCP&L, historical sales and customers broken out by class cost of service and commercial and industrial customers was available beginning in May 2005. Going forward, KCP&L will maintain this data for at least the previous 10 years.

SECTION 3: ANALYSIS OF NUMBER OF UNITS

For each major class, the utility shall describe and document its analysis of the historical relationship between the number of units and the economic and/or demographic factors (explanatory variables) that affect the number of units for that major class. The analysis may incorporate or substitute the results of secondary analyses, with the proviso that the utility analyze and verify the applicability of those results to its service territory. If the utility develops primary analyses, or to the extent they are available from secondary analyses, these relationships shall be specified as statistical or mathematical models that relate the number of units to the explanatory variables.

3.1 IDENTIFICATION OF EXPLANATORY VARIABLES

(A) Choice of Explanatory Variables. The utility shall identify appropriate explanatory variables as predictors of the number of units for each major class. The critical assumptions that influence the explanatory variables shall also be identified and documented.

A forecast of the number of households in the KC metro area from Moody's Analytics was the driver for the number of residential customers of KCP&L. The KC metro area is the same as the Metropolitan Statistical Area (MSA) defined by the US Census Bureau and it includes some counties in both states that are not served by KCP&L. Also, KCP&L's service area includes some counties that are not included in the MSA. Despite these inconsistencies in geographic areas, the number of households in the metro area is a good driver to predict the number of our residential customers because the metro area functions economically as a single entity and the metro area includes the vast majority of our customers. Many people live on one side of the state line and work on the other side. Many people shop on both sides of the state line. And many companies each year move from one side of the state line to the other. Documentation for Moody's forecast of economic activity is provided in the workpapers in the folder *\models\KCPL Base Case\Data\Economics*.

KCP&L tested the use of county level forecasts from Moody's several years ago, but saw no improvement in forecasting accuracy. This might be because it is difficult to forecast economic activity for a small geographic area, or because economic activity crosses county lines in the metro area.

The main driver for the number of small general service customers was the number of residential customers. This driver was chosen because it has worked well in the past and because most small commercial customers exist to serve households and these customers will increase in areas where there are new housing developments. Examples of small commercial customers that serve households are medical offices, grocery stores, drug stores, restaurants, churches, schools, hair salons, and movie theaters.

In the models for Medium GS, Large GS and Large Power commercial customers, both non-manufacturing employment and non-manufacturing gross metro product were tested as drivers and the one with the best fit was chosen. If neither was significant or had a positive coefficient, the driver was tested without a constant term in the model, and if still insignificant, a driver was not used.

3.2 STATISTICAL MODEL DOCUMENTATION

(B) Documentation of statistical models shall include the elements specified in subsection (2)(C) of this rule. Documentation of mathematical models shall include a specification of the functional form of the equations if the utility develops primary analyses, or to the extent they are available if the utility incorporates secondary analyses.

The following tables show the statistics for the variables in the regression models. Additional statistics and residual plots are available in the Metrix ND model files.

Table 19 MO Residential Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	202,426	6,598	30.68	0.00%
Economics.**Households**	47	8	5.67	0.00%
RUCust_CCOS.Feb06	2,009	658	3.05	0.33%
RUCust_CCOS.Dec07	-1,127	648	-1.74	8.65%
AR(1)	0.334	0.113	2.97	0.42%

Table 20 MO Small GS Commercial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	12,051	3,820	3.2	0.24%
SML_Customer.Dec09	-663	85	-7.8	0.00%
ClassCustomers.**RU_Cust**_CCOS	0.055	0.016	3.5	0.10%
SML_Customer.Feb10	-283	84	-3.4	0.13%
AR(1)	0.867	0.059	14.8	0.00%

Table 21 MO Medium GS Commercial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	2,165	599	3.6	0.06%
MED_Customer.Jul08	-238	45	-5.3	0.00%
MED_Customer.Aug08	-89	48	-1.9	6.64%
MED_Customer.Dec08	162	37	4.4	0.00%
MED_Customer.Sep08	-53	42	-1.3	21.40%
MED_Customer.lt2008jul	-586	24	-24.7	0.00%
Economics.**GP_Non_Man**	0.037	0.008	4.8	0.00%
MED_Customer.calibrate	41	31	1.3	19.52%
AR(1)	0.56	0.107	5.2	0.00%

The variable lt2008jul, shown in the table above, is defined as 1 if before July 2008 and 0 otherwise. This variable accounts for rate switching that occurred in July 2008.

Table 22 MO Large GS Commercial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
LRG_Customer.Jan09	64.1	8.9	7.2	0.00%
LRG_Customer.Dec09	56.6	8.9	6.4	0.00%
LRG_Customer.May08	38.8	8.9	4.4	0.00%
LRG_Customer.Sept07	20.9	8.9	2.3	2.19%
LRG_Customer.Apr11	-35.6	8.9	-4.0	0.02%
Economics.**Emp_NonMan**	1.033	0.011	93.2	0.00%
AR(1)	0.864	0.060	14.4	0.00%

In the model for Large GS commercial customers in Missouri, the intercept term was dropped so that an economic driver would be statistically significant.

Table 23 MO Large Power Commercial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
LP_Customer.May08	-19.9	2.1	-9.7	0.00%
LP_Customer.FEb09	-10.4	2.1	-5.1	0.00%
LP_Customer.Jul05	-12.0	2.1	-5.9	0.00%
Economics.**Emp_NonMan**	0.067	0.002	33.2	0.00%
AR(1)	0.830	0.070	11.8	0.00%

Table 24 MO Small GS Industrial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	278.7	28.6	9.8	0.00%
Economics.**Emp_Man**	4.6	0.4	12.5	0.00%
SML_Customer.Nov09	-26.6	11.4	-2.3	2.33%
SML_Customer.Jul09	41.3	10.2	4.1	0.01%
SML_Customer.Aug08	32.4	10.5	3.1	0.30%
SML_Customer.Oct09	30.7	10.6	2.9	0.55%
SML_Customer.Jun06	31.2	10.2	3.1	0.32%
SML_Customer.Aug10	28.7	10.1	2.8	0.63%
BinaryVars.Feb	5.37	4.24	1.3	21.02%
BinaryVars.Apr	-6.94	4.21	-1.6	10.51%
BinaryVars.Nov	-9.00	4.61	-2.0	5.55%
AR(1)	0.217	0.141	1.5	12.89%

Table 25 MO Medium GS Industrial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
MED_Customer.Dec08	22.4	5.5	4.1	0.01%
Economics.**Emp_Man**	4.1	0.2	23.5	0.00%
AR(1)	0.935	0.042	22.3	0.00%

Table 26 MO Large GS Industrial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
LRG_Customer.Mar07	14.86	1.93	7.7	0.00%
LRG_Customer.Jul11	-8.11	2.15	-3.8	0.04%
LRG_Customer.Aug10	-14.94	1.59	-9.4	0.00%
LRG_Customer.Jul08	-13.16	1.59	-8.3	0.00%
LRG_Customer.Sep08	-10.49	1.59	-6.6	0.00%
LRG_Customer.Feb07	-10.38	2.21	-4.7	0.00%
LRG_Customer.Jun05	-15.54	1.59	-9.8	0.00%
LRG_Customer.Jan07	7.26	1.93	3.8	0.04%
LRG_Customer.Apr10	5.47	1.59	3.5	0.10%
Economics.**Emp_Man**	1.596	0.019	86.0	0.00%
AR(1)	0.826	0.078	10.5	0.00%

Table 27 MO Large Power Industrial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
LP_Customer.Nov05	-8.18	0.76	-10.7	0.00%
LP_Customer.Dec05	7.86	0.76	10.3	0.00%
LP_Customer.Mar09	6.11	0.76	8.0	0.00%
LP_Customer.Mar10	4.42	0.93	4.8	0.00%
LP_Customer.Apr10	-7.31	0.81	-9.1	0.00%
LP_Customer.Feb09	4.11	0.76	5.4	0.00%
LP_Customer.Feb10	-3.80	0.81	-4.7	0.00%
Economics.**Emp_Man**	0.38	0.02	21.7	0.00%
AR(1)	0.923	0.045	20.6	0.00%

Table 28 KS Residential Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
Economics.**Households**	265	2	119.8	0.00%
RUCust_CCOS.Nov09	1,265	373	3.4	0.12%
AR(1)	0.956	0.041	23.5	0.00%

Table 29 KS Small GS Commercial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	3645	2903	1.3	21.39%
ClassCustomers_CCOS.**RU_Cust**_CCOS	0.079	0.014	5.7	0.00%
SML_Customer.Jul10	298	95	3.1	0.27%
SML_Customer.Jun06	211	95	2.2	3.00%
SML_Customer.May11	185	94	2.0	5.44%
AR(1)	0.640	0.103	6.2	0.00%

Table 30 KS Medium GS Commercial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
MED_Customer.Jul08	72.5	23.1	3.1	0.24%
MED_Customer.Nov09	-78.6	23.0	-3.4	0.11%
MED_Customer.Jul09	93.9	23.0	4.1	0.01%
Economics.**Emp_NonMan**	4.3	0.3	13.2	0.00%
AR(1)	0.98	0.02	40.1	0.00%

Table 31 KS Large GS Commercial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
Economics.**Emp_NonMan**	1.1	0.1	11.9	0.00%
LRG_Customer.may2008jun	129.4	10.2	12.7	0.00%
LRG_Customer.Nov07	19.2	10.2	1.9	6.40%
AR(1)	0.973	0.030	32.6	0.00%

Table 32 KS Large Power Commercial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
Simple	0.23	0.07	3.1	0.30%

A simple model was used to model Kansas Large Power commercial customer numbers because in May 2008 the number of customers dropped from 32 to 1 because of rate switching.

Table 33 KS Small GS Industrial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	593.2	26.8	22.1	0.00%
Economics.**Emp_Man**	2.1	0.4	6.0	0.00%
SML_Customer.Sep08	80.2	9.1	8.8	0.00%
SML_Customer.Nov08	-59.6	9.1	-6.6	0.00%
SML_Customer.Oct06	30.8	9.1	3.4	0.12%
SML_Customer.Jun06	38.9	9.2	4.2	0.01%
SML_Customer.calibrate	16.5	4.9	3.3	0.14%
AR(1)	0.261	0.125	2.1	4.05%

Table 34 KS Medium GS Industrial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	65.83	24.51	2.7	0.92%
MED_Customer.Aug10	-13.05	3.41	-3.8	0.03%
MED_Customer.Oct07	-13.13	3.41	-3.9	0.03%
MED_Customer.Jul11	12.27	3.51	3.5	0.08%
MED_Customer.Nov10	12.92	3.41	3.8	0.03%
MED_Customer.Jun10	-10.23	3.41	-3.0	0.38%
MED_Customer.Oct08	-9.32	3.45	-2.7	0.87%
Economics.**Emp_Man**	1.17	0.33	3.5	0.08%
MED_Customer.calibrate	-7.55	3.06	-2.5	1.61%

Table 35 KS Large GS Industrial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	82.00	5.24	15.7	0.00%
LRG_Customer.May08	48.00	1.18	40.7	0.00%
LRG_Customer.Aug06	17.49	1.18	14.9	0.00%
LRG_Customer.Jan11	-20.00	1.18	-17.0	0.00%
LRG_Customer.Jul08	3.50	1.18	3.0	0.41%
AR(1)	0.962	0.033	29.0	0.00%

No economic drivers were significant in the model for Large GS industrial customers in Kansas.

Table 36 KS Large Power Industrial Customers

Variable	Coefficient	StdErr	T-Stat	P-Value
Simple	0.224	0.073	3.1	0.30%

A simple model was used to model Large Power industrial customer numbers in Kansas because in May 2008 the number of customers dropped from 15 to 2 because of rate switching.

SECTION 4: USE PER UNIT ANALYSIS

For each major class, the utility shall describe and document its analysis of historical use per unit by end use.

4.1 END-USE LOAD DETAIL

(A) End-Use Load Detail. For each major class, use per unit shall be disaggregated, where information permits, by end-uses that contribute significantly to energy use or peak demand.

4.1.1 END-USE LOAD INFORMATION

1. The utility shall consider developing information on at least the following end-use loads:

4.1.1.1 Residential Sector

A. For the residential sector: lighting, space cooling, space heating, ventilation, water heating, refrigerators, freezers, cooking, clothes washers, clothes dryers, television, personal computers, furnace fans, plug loads, and other uses;

The list of residential enduses that KCP&L maintains the number of units and energy use per unit include electric furnaces, heat pumps with electric resistance backup, heat pumps with natural gas backup, ground source heat pumps, central air conditioning without a heat pump, window or wall AC units, electric water heaters, electric ovens, cook tops and ranges, full-sized refrigerators, small refrigerators and wine coolers, freezers, dishwashers, clothes washers, electric dryers, TVs, air cleaners, computers, video game systems, hot tubs, swimming pools, electric vehicles and miscellaneous uses.

4.1.1.2 Commercial Sector

B. For the commercial sector: space heat, space cooling, ventilation, water heat, refrigeration, lighting, office equipment, cooking equipment, and other uses; and

KCP&L maintains information on saturations per square foot of floor space and energy use per square foot (EUI) for enduses including heating, cooling, ventilation, electric water heating, electric cooking, refrigeration, outdoor lighting, indoor lighting, and office equipment and miscellaneous uses. In this filing, secondary data from the U.S. DOE for the West North Central region was adopted for both KCP&L Kansas and Missouri. The region includes the states of North Dakota, South Dakota, Minnesota, Iowa, Nebraska, Kansas and Missouri. The results are combined across building types using building type weights. The building types include assembly (theaters, libraries, churches etc.), education, food sales, food service, health care, lodging, small office, large office, mercantile/service, warehouse and other. This data is maintained in *ComIndices_MO.xls* and *ComIndices_KS.xls*. The building types are defined in *2007 NAICS Index File-AEO commercial sectorrev.xls*. These spreadsheets were provided to KCP&L by Itron Inc. through the Energy Forecasting Group (EFG). The spreadsheets are documented in *2011_CommercialSAE.pdf*. These files are provided in the workpapers.

4.1.1.3 Industrial Sector

C. For the industrial sector: machine drives, space heat, space cooling, ventilation, lighting, process heating, and other uses.

KCP&L has a relatively small industrial sector, accounting for approximately 13% of retail sales. KCP&L lacks the concentration of heavy industry that some utilities have. As such, we have modeled our industrial sector with commercial sector drivers. Major enduses are heating, cooling and other.

4.1.2 MODIFICATION OF END-USE LOADS

2. The utility may modify the end-use loads specified in paragraph (4)(A)1.

4.1.2.1 Removal or Consolidation of End-Use Loads

A. The utility may remove or consolidate the specified end-use loads if it determines that a specified end-use load is not contributing, and is not likely to

contribute in the future, significantly to energy use or peak demand in a major class.

In the last few years, KCP&L has dropped several enduses from its residential survey including VCRs, DVD players, printers, fax machines, copier/scanners and attic fans since these do not contribute significantly to energy use or peak demand.

4.1.2.2 Additions to End-Use Loads

B. The utility shall add to the specified end-use loads if it determines that an end-use load currently not specified is likely to contribute significantly to energy use or peak demand in a major class.

KCP&L has recently added electric vehicles (including PHEVs) to our database. We are currently using DOE projections for this enduse and plan to add a question for this enduse on our next residential appliance saturation survey.

In our previous residential survey conducted in 2010, we added mini/wine refrigerators and video game systems and, in 2008, we added well pumps to the residential survey questionnaire.

4.1.2.3 Modification of End-Use Documentation

C. The utility shall provide documentation of its decision to modify the specified end-use loads for which information is developed, as well as an assessment of how the modifications can be made to best preserve the continuity and integrity of the end-use load database.

KCP&L dropped the enduses listed in the previous section A because VCRs, DVD players, printers, fax machines and copier/scanners are mainly plug loads that do not contribute significantly to energy use. We added well pumps, video game systems and mini\wine refrigerators because these use substantial amounts of energy and we believed that these had a significant saturation in our service areas.

We added electric vehicles because these are likely to significantly impact our energy and peak load in the future based on various projections published in different studies. These studies are included in our workpapers.

4.1.3 SCHEDULE FOR ACQUIRING END-USE LOAD INFORMATION

3. For each major class and each end-use load, including those listed in paragraph (4)(A)1., if information is not available, the utility shall provide a schedule for acquiring this end-use load information or demonstrate that either the expected costs of acquisition were found to outweigh the expected benefits over the planning horizon or that gathering the end-use load information has proven to be infeasible.

KCP&L has chosen a contractor to conduct a DSM potential study that is scheduled for completion in 2013. This study will collect detailed end-use saturation and efficiency data from our customers in the residential, commercial and industrial sectors. KCP&L has provided copies of the contractor's proposal to the Stakeholders' group.

4.1.4 WEATHER EFFECTS ON LOAD

4. The utility shall determine the effect that weather has on the total load of each major class by disaggregating the load into its cooling, heating, and non-weather-sensitive components. If the cooling or heating components are a significant portion of the total load of the major class, then the cooling or heating components of that load shall be designated as enduses for that major class.

KCP&L used statistical regression analysis applied to the load research data to develop HELM like hourly load profiles for each month, for three different day types and for base, heating and cooling loads. The three day types are weekdays, weekends and peak days. Daily temperature was used in the regression models to identify the heating and cooling portions of the loads. The profiles were developed for each CCOS. The regressions were performed in Eviews with the program *createloadshapesccos2.prg*. The data for Eviews was created in SPSS with the program *dataprep2011kcplCCOS.SPS* which matches actual and normal temperatures to the hourly loads.

These load profiles are used in this IRP filing to allocated monthly base, heating and cooling energy to each hour of the month. These profiles are stored in *DTShapesKCPLCCOS.mdb*.

4.2 END-USE DEVELOPMENT

(B) The database and historical analysis required for each end use shall be developed from a utility-specific survey or other primary data. The database and analysis may incorporate or substitute the results of secondary data, with the proviso that the utility analyze and verify the applicability of those results to its service territory. The database and historical analysis required for each end use shall include at least the following:

4.2.1 MEASURES OF THE STOCK OF ENERGY-USING CAPITAL GOODS

1. Measures of the stock of energy-using capital goods. For each major class and end-use load identified in subsection (4)(A), the utility shall implement a procedure to develop and maintain adequate data on the energy-related characteristics of the building, appliance and equipment stock including saturation levels, efficiency levels, and sizes, where applicable. The utility shall update the data before each triennial compliance filing; and

KCP&L has conducted a residential appliance saturation survey every other year for many decades. The surveys have been conducted by mail. The last survey was conducted in the first half of 2010. Questionnaires were sent to 2,500 households in each jurisdiction and 687 and 845 responses were received from customers in Missouri and Kansas. The survey responses were matched with each customers' billing records for the previous 12 months and with heating and cooling degree days computed for the billing period and the combined data was used in a conditional demand study to estimate the energy used by each type of appliance.

In addition, KCP&L has chosen a contractor to conduct a DSM potential study that is scheduled for completion in 2013. This study will collect detailed end-use saturation and efficiency data from our customers in the residential, commercial and industrial sectors. KCP&L has provided copies of the contractor's proposal to the Stakeholders' group.

4.2.2 END-USE ENERGY AND DEMAND ESTIMATES

2. Estimates of end-use energy and demand. For the end-use loads identified in subsection (4)(A), the utility shall estimate monthly energies and demands at the time of monthly system peaks and shall calibrate these energies and demands to equal the weather-normalized monthly energies and demands at the time of monthly peaks for each major class for the most recently available data.

Monthly energies for the enduses that are included in our SAE models are calibrated in the SAE models to monthly billed sales for each CCOS. The coefficients for the base, heating and cooling loads calibrate those loads and the coefficient for the base load raises or lowers all the components of the base load when the base load is calibrated to monthly billed sales.

Monthly demand for the major enduses that are included in our SAE models are calibrated to the time of the monthly system peaks. This is done in the models by taking the hourly system demands and matching them to the hourly class enduse demands. This computes the coincident peak by class and enduse. To calibrate class enduse demands to the weather normalized system peak, the system peak and weather normalized peaks are used to develop a calibration factor that is applied to each class and enduse. This process is done for both MO and KS. This process is completed in an Excel worksheet which is provided in the workpapers.

SECTION 5: SELECTING LOAD FORECASTING MODELS

The utility shall select load forecast models and develop the historical database needed to support the selected models. The selected load forecast models will include a method of end-use load analysis for at least the residential and small commercial classes, unless the utility demonstrates that end-use load methods are not practicable and provides documentation that other methods are at a minimum comparable to end-use methods. The utility may choose multiple models and methods if it deems doing so is necessary to achieve all of the purposes of load forecasting and if the methods and models are consistent with, and calibrated to, one another. The utility shall describe and document its intended purposes for load forecast models, why the selected load forecast models best fulfill those purposes, and how the load forecast models are consistent with one another and with the end-use usage data used in the demand-side analysis as described in 4 CSR 240-22.050. As a minimum, the load forecast models shall be selected to achieve the following purposes:

5.1 CONSUMPTION DRIVERS AND USAGE PATTERNS

(A) Assessment of consumption drivers and customer usage patterns—to better understand customer preferences and their impacts on future energy and demand requirements, including weather sensitivity of load;

KCP&L uses the Statistically Adjusted End-use (SAE) method to forecast energy sales and demand for all classes except lighting and sales for resale. The SAE method creates a forecast of sales at the end-use level and then for each class aggregates the forecasts into base, heating and cooling energy and then calibrates these loads to monthly billed sales using statistical regressions. The SAE models were designed and are supported by staff at Itron Inc. This same staff used to support the end-use models REEPS, COMMEND and INFORM for EPRI.

Our end-use level forecasts are developed using both primary data collected by KCP&L and secondary data and projections produced by the U.S. Department of Energy (DOE) for the West North Central region of the U.S. DOE projections used in our models include projections of saturations for household appliances and equipment used in commercial buildings and projections of efficiencies for appliances, buildings and equipment. DOE has a large professional staff that is responsible for constructing and maintaining energy demand models and for managing contractors. The contractors survey households, businesses and buildings on a regular schedule. Contractors are also used to conduct special studies. DOE's projections are designed to account for changes in consumer preferences, technology and building design practices. Their projections also account for the impacts of appliance and equipment standards. DOE updates its projections at least once a year and we use the most recently available projections whenever we update our models.

KCP&L calibrates DOE appliance saturation projections to the saturation numbers that we obtain from our residential surveys. We also calibrate DOE's projections of unit energy consumption (UEC) for appliances to the results of our conditional demand study.

Itron hosts an annual meeting for the Energy Forecasting Group (EFG), which supports utilities that use the SAE method to forecast their sales. DOE staff attends the meeting of the EFG (which we attend) to explain changes in the assumptions, data and methods that have occurred during the previous year. Their slide decks provided during these meetings for the past several years are included in our workpapers. On their website, DOE provides detailed documentation and computer code for their models and assumptions.

5.2 <u>LONG-TERM LOAD FORECASTS</u>

(B) Long-term load forecasts—to serve as a basis for planning capacity and energy service needs. This can be served by any forecasting method or methods that produce reasonable projections (based on comparing model projections of loads to actual loads) of future demand and energy loads;

KCP&L believes that the SAE methodology is the best available for producing our load forecasts. REEPS, COMMEND and INFORM are no longer supported and never were supported as well as the DOE projections. DOE forecasts the impacts of all appliance and equipment standards most of which will substantially increase efficiency.[i] DOE also models trends in appliance ownership and utilization. For example, they have a model that tracks ownership of HDTV by technology and this model was updated this year:

> AEO 2011 also includes updated modeling of TVs. In particular, EIA aligns its projections more closely with the data coming from Energy Star savings calculators and with actual product availability. More efficient new televisions combined with higher penetration of Energy Star products and the phase out of CRT (Cathode Ray Tube) televisions results in substantial downward adjustment in UEC projections.[ii]

Other changes for 2011 include:

> AEO 2011 includes new consensus agreements between efficiency advocates and equipment/appliance manufacturers for a number of products including room air conditioners, dishwashers, clothes washers and dryers, refrigerators and freezers. These agreements provide EIA with a reasonable efficiency level to expect in future rulemakings by the Department of Energy (DOE) and are modeled as expected efficiency standards. This translates into stronger efficiency projections for the appliances in question and impacts energy usage for a number of end-uses. More information on the consensus agreements can be found here - http://www.aham.org/ht/a/GetDocumentAction/i/49956 .
>
> In addition to these standards, AEO 2011 also incorporates 2010 DOE rulemaking for water heaters. This new standard singled out water heaters above 55 gallon capacity for extra efficiency gains. For more information on this ruling, please see the following - http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/htgp_finalrule_fedreg.pdf .
>
> In addition to stronger efficiency growth projection, clothes dryer energy usage was impacted by benchmarking to the most recent data. This change is the result of DOE analysis that lowered the estimated number of loads per year from 322 to 215 thus significantly lowering the starting usage estimates. In addition, it was found that most modern clothes washers have a longer and/or more effective spinning cycle, resulting in laundry that is less wet and reducing the amount of

moisture for the dryers to remove. These results translate into a substantial downward shift in clothes dryer energy usage on top of efficiency improvements.

The structural index reflects both improvements in thermal shell efficiency and changing housing square footage. Changes in the structural index drive heating and cooling use through its interaction with the heating and cooling efficiency and saturation trends. Thermal shell efficiency is slightly stronger in the 2011 forecast reflecting EIA's assumption that recent efficiency measures (including ARRA) result in somewhat stronger adoption of home insulation and highly efficient windows.

5.3 POLICY ANALYSIS

(C) Policy analysis—to assess the impact of legal mandates, economic policies, and rate designs on future energy and demand requirements. The utility may use any load forecasting method or methods that it demonstrates can adequately analyze the impacts of legal mandates, economic policies, and rate designs.

KCP&L believes that the SAE approach is the best available method to incorporate the impacts of appliance and equipment efficiency standards because the DOE is the best qualified institution to estimate these impacts. DOE will also incorporate any federal legal impacts into its forecasts. For example, DOE has incorporated CAFÉ regulations into its forecasts of electric vehicle unit sales, which in turn impacts kWh sales for recharging EVs.

Table 37 Products Covered by DOE Standards[iii]

Covered Product Categories		
Lighting Products: • 3-Way Incandescent Lamp • Candelabra base incandescent lamp • Ceiling Fan Light Kits • Ceiling Fans • Fluorescent lamp ballasts • General Service Fluorescent Lamps • General Service Incandescent Lamps • Incandescent Reflector Lamps • Intermediate Base Incandescent Lamps • Light Emitting Diodes (LEDs) • Medium Base Compact Fluorescent Lamps • Organic Light Emitting Diodes (OLEDs) • Rough Service Lamp • Shatter-Resistant Lamp • Torchieres • Vibration Service Lamp • Mercury Vapor Lamp Ballasts • Metal Halide Lamp Ballast • Metal Halide Lamp Fixtures • High-intensity discharge lamps • Traffic Signal Modules and Pedestrian Modules • Illuminated Exit Signs	**Heating Products:** Residential: • Direct heating equipment • Furnace Fans • Furnaces • Mobile Home Furnace • Pool heaters (Gas Fired) • Residential Boilers • Residential Water heaters • Small Furnaces Commercial: • Commercial warm air furnaces • Packaged boilers • Storage water heaters, instantaneous water heaters, and unfired hot water storage tanks • Unit Heaters	**Space Cooling Products:** Residential: • Central Air Conditioners and Central Air Conditioning Heat Pumps • Room Air Conditioners Commercial: • Packaged terminal air conditioners and packaged terminal heat pumps • Single package vertical air conditioners and single package vertical heat pumps • Small commercial package air conditioning and heating equipment • Large commercial package air conditioning and heating equipment • Very large commercial package air conditioning and heating equipment

Table 38 Products Covered by DOE Standards, continued

Covered Product Categories		
Commercial Refrigeration Products: • Automatic commercial ice makers • Commercial refrigerators, freezers, and refrigerator-freezers • Refrigerated Beverage Vending Machines • Walk-in coolers and walk-in freezers	**Appliances:** Residential: • Clothes dryers • Dehumidifiers • Dishwashers • Kitchen ranges and ovens • Microwave ovens • Refrigerators, Freezers and Refrigerator-Freezers • Residential Clothes washers Commercial: • Commercial clothes washers	**Computers and Electronics:** • Battery Chargers • External Power Supplies, Class A and non-Class A • Television sets
Transformers and Motors: • Electric Motors (medium to large) • Small Electric Motors • Distribution Transformers, MV Dry and Liquid-Immersed	**Plumbing Products:** Residential: • Faucets • Showerheads (except safety shower showerheads) • Urinals • Water closets Commercial: • Commercial Pre-rinse Spray Valves	**Building Products** • None

SECTION 6: LOAD FORECASTING MODEL SPECIFICATIONS

6.1 DESCRIPTION AND DOCUMENTATION

(A) For each load forecasting model selected by the utility pursuant to section 4 CSR 240-22.030(5), the utility shall describe and document its—

6.1.1 DETERMINATION OF INDEPENDENT VARIABLES

1. Determination of appropriate independent variables as predictors of energy and peak demand for each major class. The critical assumptions that influence the independent variables shall also be identified.

