MISO Independent Load Forecast Update

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Executive Summary

This report provides an update to the independent load forecast (ILF) the State Utility Forecasting Group (SUFG) has prepared for the Midcontinent Independent System Operator (MISO). These forecasts project annual MISO regional energy demand for the ten MISO local resource zones (LRZs), zonal summer and winter seasonal peak loads and MISO system-wide annual energy and peak demands. This forecast does not attempt to replicate the forecasts that are produced by MISO's load-serving entities (LSEs). It would not be appropriate to infer a load forecast for an individual LSE from this forecast.

The update is provided as an amendment to the original three annual forecasts produced under the original project scope. Under the amendment, all models used in the forecasting process were updated and re-estimated except for the state econometric models. The Year 3 state econometric models were used in the update, except for the model for Missouri.[1]

The ILF was produced from state level econometric models of electricity sales. Projected values for independent variables were then used to forecast annual retail sales of electricity. Forecasts of metered load at the LRZ level were developed by allocating the portion of each state's sales to the appropriate LRZ and adjusting for estimated distribution system losses. LRZ seasonal peak demand projections were developed using peak conversion factors, which translated annual energy into peak demand based on historical observations assuming normal weather conditions. The LRZ peak demand forecasts are on a non-coincident basis.[2] MISO system level seasonal peak projections were developed from the LRZ forecasts by using coincidence factors. Energy efficiency (EE) adjustments were made at the LRZ level and the MISO system-wide level based on a study of those factors performed by Applied Energy Group (AEG) for MISO. Results are provided without and with the EE adjustments.

The state econometric models were developed using publicly available information for electricity sales, prices for electricity and natural gas, personal income, population, employment, gross state product, and annual cooling and heating degree days. Economic and population projections acquired from IHS Markit (formerly IHS Global Insight) and price projections developed by SUFG were used to produce projections of future retail sales. Weather variables were held constant at their 30-year normal values. Table ES-1 provides the compound annual growth rates (CAGR) for the state energy forecasts.

LRZ level energy forecasts were developed by allocating the state energy forecasts to the individual LRZs on a proportional basis. The EE adjustments were made at the LRZ level. Additionally, losses associated with the distribution system were added to produce a forecast at the metered load level. Table ES-2 provides the growth rates for the LRZ energy forecasts without and with the EE adjustments.

LRZ summer and winter non-coincident peak demand projections were developed using peak conversion factors that are based on normal weather conditions and are determined from historical relationships between average hourly load for the year, summer and winter peak levels for the year, and weather conditions at the time of the peak demand. Since these conversion factors are held constant for the forecast period, the LRZ peak demand projections without the EE adjustments have the same growth rates as the energy projections in Table

[1] SUFG elected to update the Missouri model in order to better capture the effects of the shutdown of a large manufacturing facility.

[2] Throughout this report, coincidence is stated in reference to the overall MISO system. Thus, the LRZ peak demand forecasts are for the highest level of demand for that particular LRZ, which may not coincide with the MISO system level peak.

ES-2.[3] The compound annual growth rates of the LRZ non-coincident peak demand projections with the EE adjustments are shown in Table ES-3.

Table ES-1 State Retail Sales (without EE Adjustments) Compound Annual Growth Rates (2018-2037)

State	CAGR
Arkansas	1.06
Illinois	0.51
Indiana	1.28
Iowa	1.55
Kentucky	0.87
Louisiana	0.80
Michigan	0.88
Minnesota	1.52
Mississippi	1.46
Missouri	0.97
Montana	1.14
North Dakota	0.99
South Dakota	1.65
Texas	1.86
Wisconsin	1.36

Table ES-2 LRZ Metered Load Annual Growth Rates (2018-2037)

LRZ	CAGR (without EE Adjustments)	CAGR (with EE Adjustments)
1	1.45	1.34
2	1.32	1.32
3	1.51	1.18
4	0.51	0.31
5	0.81	0.64
6	1.12	1.03
7	0.88	0.76
8	1.06	1.05
9	1.05	0.99
10	1.46	1.46

[3] It should be noted that if customer sectors grow at different rates, the assumption that energy and peak demand will grow at the same rate is unlikely to hold true. However, there has been very little long-term change in the relationship between energy and peak demand in the MISO region, with weather variations having a much larger impact.

Table ES-3 LRZ Non-Coincident Summer and Winter Peak Demand (with EE Adjustments) Compound Annual Growth Rates (2018-2037)

LRZ	CAGR (with EE Adjustments on Non-Coincident Peak)	
	Summer	Winter
1	1.34	1.32
2	1.32	1.32
3	1.19	1.12
4	0.33	0.29
5	0.67	0.64
6	1.03	1.02
7	0.78	0.74
8	1.05	1.05
9	0.99	0.98
10	1.46	1.46

MISO system-wide energy and peak demand projections were developed from the LRZ-level projections. Since each LRZ does not experience its peak demand at the same time as the others (or as the entire MISO system), the MISO coincident peak demand is less than the arithmetic sum of the individual LRZ non-coincident peak demands. The MISO system coincident peak demand is determined by applying coincidence factors to the individual LRZ non-coincident peak demands and summing. These coincidence factors represent the ratio of the LRZ's load at the time of the overall MISO system peak to the LRZ's non-coincident peak. Coincidence factors were developed for the summer and winter peaks. Since coincidence is not a factor for annual energy, the MISO energy projections are found from the simple sum of the individual LRZs. Table ES-4 provides the compound annual growth rates for the MISO energy and peak demand forecasts on a gross and net basis.

Table ES-4. MISO Energy and Seasonal Peak Demand Growth Rates (2018-2037)

MISO-System	Gross CAGR (without EE Adjustments)	Net CAGR (with EE Adjustments)
Energy	1.12	1.01
Summer Peak Demand	1.11	1.01
Winter Peak Demand	1.12	1.00

While the same process has been used as in prior forecasts, this forecast report has two major changes. First, a 20-year forecast has been provided to better match the needs of MISO's transmission planning process. Second, the adjustment from gross to net forecast no longer includes demand response (DR). This was also done to better match the MISO transmission planning process.

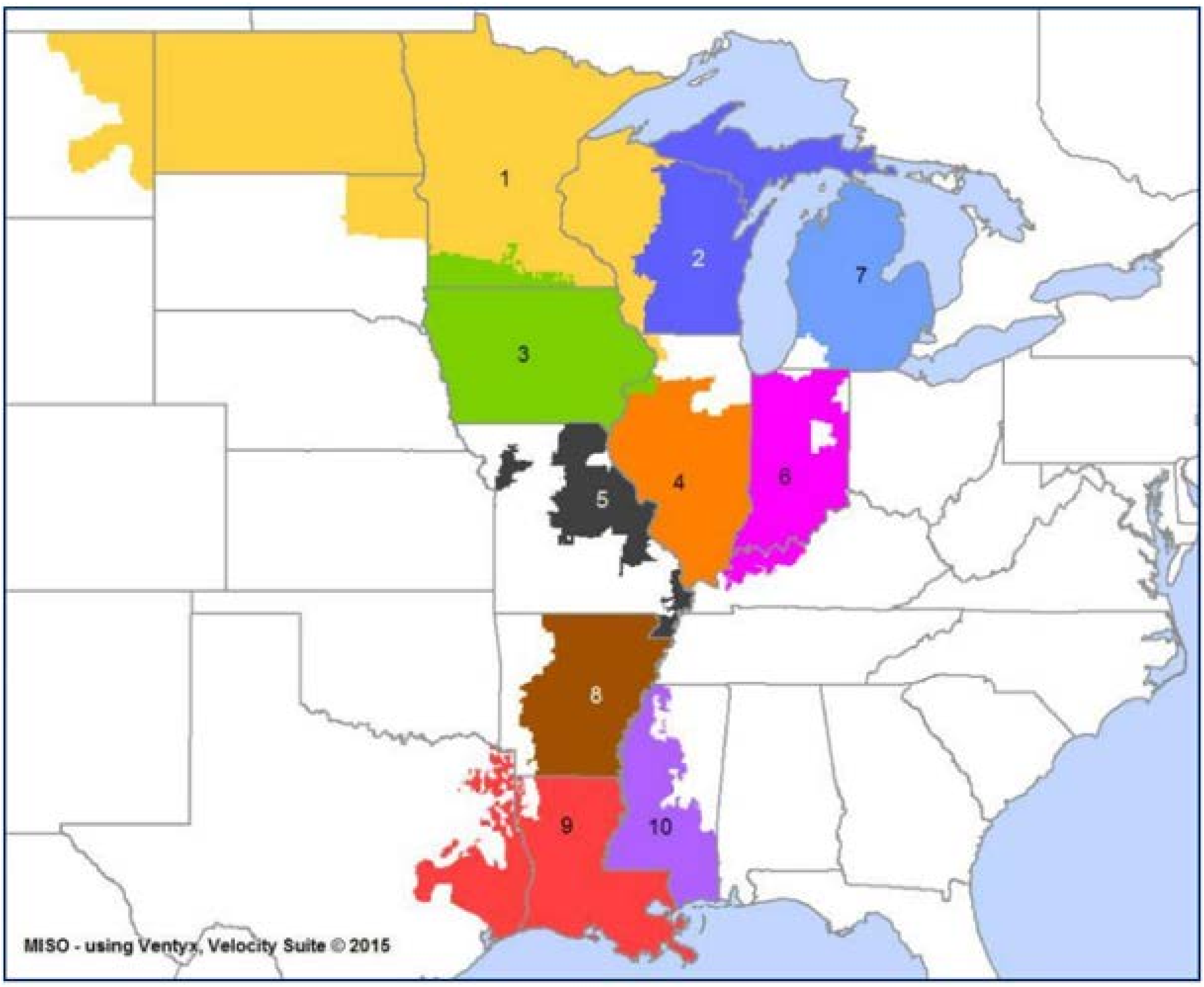
1 Introduction

This report represents an update to the annual independent load forecast (ILF) the State Utility Forecasting Group (SUFG) has prepared for the Midcontinent Independent System Operator (MISO). These forecasts project annual MISO regional energy demand for the ten MISO local resource zones (LRZs), regional winter and summer seasonal peak loads and MISO system-wide annual energy and peak demands. This forecast does not attempt to replicate the forecasts that are produced by MISO's load-serving entities (LSEs). It would not be appropriate to infer a load forecast for an individual LSE from this forecast.

1.1 OVERVIEW

The MISO market footprint consists of a number of individual Local Balancing Authorities (LBAs). It covers all or parts of 15 states and is divided into 10 LRZs. Figure 1 displays the MISO market footprint at the LRZ level.

Figure 1: MISO 2016 Planning Year LRZ Map



Source: MISO, 2016

State econometric models from the Year 3 ILF were used to project annual retail sales of electricity, except Missouri.[4] Forecasts of metered load at the LRZ level were developed by allocating the portion of each state's sales to the appropriate LRZ and adjusting for estimated distribution losses. LRZ seasonal peak demand projections were developed using conversion factors, which translated annual energy into peak demand based on historical observations assuming normal weather conditions. The LRZ peak demand forecasts are on a non-coincident basis.[5] MISO system level projections were developed from the LRZ forecasts. For the seasonal MISO peak demands, coincidence factors were used. Energy efficiency (EE) adjustments were made at the LRZ level and the MISO system-wide level based on a study of those factors performed by Applied Energy Group (AEG) for MISO.[6] Zonal energy and peak forecast results are provided without and with the EE adjustments for the period of 2018 to 2037.

1.2 REPORT STRUCTURE

In this report, Chapter 2 explains the forecasting methodology and provides the data sources. Chapter 3 covers the econometric forecasting models by state and the resulting forecasts of annual statewide retail sales. Chapter 4 explains the process for allocating the state energy forecasts to LRZ-level forecasts and provides those forecasts without and with the EE adjustments. The methodology and results for determining LRZ-level seasonal peak demands are presented in Chapter 5. The MISO system-wide results are incorporated in Chapter 6. Chapter 7 explains the methodology and results of using the models developed for the ILF process to determine weather-normalized values of historical energy and peak demand. Appendices are provided that include the state econometric models, peak demand models and alternate higher and lower projections.

[4] SUFG elected to update the Missouri model in order to better capture the effects of the shutdown of a large manufacturing facility.

[5] Throughout this report, coincidence is stated in reference to the overall MISO system. Thus, the LRZ peak demand forecasts are for the highest level of demand for that particular LRZ, which would be coincident at the LRZ level but non-coincident at the MISO system level.

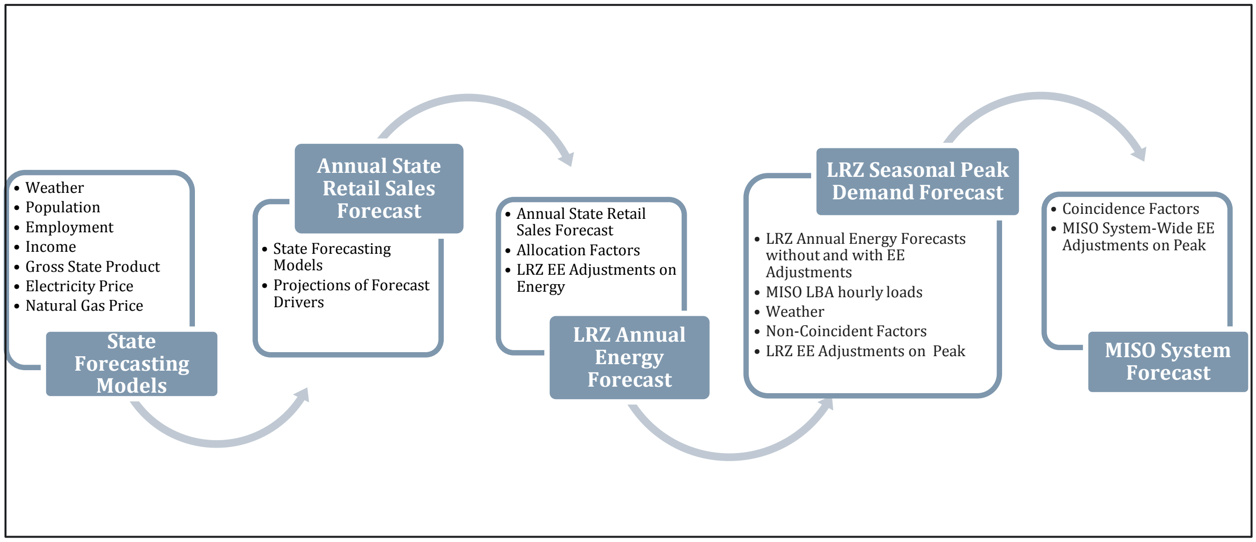
[6] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

2 Forecasting Methodology

2.1 OVERVIEW

This study employed a multi-step approach to forecast annual energy and seasonal peak demand at the MISO LRZ and system-wide levels. State econometric models in the 2016 Independent Load Forecast were used to forecast retail sales of electricity for a 20-year period, namely 2018 to 2037. The only exception is Missouri. The state econometric model for Missouri was re-estimated to capture the impact of the shutdown of the aluminum smelter in New Madrid. The statewide energy forecasts were then used to construct annual energy forecasts at the LRZ level, while accounting for the fraction of statewide load that is a part of each LRZ. The LRZ annual energy forecasts were used, in turn, to develop seasonal non-coincident peak demand projections for each LRZ. The LRZ coincident peak projections estimated from non-coincident peak demand projections were used to create the MISO system-wide peak demand projections. The overall process flow chart is illustrated in Figure 2 below. It shows the five major steps in the process and the key inputs at each step.

Figure 2: Process Flow Chart



Note: The state forecasting models were not re-estimated this year for all states in the MISO footprint, except Missouri. Those in the 2016 Independent Load Forecast were used in this update. The construction of state forecasting models is shown as the first step of the process flow chart for a comprehensive illustration of the forecasting methodology.

2.2 STATEWIDE ANNUAL ELECTRIC ENERGY FORECASTS

Econometric models of retail electricity sales were developed for each state using statewide historical data to determine the appropriate drivers of electricity consumption and the statistical relationship between those drivers and energy consumption. SUFG developed numerous possible model specifications for each state and selected models that had a good fit (significant t-statistics, high R-squared, and a significant F-statistic), that passed the statistical tests (heteroskedasticity and serial correlation), and had a set of drivers that included at least one driver that was tied to the overall growth in the state (such as employment, population and GSP). The model formulations by state are provided in APPENDIX A.

2.3 RETAIL SALES VS. METERED LOAD VS. RESOURCE NEEDS

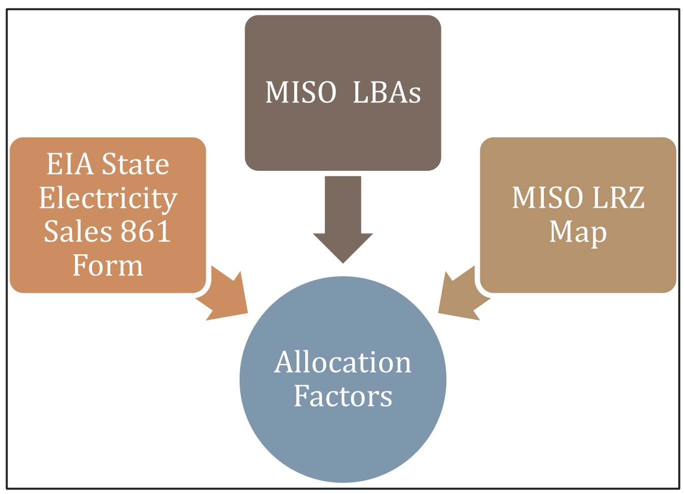
The state-level forecasts represent annual (calendar year) retail sales (electricity usage at the customer locations). This is driven by data availability, since statewide historical sales are available from the U.S. Department of Energy's Energy Information Administration (EIA). The LRZ-level forecasts are at the metered level (in essence, loads at the substations where the transmission network operated by MISO connects to the distribution systems). The historical metered loads at the LRZ-level are confidential and were provided by MISO. The difference between the two is caused by losses between the substations and customers.[7] Thus, an adjustment was made to convert retail sales forecasts to metered loads. This was accomplished by comparing historical EIA sales data for the utilities to historical metered data at the LBA level for each LRZ.

While the LRZ and MISO system projections (both energy and peak demand) are at the metered level, when determining resource needs from the peak demand projections, it may be more appropriate to include the losses associated with the transmission system between the generators and the substations,[8] since sufficient resources will be needed to provide for loads and all system losses. The annual energy forecasts at the state-level are for retail sales. For the LRZ-level forecasts, metered loads are provided. The MISO system-wide coincident peak demands have not been converted to the resource need level.

2.4 LRZ ENERGY FORECASTS

The LRZ annual energy forecasts were produced after the individual state annual forecasts were developed. This was done by allocating the fraction of each state's load to the appropriate LBA within that state (herein referred to as the load fraction) and summing across the various LBAs within each LRZ (Figure 3). Since not all regions within a state experience load growth at the same rate, the load fraction of each state may change over time. The historical load fractions of each state were calculated and used to estimate the future allocation factors. Additional adjustments also have been made to account for LBAs that operate in more than one state. In these cases, the market share of the LBA's load in each state within its service territory has been calculated in order to determine its load fraction for that state. In addition, the distribution losses of each LRZ were incorporated. A comparison between the MISO annual metered loads and retail sales was made to estimate the distribution losses by LRZ. The MISO system-wide energy forecast was obtained by summing the LRZ annual energy forecasts.

Figure 3: Structure and Logic Diagram for Allocation Factors



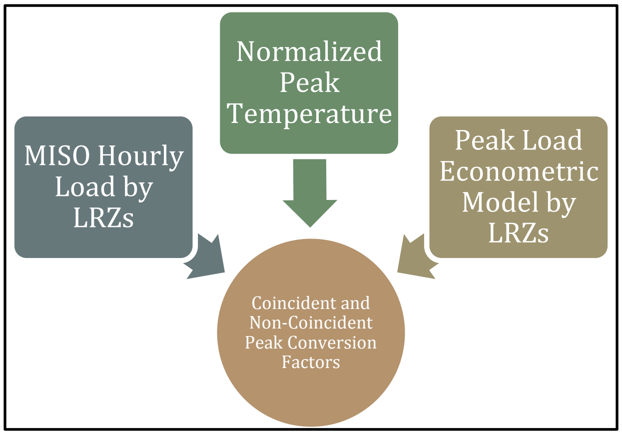
[7] These losses occur mainly in the distribution system of the load serving entities and may include some low voltage transmission lines that are not under MISO operation. They are therefore treated as distribution losses for the purposes of this forecast.

[8] These are referred to here as transmission losses, even though they exclude those low voltage transmission losses that are included in distribution losses (see previous footnote).

In addition, the EE adjustments to the LRZ energy forecasts were made based on a study of those factors performed by AEG for MISO. Unlike in years 2 and 3, the adjustments do not included demand response and distributed generation. Both non-adjusted and adjusted projections are provided at the LRZ level.

2.5 LRZ NON-COINCIDENT PEAK DEMAND FORECASTS

Figure 4: Structure and Logic Diagram for Peak Conversion Factors



The non-coincident peak demand forecasts were estimated based on load factors calculated using historical hourly load data of each LRZ provided by MISO. The structure and logic diagram in Figure 4 illustrates the resources employed in estimating the peak conversion factors. Peak load conversion factors were used to translate annual electricity sales forecasts at the LRZ level to summer and winter non-coincident peak demands. These conversion factors were determined from historical relationships between average hourly load for the year, summer/winter peak levels for the year, and weather conditions at the time of the peak demand.

2.6 MISO-LEVEL FORECASTS

The non-coincident LRZ peak demand projections were converted to MISO-level coincident peak demands using historical average coincidence factors. The coincidence factor for each LRZ is determined at the time of the MISO system-wide peak demand using the ratio of the LRZ's demand at the time of the MISO-wide (coincident) peak demand divided by the LRZ's demand at the time of the LRZ's individual (non-coincident) peak demand. The coincidence factor is generally a number slightly less than 1. The MISO system-wide peak demand forecast was obtained by summing the coincident LRZ peak demands. Since coincidence is not an issue with annual energy, the MISO system-wide annual energy forecast is the arithmetic sum of the LRZ annual energy forecasts.

2.7 DATA SOURCES

Historical annual energy sales data by state are available from EIA. Historical electricity and natural gas prices are available by state from EIA. Historical population data by state were obtained from the Census Bureau. Historical macroeconomic data, such as real personal income and gross state product, were obtained from the Bureau of Economic Analysis (BEA); employment data were obtained from the Bureau of Labor Statistics (BLS). Projections of macroeconomic data and population were provided by IHS Markit (formerly IHS Global Insight). Electricity and natural gas price projections were developed by the SUFG after IHS Global Insight stopped providing them in 2015. Actual heating and cooling degree days on a 65 degree Fahrenheit basis for all 15 states were acquired monthly from the National Oceanic and Atmospheric Administration (NOAA), and were aggregated to annual data by state. Normal weather by state used in projections were obtained from NOAA. Hourly temperature records were acquired from Midwest Regional Climate Center (MRCC). Table 1 summarizes the sources of data used in this study.

Table 1: Data sources

Data	Content	Historical Data Source	Data Used in Projection
Electricity sales	GWhs, annual retail electricity sales by state, 1990-2014	EIA	N/A
Electricity prices	Cents/KWh, 2009$, 1990-2014	EIA*	SUFG projection based on EIA data
Natural gas prices	$/Mcf (thousand cubic feet), 2009$, 1990-2014	EIA*	SUFG projection based on EIA data
Real personal income	Thousands, 2009$, 1990-2014	BEA	IHS Markit
Population	Number of people, population by state, 1990-2015	Census Bureau	IHS Markit
Manufacturing employment	Number of jobs, 1990-2014	BLS	IHS Markit
Non-manufacturing employment	Number of jobs, 1990-2014	BLS	IHS Markit
Non-farm employment	Number of jobs, 1990-2014	BLS	IHS Markit
Gross state product	Millions, 2009$, 1990-2014	BEA	IHS Markit
Cooling degree days (CDD)	Summations of monthly cooling degree days, base 65°F, 1970-2015	NOAA	NOAA 30-year normal
Heating degree days (HDD)	Summations of monthly heating degree days, base 65°F, 1970-2015	NOAA	NOAA 30-year normal
Hourly Temperature	Historical hourly temperature of selected weather stations, 1997-2015	MRCC	Normalized Temperature for Seasonal Peak Analysis

** Original data was in nominal dollars. SUFG converted it to real 2009 dollars using state level CPI from IHS Markit.*

2.8 Modeling Modification

The modeling approach used in this update is the same as that used in the 2016 ILF. The only difference is the adjustments used to derive net forecasts from gross forecasts. In 2015 and 2016, EE/DR/DG adjustments were made at the LRZ level and the MISO system-wide level based on a study of those factors performed by AEG for MISO. This year, only EE adjustments based on AEG's study were used to better match the net forecast to the requirements of MISO's transmission planning process, which considers demand response as a potential resource rather than a load reduction. Therefore, net forecasts of this year are not directly comparable to those of last year.

3 Statewide Annual Energy Forecasts

SUFG developed econometric models of annual retail electricity sales for each of 15 MISO states. The models were based on historical values for a variety of explanatory variables (or drivers), using Eviews, a statistical analysis program. The candidate variables and their data sources are provided in Table 2. For this update, state models were not re-estimated, except the model for Missouri.

Table 2: Dependent and Explanatory Variables

Variables	Eviews Name	Historical Data Source	Projected Data Source
Dependent variable:			
Electricity sales	ELECTRICITY_SALES	EIA	N/A
Explanatory variables:			
Electricity prices	REAL_ELECTRICITY_PRICE	EIA*	SUFG projection based on EIA data
Natural gas prices	REAL_NATURAL_GAS_PRICE	EIA*	SUFG projection based on EIA data
Real personal income	REAL_INCOME	BEA	IHS Markit
Population	POPULATION	Census Bureau	IHS Markit
Manufacturing employment	MANUFACTURING_EMP	BLS	IHS Markit
Non-manufacturing employment	NON_MANUFACTURING_EMP	BLS	IHS Markit
Non-farm employment	NON_FARM_EMP	BLS	IHS Markit
Gross state product	REAL_GSP	BEA	IHS Markit
Cooling degree days	CDD	NOAA	NOAA
Heating degree days	HDD	NOAA	NOAA

** Original data was in nominal dollars. SUFG converted it to real 2009 dollars using state level CPI from IHS Markit.*

Each state's electricity sales forecast was determined using projections of values for the applicable drivers for that state. Table 3 provides compound annual growth rates for the explanatory variables over the forecast period (2018-2037). Cells with no entry indicate that the corresponding variables are not included in that state's model. Cooling degree days and heating degree days are held constant at their 30-year normal values from NOAA for the projections. The projections provided in Table 3 are from a macroeconomic forecast by IHS Markit, except the electricity price forecast and the natural gas price forecast. They were developed by the SUFG using a similar method adopted in the 2015 ILF, with details being provided in the 2015 Independent Load Forecast report.

Table 3: Explanatory Variable Compound Annual Growth Rates for the 2018-2037 Period (%)

Variables	AR	IL	IN	IA	KY	LA	MI	MN	MS	MO	MT	ND	SD	TX	WI
REAL_ELECTRICITY_PRICE	0.83	0.60	0.60	0.04	0.17	0.84	0.59	0.02	0.13	-0.01	0.47	0.02	-0.01	0.82	0.59
REAL_NATURAL_GAS_PRICE			1.35	1.26	1.31			1.19			1.09	1.27	1.29	1.63	1.29
REAL_INCOME				2.05				2.24	1.95						
POPULATION					0.39					0.42			0.63		
REAL_INCOME/POPULATION							1.69				1.58				
REAL_GSP	1.74	1.34	1.75			1.90	1.31		1.63					2.88	1.75
NON_MANUFACTURING_EMP										0.58		0.59			
MANUFACTURING_EMP											-0.15				

For the state of Missouri, SUFG observed a 3% drop of the electricity load in 2015. This was caused by the shutdown of the aluminum smelter in New Madrid. Therefore, the Missouri state model was re-estimated in this update to reflect the impact of this load drop on future load projection.

Table 4 and Figure 5 through Figure 19 provide the gross (i.e., prior to any EE adjustments) state-level forecasts. The retail sales by state for the year 2016 are not actual observed values since EIA had not published the final release of the data. Therefore, the state econometric models were used to “forecast” 2016 values (as well as 2017 values) to provide continuity between the historical data and the forecast period (2018 to 2037).

STATEWIDE ANNUAL ENERGY FORECASTS

Table 4: Gross State Energy Forecasts (Annual Retail Sales in GWh)[9]

Year	AR	IL	IN	IA	KY	LA	MI	MN
1990	27,365	111,577	73,982	29,437	61,097	63,826	82,367	47,167
1991	28,440	116,869	77,034	30,781	64,194	64,704	84,519	48,755
1992	28,451	112,521	76,977	30,208	67,068	65,098	83,840	47,412
1993	31,663	117,786	81,931	32,104	68,149	67,756	87,589	49,211
1994	32,619	121,490	83,808	33,039	72,485	70,132	91,160	51,155
1995	34,671	126,231	87,006	34,301	74,548	72,827	94,701	53,959
1996	36,137	125,990	88,901	34,999	77,019	75,269	96,302	54,942
1997	36,858	126,953	89,147	36,148	76,836	75,886	97,391	55,674
1998	39,315	131,697	92,059	37,318	75,850	77,716	100,506	56,744
1999	39,789	132,682	96,735	38,034	79,098	78,267	103,981	57,399
2000	41,611	134,697	97,775	39,088	78,316	80,690	104,772	59,782
2001	41,732	136,034	97,734	39,444	79,975	74,693	102,409	60,687
2002	42,450	138,447	101,429	40,898	87,267	79,261	104,714	62,162
2003	43,108	136,248	100,468	41,207	85,220	77,769	108,877	63,087
2004	43,672	139,254	103,094	40,903	86,521	79,737	106,606	63,340
2005	46,165	144,986	106,549	42,757	89,351	77,389	110,445	66,019
2006	46,636	142,448	105,664	43,337	88,743	77,468	108,018	66,770
2007	47,055	146,055	109,420	45,270	92,404	79,567	109,297	68,231
2008	46,135	144,620	106,981	45,488	93,428	78,726	105,781	68,794
2009	43,173	136,688	99,312	43,641	88,897	78,670	98,121	64,004
2010	48,194	144,761	105,994	45,445	93,569	85,080	103,649	67,800
2011	47,928	142,886	105,818	45,655	89,538	86,369	105,054	68,533
2012	46,860	143,540	105,173	45,709	89,048	84,731	104,818	67,989
2013	46,683	141,805	105,487	46,705	84,764	85,808	103,038	68,644
2014	47,080	141,540	106,943	47,202	78,839	90,628	103,314	68,719
2015	46,465	138,620	104,515	47,147	76,039	91,676	102,480	66,579
2016	47,908	145,476	109,392	47,353	78,186	83,190	107,874	69,910
2017	48,625	146,004	110,922	47,226	78,877	84,614	109,743	70,911
2018	49,445	146,671	112,982	47,960	80,083	86,416	112,145	72,262
2019	50,257	147,649	114,712	48,876	81,246	87,062	113,379	73,735
2020	50,731	148,481	116,430	50,212	82,489	88,818	114,867	75,152
2021	51,199	149,186	118,070	51,122	83,560	89,070	115,724	76,452
2022	51,469	149,858	119,577	51,894	84,361	88,857	116,423	77,737
2023	51,844	150,311	120,980	52,546	85,080	89,495	117,270	78,827
2024	52,376	150,872	122,371	52,990	85,795	89,839	117,976	79,878
2025	52,855	151,350	123,690	53,670	86,532	90,624	118,746	81,015
2026	53,347	151,868	125,098	54,574	87,238	91,544	119,891	82,150
2027	53,804	152,479	126,525	55,372	87,896	91,890	120,742	83,378
2028	54,267	153,118	128,082	56,262	88,636	92,389	121,584	84,675
2029	54,789	153,695	129,679	57,142	89,341	93,131	122,664	85,879
2030	55,386	154,373	131,287	57,980	90,026	93,889	123,641	87,123
2031	55,987	155,312	132,969	58,872	90,719	94,574	124,693	88,402
2032	56,637	156,267	134,650	59,743	91,405	95,406	125,794	89,630
2033	57,360	157,277	136,397	60,583	92,063	96,274	127,074	90,864
2034	58,164	158,393	138,288	61,476	92,661	97,501	128,439	92,104
2035	58,966	159,505	140,195	62,407	93,252	98,558	129,910	93,444
2036	59,713	160,576	142,083	63,339	93,839	99,567	131,304	94,857
2037	60,454	161,626	143,941	64,279	94,406	100,468	132,498	96,182
Compound Annual Growth Rates (%)								
2018-2022	1.01	0.54	1.43	1.99	1.31	0.70	0.94	1.84
2018-2027	0.94	0.43	1.27	1.61	1.04	0.68	0.82	1.60
2018-2037	1.06	0.51	1.28	1.55	0.87	0.80	0.88	1.52

[9] The gross forecast is prior to the EE adjustments.

Table 4: Gross State Energy Forecasts (Annual Retail Sales in GWh) – continued

Year	MS	MO	MT	ND	SD	TX	WI
1990	32,127	53,925	13,125	7,014	6,334	237,415	49,198
1991	33,019	56,514	13,407	7,255	6,685	240,352	51,032
1992	33,241	54,411	13,096	7,128	6,494	239,431	50,925
1993	34,749	58,622	12,929	7,432	6,905	250,084	53,156
1994	36,627	59,693	13,184	7,681	7,174	258,180	55,412
1995	37,868	62,259	13,419	7,883	7,414	263,279	57,967
1996	39,622	64,843	13,820	8,314	7,736	278,450	58,744
1997	40,089	65,711	11,917	8,282	7,773	286,704	60,094
1998	42,510	69,010	14,145	8,220	7,824	304,705	62,061
1999	43,980	69,045	13,282	9,112	7,922	301,844	63,547
2000	45,336	72,643	14,580	9,413	8,283	318,263	65,146
2001	44,287	73,213	11,447	9,810	8,627	318,044	65,218
2002	45,452	75,001	12,831	10,219	8,937	320,846	66,999
2003	45,544	74,240	12,825	10,461	9,080	322,686	67,241
2004	46,033	74,054	12,957	10,516	9,214	320,615	67,976
2005	45,901	80,940	13,479	10,840	9,811	334,258	70,336
2006	46,936	82,015	13,815	11,245	10,056	342,724	69,821
2007	48,153	85,533	15,532	11,906	10,603	343,829	71,301
2008	47,721	84,382	15,326	12,416	10,974	347,815	70,122
2009	46,049	79,897	14,354	12,649	11,010	345,351	66,286
2010	49,687	86,085	13,771	12,956	11,356	358,458	68,752
2011	49,338	84,255	13,788	13,737	11,680	376,065	68,612
2012	48,388	82,435	13,863	14,717	11,734	365,104	68,820
2013	48,782	83,407	14,045	16,033	12,210	378,817	69,124
2014	49,409	83,878	14,102	18,240	12,355	389,670	69,495
2015	48,692	81,504	14,207	18,129	12,102	392,337	68,699
2016	49,385	83,932	14,459	15,929	12,751	396,457	70,918
2017	50,388	84,954	14,654	15,764	12,794	400,374	72,140
2018	51,424	85,970	15,763	16,171	13,046	409,155	73,669
2019	52,440	87,003	16,089	16,664	13,377	418,590	74,840
2020	53,461	88,199	16,284	17,120	13,900	427,908	75,815
2021	54,356	89,337	16,493	17,372	14,252	435,628	76,759
2022	55,143	90,447	16,302	17,545	14,558	443,487	77,770
2023	55,948	91,315	16,395	17,737	14,817	451,457	78,687
2024	56,728	92,174	16,731	17,922	14,979	458,650	79,591
2025	57,492	92,967	16,795	18,086	15,201	465,903	80,435
2026	58,192	93,728	17,014	18,253	15,495	473,818	81,378
2027	58,880	94,610	17,303	18,401	15,735	481,322	82,450
2028	59,682	95,590	17,592	18,549	15,979	489,873	83,609
2029	60,529	96,498	17,865	18,660	16,223	499,183	84,839
2030	61,408	97,496	18,131	18,805	16,451	508,708	86,006
2031	62,273	98,398	18,281	18,869	16,675	518,346	87,357
2032	63,158	99,244	18,353	18,966	16,884	528,191	88,623
2033	64,040	100,026	18,522	19,068	17,074	538,122	89,873
2034	64,953	100,848	18,781	19,171	17,249	549,057	91,222
2035	65,887	101,675	19,062	19,295	17,422	559,481	92,575
2036	66,795	102,496	19,326	19,420	17,607	570,196	93,858
2037	67,680	103,318	19,549	19,516	17,795	581,192	95,140
Compound Annual Growth Rates (%)							
2018-2022	1.76	1.28	0.84	2.06	2.78	2.03	1.36
2018-2027	1.52	1.07	1.04	1.45	2.10	1.82	1.26
2018-2037	1.46	0.97	1.14	0.99	1.65	1.86	1.36

STATEWIDE ANNUAL ENERGY FORECASTS

Figure 5: Gross Arkansas Energy Forecast (Annual Retail Sales in GWh)

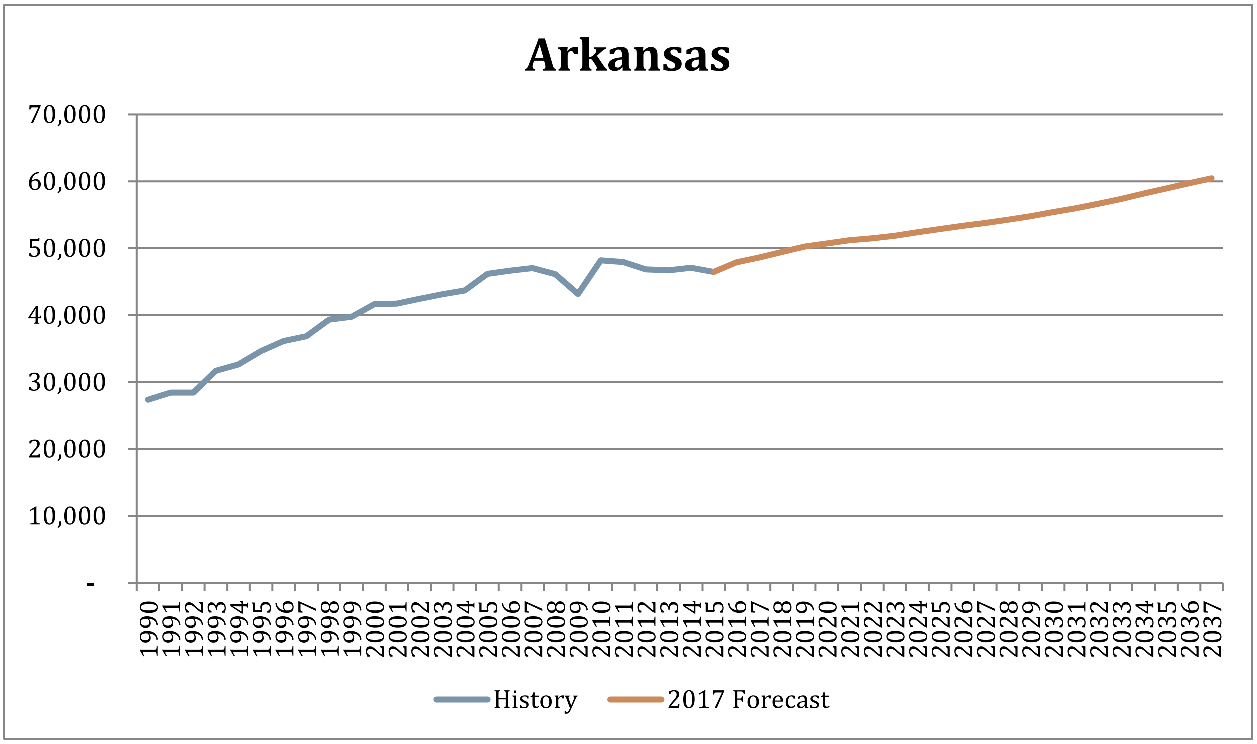
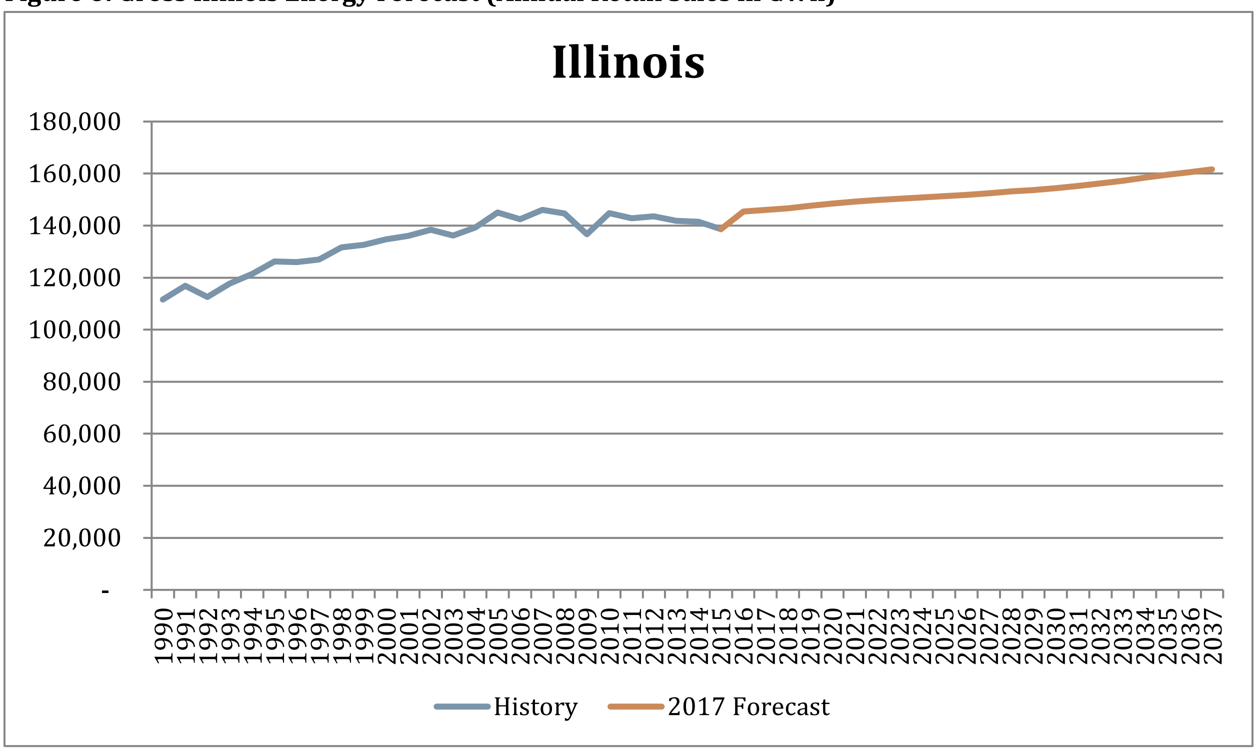