In the models of residential use per customer, the independent variables were appliance saturations, appliance UECs, the real price of electricity, real per capita income and persons per household. The appliance saturations and UEC forecasts were adopted from DOE's forecast for the west north central region. The critical assumptions influencing the forecasts of saturations and UECs are discussed in *m067(2010).pdf*, which is supplied in the electronic workpapers and which describes the model assumptions, computational methodology, parameter estimation techniques, and FORTRAN source code. These forecasts incorporate appliance ownership trends, trends in efficiency, updated building standards and technological change.

The forecasts of real per capita income and persons per household were produced by Moody's analytics for the KC metro area. Moody's documents its assumptions in *macromodel.pdf*, *state-model-methodology.pdf* and *assum_metro_midwest.pdf*, which are supplied in the workpapers. These independent variables were used to construct an end-use forecast of residential use per customer for three major enduses: heating, cooling and other, and these were then calibrated to monthly billed sales per customer in a linear regression. This is described in *Residential SAE Modeling Framework* in the file *Res2011SAEUpdate.pdf*.

In the models of commercial and industrial sales and use per customer, the independent variables were equipment saturations and EUIs, the real price of electricity and economic variables. Economic variables were non-manufacturing employment or non-manufacturing GMP or manufacturing employment or manufacturing GMP. The forecasts from DOE incorporate trends in equipment saturations, equipment efficiencies, equipment standards, building standards and technological change. These independent variables were used to construct an end-use forecast of commercial use for three major enduses: heating, cooling and other, and these were then calibrated to monthly billed sales or sales per customer in a linear regression. This is described in *Commercial Statistically Adjusted End-Use Model* in the file *2011_CommercialSAE.pdf*.

A. The utility shall assess the applicability of the historical explanatory variables pursuant to subsection (3)(A) to its selected forecast model.

The explanatory variables used by KCP&L in its forecasting models incorporate the most important drivers of energy use. These drivers are energy standards, building standards, trends in saturations and equipment efficiency, economic growth at the sector level and existing company energy efficiency and DSM programs.

B. To the extent that the independent variables selected by the utility differ from the historical explanatory variables, the utility shall describe and document those differences;

KCP&L has used the SAE approach since 2004 to forecast its loads. The economic drivers for the residential sector have been the number of households in the KC metro area during this time period. This filing is the first time that KCP&L has modeled commercial and industrial sales at the CCOS level, so these models are new.

For this filing, we are using updated projections from DOE for 2011 and a June 2011 vintage economic forecast of the KC metro area from Moody's Analytics.

2. Development of any mathematical or statistical equations comprising the load forecast models, including a specification of the functional form of the equations; and

Table 39 MO Residential kWh per Customer

Variable	Coefficient	StdErr	T-Stat	P-Value
StrucVars.XHeat55_CCOS	1.267	0.044	29.1	0.00%
StrucVars.XCool65_CCOS	0.760	0.112	6.8	0.00%
StrucVars.XCool70_CCOS	0.183	0.080	2.3	2.56%
StrucVars.XOther_CCOS	0.904	0.014	63.4	0.00%
RUAvgUse_CCOS.Sep05	-48.59	21.17	-2.3	2.53%
RUAvgUse_CCOS.Jun05	37.73	20.86	1.8	7.56%
RUAvgUse_CCOS.Jun06	-32.22	20.93	-1.5	12.91%
BinaryVars.Jan	16.20	9.47	1.7	9.23%
BinaryVars.Jun	41.40	14.28	2.9	0.52%
BinaryVars.Jul	134.91	21.07	6.4	0.00%
BinaryVars.Aug	124.40	23.88	5.2	0.00%
BinaryVars.Sep	70.87	16.81	4.2	0.01%
BinaryVars.Dec	12.95	9.17	1.4	16.32%
Year<2009	-27.64	8.08	-3.4	0.11%
AR(1)	0.407	0.132	3.1	0.31%

Table 40 MO Small GS Commercial kWh per Customer

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	469	139	3.4	0.12%
StrucVars.XHeat55_SML	0.840	0.061	13.8	0.00%
StrucVars.XCool60_SML	2.101	0.083	25.3	0.00%
StrucVars.XOther_SML	0.440	0.107	4.1	0.01%
SML_AvgUse.Nov08	-80.30	39.78	-2.0	4.76%
SML_AvgUse.Sept05	-100.5	39.7	-2.5	1.37%
SML_AvgUse.Jun05	71.9	39.5	1.8	7.36%
AR(1)	0.814	0.071	11.5	0.00%

Table 41 MO Medium GS Commercial kWh per Customer

Variable	Coefficient	StdErr	T-Stat	P-Value
StrucVars.XHeat55_MED	0.437	0.053	8.3	0.00%
StrucVars.XCool55_MED	1.633	0.265	6.2	0.00%
StrucVars.XCool65_MED	0.447	0.177	2.5	1.38%
StrucVars.XOther_MED	0.910	0.014	65.1	0.00%
MED_AvgUse.Jan09	-2861	388	-7.4	0.00%
AR(1)	0.385	0.126	3.058	0.32%

Table 42 MO Large GS Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	39,512,525	10,252,717	3.9	0.03%
StrucVars.XHeat55_LRG	577	39	14.9	0.00%
StrucVars.XCool55_LRG	1,503	64	23.7	0.00%
StrucVars.XOther_LRG	669	67	10.0	0.00%
LRG_Sales.Oct08	-14,202,881	3,057,911	-4.6	0.00%
LRG_Sales.Jan09	15,521,557	3,097,219	5.011	0.00%
LRG_Sales.Nov05	-9,199,794	3,197,230	-2.9	0.54%
LRG_Sales.May11	9,235,328	3,094,721	3.0	0.40%
LRG_Sales.Jun08	-12,325,950	3,093,014	-4.0	0.02%
AR(1)	0.635	0.099	6.4	0.00%

Table 43 MO Large Power Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	14,049,934	8,384,505	1.7	9.90%
StrucVars.XHeat55_LP	24	62	0.4	70.12%
StrucVars.XCool55_LP	1,837	95	19.3	0.00%
StrucVars.XOther_LP	793	121	6.6	0.00%
LP_Sales.Oct08	17,282,997	2,228,912	7.8	0.00%
LP_Sales.Dec05	9,451,502	2,305,936	4.099	0.01%
LP_Sales.Mar10	8,188,110	2,308,565	3.5	0.08%
LP_Sales.Jul10	-6,003,324	2,273,468	-2.6	1.05%
Year<2009	-4,472,060	1,232,843	-3.6	0.06%
LP_Sales.Jun08	4,701,850	2,252,340	2.1	4.11%
LP_Sales.Apr07	-6,390,789	2,421,660	-2.6	1.06%
BinaryVars.Apr	-1,100,855	1,033,199	-1.1	29.09%
BinaryVars.Aug	1,982,895	1,021,567	1.9	5.70%
AR(1)	0.510	0.123	4.2	0.01%

Table 44 MO Small GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	196,870	197,364	1.0	32.22%
StrucVars.XHeat50_SML	614	73	8.4	0.00%
StrucVars.XCool65_SML	1,608	97	16.6	0.00%
StrucVars.XOther_SML	44	17	2.6	1.08%
SML_Sales.Dec08	-874,898	59,699	-14.7	0.00%
SML_Sales.Nov10	-244,351	57,185	-4.273	0.01%
Year<2009	191,056	29,912	6.4	0.00%
BinaryVars.Jan	-37,380	24,682	-1.5	13.48%
AR(1)	0	0	4.2	0.01%

Table 45 MO Medium GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	1,005,403	962,296	1.0	30.02%
StrucVars.XHeat50_MED	191	40	4.7	0.00%
StrucVars.XCool65_MED	1,137	74	15.3	0.00%
StrucVars.XOther_MED	71	18	3.9	0.02%
MED_Sales.Jul08	574,892	120,781	4.8	0.00%
MED_Sales.Dec08	711,764	129,915	5.479	0.00%
MED_Sales.Sep08	497,634	119,724	4.2	0.01%
BinaryVars.Jan	-315,290	84,672	-3.7	0.04%
BinaryVars.Jun	-95,744	48,878	-2.0	5.47%
BinaryVars.Oct	162,952	51,527	3.2	0.24%
BinaryVars.Dec	-66,869	127,060	-0.5	60.06%
BinaryVars.Aug	134,388	79,184	1.7	9.48%
AR(1)	0.917	0.055	16.6	0.00%

Table 46 MO Large GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	3,044,281	2,844,309	1.1	28.86%
StrucVars.XCool65_LRG	470	76	6.2	0.00%
StrucVars.XOther_LRG	75	13	5.6	0.00%
LRG_Sales.Nov09	2,619,490	644,049	4.1	0.01%
LRG_Sales.Mar10	1,927,650	644,375	3.0	0.40%
LRG_Sales.Mar07	2,260,396	634,674	3.562	0.07%
LRG_Sales.Jan08	-943,177	740,527	-1.3	20.75%
BinaryVars.Jan	-977,521	287,179	-3.4	0.12%
BinaryVars.Aug	780,564	325,311	2.4	1.94%
Year<2008	843,028	521,713	1.6	11.11%
AR(1)	0.652	0.098	6.7	0.00%

Table 47 MO Large Power Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	68,239,316	16,375,396	4.2	0.01%
StrucVars.XCool55_LP	824	77	10.6	0.00%
StrucVars.XOther_LP	30	14	2.1	4.17%
LP_Sales.Nov_Dec05	-56,184,998	3,796,298	-14.8	0.00%
LP_Sales.Feb_Mar09	-45,042,713	3,844,882	-11.7	0.00%
LP_Sales.Feb_Mar10	-45,091,995	3,779,489	-11.9	0.00%
LP_Sales.Jun_Jul09	-24,944,417	3,780,505	-6.6	0.00%
Year<2008	5,224,479	1,510,520	3.5	0.10%

Table 48 KS Residential kWh per Customer

Variable	Coefficient	StdErr	T-Stat	P-Value
StrucVars.XHeat55_CCOS	1.130	0.030	38.2	0.00%
StrucVars.XCool65_CCOS	1.335	0.034	39.3	0.00%
StrucVars.XCool75_CCOS	-0.142	0.021	-6.7	0.00%
StrucVars.XOther_CCOS	0.875	0.012	75.4	0.00%
RUAvgUse_CCOS.Sep05	-87.52	23.38	-3.7	0.04%
RUAvgUse_CCOS.Jun06	-99.53	23.83	-4.2	0.01%
RUAvgUse_CCOS.Jul06	-61.03	24.21	-2.5	1.44%
RUAvgUse_CCOS.Jan06	64.95	21.74	3.0	0.41%
RUAvgUse_CCOS.Nov10	-31.54	22.02	-1.4	15.72%
RUAvgUse_CCOS.Jul11	119.49	25.76	4.6	0.00%
RUAvgUse_CCOS.Aug10	88.57	24.22	3.7	0.05%
Year<2009	-32.21	7.67	-4.2	0.01%
BinaryVars.Jul	50.62	12.79	4.0	0.02%
BinaryVars.Aug	37.41	16.49	2.3	2.69%
AR(1)	0.289	0.137	2.1	3.87%

Table 49 KS Small GS Commercial kWh per Customer

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	315.619	103.817	3.0	0.34%
StrucVars.XHeat55_SML	0.678	0.045	15.1	0.00%
StrucVars.XCool60_SML	2.021	0.055	37.0	0.00%
StrucVars.XOther_SML	0.524	0.087	6.0	0.00%
SML_AvgUse.Sep05	-84.89	24.40	-3.5	0.09%
SML_AvgUse.Nov06	-73.95	24.30	-3.0	0.34%
SML_AvgUse.Jun11	-78.06	24.11	-3.2	0.19%
SML_AvgUse.Feb10	80.99	24.16	3.4	0.14%
Year<2010	32.95	27.18	1.2	22.99%
AR(1)	0.803	0.070	11.5	0.00%

Table 50 KS Medium GS Commercial kWh per Customer

Variable	Coefficient	StdErr	T-Stat	P-Value
StrucVars.XHeat55_MED	0.415	0.046	9.1	0.00%
StrucVars.XCool55_MED	1.935	0.221	8.7	0.00%
StrucVars.XCool65_MED	0.322	0.148	2.2	3.32%
StrucVars.XOther_MED	0.852	0.011	74.7	0.00%
MED_AvgUse.Jul11	706	305	2.3	2.37%
MED_AvgUse.Feb11	-563	289	-1.9	5.56%
MED_AvgUse.May11	639	284	2.3	2.75%
AR(1)	0.327	0.132	2.5	1.61%

Table 51 KS Large GS Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	59,348,484	8,673,059	6.8	0.00%
StrucVars.XHeat50_LRG	455	31	14.6	0.00%
StrucVars.XCool55_LRG	1,756	57	30.6	0.00%
StrucVars.XOther_LRG	714	68	10.5	0.00%
LRG_Sales.May08	90,218,614	2,862,478	31.5	0.00%
LRG_Sales.May11	8,366,540	2,316,479	3.6	0.06%
LRG_Sales.Jun08	-5,264,572	2,659,836	-2.0	5.21%
LRG_Sales.Aug05	-5,209,859	2,277,311	-2.3	2.55%
LRG_Sales.lt2008may	-36,723,285	1,888,354	-19.4	0.00%
AR(1)	0.665	0.106	6.3	0.00%

Table 52 KS Large Power Commercial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
StrucVars.XHeat55_LP	215	66	3.3	0.16%
StrucVars.XCool60_LP	509	73	7.0	0.00%
StrucVars.XOther_LP	176	20	8.9	0.00%
LP_Sales.May08	-93,678,408	1,475,901	-63.5	0.00%
LP_Sales.lt2008may	28,556,955	813,776	35.1	0.00%
AR(1)	1	0	5.3	0.00%

Table 53 KS Small GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
StrucVars.XHeat50_SML	280	53	5.3	0.00%
StrucVars.XCool65_SML	520	78	6.7	0.00%
StrucVars.XOther_SML	90	1	64.6	0.00%
SML_Sales.Nov10	-197,288	40,914	-4.8	0.00%
SML_Sales.Jun08	-162,006	41,057	-3.9	0.02%
SML_Sales.Feb10	149,242	40,534	3.7	0.05%
BinaryVars.Aug	22,590	18,538	1.2	22.73%
AR(1)	0.625	0.097	6.4	0.00%

Table 54 KS Medium GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	1,114,973	273,564	4.1	0.01%
StrucVars.XHeat50_MED	168	54	3.1	0.25%
StrucVars.XCool65_MED	1,288	73	17.7	0.00%
StrucVars.XOther_MED	45	12	3.7	0.05%
MED_Sales.Aug06	-2,121,919	68,531	-31.0	0.00%
MED_Sales.Jun08	156,080	65,313	2.4	1.97%
AR(1)	0.671	0.092	7.3	0.00%

Table 55 KS Large GS Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
StrucVars.XCool65_LRG	1,285	232	5.5	0.00%
StrucVars.XOther_LRG	145	21	7.1	0.00%
LRG_Sales.Aug10	1,158,615	762,417	1.5	13.59%
LRG_Sales.May08	70,387,185	930,905	75.6	0.00%
LRG_Sales.Jul08	3,006,820	1,186,089	2.5	1.50%
LRG_Sales.Jun08	-25,742,649	1,154,583	-22.3	0.00%
LRG_Sales.Aug08	2,056,044	975,138	2.1	4.09%
AR(1)	0.956	0.031	31.1	0.00%

Table 56 KS Large Power Industrial Sales

Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	5,132,308	721,823	7.1	0.00%
StrucVars.XCool65_LP	200	83	2.4	2.25%
LP_Sales.May08	-69,354,008	682,889	-101.6	0.00%
LP_Sales.Jul08	-2,232,302	892,422	-2.5	1.83%
LP_Sales.Aug08	-1,615,540	690,348	-2.3	2.64%
LP_Sales.Jun08	26,466,843	877,508	30.2	0.00%
LP_Sales.Mar10	3,930,343	571,687	6.9	0.00%
LP_Sales.Mar09	5,223,865	571,059	9.1	0.00%
LP_Sales.Feb09	-5,403,940	571,011	-9.5	0.00%
LP_Sales.Feb10	-4,644,726	571,012	-8.1	0.00%
AR(1)	0.824	0.043	19.2	0.00%

3. Assessment of the applicability of any load forecast models or portions of models that were utilized by the utility but developed by others, including a specification of the functional forms of any equations or models, to the extent they are available.

The load forecasting models rely on a forecast of economic activity for the KC metro area that was produced by Moody's Analytics. The KC metro area is the same as the Metropolitan Statistical Area (MSA) defined by the US Census Bureau and it includes some counties in both states that are not served by KCP&L. Also, KCP&L's service area includes some counties that are not included in the MSA. Despite these inconsistencies in geographic areas, there are reasons why this forecast is representative of our service areas. Many people live on one side of the state line and work on the other side. Many people shop on both sides of the state line. And many companies each year move from one side of the state line to the other. Documentation for Moody's forecast of economic activity is provided in the workpapers in the folder \KCPL Base Case\Data\Economics.

The load forecasting models also rely on saturation and appliance and equipment utilization forecasts from the DOE. The advantages of the projections from these models is 1) DOE's Forecasting and Analyst staff includes dozens of experts and maintains a large budget for data collection and consultants, 2) DOE has a focus on measuring the impacts of appliance and equipment standards and legal mandates and 3) DOE is very transparent, making available its work and computer code on its website.[iv] KCP&L also relies on the staff that developed and maintained some of EPRI's end-use models recommended and developed the SAE approach for KCP&L and many other utilities. EPRI no longer maintains its end-use forecasting models.

A potential downside of these projections for KCP&L is that the data and models developed by DOE are developed at a regional level rather than specifically for KCP&L, although this can be an advantage when one service area or region has insufficient variation to measure the impact of a variable such as electric price. Cross sectional variation in the data can be an advantage in situations where price or income elasticities are being modeled.

(B) If the utility selects load forecast models that include end-use load methods, the utility shall describe and document any deviations in the independent variables or functional forms of the equations from those derived from load analysis in sections (3) and (4).

KCP&L is not aware of any such deviations.

(C) Historical Database for Load Forecasting. In addition to the load analysis database, the utility shall develop and maintain a database consistent with and as needed to run each forecast model utilized by the utility. The utility shall describe and document its load forecasting historical database in the triennial compliance filings. As a minimum, the utility shall—

1. Develop and maintain a data set of historical values for each independent variable of each forecast model. The historical values for each independent variable shall be collected for a period of ten (10) years, or such period deemed sufficient to allow the independent variables to be accurately forecasted over the entire planning horizon;

The independent variables acquired from Moody's are available back to 1990. These are updated every time that KCP&L acquires a new economic and demographic forecast as revisions to this data far back in time are common.

The independent variables acquired from DOE are also available back to 1990 and these too replace the historical values when each year new spreadsheets are provided to KCP&L. New studies or data can revise historical estimates of efficiencies and saturations.

The independent variables for natural gas prices of local utilities are maintained back to 1991.

Temperature data is maintained back to 1971 when the Kansas City International Airport opened for business.

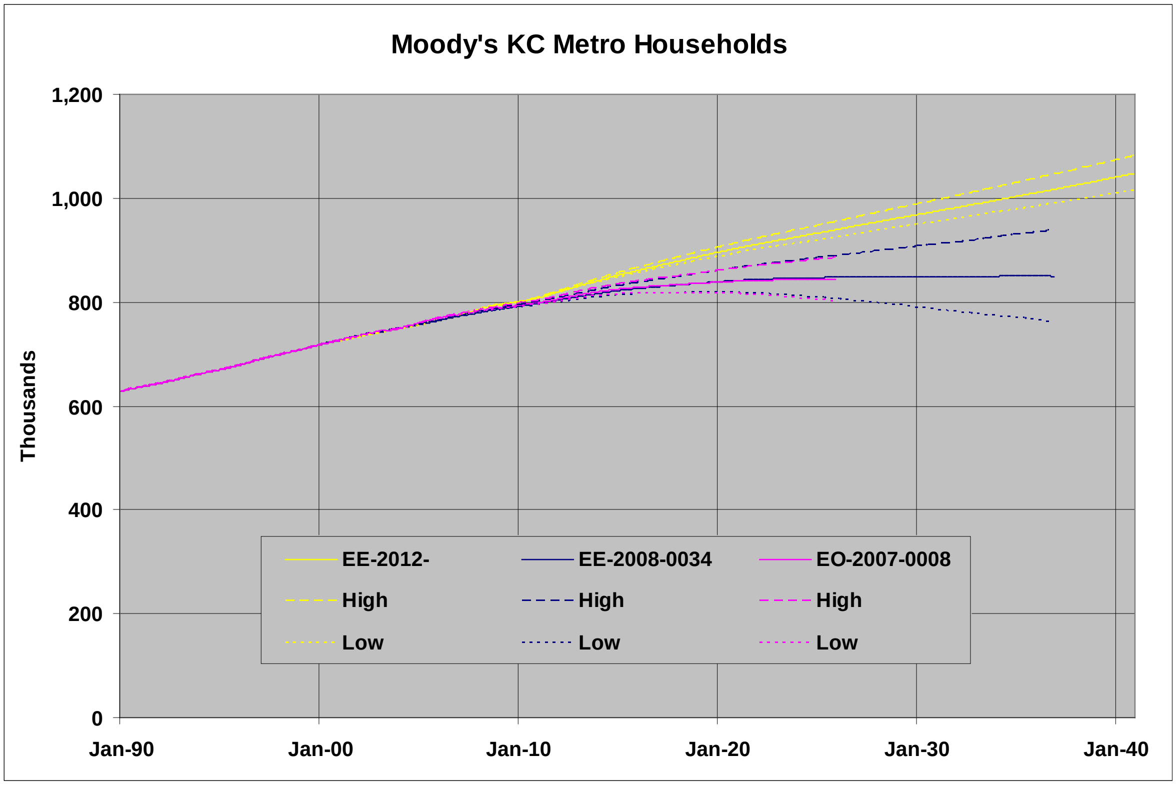
2. Explain any adjustments that it made to historical data prior to using it in its development of the forecasting models;

KCP&L staff is not aware of any adjustments made to independent variables used in its load forecasting models.

3. Archive previous projections of all independent variables used in the energy usage and peak load forecasts made in at least the past ten (10) years and provide a comparison of the historical projected values in prior plan filings to actual historical values and to projected values in the current compliance filing; and

KCP&L still possesses the electronic files that it received with the independent variables used in producing energy and peak forecasts during the last ten years. Below we plot the base, high and low bands for the most important economic and demographic independent variables used in the current and two previous IRP filings.

Figure 25: Households



When asked about the change in the household forecast that occurred with that used in this filing, Moody's responded

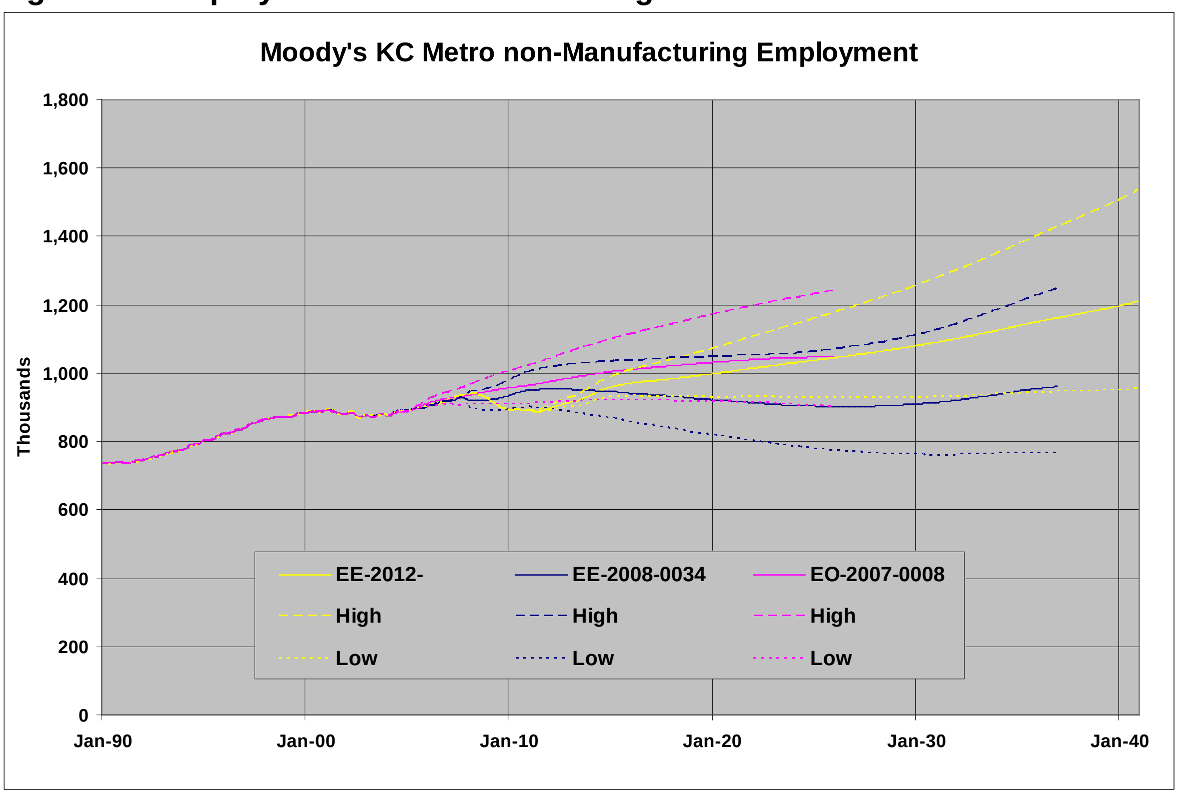
> "we view the metro area as having solid growth drivers that should enable population growth to outpace the nation. It has below average costs and an extremely diversified economy. Its workforce has an above average educational attainment when compared with the regional average, which will help it attract new businesses. In light of these characteristics, a severe decline in the rate of population growth beginning immediately in the forecast period simply couldn't be justified, hence the revisions. The changes in the household forecast follow directly from changes to population."[v]

The high and low bands for the current forecast are closer together compared to the two previous forecasts. We ask to explain, Moody's responded

"The different properties of the high/low bands I sent most recently are a result of the newer methodology I mentioned. Previously, your data delivery used a different, older methodology, but it will be migrated to the new one going forward. Since you requested an update of the households data, I used the new methodology since it will match what you will be receiving in the future.

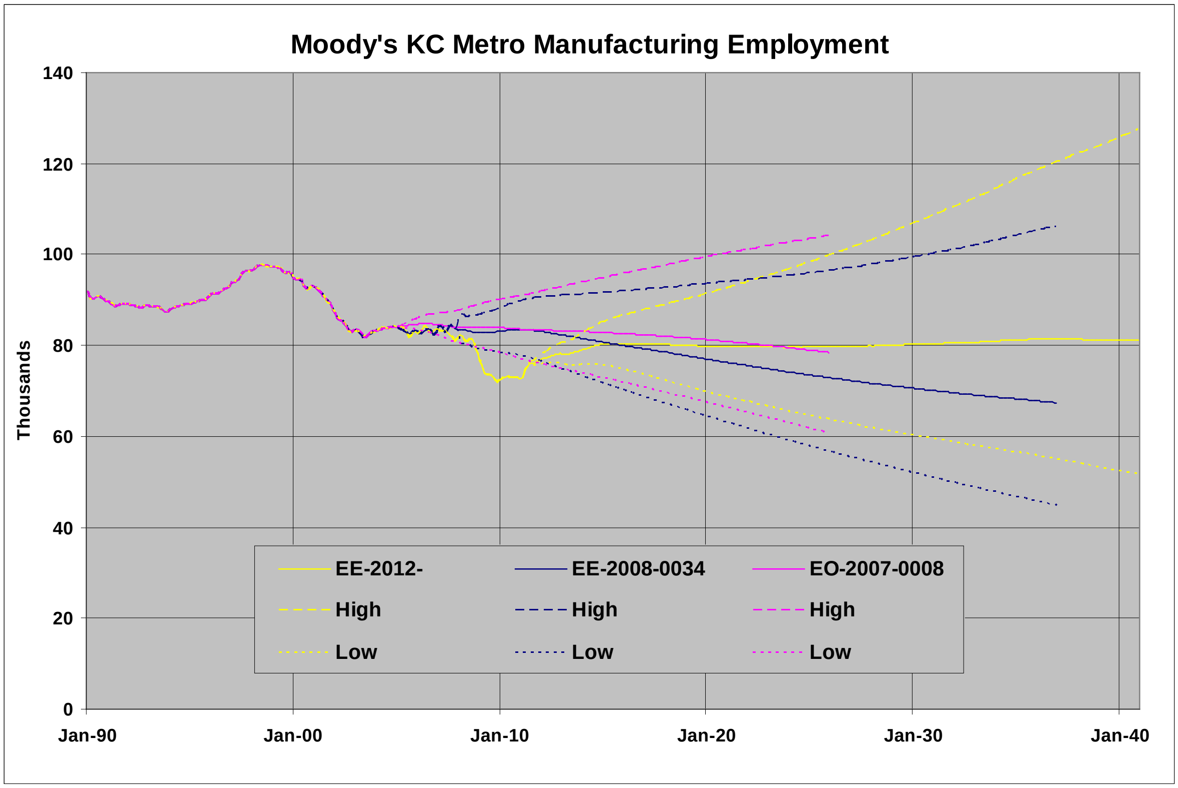
"The new methodology relies on the historical variation in the growth rates of the time series. Growth in households (both in general and for Kansas City) are quite consistent compared with many other economic time series. For KAN, quarterly growth has ranged only from about 0.1% and 0.7%, with a standard deviation of just over 0.1%. This is what is causing the high and low bands to have relatively small divergence. To illustrate slightly further: If households for KAN were 10% higher than the baseline in 2035, that would be equivalent to a quarterly growth rate about a full standard deviation higher than the baseline expectation in every single quarter. We view that as being too unlikely for the purposes of these high/low bands."[vi]

Figure 26: Employment Non-Manufacturing



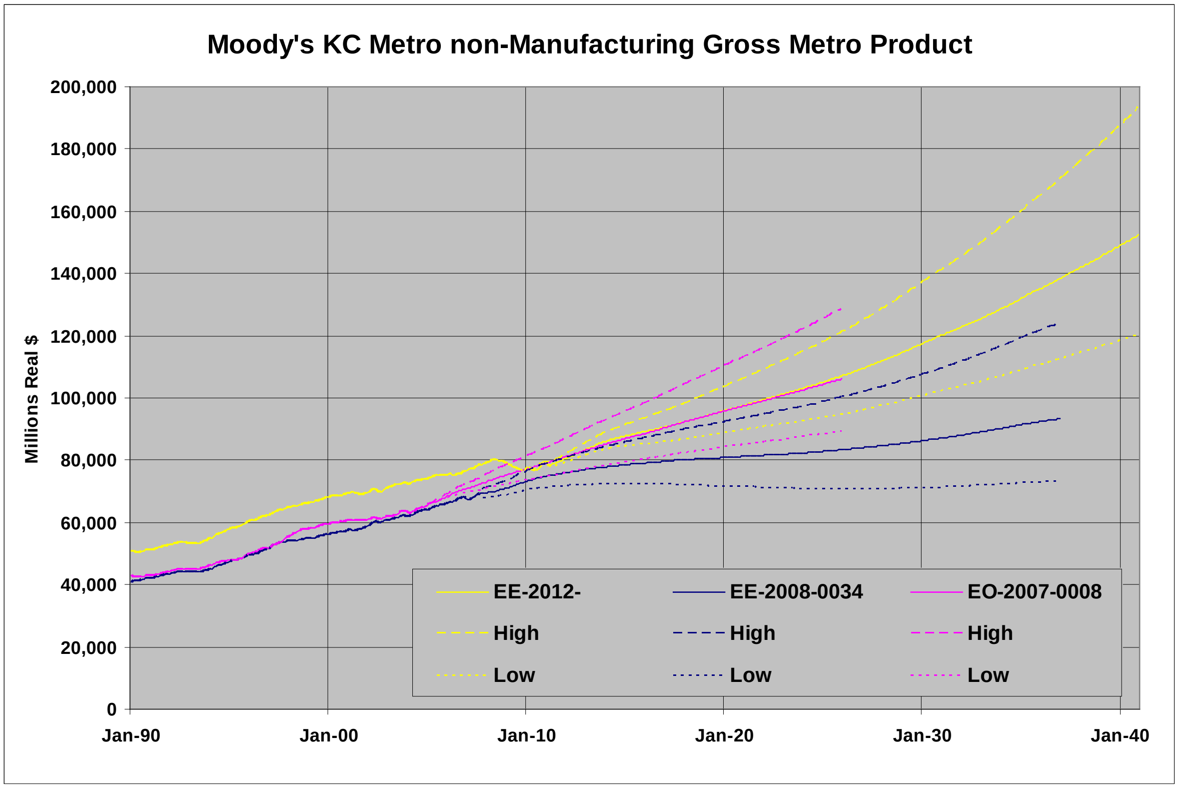
The current forecast of non-manufacturing employment shows a substantial drop during and several years after the last recession, then a rapid rebound and then steady robust growth. The previous forecast shows only a small drop and no increases until the mid 20s. The current forecast reflects a change in assumptions mentioned in the paragraph above for households for the competitiveness of the KC metro economy.

Figure 27: Employment Manufacturing



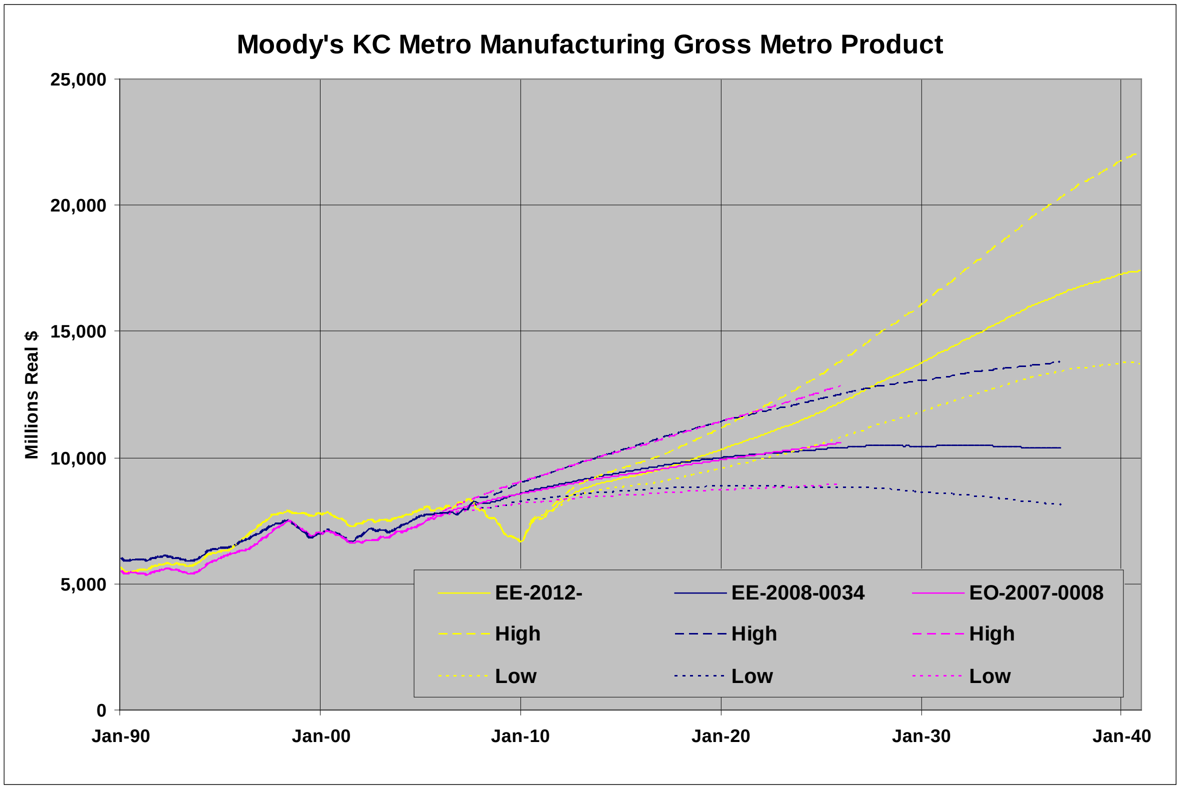
In the current forecast, manufacturing employment shows a huge decline during and several years after the last recession. After a strong rebound, employment is flat thereafter.

Figure 28: Gross Metro Product Non-Manufacturing



Real non-manufacturing GMP is growing much faster than employment in all three scenarios due to rising productivity. The current forecast shows a drop during and after the last recession. Real GMP in the current forecast was rebased to 2005 $.

Figure 29: Gross Metro Product Manufacturing



While manufacturing employment is flat after 2015, real manufacturing GMP shows strong growth. The current forecast shows the strongest growth.

4. Archive all previous forecasts of energy and peak demand, including the final data sets used to develop the forecasts, made in at least the past ten (10) years. Provide a comparison of the historical final forecasts to the actual historical energy and peak demands and to the current forecasts in the current triennial compliance filing.

KCP&L maintains an archive of the electronic files associated with our previous forecasts of energy use and peak demand for at least the last ten years. The graphs below compare our previous long-run forecasts of NSI and peak demand. The most recent forecast reflects a significant slowdown in economic growth that began in 2008, expectations for slower economic growth and additional energy standards.

Figure 30: Net System Input (NSI) Historical and Final Forecasts

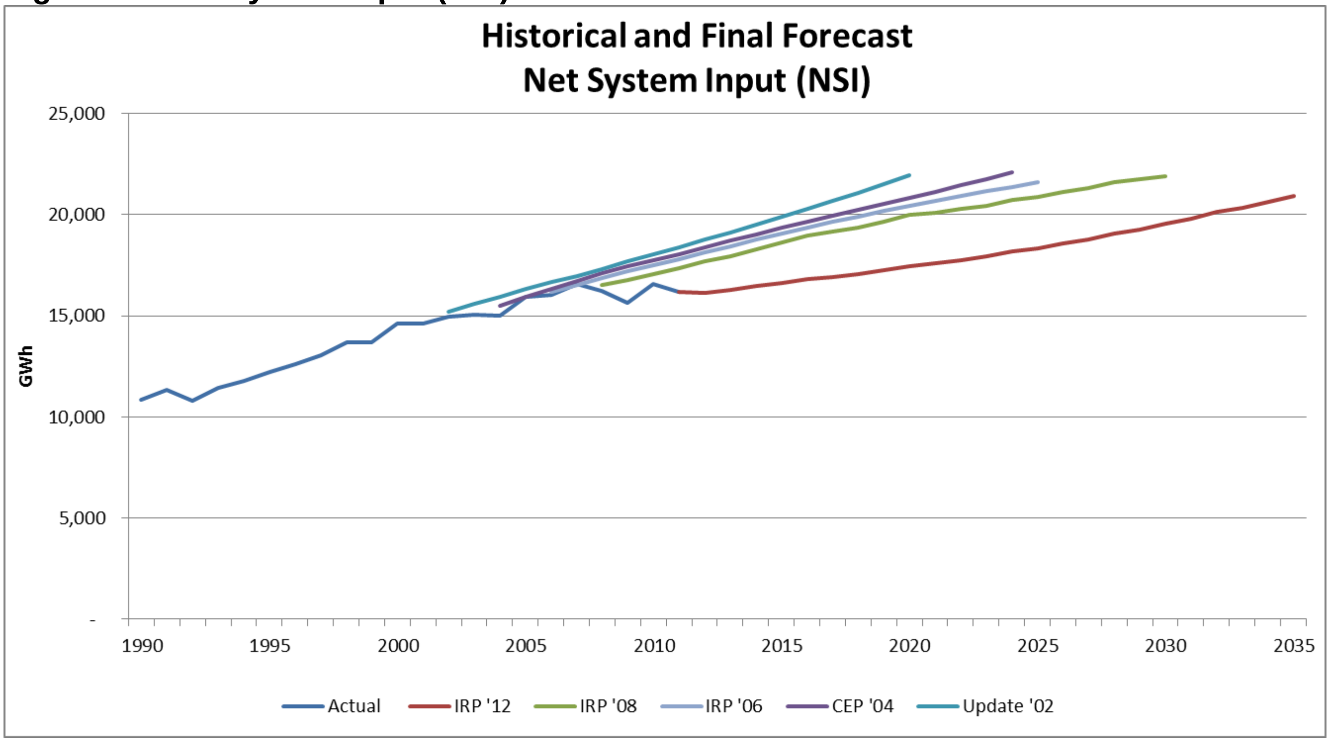
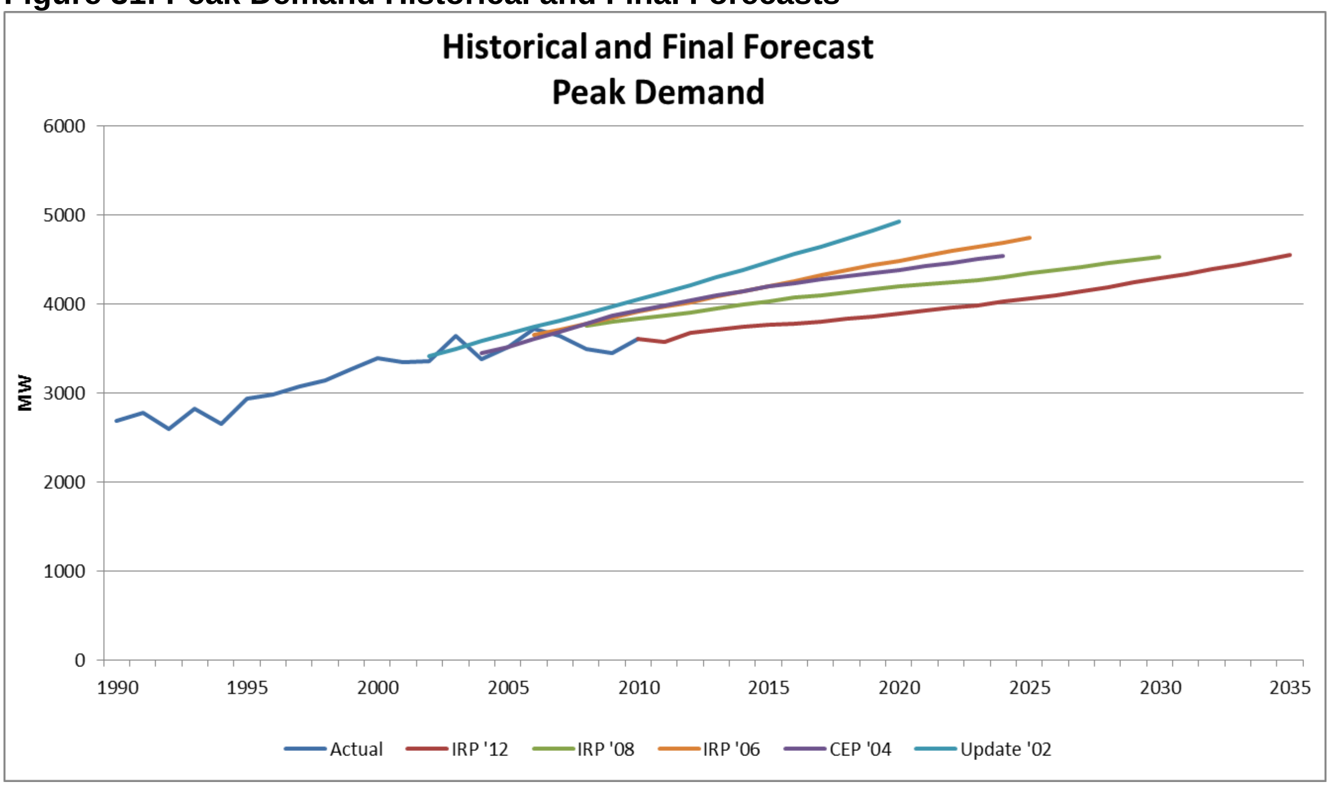


Figure 31: Peak Demand Historical and Final Forecasts



SECTION 7: BASE-CASE LOAD FORECAST

The utility's base-case load forecast shall be based on projections of the independent variables that utility decision-makers believe to be most likely. All components of the base-case load forecast shall assume normal weather conditions. The load impacts of implemented demand-side programs and rates shall be incorporated in the base-case load forecast, but the load impacts of proposed demand-side programs and rates shall not be included in the base-case forecast.

KCP&L's base-case forecast was produced with a base-case economic forecast from Moody's Analytics obtained in June 2011. The forecast included the impacts of KCP&L's implemented energy efficiency and DSM programs on NSI and peak load. The forecast was produced using normal weather.

7.1 MAJOR CLASS AND TOTAL LOAD DETAIL

(A) Major Class and Total Load Detail.

The utility shall produce forecasts of monthly energy usage and demands at the time of the summer and winter system peaks by major class for each year of the planning horizon, and shall describe and document those forecasts in its triennial compliance filings. Where applicable, these major class forecasts shall be separated into their jurisdictional components.

7.1.1 DESCRIBE AND DOCUMENT RELEVENT ECONOMIC AND DEMOGRAPHICS

1. The utility shall describe and document how the base-case forecasts of energy usage and demands have taken into account the effects of real prices of electricity, real prices of competitive energy sources, real incomes, and any other relevant economic and demographic factors. If the methodology does not incorporate economic and demographic factors, the utility shall explain how it accounted for the effects of these factors.

KCP&L accounted for the effects of real electricity prices in two ways. First, the prices of electricity and natural gas were used in the models that forecast the saturations of electric space heating for residential and commercial customers. These models are described in the section of this document for rule 7.B.1. Second, KCP&L assumes a price elasticity of -0.15 in each model of sales or sales per customer. These elasticities are close to the default values in the ERPI models REEPS and COMEND, which ITRON used in the original SAE models that they delivered to KCP&L in 2004. Since, then KCP&L has made some small changes to these values to improve the fit of the models.

In the residential models of kWh per customer, KCP&L assumes an income elasticity of 0.2 for heating and cooling and 0.1 for other uses and a persons-per-household elasticity of 0.2. Moody's forecast of households for the KC metro area were used in the models of residential customers as was described previously in the section for rule 3.B.

7.1.2 DESCRIBE AND DOCUMENT EFFECTS OF LEGAL MANDATES

2. The utility shall describe and document how the forecasts of energy usage and demands have taken into account the effects of legal mandates affecting the consumption of electricity.

KCP&L uses the SAE methodology to forecast kWh sales for residential, commercial and industrial sales. This methodology relies on DOE forecasts of UECs and EUIs, which account for appliance efficiency standards and building codes.[vii]

7.1.3 DESCRIBE AND DOCUMENT CONSISTENCY

3. The utility shall describe and document how the forecasts of energy usage and demands are consistent with trends in historical consumption patterns, end uses, and end-use efficiency in the utility's service area as identified pursuant to sections 4 CSR 240-22.030(2), (3), and (4).

KCP&L forecasts incorporate and thus are consistent with the following trends:

- Electric space heating models explain the rapid rise of electric space heating saturations in the residential and commercial sector as a function of the relative costs of using electricity and natural gas. These costs depend on electricity and natural gas prices and the efficiencies of heat pumps and natural gas furnaces.

- Forecasts of UECs and EUIs used in our models reflect the impacts of energy standards in both the past and the future.

- Forecasts of appliance and equipment saturations reflect the penetration of new devices such as HDTVs and the limitations of further increases for appliances that are reaching equilibrium such as dishwashers and central air conditioners.

7.1.4 <u>DESCRIBE AND DOCUMENT WEATHER NORMALIZED CLASS LOADS</u>

4. For at least the base year of the forecast, the utility shall describe and document its estimates of the monthly cooling, heating, and non-weather-sensitive components of the weather-normalized major class loads.

The estimates are shown below.

Figure 32: Estimates of MO Residential Monthly Cooling, Heating, and Base

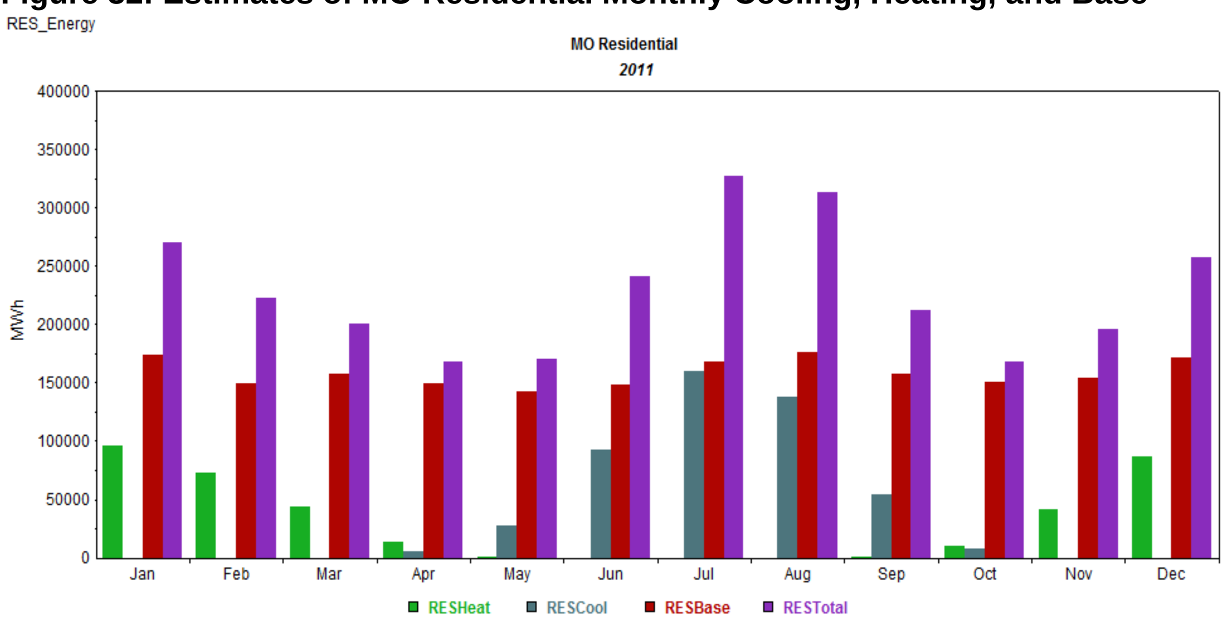


Table 57: Data Table of MO Residential Monthly Cooling, Heating, and Base

Date	RESHeat	RESCool	RESBase	RESTotal
Jan-11	95,618	-	174,041	269,658
Feb-11	72,255	-	149,644	221,899
Mar-11	43,333	-	157,070	200,403
Apr-11	12,869	5,626	149,728	168,224
May-11	696	27,570	142,341	170,607
Jun-11	-	92,805	147,853	240,658
Jul-11	-	159,466	167,343	326,808
Aug-11	-	137,556	175,987	313,543
Sep-11	318	53,609	157,404	211,331
Oct-11	10,285	7,078	149,977	167,340
Nov-11	41,692	-	153,854	195,546
Dec-11	86,277	-	171,287	257,564

Figure 33: Estimates of MO Small General Service Monthly Cooling, Heating, and Base

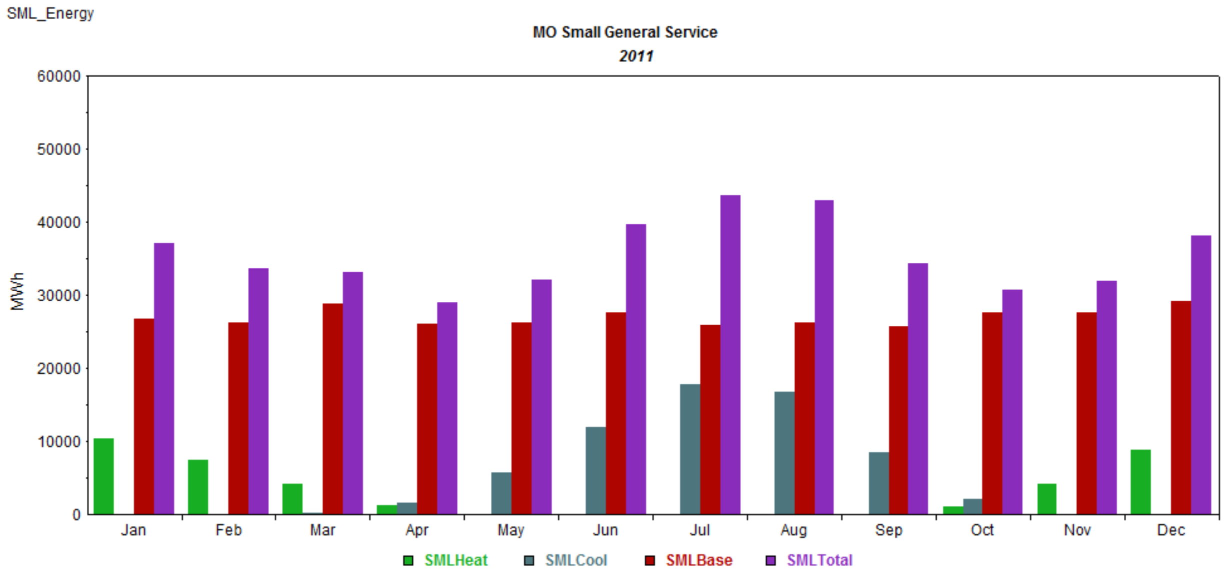


Table 58: Data Table of MO Small General Service Monthly Cooling, Heating, and Base

Date	SMLHeat	SMLCool	SMLBase	SMLTotal
Jan-11	10,332	-	26,762	37,094
Feb-11	7,503	-	26,237	33,740
Mar-11	4,143	191	28,890	33,224
Apr-11	1,348	1,675	26,060	29,083
May-11	70	5,808	26,271	32,149
Jun-11	-	12,013	27,664	39,677
Jul-11	-	17,876	25,826	43,702
Aug-11	-	16,685	26,237	42,922
Sep-11	32	8,529	25,755	34,316
Oct-11	1,037	2,049	27,651	30,738
Nov-11	4,248	72	27,655	31,974
Dec-11	8,843	0	29,238	38,081

Figure 34: Estimates of MO Medium General Service Monthly Cooling, Heating, and Base