Figure 6: Gross Illinois Energy Forecast (Annual Retail Sales in GWh)



STATEWIDE ANNUAL ENERGY FORECASTS

Figure 7: Gross Indiana Energy Forecast (Annual Retail Sales in GWh)

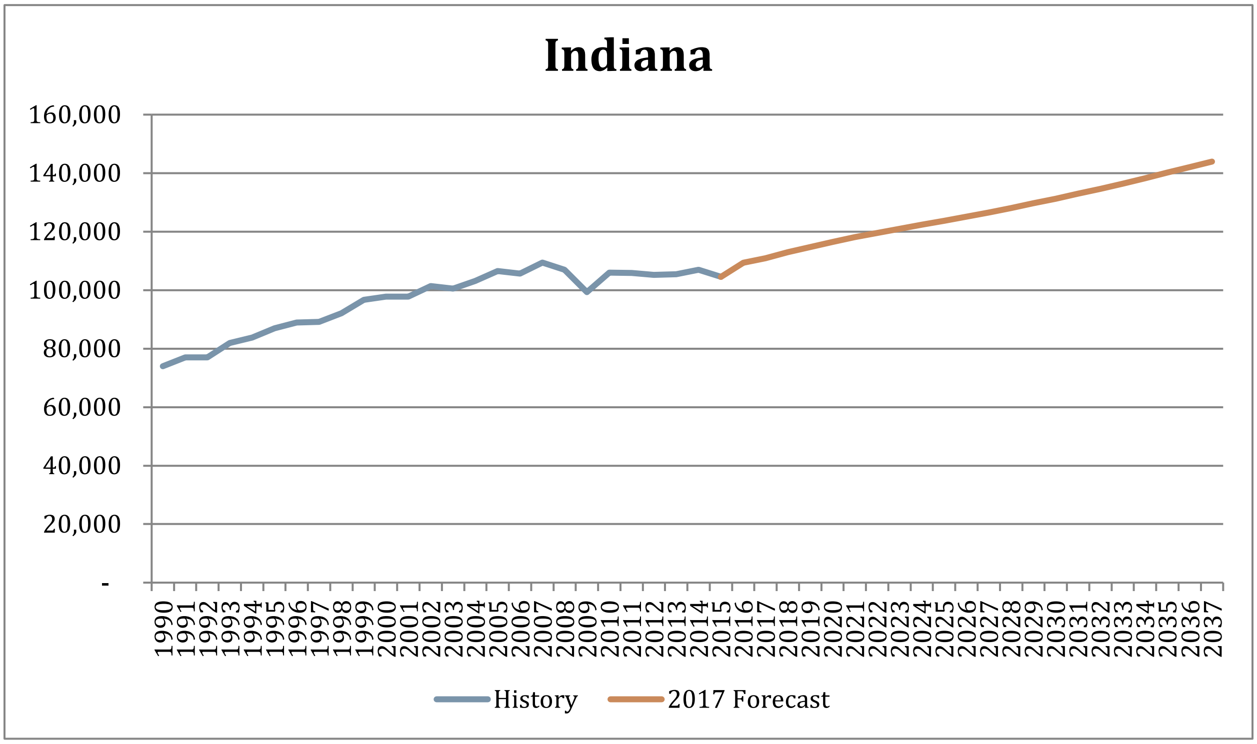
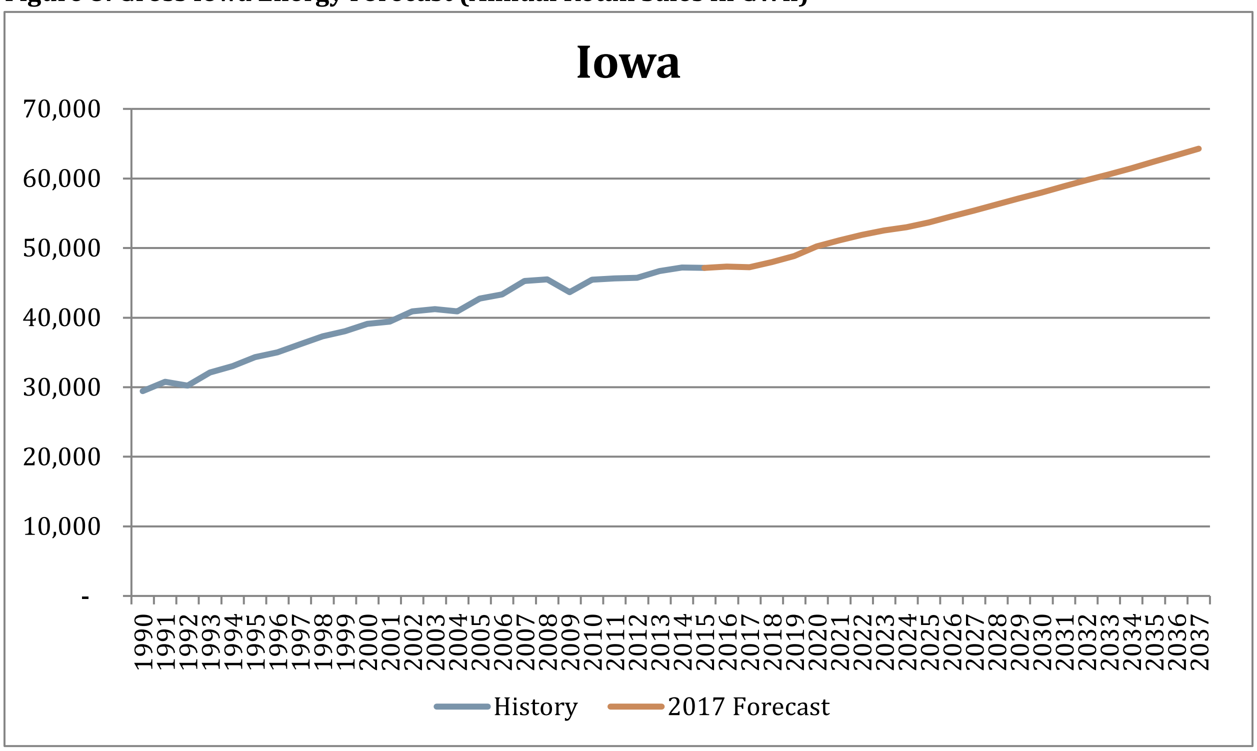


Figure 8: Gross Iowa Energy Forecast (Annual Retail Sales in GWh)



STATEWIDE ANNUAL ENERGY FORECASTS

Figure 9: Gross Kentucky Energy Forecast (Annual Retail Sales in GWh)

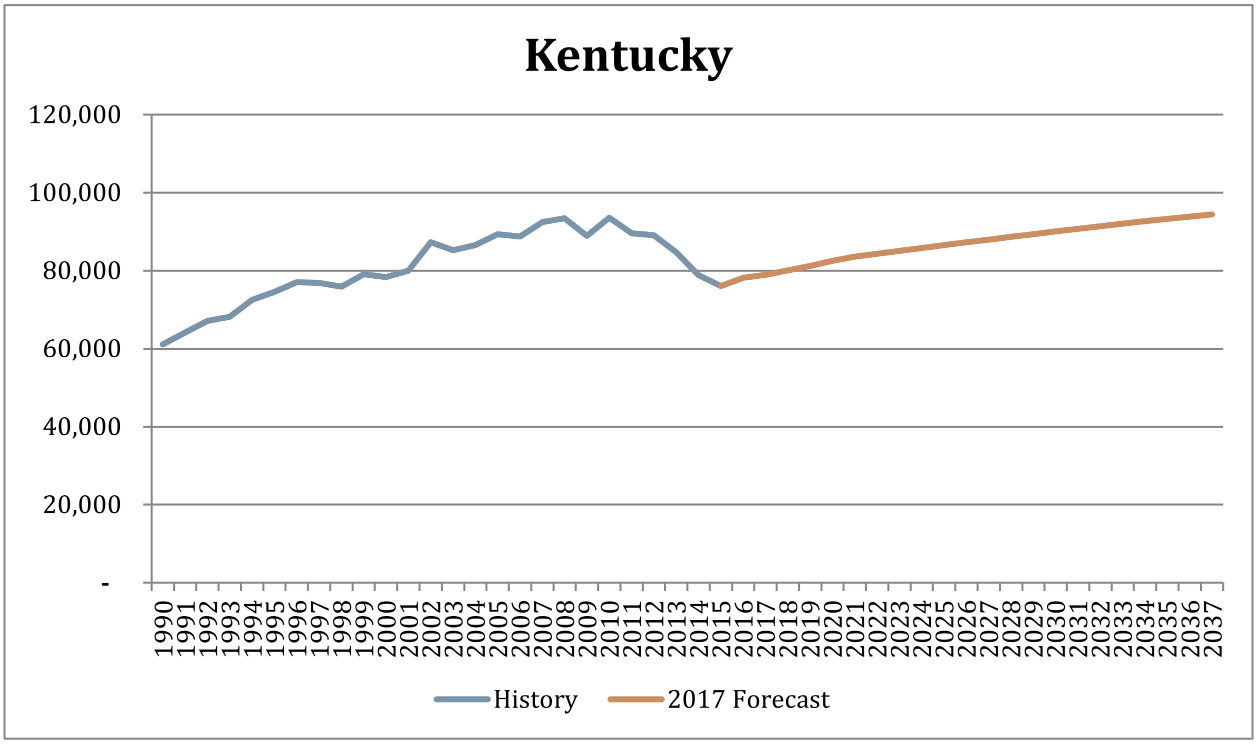
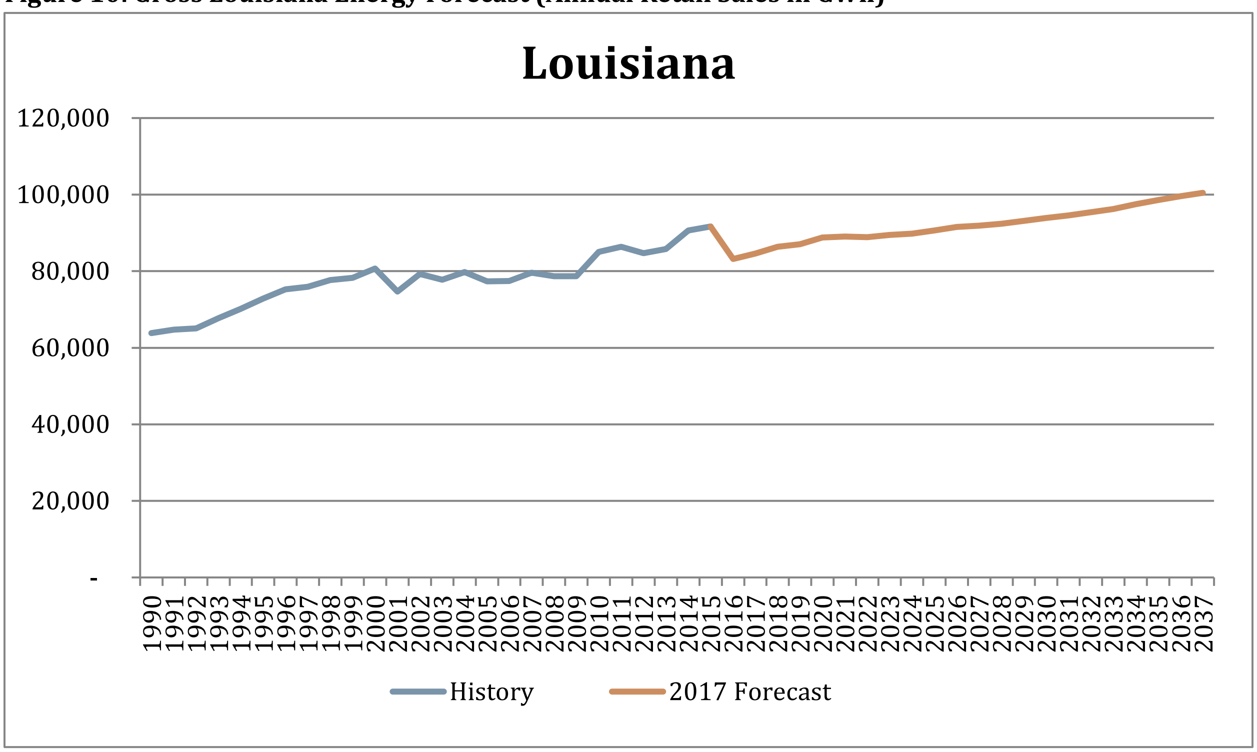


Figure 10: Gross Louisiana Energy Forecast (Annual Retail Sales in GWh)



STATEWIDE ANNUAL ENERGY FORECASTS

Figure 11: Gross Michigan Energy Forecast (Annual Retail Sales in GWh)

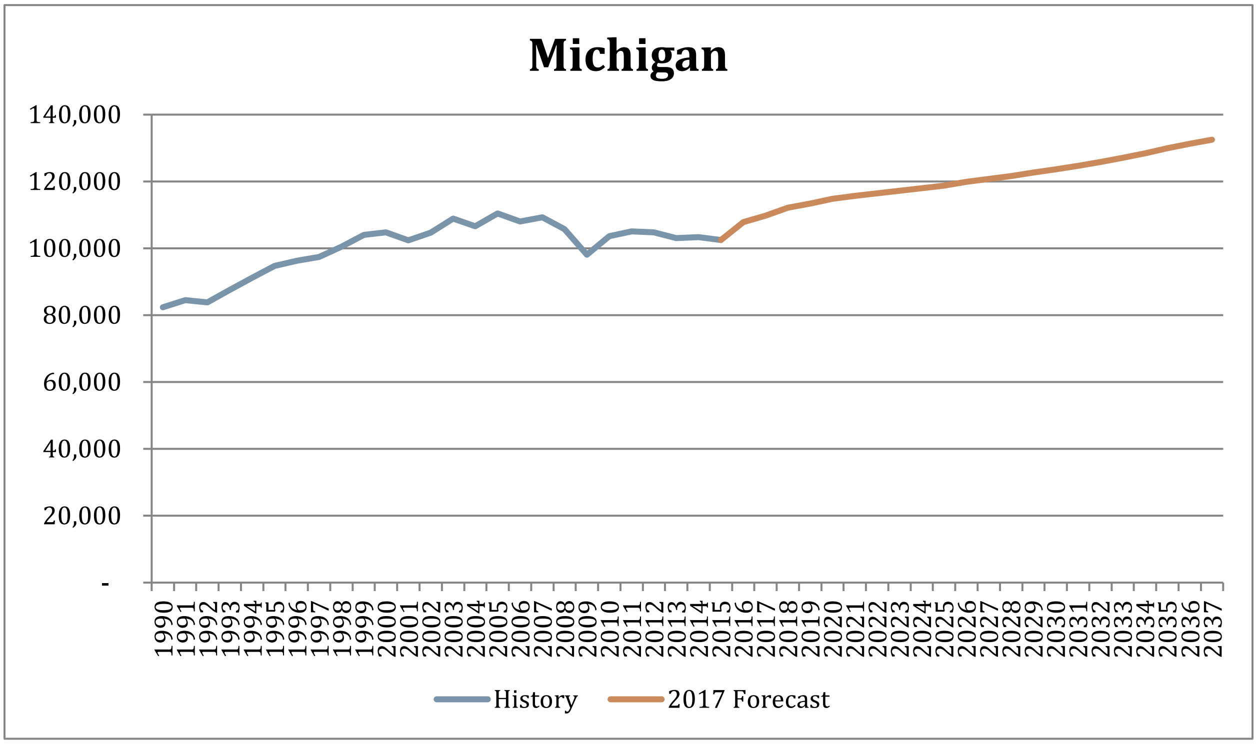
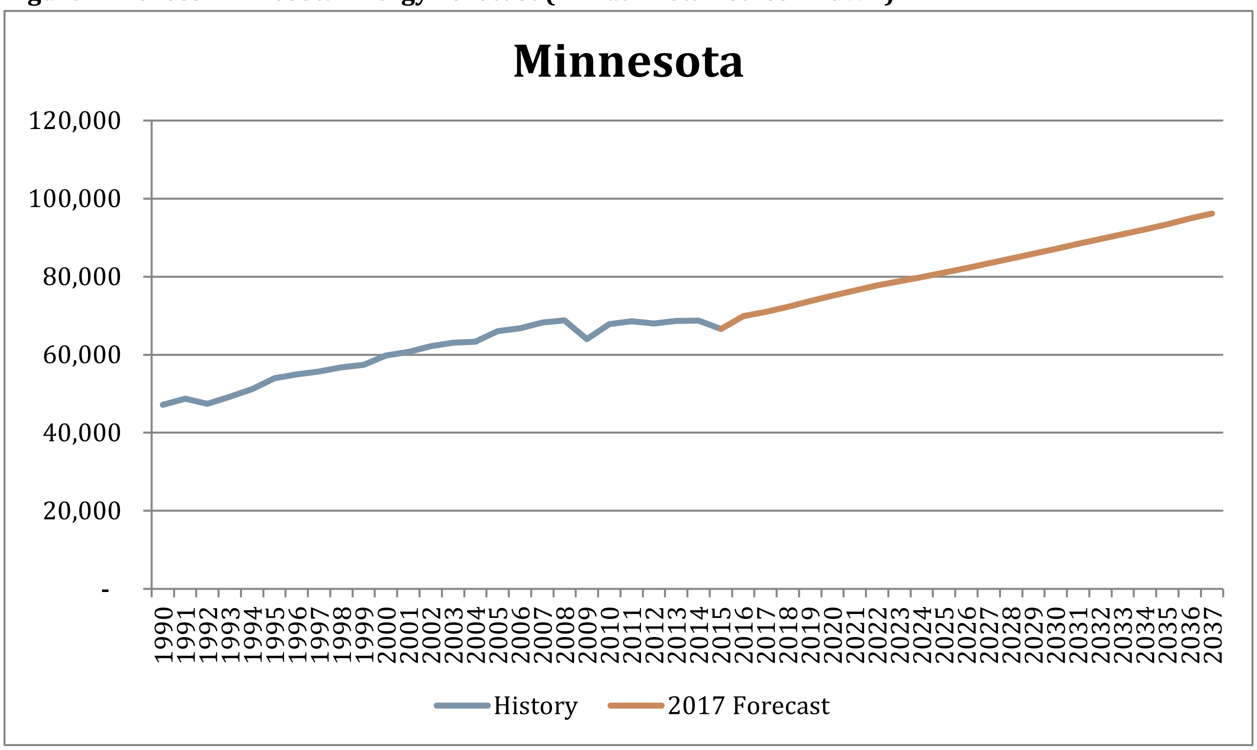


Figure 12: Gross Minnesota Energy Forecast (Annual Retail Sales in GWh)



STATEWIDE ANNUAL ENERGY FORECASTS

Figure 13: Gross Mississippi Energy Forecast (Annual Retail Sales in GWh)

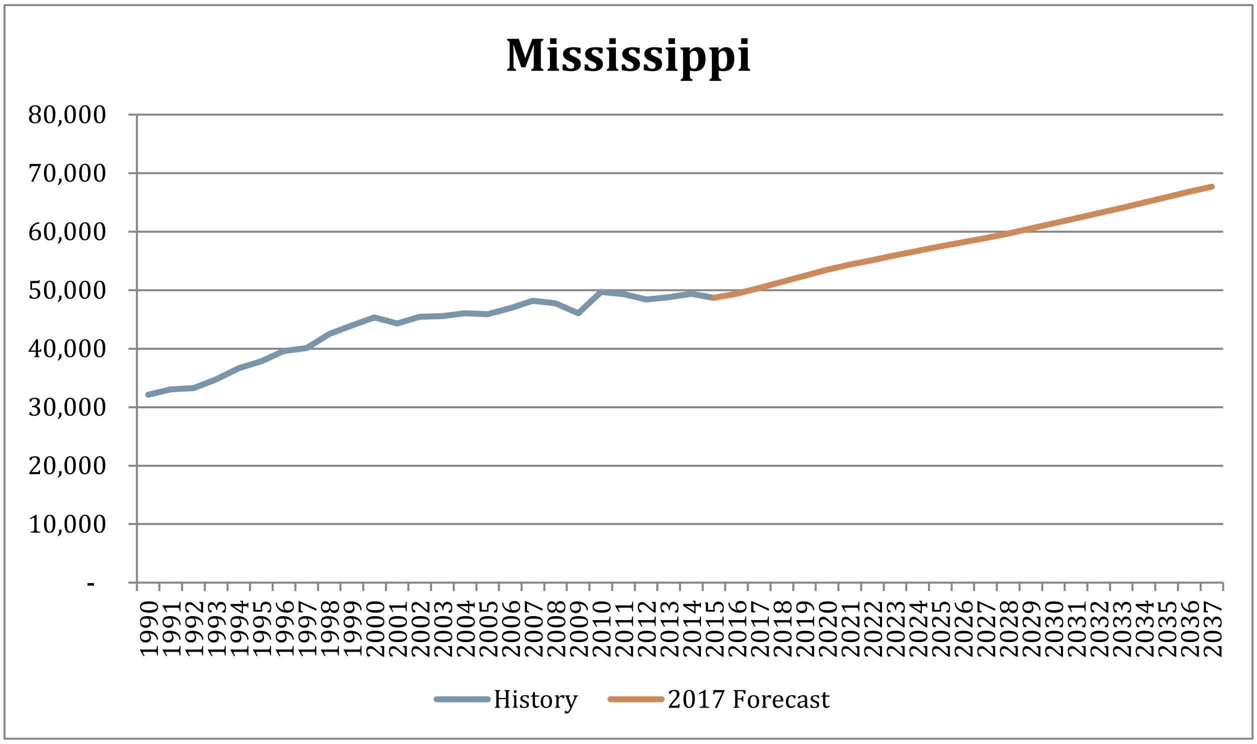
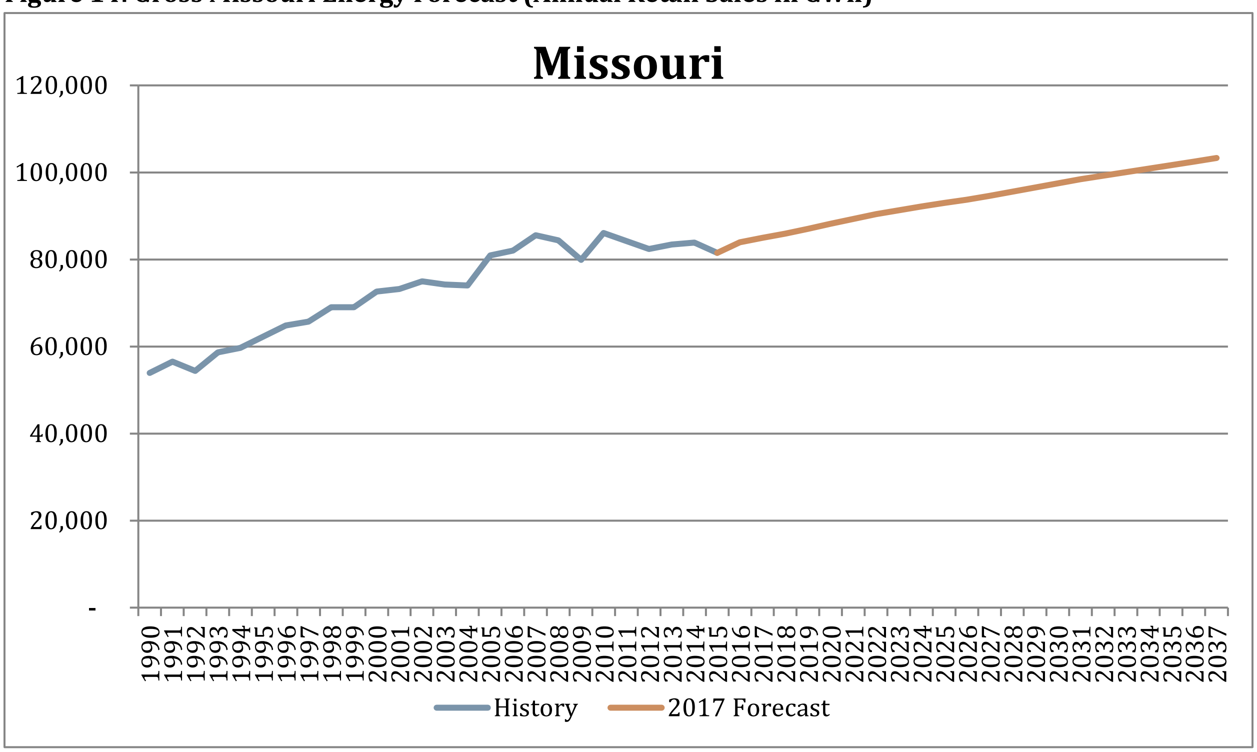


Figure 14: Gross Missouri Energy Forecast (Annual Retail Sales in GWh)



STATEWIDE ANNUAL ENERGY FORECASTS

Figure 15: Gross Montana Energy Forecast (Annual Retail Sales in GWh)

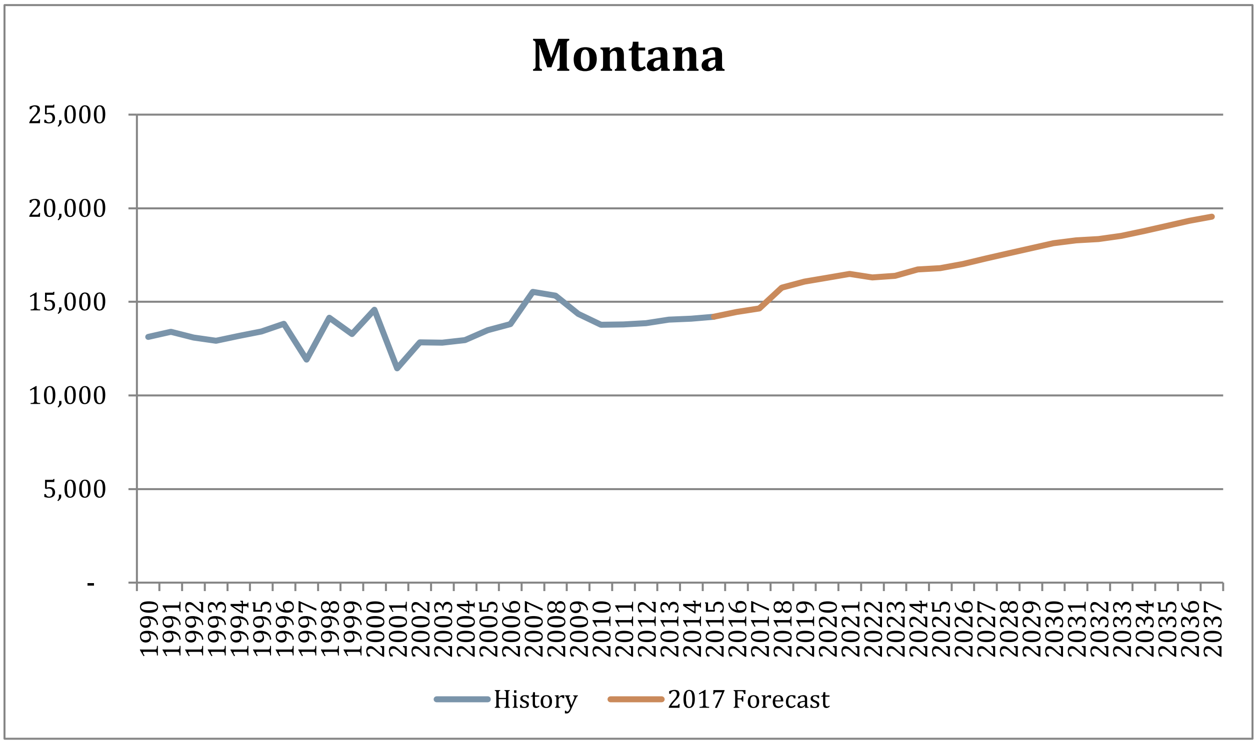
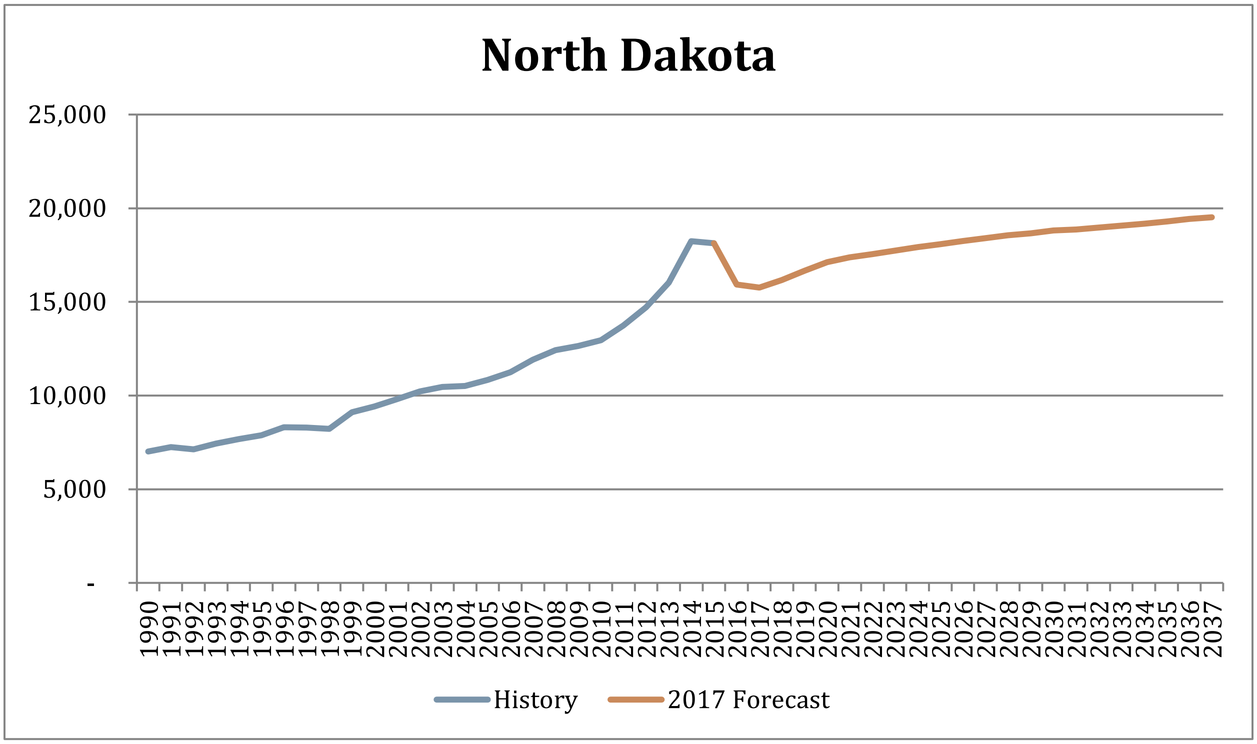


Figure 16: Gross North Dakota Energy Forecast (Annual Retail Sales in GWh)



STATEWIDE ANNUAL ENERGY FORECASTS

Figure 17: Gross South Dakota Energy Forecast (Annual Retail Sales in GWh)

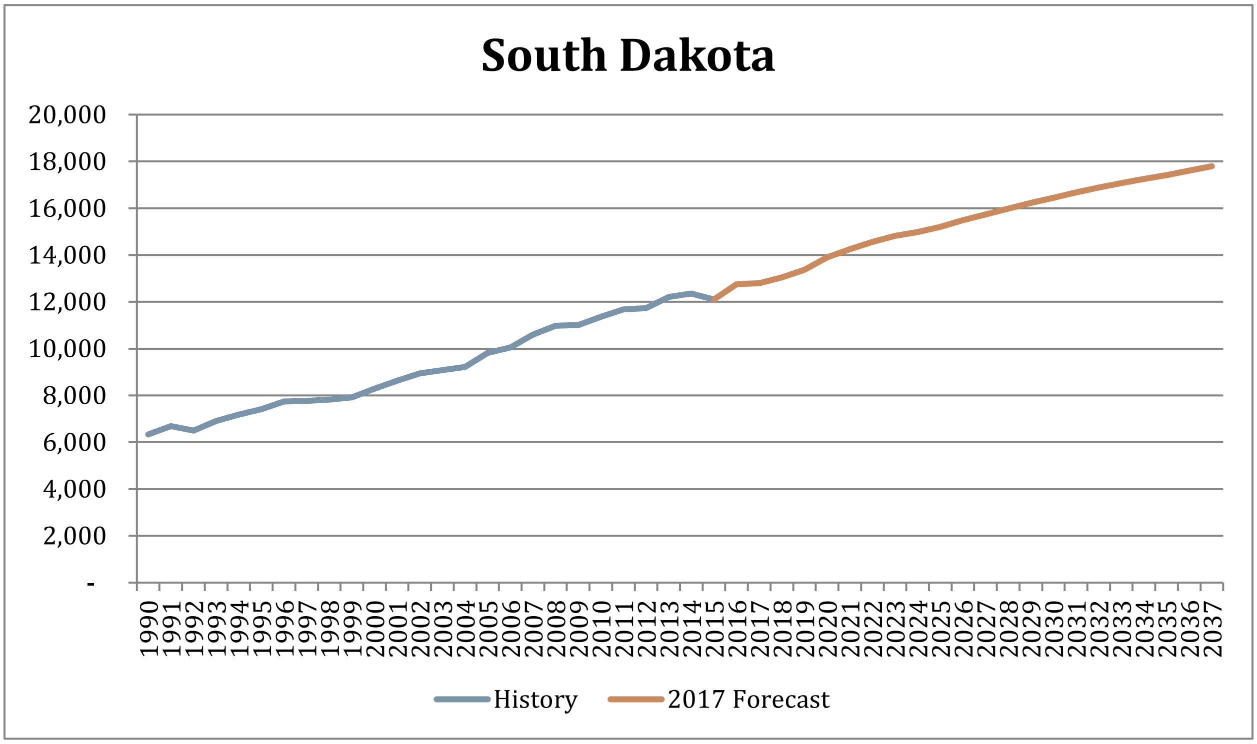
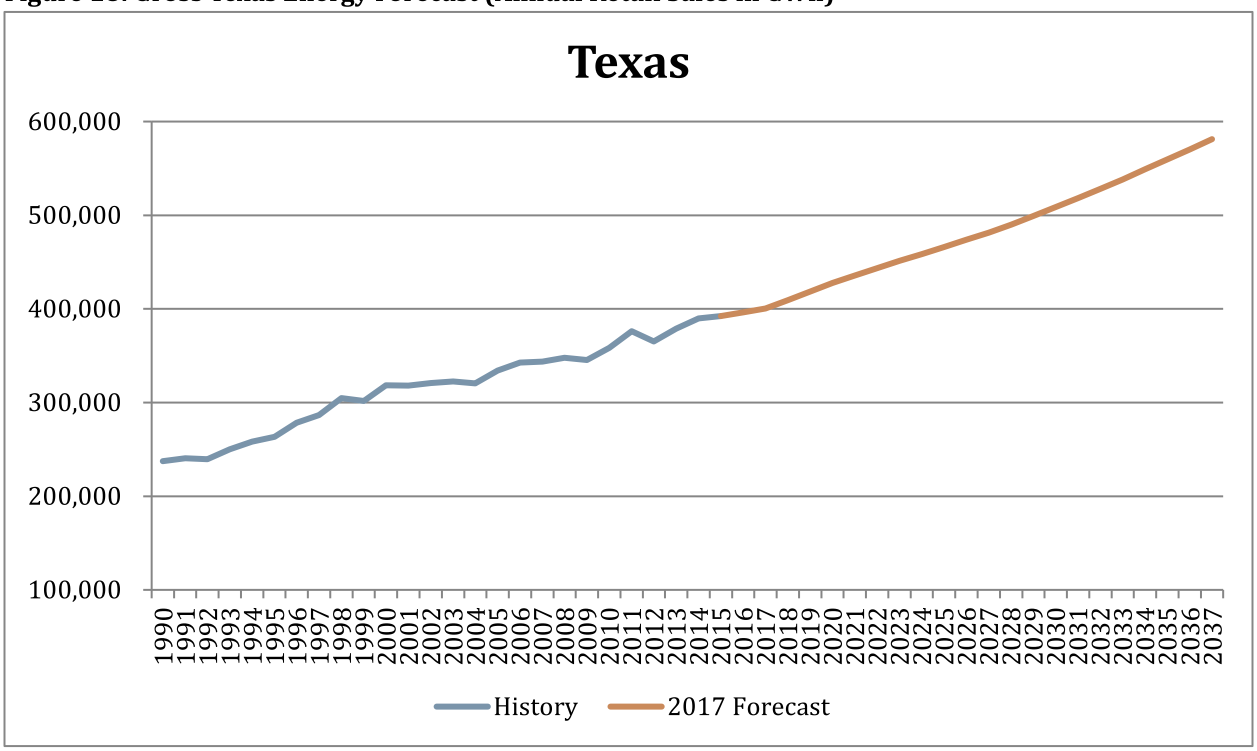
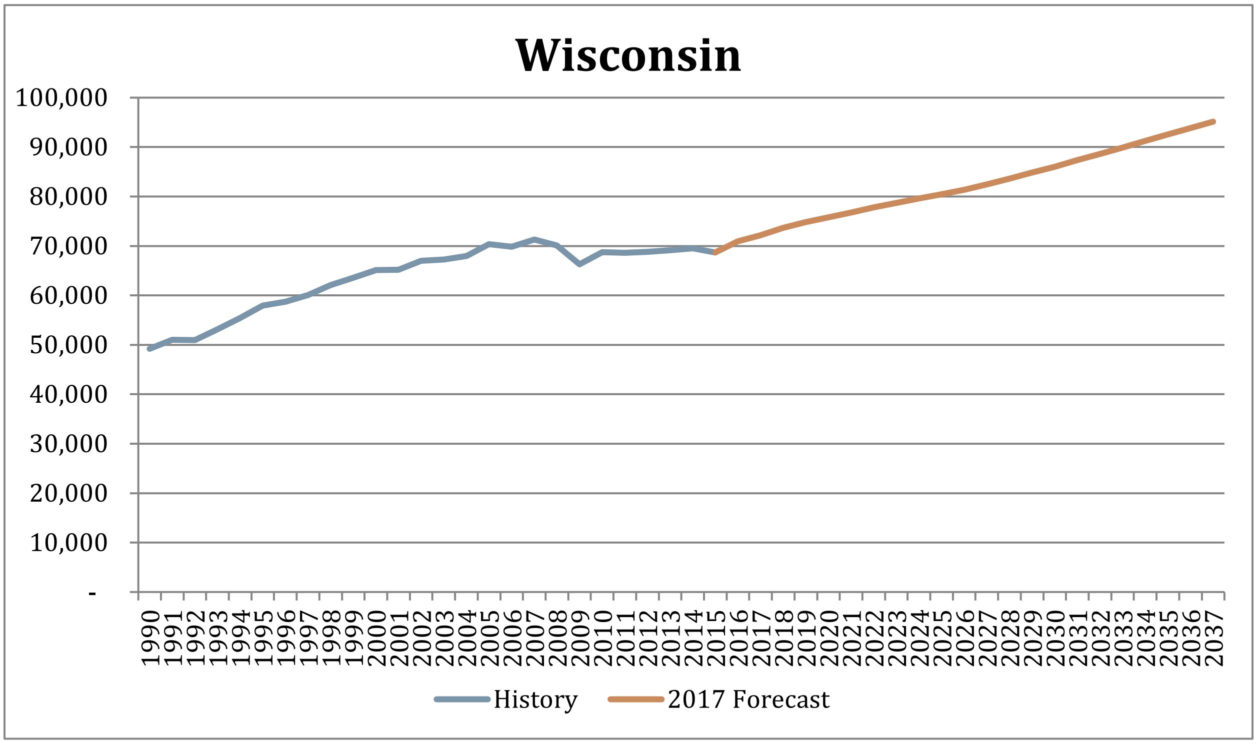


Figure 18: Gross Texas Energy Forecast (Annual Retail Sales in GWh)



STATEWIDE ANNUAL ENERGY FORECASTS

Figure 19: Gross Wisconsin Energy Forecast (Annual Retail Sales in GWh)



4 MISO Regional Energy Forecasts

4.1 ALLOCATION FACTORS

Allocation factors were used to convert annual electricity sales forecasts at the state level to the MISO LRZ level energy forecasts. The shares of electricity sales within the MISO market footprint were calculated from sales of the LBAs within the MISO market footprint. The correspondence between LBAs and LRZs within MISO is displayed in Table 5. EIA Form 861's historical annual electricity sales data from 2009 to 2015 were used to estimate the annual MISO load fraction at the state level. For most states, the MISO load fraction at either the state or the LRZ level showed the same pattern with less than a 1% absolute change annually.