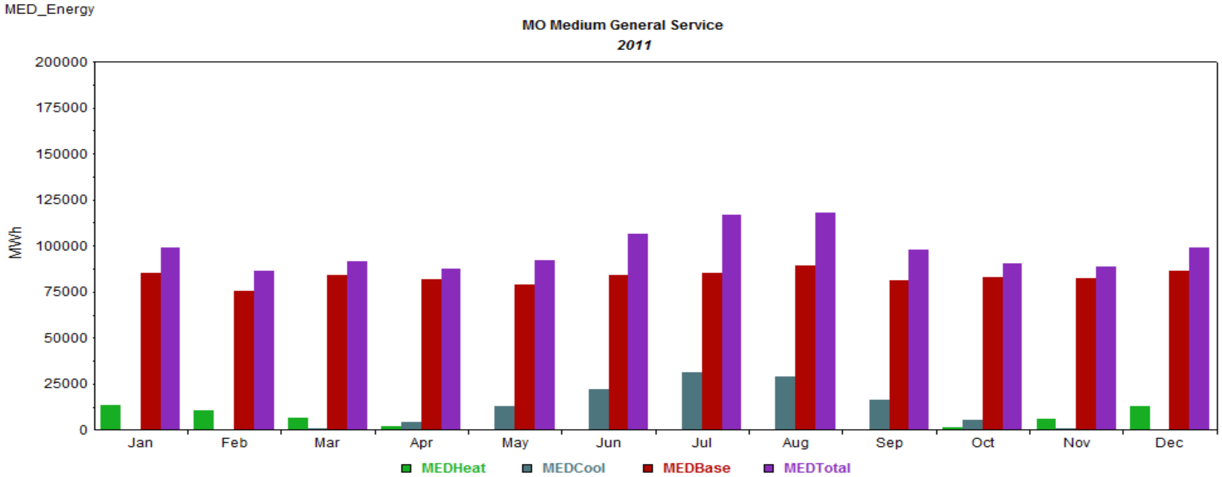


Table 59: Data Table of MO Medium General Service Monthly Cooling, Heating, and Base

Date	MEDHeat	MEDCool	MEDBase	MEDTotal
Jan-11	13,651	-	85,274	98,925
Feb-11	10,655	-	75,623	86,278
Mar-11	6,412	1,064	83,859	91,335
Apr-11	1,827	4,333	81,442	87,602
May-11	99	13,075	79,074	92,247
Jun-11	-	22,342	83,971	106,312
Jul-11	-	31,426	85,448	116,874
Aug-11	-	28,687	88,948	117,635
Sep-11	45	16,583	81,241	97,868
Oct-11	1,482	5,465	83,204	90,151
Nov-11	6,074	572	82,106	88,752
Dec-11	12,659	-	86,494	99,153

Figure 35: Estimates of MO Large General Service Monthly Cooling, Heating, and Base

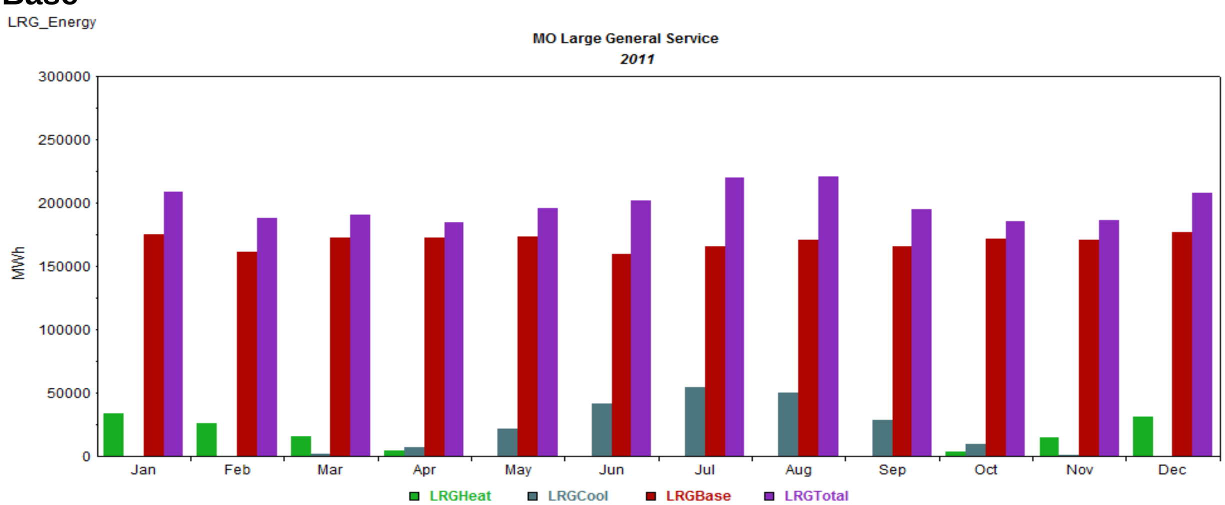


Table 60: Data Table of MO Large General Service Monthly Cooling, Heating, and Base

Date	LRGHeat	LRGCool	LRGBase	LRGTotal
Jan-11	34,389	-	174,783	209,173
Feb-11	26,394	-	161,276	187,669
Mar-11	15,791	1,865	172,942	190,598
Apr-11	4,468	7,483	172,779	184,731
May-11	242	22,312	173,320	195,873
Jun-11	-	41,680	160,057	201,737
Jul-11	-	54,529	165,532	220,061
Aug-11	-	50,399	170,452	220,851
Sep-11	114	29,120	165,434	194,668
Oct-11	3,690	9,594	172,056	185,340
Nov-11	14,986	1,004	170,614	186,603
Dec-11	31,042	-	176,693	207,735

Figure 36: Estimates of MO Large Power Monthly Cooling, Heating, and Base

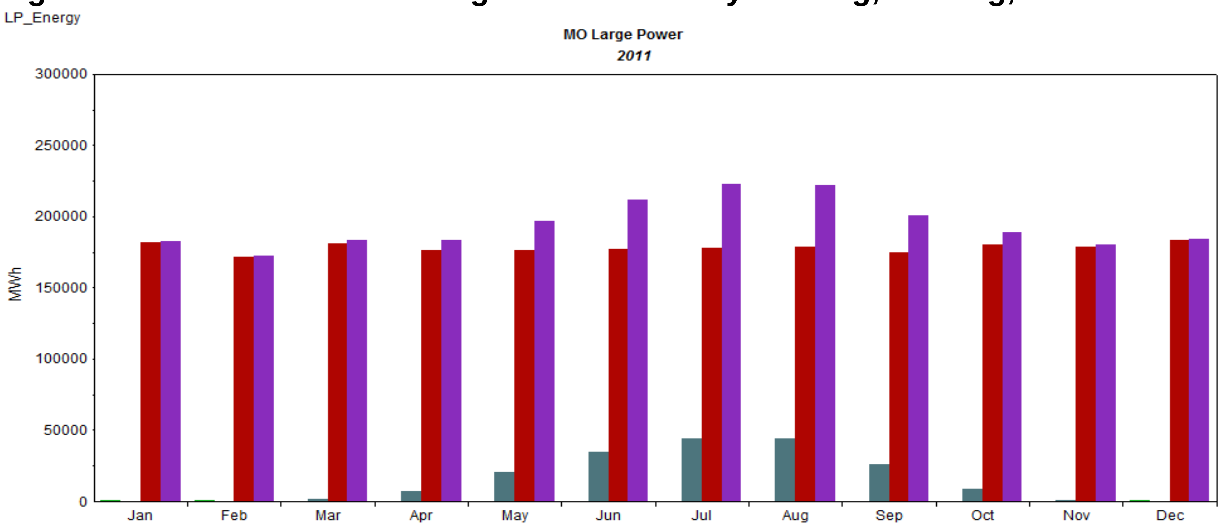


Table 61: Data Table of MO Large Power Monthly Cooling, Heating, and Base

Date	LPHeat	LPCool	LPBase	LPTotal
Jan-11	647	-	182,130	182,777
Feb-11	503	-	171,854	172,357
Mar-11	289	1,626	181,192	183,108
Apr-11	88	6,864	176,050	183,002
May-11	5	20,213	176,644	196,862
Jun-11	-	34,604	176,868	211,473
Jul-11	-	44,349	178,024	222,373
Aug-11	-	43,725	178,435	222,160
Sep-11	2	25,590	174,694	200,287
Oct-11	71	8,585	180,085	188,741
Nov-11	286	911	178,987	180,184
Dec-11	593	-	183,575	184,168

Figure 37: Other MO Load (SFR & Lighting)

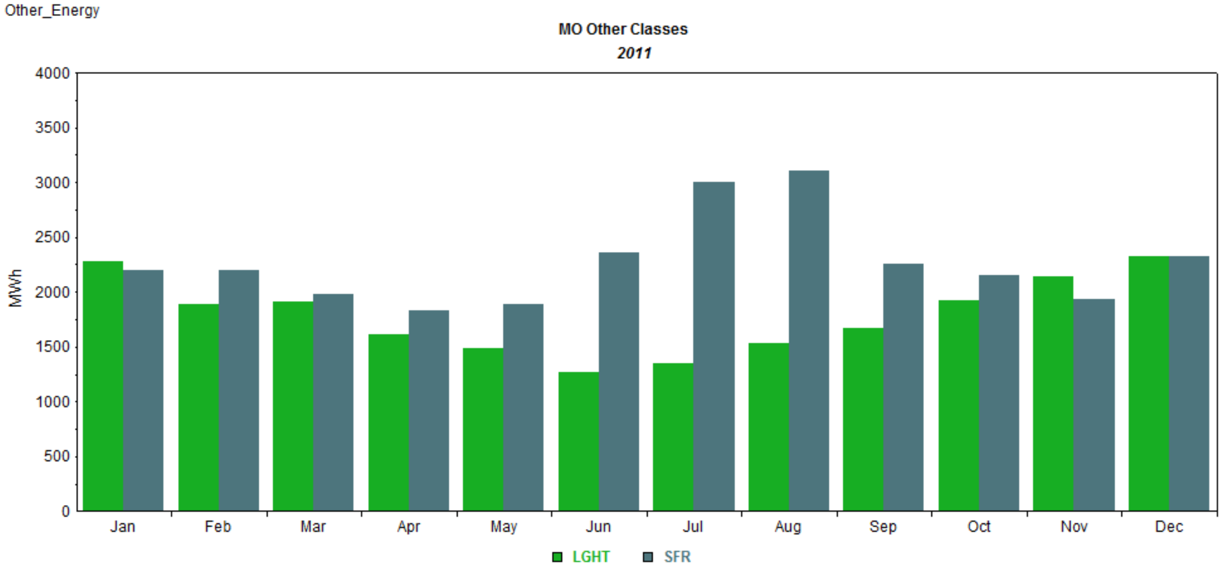


Table 62: Data Table Other MO Load (SFR & Lighting)

Date	LGHT	SFR
Jan-11	2,279	2,193
Feb-11	1,888	2,198
Mar-11	1,912	1,983
Apr-11	1,616	1,833
May-11	1,484	1,887
Jun-11	1,263	2,361
Jul-11	1,353	2,997
Aug-11	1,527	3,112
Sep-11	1,671	2,254
Oct-11	1,926	2,157
Nov-11	2,141	1,930
Dec-11	2,320	2,328

Figure 38: Estimates of KS Residential Monthly Cooling, Heating, and Base

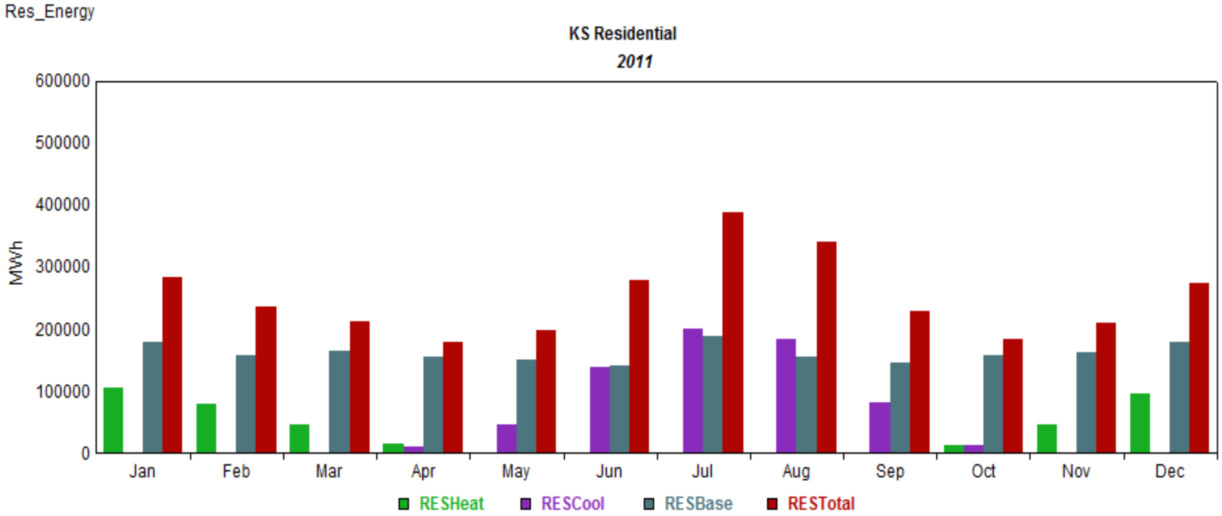


Table 63: Data Table of KS Residential Monthly Cooling, Heating, and Base

Date	RESHeat	RESCool	RESBase	RESTotal
Jan-11	104,350	-	178,220	282,570
Feb-11	78,284	-	157,112	235,396
Mar-11	46,508	-	165,313	211,821
Apr-11	14,334	10,421	155,096	179,851
May-11	752	45,743	150,564	197,059
Jun-11	-	138,880	140,186	279,066
Jul-11	-	199,342	187,747	387,089
Aug-11	-	184,046	155,969	340,015
Sep-11	351	82,233	145,594	228,178
Oct-11	11,377	12,714	158,303	182,394
Nov-11	46,177	-	162,743	208,920
Dec-11	95,715	-	177,808	273,522

Figure 39: Estimates of KS Small General Service Monthly Cooling, Heating, and Base

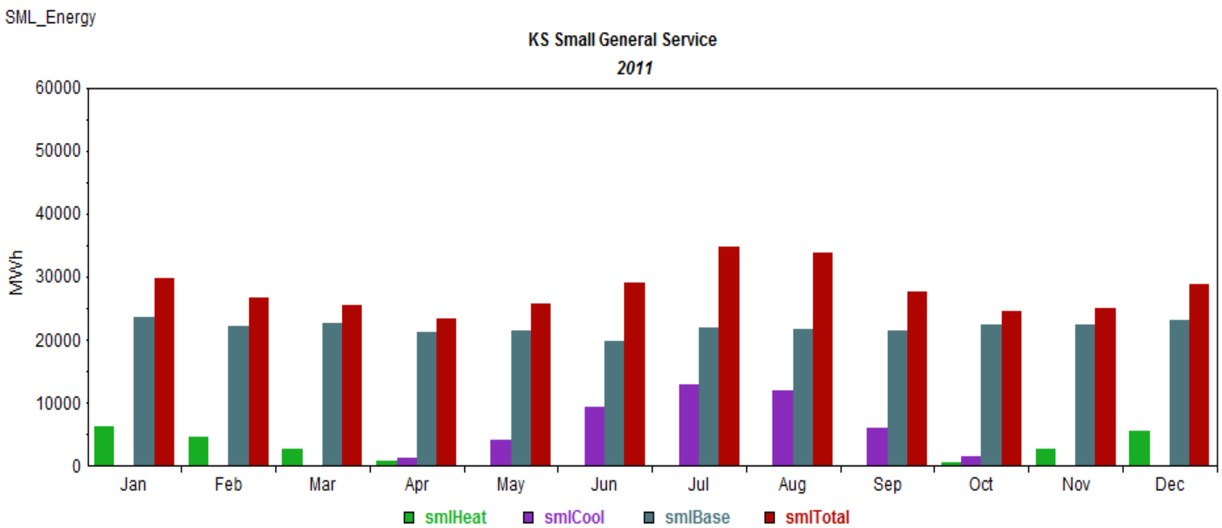


Table 64: Data Table of KS Small General Service Monthly Cooling, Heating, and Base

Date	smlHeat	smlCool	smlBase	smlTotal
Jan-11	6,221	-	23,541	29,762
Feb-11	4,594	-	22,040	26,634
Mar-11	2,661	141	22,723	25,525
Apr-11	843	1,197	21,276	23,317
May-11	44	4,138	21,502	25,684
Jun-11	-	9,223	19,852	29,075
Jul-11	-	12,893	21,826	34,719
Aug-11	-	12,047	21,769	33,816
Sep-11	20	6,057	21,435	27,512
Oct-11	662	1,442	22,398	24,502
Nov-11	2,705	45	22,308	25,057
Dec-11	5,627	-	23,134	28,762

Figure 40: Estimates of KS Medium General Service Monthly Cooling, Heating, and Base

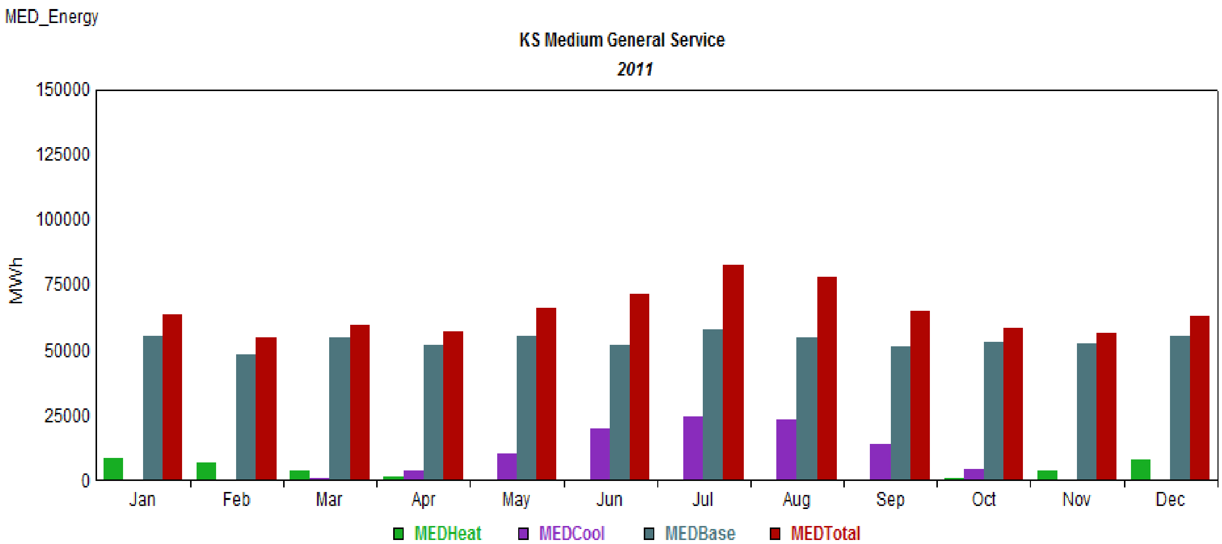


Table 65: Data Table of KS Medium General Service Monthly Cooling, Heating, and Base

Date	MEDHeat	MEDCool	MEDBase	MEDTotal
Jan-11	8,411	-	55,577	63,989
Feb-11	6,495	-	48,010	54,504
Mar-11	3,765	866	54,854	59,486
Apr-11	1,160	3,774	52,129	57,063
May-11	58	10,495	55,446	66,000
Jun-11	-	19,483	51,862	71,345
Jul-11	-	24,645	57,817	82,462
Aug-11	-	23,347	54,855	78,201
Sep-11	27	13,581	51,223	64,831
Oct-11	892	4,512	53,026	58,430
Nov-11	3,643	475	52,624	56,742
Dec-11	7,580	-	55,545	63,126

Figure 41: Estimates of KS Large General Service Monthly Cooling, Heating, and Base

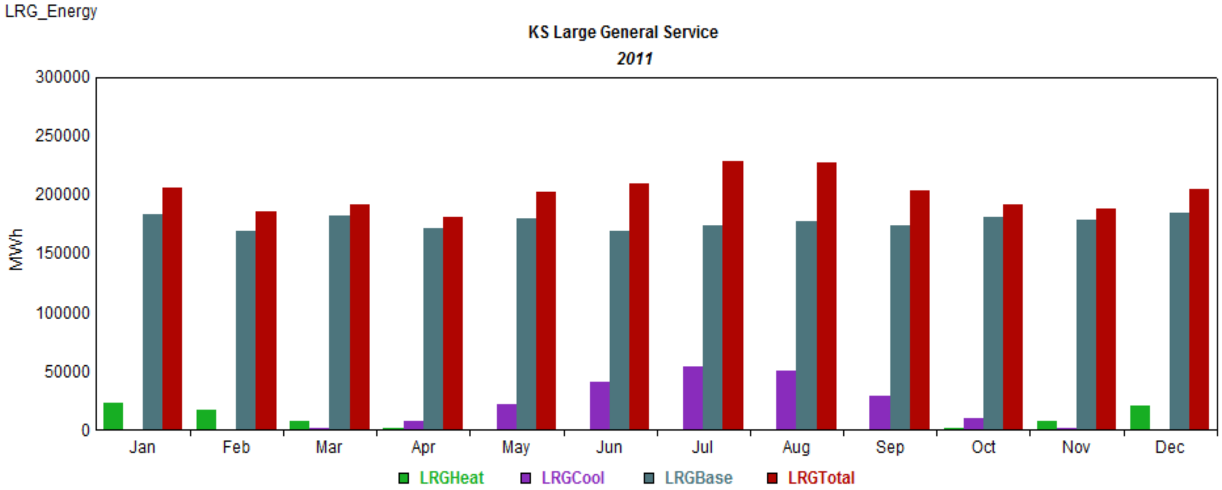


Table 66: Data Table of KS Large General Service Monthly Cooling, Heating, and Base

Date	LRGHeat	LRGCool	LRGBase	LRGTotal
Jan-11	22,470	-	182,741	205,212
Feb-11	16,651	-	168,721	185,373
Mar-11	7,933	1,689	181,989	191,611
Apr-11	1,691	7,623	171,516	180,829
May-11	-	21,916	179,766	201,682
Jun-11	-	41,148	168,365	209,514
Jul-11	-	53,942	173,856	227,798
Aug-11	-	50,155	177,472	227,627
Sep-11	-	28,818	174,069	202,887
Oct-11	1,184	9,418	180,294	190,896
Nov-11	7,989	978	178,969	187,936
Dec-11	19,965	-	184,637	204,602

Figure 42: Estimates of KS Large Power Monthly Cooling, Heating, and Base

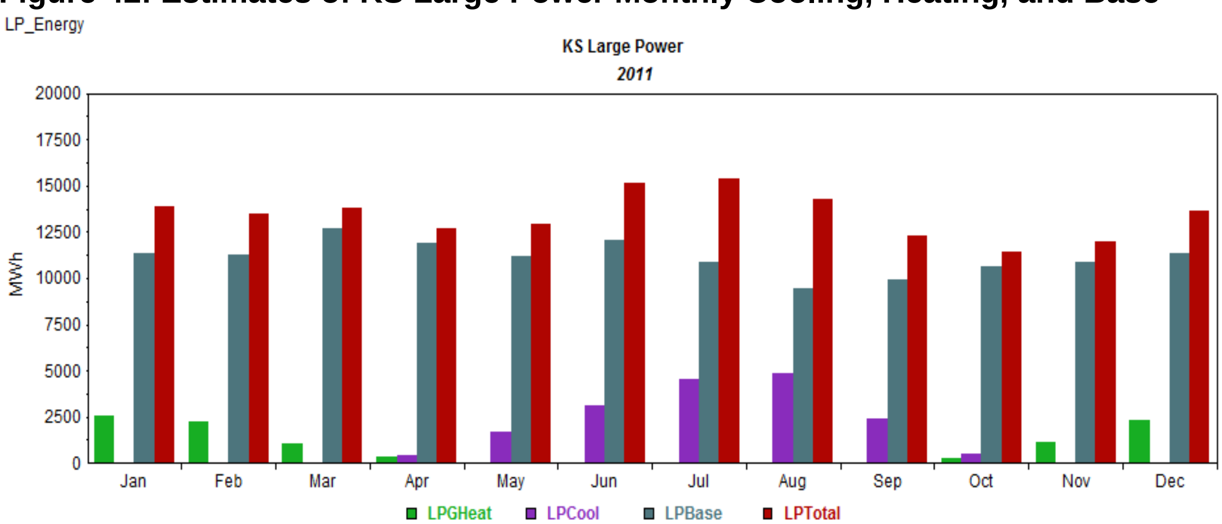


Table 67: Data Table of KS Large Power Monthly Cooling, Heating, and Base

Date	LPGHeat	LPCool	LPBase	LPTotal
Jan-11	2,572	-	11,318	13,890
Feb-11	2,223	-	11,254	13,476
Mar-11	1,034	44	12,694	13,772
Apr-11	354	444	11,911	12,709
May-11	20	1,677	11,200	12,897
Jun-11	-	3,097	12,052	15,150
Jul-11	-	4,506	10,843	15,349
Aug-11	-	4,880	9,421	14,301
Sep-11	8	2,374	9,884	12,266
Oct-11	273	531	10,646	11,450
Nov-11	1,108	15	10,852	11,975
Dec-11	2,299	-	11,348	13,648

Figure 43: Other KS Load (SFR & Lighting)

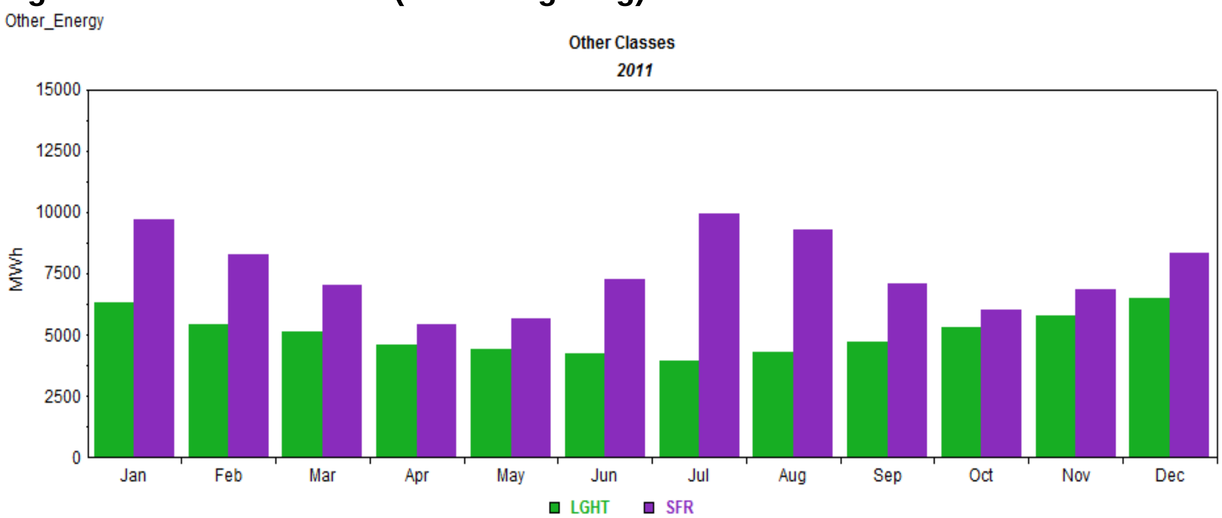


Table 68: Data Table Other KS Load (SFR & Lighting)

Date	LGHT	SFR
Jan-11	6,302	9,669
Feb-11	5,409	8,251
Mar-11	5,109	7,022
Apr-11	4,571	5,424
May-11	4,396	5,628
Jun-11	4,233	7,232
Jul-11	3,931	9,943
Aug-11	4,317	9,280
Sep-11	4,703	7,100
Oct-11	5,296	6,028
Nov-11	5,783	6,816
Dec-11	6,477	8,304

7.1.5 DESCRIBE AND DOCUMENT MODIFICATION OF MODELS

5. Where judgment has been applied to modify the results of its energy and peak forecast models, the utility shall describe and document the factors which caused the modification and how those factors were quantified.

The results of all models were used as is except to calibrate the system peak forecast to the weather normalized 2011 peak in each jurisdiction.