4.1.1 MISO Local Resource Zone

The MISO market footprint covers all or parts of 17 states and is divided into 10 LRZs.[10] Figure 1 in Chapter 1 displays the MISO market footprint at the LRZ level. Table 6 lists MISO local balancing authorities' names and acronyms for each LRZ.

[10] A very small amount of load in Oklahoma and Tennessee is served by MISO LBAs in LRZ 8. Rather than develop individual state econometric models for those states, it is assumed that these loads grow at the rate of the rest of LRZ 8.

Table 5: MISO Local Balancing Authorities, 2016

BA Acronym	Local Balancing Authority (MISO)	LRZ
DPC	Dairy Land Power Cooperative	1
GRE	Great River Energy	1
MDU	Montana-Dakota Utilities	1
MP	Minnesota Power, Inc.	1
NSP	Northern States Power	1
OTP	Otter Tail Power Company	1
SMP	Southern Minnesota Municipal Power Association	1
ATC	American Transmission Company	2
ITCM	International Transmission Company Midwest LLC	3
MEC	MidAmerican Electric Company	3
MPW	Muscatine Power & Water	3
AMIL	Ameren - Illinois	4
CWLP	City Water Light & Power	4
SIPC	Southern Illinois Power Cooperative	4
AMMO	Ameren - Missouri	5
CWLD	Columbia Water & Light District	5
BREC	Big Rivers Electric Cooperative	6
DEI	Duke Energy Indiana (includes Indiana Municipal Power Agency and Wabash Valley Power Association)	6
HE	Hoosier Energy	6
IPL	Indianapolis Power and Light	6
NIPS	Northern Indiana Public Service Company	6
VECT	Vectren Energy	6
METC	Michigan Joint Zone (includes Michigan Electric Transmission Company LLC, Michigan Public Power Agency, Wolverine Power Supply and Consumers Energy Company)	7
ITC	International Transmission Company	7
EATO	Entergy Arkansas, Inc.	8
CLCE	Cleco Power LLC	9
ELTO	Entergy Louisiana, LLC	9
ENTO	Entergy New Orleans, Inc.	9
ETTO	Energy Texas, Inc.	9
LAFA	Lafayette City-Parish Consolidated Government	9
EMTO	Entergy Mississippi, Inc.	10
SME	South Mississippi Electric Power Association	10

Source: MAP of MEP Local Resource Zone Boundaries, MISO, September 1, 2016

MISO REGIONAL ENERGY FORECASTS

Table 6 summarizes the historical MISO load fractions at the state level for the period of 2009-2015. The category named "MISO Sales" includes all electricity sales from either MISO utilities or utilities listing a MISO LBA as the local balancing authority. At the request of MISO staff and due to concerns over providing utility-specific information in states that only have a single MISO utility, the annual electricity sales of Indiana and Kentucky are combined (IN+KY). Similarly, North Dakota and Montana have been combined (ND+MT).

Table 6: MISO Load Fraction at State Level (MWh), 2015

State	MISO Sales (Megawatt hours)	Non-MISO Sales (Megawatt hours)	2009	2010	2011	2012	2013	2014	2015
AR	33,595,698	12,869,456	70.03%	70.57%	70.39%	70.52%	70.45%	72.23%	72.30%
IA	43,808,164	3,339,129	92.03%	92.92%	93.04%	93.22%	92.92%	93.05%	92.92%
IL	48,286,307	90,333,663	33.95%	34.55%	34.80%	33.91%	34.59%	34.84%	34.83%
IN+KY	93,627,609	86,925,539	47.37%	47.49%	48.49%	48.78%	49.94%	51.95%	51.86%
LA	84,945,422	6,731,067	91.82%	91.77%	91.74%	92.06%	92.20%	92.67%	92.66%
MI	98,474,957	4,004,964	95.28%	96.01%	96.16%	96.21%	96.10%	96.08%	96.09%
MN	65,753,711	825,523	98.66%	98.73%	98.73%	98.84%	98.75%	98.77%	98.76%
MO	39,923,705	41,580,376	48.83%	49.55%	49.35%	50.22%	49.38%	49.06%	48.98%
MS	21,939,832	26,751,697	45.58%	45.89%	45.24%	44.78%	44.73%	44.56%	45.06%
ND+MT	11,362,866	20,972,993	36.03%	37.35%	37.90%	36.76%	37.46%	36.30%	35.14%
SD	3,094,934	9,007,045	26.48%	26.87%	26.07%	26.02%	25.32%	25.26%	25.57%
TX	21,442,210	370,261,957	5.53%	5.66%	5.46%	5.99%	5.74%	5.60%	5.47%
WI	68,698,932	0	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Electric power sales, revenue, and energy efficiency 861 detailed data files, U.S. Energy Information Administration, calculated by SUFG.

Figure 20 illustrates the percentage of total electricity sales from MISO associated utilities at the state level for the period of 2009-2015. The numbers above the bars represent the seven-year average MISO load fraction at the state level.

Figure 20: State-Level MISO Load Fraction, 2009 to 2015

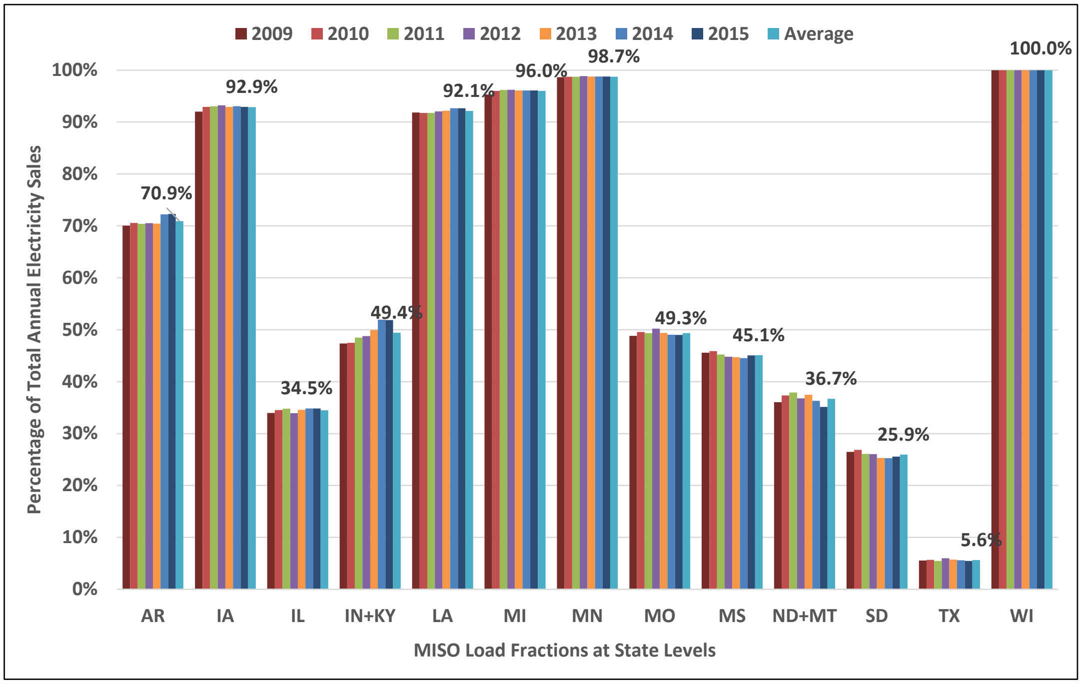


Table 7 shows the average percentage of annual electricity sales at the state level that was located in each MISO LRZ. The last row named "Non-MISO" lists the average percentage of electricity sales from non-MISO utilities at the state level.

Table 7: MISO Load Fraction at LRZ Level (Average Percentage of State-Level Electricity Sales from 2009 to 2015)

LRZ	AR	IA	IL	IN+KY	LA	MI	MN	MO	MS	ND+MT	SD	TX	WI
1		1.8%	0.0002%			0.1%	96.8%			36.7%	24.1%		16.8%
2						4.9%							83.2%
3		91.1%	1.4%				1.9%				1.8%		
4			33.1%										
5								49.2%					
6				49.4%									
7						90.9%							
8	70.9%							0.02%				0.01%	
9					92.1%							5.6%	
10									45.1%				
Non-MISO	29.1%	7.1%	65.5%	50.6%	7.9%	4.0%	1.3%	50.8%	54.9%	63.3%	74.1%	94.4%	0.0%

Source: Electric power sales, revenue, and energy efficiency Form 861 detailed data files, U.S. Energy Information Administration, calculated by SUFG.

Table 8 summarizes the percentage of MISO electricity sales in each state for the period of 2009-2015 and the seven-year average by LRZ. For most states, their percentage of electricity sales from MISO utilities was quite stable during this period. Figure 21 to Figure 30 display MISO state level load fraction by LRZ from 2009 to 2015.

Table 8: State Level MISO Load Fraction by MISO LRZs

MISO LRZ	State	State Level MISO Load Fraction							
		Average	2009	2010	2011	2012	2013	2014	2015
1	IA	1.78%	1.78%	1.77%	1.76%	1.73%	1.78%	1.83%	1.84%
	IL	0.0002%	0.0002%	0.0002%	0.0002%	0.0002%	0.0002%	0.0002%	0.0002%
	MI	0.14%	0.14%	0.14%	0.14%	0.13%	0.14%	0.14%	0.13%
	MN	96.84%	96.60%	96.73%	96.76%	96.93%	96.89%	96.76%	97.20%
	ND+MT	36.70%	35.99%	37.35%	37.90%	36.76%	37.46%	36.30%	35.14%
	SD	24.13%	24.64%	24.97%	24.28%	24.24%	23.51%	23.51%	23.78%
	WI	16.80%	16.84%	16.59%	16.94%	16.23%	17.02%	17.05%	16.90%
2	MI	4.95%	4.32%	5.22%	5.28%	4.89%	4.94%	5.14%	4.83%
	WI	83.20%	83.16%	83.41%	83.06%	83.77%	82.98%	82.95%	83.10%
3	IA	91.09%	90.25%	91.14%	91.28%	91.48%	91.15%	91.22%	91.07%
	IL	1.42%	1.40%	1.42%	1.45%	1.42%	1.42%	1.40%	1.41%
	MN	1.91%	2.06%	2.00%	1.97%	1.91%	1.86%	2.01%	1.56%
	SD	1.81%	1.84%	1.90%	1.79%	1.77%	1.80%	1.75%	1.79%
4	IL	33.08%	32.55%	33.12%	33.35%	32.49%	33.17%	33.44%	33.42%
5	MO	49.22%	48.56%	49.41%	49.22%	50.08%	49.26%	49.04%	48.96%
6	IN+KY	49.38%	47.35%	47.49%	48.49%	48.60%	49.94%	51.95%	51.86%
7	MI	90.91%	90.82%	90.65%	90.75%	91.19%	91.02%	90.80%	91.13%
8	AR	70.93%	70.03%	70.57%	70.39%	70.52%	70.45%	72.23%	72.30%
	MO[11]	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%
	TX	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
9	LA	92.13%	91.82%	91.77%	91.74%	92.06%	92.20%	92.67%	92.66%
	TX	5.63%	5.52%	5.65%	5.46%	5.98%	5.73%	5.59%	5.47%
10	MS	45.12%	45.58%	45.89%	45.24%	44.78%	44.73%	44.56%	45.06%

Source: Electric power sales, revenue, and energy efficiency Form 861 detailed data files, U.S. Energy Information Administration, calculated by SUFG.

[11] The sales of City of West Plains, MO were grouped as MISO sales in previous reports since its balancing agency was MISO according to EIA 861 records. However, EIA revised the balancing agency of City of West Plains as SWPP in the 2015 EIA 861 data release. After consulting with MISO, the sales of City of West Plains were categorized as non-MISO sales from 2009 to 2015. Before the change, the average MISO share in MO in LRZ 8 was 0.24% in 2016 report. It decreased to 0.02% after the sale adjustment.

Figure 21: MISO State-Level Load Fractions at LRZ 1

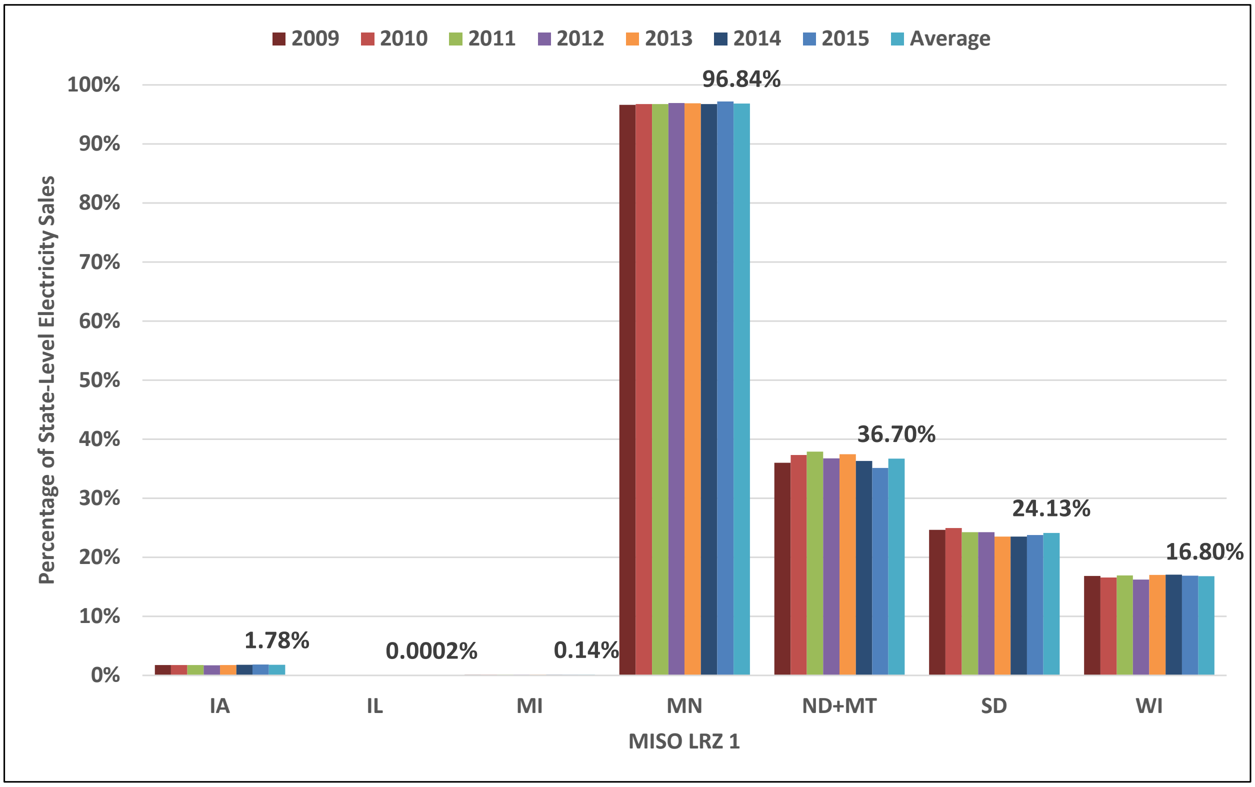


Figure 22: MISO State-Level Load Fractions at LRZ 2

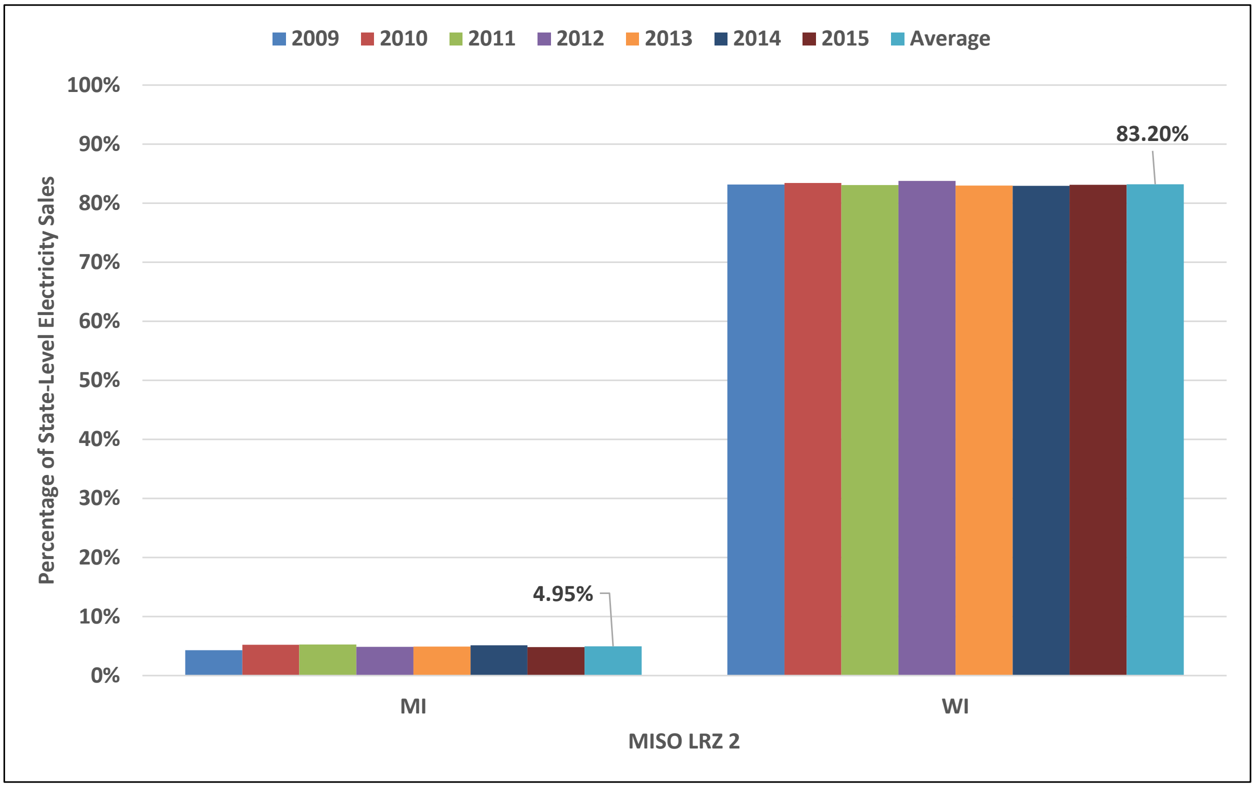


Figure 23: MISO State-Level Load Fractions at LRZ 3

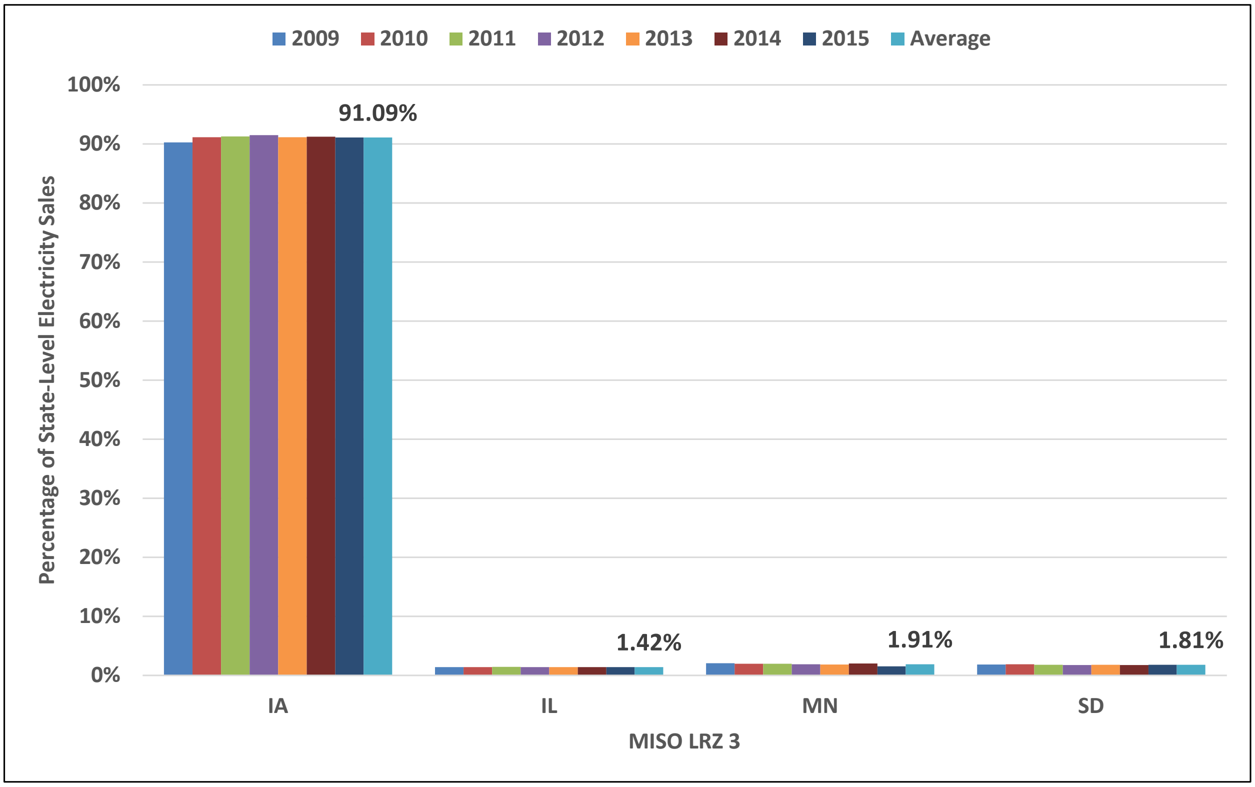


Figure 24: MISO State-Level Load Fractions at LRZ 4

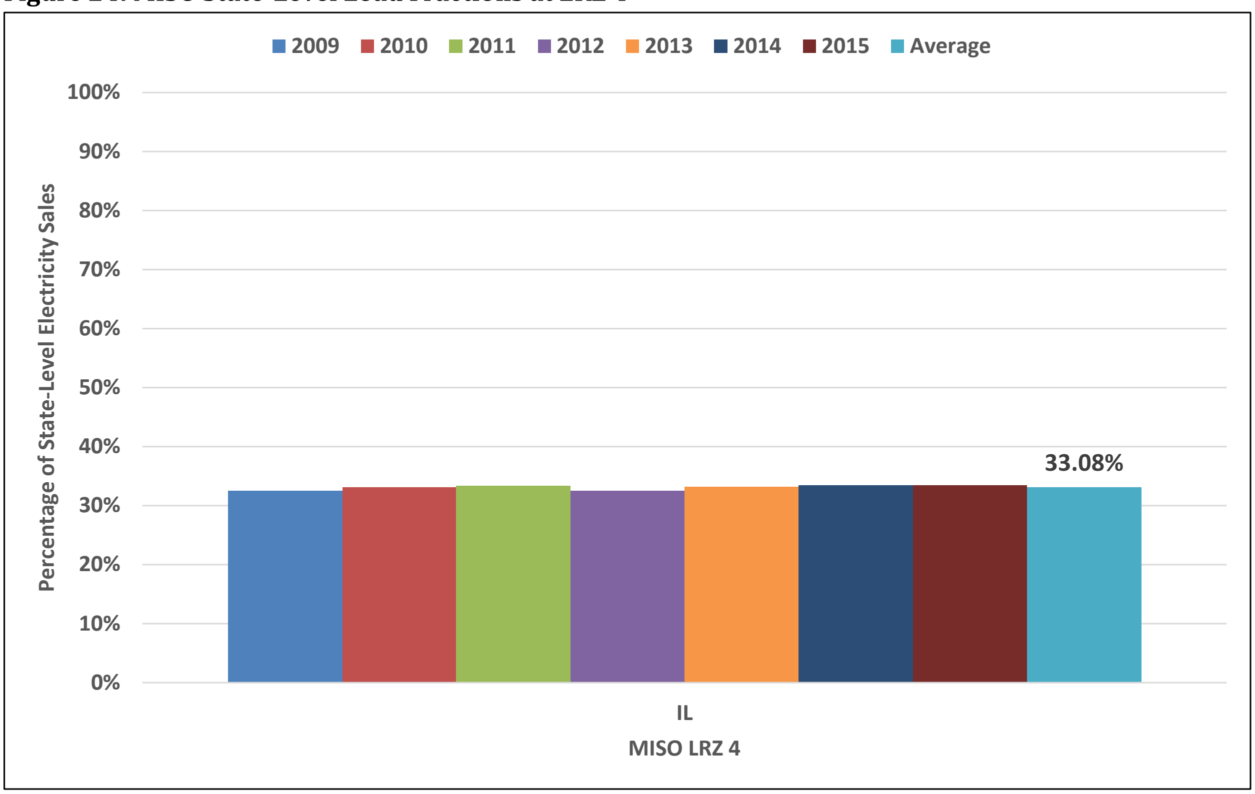


Figure 25: MISO State-Level Load Fractions at LRZ 5

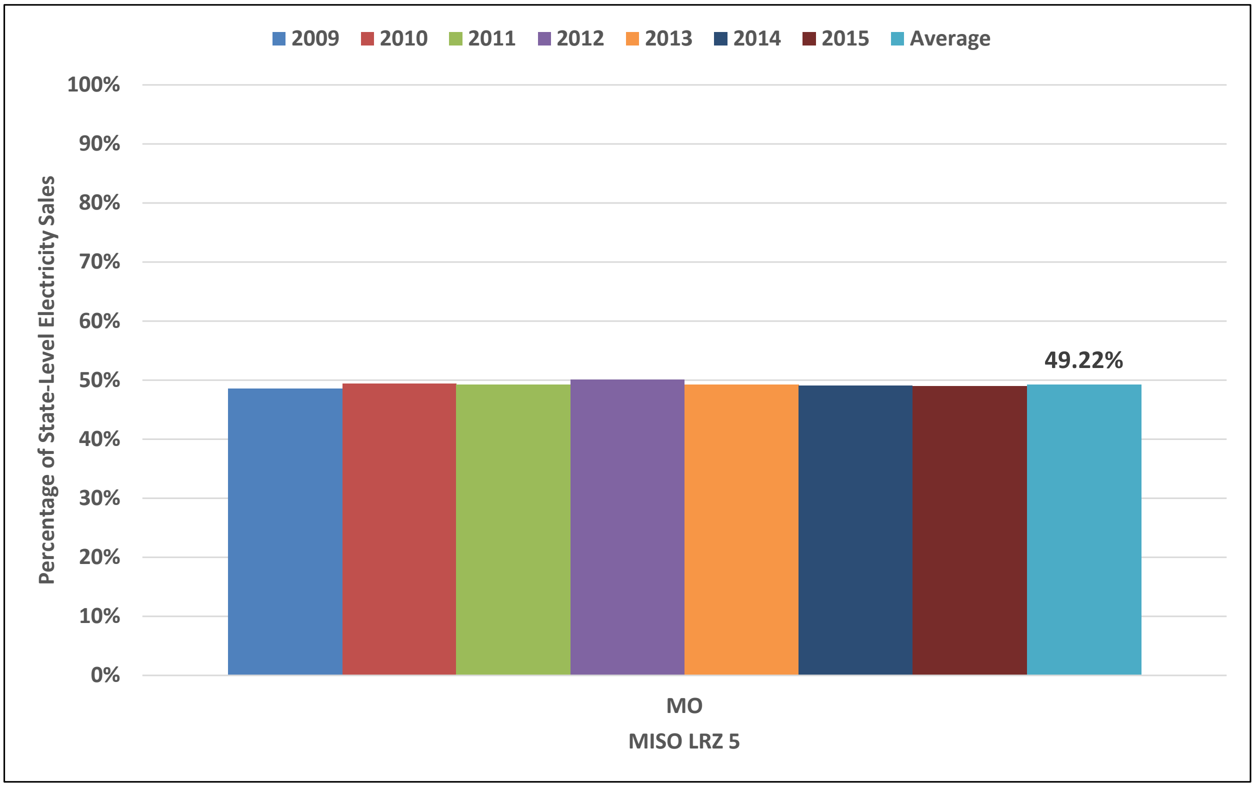


Figure 26: MISO State-Level Load Fractions at LRZ 6

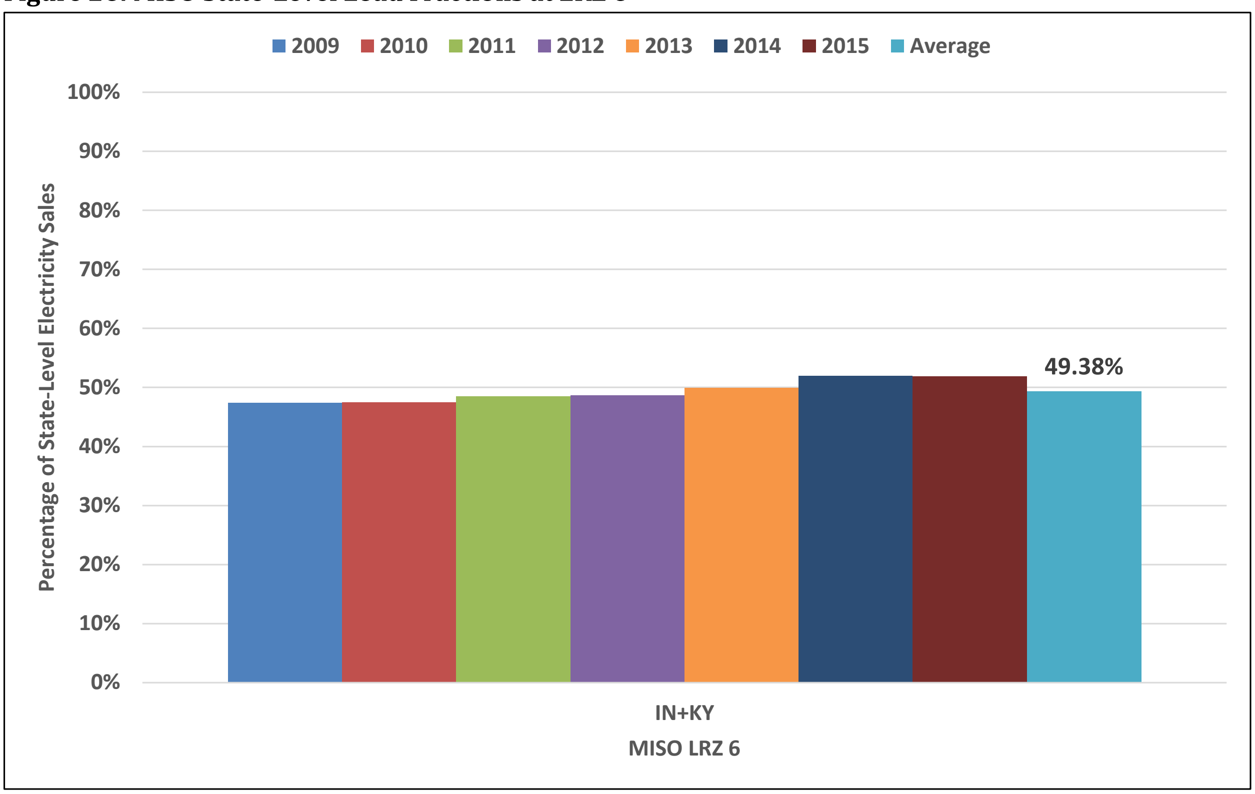


Figure 27: MISO State-Level Load Fractions at LRZ 7

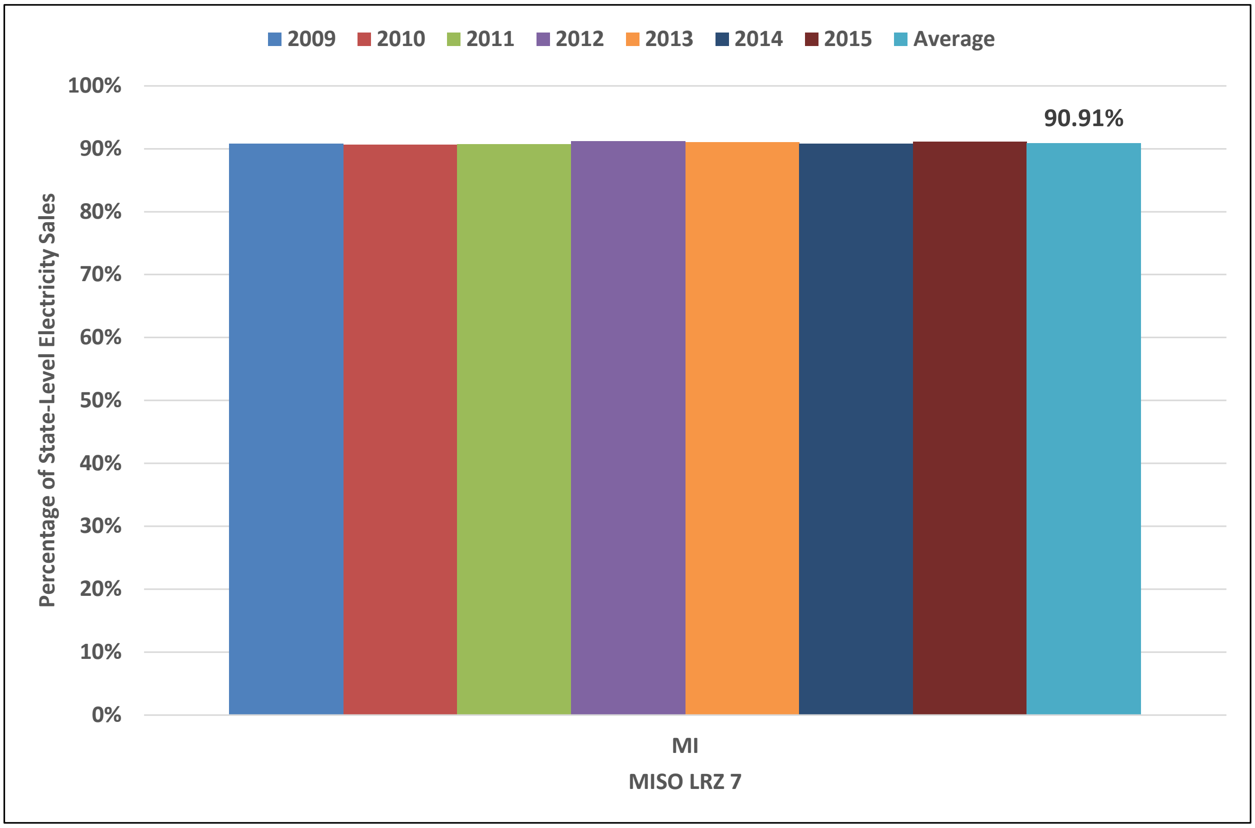


Figure 28: MISO State-Level Load Fractions at LRZ 8

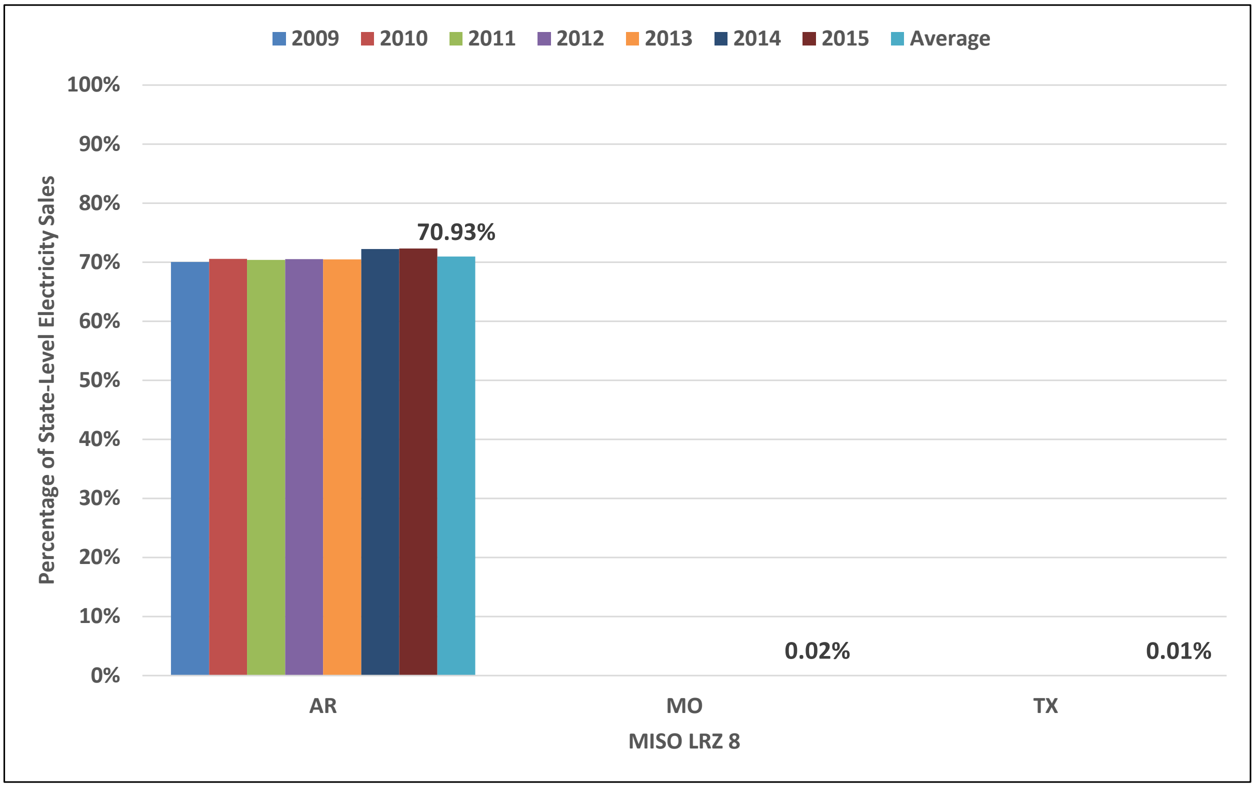


Figure 29: MISO State-Level Load Fractions at LRZ 9

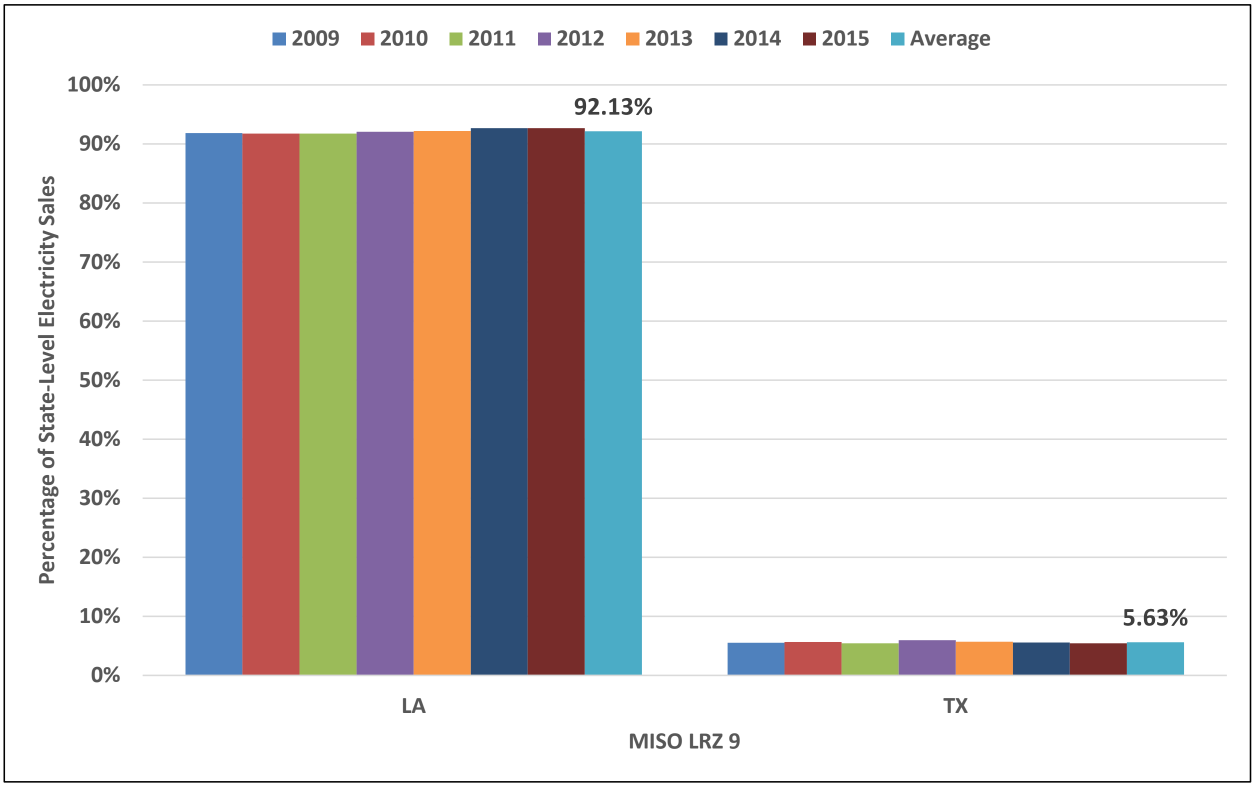
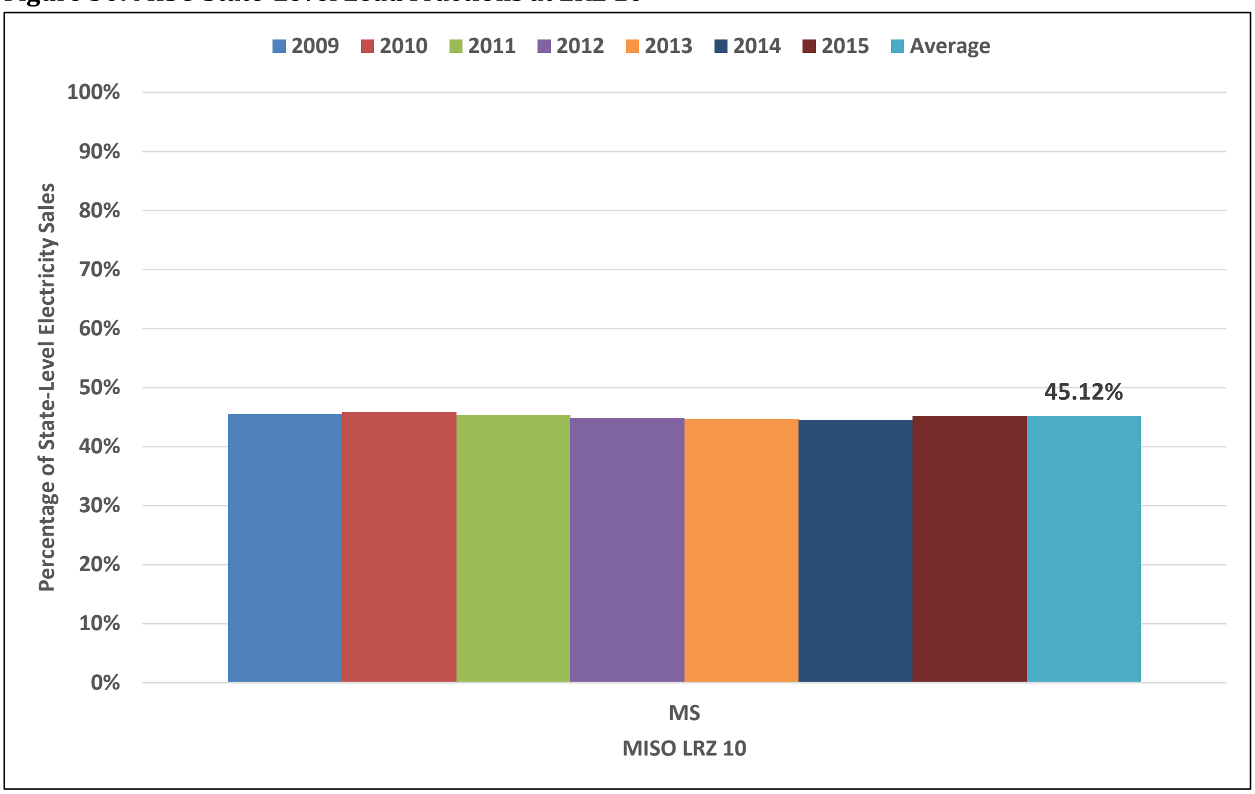


Figure 30: MISO State-Level Load Fractions at LRZ 10



4.1.2 MISO Future Allocation Factors

In determining the future allocation factors, a number of elements were considered. These include the stability of the historical market shares, any distinct upward or downward trend in the historical market shares, and information regarding expected growth for sub-state areas where those areas are particularly indicative of either the MISO or the non-MISO portion of the state. For example, most of the MISO portion of Missouri is in or near the St. Louis metropolitan area. Since the economic drivers for the St. Louis area grow slightly slower than the entire state of Missouri, the share of electricity sales in the MISO portion is reduced over time. A similar analysis was performed for Illinois using the Chicago metropolitan area, but did not indicate that an adjustment is warranted. Table 9 provides the allocation factors for each LRZ. The allocation factors were then applied to the state load forecasts to obtain LRZ-level forecasts of annual calendar-year energy sales. These were then converted to metered load forecasts by applying the estimated historical distribution losses. Figure 31 to Figure 43 provide historical market shares and future allocation factors for the 15 states within the MISO market footprint.

Table 9: Allocation Factors to Convert State Sales to LRZ Sales

MISO LRZ	State	Allocation Factor	
		Basis	Forecasting Period
1	IA	Historical average (2009-2015)	Constant at 1.78%
	IL	Historical average (2009-2015)	Constant at 0.0002%
	MI	Historical average (2009-2015)	Constant at 0.14%
	MN	Historical average (2009-2015)	Constant at 96.84%
	ND+MT	Historical average (2009-2015)	Constant at 36.70%
	SD	Historical average (2009-2015)	Constant at 24.13%
	WI	Historical average (2009-2015)	Constant at 16.80%
2	MI	Historical average (2009-2015)	Constant at 4.95%
	WI	Historical average (2009-2015)	Constant at 83.20%
3	IA	Historical average (2009-2015)	Constant at 91.09%
	IL	Historical average (2009-2015)	Constant at 1.42%
	MN	Historical average (2009-2015)	Constant at 1.91%
	SD	Historical average (2009-2015)	Constant at 1.81%
4	IL	Chicago vs. state growth Historical average (2009-2015)	Constant at 33.08%
5	MO	St. Louis vs. state growth Decrease over time	Reduced from 49.11% in 2016 to 47.06% in 2027
6	IN+KY	Historical average (2014-2015)	Constant at 51.90%
7	MI	Historical average (2009-2015)	Constant at 90.91%
8	AR	Historical average (2009-2015)	Constant at 70.93%
	MO	Historical average (2009-2015)	Constant at 0.02%[12]
	TX	Historical average (2009-2015)	Constant at 0.0060%
9	LA	Historical average (2009-2015)	Constant at 92.13%
	TX	Historical average (2009-2015)	Constant at 5.63%
10	MS	Historical average (2009-2015)	Constant at 45.12%

[12] The average MISO share of MO in Zone 8 was revised significantly lower than last year (0.24%) due to information from MISO that the City of West Plains is a non-MISO utility.

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Figure 31 shows the historical MISO market share and future allocation factor for the state of Arkansas. Historical values for LRZ 8 are in the range of 70.03% to 72.30%. The allocation factor is held constant at the average of the historical values (70.93%).

Figure 31: MISO Allocation Factors—AR

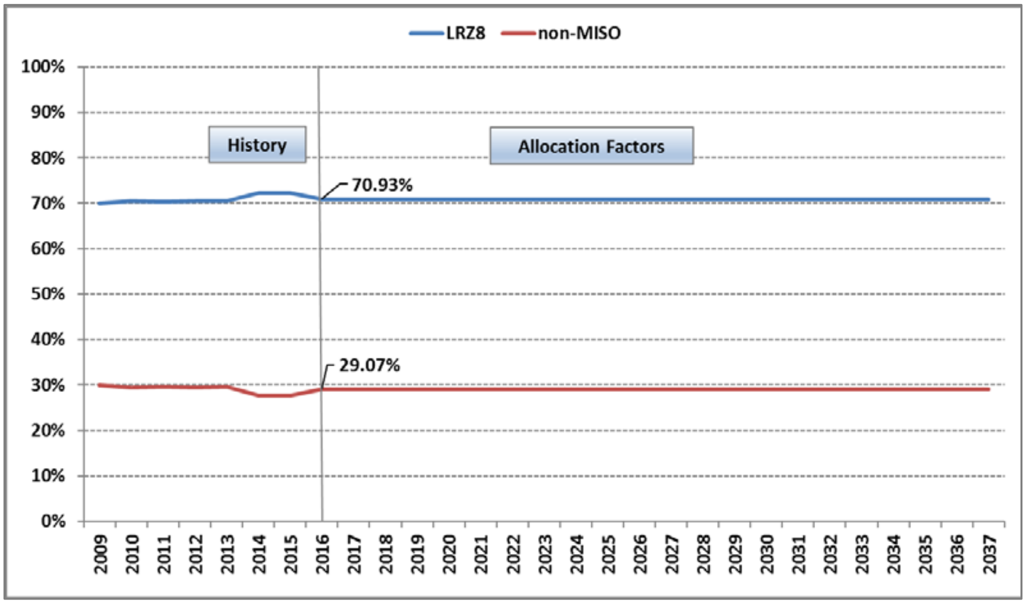


Figure 32 shows the historical MISO market share and future allocation factor for Iowa. Historical values for LRZ 1 are in the range of 1.73% to 1.84%. The allocation factor is held constant at the average of the historical values (1.78%). For LRZ 3, historical values have little variation, which range from 90.25% to 91.48%. The allocation factor is held constant at the average of the historical values (91.09%).

Figure 32 : MISO Allocation Factors—IA

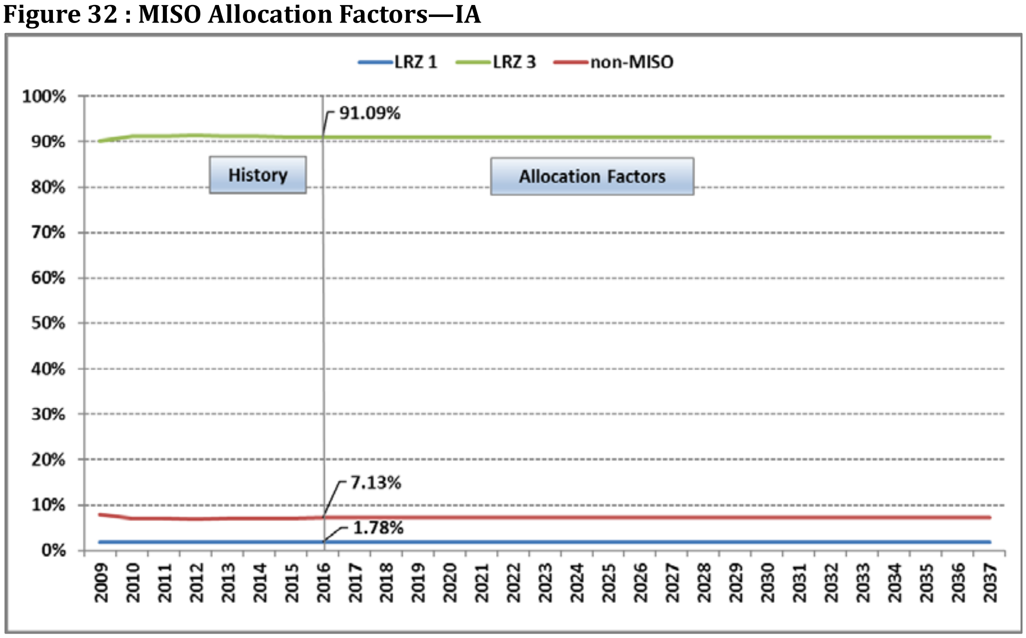


Figure 33 shows the historical MISO market share and future allocation factor for Illinois. Based on the projections of the values for the model drivers for the state of Illinois and for the Chicago area, the non-MISO region is projected to grow at a similar rate to the MISO region. Therefore, the allocation factors for LRZ 4 are held constant at the average of the historical values (33.08%). For LRZ 1 and LRZ 3, very small variations are observed in their historical values. They are held constant at the averages of their historical values (0.0002% and 1.42% respectively).

Figure 33: MISO Allocation Factors—IL

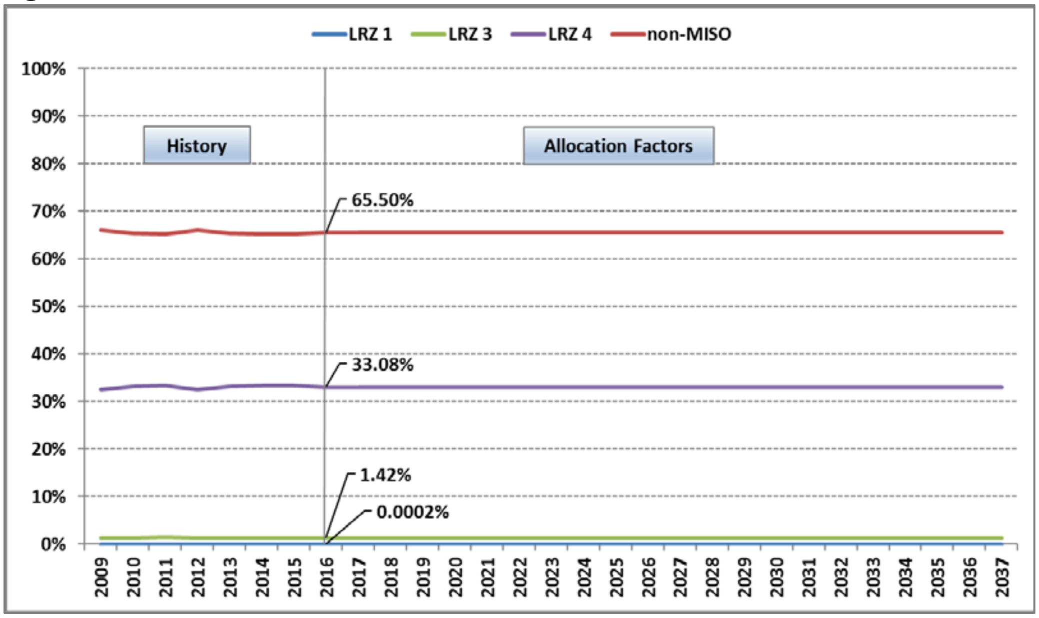


Figure 34 shows the combined historical MISO market share for Indiana and Kentucky and the future allocation factor. The historical MISO share in IN+KY has risen throughout the observations (from 47.35% in 2009 to 51.95% in 2014 and 51.86% in 2015). Because the 2014 and 2015 values reflect the MISO shares in LRZ 6 after the complete shutdown of the Paducah Gaseous Diffusion Plant in Kentucky,[13] the future allocation factor is held constant at the average of 2014 and 2015 values (51.90%).

[13] Paducah Gaseous Diffusion Plant was closed in mid-2013, which represented a 3 GW load on the Tennessee Valley Authority (TVA) system and accounts for more than 10% of Kentucky's retail sales.

Figure 34: MISO Allocation Factors—IN+KY

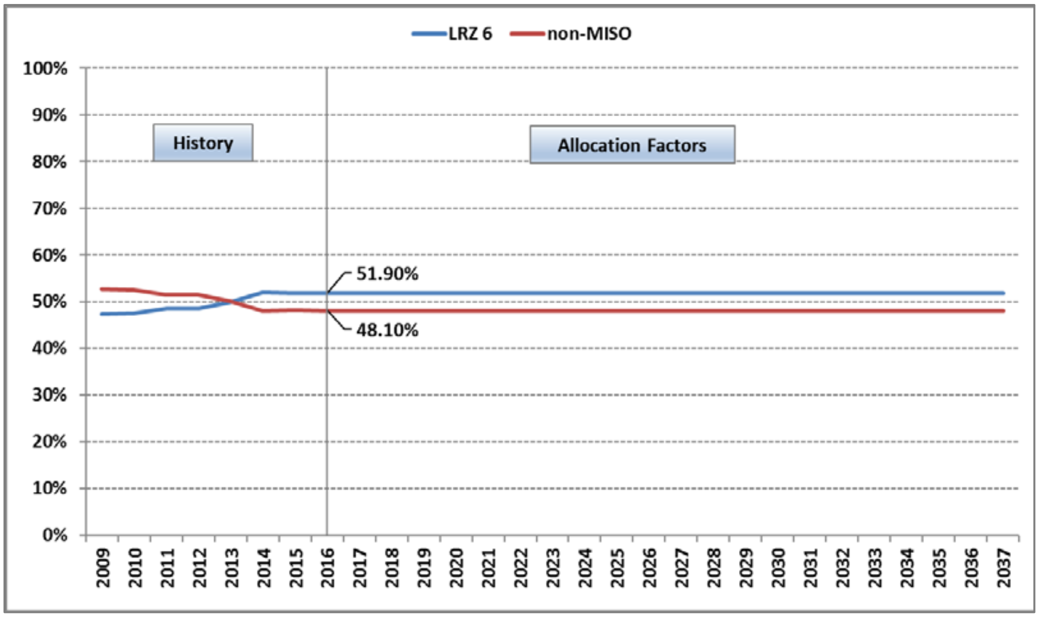


Figure 35 shows the historical MISO market share and future allocation factor for Louisiana. Very small variations are observed in the historical shares, which are in the range of 91.74% to 92.67%. The allocation factor is held constant at the average of the historical values (92.13%).

Figure 35: MISO Allocation Factors—LA

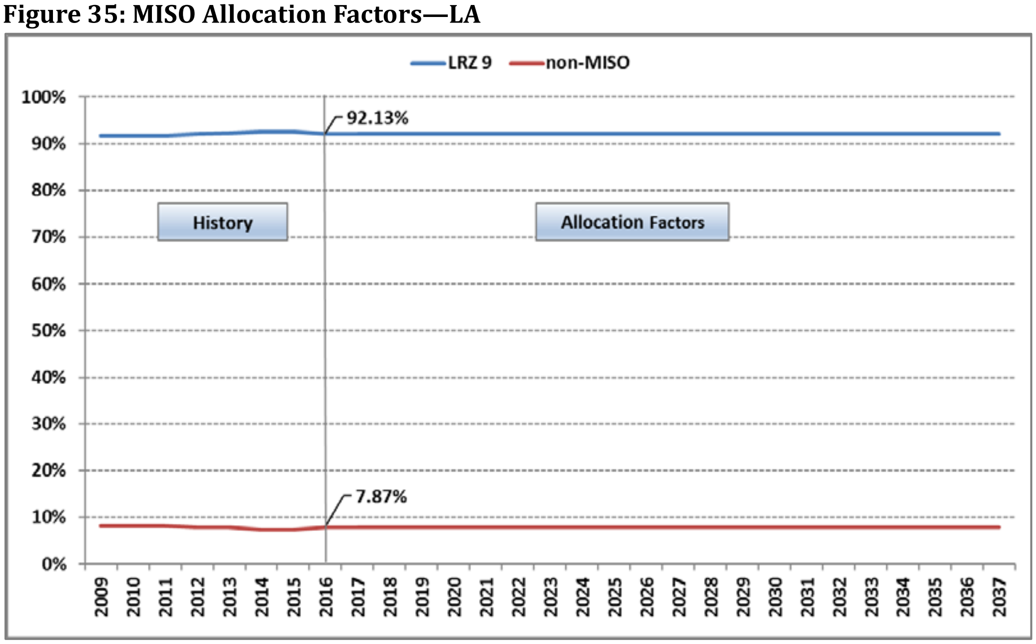


Figure 36 shows the historical MISO market share and future allocation factor for Michigan. LRZ 1 has very little variation in historical shares and is held constant at the average of the historical values (0.14%). LRZ 2 has historical shares ranging from 4.32% to 5.28%. The allocation factor is held constant at the historical average (4.95%). The variation in LRZ 7 has been low (between 90.65% and 91.19%). The allocation factor is held constant at the average of the historical values (90.91%).

Figure 36: MISO Allocation Factors—MI

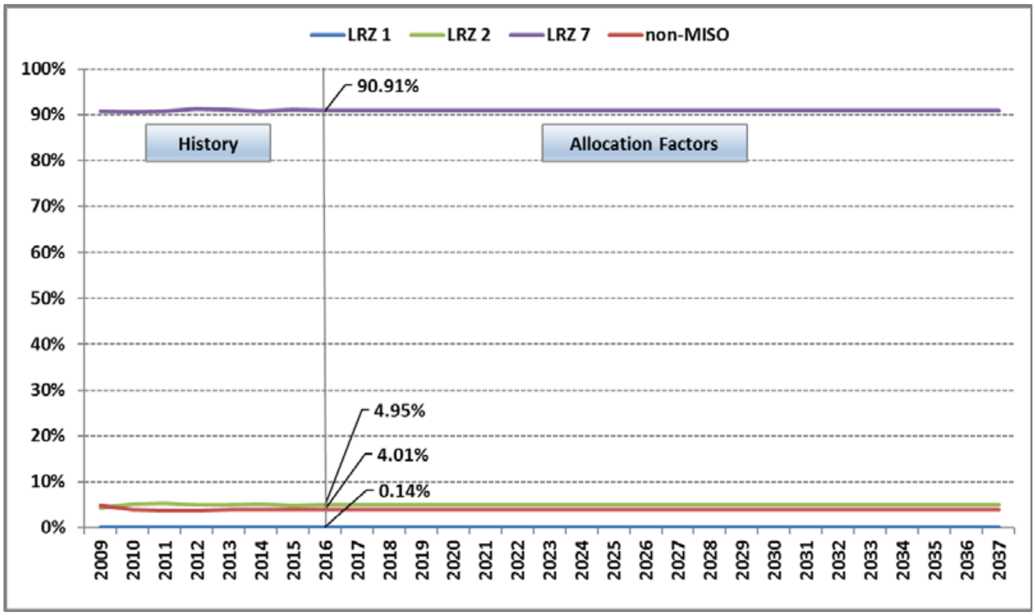


Figure 37 shows the historical MISO market share and future allocation factor for Minnesota. The variation in LRZ 1 has been very low (between 96.60% and 97.20%). The allocation factor is held constant at the average of the historical values (96.84%). The variation in LRZ 3 has also been low (between 1.56% and 2.06%). The allocation factor is held constant at the average of the historical values (1.91%).

Figure 37: MISO Allocation Factors—MN

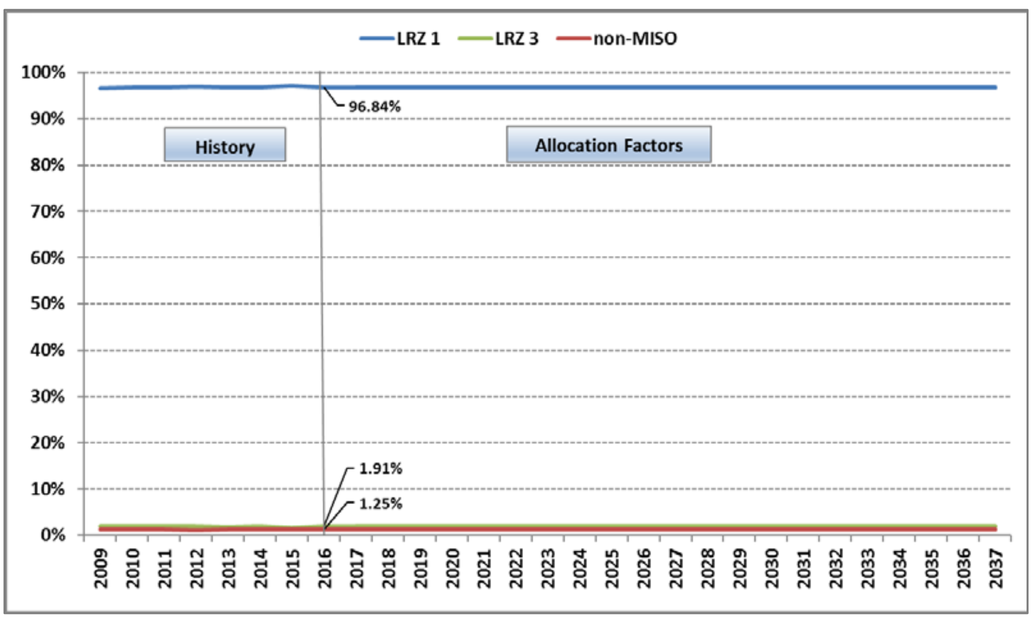


Figure 38 shows the historical MISO market share and future allocation factor for Missouri. Please note that most of the MISO LRZ5 portion of Missouri is in or near the St. Louis metropolitan area. Based on the projections of the values for the model drivers for the state of Missouri and for the St. Louis metropolitan statistical area from HIS Markit, the non-MISO region is projected to grow slightly faster than the MISO region. Therefore, the allocation factor for LRZ5 is reduced from 49.11% in 2016 to 47.06% in 2027, which would give LRZ5 the same percent compound annual growth rate as the state model gets using the St. Louis metropolitan area macroeconomic drivers. The allocation factor for LRZ5 is held constant at 47.06% after 2027. The variation in the historical share of LRZ 8 is low. The allocation factor is held constant at the average of the historical values (0.02%).

Figure 38: MISO Allocation Factors—MO

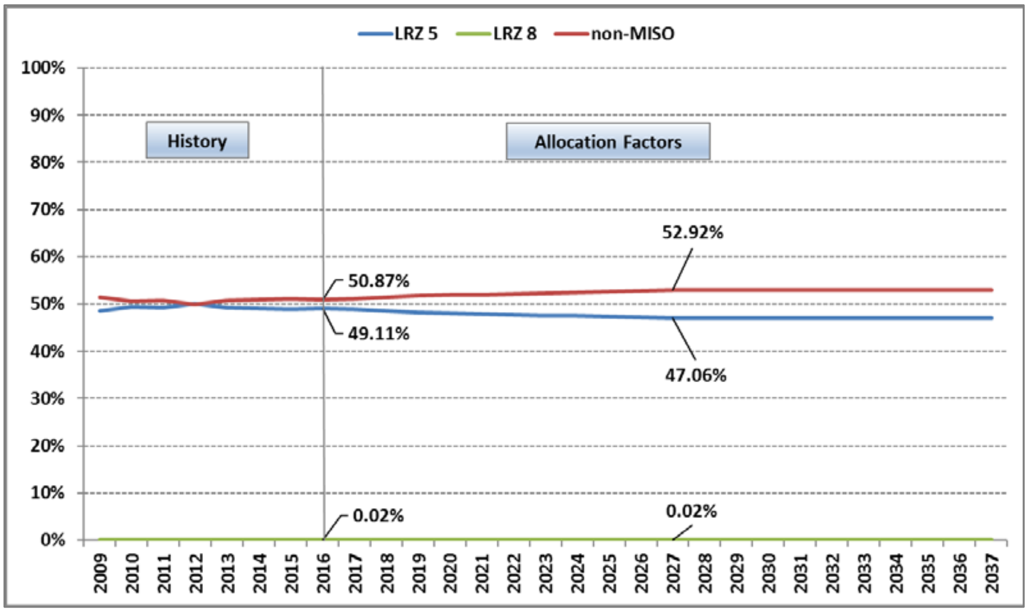


Figure 39 shows the historical MISO market share and future allocation factor for Mississippi. While there is some variation in the historical share (between 44.73% and 45.89%), there is no consistent pattern of growth or shrinkage. The allocation factor is held constant at the average of the historical values (45.12%).

Figure 39: MISO Allocation Factors—MS

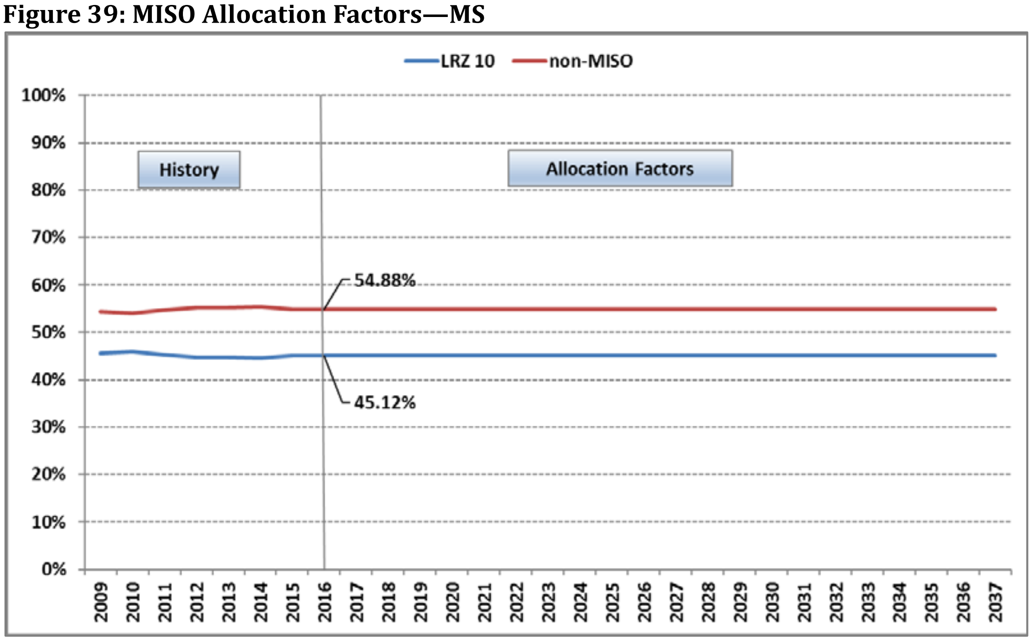


Figure 40 shows the combined historical MISO market share in North Dakota and Montana and the future allocation factor. The historical shares range from 35.14% to 37.90%, without a clear trend of growing or shrinking. The allocation factor is held constant at the average of the historical values of the period of 2009-2015 (36.70%).

Figure 40: MISO Allocation Factors—ND+MT

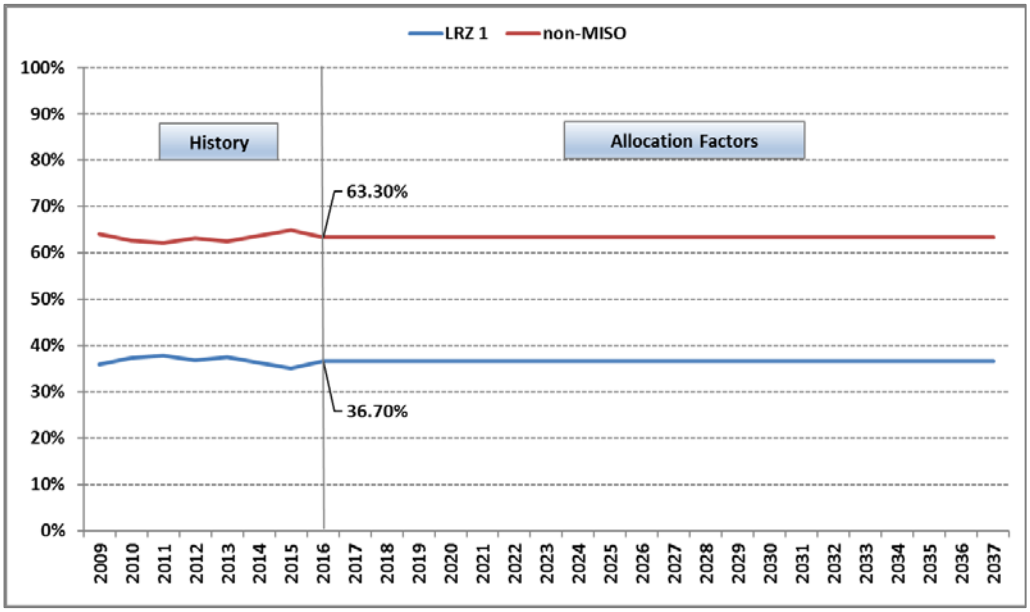


Figure 41 shows the historical MISO market share and future allocation factor for South Dakota. The variation in the historical share of LRZ 1 is moderate (between 23.51% and 24.97%). The allocation factor is held constant at the average of the historical values (24.13%). The variation in the historical share of LRZ3 is low (between 1.75% and 1.90%). The allocation factor is held constant at the average of the historical values (1.81%).

Figure 41: MISO Allocation Factors—SD

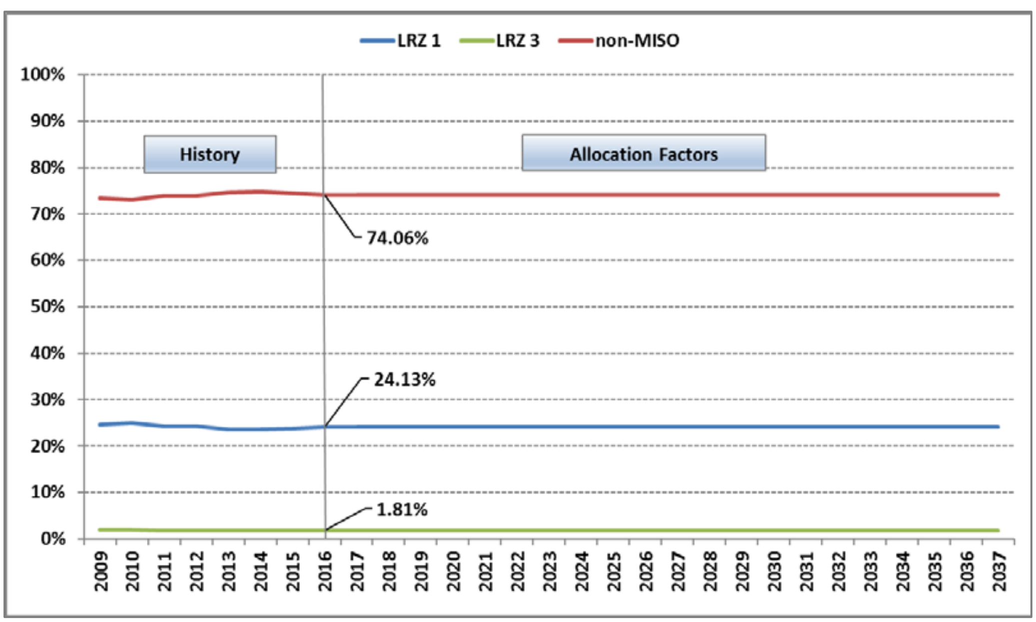


Figure 42 shows the historical MISO market share and future allocation factor for Texas. The variation has been very low for LRZ8 (between 0.0057% and 0.0065%). The allocation factor is held constant at the average of historical values (0.0060%). For LRZ9, historical shares fluctuated in the range of 5.46% to 5.98%. The allocation factor is held constant at its historical average (5.63%).

Figure 42: MISO Allocation Factors—TX

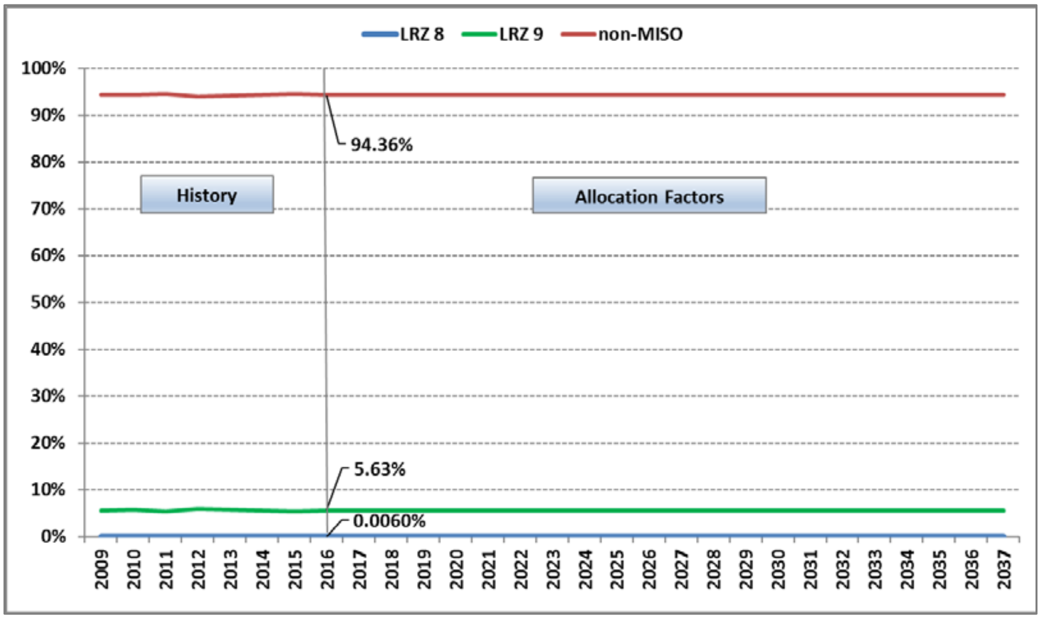
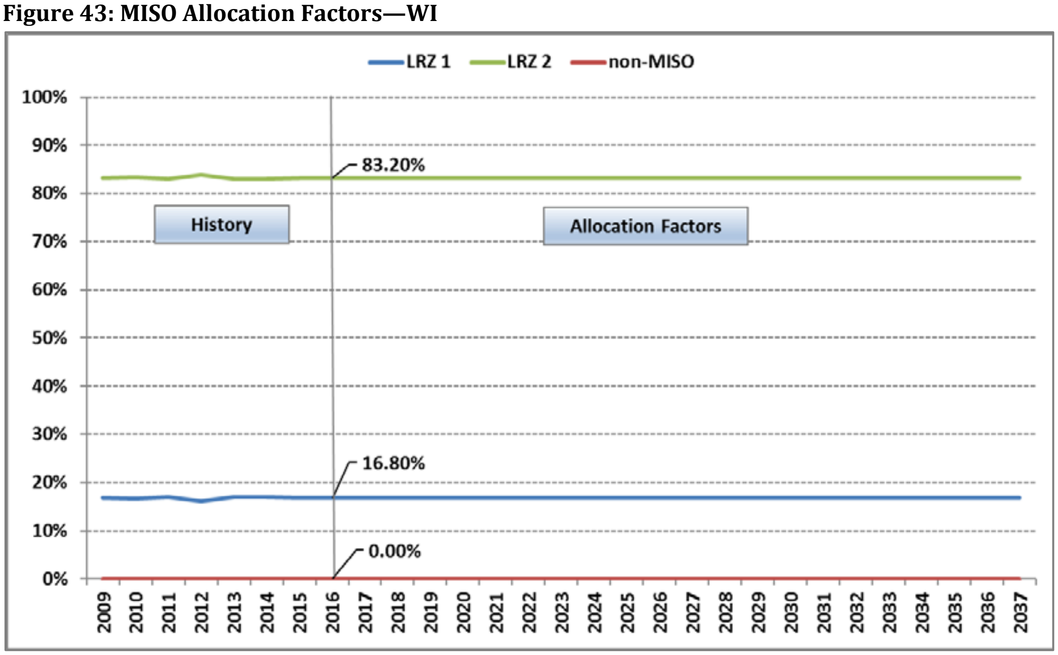


Figure 43 shows the historical MISO market share and future allocation factor for Wisconsin. The variation in the historical share of LRZ 1 is moderate (between 16.23% and 17.05%). The allocation factor is held constant at the average of the historical values (16.80%). The variation in the historical share of LRZ2 is also moderate (between 82.95% and 83.77%). The allocation factor is held constant at the average of the historical values (83.20%).

Figure 43: MISO Allocation Factors—WI



4.2 ANNUAL ENERGY FORECASTS

Table 10 provides the gross LRZ annual metered load projections (without the EE adjustments) and Table 11 provides the net LRZ annual metered load projections (with the EE adjustments). Please note that 2016 data shown in the following tables are actual loads provided by MISO. Thus, they are the same on both the gross and net basis. Also, there are no EE adjustments for LRZ2 and LRZ10 because none were indicated from the data provided by MISO.

Table 10: Gross LRZ Energy Forecasts without EE Adjustments (Annual Metered Load in GWh)

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	96,781	65,531	48,732	49,373	38,679	94,622	101,919	36,768	111,836	22,488
2017	101,443	68,006	47,600	51,432	43,599	104,198	106,298	37,812	105,420	23,044
2018	103,767	69,451	48,323	51,666	43,844	105,991	108,626	38,449	107,679	23,519
2019	105,902	70,526	49,223	52,011	44,157	107,580	109,821	39,081	108,861	23,983
2020	107,938	71,446	50,513	52,304	44,601	109,205	111,262	39,450	111,109	24,450
2021	109,722	72,306	51,400	52,553	45,035	110,693	112,093	39,814	111,809	24,860
2022	111,302	73,216	52,157	52,789	45,447	111,960	112,769	40,024	112,066	25,219
2023	112,771	74,053	52,796	52,949	45,722	113,125	113,589	40,316	113,154	25,587
2024	114,258	74,870	53,240	53,147	46,003	114,282	114,274	40,730	113,911	25,944
2025	115,730	75,639	53,905	53,315	46,268	115,410	115,020	41,103	115,098	26,294
2026	117,302	76,514	54,779	53,497	46,510	116,571	116,129	41,486	116,454	26,614
2027	118,996	77,484	55,558	53,712	46,800	117,716	116,953	41,841	117,232	26,928
2028	120,777	78,530	56,423	53,938	47,284	118,977	117,768	42,201	118,219	27,295
2029	122,456	79,648	57,277	54,141	47,733	120,241	118,815	42,608	119,487	27,683
2030	124,171	80,707	58,095	54,380	48,227	121,499	119,761	43,073	120,781	28,085
2031	125,878	81,930	58,965	54,711	48,673	122,803	120,780	43,540	122,013	28,480
2032	127,496	83,080	59,816	55,047	49,092	124,102	121,846	44,046	123,398	28,885
2033	129,150	84,227	60,639	55,403	49,479	125,423	123,086	44,608	124,823	29,288
2034	130,862	85,463	61,512	55,796	49,885	126,789	124,408	45,233	126,656	29,706
2035	132,694	86,709	62,422	56,187	50,294	128,161	125,833	45,857	128,293	30,133
2036	134,584	87,889	63,334	56,565	50,700	129,519	127,184	46,438	129,900	30,548
2037	136,358	89,058	64,252	56,935	51,107	130,850	128,340	47,014	131,421	30,953
Compound Annual Growth Rates (%)										
2018-2022	1.77	1.33	1.93	0.54	0.90	1.38	0.94	1.01	1.00	1.76
2018-2027	1.53	1.22	1.56	0.43	0.73	1.17	0.82	0.94	0.95	1.52
2018-2037	1.45	1.32	1.51	0.51	0.81	1.12	0.88	1.06	1.05	1.46

Table 11: Net LRZ Energy Forecasts with EE Adjustments[14] (Annual Metered Load in GWh)

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	96,781	65,531	48,732	49,373	38,679	94,622	101,919	36,768	111,836	22,488
2017	101,370	68,006	47,396	51,286	43,518	104,118	106,107	37,801	105,402	23,044
2018	103,620	69,451	47,939	51,428	43,693	105,849	108,324	38,436	107,634	23,519
2019	105,676	70,526	48,657	51,677	43,934	107,372	109,406	39,065	108,785	23,983
2020	107,624	71,446	49,764	51,873	44,304	108,928	110,730	39,430	110,995	24,450
2021	109,314	72,306	50,466	52,021	44,663	110,341	111,439	39,791	111,653	24,860
2022	110,788	73,216	51,036	52,156	44,998	111,529	111,990	39,998	111,863	25,219
2023	112,147	74,053	51,486	52,211	45,195	112,610	112,679	40,286	112,898	25,587
2024	113,518	74,870	51,738	52,302	45,396	113,677	113,229	40,697	113,596	25,944
2025	114,866	75,639	52,209	52,362	45,580	114,711	113,836	41,066	114,719	26,294
2026	116,306	76,514	52,885	52,434	45,739	115,772	114,802	41,444	116,005	26,614
2027	117,861	77,484	53,461	52,536	45,945	116,812	115,478	41,796	116,708	26,928
2028	119,495	78,530	54,120	52,647	46,343	117,963	116,139	42,151	117,613	27,295
2029	121,019	79,648	54,762	52,735	46,705	119,110	117,027	42,553	118,792	27,683
2030	122,569	80,707	55,363	52,857	47,109	120,246	117,809	43,013	119,993	28,085
2031	124,102	81,930	56,011	53,071	47,464	121,422	118,658	43,476	121,123	28,480
2032	125,540	83,080	56,636	53,288	47,790	122,588	119,549	43,976	122,402	28,885
2033	127,006	84,227	57,227	53,523	48,083	123,769	120,610	44,533	123,714	29,288
2034	128,522	85,463	57,865	53,794	48,395	124,992	121,749	45,153	125,427	29,706
2035	130,150	86,709	58,535	54,062	48,707	126,214	122,987	45,771	126,938	30,133
2036	131,828	87,889	59,202	54,314	49,016	127,416	124,146	46,346	128,413	30,548
2037	133,381	89,058	59,876	54,558	49,324	128,587	125,107	46,916	129,793	30,953
Compound Annual Growth Rates (%)										
2018-2022	1.69	1.33	1.58	0.35	0.74	1.32	0.84	1.00	0.97	1.76
2018-2027	1.44	1.22	1.22	0.24	0.56	1.10	0.71	0.94	0.90	1.52
2018-2037	1.34	1.32	1.18	0.31	0.64	1.03	0.76	1.05	0.99	1.46

[14] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

5 MISO Regional Non-Coincident Peak Demand Forecasts

5.1 PEAK LOAD CONVERSION FACTORS

Peak load conversion factors were used to translate annual metered load at the MISO LRZ level to summer and winter non-coincident peak demands. These conversion factors are based on normal weather conditions at the time of peak demand and are determined from historical relationships between average hourly load for the year, summer/winter peak levels for the year, and weather conditions at the time of the peak demand.