The first step is the weather normalization of the jurisdictional hourly load data. After normalizing the hourly loads, the demand side management, mpower and dynamic voltage control reductions at the time of peak are determined. This reduction in load is then added back to the weather normalized data to produce weather normalized monthly gross peaks. The base year weather normalized annual peak is then used to calibrate the jurisdictional peaks that are produced in MetrixLT. This is done by taking the base year normalized peak and using it as the first data point in the calibration process and then applying the annual growth rates from the peak forecast produced in MetrixLT. Then the annual peak is distributed across the months based on the percentage of that month's peak as percent to the annual peak. The percent of each month's contribution to the annual peaks is determined by the output of monthly peaks from MetrixLT. After each jurisdiction has been calibrated, the monthly peaks are then imported back in to MetrixLT and each hour for the peak day is adjusted to reflect the new calibrated peak.

The calibration of the peaks can be found in the jurisdictional system datalyzer folder which is provided in the work papers.

7.1.6 PLOTS OF CLASS MONTHLY ENERGY AND COINCIDENT PEAK DEMAND

6. For each major class specified pursuant to subsection (2)(A), the utility shall provide plots of class monthly energy and coincident peak demand at the time of summer and winter system peaks. The plots shall cover the historical database period and the forecast period of at least twenty (20) years. The plots of coincident peak demands for the historical period shall include both actual and weather-

normalized peak demands at the time of summer and winter system peaks. The plots of coincident peak demand for the forecast period shall show the class coincident demands for the base-case forecast at the time of summer and winter system peaks.

Plots for class monthly energy and coincident peak demand at the time of summer and winter system loads are provided in *Appendix 3B*. Energy plots by jurisdiction and system are provided in the file *IRP_7.1.6_KCPL_MWh.xlsx* and peak plots are in the file *IRP_7.1.6_KCPL_Peaks.xlsx*.

7.1.7 PLOTS OF NET SYSTEM LOAD PROFILES

7. The utility shall provide plots of the net system load profiles for the summer peak day and the winter peak day showing the contribution of each major class. The plots shall be provided in the triennial filing for the base year of the forecast and for the fifth, tenth, and twentieth years of the forecast. Plots for all years shall be included in the workpapers supplied at the time of the triennial filing.

The figures below show the load profiles for the base, fifth, tenth, and twentieth years broken out by summer and winter peak days for each major class in Missouri, Kansas and for the system. The plots with data tables are provided in *Appendix 3C*. Plots for additional years can be found in the MetrixLT files (*MO_Fcst*, *KS_Fcst*, and *System*) included in the workpapers.

Figure 44: Base Year (2011) Net System Load Profiles for MO, KS, and System

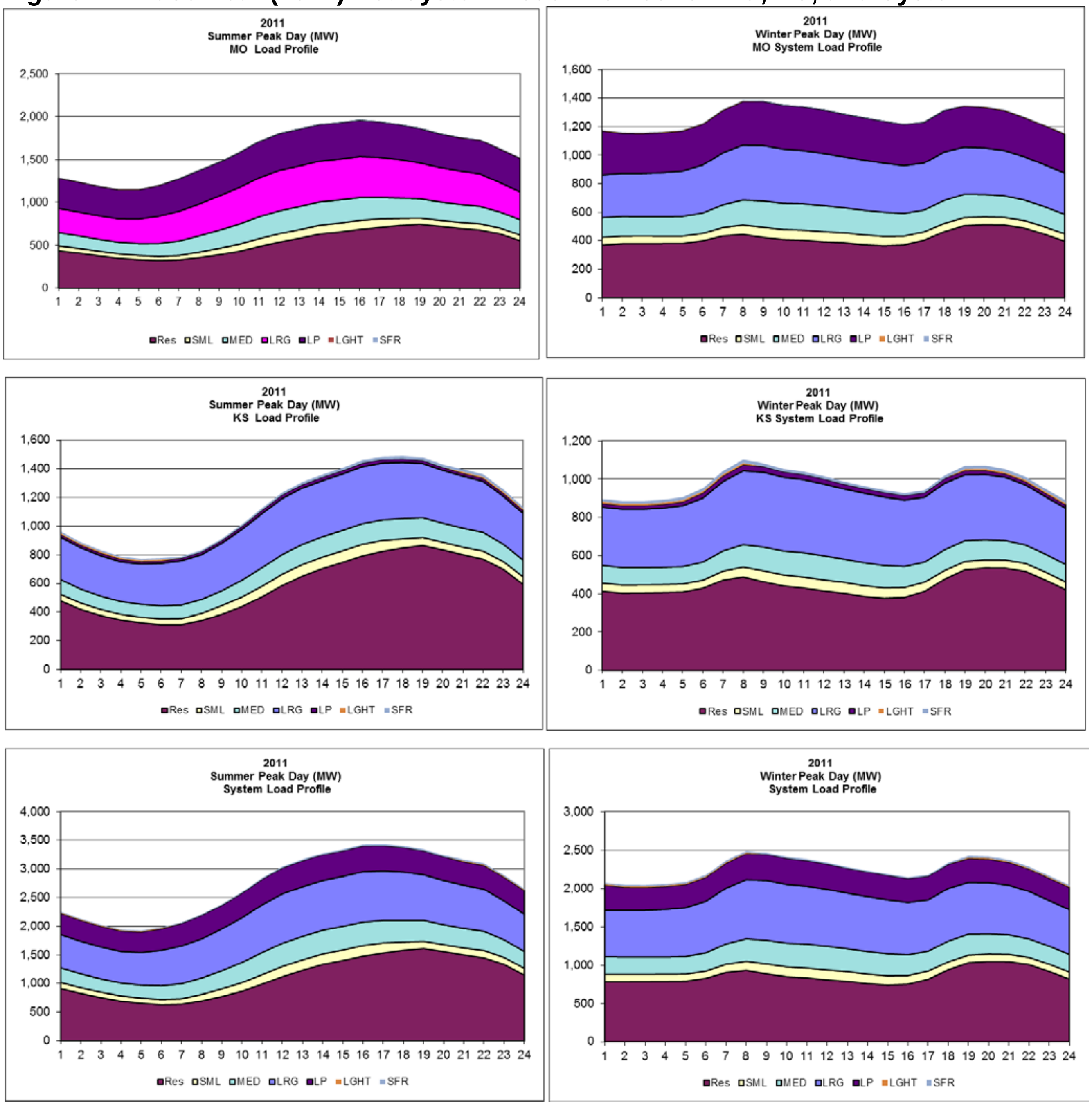


Figure 45: Fifth Year (2016) Net System Load Profiles for MO, KS, and System

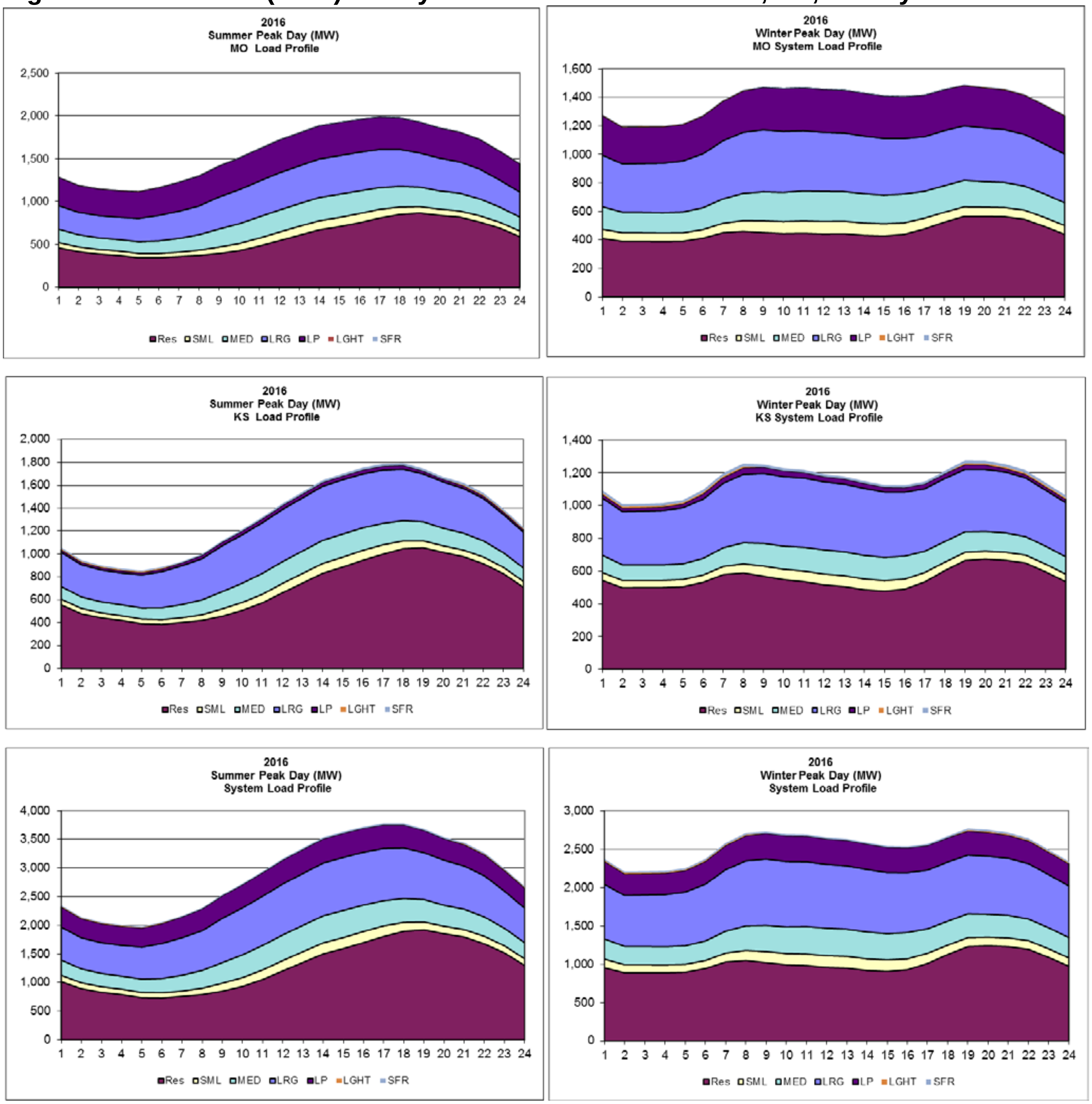


Figure 46: Tenth Year (2021) Net System Load Profiles for MO, KS, and System

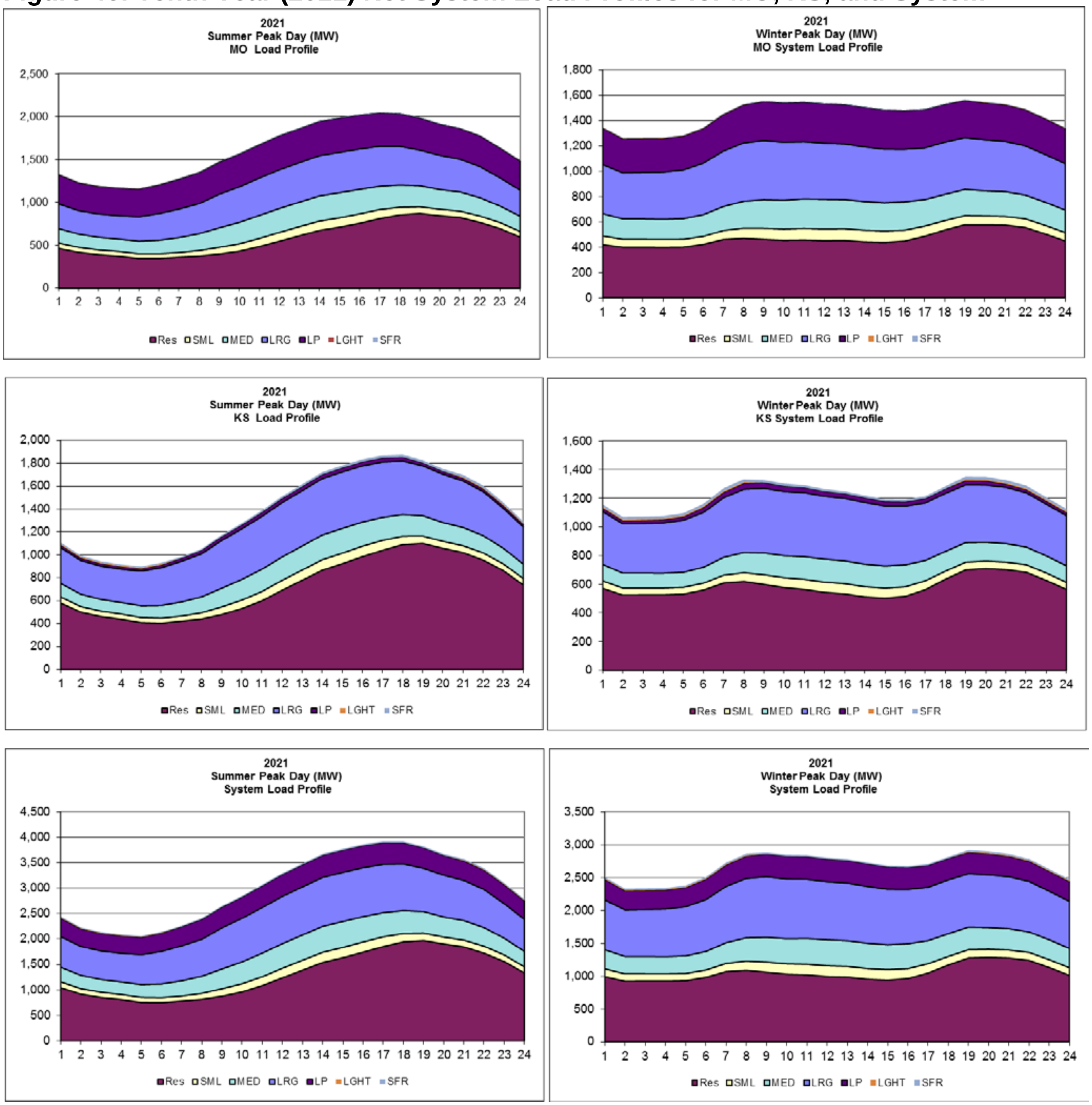
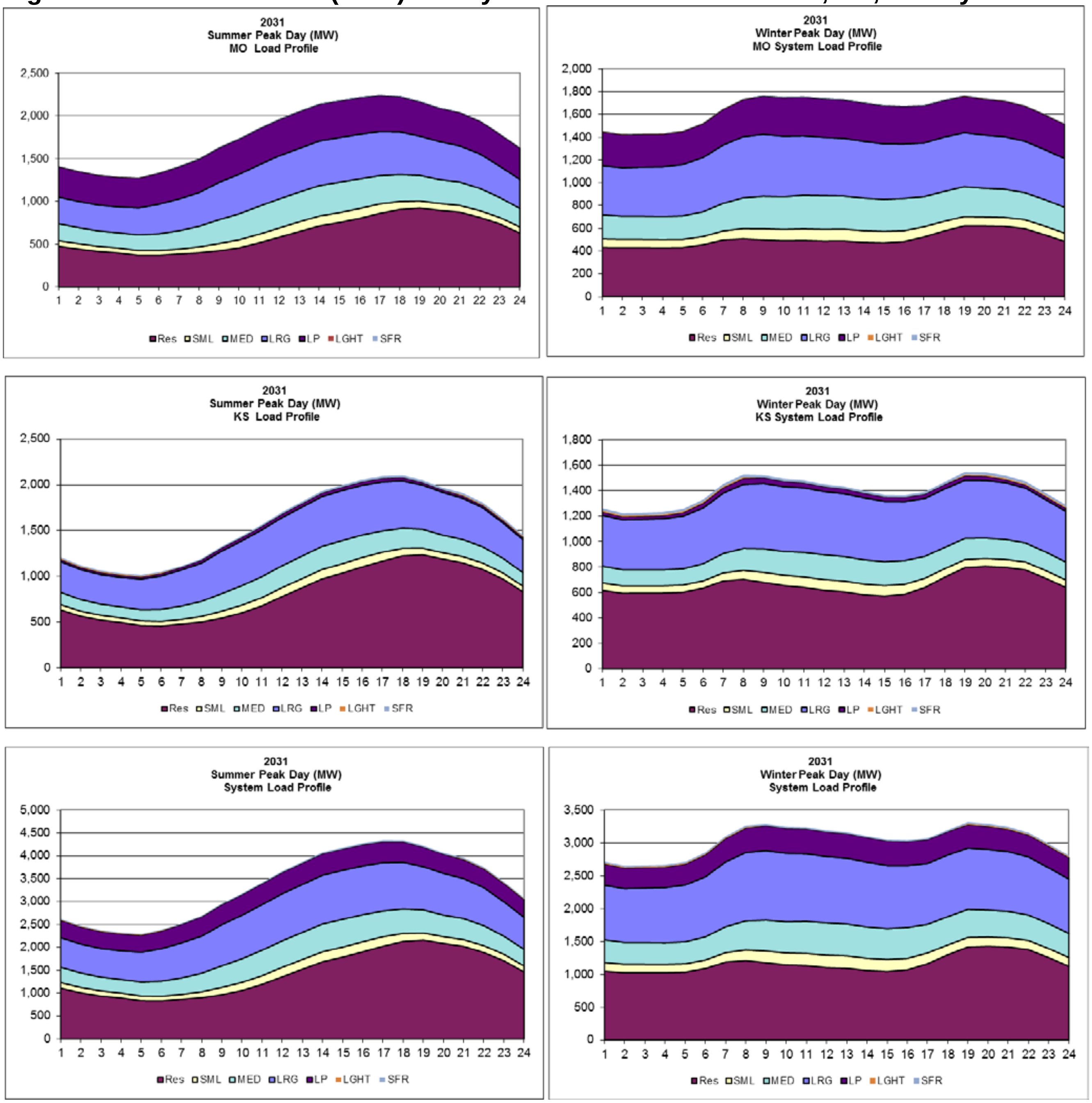


Figure 47: Twentieth Year (2031) Net System Load Profiles for MO, KS, and System



7.2 <u>DESCRIBE AND DOCUMENT FORECASTS OF INDEPENDENT VARIABLES</u>

(B) Forecasts of Independent Variables.

The forecasts of independent variables shall be specified, described, and documented.

The forecasts of independent variables were described above in the section for rule 6.C.3 and below in the section for rule for 7.B.3.

7.2.1 DOCUMENTATION OF MATHEMATICAL MODELS

1. Documentation of mathematical models developed by the utility to forecast the independent variables shall include the reasons the utility selected the models as well as specification of the functional form of the equations.

KCP&L acquired forecasts of independent variables from Moody's and DOE as described previously. KCP&L developed its own models to forecast the saturation of electric space heating for residential and commercial customers (*SpaceHeating.xls*). KCP&L has discounted tariffs for customers that have electric space heating and the percentage of customers on these tariffs is used as a measure of electric space heating saturations. The models predict both the penetration rate of electric space heating for new customers and the percentage rate of conversion to electric space heating for customers that use natural gas or propane to heat their homes. These rates are driven by the difference in costs to heat a home by electricity and natural gas. These costs are determined by the average natural gas rates for local gas utilities, KCP&L's winter tail-block rates and heating equipment efficiency rates.

The real price differential per million Btu is computed as

$$PD = (1{,}000{,}000/1{,}028{,}000/\text{Gas Furnace Efficiency}*\text{Gas rate} - 1{,}000{,}000/(\text{Heat pump Efficiency}*1{,}000)*\text{Electric tail block rate})*CPI_{2004}/CPI_t$$

The heat pump efficiency is Btu out per Watt hour in.

The equation to predict the number of additional customers using electric space heating is

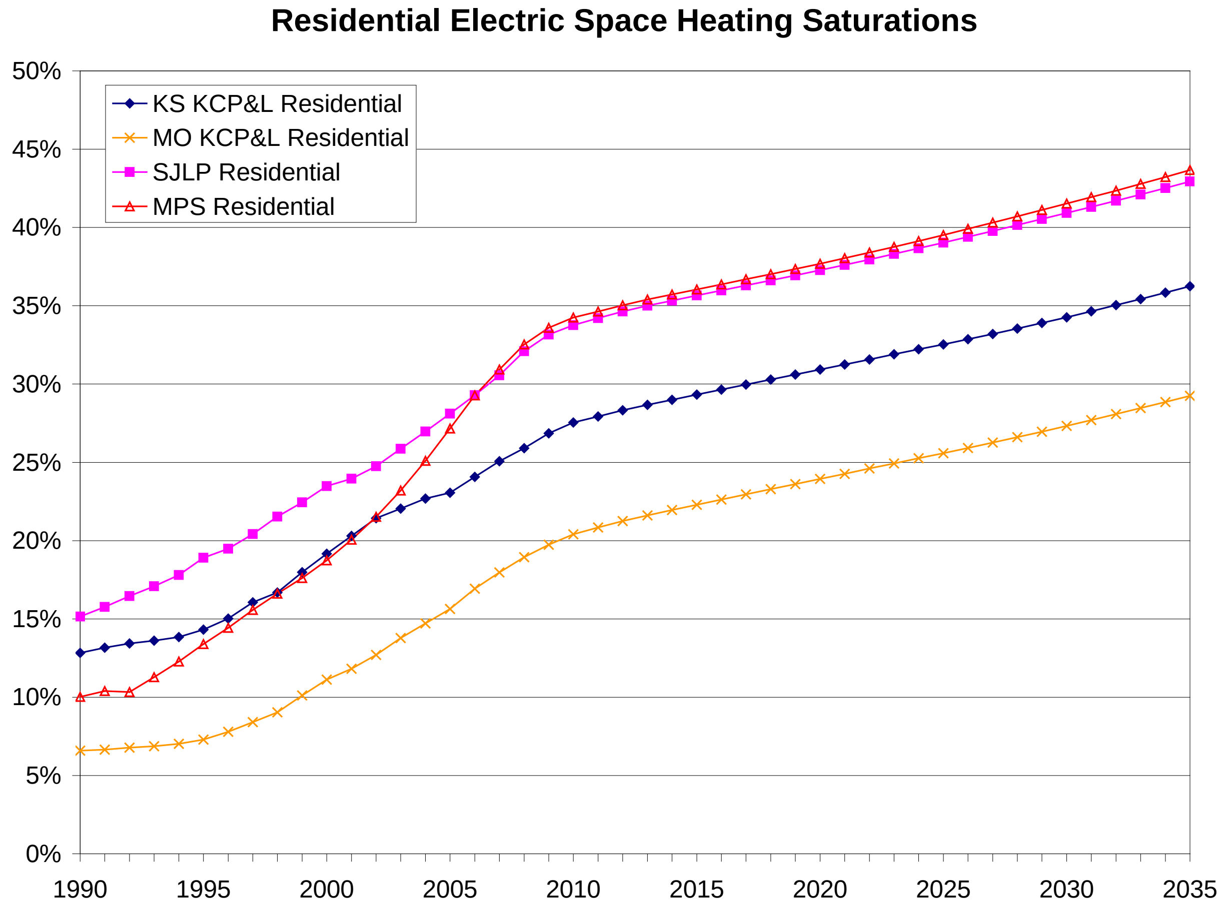
$$\text{New customers}/(1+EXP(-\text{newCust}*PD-C_1))+$$
$$\text{customers wo electric heat}/(1+EXP(-\text{conversions}*PD+C_2+\text{incentive}*\text{tax credit}))$$

where tax credit = federal tax credits and KCP&L rebates available, newCust, conversions, incentive, C_1, C_2 are coefficients.

The coefficients were estimated with least squares regression pooling the data for Kansas and Missouri. Equations were estimated separately for residential and commercial customers.

The forecasts for KCP&L and GMO are compared in the figure below.

Figure 48: Residential Space Heating Saturations



7.2.2 DOCUMENTATION OF ADOPTED FORECASTS DEVELOPED BY ANOTHER ENTITY

2. If the utility adopted forecasts of independent variables developed by another entity, documentation shall include the reasons the utility selected those forecasts, an analysis showing that the forecasts are applicable to the utility's service

territory, and, if available, a specification of the functional form of the equations used to forecast the independent variables.

KCP&L used a forecast of economic and demographic variables for the KC metro area that was developed by Moody's Analytics. The reasons for using this forecast, the applicability to KCP&L's service area and documentation for the forecast were discussed in the sections for rules 3 A and 6 A 3.

KCP&L used forecasts of saturations, UECs, EUIs and building efficiencies from DOE. The reasons for using these forecasts, the applicability to KCP&L's service area and documentation for the forecast were discussed in the sections for rules 3 A, 4 A 1 B, 5 A, 5 B AND 6 A 3.

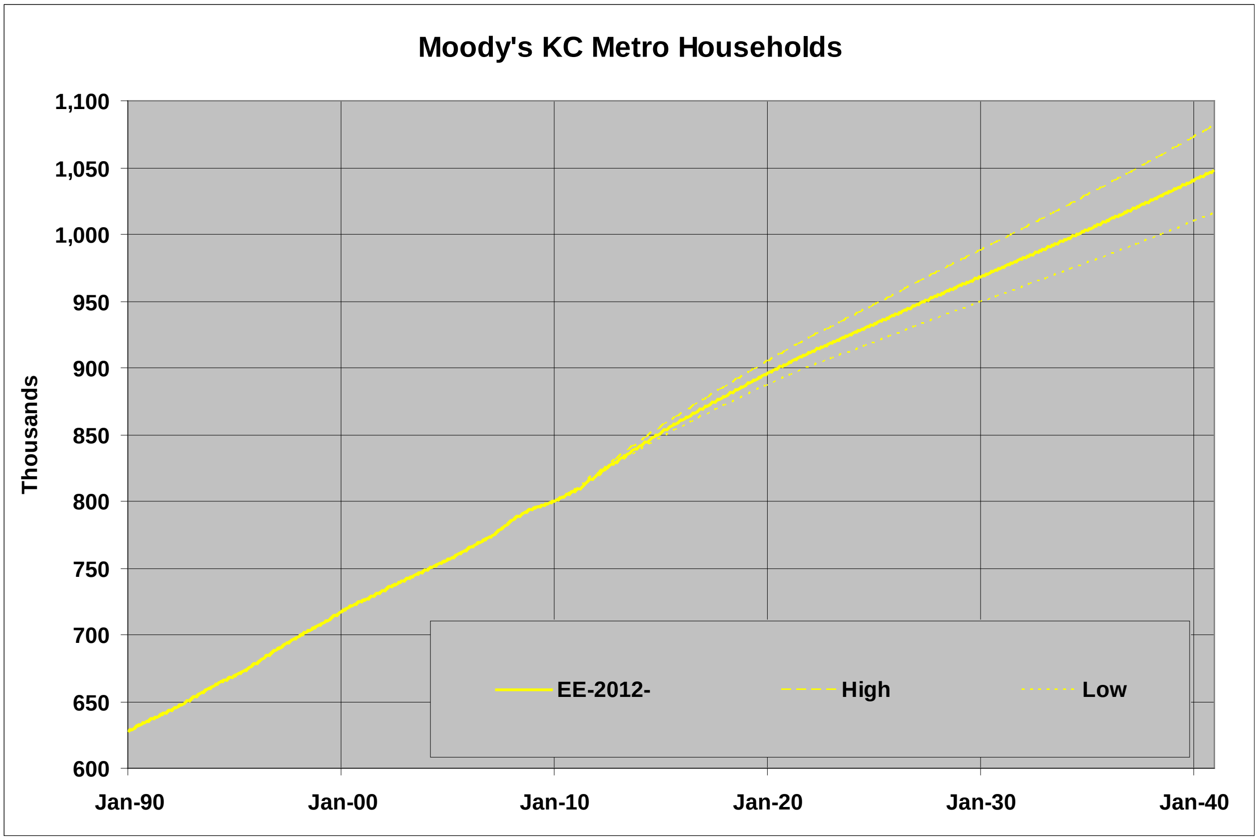
7.2.3 COMPARISON OF FORECAST FROM INDEPENDENT VARIABLES TO HISTORICAL TRENDS

3. These forecasts of independent variables shall be compared to historical trends in the variables, and significant differences between the forecasts and long-term and recent trends shall be analyzed and explained.