The process involves three steps: (1) determine the relationship between the peak demand (normalized to the average demand level for the year) and temperature[15] using historical data, (2) estimate the "normal" weather conditions at the time of the peak demand, and (3) determine the relationship between peak demand and average demand under normal weather conditions.

5.1.1 Load Data and Selected Weather Stations

The zonal hourly load data was obtained from MISO and contains seven years' hourly load observations of LRZ-level loads from January 1, 2010 to December 31, 2016. These hourly load records represent the MISO footprint at the time the data was collected. In 2014, the MISO market footprint was divided into 9 zones. In 2015, MISO split Mississippi from LRZ 9 and assigned it as LRZ 10.

Actual hourly weather data from 1997 to 2016 was obtained from the Midwest Regional Climate Center. For each LRZ, one weather station was selected to be as centrally located within the load center of the particular LRZ. Table 12 lists the selected weather stations for each LRZ.

Table 12: Selected Weather Stations for LRZs, Midwest Regional Climate Center

LRZ	City	Station WBAN ID	Station Call Sign
1	Minneapolis-St. Paul, MN	14922	KMSP
2	Milwaukee, WI	14839	KMKE
3	Des Moines, IA	14933	KDSM
4	Springfield, IL	93822	KSPI
5	St. Louis, MO	13994	KSTL
6	Indianapolis, IN	93819	KIND
7	Lansing, MI	14836	KLAN
8	Little Rock, AR	13963	KLIT
9	Lake Charles, LA	03937	KLCH
10	Jackson, MS	03940	KJAN

5.1.2 Relationship between Peak Demand and Temperature

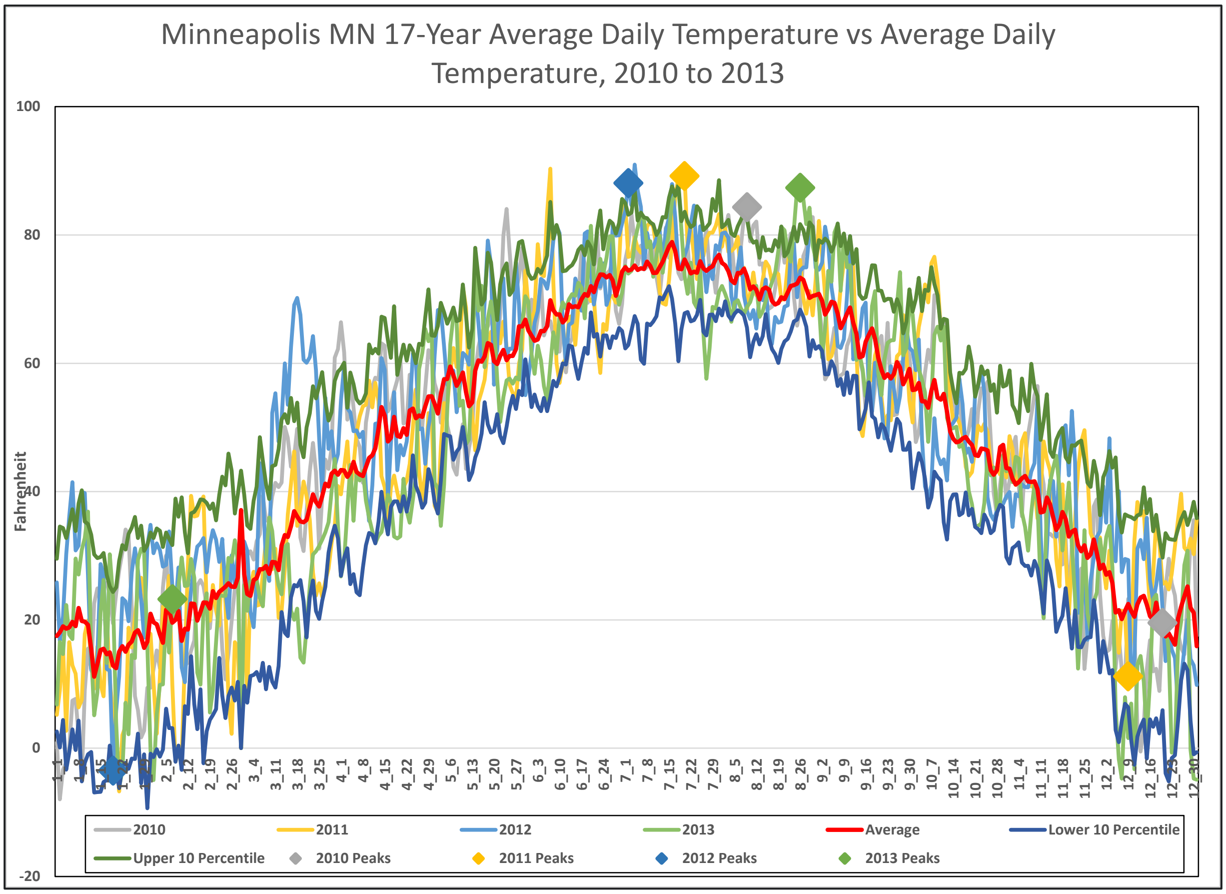
There are a number of factors affecting hourly load demand, such as humidity, wind speed, and temperature, etc. Of all the weather related factors, temperature is the most important one to determine the timing and magnitude of the peak. A closer look at the historical relationships between hourly loads and hourly

[15] While heat index was considered as a substitute for temperature for summer peaks, it was found to be less indicative of peak demand occurrences than ambient temperature was.

temperatures shows that temperature has an enormous impact on annual electricity demand, zonal winter and summer peak hourly loads and when seasonal peaks occur.

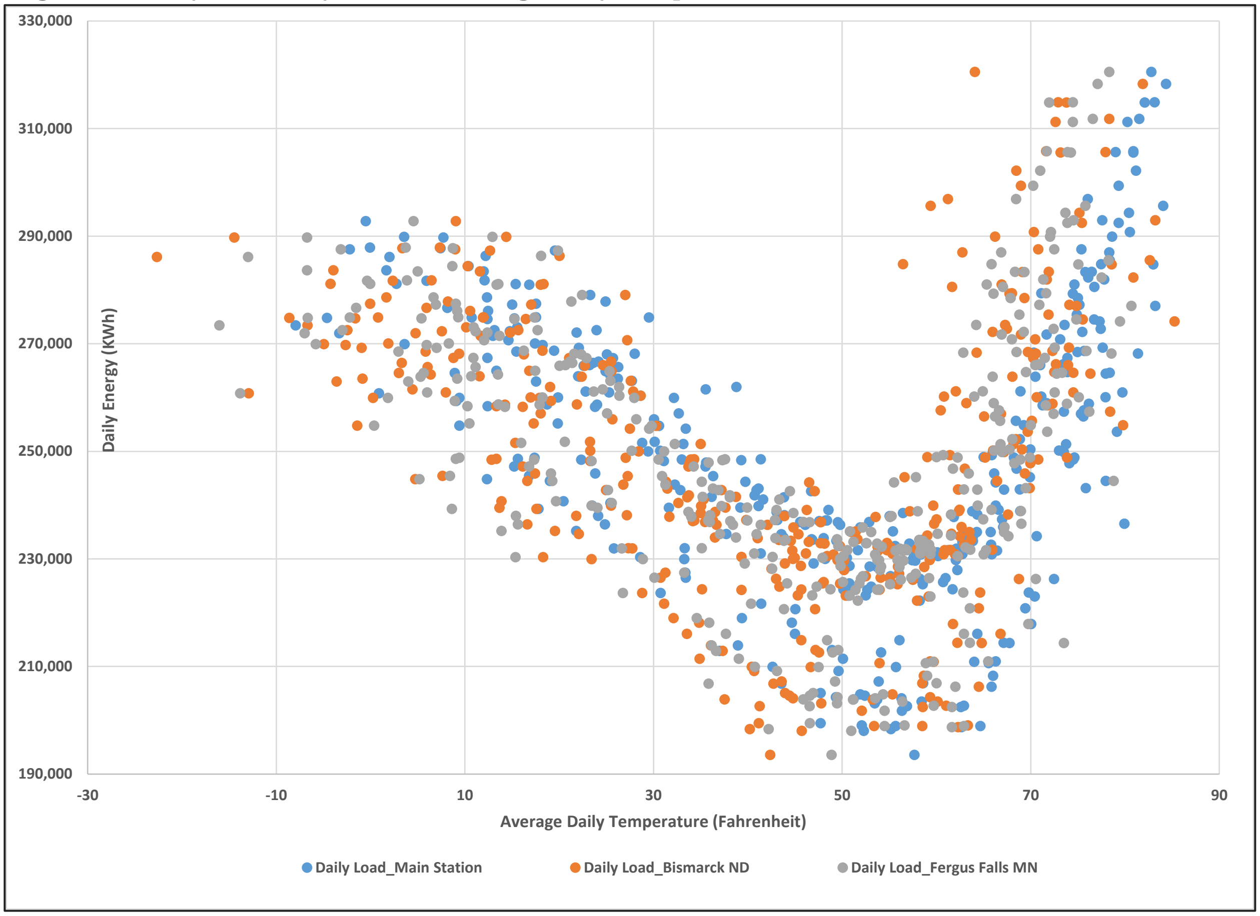
The likelihood of a peak occurrence increases as the weather gets colder in the winter or hotter in the summer. While the peak may or may not occur at the hour when the temperature is coldest or hottest, it often occurs on the day when the average daily temperature is the year's coldest or hottest. Using Minnesota as an example, Figure 44 shows the historical relationships between hourly peaks and average daily temperatures. The red line represents the average of historical average daily temperature values across years using the 17 years of hourly temperature records of Minneapolis, MN from 1997 to 2013. The dark blue line represents the average daily temperature at the lower 10th percentile and the dark green line represents the upper 10th percentile. The other four lines represent average daily temperature for each year from 2010 to 2013. The diamonds represent actual summer and winter peaks recorded in 2010 to 2013. The curves in the chart show the volatility of weather over years. Summer peaks usually occur when the average daily temperature is above the 10th percentile value of the hottest days of a year. Winter peaks are less consistent. The chart indicates that the peaks usually happen at extreme temperatures instead of normal temperature, especially for summer peaks.

Figure 44: Average Daily Temperature and Peaks (Fahrenheit)



An investigation of historical MISO zonal load data and zonal weather patterns shows that the relationship between temperature and electricity usage is nonlinear. Figure 45 illustrates the daily electricity load of LRZ 1 vs. the average daily temperature. The dots represent the daily electricity load of LRZ 1 versus the average daily temperature of selected weather stations. For days with colder temperatures (generally below 40 degrees), load increases as temperature decreases. For warmer days (above 65 degrees), load increases as temperature increases. When the average daily temperature falls around 40 to 65 Fahrenheit degrees, the daily load is relatively insensitive to temperature since the need for space heating or air conditioning is less than in winter or summer. In addition, the load is more sensitive to temperature in the summer than winter as the slope is steeper in summer than winter. It can also be observed that when the temperature is extremely cold or hot, the daily load is less responsive to temperature changes because the heating/cooling end uses are already being nearly fully utilized.

Figure 45: Daily Electricity Load vs. Average Daily Temperature, 2010



During the period of 2010-2016, the peaks of 10 LRZs all occurred on weekdays. Summer peaks usually happened in the late afternoon to early evening while winter peaks occurred either in the morning or in the evening.

5.1.3 Multiple Linear Regression

Multiple linear regression (MLR) analyses were used to estimate the relationship of peak load and temperature quantitatively. In this study, several MLR models were developed such as classical models with seasonal dummy variables, autoregressive models and models with moving average of hourly temperatures, etc. After comparing the fitted results with actual peaks and other statistics (significant t-statistics, high R-squared, a significant F-statistic and no heteroscedasticity), a model that could provide best peak prediction was selected for each LRZ respectively.

5.1.4 Sample Selection

There are 61,368 hourly load records for each zone from 2010 to 2016. More than half of those records either are insensitive to the changes of temperature or occur at the time when peak demand is unlikely to occur, namely weekend and holiday loads, spring and fall loads, and hourly loads between 9 pm and 6 am. Thus, SUFG decided to only select those hourly records that are sensitive to temperature changes for regression analysis. For each LRZ, the winter and summer weekday daily peak hourly loads were selected. The loads occurred in January, February, November and December were categorized as winter loads while the loads occurred from June to September were grouped as summer loads. The loads that occur outside of the summer and winter seasons were removed since they were not sensitive to changes of hourly temperature. The remaining loads and corresponding temperature information were then used in the regression analysis for each LRZ.

5.1.5 Variables and Models

The regression models capture the impact of weather on peak demand through a load factor approach, which compares the level of average hourly demand to the level of seasonal peak demand. Load factor is found through dividing the average hourly load over a given period of time (usually one calendar year) by the highest level of demand during that time period. For purposes of this study, SUFG used a slightly modified version of the traditional load factor, which is referred to herein as the Daily Peak Load Factor. It is the ratio of the annual average hourly load over the whole period to the peak demand for a particular day in the period. This modification can exclude the effect of economic and demographic factors on peak energy demand and be used to capture the impact of hourly and daily temperature on energy demand relative to the normal levels of demand. The Daily Peak Load Factor is used as the dependent variable for the peak demand model.

Numerous possible model specifications for each zone were developed, with final models selected based on key statistics and the ability to predict peaks in comparison with actual values. Appendix B provides the regression models for each LRZ.

As Figure 44 showed earlier, peak demand often occurs at temperature extremes for a given time of a year. Thus, it is necessary to investigate what typical weather conditions are when the peak demand occurs instead of the average conditions for a given day or month. However, determining the typical conditions can be problematic, especially when there is a limited number of peak observations. These data limitations can cause one or two unusual years to bias the results. Examples include the mild summers of 2013 and 2014, as well as the Polar Vortex of January 2014.

Table 13 presents the historical zonal peak load factors and associated temperatures from 2010 to 2016. "Temp" represents the actual temperature when peak occurred, "Avg Temp" is the average daily temperature on the day when seasonal peak occurred, "T Max" is the highest temperature on the day when the seasonal peak occurred and "MAVGT3" represents the moving average of the temperature of the previous two hours plus the peak hour itself. For summer peaks, the impact of the mild summers on peak loads can be observed in 2013 and 2014 when multiple summer peaks occurred in September. For winter peaks, it is noted that the 2014 zonal load factors are lower than other years. The recorded hourly temperature when the peak occurred is generally much colder than previous years. Using just these observations would bias the normal peak conditions calculations to be cooler in both summer and winter. It is worth noting that MAVGT3 is either higher or the same as the peak hour temperature for most of LRZs in summer. It indicates summer peaks tend to occur when the temperatures of the two hours previous to the peak hour are at least as high as the temperature during the peak hour. For winter peaks, the peak usually occurs when the temperature of the past two hours is colder than or as cold as the peak hour temperature. The regression analysis also shows the coldest daily hourly temperature is not statistically significant for determining the daily peak load factor while Avg Temp and MAVGT3 play more significant roles in determining the level of the daily peak hourly load.

Table 13: Historical Summer and Winter Peak Load Factors and Temperatures, 2010-2016 (Fahrenheit)

LRZ	Year	Summer Peak						Winter Peak					
		Peak Time	Temp	Avg Temp	T Max	MAVGT 3	Load Factor	Peak Time	Temp	Avg Temp	T Max	MAVGT 3	Load Factor
	2010	8/9/2010 15:00	93	84	94	93	65%	12/20/2010 18:00	23	20	26	22	76%
	2011	7/20/2011 16:00	95	89	96	95	63%	2/7/2011 19:00	3	11	24	3	78%
	2012	7/2/2012 14:00	98	88	99	97	61%	1/19/2012 8:00	-10	-3	6	-11	78%
1	2013	8/26/2013 14:00	96	87	96	94	63%	12/9/2013 19:00	-2	4	12	-2	76%
	2014	7/21/2014 15:00	91	82	91	91	67%	1/22/2014 19:00	-3	2	7	-3	75%
	2015	8/14/2015 15:00	91	82	93	92	65%	1/8/2015 19:00	7	6	15	9	73%
	2016	7/20/2016 16:00	89	82	92	91	63%	12/14/2016 19:00	1	5	10	1	75%
	2010	8/12/2010 15:00	87	81	88	88	60%	12/13/2010 18:00	11	12	16	12	77%
	2011	7/20/2011 16:00	97	87	98	97	56%	2/9/2011 19:00	4	6	13	7	81%
	2012	7/16/2012 15:00	96	87	97	96	56%	1/19/2012 19:00	3	9	25	3	80%
2	2013	8/27/2013 15:00	94	84	94	94	59%	12/11/2013 18:00	4	10	17	5	77%
	2014	7/22/2014 16:00	87	79	89	87	63%	1/6/2014 18:00	-12	-11	-6	-11	74%
	2015	8/14/2015 15:00	93	79	93	93	64%	1/7/2015 18:00	-2	0	5	-2	75%
	2016	8/10/2016 16:00	86	80	86	85	62%	12/19/2016 18:00	12	4	16	12	78%
	2010	8/12/2010 15:00	93	86	94	94	61%	12/13/2010 18:00	9	8	15	10	77%
	2011	7/19/2011 17:00	95	89	98	97	59%	2/8/2011 19:00	2	-1	13	2	77%
	2012	7/25/2012 16:00	105	91	106	105	58%	1/12/2012 19:00	14	14	18	15	79%
3	2013	9/9/2013 16:00	97	86	101	99	60%	12/11/2013 18:00	4	9	24	5	74%
	2014	9/4/2014 16:00	91	84	93	92	65%	1/6/2014 19:00	-4	-7	-1	-4	74%
	2015	7/17/2015 16:00	94	85	95	95	61%	1/7/2015 19:00	-6	-2	7	-4	74%
	2016	7/21/2016 13:00	95	88	96	94	62%	12/14/2016 19:00	14	17	23	16	77%
	2010	8/3/2010 16:00	94	85	95	95	59%	12/13/2010 19:00	9	9	16	10	74%
	2011	7/21/2011 16:00	97	88	98	97	56%	2/10/2011 8:00	5	12	24	0	77%
	2012	7/25/2012 16:00	101	91	103	102	55%	1/12/2012 19:00	15	19	32	15	77%
4	2013	8/30/2013 15:00	93	83	94	94	60%	12/11/2013 20:00	7	18	27	9	76%
	2014	8/25/2014 15:00	96	85	96	95	60%	1/6/2014 18:00	-10	-9	-4	-8	70%
	2015	7/13/2015 16:00	91	84	93	92	61%	1/7/2015 19:00	-1	4	16	0	69%
	2016	7/21/2016 16:00	93	85	94	93	59%	1/18/2016 18:00	8	7	13	9	73%
	2010	8/3/2010 16:00	100	92	102	101	57%	1/7/2010 19:00	11	15	26	12	69%
	2011	8/2/2011 16:00	101	92	102	102	55%	2/10/2011 8:00	13	21	32	10	70%
	2012	7/25/2012 16:00	106	96	107	106	53%	1/12/2012 19:00	17	21	35	16	72%
5	2013	8/30/2013 15:00	99	90	100	100	59%	2/1/2013 8:00	13	20	30	11	72%
	2014	8/25/2014 16:00	95	89	98	96	58%	1/6/2014 19:00	-3	-3	1	-2	64%
	2015	7/13/2015 16:00	97	90	98	98	57%	1/8/2015 8:00	8	17	32	6	64%
	2016	7/21/2016 16:00	98	89	98	97	55%	12/19/2016 8:00	6	14	25	5	64%
	2010	8/10/2010 16:00	96	87	96	96	65%	12/15/2010 7:00	5	14	23	4	74%
	2011	7/20/2011 14:00	98	88	98	96	63%	2/10/2011 7:00	8	12	22	5	73%
	2012	7/25/2012 16:00	99	88	102	101	63%	1/13/2012 10:00	16	17	19	15	78%
6	2013	7/18/2013 15:00	91	84	93	91	65%	12/12/2013 7:00	2	12	20	3	74%
	2014	9/5/2014 15:00	88	79	89	88	68%	1/24/2014 8:00	-4	8	22	-5	69%
	2015	7/29/2015 14:00	88	81	90	89	65%	1/7/2015 19:00	-2	3	12	0	67%
	2016	8/11/2016 15:00	90	83	92	91	64%	1/19/2016 7:00	4	11	18	4	70%
	2010	7/7/2010 15:00	91	82	92	91	56%	12/13/2010 18:00	10	12	15	11	77%
	2011	7/21/2011 14:00	95	85	96	94	52%	12/8/2011 18:00	31	30	35	32	82%
	2012	7/17/2012 15:00	98	87	98	97	51%	1/19/2012 18:00	9	17	27	10	82%
7	2013	7/17/2013 14:00	92	84	93	91	53%	12/12/2013 18:00	16	13	21	15	78%
	2014	9/5/2014 15:00	86	77	88	87	59%	1/28/2014 18:00	2	-1	7	4	77%
	2015	7/28/2015 15:00	87	77	88	87	57%	1/8/2015 18:00	4	5	12	4	76%
	2016	8/11/2016 15:00	92	82	92	91	55%	12/15/2016 18:00	9	8	16	11	79%
	2010	8/2/2010 15:00	103	89	104	103	58%	1/8/2010 7:00	13	20	26	13	67%
	2011	8/3/2011 14:00	111	96	113	112	53%	1/13/2011 7:00	17	23	31	17	69%
	2012	7/30/2012 14:00	111	95	111	109	55%	1/12/2012 20:00	30	35	48	31	76%
8	2013	7/9/2013 16:00	96	87	96	96	59%	1/15/2013 7:00	26	29	32	25	72%
	2014	8/25/2014 13:00	96	85	96	95	60%	1/24/2014 8:00	17	25	38	14	62%
	2015	7/29/2015 15:00	98	90	101	99	56%	1/8/2015 8:00	15	23	33	13	61%
	2016	7/19/2016 14:00	97	89	97	96	57%	12/20/2016 8:00	19	30	47	19	66%

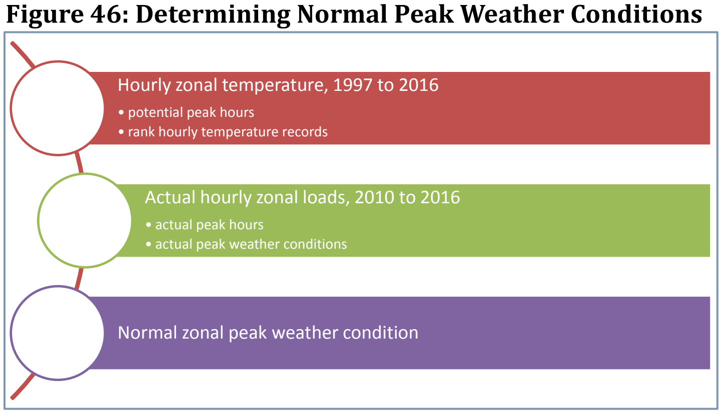
LRZ	Year	Summer Peak						Winter Peak					
		Peak Time	Temp	Avg Temp	T Max	MAVGT 3	Load Factor	Peak Time	Temp	Avg Temp	T Max	MAVGT 3	Load Factor
9	2010	8/2/2010 16:00	95	88	104	97	63%	1/11/2010 8:00	33	36	51	27	67%
	2011	8/31/2011 16:00	94	85	99	95	63%	1/13/2011 8:00	31	35	42	28	69%
	2012	6/26/2012 16:00	96	88	103	98	62%	1/13/2012 8:00	41	42	49	35	78%
	2013	8/7/2013 16:00	91	86	97	93	62%	12/16/2013 7:00	34	43	61	32	75%
	2014	8/22/2014 16:00	90	84	93	91	66%	1/7/2014 7:00	22	29	38	21	65%
	2015	8/10/2015 15:00	99	88	100	99	60%	1/8/2015 7:00	25	31	36	25	68%
	2016	8/2/2016 15:00	92	86	96	94	64%	12/19/2016 8:00	32	39	50	31	75%
10	2010	8/2/2010 14:00	104	89	104	104	56%	1/11/2010 8:00	27	31	47	21	66%
	2011	8/3/2011 14:00	87	89	98	90	52%	1/13/2011 8:00	27	27	39	23	66%
	2012	7/30/2012 16:00	90	89	98	93	52%	1/13/2012 8:00	35	35	46	30	72%
	2013	8/8/2013 16:00	96	87	97	96	55%	1/22/2013 8:00	38	42	50	36	71%
	2014	8/6/2014 16:00	94	83	95	95	58%	1/7/2014 8:00	18	21	31	16	59%
	2015	8/10/2015 15:00	86	86	101	93	54%	1/8/2015 7:00	15	23	35	14	61%
	2016	8/2/2016 15:00	96	86	96	95	55%	12/19/2016 9:00	29	31	42	27	71%

The regression models are used to convert annual energy to peak demand under typical weather conditions when the peak occurs. In this case, the limited number of peaks result in a small weather sample that may not be representative of longer term weather. This is done by using a longer weather series than the period for which peak load data are available to establish 'normal weather.' This allows for the adjustment of peak conditions if weather for the period during which peak load observations were available were warmer or colder than the longer weather data period. Details of the procedures for the weather normalization follow.

To estimate typical temperature conditions on peak, historical weather data were used going back to 1997. Extreme hourly temperatures that occurred during hours when demand does not historically peak were excluded from the analysis. These include weekends, holidays and off-peak hours. The potential peak hours were determined using the highest load hours during the years for which hourly loads were available. While there is some variation across LRZs, peak hours generally occur in the morning and evening in winter and the afternoon and evening in summer. The elimination of off-peak hours was especially important for the winter analysis, since many of the coldest temperatures occurred in the middle of the night when the demand for energy is low.

After eliminating off-peak hours, the remaining hours were ranked in descending order within the calendar year. Therefore, a list of temperatures ranked in descending order is available for each year from 1997 to 2016. For years where the hourly loads were known, the rank of the peak temperature and its actual value on peak was compared to the temperatures of the same ranking for the period of 2010 and 2016. Usually, the peak demand did not occur on the hour with the most extreme temperature and occasionally, the peak occurred on an hour which ranked outside of the top ten or twenty extreme hours.

Figure 46: Determining Normal Peak Weather Conditions



Next, the average of the ranked extreme temperatures was calculated for two separate time periods: 1997-2016 (which included all weather data) and 2010-2016 (the years for which the hour when the peak demand occurred was known). This facilitated a comparison of the extremity of the temperatures over the smaller period to the larger period, which indicated whether the shorter period was generally warmer or colder than the longer period. The next step was to calculate the average of the actual temperatures at the time of the peak for the years that these were known. Finally, this average was adjusted if the 1997-2016 period was warmer or colder than the known period 2010-2016. Figure 46 illustrates the strategic and logic diagram to derive the normalized peak weather condition. Table 14 lists the summer and winter temperatures used as normal peak temperatures for each LRZ.

Table 14: Typical Peak Weather Temperatures (Fahrenheit)

LRZ	Winter					Summer				
	Hourly Temp	Average Daily Temp	Daily Max Temp	Moving Average Temp	Selected Hours	Hourly Temp	Average Daily Temp	Daily Max Temp	Moving Average Temp	Selected Hours
LRZ 1	3.9	7.2	16.5	4.0	8,18,19	93.2	84.6	94.4	93.2	13,14,15,16,17,20
LRZ 2	3.8	4.8	12.0	4.0	17-20	90.5	81.4	90.9	90.6	11-17
LRZ 3	4.6	5.1	14.2	5.6	8,9,10,11,18,19,20	93.9	85.8	96.3	94.9	13,14,15,16,17,18
LRZ 4	3.7	9.2	17.2	4.6	8,9,11,12,18,19,20	93.6	84.9	94.7	94.0	13,14,15,16,17
LRZ 5	8.5	13.9	27.7	7.7	7,8, 10, 11, 12,18,19,20	98.3	90.2	99.5	98.7	13,14,15,16,17
LRZ 6	4.1	11.7	21.0	3.9	7,8,9,10,12,18,19,20	91.0	83.1	92.1	91.2	12,13,14,15,16,17
LRZ 7	11.8	12.2	19.3	12.8	10,17,18,19	91.0	81.4	92.0	90.9	12,13,14,15,16,17
LRZ 8	19.9	26.6	37.9	18.9	7,8,9,11,18,19,20,21	100.4	88.9	101.3	100.2	13,14,15,16,17
LRZ 9	31.8	37.2	50.1	28.9	7,8,9,10,12,18,19,20, 21	93.5	86.1	98.0	95.1	14,15,16,17
LRZ 10	27.3	30.8	42.5	23.5	7,8,9,19,20,21	93.9	86.2	98.4	95.6	13,14,15,16

5.1.6 Regression Results

Table 15 lists the adjusted seasonal peak load factors under typical peak weather conditions. For each zone, the load factor in the winter is higher than that in the summer. This means that the winter peak load is less than the summer peak load. By plugging in normalized peak weather conditions into the finalized peak conversion models, fitted peak load factors for each zone were obtained. Appendix B provides a comparison among the historical and fitted peak load factors and the normalized seasonal peak load factors.

Table 15: Adjusted Peak Load Factors under Typical Peak Temperatures

LRZ	Adjusted Peak Load Factors under Typical Weather	
	Summer	Winter
1	0.6330	0.7608
2	0.6085	0.7755
3	0.6136	0.7587
4	0.5957	0.7393
5	0.5699	0.6708
6	0.6527	0.7218
7	0.5463	0.7898
8	0.5734	0.6803
9	0.6355	0.7152
10	0.5472	0.6468

These load factors are the ratios of annual average hourly load over summer (or winter) peak demand under normal peak weather conditions. The reciprocals of the peak load factors are the peak demand conversion factors in Table 16. For comparison purpose, the conversion factors in the 2014, 2015 and 2016 Independent Load Forecast are also included in the table. The study period of each version is listed in parentheses. In general, this version's summer and winter peak conversion factors are similar to 2016 version. The similar peak weather conditions between 2016 and 2015 result in minor variation in the conversion factors. In addition, one more year's hourly load records enhance the stability of the peak model. The 2016 summer peak conversion factors are relatively higher than the 2015 version and less than the 2014 version. The 2016 winter peak conversion factors are slightly higher than the 2014 and 2015 versions. There are multiple factors that may contribute to the changes among different versions, such as a new dataset added to the regression model, changes in methodology and normalization of peak weather conditions. Also, the addition of the mild summer and extremely cold winter in 2014 affect the results.

Multiplying the average hourly load for a given year of the forecast by the conversion factor would yield the peak hourly demand. An example of the calculation follows:

Suppose the forecast annual energy for a given year in LRZ 1 is 100 million MWh. The average hourly load is found by dividing the annual energy by the number of hours in the year.

$$\frac{100{,}000{,}000\ MWh}{8{,}760\ hr} = 11{,}416\ MW$$

The summer and winter peak demands are found by multiplying the average hourly load by the appropriate conversion factor, taking the current version for LRZ 1 as an example.

$$11{,}416\ MW * 1.580 = 18{,}037\ MW\ (summer)$$

$$11{,}416\ MW * 1.314 = 15{,}001\ MW\ (winter)$$

Table 16: Peak Demand Conversion Factors

LRZ	Update (2010-2016)		2016 Version (2010-2015)		2015 Version (2010-2014)		2014 Version (2010-2013)	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
1	1.580	1.314	1.567	1.309	1.541	1.329	1.568	1.282
2	1.643	1.290	1.639	1.293	1.695	1.336	1.672	1.267
3	1.630	1.318	1.639	1.325	1.635	1.323	1.638	1.275
4	1.679	1.353	1.678	1.355	1.707	1.348	1.717	1.303
5	1.755	1.491	1.743	1.466	1.741	1.451	1.749	1.405
6	1.532	1.385	1.527	1.378	1.508	1.372	1.542	1.340
7	1.830	1.266	1.782	1.272	1.792	1.286	1.826	1.245
8	1.744	1.470	1.755	1.461	1.726	1.448	1.739	1.412
9	1.574	1.398	1.578	1.403	1.536	1.388	1.634	1.363
10	1.827	1.546	1.827	1.569	1.831	1.489		

5.2 NON-COINCIDENT PEAK DEMANDS

The LRZ-level non-coincident[16] summer and winter peak demands were calculated by applying the energy-to-peak conversion factors to the LRZ annual metered load projections. These values represent the projected peak demands for the summer and winter under normal weather conditions. Usually, the non-coincident peak of each LRZ does not occur at the same time when the MISO reaches system-wide peak. The EE adjustments were made directly on non-coincident peak projections. Table 17 to Table 20 provide gross and net (without and with EE adjustments) non-coincident peak demand projections for summer and winter. Please note that 2016 data are historical and therefore are the same for the cases without and with the EE Adjustments. Figure 47 to Figure 56 provide the same information graphically.

[16] Non-coincident from the perspective of the MISO system peak load.

Table 17: Summer Non-Coincident Peak Demand without EE Adjustments (Metered Load in MW)

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	17,571	12,128	8,906	9,541	7,962	16,727	21,013	7,324	19,812	4,617
2017	18,296	12,758	8,856	9,856	8,733	18,225	22,212	7,528	18,938	4,807
2018	18,715	13,029	8,991	9,901	8,782	18,538	22,698	7,655	19,344	4,906
2019	19,100	13,231	9,158	9,967	8,845	18,816	22,948	7,781	19,556	5,003
2020	19,467	13,403	9,398	10,023	8,934	19,100	23,249	7,854	19,960	5,101
2021	19,789	13,564	9,563	10,070	9,021	19,361	23,423	7,926	20,086	5,186
2022	20,074	13,735	9,704	10,116	9,104	19,582	23,564	7,968	20,132	5,261
2023	20,338	13,892	9,823	10,146	9,159	19,786	23,736	8,026	20,327	5,338
2024	20,607	14,045	9,906	10,184	9,215	19,988	23,879	8,109	20,463	5,412
2025	20,872	14,190	10,029	10,216	9,268	20,186	24,035	8,183	20,677	5,485
2026	21,156	14,354	10,192	10,251	9,316	20,389	24,266	8,259	20,920	5,552
2027	21,461	14,536	10,337	10,293	9,374	20,589	24,438	8,330	21,060	5,618
2028	21,783	14,732	10,498	10,336	9,472	20,809	24,609	8,402	21,237	5,694
2029	22,085	14,942	10,657	10,375	9,562	21,031	24,828	8,483	21,465	5,775
2030	22,395	15,140	10,809	10,420	9,660	21,251	25,025	8,575	21,697	5,859
2031	22,702	15,370	10,971	10,484	9,750	21,479	25,238	8,668	21,919	5,941
2032	22,994	15,586	11,129	10,548	9,834	21,706	25,461	8,769	22,168	6,026
2033	23,293	15,801	11,282	10,616	9,911	21,937	25,720	8,881	22,424	6,110
2034	23,601	16,033	11,445	10,692	9,993	22,176	25,996	9,005	22,753	6,197
2035	23,932	16,266	11,614	10,767	10,074	22,416	26,294	9,130	23,047	6,286
2036	24,273	16,488	11,784	10,839	10,156	22,653	26,576	9,245	23,336	6,373
2037	24,593	16,707	11,954	10,910	10,237	22,886	26,818	9,360	23,609	6,457
Compound Annual Growth Rates (%)										
2018-2022	1.77	1.33	1.93	0.54	0.90	1.38	0.94	1.01	1.00	1.76
2018-2027	1.53	1.22	1.56	0.43	0.73	1.17	0.82	0.94	0.95	1.52
2018-2037	1.45	1.32	1.51	0.51	0.81	1.12	0.88	1.06	1.05	1.46

Table 18: Winter Non-Coincident Peak Demand without EE Adjustments (Metered Load in MW)

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	14,715	9,615	7,203	7,656	6,846	15,424	14,615	6,309	16,966	3,615
2017	15,222	10,011	7,162	7,942	7,419	16,478	15,365	6,344	16,827	4,067
2018	15,571	10,224	7,271	7,978	7,461	16,762	15,701	6,451	17,188	4,151
2019	15,891	10,382	7,406	8,031	7,514	17,013	15,874	6,557	17,377	4,233
2020	16,197	10,517	7,600	8,077	7,590	17,270	16,082	6,619	17,735	4,315
2021	16,464	10,644	7,734	8,115	7,664	17,505	16,202	6,680	17,847	4,388
2022	16,701	10,778	7,848	8,151	7,734	17,706	16,300	6,716	17,888	4,451
2023	16,922	10,901	7,944	8,176	7,781	17,890	16,418	6,765	18,062	4,516
2024	17,145	11,022	8,010	8,207	7,828	18,073	16,517	6,834	18,183	4,579
2025	17,366	11,135	8,110	8,233	7,873	18,251	16,625	6,897	18,372	4,641
2026	17,602	11,263	8,242	8,261	7,915	18,435	16,786	6,961	18,589	4,697
2027	17,856	11,406	8,359	8,294	7,964	18,616	16,905	7,021	18,713	4,753
2028	18,123	11,560	8,489	8,329	8,046	18,815	17,023	7,081	18,870	4,817
2029	18,375	11,725	8,618	8,360	8,123	19,015	17,174	7,149	19,073	4,886
2030	18,633	11,881	8,741	8,397	8,207	19,214	17,311	7,227	19,279	4,957
2031	18,889	12,061	8,872	8,448	8,283	19,420	17,458	7,306	19,476	5,027
2032	19,131	12,230	9,000	8,500	8,354	19,626	17,612	7,390	19,697	5,098
2033	19,380	12,399	9,124	8,555	8,420	19,835	17,791	7,485	19,924	5,169
2034	19,637	12,581	9,255	8,616	8,489	20,051	17,982	7,590	20,217	5,243
2035	19,911	12,764	9,392	8,676	8,559	20,268	18,188	7,694	20,478	5,318
2036	20,195	12,938	9,529	8,734	8,628	20,483	18,383	7,792	20,735	5,392
2037	20,461	13,110	9,667	8,791	8,697	20,693	18,551	7,889	20,978	5,463
Compound Annual Growth Rates (%)										
2018-2022	1.77	1.33	1.93	0.54	0.90	1.38	0.94	1.01	1.00	1.76
2018-2027	1.53	1.22	1.56	0.43	0.73	1.17	0.82	0.94	0.95	1.52
2018-2037	1.45	1.32	1.51	0.51	0.81	1.12	0.88	1.06	1.05	1.46

Table 19: Summer Non-Coincident Peak Demand with EE Adjustments[17] (Metered Load in MW)

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	17,571	12,128	8,906	9,541	7,962	16,727	21,013	7,324	19,812	4,617
2017	18,283	12,758	8,820	9,828	8,720	18,211	22,179	7,525	18,935	4,807
2018	18,690	13,029	8,922	9,857	8,757	18,515	22,647	7,652	19,335	4,906
2019	19,061	13,231	9,057	9,906	8,808	18,782	22,878	7,777	19,542	5,003
2020	19,414	13,403	9,265	9,945	8,885	19,054	23,159	7,849	19,938	5,101
2021	19,719	13,564	9,397	9,976	8,959	19,302	23,312	7,921	20,056	5,186
2022	19,986	13,735	9,505	10,003	9,029	19,511	23,433	7,962	20,094	5,261
2023	20,233	13,892	9,590	10,016	9,071	19,701	23,582	8,019	20,280	5,338
2024	20,481	14,045	9,639	10,035	9,113	19,888	23,703	8,101	20,405	5,412
2025	20,726	14,190	9,728	10,048	9,153	20,070	23,835	8,174	20,606	5,485
2026	20,987	14,354	9,855	10,064	9,187	20,256	24,043	8,250	20,837	5,552
2027	21,269	14,536	9,965	10,085	9,231	20,439	24,190	8,319	20,963	5,618
2028	21,565	14,732	10,089	10,109	9,314	20,641	24,335	8,390	21,126	5,694
2029	21,841	14,942	10,211	10,127	9,389	20,843	24,527	8,470	21,337	5,775
2030	22,122	15,140	10,324	10,153	9,473	21,043	24,697	8,561	21,553	5,859
2031	22,401	15,370	10,447	10,196	9,547	21,249	24,881	8,653	21,756	5,941
2032	22,662	15,586	10,566	10,240	9,616	21,454	25,074	8,753	21,985	6,026
2033	22,928	15,801	10,678	10,287	9,677	21,662	25,303	8,863	22,221	6,110
2034	23,204	16,033	10,799	10,341	9,743	21,877	25,549	8,986	22,529	6,197
2035	23,499	16,266	10,926	10,395	9,809	22,092	25,815	9,109	22,800	6,286
2036	23,804	16,488	11,053	10,445	9,874	22,304	26,065	9,224	23,065	6,373
2037	24,087	16,707	11,181	10,494	9,939	22,510	26,274	9,337	23,313	6,457
Compound Annual Growth Rates (%)										
2018-2022	1.69	1.33	1.59	0.37	0.77	1.32	0.86	1.00	0.97	1.76
2018-2027	1.45	1.22	1.24	0.25	0.59	1.10	0.73	0.93	0.90	1.52
2018-2037	1.34	1.32	1.19	0.33	0.67	1.03	0.78	1.05	0.99	1.46