Table 69 Growth Rates for KC Metro Area

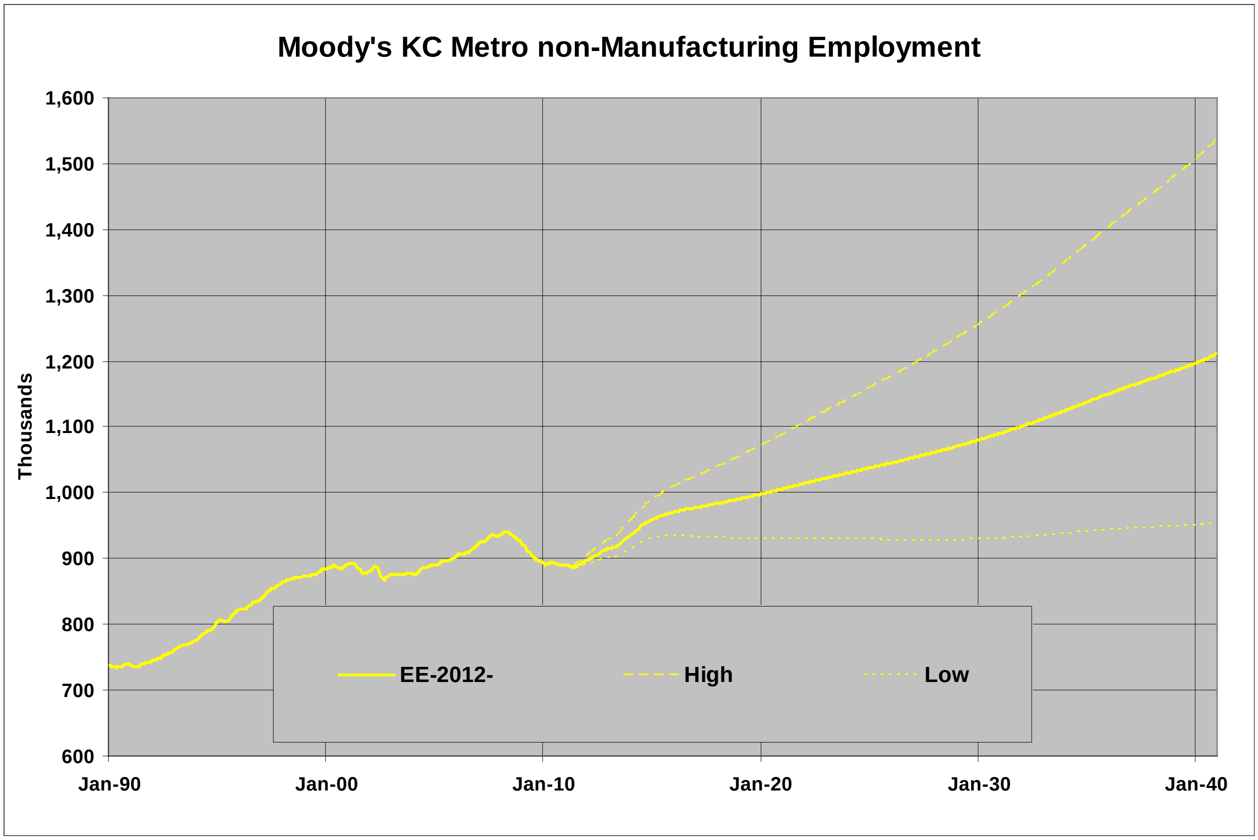
	Households	Employment Non-Manufacturing	Employment Manufacturing	Gross Product Non-Manufacturing	Gross Product Manufacturing
1990-2000	1.3%	1.9%	0.3%	3.0%	3.2%
2000-2010	1.1%	0.0%	-2.4%	1.3%	0.0%
2010-2020	1.1%	1.2%	0.9%	2.2%	3.4%
2020-2030	0.8%	0.8%	0.1%	2.1%	3.0%

Figure 49: Households



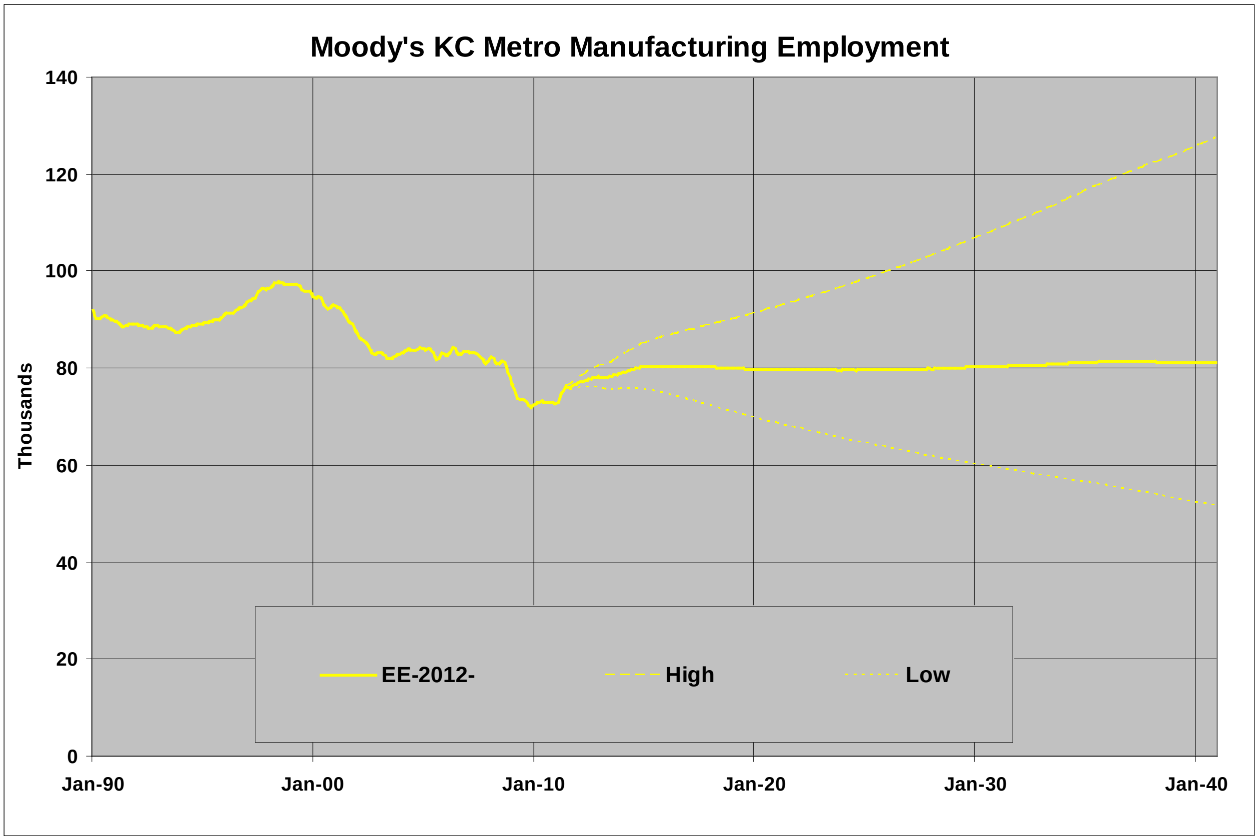
The household data and projection shows robust growth from 1990 until the beginning of the last recession at the end of 2007, at which time growth slowed substantially. The forecast is for the housing stock to growth rapidly again after the current period of low U.S. economic growth to allow the housing stock to catch up with demographic growth. Then growth slows to a level lower than what we have seen in the last two decades.

Figure 50: Employment Non-Manufacturing



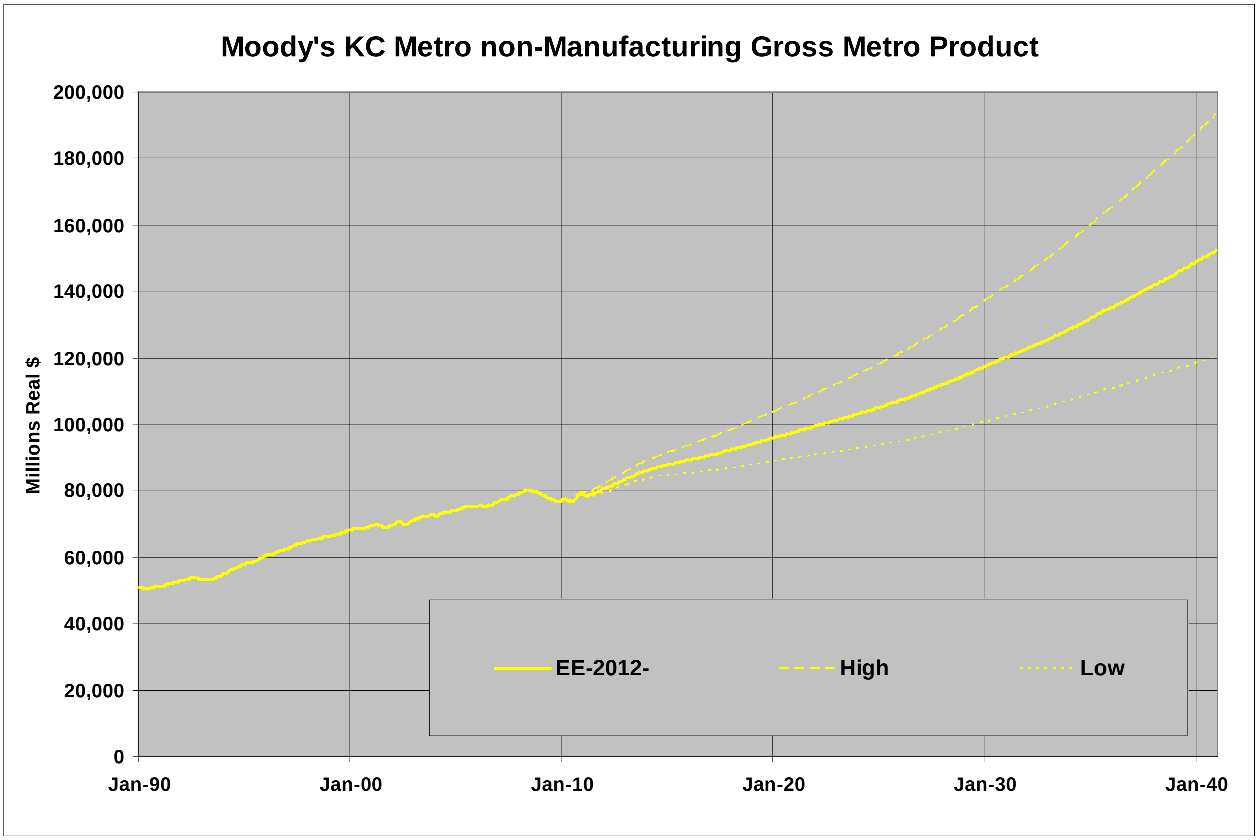
Non-manufacturing showed very strong growth in the 1990s, 1.9% per year, then stalled after the 2001 recession, picked up strongly in 2004 and then turned negative during the last recession. Moody's expects growth to rebound strongly after the current slump and then hold at about 1% after that.

Figure 51: Employment Manufacturing



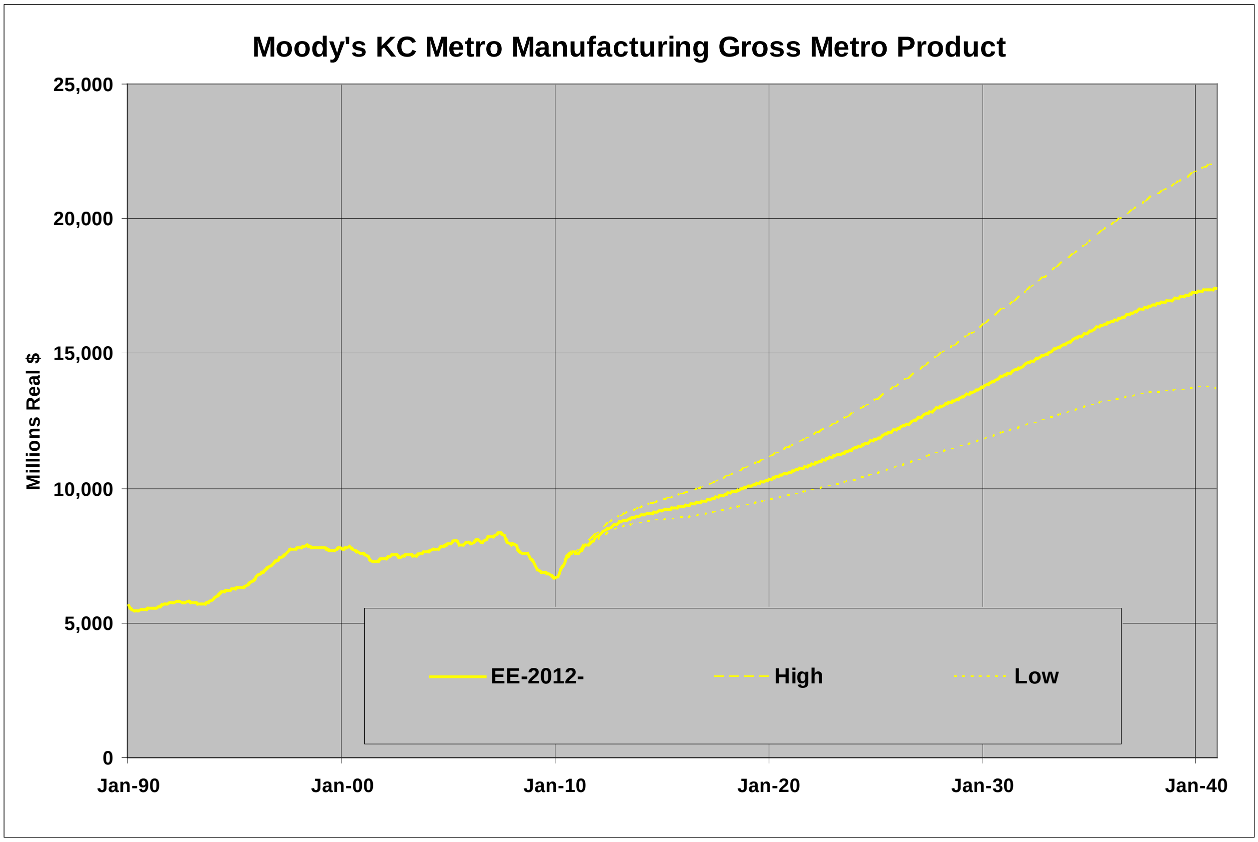
Manufacturing employment peaked in the late 1990s and has fallen since. It fell precipitously between 1999 and 2003 and again during the last recession. Moody's expects flat growth after we bounce back from the current economic slump.

Figure 52: Gross Metro Product Non-Manufacturing



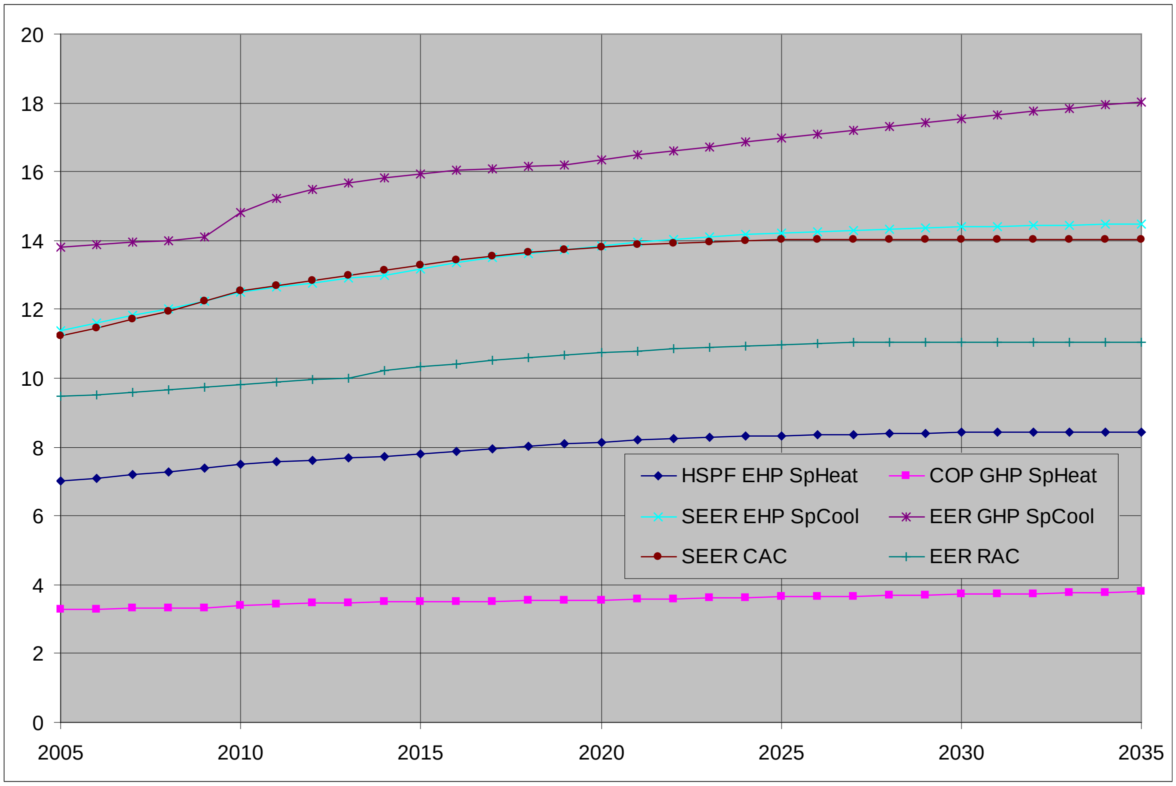
Real non-manufacturing gross metro product grew 3% per year during the 1990s, slowed down a bit after that and then declined during the last recession. GMP is growing faster than employment because of increasing productivity, a trend seen nationally and across many service sectors. Moody's expects above trend growth coming out of the current slump and then trend growth after that.

Figure 53: Gross Metro Product Manufacturing



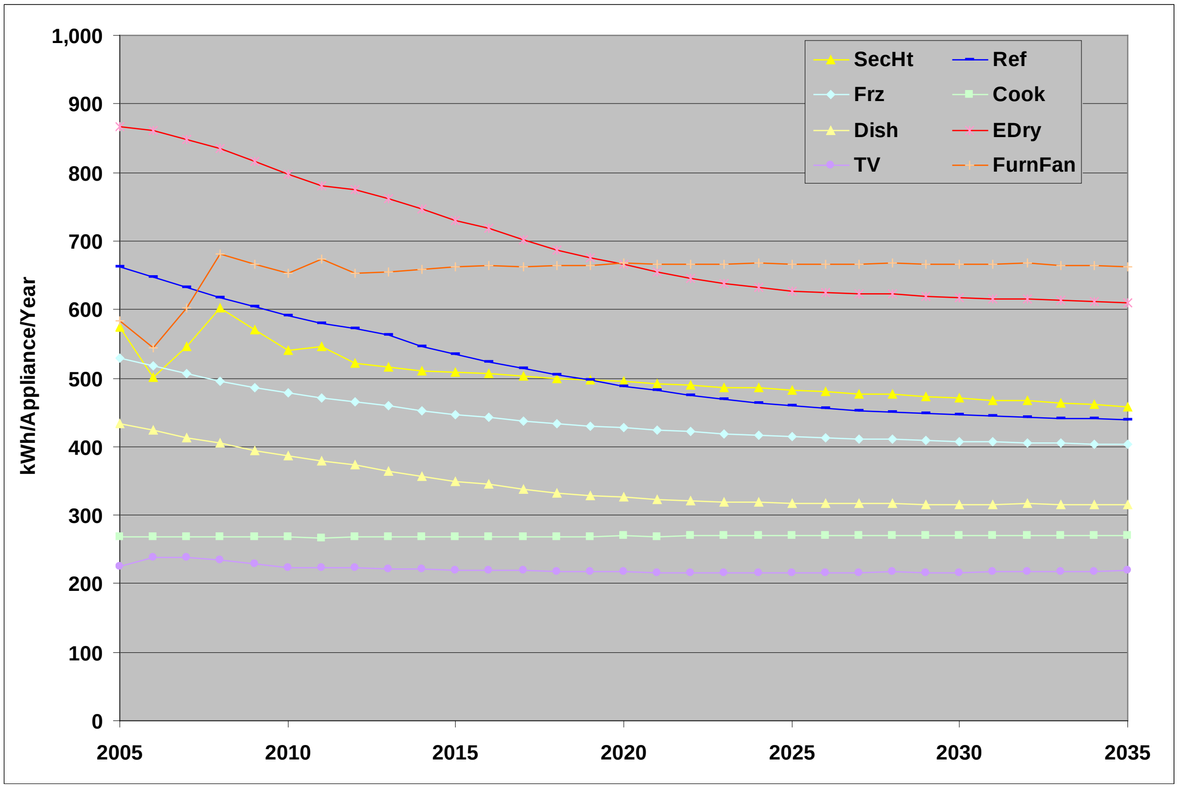
Real gross metro product from the manufacturing sector grew strongly during the 1990s and then fell flat until it plunged during the last recession. Moody's expects rebound growth coming out of the current economic slump and then trend growth after that. GMP for this sector is growing while employment is flat or declining because of increasing productivity and because more labor intensive industries tend to move overseas where there is lower cost labor.

Figure 54: DOE Stock Average Appliance Efficiency Projections



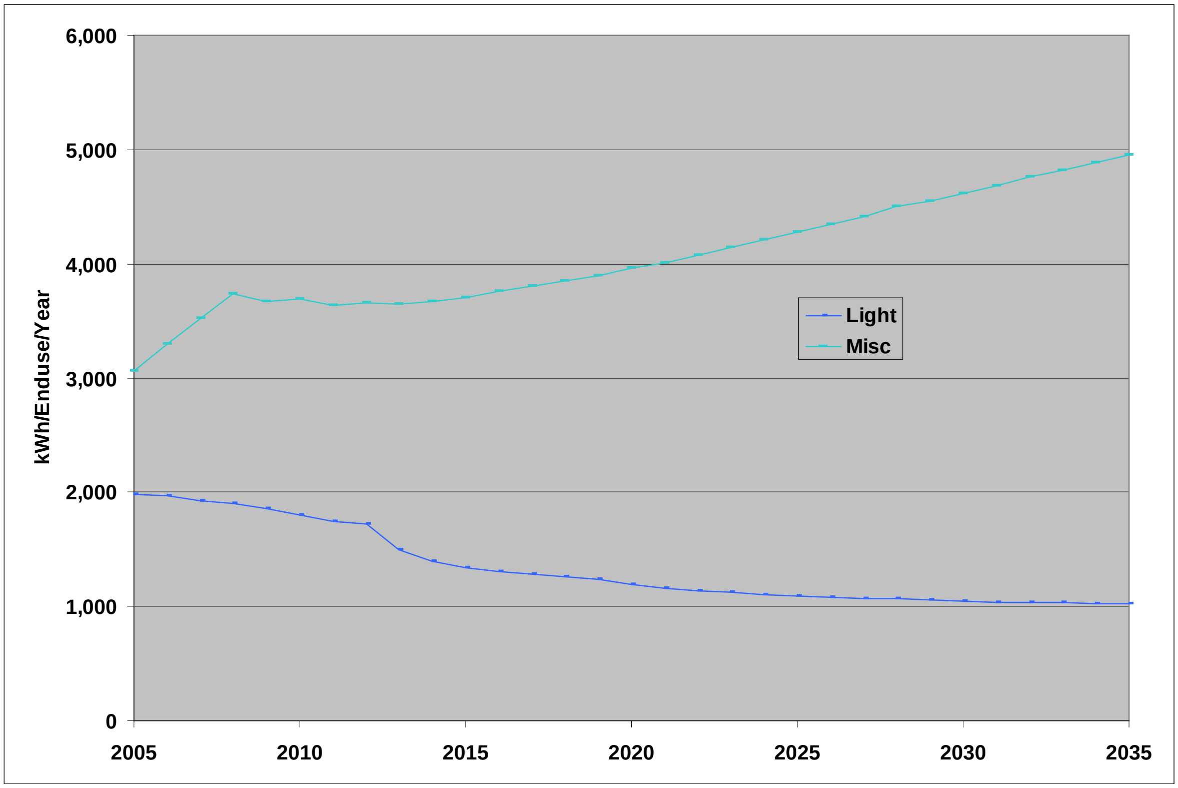
DOE is expecting increases in the stock average appliance efficiencies for residential heating and cooling equipment. This is resulting from appliance standards. In January 2006 a new standard raised the SEER standard by 30 percent for central air conditioners. This standard impacts the stock average efficiency both from new construction and when units are replaced.

Figure 55: DOE UEC Projections (<1000 kWh/year)



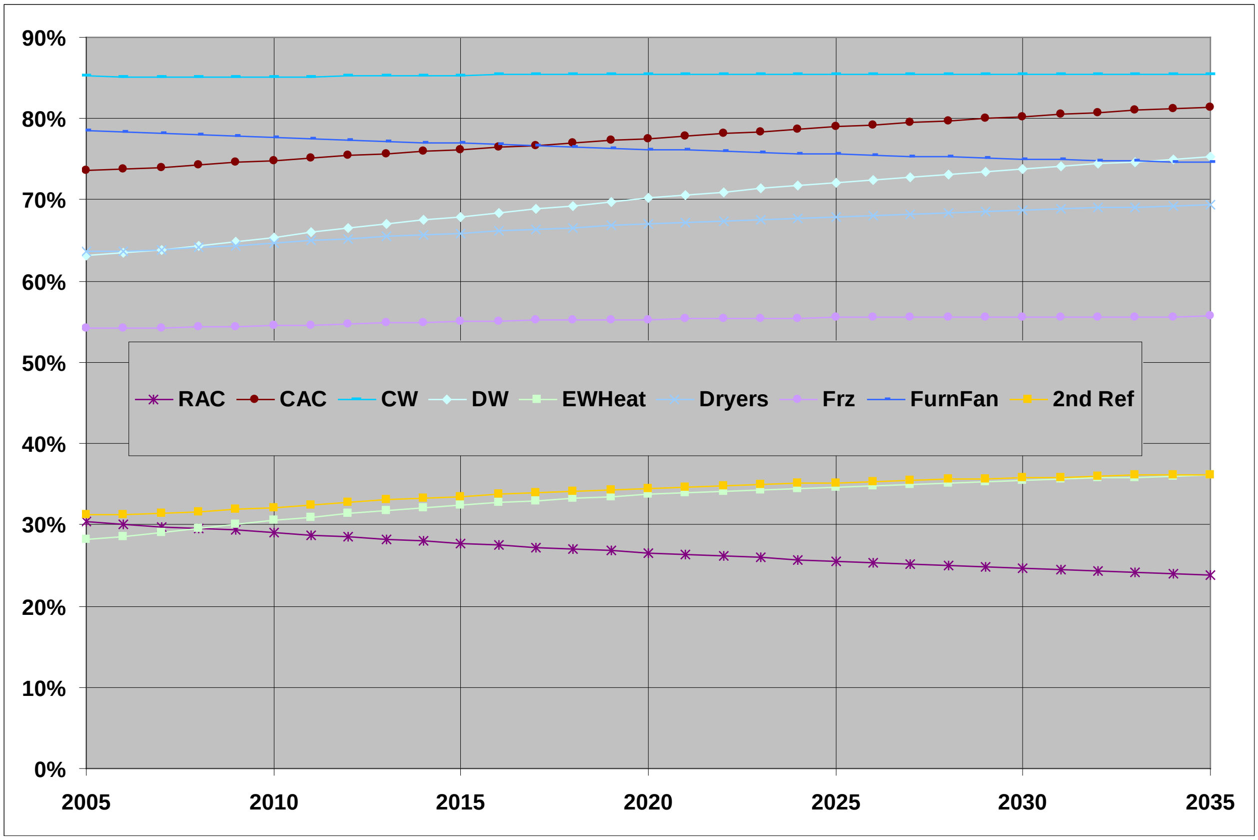
UECs are expected to decline substantially for electric clothes dryers, refrigerators, electric cooking and dishwashers due to appliance efficiency standards.

Figure 56: DOE UEC Projections (>1000 kWh/year)



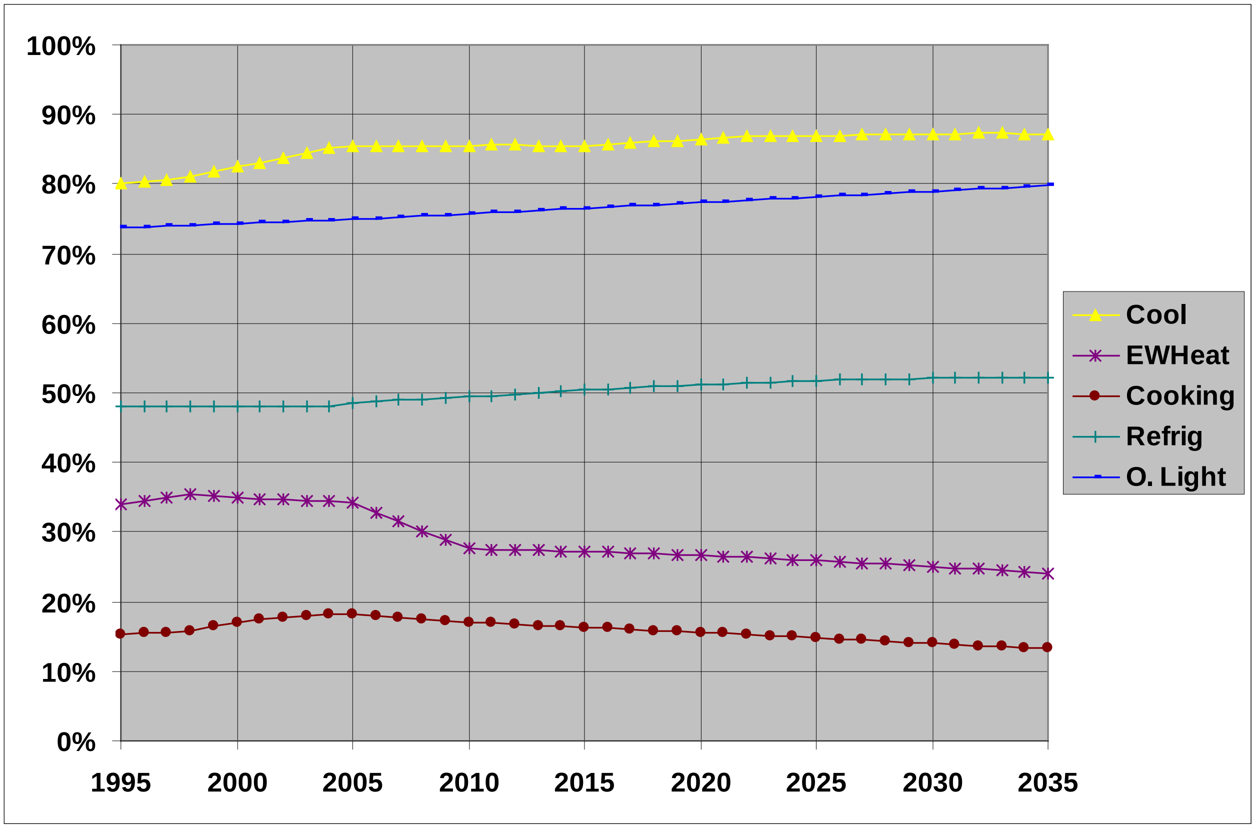
The UEC for lighting is declining because of the increasing sales of CFLs and is expected to decline even more rapidly beginning in 2012 due to a new standard for light bulbs.

Figure 57: DOE Electric Appliance Saturation Projections (< 100%)



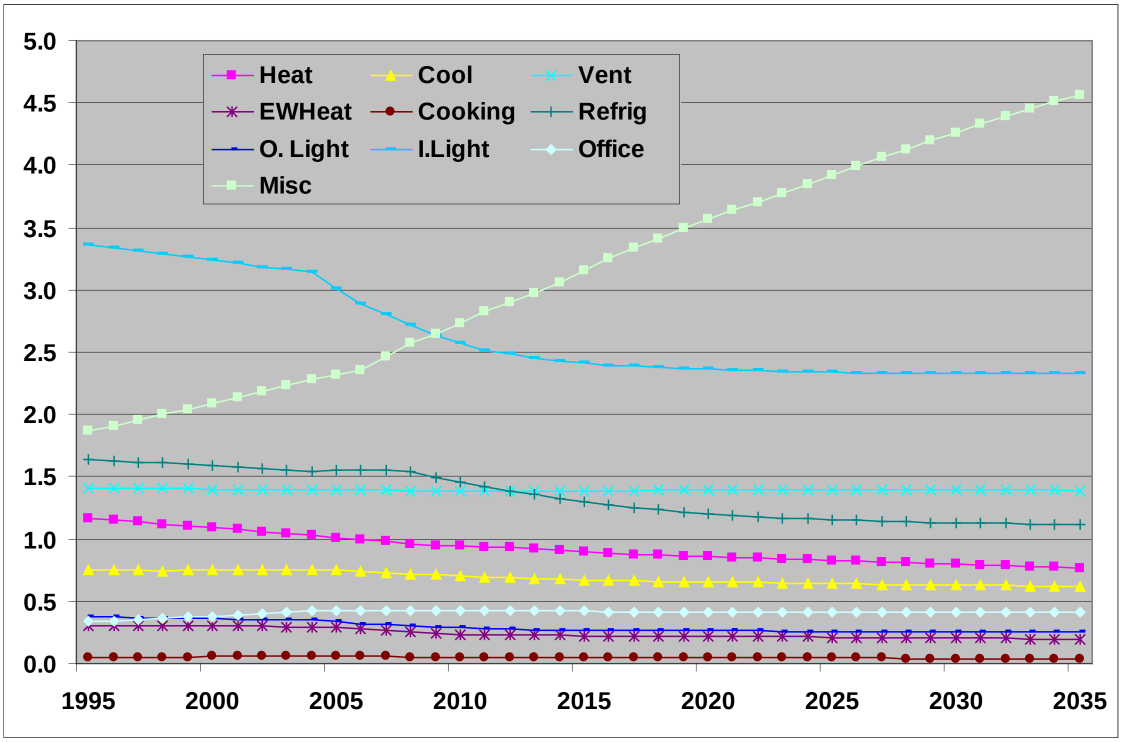
DOE saturation projections shown above are in line with recent historical trends.

Figure 58: DOE Equipment Saturation Projections (Average over all Commercial Building Types)



DOE commercial sector saturations are mostly in line with trends in recent historical data. The saturation of electric water heating dropped from about 34% in 2004 to 28% in 2010 perhaps because natural gas prices have fallen precipitously. Electric cooking saturations are also falling.

Figure 59 DOE EUI Projections
(Average over all Commercial Building Types)



DOE estimates of the EUI for lighting has been declining since 1995 and started falling more rapidly in 2005, probably because of the use of CFLs, especially for lodging and in recessed fixtures in offices. The refrigeration EUI has been declining historically and started a more rapid decline in 2009, which continues with the projection. New standards for commercial refrigeration equipment went into effect at the beginning of 2010.[viii] The heating EUI is declining and expected to further decline. A new standard for commercial heating and cooling equipment became effective in April 2007 and November 2004.[ix] The EUI for miscellaneous equipment has been rising rapidly and is expected to continue that trend.

7.2.4 SPECIFICATION AND QUANTIFICATION OF FACTORS

4. Where judgment has been applied to modify the results of a statistical or mathematical model, the utility shall specify the factors which caused the modification and shall explain how those factors were quantified.

KCP&L used the forecasts of economic and demographic variables as is from Moody's Analytics.

The projections of appliance saturations from DOE were calibrated to the results of our Residential Appliance Saturation.

7.3 NET SYSTEM LOAD FORECAST

(C) Net System Load Forecast. The utility shall produce a forecast of net system load profiles for each year of the planning horizon. The net system load forecast shall be consistent with the utility's forecasts of monthly energy and peak demands at time of summer and winter system peaks for each major class.

KCP&L has produced an hourly forecast for each major class and the sum of these forecasts is the hourly forecast of NSI.

SECTION 8: LOAD FORECAST SENSITIVITY ANALYSIS

(8) Load Forecast Sensitivity Analysis.

The utility shall describe and document its analysis of the sensitivity of the dependent variables of the base-case forecast for each major class to variations in the independent variables identified in subsection 4 CSR 240-22.030(8).

To perform a sensitivity analysis, we are using a method that was suggested by the Missouri Public Service Commission Staff for KCPL's IRP. For each customer class, mwh sales were regressed on important driver variables and degree days and the standardized variables are used to show the relative importance of each explanatory variable. We also show the elasticity for each driver variable as measured by the statistical regression. The sensitivity analysis was first run using the class cost of service groups. Unfortunately, there was not enough data to obtain statically significant results since this data was available only from 2005. The analysis was repeated using revenue classes, residential, commercial and industrial with monthly data available from 1990 to 2011.

Table 70 displays the results for MO residential customers. Among the driving variables, the number of cooling degree days times the number of households has the largest standardized coefficient, followed by the number of heating degree days also multiplied by the number of customers. Heating degree days times the number of customers times a trend was the third most important variable because the rising saturation of electric space heating has hugely increased winter sales. The inflation adjusted real price of electricity times the number of customers was highly statistically significant and has a t-statistic of -8.4. The price of electricity was multiplied by the number of customers because the magnitude of the price impact on kWh sales would be expected to rise proportionally to the number of customers. The elasticity for this variable was -0.27. The variable hddPriceRatio is heating degree days with a base temperature of 55 degrees times the number of customers times the price of natural gas for MGE's residential customers divided by the price of electricity. The purpose of this variable is to measure the impact of gas and electric prices on electric space heating loads. The variable had the expected sign, but was not significant. The variable DAYS is the number of billing days averaged over each billing cycle. The regression periods used for these regressions are monthly from January 1990 to October 2011.

Table 70 Missouri Residential

VARIABLE	Standardized Coefficient	t-Statistic	Elasticity
DAYS	4,223,218	8.7	
Total_Households	3,246,500	3.9	0.25
PrElecCus	-8,524,875	-8.4	-0.27
hddPriceRatio	2,075,823	0.8	0.01
resCusCDD65	66,000,865	48.7	
resCusHdd55	38,594,165	10.8	
hddTrend	15,199,733	7.8	
cddTrend	1,240,428	0.9	

Table 71 provides the results for Missouri commercial customers. As for residential customers, the two variables with the largest standardized coefficients were heating and cooling degree days. Several economic drivers were tested and the number of households was more significant than non-manufacturing employment or GMP. The real price of electricity was highly significant with an elasticity of -0.18. The gas to electric price ratio was not significant.

Table 71 Missouri Commercial

VARIABLE	Standardized Coefficient	t-Statistic	Elasticity
DAYS	6,710,541	12.8	
Total_Households	9,509,541	10.2	0.43
prElecCus	-11,144,508	-11.5	-0.18
HDDpriceRatio	361,703	0.1	0.00
comCusCDD55	52,244,970	35.8	
comCusHdd55	28,819,717	7.3	
cddTrend	9,198,211	6.0	
HddTrend	12,875,984	5.7	
may1999jun	-3,679,645	-8.5	

Only three variables were significant for Missouri industrial customers, manufacturing employment, the price of electricity and cooling degree days. The electric price elasticity was -0.15.

Table 72 Missouri Industrial

VARIABLE	Standardized Coefficient	t-Statistic	Elasticity
Employment_Manufacturing	13,933,850	22.4	
prElecCus	-4,927,347	-3.2	-0.15
CDD55	6,320,383	5.9	0.04

Table 73 shows the results for residential customers in Kansas. The variables with the largest standardized coefficients are degree days followed by the number of customers. The electric price elasticity was -0.15 and the elasticity for the ratio of gas and electric prices for electric space heating was 0.03.

Table 73 Kansas Residential

VARIABLE	Standardized Coefficient	t-Statistic	Elasticity
DAYS	801,928	2.2	
resCus	14,763,953	11.9	0.63
PrElecCus	-3,917,433	-4.1	-0.15
hddPriceRatio	7,106,793	2.5	0.03
resCusCDD65	67,812,646	45.8	
resCusHdd55	35,823,262	10.6	
hddTrend	10,688,007	6.4	
cddTrend	246,583	0.2	

Table 74 shows the results for commercial customers in Kansas. The first and third largest coefficients are for degree day variables, with that for residential customers being the second largest. The residential customer variable was the most statistically significant economic driver that was tested in the model. Commercial growth in Johnson County Kansas is mostly driven by the need to service the local population. The electric price elasticity was -0.28.

Table 74 Kansas Commercial

VARIABLE	Standardized Coefficient	t-Statistic	Elasticity
DAYS	418,949	1.3	
resCus	26,386,242	26.6	1.03
prElecCus	-6,912,297	-11.0	-0.28
HDDpriceRatio	2,523,480	1.1	0.01
comCusCDD55	40,337,815	32.8	
comCusHdd55	19,972,192	7.3	
cddTrend	8,905,192	7.3	
HddTrend	9,199,998	6.7	

Table 63 reports the results of the sensitivity analysis for manufacturing customers in Kansas. The electric price elasticity is -0.9.

Table 75 Kansas Industrial

VARIABLE	Standardized Coefficient	t-Statistic	Elasticity
Employment_Manufacturing	62,929,163	1.4	
prElecCus	4,745,865	3.8	-0.09
indCusCDD55	-3,804,171	-2.3	0.07

8.1 TWO ADDITIONAL NORMAL WEATHER LOAD FORECASTS

(A) The utility shall produce at least two (2) additional normal weather load forecasts (a high-growth case and a low-growth case) that bracket the base-case load forecast. Subjective probabilities shall be assigned to each of the load forecast cases. These forecasts and associated subjective probabilities shall be used as inputs to the risk analysis required by 4 CSR 240-22.060.

KCP&L used two additional economic forecasts from Moody's Analytics to produce high-growth and low-growth load forecast scenarios. These additional scenarios represent economic growth one standard deviation above and below the base case forecast.

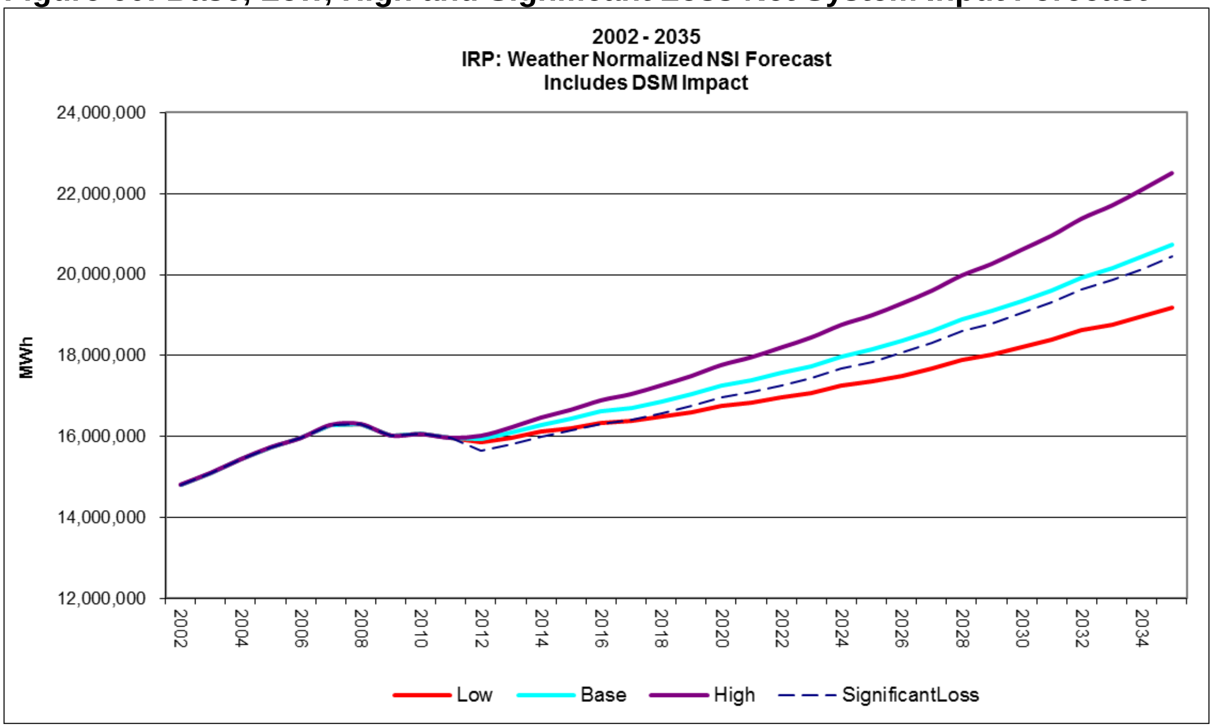
In addition to these two scenarios, KCP&L produced an additional scenario to comply with the Commission's on October 19, 2011, *ORDER ESTABLISHING SPECIAL CONTEMPORARY RESOURCE PLANNING ISSUES*:

> Investigate and document the impacts on KCP&L's preferred resource plan and contingency plans of a loss of significant load for the short term and potentially for the long term that may be the result of a prolonged double-dip recession or a large customer or group of customers no longer taking service from KCP&L.

KCP&L constructed this scenario by subtracting the energy and peak demand from the largest customer in both Kansas and Missouri from the results for the base case scenario. The most recent 12 billing records from each customer were used and the energy and peak from each month was used for that particular month in the forecast. Losses were added to the energy and peak demands.

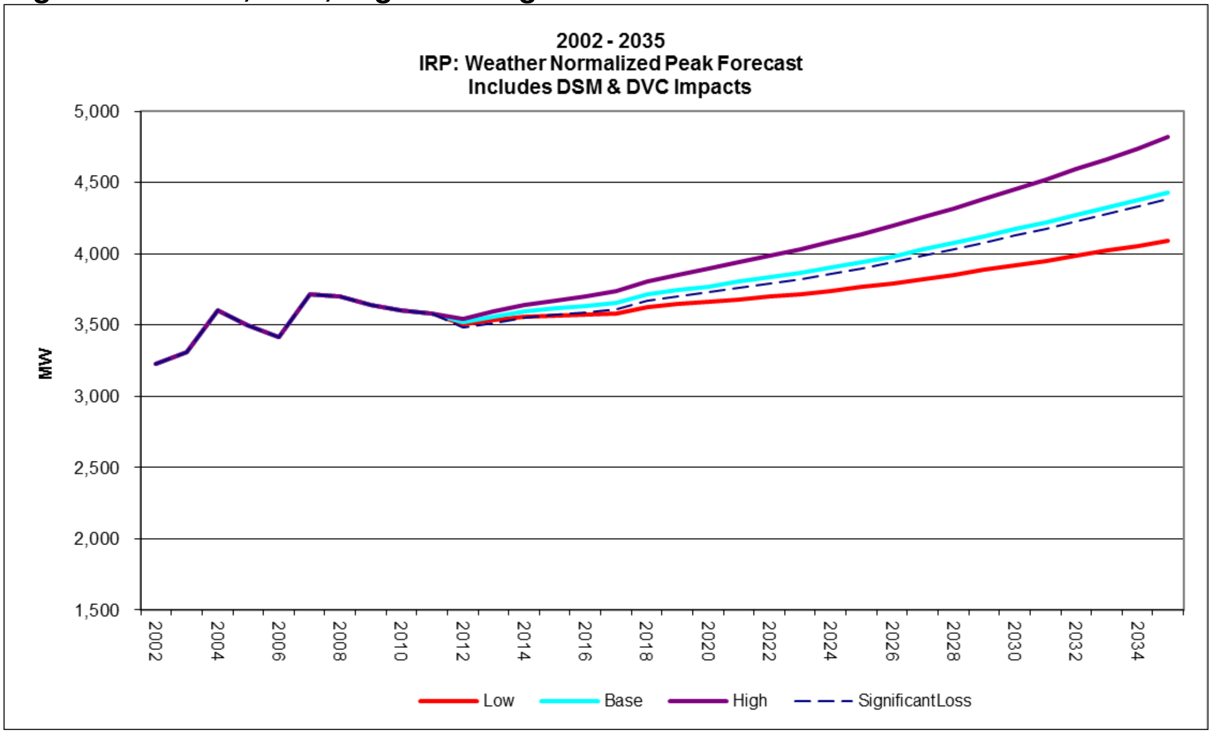
The corresponding figures below show the base-case, low-case, high-case, and significant loss forecasts for energy and demand. The impact of the last recession and the economic malaise since then are evident in the plot for energy. Growth in the forecast is lower than it was prior to the last recession and this is primarily because U.S. growth prior to the recession was fueled by circumstances that will not be repeated in the forecast horizon such as extremely lax lending standards.

Figure 60: Base, Low, High and Significant Loss Net System Input Forecast



It was reported in the local press on March 1, 2012 that the customer that we picked for Kansas, Amcor, would shut down by June 2012. Amcor manufactured plastic bottles.

Figure 61: Base, Low, High and Significant Loss Peak Demand Forecast



8.2 ESTIMATE OF SENSITIVITY OF SYSTEM PEAK LOAD FORECASTS TO EXTREME-WEATHER

(B) The utility shall estimate the sensitivity of system peak load forecasts to extreme weather conditions. This information shall be considered by utility decision-makers to assess the ability of alternative resource plans to serve load under extreme weather conditions when selecting the preferred resource plan pursuant to 4 CSR 240-22.070(1).

KCP&L created a forecast scenario using the base case economic scenario and weather from the years with more than 1,700 cooling degree days at KCI. These years were 1980, 1988, 2006 and 2010. The number of cooling degree days those years were 1,746, 1,724, 1,724 and 1,705. The scenario was created by running our computer programs with normal weather computed with those four years instead of with 30 years. In 2012, the peak rose from 3,672 mW to 3,865 mW. In 2020, the peak increased from 4,552 to 4,775 under this scenario. The complete set of results is in a file, *KCPL NSI_Peak Monthly_Annual 11_07_11.xls.* This file contains monthly NSI and peak load for all forecast scenarios.

The corresponding figures below show the base-case, low-case, high-case, and extreme weather forecasts for energy and demand.

Figure 62: Base, Low, High, and Extreme Weather Energy Forecast

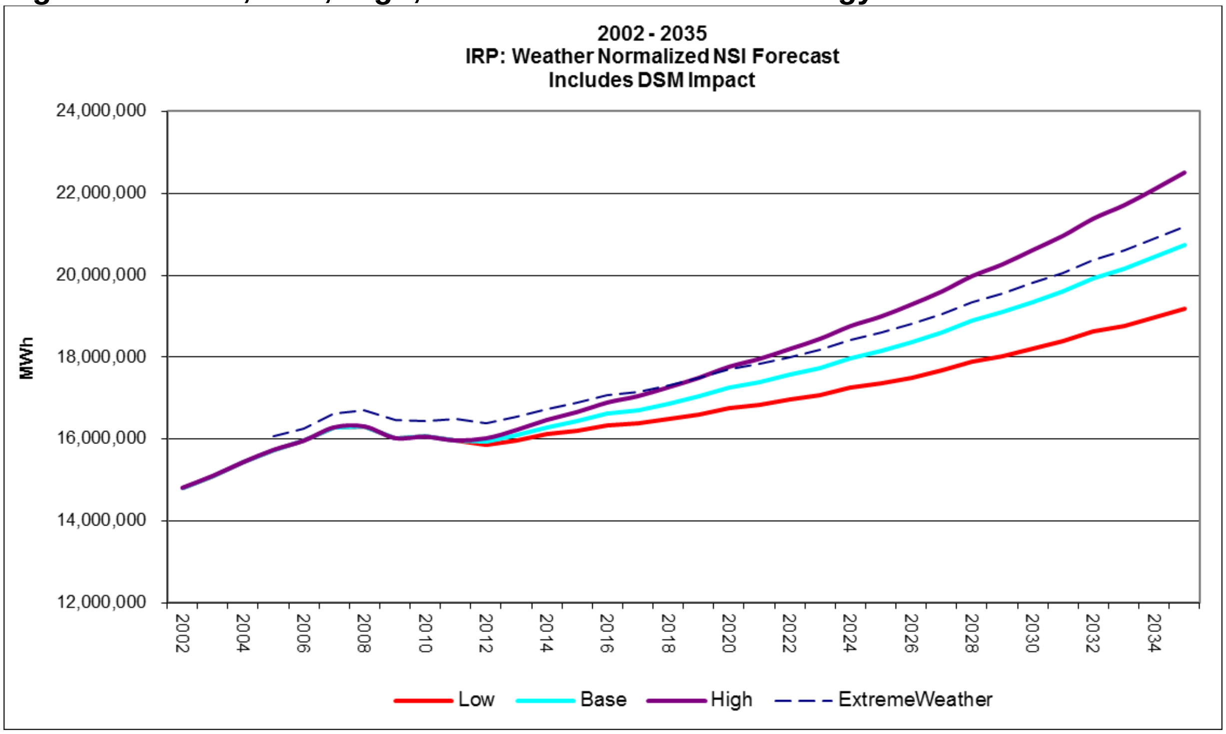
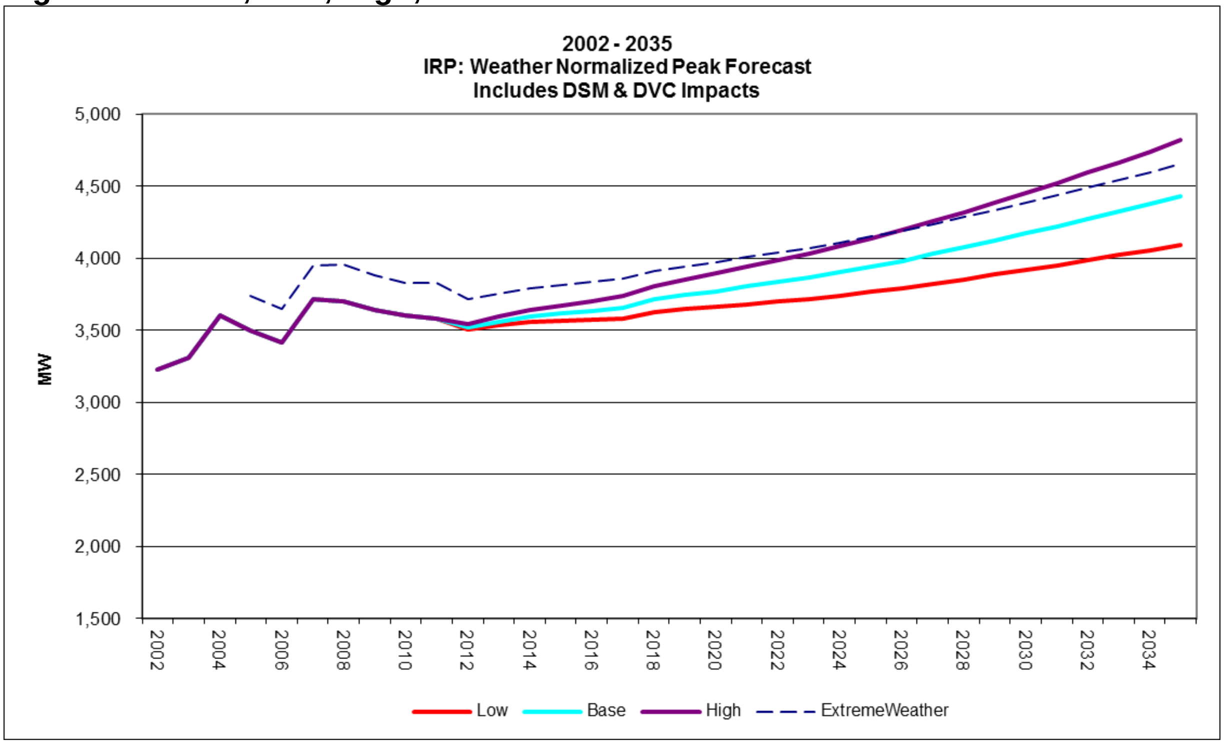


Figure 63: Base, Low, High, and Extreme Weather Peak Demand Forecast



8.3 ENERGY USAGE AND PEAK DEMAND PLOTS

(C) The utility shall provide plots of energy usage and peak demand covering the historical database period and the forecast period of at least twenty (20) years.