[17] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

Table 20: Winter Non-Coincident Peak Demand with EE Adjustments[18] (Metered Load in MW)

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	14,715	9,615	7,203	7,656	6,846	15,424	14,615	6,309	16,966	3,615
2017	15,209	10,011	7,126	7,915	7,406	16,465	15,332	6,342	16,824	4,067
2018	15,546	10,224	7,202	7,935	7,436	16,738	15,650	6,448	17,179	4,151
2019	15,853	10,382	7,305	7,971	7,477	16,979	15,804	6,554	17,362	4,233
2020	16,143	10,517	7,467	7,999	7,540	17,224	15,992	6,615	17,714	4,315
2021	16,395	10,644	7,567	8,020	7,601	17,447	16,092	6,675	17,818	4,388
2022	16,614	10,778	7,648	8,039	7,659	17,634	16,168	6,710	17,850	4,451
2023	16,816	10,901	7,711	8,045	7,693	17,805	16,265	6,758	18,014	4,516
2024	17,019	11,022	7,743	8,057	7,727	17,973	16,341	6,826	18,124	4,579
2025	17,219	11,135	7,809	8,064	7,758	18,135	16,426	6,888	18,302	4,641
2026	17,433	11,263	7,905	8,073	7,786	18,302	16,562	6,951	18,506	4,697
2027	17,663	11,406	7,987	8,087	7,821	18,466	16,656	7,010	18,616	4,753
2028	17,906	11,560	8,081	8,102	7,889	18,647	16,748	7,069	18,759	4,817
2029	18,131	11,725	8,172	8,113	7,951	18,828	16,873	7,136	18,945	4,886
2030	18,360	11,881	8,257	8,130	8,020	19,006	16,982	7,213	19,135	4,957
2031	18,587	12,061	8,348	8,160	8,080	19,191	17,101	7,290	19,313	5,027
2032	18,799	12,230	8,436	8,191	8,136	19,374	17,225	7,374	19,515	5,098
2033	19,015	12,399	8,519	8,225	8,186	19,560	17,375	7,467	19,722	5,169
2034	19,239	12,581	8,609	8,265	8,239	19,752	17,535	7,571	19,993	5,243
2035	19,479	12,764	8,704	8,304	8,293	19,944	17,709	7,674	20,231	5,318
2036	19,727	12,938	8,798	8,340	8,345	20,133	17,872	7,770	20,464	5,392
2037	19,955	13,110	8,894	8,376	8,398	20,317	18,006	7,865	20,681	5,463
Compound Annual Growth Rates (%)										
2018-2022	1.68	1.33	1.51	0.33	0.74	1.31	0.82	1.00	0.96	1.76
2018-2027	1.43	1.22	1.16	0.21	0.56	1.10	0.69	0.93	0.90	1.52
2018-2037	1.32	1.32	1.12	0.29	0.64	1.02	0.74	1.05	0.98	1.46

[18] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

Figure 47: Gross and Net LRZ1 Summer and Winter Non-Coincident Peak Demand (MW)

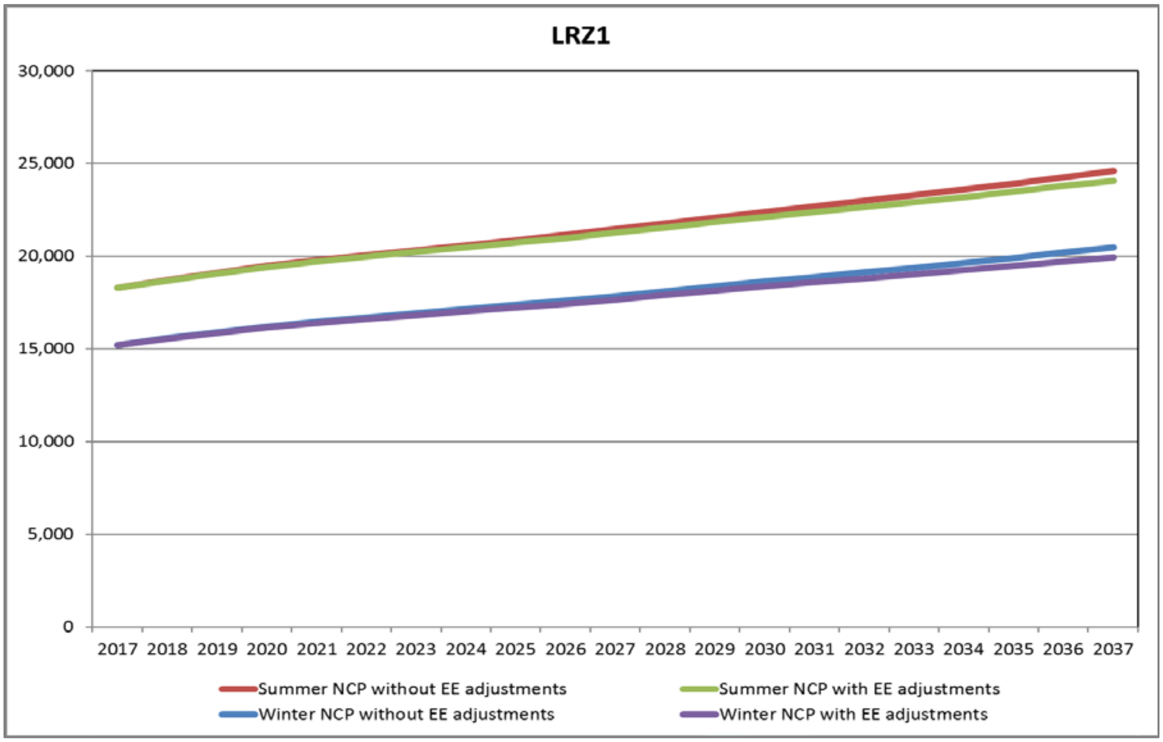
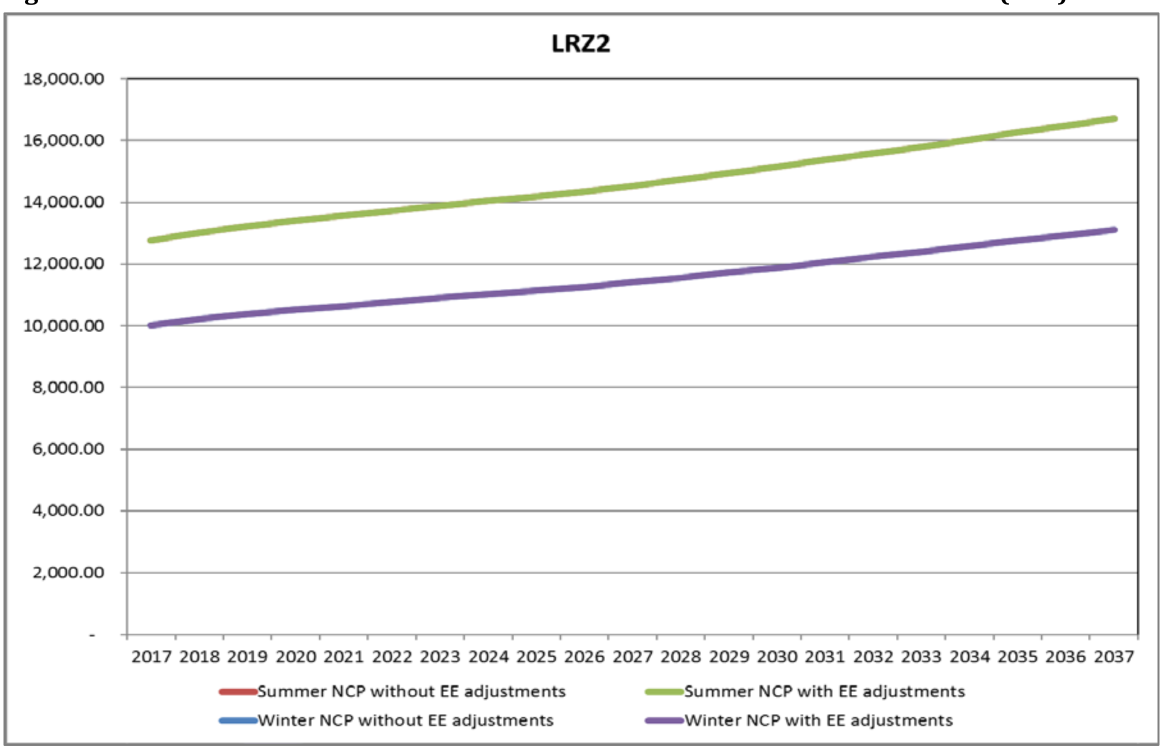


Figure 48: Gross and Net LRZ2 Summer and Winter Non-Coincident Peak Demand (MW)[19]



[19] The EE adjustments for LRZ 2 is zero. Thus, the gross value overlaps the net value.

Figure 49: Gross and Net LRZ3 Summer and Winter Non-Coincident Peak Demand (MW)

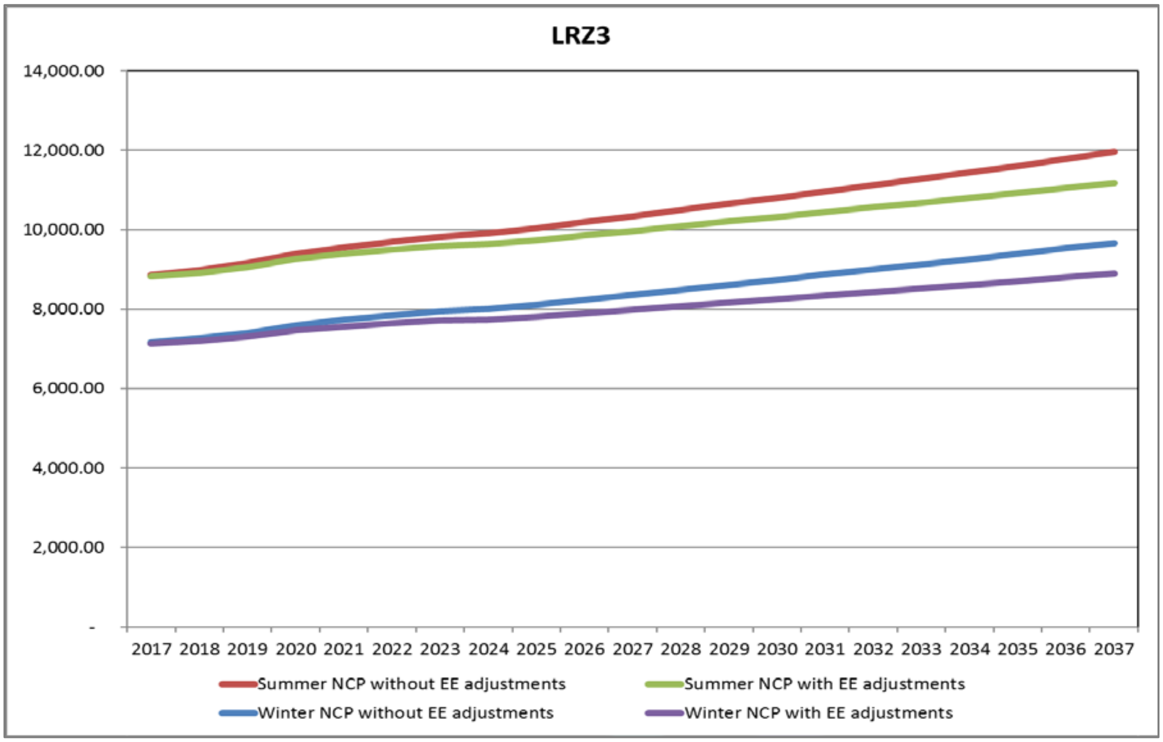
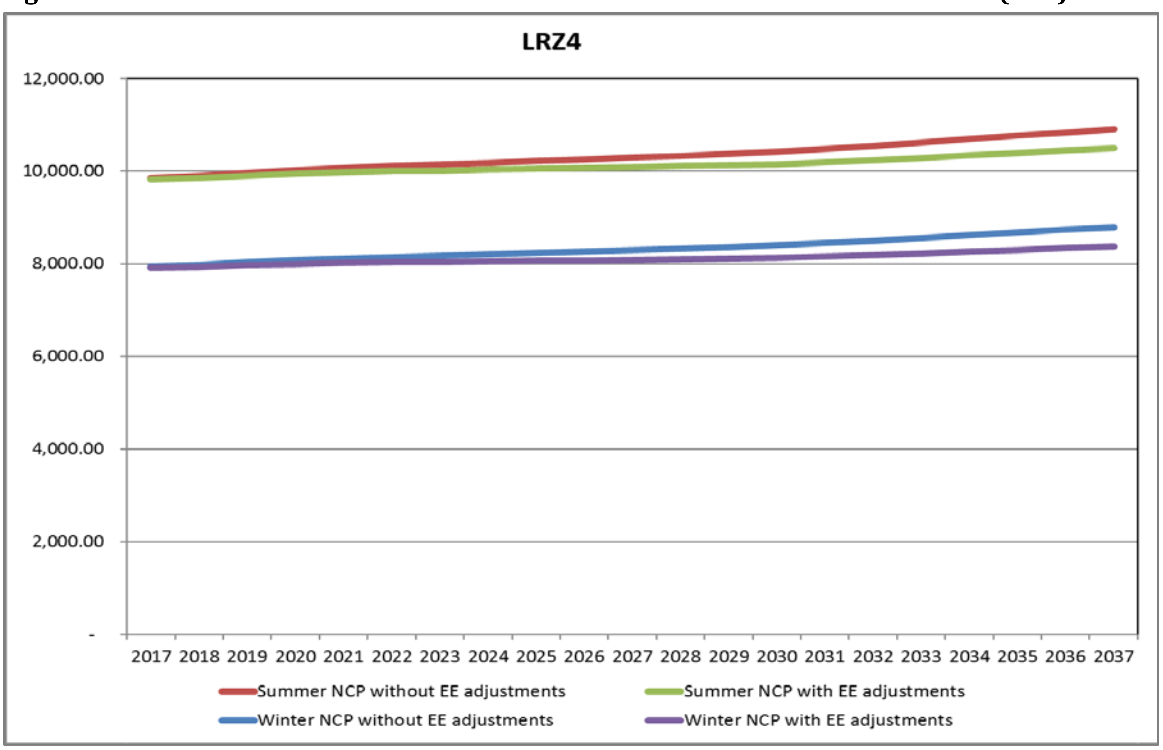


Figure 50: Gross and Net LRZ4 Summer and Winter Non-Coincident Peak Demand (MW)



MISO REGIONAL PEAK DEMAND FORECASTS

Figure 51: Gross and Net LRZ5 Summer and Winter Non-Coincident Peak Demand (MW)

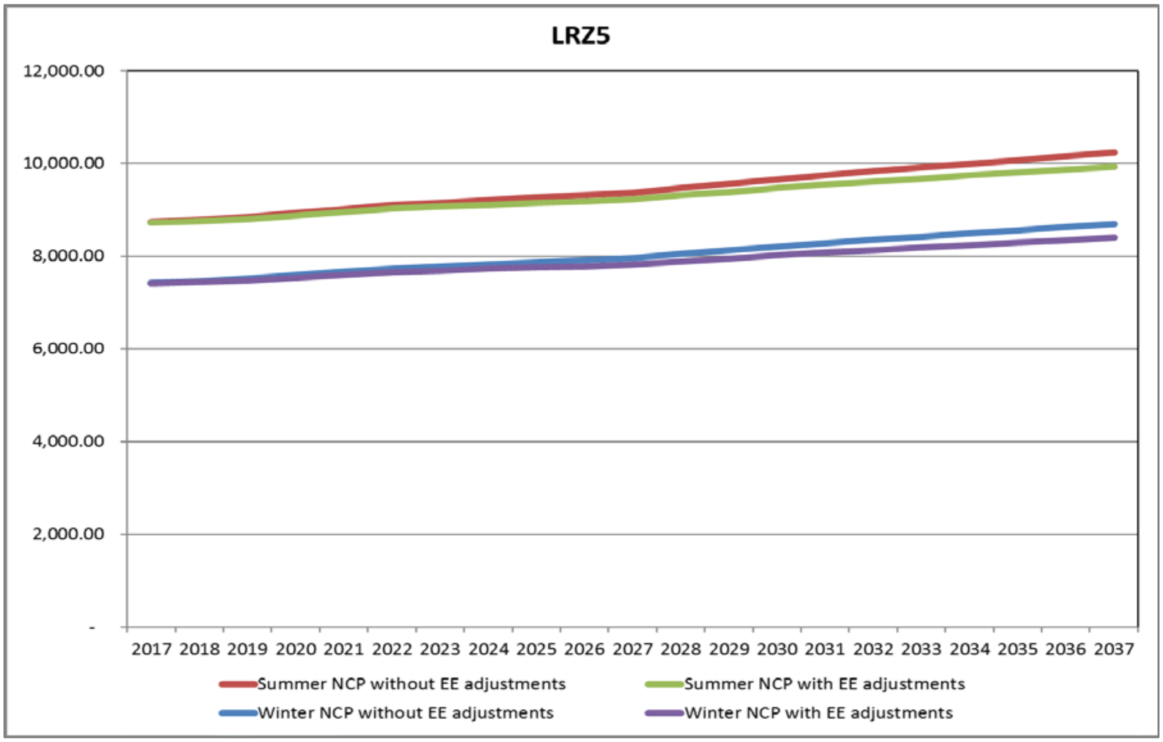


Figure 52: Gross and Net LRZ6 Summer and Winter Non-Coincident Peak Demand (MW)

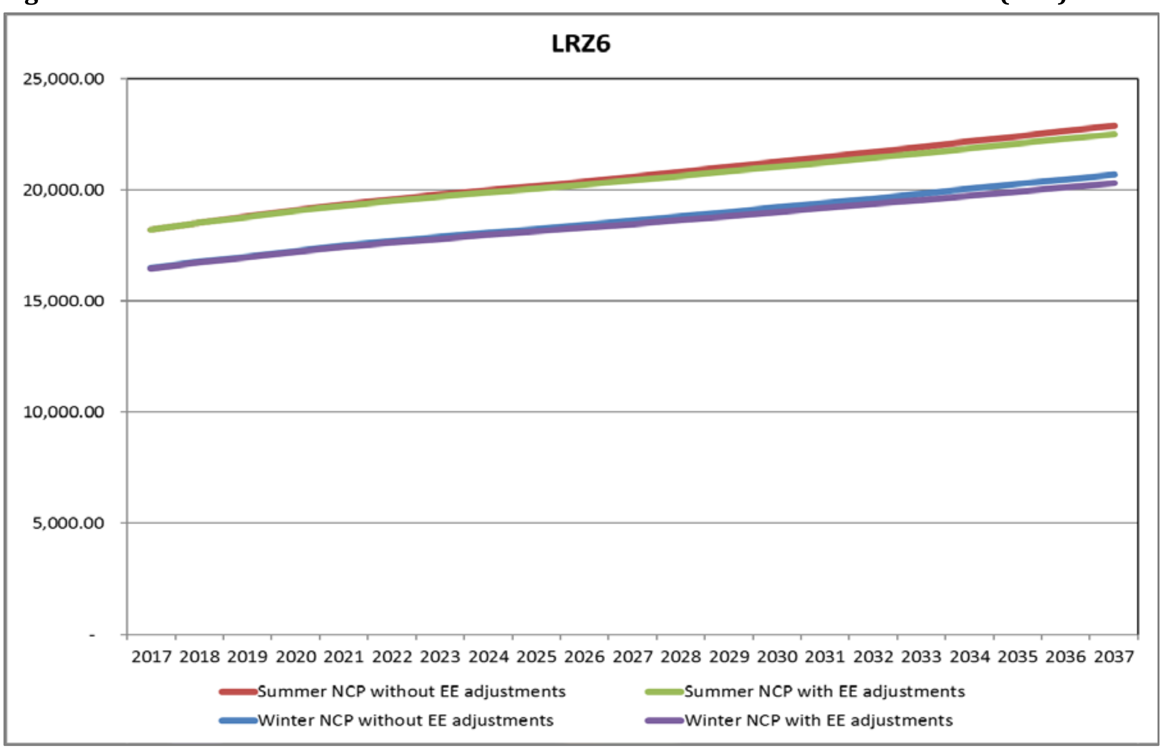


Figure 53: Gross and Net LRZ7 Summer and Winter Non-Coincident Peak Demand (MW)

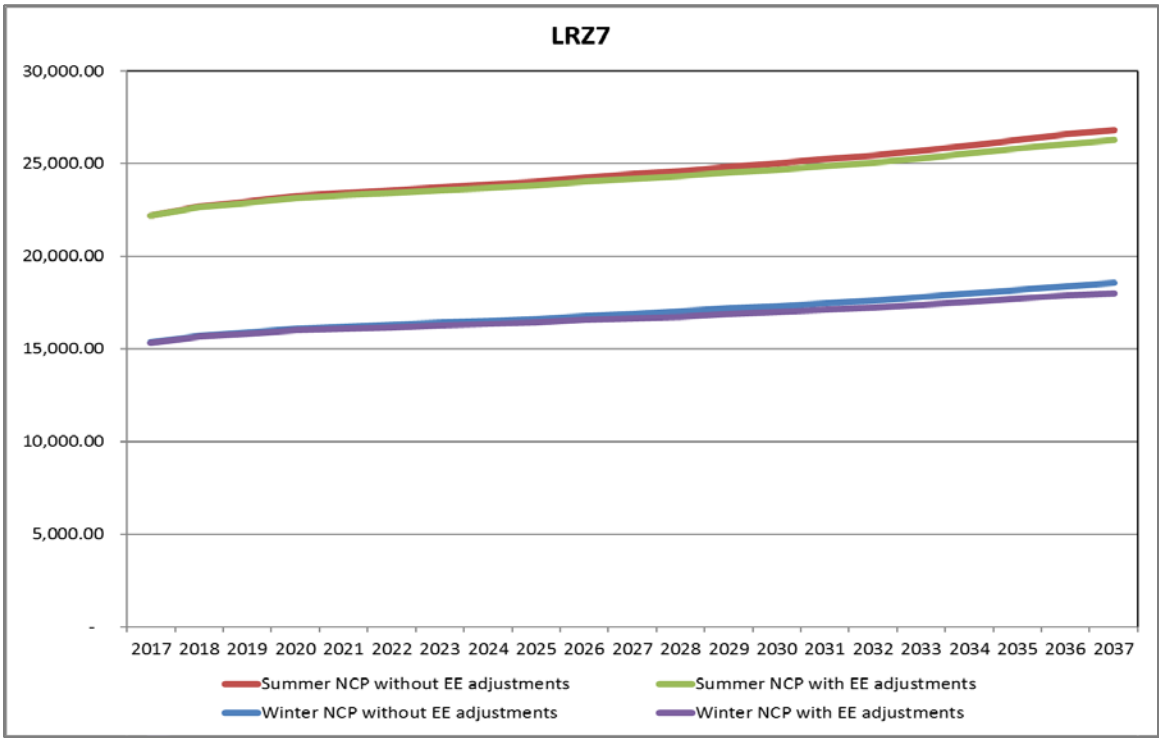


Figure 54: Gross and Net LRZ8 Summer and Winter Non-Coincident Peak Demand (MW)

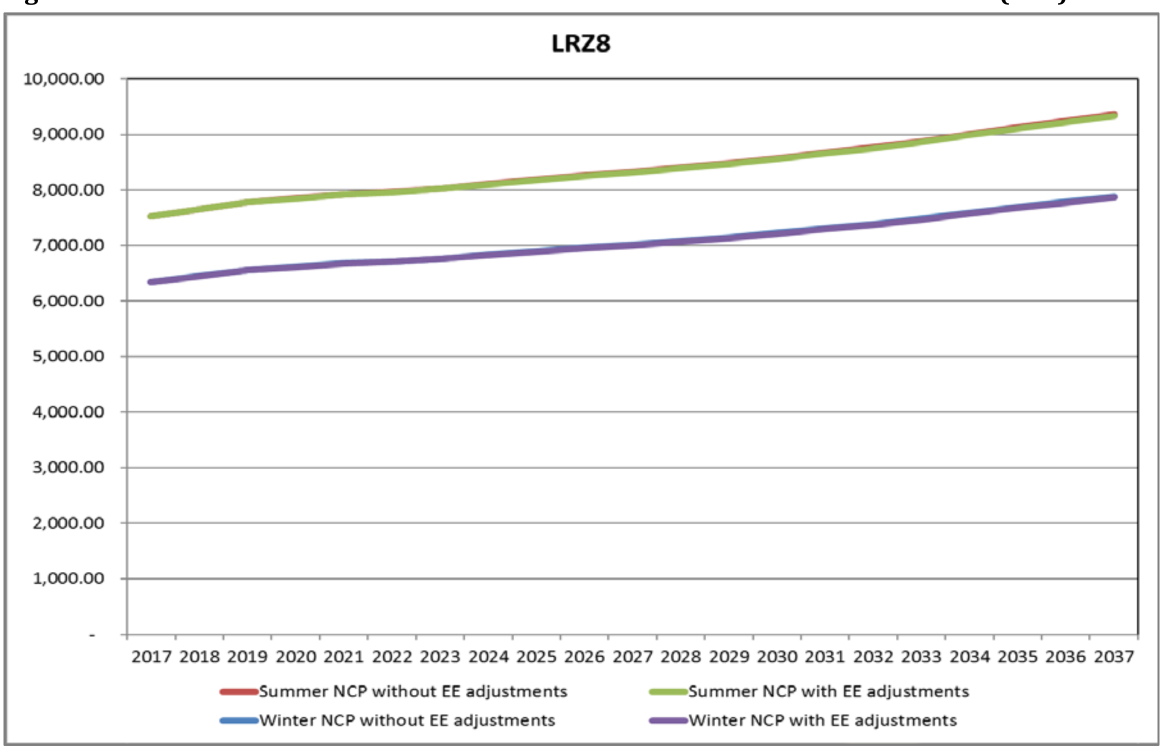


Figure 55: Gross and Net LRZ9 Summer and Winter Non-Coincident Peak Demand (MW)

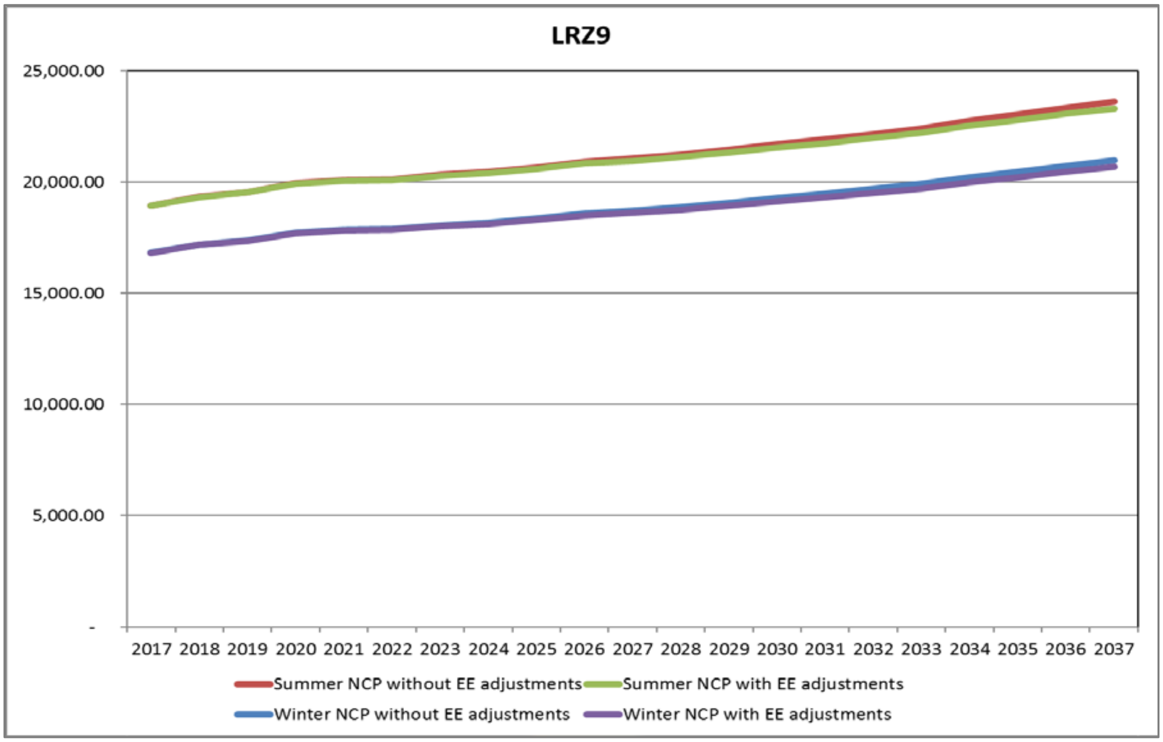
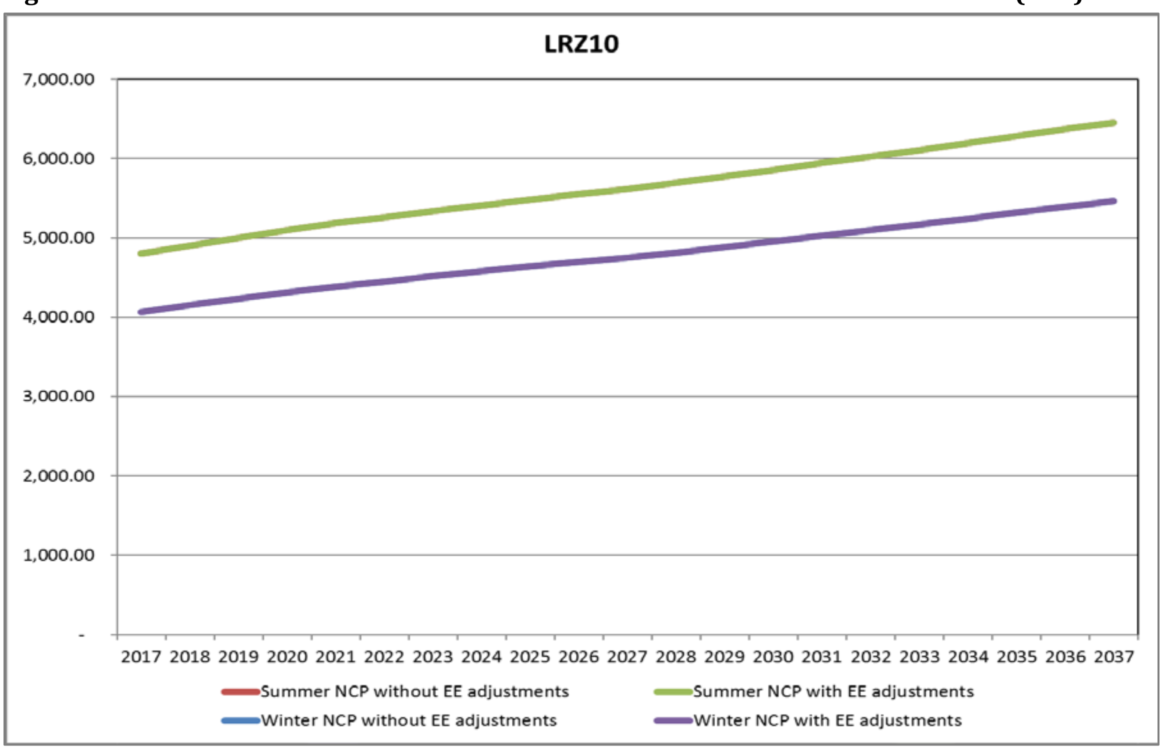


Figure 56: Gross and Net LRZ10 Summer and Winter Non-Coincident Peak Demand (MW)[20]



[20] The EE adjustments for LRZ 10 is zero. Thus, the gross value overlaps the net value.

6 MISO System-Wide Forecasts

6.1 MISO SYSTEM ENERGY FORECAST

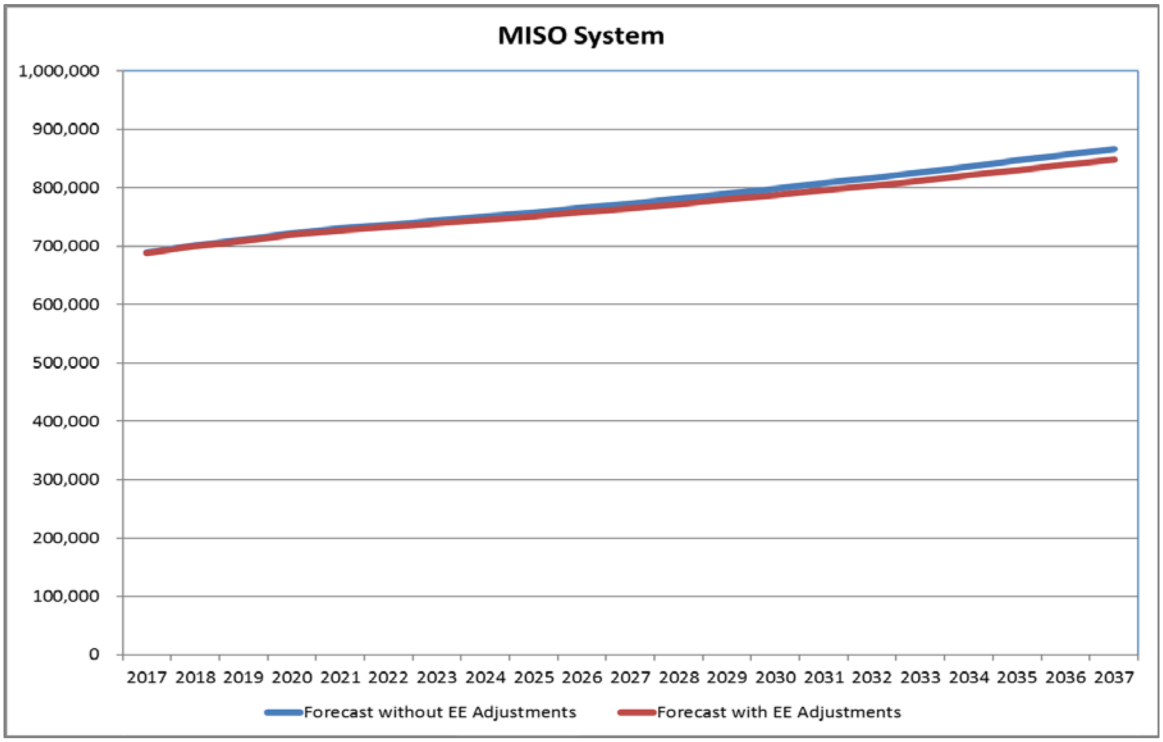
The MISO system energy forecast is found by summing the individual LRZ metered load forecasts. Table 21 and Figure 57 provide the MISO-level energy forecast. Please note the forecasts are for the specified calendar year, not the MISO planning year.

Table 21: Gross and Net MISO System Energy[21] (Annual Metered Load in GWh)

Year	MISO Energy without EE Adjustments	MISO Energy with EE Adjustments
2016	666,730	666,730
2017	688,852	688,048
2018	701,315	699,893
2019	711,146	709,082
2020	722,278	719,545
2021	730,283	726,853
2022	736,951	732,793
2023	744,063	739,154
2024	750,658	744,969
2025	757,782	751,282
2026	765,854	758,515
2027	773,220	765,009
2028	781,413	772,296
2029	790,089	780,035
2030	798,778	787,752
2031	807,772	795,737
2032	816,808	803,734
2033	826,125	811,981
2034	836,310	821,066
2035	846,583	830,206
2036	856,663	839,119
2037	866,288	847,554
Compound Annual Growth Rates (%)		
2018-2022	1.25	1.15
2018-2027	1.09	0.99
2018-2037	1.12	1.01

[21] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

Figure 57: Gross and Net MISO System Energy Forecast (Metered Load in GWh)



6.2 MISO SYSTEM COINCIDENT PEAK DEMAND FORECAST

Not all LRZs experience their peak demand levels at the same time. This load diversity means that the MISO system peak demand level is less than the arithmetic sum of the LRZ non-coincident peak demands. The MISO system coincident peak demand is determined by applying coincidence factors to the individual LRZ non-coincident peak demands and summing. These coincidence factors represent the ratio of the LRZ's load at the time of the overall MISO system peak to the LRZ's non-coincident peak. Coincidence factors were calculated from hourly loads over the 2010 to 2016 timeframe. Table 22 and Table 23 list the summer and winter coincidence factors. When the coincidence factor equals 1, it means the peak for that zone coincides with the MISO system peak. The net MISO coincident peak is calculated by subtracting the EE coincident load impact at the MISO level directly from MISO coincident peak without the EE adjustments. Table 24 and Figure 58 provide the MISO system seasonal peak demand forecasts with and without EE adjustments.

Table 22: MISO Coincident Factors—Winter

LRZ	Winter Coincident Factor						
	Average	2010	2011	2012	2013	2014	2015	2016
1	0.9802	0.990	0.994	0.962	1.000	0.994	0.962	0.958
2	0.9709	0.993	0.976	0.963	0.990	0.989	0.944	0.942
3	0.9873	0.996	0.971	1.000	0.979	1.000	0.970	0.995
4	0.9867	1.000	1.000	1.000	0.980	0.992	0.957	0.978
5	0.9894	0.962	1.000	1.000	0.964	1.000	1.000	1.000
6	0.9761	0.983	0.993	0.992	0.928	0.988	0.988	0.961
7	0.9499	0.988	0.958	0.938	0.959	0.944	0.936	0.927
8	0.9639	0.889	0.929	0.995	0.954	0.981	1.000	1.000
9	0.9321	0.832	0.950	0.895	0.887	0.977	0.984	1.000
10	0.9432	0.924	0.892	0.936	0.858	0.998	0.999	0.995

Table 23: MISO Coincident Factors—Summer

LRZ	Summer Coincident Factor							
	Average	2010	2011	2012	2013	2014	2015	2016
1	0.9463	0.968	1.000	0.945	0.973	0.896	0.891	0.951
2	0.9776	0.948	1.000	0.969	0.999	1.000	0.950	0.977
3	0.9596	0.952	0.986	0.974	0.969	0.992	0.848	0.997
4	0.9688	1.000	0.988	0.945	0.988	0.885	0.976	0.999
5	0.9688	1.000	0.971	0.949	0.963	0.907	0.999	0.993
6	0.9781	0.968	0.991	0.973	1.000	0.970	0.995	0.950
7	0.9621	0.913	0.961	1.000	0.999	0.998	1.000	0.863
8	0.9386	0.964	0.936	0.929	0.936	0.875	0.950	0.981
9	0.9319	0.982	0.917	0.912	0.860	0.920	0.937	0.996
10	0.9066	0.960	0.901	0.894	0.791	0.844	0.968	0.988

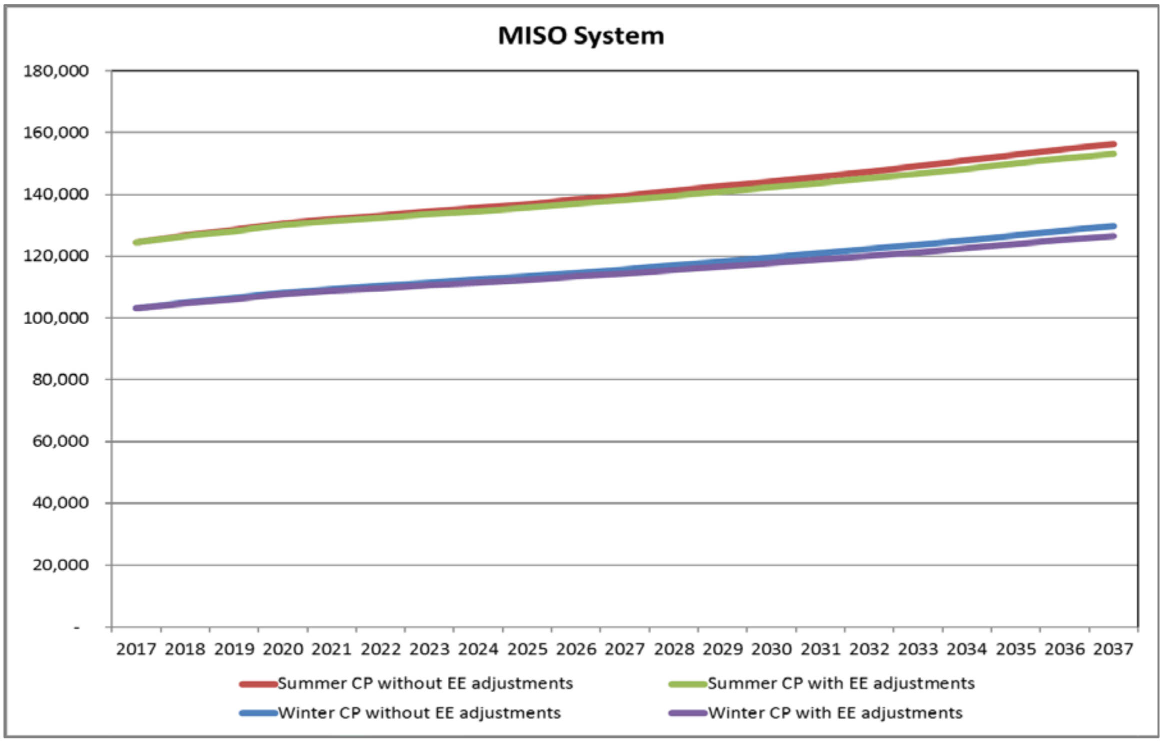
Table 24: Gross and Net MISO System Coincident Peak Demand[22] (Metered Load in MW)

Year	MISO Summer CP without EE Adjustments	MISO Summer CP with EE Adjustments	MISO Winter CP without EE Adjustments	MISO Winter CP with EE Adjustments
2016	120,364	120,364	99,899	99,899
2017	124,561	124,419	103,203	103,061
2018	126,804	126,556	105,050	104,802
2019	128,567	128,208	106,521	106,162
2020	130,555	130,080	108,184	107,709
2021	131,990	131,395	109,387	108,791
2022	133,189	132,468	110,388	109,666
2023	134,461	133,610	111,452	110,600
2024	135,642	134,656	112,442	111,456
2025	136,913	135,788	113,509	112,384
2026	138,359	137,089	114,712	113,441
2027	139,679	138,258	115,813	114,392
2028	141,147	139,570	117,041	115,464
2029	142,704	140,966	118,339	116,601
2030	144,262	142,356	119,643	117,736
2031	145,877	143,797	120,989	118,909
2032	147,500	145,241	122,342	120,083
2033	149,175	146,732	123,735	121,291
2034	151,004	148,371	125,257	122,624
2035	152,853	150,024	126,791	123,963
2036	154,664	151,634	128,297	125,267
2037	156,391	153,156	129,737	126,502
Compound Annual Growth Rates (%)				
2018-2022	1.24	1.15	1.25	1.14
2018-2027	1.08	0.99	1.09	0.98
2018-2037	1.11	1.01	1.12	1.00

[22] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

MISO SYSYTEM-WIDE FORECASTS

Figure 58: Gross and Net MISO System Coincident Peak Demand (Metered Load in MW)



6.3 MISO SYSTEM HIGH AND LOW FORECASTS

Alternate 90/10 (High/Low) forecasts were developed. Figure 59 shows the MISO system net energy forecasts for the Low, Base and High scenarios and Table 25 provides the growth rates for net energy and seasonal peaks. Appendix C contains more information on the high and low forecasts.