1. The energy plots shall include the summer, non-summer, and total energy usage for each calendar year. The peak demand plots shall include the summer and winter peak demands.

The figures below represent actual and weather normalized Net System Input (Energy) for summer, non-summer, and total year for the base case forecast. Corresponding tables can be found in *Appendix 3D* and in the file *IRP_8C_KCPL_NSI_Peak.xls*. Weather normalization significantly smooths out the energy plots. Growth in the forecasts is substantially slower than during the period prior to the last recession.

Figure 64: Base Case Actual and Weather Normalized Summer Energy Plots

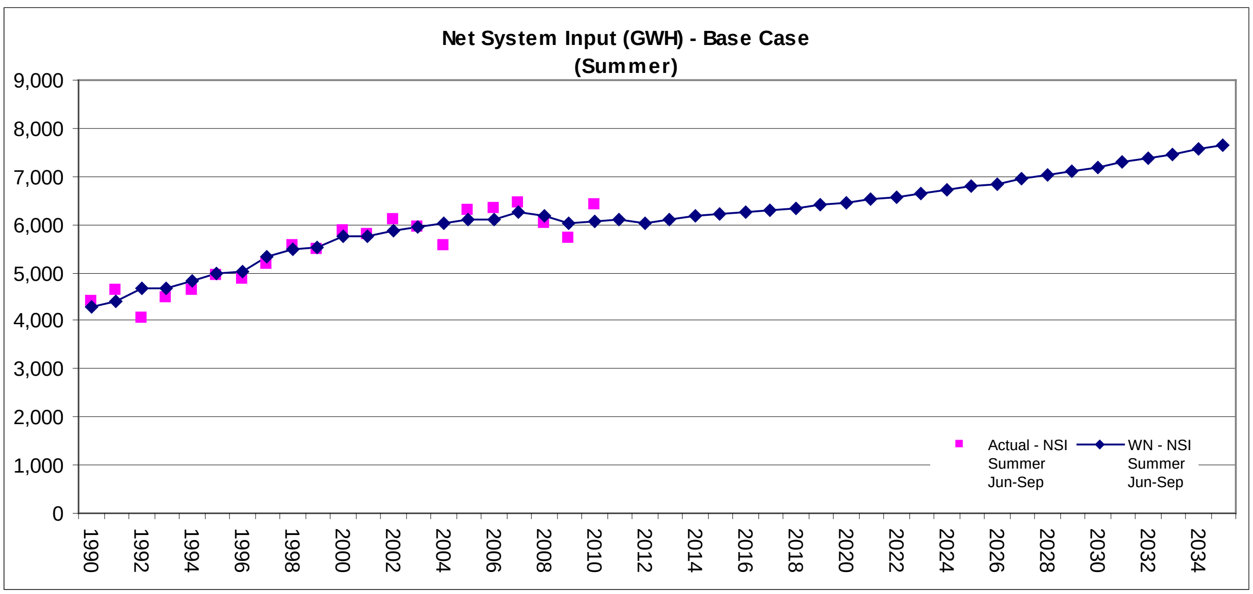


Figure 65: Base Case Actual and Weather Normalized Non-Summer Energy Plots

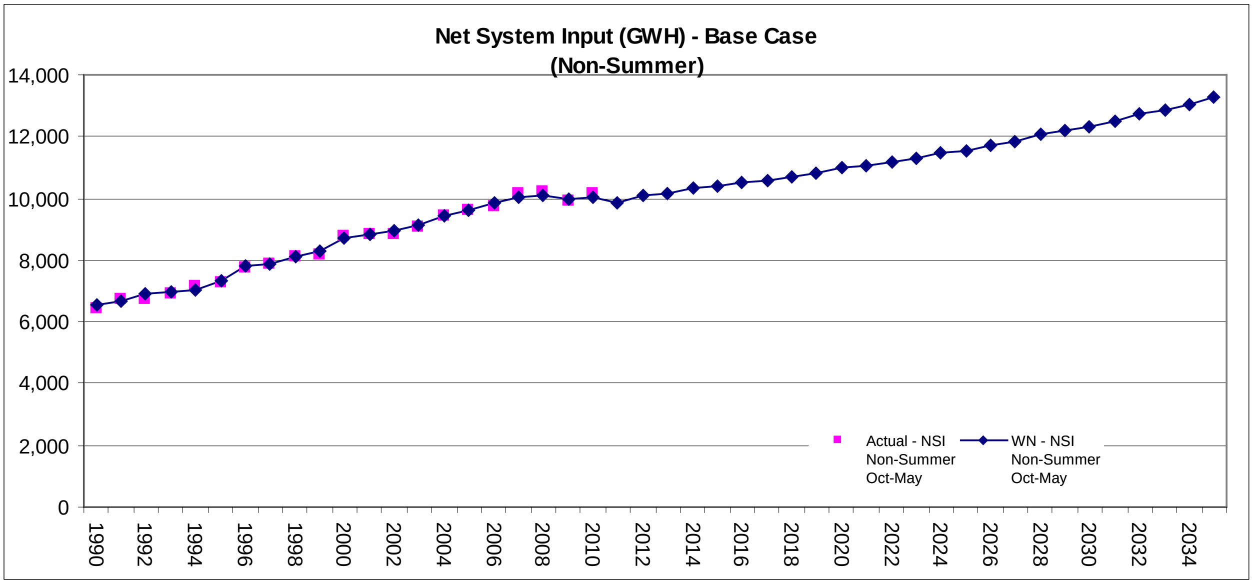
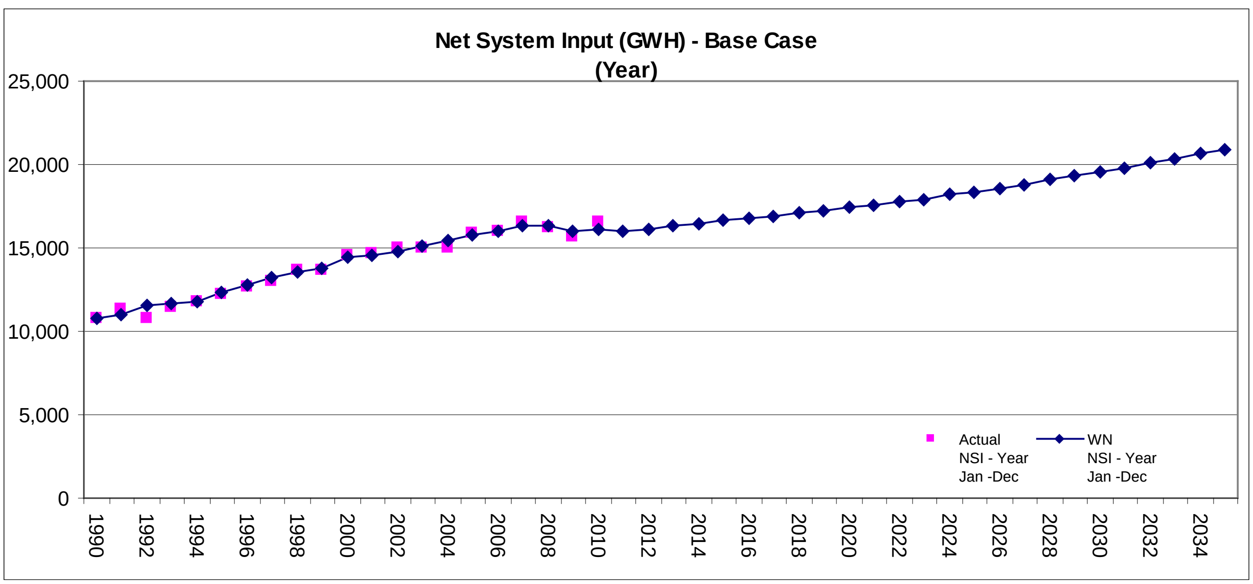


Figure 66: Base Case Actual and Weather Normalized Total Energy Plots



The figures below represent actual and weather normalized peak demand for summer and non-summer for the base case forecast. Annual peak demand plots are not shown, since they are the same as summer demand plots. Corresponding tables can be found in *Appendix 3D* and the file *IRP_8C_KCPL_NSI_Peak.xls*.

Figure 67: Base Case Actual and Weather Normalized Summer Peak Demand Plots

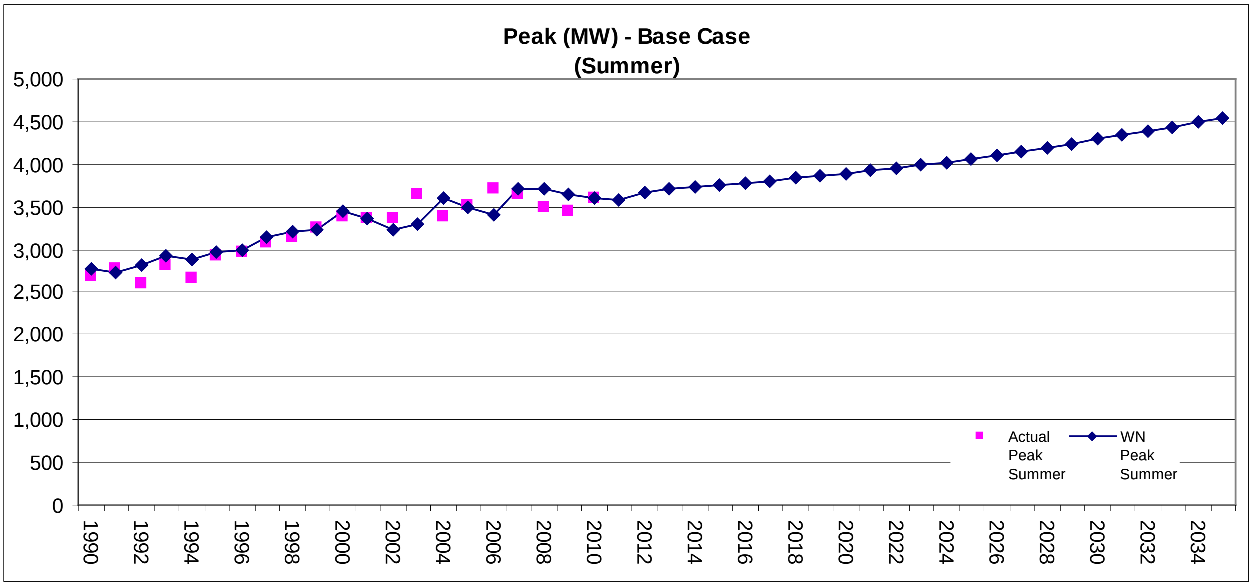
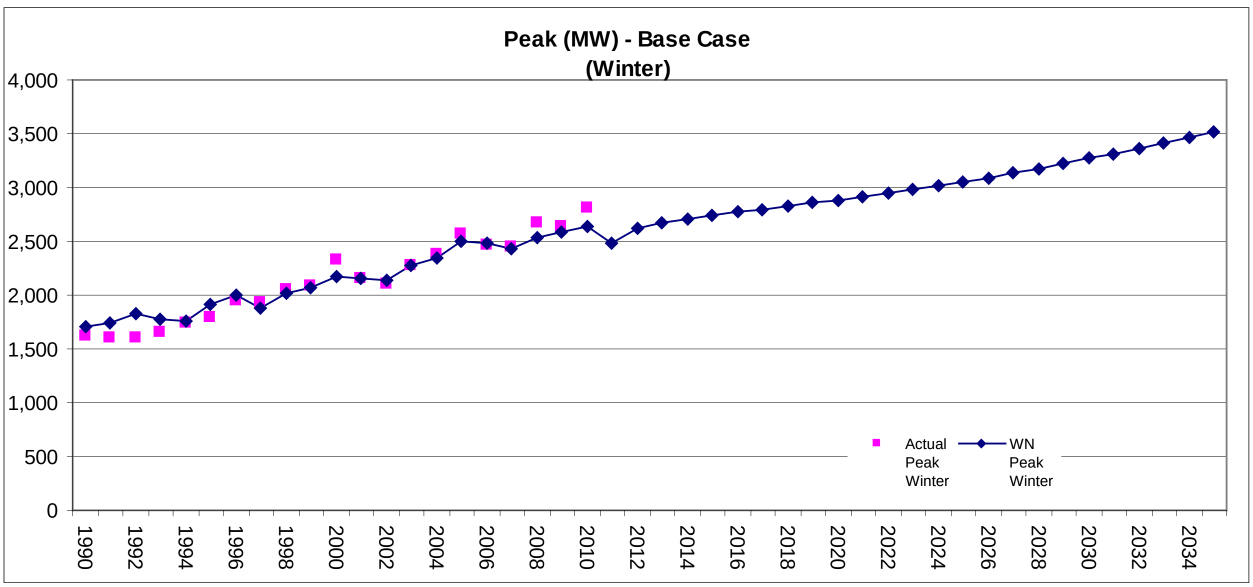


Figure 68: Base Case Actual and Weather Normalized Winter Peak Demand Plots



2. The historical period shall include both actual and weather-normalized values. The forecast period shall include the base-case, low-case, and high-case forecasts.

The figures below represent Net System Input (energy) for summer, non-summer, and the whole year for the base, low and high scenario forecasts. Corresponding tables can be found in *Appendix 3D* and the file *IRP_8C_KCPL_NSI_Peak.xls*.

Figure 69: Base-Case, Low-Case, and High-Case Summer Energy Plots

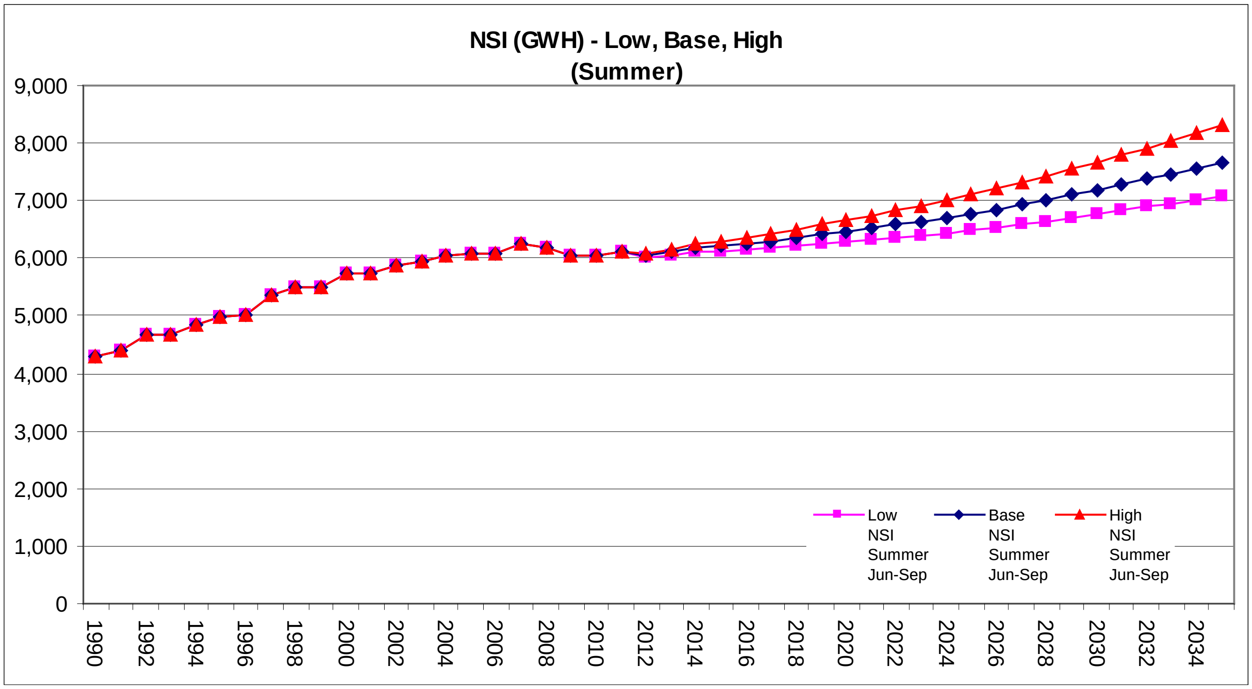


Figure 70: Base-Case, Low-Case, and High-Case Non-Summer Energy Plots

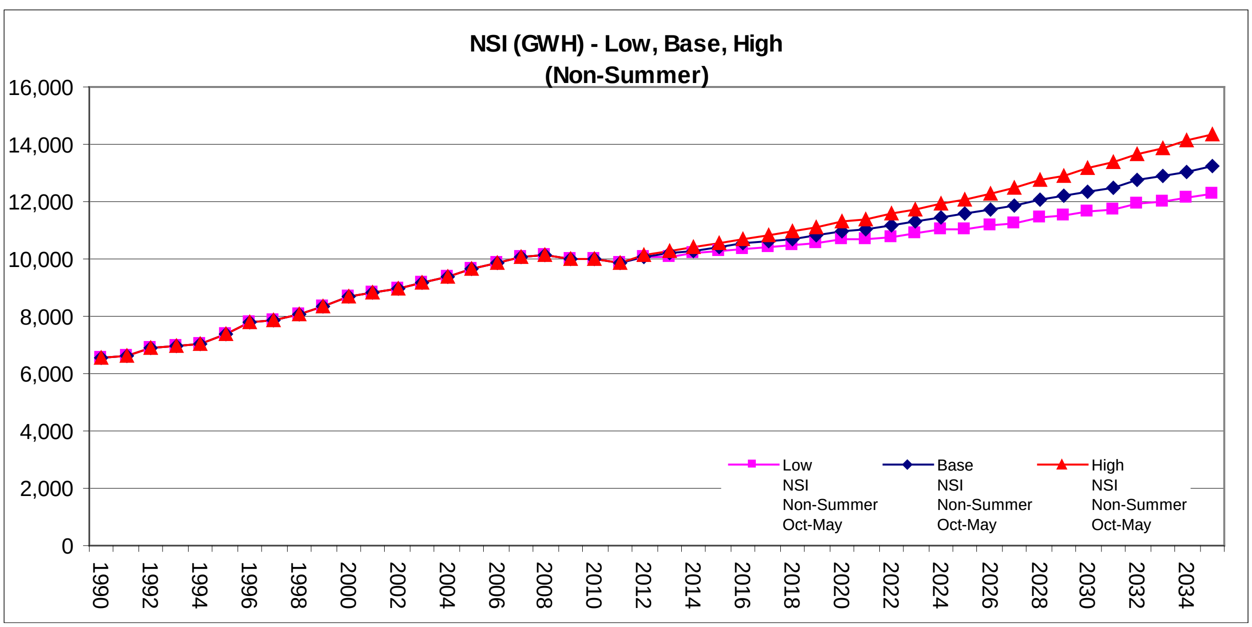
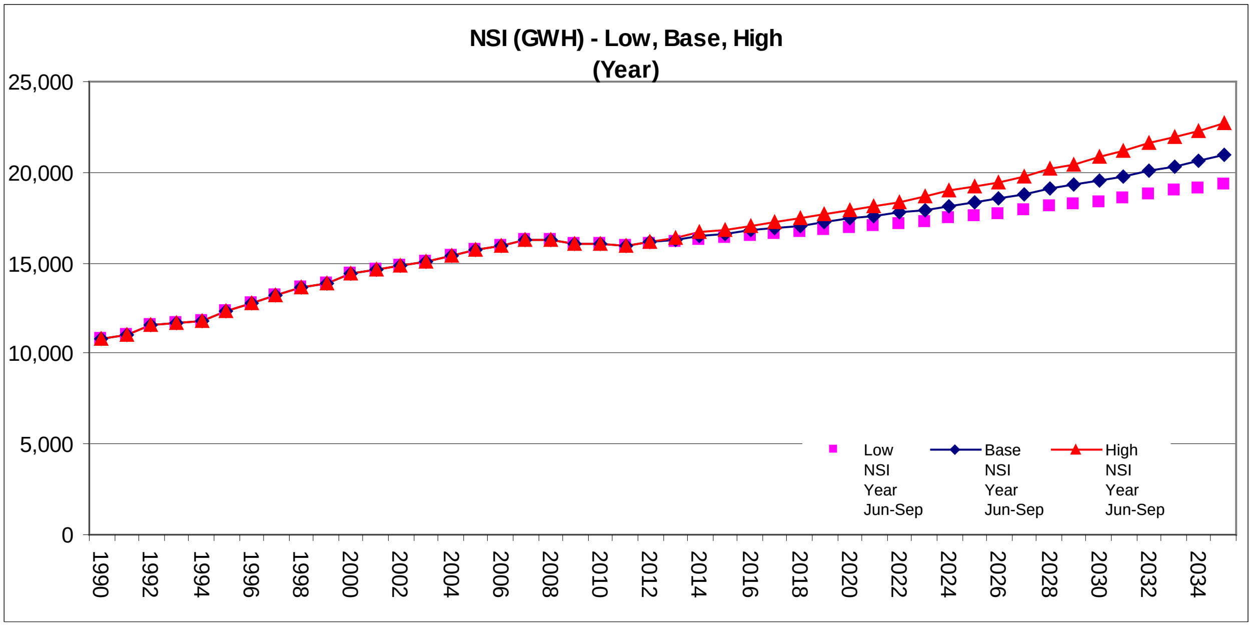


Figure 71: Base-Case, Low-Case, and High-Case Total Energy Plots



The figures below represent peak demand for summer and non-summer for the base, low, and high scenario forecasts. Annual peak demand plots are not shown, since they are the same as summer demand plots. Corresponding tables can be found in *Appendix 3D* and in the file *IRP_8C_KCPL_NSI_Peak.xls*.

Figure 72: Base-Case, Low-Case, and High-Case Summer Peak Demand Plots

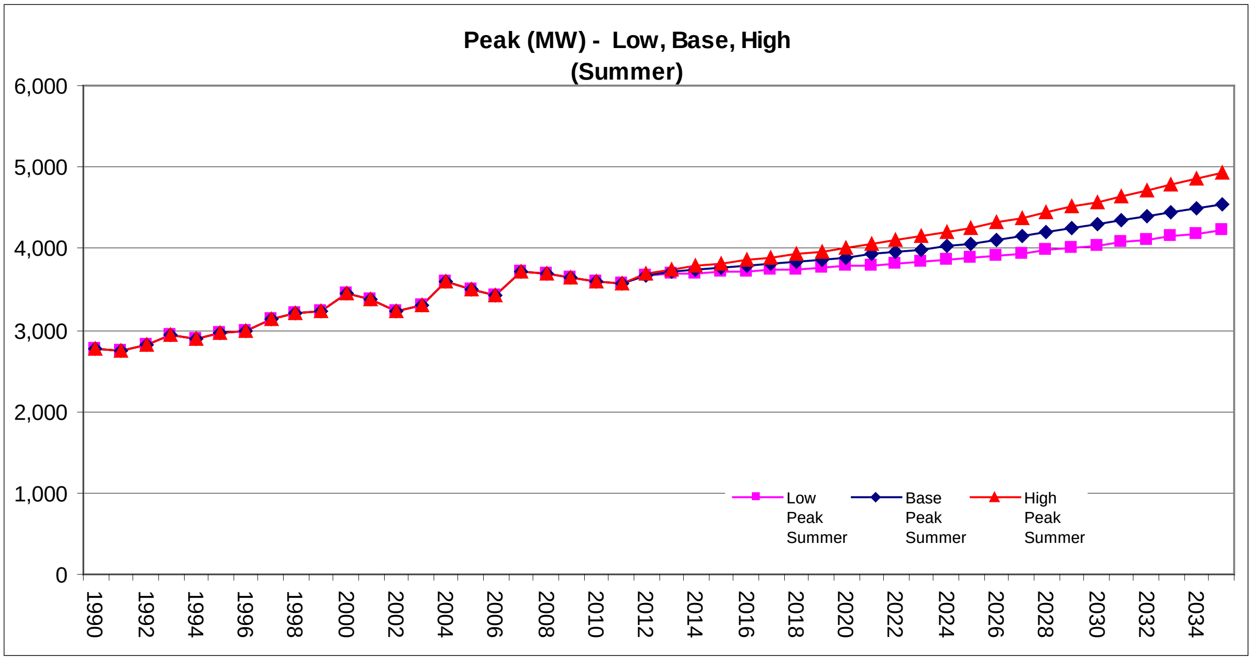
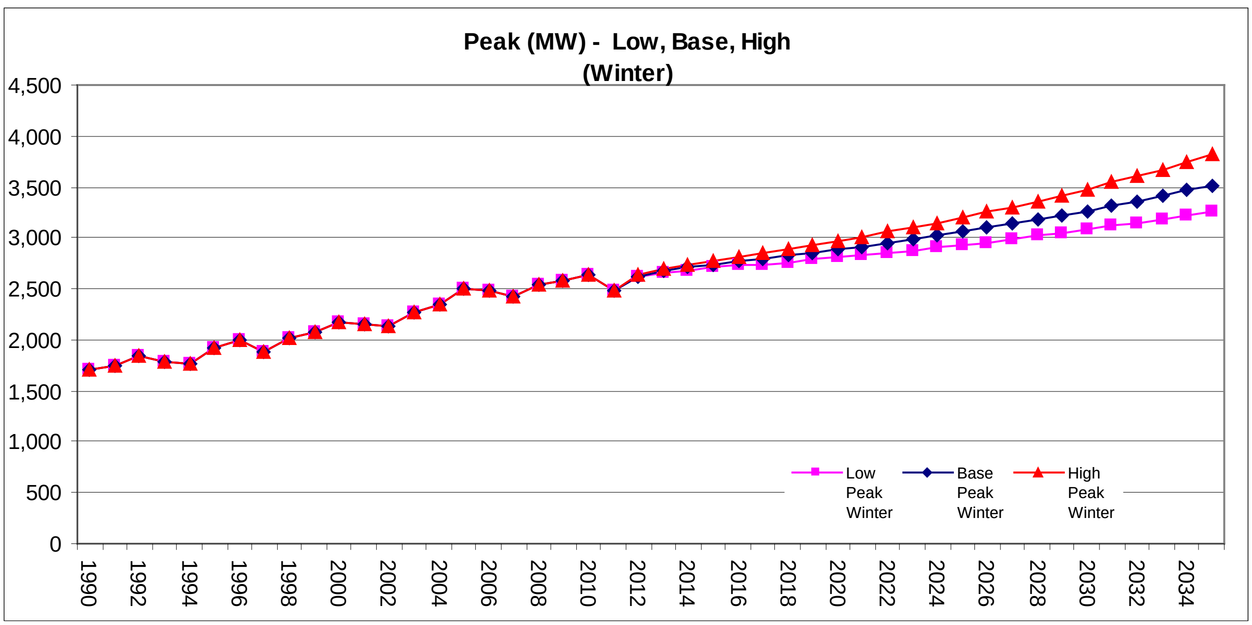


Figure 73: Base-Case, Low-Case, and High-Case Winter Peak Demand Plots



[i] http://www1.eere.energy.gov/buildings/appliance_standards/residential/residential_cac_hp.html
[ii] DOE slide deck *RES2011SAEUpdate.pdf*, provided in the workpapers.
[iii] Multi-Year Program Plan, Building Regulatory Programs, U.S. Department of Energy Energy Efficiency and Renewable Energy Building Technologies Program October 2010.
[iv] http://www.eia.gov/analysis/model-documentation.cfm
[v] Email from Benjamin Kanigel dated 7/6/2010.
[vi] Email to Al Bass from Benjamin Kanigel dated 9/23/2010.
[vii] See regulatory_programs_mypp.pdf .
[viii] www1.eere.energy.gov/buildings/appliance_standards/commercial/refrig_equip_final_rule.html and www1.eere.energy.gov/buildings/appliance_standards/commercial/automatic_ice_making_equipment.html
[ix] www1.eere.energy.gov/buildings/appliance_standards/commercial/ashrae_products_docs_meeting.html