Figure 59: Net MISO System Energy for Alternate Forecasts (Annual Metered Load in GWh)

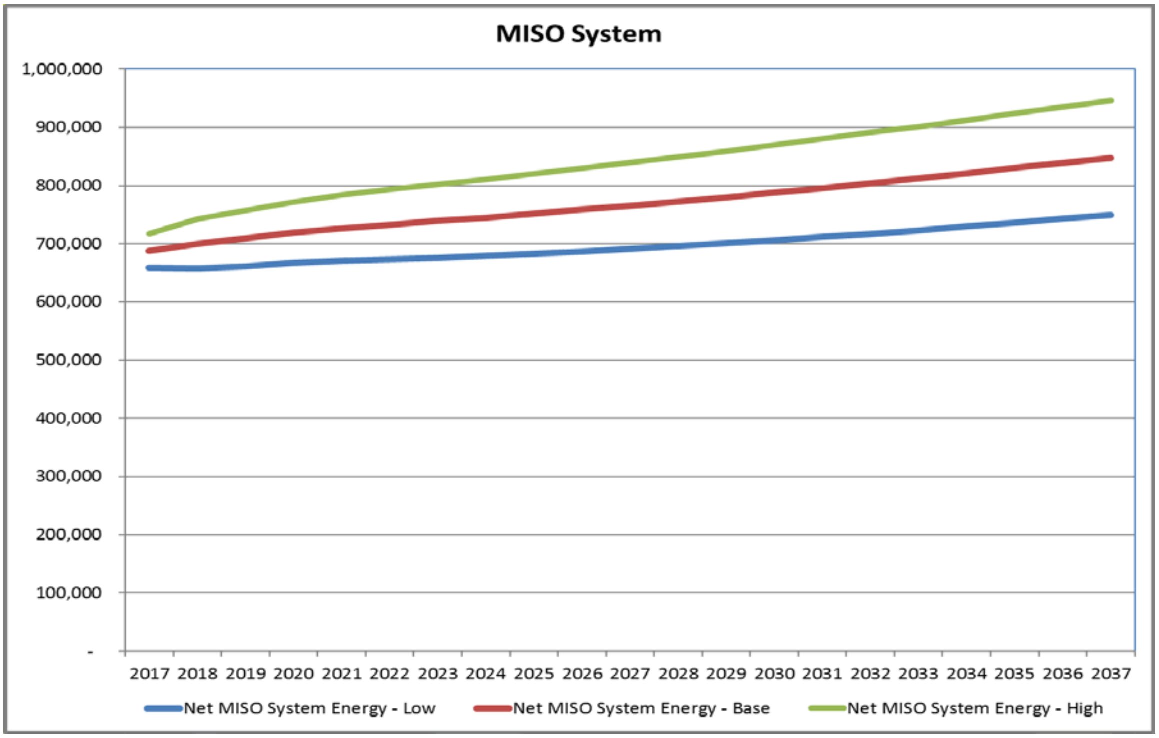


Table 25: Net MISO System Compound Annual Growth Rates for Alternate Forecasts[23] (2018-2037)

	BASE	HIGH	LOW
Energy	1.01	1.28	0.69
Summer Peak	1.01	1.28	0.68
Winter Peak	1.00	1.26	0.67

[23] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

7 Weather Normalization

Starting in 2016, SUFG has used the models developed in the ILF process to remove the effects of weather variation from historical MISO loads. The weather normalization facilitates a comparison of load forecasts to historical loads. In the weather normalization process, the historical loads are adjusted based on the difference between the actual values of the weather variables and their longer term normal variables. These differences are then multiplied by the coefficients of the variables in the forecasting models to find the changes in load that would have occurred if normal conditions had been in place. In this case, the weather variables are annual cooling degree days and heating degree days at the state level for the annual energy data and temperature at the LRZ level for peak demand data. Weather normalization has been performed for each of the years of historical MISO data (2011-2016). Results are shown in Tables 26 through Table 29.

Table 26: Normalized LRZ Energy (Annual Metered Load in GWh)

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2011	95,438	64,517	45,673	49,416	42,372	99,796	100,046	36,121	101,273	20,605
2012	95,926	64,704	45,984	49,517	42,425	100,719	101,791	35,899	103,862	22,871
2013	95,898	64,402	46,273	49,716	42,797	100,060	99,341	36,052	105,947	22,684
2014	98,634	65,080	47,302	50,081	42,758	100,404	99,564	37,070	109,845	21,475
2015	96,734	64,820	47,324	49,429	42,200	98,449	99,820	36,748	109,062	22,211
2016	97,069	65,121	48,594	48,584	38,226	94,202	101,291	36,876	110,049	22,315

Table 27: Normalized Summer Non-Coincident Peak Demand (Metered Load in MW)

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2011	16,938	12,282	8,615	9,704	8,865	17,428	20,508	7,064	19,289	4,742
2012	17,505	12,325	8,620	9,287	8,351	17,436	20,336	6,707	18,364	4,748
2013	17,504	12,270	8,814	9,831	8,447	17,246	20,667	7,416	19,795	4,738
2014	17,545	12,494	8,538	9,453	8,603	18,153	21,408	7,489	20,399	4,646
2015	17,531	12,297	8,759	9,439	8,423	17,586	21,170	7,468	20,464	4,638
2016	18,198	12,657	8,864	9,522	8,192	16,692	20,568	7,595	20,132	4,760

Table 28: Normalized Winter Non-Coincident Peak Demand (Metered Load in MW)

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2011	14,376	9,366	6,727	7,526	7,379	15,809	14,759	6,165	17,114	3,765
2012	13,871	9,472	6,890	7,612	7,065	15,317	14,307	5,765	15,937	3,567
2013	14,697	9,932	7,262	7,766	7,100	15,417	14,692	6,133	16,373	3,993
2014	15,052	9,865	7,156	7,710	6,935	16,261	14,213	6,773	17,519	4,187
2015	15,220	9,794	7,152	8,012	7,514	15,961	14,906	6,727	17,983	4,053
2016	14,501	9,727	7,634	7,639	6,685	15,403	14,466	6,535	17,684	4,448

WEATHER NORMALIZATION

Table 29: Normalized MISO System Energy and Peak Demand (Metered Load)

Year	System Energy (GWh)	System Peak (MW)	
		Summer	Winter
2011	655,255	121,443	100,220
2012	663,697	118,103	95,982
2013	663,171	121,291	98,372
2014	672,212	121,069	103,938
2015	666,798	121,787	104,371
2016	662,327	121,952	101,665

APPENDIX A State Electric Energy Forecasting Models

Arkansas

Dependent Variable:
ELECTRICITY_SALES
Method: Least Squares
Sample: 1990 2014
Included observations: 25

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	18922.77	3202.394	5.908946	0.0000	
@MOVAV(REAL_ELECTRICITY_PRICE,4)	-1644.084	176.6988	-9.304444	0.0000	-0.2484
GSP	0.278528	0.016122	17.27614	0.0000	0.6491
CDD	3.56418	0.488213	7.300467	0.0000	0.1590
HDD	1.082386	0.358589	3.018457	0.0068	0.0928
R-squared	0.994928	Mean dependent var	40551.61		
Adjusted R-squared	0.993914	S.D. dependent var	6716.979		
S.E. of regression	524.0147	Durbin-Watson stat	1.575739		
F-statistic	980.8533				
Prob(F-statistic)	0.000000				

Illinois

Dependent Variable: ELECTRICITY_SALES
Method: Least Squares
Sample: 1990 2014
Included observations: 25

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	88116.68	14962.59	5.889134	0.0000	
@MOVAV(REAL_ELECTRICITY_PRICE,5)	-2367.163	612.858	-3.862499	0.0010	-0.1419
GSP	0.082279	0.014402	5.712963	0.0000	0.3891
CDD	10.70239	1.338207	7.997555	0.0000	0.0778
HDD	1.510145	0.570358	2.647716	0.0154	0.0670
R-squared	0.99072	Mean dependent var	133512.2		
Adjusted R-squared	0.988864	S.D. dependent var	10743.76		
S.E. of regression	1133.768	Durbin-Watson stat	1.978099		
F-statistic	533.7845				
Prob(F-statistic)	0.000000				

Indiana

Dependent Variable: ELECTRICITY_SALES
Method: Least Squares
Sample: 1990 2014
Included observations: 25

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	23938.99	3441.989	6.954987	0.0000	
@MOVAV(REAL_ELECTRICITY_PRICE,3)	-1225.3	227.6832	-5.381601	0.0000	-0.0944
@MOVAV(REAL_NATURAL_GAS_PRICE,2)	363.4235	103.8457	3.499648	0.0024	0.0246
REAL_GSP	0.252658	0.004863	51.95145	0.0000	0.6810
CDD	6.156419	0.764461	8.053285	0.0000	0.0674
HDD	1.813066	0.381139	4.756967	0.0001	0.1033

R-squared	0.996911	Mean dependent var	96216.86
Adjusted R-squared	0.996098	S.D. dependent var	10913.56
S.E. of regression	681.7222	Durbin-Watson stat	2.007218
F-statistic	1226.353		
Prob(F-statistic)	0.000000		

Iowa

Dependent Variable: ELECTRICITY_SALES
Method: Least Squares
Sample: 1993 2014
Included observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	16948.22	3105.043	5.458289	0.0001	
REAL_ELECTRICITY_PRICE(-2)	-1286.671	282.2488	-4.558639	0.0003	-0.2024
REAL_NATURAL_GAS_PRICE(-2)	188.075	60.33242	3.117313	0.0066	0.0297
REAL INCOME	0.000214	0.0000106	20.1258	0.0000	0.6498
CDD	2.933447	0.694937	4.221169	0.0006	0.0664
HDD	0.664417	0.212405	3.128059	0.0065	0.1084

R-squared	0.994364	Mean dependent var	40849.62
Adjusted R-squared	0.992603	S.D. dependent var	4697.763
S.E. of regression	404.0402	Durbin-Watson stat	1.351322
F-statistic	564.583		
Prob(F-statistic)	0.000000		

Kentucky

Dependent Variable: ELECTRICITY_SALES
Method: Least Squares
Sample: 1993 2014
Included observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	-83509.28	10478.3	-7.969739	0.0000	
@MOVAV(EL_PRICE_KY,3)	-2373.248	738.2586	-3.214657	0.0054	-0.190776
@MOVAV(NG_PRICE_KY,3)	786.6778	217.4875	3.617118	0.0023	0.059757
POPULATION_KY	0.037176	0.002669	13.93053	0.0000	1.799768
CDD_KY	4.107741	1.891501	2.171683	0.0453	0.0646
HDD_KY	3.550747	1.175732	3.020031	0.0081	0.1882

R-squared	0.969562	Mean dependent var	84063.79
Adjusted R-squared	0.96005	S.D. dependent var	7646.604
S.E. of regression	1528.368	Durbin-Watson stat	2.047813
F-statistic	101.931		
Prob(F-statistic)	0.000000		

Louisiana

Dependent Variable: ELECTRICITY_SALES
Method: Least Squares
Sample: 1990 2004 2006 2014
Included observations: 24

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	43231.93	9063.392	4.769951	0.0001	
REAL_ELECTRICITY_PRICE(-2)	-2880.37	494.0632	-5.829963	0.0000	-0.2313
REAL_GSP	0.182654	0.028914	6.317075	0.0000	0.4319
CDD	4.680232	2.400735	1.9495	0.0662	0.1765
HDD	6.425083	1.936429	3.318006	0.0036	0.1269

R-squared	0.942101	Mean dependent var	77111.55
Adjusted R-squared	0.929912	S.D. dependent var	7050.546
S.E. of regression	1866.571	Durbin-Watson stat	1.716599
F-statistic	77.28978		
Prob(F-statistic)	0.000000		

Michigan

Dependent Variable: MI_EL_SALES
Method: Least Squares
Sample: 1990 2014
Included observations: 25

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	55168.01	8066.145	6.839452	0.0000	
EL_PRICE_MI(-2)	-2483.754	402.4724	-6.171241	0.0000	-0.240701
PI_MI/POPULATION_MI	919.3478	156.8794	5.860222	0.0000	0.354329
GSP_MI	0.061895	0.017859	3.46581	0.0026	0.248093
CDD_MI	5.449304	1.364307	3.994192	0.0008	0.0436
HDD_MI	1.197745	0.559924	2.139122	0.0456	0.0743
R-squared	0.986385	Mean dependent var	100050.7		
Adjusted R-squared	0.982802	S.D. dependent var	8318.694		
S.E. of regression	1090.925	Durbin-Watson stat	1.940867		
F-statistic	275.3014				
Prob(F-statistic)	0.000000				

Minnesota

Dependent Variable: ELECTRICITY_SALES
Method: Least Squares
Sample: 1991 2014
Included observations: 24

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	20842.71	3265.525	6.382653	0.0000	
@MOVAV(REAL_ELECTRICITY_PRICE,5)	-785.6936	286.9386	-2.738194	0.0135	-0.0981
@MOVAV(REAL_NATURAL_GAS_PRICE,4)	465.4847	120.0009	3.87901	0.0011	0.0503
REAL_INCOME	0.000154	5.56E-06	27.74229	0.0000	0.5647
CDD	6.109774	1.119473	5.457725	0.0000	0.0650
HDD	1.012256	0.279173	3.625913	0.0019	0.1328
R-squared	0.992912	Mean dependent var	60825.52		
Adjusted R-squared	0.990943	S.D. dependent var	7158.567		
S.E. of regression	681.2834	Durbin-Watson stat	1.444467		
F-statistic	504.2722				
Prob(F-statistic)	0.000000				

Mississippi

Dependent Variable: ELECTRICITY_SALES
Method: Least Squares
Sample: 1993 2014
Included observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	13364.2	4658.947	2.868501	0.0111	
@MOVAV(REAL_ELECTRICITY_PRICE,3)	-1736.159	243.0253	-7.143943	0.0000	-0.3049
REAL_INCOME(-1)	0.000136	5.15E-05	2.643591	0.0177	0.3000
REAL_GSP	0.256937	0.090669	2.833794	0.0120	0.4921
CDD	3.047907	0.687354	4.434262	0.0004	0.1529
HDD	1.709259	0.615461	2.777203	0.0135	0.0952

R-squared	0.98633	Mean dependent var	44657.31
Adjusted R-squared	0.982059	S.D. dependent var	4336.682
S.E. of regression	580.879	Durbin-Watson stat	2.072365
F-statistic	230.8954		
Prob(F-statistic)	0.000000		

Missouri

Dependent Variable: ELECTRICITY_SALES
Method: Least Squares
Sample: 1998 2015
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2015 (weather at means)
C	-89558.56	9913.456	-9.03404	0.0000	
@MOVAV(REAL_ELECTRICITY_PRICE,5)	-2820.807	382.632	-7.372115	0.0000	-0.2975
POPULATION	0.017089	0.001829	9.3418	0.0000	1.2745
NON_MANUFACTURING_EMP	0.025999	0.005768	4.507635	0.0007	0.8052
CDD	8.640722	1.0294	8.393937	0.0000	0.1670
HDD	2.929798	0.555052	5.278417	0.0002	0.1702

R-squared	0.986686	Mean dependent var	78974.32
Adjusted R-squared	0.981138	S.D. dependent var	5741.056
S.E. of regression	788.4653	Durbin-Watson stat	1.730957
F-statistic	177.8592		
Prob(F-statistic)	0.000000		

Montana

Dependent Variable: ELECTRICITY_SALES
Method: Least Squares
Sample: 1996 2014
Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	-524.7233	3615.793	-0.14512	0.8870	
REAL_ELECTRICITY_PRICE	-1857.406	230.4096	-8.061322	0.0000	-1.0301
@MOVAV(REAL_NATURAL_GAS_PRICE,5)	497.9886	76.74329	6.489018	0.0000	0.2770
REAL_INCOME/POPULATION	299.0434	45.60662	6.557017	0.0000	0.8229
MANUFACTURING_EMP	0.288485	0.072824	3.961422	0.0019	0.3873
CDD	2.261957	0.774918	2.918963	0.0129	0.0768
HDD	0.962943	0.241059	3.994629	0.0018	0.5059
R-squared	0.938059	Mean dependent var	13677.86		
Adjusted R-squared	0.907089	S.D. dependent var	1008.073		
S.E. of regression	307.2734	Durbin-Watson stat	2.010131		
F-statistic	30.28902				
Prob(F-statistic)	0.000001				

North Dakota

Dependent Variable: ELECTRICITY_SALES
Method: Least Squares
Sample: 1994 2014
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	-9908.14	2012.282	-4.923834	0.0002	
@MOVAV(REAL_ELECTRICITY_PRICE,3)	-373.9147	179.1613	-2.087029	0.0532	-0.1467
@MOVAV(REAL_NATURAL_GAS_PRICE,3)	164.4758	62.95955	2.612404	0.0189	0.0530
NON_MANUFACTURING_EMP	0.059875	0.00196	30.5538	0.0000	1.4298
HDD	0.335733	0.123958	2.708439	0.0155	0.2612
R-squared	0.988901	Mean dependent var	11173.86		
Adjusted R-squared	0.986126	S.D. dependent var	2824.577		
S.E. of regression	332.6993	Durbin-Watson stat	1.562303		
F-statistic	356.3902				
Prob(F-statistic)	0.000000				

South Dakota

Dependent Variable: ELECTRICITY_SALES

Method: Least Squares

Sample: 1995 2014

Included observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	-19621.55	1128.682	-17.38448	0.0000	
REAL_ELECTRICITY_PRICE(-2)	-461.3775	77.83107	-5.927934	0.0000	-0.3033
REAL_NATURAL_GAS_PRICE(-2)	56.99736	21.45578	2.656504	0.0188	0.0310
POPULATION	0.039219	0.000887	44.19976	0.0000	2.7102
CDD	0.484225	0.155823	3.10753	0.0077	0.0358
HDD	0.19127	0.0551	3.471316	0.0037	0.1460

R-squared	0.997687	Mean dependent var	9729.92
Adjusted R-squared	0.996861	S.D. dependent var	1658.558
S.E. of regression	92.91854	Durbin-Watson stat	1.833796
F-statistic	1207.911		
Prob(F-statistic)	0.000000		

Texas

Dependent Variable: ELECTRICITY_SALES

Method: Least Squares

Sample: 1996 2014

Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	86745.8	17633.71	4.919318	0.0003	
REAL_ELECTRICITY_PRICE(-2)	-3684.416	1674.161	-2.200754	0.0464	-0.0757
REAL_NATURAL_GAS_PRICE(-2)	2497.617	894.5251	2.792115	0.0153	0.0333
REAL_GSP	0.146033	0.005283	27.64047	0.0000	0.5461
CDD	25.49181	4.828415	5.27954	0.0001	0.2328
HDD	16.33358	4.96877	3.287248	0.0059	0.0906

R-squared	0.989578	Mean dependent var	334434
Adjusted R-squared	0.98557	S.D. dependent var	30848.37
S.E. of regression	3705.698	Durbin-Watson stat	2.04072
F-statistic	246.875		
Prob(F-statistic)	0.000000		

Wisconsin

Dependent Variable: ELECTRICITY_SALES

Method: Least Squares

Sample: 1990 2014

Included observations: 25

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity at 2014 (weather at means)
C	20597.33	2190.601	9.402594	0.0000	
@MOVAV(REAL_ELECTRICITY_PRICE,3)	-1299.039	114.4711	-11.34818	0.0000	-0.1789
REAL_NATURAL_GAS_PRICE	257.5846	71.14299	3.62066	0.0018	0.0308
REAL_GSP	0.200844	0.003783	53.09825	0.0000	0.7673
CDD	3.974989	0.738156	5.385027	0.0000	0.0376
HDD	0.569158	0.251927	2.259222	0.0358	0.0637

R-squared	0.99579	Mean dependent var	63495.47
Adjusted R-squared	0.994682	S.D. dependent var	6946.586
S.E. of regression	506.5929	Durbin-Watson stat	1.494082
F-statistic	898.7386		
Prob(F-statistic)	0.000000		

APPENDIX B Peak Demand Models

Regression Models

LRZ	Model Specification (Summer Peak Load Factors)
1	$C + Avg\ Temp + Avg\ Temp^2 + Avg\ Temp^3 + SP + MAVGT3 + T\ Max + Temp$
2	$C + Avg\ Temp + Avg\ Temp^2 + Avg\ Temp^3 + SP + MAVGT3 + T\ Max + Temp$
3	$C + Avg\ Temp + Avg\ Temp^2 + Avg\ Temp^3 + SP + T\ Max + Temp + Temp^2$
4	$C + Avg\ Temp + T\ Max + T\ Max^2 + SP$
5	$C + Avg\ Temp + SP + MVGT3 + Temp + Temp^2$
6	$C + Avg\ Temp + Avg\ Temp^2 + T\ Max + T\ Max^2 + SP$
7	$C + Avg\ Temp + Avg\ Temp^2 + SP + MAVGT3$
8	$C + Avg\ Temp + Avg\ Temp^2 + SP + Temp + T\ Max$
9	$C + Avg\ Temp + Temp + T\ Max + SP$
10	$C + Avg\ Temp + Avg\ Temp^2 + Avg\ Temp^3 + SP + T\ Max + Temp + MAVGT3$
LRZ	**Model Specification (Winter Peak Load Factors)**
1	$C + Avg\ Temp^2 + Avg\ Temp^3 + WP + MAVGT3 + T\ Max + Temp$
2	$C + Avg\ Temp + Avg\ Temp^2 + WP$
3	$C + Avg\ Temp + Temp + WP$
4	$C + Avg\ Temp + Temp + WP$
5	$C + Avg\ Temp + (T\ Max - Temp) + (T\ Max - Temp)^2 + WP + MAVGT3$
6	$C + Avg\ Temp + MAVGT3 + MAVGT3^2 + WP$
7	$C + Avg\ Temp + Avg\ Temp^2 + WP + MAVGT3$
8	$C + Avg\ Temp + AvgTemp^2 + WP + MAVGT3$
9	$C + Avg\ Temp + Avg\ Temp^2 + Avg\ Temp^3 + WP + MAVGT3 + MAVGT3^2$
10	$C + Avg\ Temp + Avg\ Temp^2 + Avg\ Temp^3 + WP + MAVGT3 + MAVGT^2$

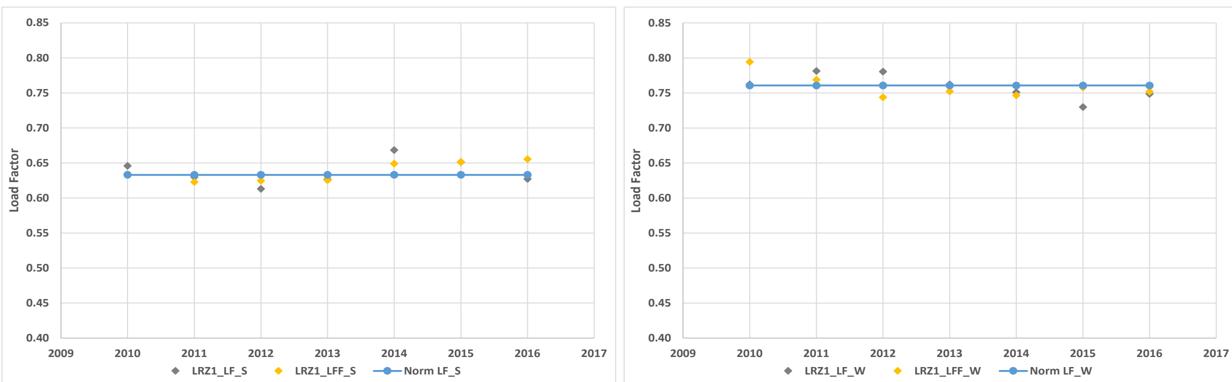
The followings are variable names and definitions:

- SP: binary variable, the value is 1 for summer peak load factor, otherwise it is 0;
- WP: binary variable, the value is 1 for winter peak load factor, otherwise it is 0;

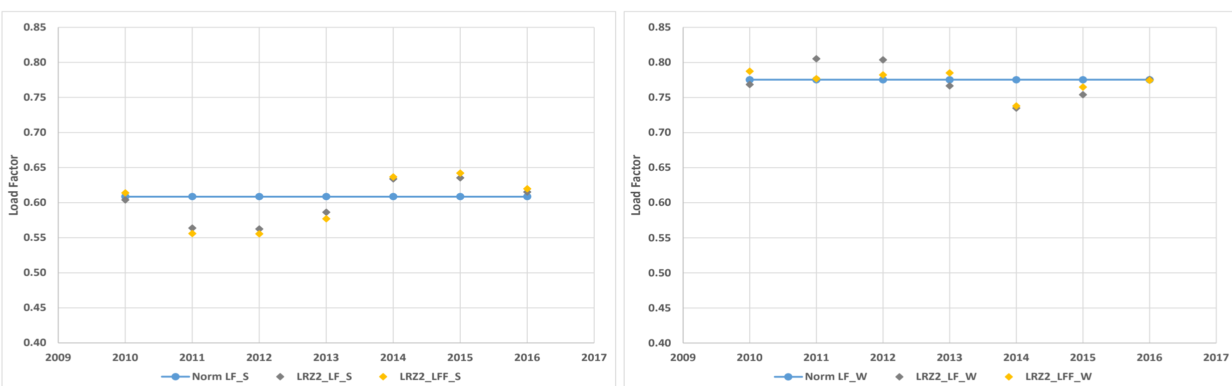
- Temp: hourly temperature observed;
- Avg Temp: average daily temperature in respect to the daily peak load factor;
- T Max: highest daily temperature in respect to the daily peak load factor;
- MAVGT3: Moving average temperature of the previous two hours and the hour when the daily peak occurred;
- Daily Peak Load Factor: dependent variable, the ratio of annual average hourly load over daily peak load.

The following figures show the comparison of historical peak load factors, fitted peak load factors and normalized peak load factors. The grey diamonds represent actual peak load factors, the yellow diamonds indicate the fitted peak load factors from the model under actual peak weather conditions, and the blue line shows the normalized peak load factors under normalized seasonal peak weather conditions.

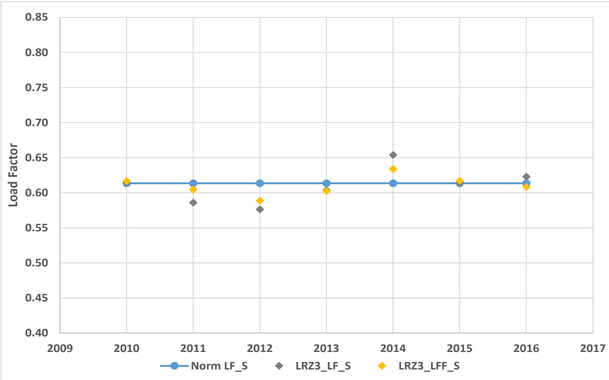
Actual Peak Load Factors vs. Fitted Peak Load Factors for LRZ 1

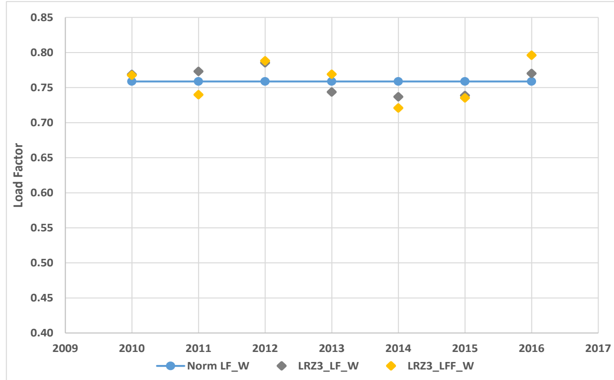


Actual Peak Load Factors vs. Fitted Peak Load Factors for LRZ 2

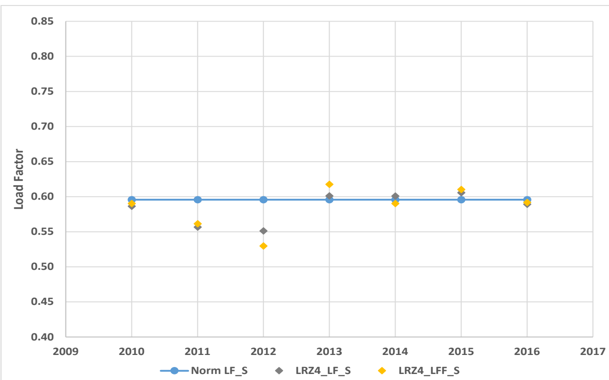


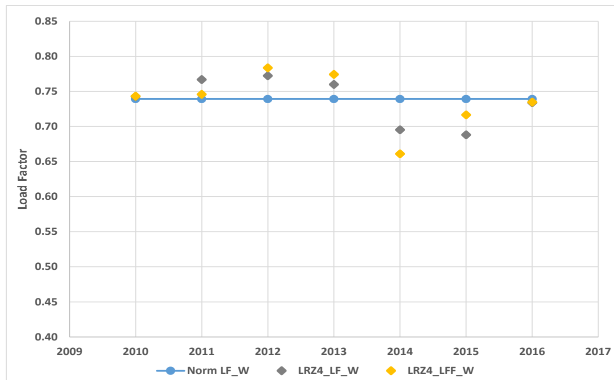
Actual Peak Load Factors vs. Fitted Peak Load Factors for LRZ 3



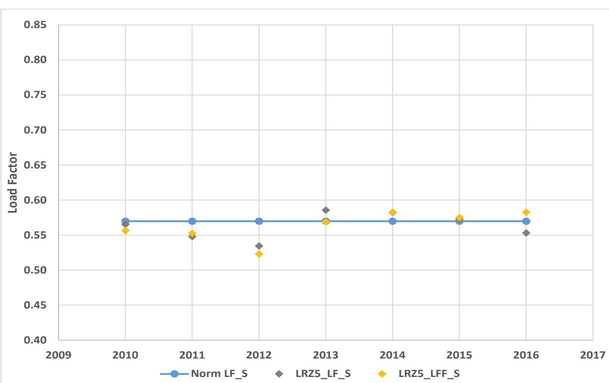


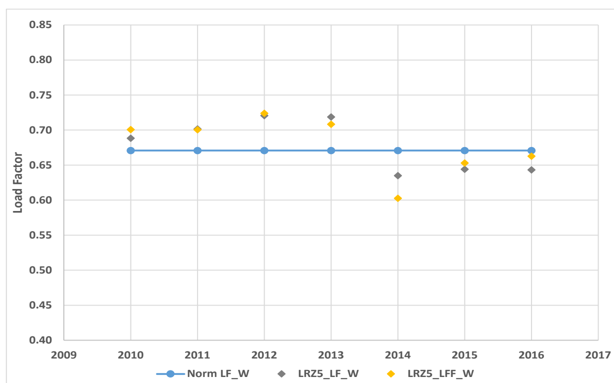
Actual Peak Load Factors vs. Fitted Peak Load Factors for LRZ 4



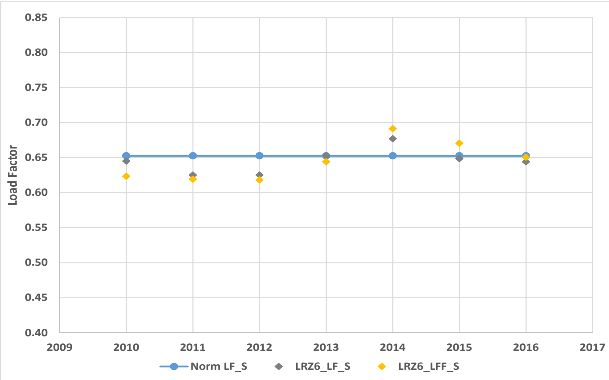


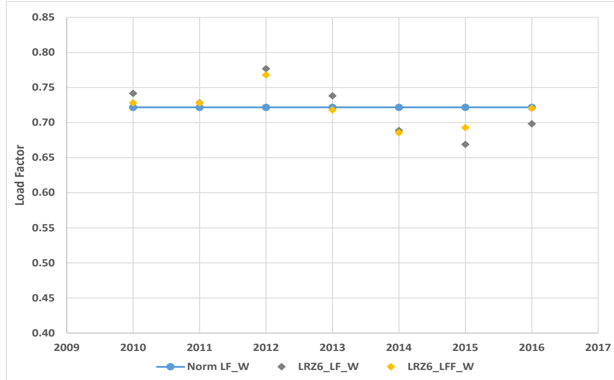
Actual Peak Load Factors vs. Fitted Peak Load Factors for LRZ 5



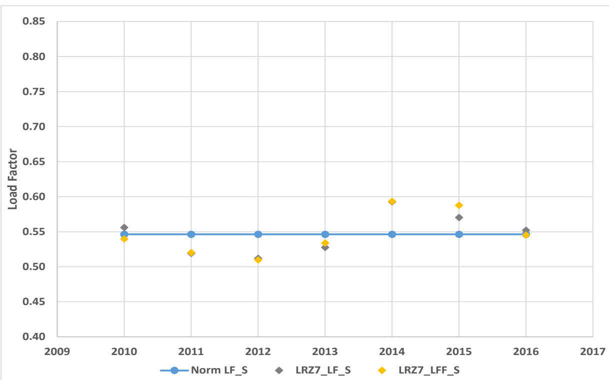


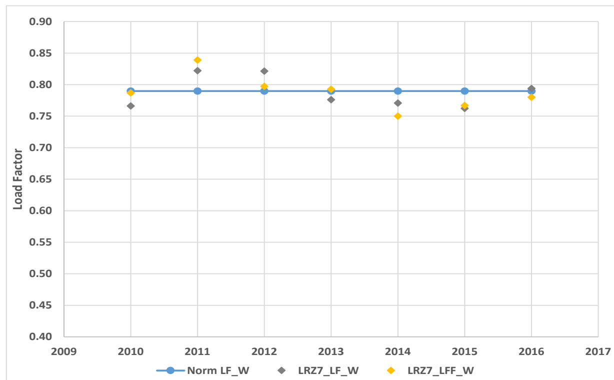
Actual Peak Load Factors vs. Fitted Peak Load Factors for LRZ 6



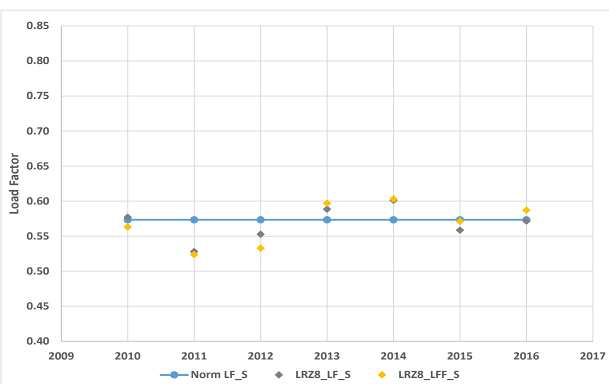


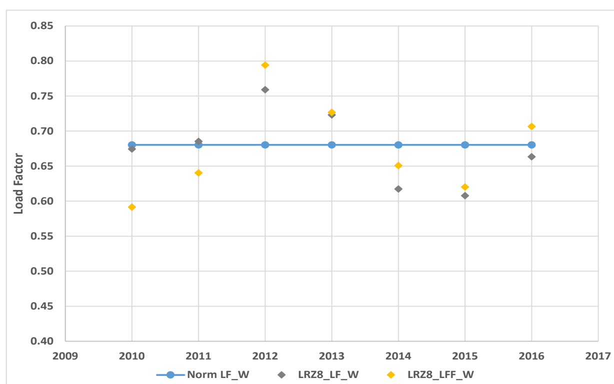
Actual Peak Load Factors vs. Fitted Peak Load Factors for LRZ 7



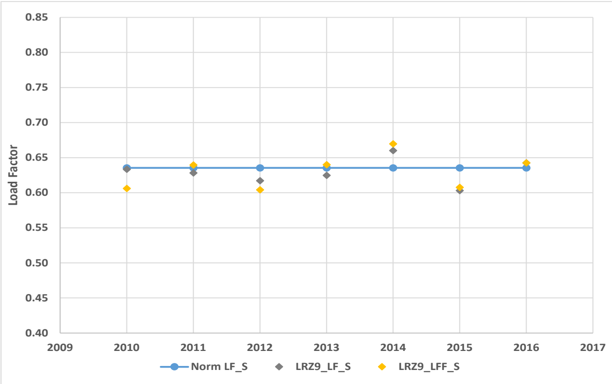


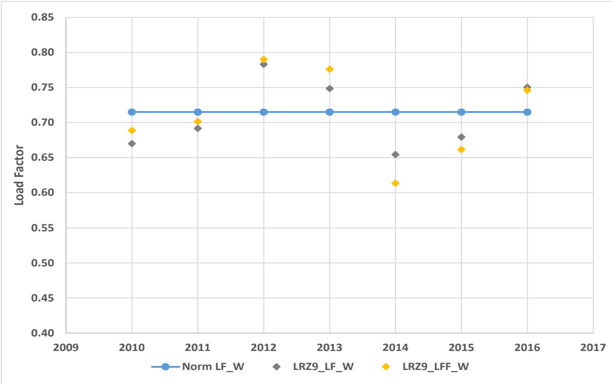
Actual Peak Load Factors vs. Fitted Peak Load Factors for LRZ 8



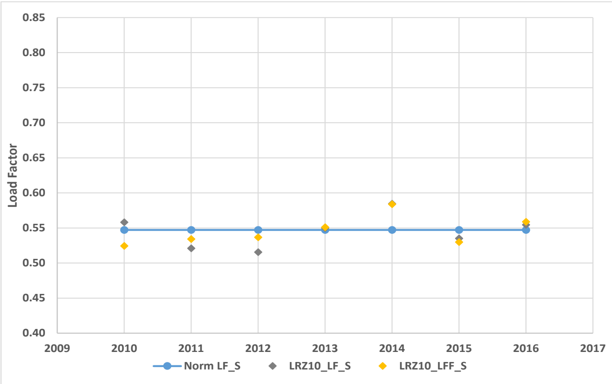


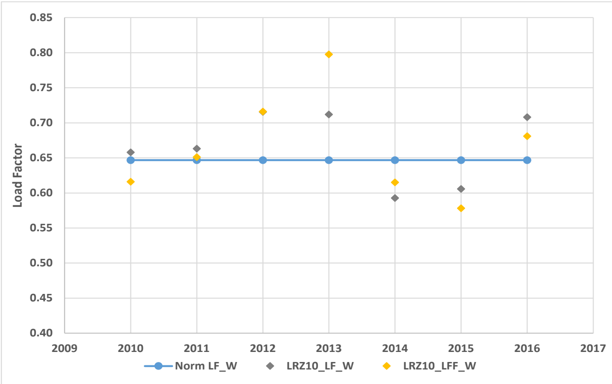
Actual Peak Load Factors vs. Fitted Peak Load Factors for LRZ 9





Actual Peak Load Factors vs. Fitted Peak Load Factors for LRZ 10





APPENDIX C High and Low Forecasts

Gross State Energy Forecasts (Annual Retail Sales in GWh)—High

Year	AR	IL	IN	IA	KY	LA	MI	MN
1990	27,365	111,577	73,982	29,437	61,097	63,826	82,367	47,167
1991	28,440	116,869	77,034	30,781	64,194	64,704	84,519	48,755
1992	28,451	112,521	76,977	30,208	67,068	65,098	83,840	47,412
1993	31,663	117,786	81,931	32,104	68,149	67,756	87,589	49,211
1994	32,619	121,490	83,808	33,039	72,485	70,132	91,160	51,155
1995	34,671	126,231	87,006	34,301	74,548	72,827	94,701	53,959
1996	36,137	125,990	88,901	34,999	77,019	75,269	96,302	54,942
1997	36,858	126,953	89,147	36,148	76,836	75,886	97,391	55,674
1998	39,315	131,697	92,059	37,318	75,850	77,716	100,506	56,744
1999	39,789	132,682	96,735	38,034	79,098	78,267	103,981	57,399
2000	41,611	134,697	97,775	39,088	78,316	80,690	104,772	59,782
2001	41,732	136,034	97,734	39,444	79,975	74,693	102,409	60,687
2002	42,450	138,447	101,429	40,898	87,267	79,261	104,714	62,162
2003	43,108	136,248	100,468	41,207	85,220	77,769	108,877	63,087
2004	43,672	139,254	103,094	40,903	86,521	79,737	106,606	63,340
2005	46,165	144,986	106,549	42,757	89,351	77,389	110,445	66,019
2006	46,636	142,448	105,664	43,337	88,743	77,468	108,018	66,770
2007	47,055	146,055	109,420	45,270	92,404	79,567	109,297	68,231
2008	46,135	144,620	106,981	45,488	93,428	78,726	105,781	68,794
2009	43,173	136,688	99,312	43,641	88,897	78,670	98,121	64,004
2010	48,194	144,761	105,994	45,445	93,569	85,080	103,649	67,800
2011	47,928	142,886	105,818	45,655	89,538	86,369	105,054	68,533
2012	46,860	143,540	105,173	45,709	89,048	84,731	104,818	67,989
2013	46,683	141,805	105,487	46,705	84,764	85,808	103,038	68,644
2014	47,080	141,540	106,943	47,202	78,839	90,628	103,314	68,719
2015	46,465	138,620	104,515	47,147	76,039	91,676	102,480	66,579
2016	49,203	147,811	114,483	48,865	79,844	85,737	111,492	72,079
2017	50,517	149,187	117,835	49,098	81,909	87,748	114,198	74,002
2018	51,804	150,640	121,139	51,171	84,561	93,528	119,106	76,280
2019	53,070	152,375	123,787	52,555	86,106	94,771	121,389	78,725
2020	53,668	153,957	126,319	54,289	87,652	97,021	123,789	80,826
2021	54,173	154,940	128,816	55,563	88,973	97,692	125,485	82,715
2022	54,581	155,846	131,047	56,652	89,988	98,557	126,966	84,547
2023	55,061	156,480	133,135	57,623	90,902	98,819	128,566	86,141
2024	55,676	157,173	135,082	58,370	91,819	99,456	129,992	87,681
2025	56,235	157,765	137,082	59,327	92,732	100,536	131,410	89,300
2026	56,784	158,368	139,077	60,488	93,612	101,791	133,203	90,905
2027	57,291	159,052	141,143	61,585	94,436	102,409	134,683	92,584
2028	57,803	159,726	143,274	62,720	95,336	103,168	136,116	94,342
2029	58,377	160,370	145,461	63,863	96,202	104,248	137,792	96,005
2030	59,009	161,089	147,661	64,970	97,021	105,257	139,375	97,679
2031	59,630	162,061	150,050	66,111	97,850	106,216	140,979	99,406
2032	60,303	163,051	152,270	67,215	98,663	107,339	142,658	101,076
2033	61,052	164,090	154,722	68,316	99,471	108,551	144,450	102,727
2034	61,890	165,215	157,171	69,453	100,203	109,927	146,360	104,399
2035	62,709	166,323	159,619	70,620	100,925	111,275	148,362	106,137
2036	63,475	167,426	162,172	71,800	101,635	112,517	150,237	107,969
2037	64,225	168,485	164,633	73,015	102,317	113,696	151,965	109,705
Compound Annual Growth Rates (%)								
2018-2022	1.31	0.85	1.98	2.58	1.57	1.32	1.61	2.61
2018-2027	1.12	0.61	1.71	2.08	1.23	1.01	1.38	2.18
2018-2037	1.14	0.59	1.63	1.89	1.01	1.03	1.29	1.93

Gross State Energy Forecasts (Annual Retail Sales in GWh)—High - continued

Year	MS	MO	MT	ND	SD	TX	WI
1990	32,127	53,925	13,125	7,014	6,334	237,415	49,198
1991	33,019	56,514	13,407	7,255	6,685	240,352	51,032
1992	33,241	54,411	13,096	7,128	6,494	239,431	50,925
1993	34,749	58,622	12,929	7,432	6,905	250,084	53,156
1994	36,627	59,693	13,184	7,681	7,174	258,180	55,412
1995	37,868	62,259	13,419	7,883	7,414	263,279	57,967
1996	39,622	64,843	13,820	8,314	7,736	278,450	58,744
1997	40,089	65,711	11,917	8,282	7,773	286,704	60,094
1998	42,510	69,010	14,145	8,220	7,824	304,705	62,061
1999	43,980	69,045	13,282	9,112	7,922	301,844	63,547
2000	45,336	72,643	14,580	9,413	8,283	318,263	65,146
2001	44,287	73,213	11,447	9,810	8,627	318,044	65,218
2002	45,452	75,001	12,831	10,219	8,937	320,846	66,999
2003	45,544	74,240	12,825	10,461	9,080	322,686	67,241
2004	46,033	74,054	12,957	10,516	9,214	320,615	67,976
2005	45,901	80,940	13,479	10,840	9,811	334,258	70,336
2006	46,936	82,015	13,815	11,245	10,056	342,724	69,821
2007	48,153	85,533	15,532	11,906	10,603	343,829	71,301
2008	47,721	84,382	15,326	12,416	10,974	347,815	70,122
2009	46,049	79,897	14,354	12,649	11,010	345,351	66,286
2010	49,687	86,085	13,771	12,956	11,356	358,458	68,752
2011	49,338	84,255	13,788	13,737	11,680	376,065	68,612
2012	48,388	82,435	13,863	14,717	11,734	365,104	68,820
2013	48,782	83,407	14,045	16,033	12,210	378,817	69,124
2014	49,409	83,878	14,102	18,240	12,355	389,670	69,495
2015	48,692	81,504	14,207	18,129	12,102	392,337	68,699
2016	51,188	85,962	17,501	16,824	12,906	404,438	73,330
2017	52,876	87,571	18,325	17,015	12,990	410,354	75,244
2018	54,970	89,159	20,726	17,774	13,563	432,384	77,429
2019	56,458	90,769	20,854	18,436	13,953	443,999	78,961
2020	57,602	92,564	21,509	19,035	14,526	455,064	80,243
2021	58,743	94,022	21,901	19,411	14,919	464,362	81,446
2022	59,759	95,403	21,877	19,698	15,265	473,739	82,706
2023	60,786	96,526	22,135	20,003	15,561	483,251	83,820
2024	61,792	97,613	22,612	20,286	15,760	491,881	84,935
2025	62,725	98,635	22,801	20,540	16,022	500,660	85,944
2026	63,587	99,592	23,155	20,787	16,356	510,013	87,042
2027	64,419	100,677	23,567	21,013	16,636	519,153	88,257
2028	65,415	101,834	23,979	21,236	16,921	529,120	89,564
2029	66,403	102,907	24,375	21,443	17,207	540,041	90,918
2030	67,369	104,079	24,748	21,651	17,479	551,112	92,205
2031	68,374	105,133	25,089	21,775	17,750	562,302	93,707
2032	69,384	106,125	25,258	21,908	18,081	573,691	95,840
2033	70,392	107,066	25,545	22,063	18,252	585,419	96,422
2034	71,430	108,044	25,918	22,215	18,482	598,098	97,847
2035	72,448	109,013	26,340	22,381	18,710	610,172	99,289
2036	73,447	109,972	26,604	22,555	18,959	622,637	100,656
2037	74,435	110,934	26,930	22,690	19,205	635,666	102,022
Compound Annual Growth Rates (%)							
2018-2022	2.11	1.71	1.36	2.60	3.00	2.31	1.66
2018-2027	1.78	1.36	1.44	1.88	2.29	2.05	1.46
2018-2037	1.61	1.16	1.39	1.29	1.85	2.05	1.46

Gross LRZ Energy Forecasts (Annual Metered Load in GWh) —High

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	96,781	65,531	48,732	49,373	38,679	94,622	101,919	36,768	111,836	22,488
2017	107,157	70,918	49,449	52,553	44,942	109,658	110,614	39,282	109,038	24,183
2018	111,292	73,059	51,451	53,065	45,471	112,928	115,368	40,283	115,925	25,140
2019	114,500	74,501	52,816	53,676	46,069	115,230	117,579	41,268	117,812	25,821
2020	117,546	75,732	54,501	54,233	46,808	117,468	119,905	41,733	120,640	26,344
2021	120,116	76,860	55,743	54,579	47,396	119,565	121,547	42,126	121,838	26,866
2022	122,426	78,025	56,810	54,898	47,937	121,346	122,981	42,444	123,228	27,330
2023	124,569	79,070	57,758	55,122	48,332	122,995	124,531	42,818	124,042	27,800
2024	126,704	80,107	58,495	55,366	48,717	124,567	125,912	43,297	125,168	28,260
2025	128,797	81,053	59,429	55,575	49,089	126,166	127,286	43,731	126,730	28,687
2026	130,977	82,094	60,554	55,787	49,420	127,744	129,022	44,159	128,495	29,081
2027	133,251	83,221	61,620	56,028	49,801	129,331	130,456	44,553	129,633	29,462
2028	135,624	84,424	62,724	56,265	50,373	130,995	131,844	44,952	130,954	29,917
2029	137,896	85,681	63,833	56,492	50,904	132,671	133,468	45,399	132,643	30,369
2030	140,155	86,875	64,910	56,745	51,483	134,329	135,001	45,890	134,273	30,811
2031	142,461	88,255	66,022	57,088	52,005	136,095	136,555	46,374	135,859	31,271
2032	144,772	90,186	67,100	57,437	52,496	137,760	138,181	46,897	137,618	31,732
2033	146,803	90,781	68,174	57,803	52,961	139,550	139,916	47,481	139,482	32,194
2034	149,052	92,111	69,283	58,199	53,445	141,296	141,767	48,132	141,560	32,668
2035	151,398	93,461	70,422	58,589	53,924	143,037	143,706	48,769	143,576	33,134
2036	153,773	94,739	71,574	58,978	54,398	144,828	145,522	49,365	145,513	33,591
2037	156,058	96,009	72,756	59,351	54,874	146,554	147,196	49,949	147,422	34,042
Compound Annual Growth Rates (%)										
2018-2022	2.41	1.66	2.51	0.85	1.33	1.81	1.61	1.31	1.54	2.11
2018-2027	2.02	1.46	2.02	0.61	1.02	1.52	1.38	1.13	1.25	1.78
2018-2037	1.80	1.45	1.84	0.59	0.99	1.38	1.29	1.14	1.27	1.61

Net LRZ Energy Forecasts (Annual Metered Load in GWh) [24] **—High**

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	96,781	65,531	48,732	49,373	38,679	94,622	101,919	36,768	111,836	22,488
2017	107,083	70,918	49,245	52,407	44,861	109,577	110,423	39,272	109,020	24,183
2018	111,146	73,059	51,067	52,826	45,320	112,786	115,067	40,270	115,879	25,140
2019	114,274	74,501	52,251	53,342	45,846	115,023	117,165	41,252	117,735	25,821
2020	117,232	75,732	53,752	53,802	46,511	117,191	119,372	41,714	120,527	26,344
2021	119,707	76,860	54,809	54,048	47,024	119,213	120,893	42,104	121,682	26,866
2022	121,912	78,025	55,689	54,265	47,488	120,915	122,202	42,418	123,025	27,330
2023	123,946	79,070	56,448	54,384	47,805	122,479	123,621	42,789	123,786	27,800
2024	125,964	80,107	56,994	54,522	48,110	123,962	124,868	43,263	124,853	28,260
2025	127,933	81,053	57,733	54,622	48,401	125,467	126,103	43,694	126,351	28,687
2026	129,982	82,094	58,660	54,724	48,649	126,945	127,695	44,117	128,046	29,081
2027	132,117	83,221	59,524	54,852	48,946	128,427	128,981	44,508	129,108	29,462
2028	134,342	84,424	60,421	54,974	49,432	129,981	130,215	44,902	130,348	29,917
2029	136,458	85,681	61,319	55,086	49,875	131,540	131,680	45,344	131,949	30,369
2030	138,552	86,875	62,178	55,223	50,365	133,076	133,049	45,831	133,484	30,811
2031	140,686	88,255	63,068	55,448	50,796	134,714	134,433	46,309	134,970	31,271
2032	142,816	90,186	63,920	55,678	51,194	136,246	135,884	46,828	136,622	31,732
2033	144,659	90,781	64,763	55,923	51,566	137,897	137,441	47,406	138,373	32,194
2034	146,712	92,111	65,636	56,197	51,954	139,500	139,108	48,052	140,332	32,668
2035	148,854	93,461	66,535	56,464	52,338	141,090	140,861	48,683	142,221	33,134
2036	151,016	94,739	67,441	56,727	52,714	142,725	142,485	49,273	144,025	33,591
2037	153,081	96,009	68,380	56,975	53,092	144,291	143,963	49,850	145,794	34,042
Compound Annual Growth Rates (%)										
2018-2022	2.34	1.66	2.19	0.67	1.18	1.75	1.52	1.31	1.51	2.11
2018-2027	1.94	1.46	1.72	0.42	0.86	1.45	1.28	1.12	1.21	1.78
2018-2037	1.70	1.45	1.55	0.40	0.84	1.30	1.19	1.13	1.22	1.61

[24] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

Gross Summer Non-Coincident Peak Demand (Metered Load in MW) —High

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	17,571	12,128	8,906	9,541	7,962	16,727	21,013	7,324	19,812	4,617
2017	19,326	13,304	9,200	10,070	9,002	19,180	23,114	7,821	19,588	5,045
2018	20,072	13,706	9,573	10,168	9,108	19,751	24,107	8,020	20,825	5,245
2019	20,650	13,976	9,827	10,286	9,228	20,154	24,569	8,216	21,164	5,387
2020	21,200	14,207	10,140	10,392	9,376	20,546	25,055	8,309	21,672	5,496
2021	21,663	14,419	10,371	10,459	9,494	20,912	25,398	8,387	21,887	5,605
2022	22,080	14,637	10,570	10,520	9,602	21,224	25,698	8,450	22,137	5,701
2023	22,466	14,833	10,746	10,563	9,681	21,512	26,022	8,525	22,283	5,799
2024	22,851	15,028	10,883	10,609	9,759	21,787	26,311	8,620	22,486	5,895
2025	23,229	15,205	11,057	10,649	9,833	22,067	26,598	8,706	22,766	5,984
2026	23,622	15,400	11,266	10,690	9,899	22,343	26,960	8,791	23,083	6,067
2027	24,032	15,612	11,465	10,736	9,976	22,620	27,260	8,870	23,288	6,146
2028	24,460	15,838	11,670	10,782	10,090	22,912	27,550	8,949	23,525	6,241
2029	24,870	16,073	11,877	10,825	10,197	23,205	27,889	9,038	23,828	6,335
2030	25,277	16,297	12,077	10,874	10,313	23,495	28,210	9,136	24,121	6,428
2031	25,693	16,556	12,284	10,939	10,417	23,804	28,534	9,232	24,406	6,523
2032	26,110	16,919	12,484	11,006	10,515	24,095	28,874	9,337	24,722	6,620
2033	26,476	17,030	12,684	11,076	10,609	24,408	29,237	9,453	25,057	6,716
2034	26,882	17,280	12,891	11,152	10,706	24,713	29,624	9,582	25,430	6,815
2035	27,305	17,533	13,102	11,227	10,802	25,018	30,029	9,709	25,792	6,912
2036	27,733	17,773	13,317	11,302	10,897	25,331	30,408	9,828	26,140	7,007
2037	28,145	18,011	13,537	11,373	10,992	25,633	30,758	9,944	26,483	7,102
Compound Annual Growth Rates (%)										
2018-2022	2.41	1.66	2.51	0.85	1.33	1.81	1.61	1.31	1.54	2.11
2018-2027	2.02	1.46	2.02	0.61	1.02	1.52	1.38	1.13	1.25	1.78
2018-2037	1.80	1.45	1.84	0.59	0.99	1.38	1.29	1.14	1.27	1.61

Gross Winter Non-Coincident Peak Demand (Metered Load in MW) —High

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	14,715	9,615	7,203	7,656	6,846	15,424	14,615	6,309	16,966	3,615
2017	16,079	10,440	7,440	8,115	7,648	17,342	15,988	6,591	17,405	4,268
2018	16,700	10,755	7,741	8,194	7,738	17,859	16,676	6,759	18,504	4,437
2019	17,181	10,967	7,947	8,288	7,840	18,223	16,995	6,924	18,805	4,557
2020	17,638	11,148	8,200	8,374	7,965	18,577	17,331	7,002	19,257	4,649
2021	18,024	11,314	8,387	8,428	8,065	18,908	17,569	7,068	19,448	4,742
2022	18,371	11,486	8,548	8,477	8,157	19,190	17,776	7,122	19,670	4,824
2023	18,692	11,640	8,690	8,512	8,225	19,451	18,000	7,185	19,800	4,907
2024	19,013	11,792	8,801	8,549	8,290	19,699	18,200	7,265	19,979	4,988
2025	19,327	11,932	8,942	8,581	8,353	19,952	18,398	7,338	20,229	5,063
2026	19,654	12,085	9,111	8,614	8,410	20,202	18,649	7,409	20,511	5,133
2027	19,995	12,251	9,271	8,651	8,475	20,453	18,857	7,476	20,692	5,200
2028	20,351	12,428	9,437	8,688	8,572	20,716	19,057	7,542	20,903	5,280
2029	20,692	12,613	9,604	8,723	8,662	20,981	19,292	7,617	21,173	5,360
2030	21,031	12,789	9,766	8,762	8,761	21,243	19,513	7,700	21,433	5,438
2031	21,377	12,992	9,934	8,815	8,850	21,522	19,738	7,781	21,686	5,519
2032	21,724	13,276	10,096	8,869	8,933	21,786	19,973	7,869	21,967	5,601
2033	22,029	13,364	10,257	8,926	9,012	22,069	20,224	7,967	22,264	5,682
2034	22,366	13,560	10,424	8,987	9,095	22,345	20,491	8,076	22,596	5,766
2035	22,718	13,758	10,596	9,047	9,176	22,620	20,772	8,183	22,918	5,848
2036	23,074	13,946	10,769	9,107	9,257	22,904	21,034	8,283	23,227	5,928
2037	23,417	14,133	10,947	9,165	9,338	23,176	21,276	8,381	23,532	6,008
Compound Annual Growth Rates (%)										
2018-2022	2.41	1.66	2.51	0.85	1.33	1.81	1.61	1.31	1.54	2.11
2018-2027	2.02	1.46	2.02	0.61	1.02	1.52	1.38	1.13	1.25	1.78
2018-2037	1.80	1.45	1.84	0.59	0.99	1.38	1.29	1.14	1.27	1.61

Net Summer Non-Coincident Peak Demand (Metered Load in MW) [25] —High

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	17,571	12,128	8,906	9,541	7,962	16,727	21,013	7,324	19,812	4,617
2017	19,313	13,304	9,164	10,043	8,989	19,166	23,081	7,818	19,584	5,045
2018	20,047	13,706	9,504	10,125	9,083	19,728	24,056	8,017	20,816	5,245
2019	20,612	13,976	9,726	10,225	9,191	20,120	24,499	8,212	21,149	5,387
2020	21,146	14,207	10,007	10,315	9,327	20,500	24,965	8,304	21,651	5,496
2021	21,594	14,419	10,205	10,364	9,432	20,854	25,288	8,381	21,858	5,605
2022	21,993	14,637	10,370	10,407	9,527	21,152	25,567	8,444	22,099	5,701
2023	22,361	14,833	10,513	10,432	9,593	21,427	25,869	8,518	22,235	5,799
2024	22,726	15,028	10,616	10,460	9,657	21,687	26,135	8,612	22,427	5,895
2025	23,082	15,205	10,756	10,481	9,718	21,951	26,398	8,698	22,696	5,984
2026	23,453	15,400	10,930	10,503	9,770	22,210	26,737	8,782	23,000	6,067
2027	23,840	15,612	11,092	10,529	9,833	22,471	27,012	8,859	23,191	6,146
2028	24,242	15,838	11,261	10,555	9,933	22,743	27,276	8,938	23,413	6,241
2029	24,626	16,073	11,430	10,578	10,024	23,017	27,589	9,026	23,701	6,335
2030	25,005	16,297	11,592	10,606	10,125	23,287	27,881	9,122	23,976	6,428
2031	25,392	16,556	11,760	10,652	10,215	23,574	28,177	9,217	24,243	6,523
2032	25,778	16,919	11,921	10,698	10,297	23,843	28,488	9,320	24,540	6,620
2033	26,112	17,030	12,080	10,747	10,375	24,133	28,820	9,435	24,854	6,716
2034	26,484	17,280	12,245	10,801	10,456	24,415	29,176	9,564	25,206	6,815
2035	26,873	17,533	12,415	10,855	10,536	24,694	29,550	9,689	25,545	6,912
2036	27,265	17,773	12,586	10,907	10,614	24,981	29,897	9,806	25,869	7,007
2037	27,639	18,011	12,763	10,957	10,693	25,256	30,214	9,921	26,187	7,102
Compound Annual Growth Rates (%)										
2018-2022	2.34	1.66	2.20	0.69	1.20	1.76	1.53	1.31	1.51	2.11
2018-2027	1.94	1.46	1.73	0.44	0.88	1.46	1.30	1.12	1.21	1.78
2018-2037	1.70	1.45	1.56	0.42	0.86	1.31	1.21	1.13	1.22	1.61

[25] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

Net Winter Non-Coincident Peak Demand (Metered Load in MW) [26]—High

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	14,715	9,615	7,203	7,656	6,846	15,424	14,615	6,309	16,966	3,615
2017	16,067	10,440	7,404	8,088	7,634	17,328	15,956	6,589	17,401	4,268
2018	16,675	10,755	7,673	8,150	7,713	17,835	16,624	6,756	18,495	4,437
2019	17,143	10,967	7,846	8,228	7,802	18,188	16,925	6,921	18,791	4,557
2020	17,585	11,148	8,067	8,297	7,916	18,531	17,241	6,998	19,235	4,649
2021	17,955	11,314	8,221	8,333	8,003	18,850	17,458	7,063	19,419	4,742
2022	18,283	11,486	8,348	8,365	8,083	19,119	17,645	7,116	19,632	4,824
2023	18,586	11,640	8,457	8,381	8,137	19,365	17,847	7,178	19,752	4,907
2024	18,887	11,792	8,534	8,400	8,189	19,599	18,024	7,257	19,921	4,988
2025	19,180	11,932	8,640	8,413	8,238	19,836	18,199	7,329	20,159	5,063
2026	19,485	12,085	8,774	8,427	8,281	20,069	18,426	7,400	20,427	5,133
2027	19,802	12,251	8,899	8,444	8,332	20,303	18,608	7,465	20,595	5,200
2028	20,133	12,428	9,029	8,461	8,415	20,548	18,783	7,531	20,791	5,280
2029	20,448	12,613	9,158	8,476	8,490	20,793	18,991	7,605	21,045	5,360
2030	20,759	12,789	9,282	8,495	8,574	21,035	19,185	7,686	21,288	5,438
2031	21,075	12,992	9,410	8,527	8,647	21,293	19,381	7,766	21,523	5,519
2032	21,391	13,276	9,532	8,560	8,715	21,534	19,586	7,853	21,784	5,601
2033	21,664	13,364	9,653	8,596	8,779	21,794	19,807	7,949	22,062	5,682
2034	21,968	13,560	9,779	8,636	8,845	22,046	20,044	8,057	22,372	5,766
2035	22,286	13,758	9,908	8,675	8,910	22,297	20,293	8,163	22,671	5,848
2036	22,606	13,946	10,038	8,713	8,975	22,554	20,523	8,261	22,956	5,928
2037	22,911	14,133	10,173	8,749	9,039	22,800	20,732	8,358	23,236	6,008
Compound Annual Growth Rates (%)										
2018-2022	2.33	1.66	2.13	0.65	1.18	1.75	1.50	1.30	1.50	2.11
2018-2027	1.93	1.46	1.66	0.39	0.86	1.45	1.26	1.11	1.20	1.78
2018-2037	1.69	1.45	1.50	0.37	0.84	1.30	1.17	1.13	1.21	1.61

[26] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

HIGH AND LOW FORECASTS

Gross and Net MISO System Energy (Annual Metered Load in GWh)[27] —High

Year	MISO Energy without EE Adjustments	MISO Energy with EE Adjustments
2016	666,730	666,730
2017	717,792	716,989
2018	743,982	742,560
2019	759,271	757,207
2020	774,911	772,178
2021	786,636	783,205
2022	797,427	793,269
2023	807,037	802,128
2024	816,593	810,904
2025	826,543	820,043
2026	837,332	829,993
2027	847,356	839,145
2028	858,073	848,957
2029	869,356	859,302
2030	880,471	869,445
2031	891,985	879,951
2032	904,180	891,106
2033	915,144	901,001
2034	927,514	912,270
2035	940,016	923,639
2036	952,281	934,737
2037	964,211	945,477
Compound Annual Growth Rates (%)		
2018-2022	1.75	1.67
2018-2027	1.46	1.37
2018-2037	1.37	1.28

[27] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

Gross and Net MISO System Coincident Peak Demand (Metered Load in MW) [28] —High

Year	MISO Summer CP without EE Adjustments	MISO Summer CP with EE Adjustments	MISO Winter CP without EE Adjustments	MISO Winter CP with EE Adjustments
2016	120,364	120,364	99,899	99,899
2017	129,766	129,625	107,532	107,390
2018	134,456	134,207	111,414	111,165
2019	137,208	136,849	113,701	113,341
2020	140,011	139,536	116,032	115,557
2021	142,118	141,522	117,785	117,190
2022	144,054	143,333	119,397	118,676
2023	145,787	144,936	120,830	119,979
2024	147,505	146,519	122,258	121,272
2025	149,287	148,161	123,743	122,618
2026	151,223	149,952	125,347	124,076
2027	153,023	151,602	126,840	125,419
2028	154,946	153,369	128,442	126,865
2029	156,973	155,234	130,125	128,386
2030	158,969	157,062	131,786	129,879
2031	161,036	158,956	133,504	131,424
2032	163,229	160,969	135,320	133,060
2033	165,198	162,754	136,960	134,516
2034	167,421	164,788	138,805	136,171
2035	169,670	166,842	140,667	137,839
2036	171,873	168,844	142,496	139,466
2037	174,014	170,780	144,276	141,041
Compound Annual Growth Rates (%)				
2018-2022	1.74	1.66	1.75	1.65
2018-2027	1.45	1.36	1.45	1.35
2018-2037	1.37	1.28	1.37	1.26

[28] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

Gross State Energy Forecasts (Annual Retail Sales in GWh) —Low

Year	AR	IL	IN	IA	KY	LA	MI	MN
1990	27,365	111,577	73,982	29,437	61,097	63,826	82,367	47,167
1991	28,440	116,869	77,034	30,781	64,194	64,704	84,519	48,755
1992	28,451	112,521	76,977	30,208	67,068	65,098	83,840	47,412
1993	31,663	117,786	81,931	32,104	68,149	67,756	87,589	49,211
1994	32,619	121,490	83,808	33,039	72,485	70,132	91,160	51,155
1995	34,671	126,231	87,006	34,301	74,548	72,827	94,701	53,959
1996	36,137	125,990	88,901	34,999	77,019	75,269	96,302	54,942
1997	36,858	126,953	89,147	36,148	76,836	75,886	97,391	55,674
1998	39,315	131,697	92,059	37,318	75,850	77,716	100,506	56,744
1999	39,789	132,682	96,735	38,034	79,098	78,267	103,981	57,399
2000	41,611	134,697	97,775	39,088	78,316	80,690	104,772	59,782
2001	41,732	136,034	97,734	39,444	79,975	74,693	102,409	60,687
2002	42,450	138,447	101,429	40,898	87,267	79,261	104,714	62,162
2003	43,108	136,248	100,468	41,207	85,220	77,769	108,877	63,087
2004	43,672	139,254	103,094	40,903	86,521	79,737	106,606	63,340
2005	46,165	144,986	106,549	42,757	89,351	77,389	110,445	66,019
2006	46,636	142,448	105,664	43,337	88,743	77,468	108,018	66,770
2007	47,055	146,055	109,420	45,270	92,404	79,567	109,297	68,231
2008	46,135	144,620	106,981	45,488	93,428	78,726	105,781	68,794
2009	43,173	136,688	99,312	43,641	88,897	78,670	98,121	64,004
2010	48,194	144,761	105,994	45,445	93,569	85,080	103,649	67,800
2011	47,928	142,886	105,818	45,655	89,538	86,369	105,054	68,533
2012	46,860	143,540	105,173	45,709	89,048	84,731	104,818	67,989
2013	46,683	141,805	105,487	46,705	84,764	85,808	103,038	68,644
2014	47,080	141,540	106,943	47,202	78,839	90,628	103,314	68,719
2015	46,465	138,620	104,515	47,147	76,039	91,676	102,480	66,579
2016	46,678	143,140	104,304	45,808	76,523	80,628	104,264	67,578
2017	46,916	142,136	104,020	45,316	75,844	81,465	105,285	67,636
2018	47,274	142,706	104,825	44,707	75,603	79,301	105,178	68,051
2019	47,631	142,923	105,629	45,169	76,390	79,357	105,379	68,546
2020	47,910	143,014	106,559	46,102	77,338	80,654	105,940	69,260
2021	48,222	143,418	107,457	46,653	78,159	80,486	105,950	69,988
2022	48,366	143,871	108,228	47,070	78,473	79,926	105,882	70,724
2023	48,623	144,154	108,939	47,409	78,976	80,180	105,992	71,288
2024	49,081	144,569	109,411	47,571	79,491	80,248	105,973	71,820
2025	49,477	144,941	110,055	47,957	80,313	80,680	106,073	72,459
2026	49,898	145,351	111,128	48,563	80,842	81,292	106,577	73,113
2027	50,319	145,909	111,915	49,090	81,344	81,338	106,834	73,906
2028	50,724	146,472	112,906	49,710	81,921	81,625	107,052	74,763
2029	51,200	147,013	113,791	50,337	82,486	82,061	107,537	75,533
2030	51,766	147,670	114,869	50,936	83,036	82,532	107,954	76,332
2031	52,328	148,570	115,881	51,568	83,605	82,992	108,461	77,162
2032	52,961	149,478	116,938	52,187	84,154	83,521	109,007	77,930
2033	53,653	150,466	118,125	52,757	84,676	84,155	109,759	78,721
2034	54,445	151,573	119,383	53,398	85,130	85,095	110,581	79,518
2035	55,233	152,657	120,635	54,093	85,596	85,896	111,552	80,447
2036	55,961	153,718	121,874	54,759	86,064	86,646	112,379	81,428
2037	56,690	154,751	123,056	55,452	86,503	87,282	113,136	82,348
Compound Annual Growth Rates (%)								
2018-2022	0.57	0.20	0.80	1.30	0.94	0.20	0.17	0.97
2018-2027	0.70	0.25	0.73	1.04	0.82	0.28	0.17	0.92
2018-2037	0.96	0.43	0.85	1.14	0.71	0.51	0.38	1.01

Gross State Energy Forecasts (Annual Retail Sales in GWh) —Low – continued

Year	MS	MO	MT	ND	SD	TX	WI
1990	32,127	53,925	13,125	7,014	6,334	237,415	49,198
1991	33,019	56,514	13,407	7,255	6,685	240,352	51,032
1992	33,241	54,411	13,096	7,128	6,494	239,431	50,925
1993	34,749	58,622	12,929	7,432	6,905	250,084	53,156
1994	36,627	59,693	13,184	7,681	7,174	258,180	55,412
1995	37,868	62,259	13,419	7,883	7,414	263,279	57,967
1996	39,622	64,843	13,820	8,314	7,736	278,450	58,744
1997	40,089	65,711	11,917	8,282	7,773	286,704	60,094
1998	42,510	69,010	14,145	8,220	7,824	304,705	62,061
1999	43,980	69,045	13,282	9,112	7,922	301,844	63,547
2000	45,336	72,643	14,580	9,413	8,283	318,263	65,146
2001	44,287	73,213	11,447	9,810	8,627	318,044	65,218
2002	45,452	75,001	12,831	10,219	8,937	320,846	66,999
2003	45,544	74,240	12,825	10,461	9,080	322,686	67,241
2004	46,033	74,054	12,957	10,516	9,214	320,615	67,976
2005	45,901	80,940	13,479	10,840	9,811	334,258	70,336
2006	46,936	82,015	13,815	11,245	10,056	342,724	69,821
2007	48,153	85,533	15,532	11,906	10,603	343,829	71,301
2008	47,721	84,382	15,326	12,416	10,974	347,815	70,122
2009	46,049	79,897	14,354	12,649	11,010	345,351	66,286
2010	49,687	86,085	13,771	12,956	11,356	358,458	68,752
2011	49,338	84,255	13,788	13,737	11,680	376,065	68,612
2012	48,388	82,435	13,863	14,717	11,734	365,104	68,820
2013	48,782	83,407	14,045	16,033	12,210	378,817	69,124
2014	49,409	83,878	14,102	18,240	12,355	389,670	69,495
2015	48,692	81,504	14,207	18,129	12,102	392,337	68,699
2016	48,079	81,913	11,406	15,035	12,595	388,450	68,506
2017	48,241	82,340	10,979	14,510	12,598	390,411	69,038
2018	48,742	82,785	11,538	14,567	12,530	385,977	69,914
2019	49,385	83,226	11,352	14,894	12,800	393,304	70,738
2020	50,033	83,829	11,050	15,204	13,277	400,793	71,394
2021	50,636	84,657	11,077	14,963	13,588	406,815	72,055
2022	51,166	85,494	10,727	15,001	13,855	413,090	72,824
2023	51,757	86,103	10,672	15,478	14,076	419,695	73,539
2024	52,373	86,733	10,846	15,561	14,202	425,395	74,266
2025	52,952	87,310	10,772	15,628	14,383	431,092	74,934
2026	53,477	87,871	10,840	15,709	14,638	437,461	75,722
2027	53,977	88,556	11,009	15,776	14,840	442,725	76,651
2028	54,676	89,357	11,186	15,848	15,044	450,413	77,678
2029	55,392	90,092	11,329	15,889	15,245	458,196	78,773
2030	56,072	90,936	11,500	15,962	15,424	466,182	79,825
2031	56,832	91,673	11,338	15,981	15,602	474,266	81,047
2032	57,594	92,353	11,506	16,020	15,762	482,607	82,219
2033	58,351	92,987	11,564	16,064	15,900	490,836	83,356
2034	59,169	93,651	11,705	16,117	16,020	500,102	84,587
2035	59,983	94,339	11,896	16,191	16,097	508,726	85,695
2036	60,769	95,016	12,051	16,270	16,260	517,475	86,882
2037	61,553	95,693	12,166	16,324	16,388	526,639	88,090
Compound Annual Growth Rates (%)							
2018-2022	1.22	0.81	-1.81	0.74	2.54	1.71	1.02
2018-2027	1.14	0.75	-0.52	0.89	1.90	1.54	1.03
2018-2037	1.24	0.77	0.28	0.60	1.42	1.65	1.22

Gross LRZ Energy Forecasts (Annual Metered Load in GWh) —Low

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	96,781	65,531	48,732	49,373	38,679	94,622	101,919	36,768	111,836	22,488
2017	95,540	65,095	45,702	50,069	42,257	98,744	101,981	36,483	101,787	22,063
2018	96,330	65,846	45,152	50,270	42,220	99,054	101,878	36,761	99,434	22,292
2019	97,115	66,569	45,599	50,346	42,240	99,927	102,072	37,039	99,921	22,586
2020	98,105	67,165	46,489	50,378	42,391	100,958	102,615	37,256	101,617	22,882
2021	98,974	67,737	47,027	50,521	42,675	101,902	102,625	37,498	101,811	23,158
2022	99,818	68,398	47,440	50,680	42,958	102,497	102,559	37,611	101,640	23,401
2023	100,747	69,023	47,774	50,780	43,113	103,164	102,666	37,812	102,275	23,671
2024	101,556	69,650	47,943	50,926	43,287	103,705	102,647	38,167	102,678	23,953
2025	102,379	70,232	48,323	51,057	43,452	104,510	102,744	38,475	103,432	24,217
2026	103,323	70,940	48,909	51,202	43,603	105,390	103,232	38,803	104,400	24,458
2027	104,452	71,756	49,426	51,398	43,805	106,098	103,481	39,131	104,755	24,686
2028	105,671	72,655	50,031	51,597	44,201	106,959	103,692	39,446	105,486	25,006
2029	106,789	73,626	50,640	51,787	44,565	107,755	104,163	39,816	106,367	25,333
2030	107,946	74,558	51,225	52,019	44,982	108,648	104,566	40,256	107,294	25,644
2031	109,013	75,640	51,844	52,335	45,347	109,516	105,057	40,694	108,216	25,992
2032	110,140	76,681	52,450	52,655	45,683	110,397	105,586	41,186	109,220	26,340
2033	111,238	77,703	53,012	53,004	45,996	111,336	106,315	41,724	110,319	26,687
2034	112,391	78,809	53,641	53,393	46,325	112,276	107,111	42,340	111,775	27,060
2035	113,675	79,817	54,322	53,775	46,666	113,219	108,051	42,953	113,058	27,433
2036	115,035	80,886	54,978	54,149	47,000	114,156	108,852	43,519	114,299	27,792
2037	116,303	81,969	55,657	54,513	47,335	115,046	109,585	44,086	115,455	28,151
Compound Annual Growth Rates (%)										
2018-2022	0.89	0.96	1.24	0.20	0.43	0.86	0.17	0.57	0.55	1.22
2018-2027	0.90	0.96	1.01	0.25	0.41	0.77	0.17	0.70	0.58	1.14
2018-2037	1.00	1.16	1.11	0.43	0.60	0.79	0.38	0.96	0.79	1.24

Net LRZ Energy Forecasts (Annual Metered Load in GWh) [29] —Low

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	96,781	65,531	48,732	49,373	38,679	94,622	101,919	36,768	111,836	22,488
2017	95,467	65,095	45,498	49,923	42,177	98,663	101,790	36,473	101,769	22,063
2018	96,184	65,846	44,768	50,031	42,069	98,912	101,576	36,747	99,388	22,292
2019	96,889	66,569	45,033	50,012	42,017	99,720	101,658	37,023	99,844	22,586
2020	97,791	67,165	45,740	49,947	42,094	100,681	102,083	37,236	101,504	22,882
2021	98,565	67,737	46,093	49,989	42,303	101,550	101,971	37,476	101,655	23,158
2022	99,304	68,398	46,320	50,047	42,509	102,066	101,779	37,585	101,436	23,401
2023	100,124	69,023	46,464	50,042	42,585	102,648	101,756	37,782	102,019	23,671
2024	100,816	69,650	46,442	50,082	42,680	103,100	101,603	38,134	102,363	23,953
2025	101,516	70,232	46,627	50,105	42,764	103,811	101,560	38,438	103,053	24,217
2026	102,327	70,940	47,015	50,138	42,833	104,591	101,905	38,762	103,951	24,458
2027	103,318	71,756	47,330	50,222	42,950	105,194	102,006	39,085	104,230	24,686
2028	104,389	72,655	47,727	50,305	43,260	105,944	102,063	39,396	104,880	25,006
2029	105,351	73,626	48,125	50,380	43,536	106,624	102,375	39,762	105,673	25,333
2030	106,343	74,558	48,494	50,496	43,864	107,395	102,614	40,197	106,506	25,644
2031	107,238	75,640	48,890	50,696	44,137	108,136	102,935	40,630	107,327	25,992
2032	108,184	76,681	49,269	50,896	44,381	108,883	103,289	41,117	108,224	26,340
2033	109,094	77,703	49,600	51,124	44,601	109,683	103,839	41,650	109,209	26,687
2034	110,050	78,809	49,994	51,391	44,835	110,479	104,452	42,260	110,546	27,060
2035	111,131	79,817	50,435	51,650	45,079	111,272	105,205	42,867	111,703	27,433
2036	112,278	80,886	50,846	51,899	45,316	112,053	105,815	43,427	112,812	27,792
2037	113,326	81,969	51,281	52,136	45,553	112,783	106,353	43,988	113,827	28,151
Compound Annual Growth Rates (%)										
2018-2022	0.80	0.96	0.86	0.01	0.26	0.79	0.05	0.57	0.51	1.22
2018-2027	0.80	0.96	0.62	0.04	0.23	0.69	0.05	0.69	0.53	1.14
2018-2037	0.87	1.16	0.72	0.22	0.42	0.69	0.24	0.95	0.72	1.24

[29] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

Gross Summer Non-Coincident Peak Demand (Metered Load in MW) —Low

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	17,571	12,128	8,906	9,541	7,962	16,727	21,013	7,324	19,812	4,617
2017	17,231	12,212	8,503	9,594	8,465	17,271	21,310	7,263	18,285	4,603
2018	17,373	12,353	8,401	9,633	8,457	17,325	21,288	7,319	17,863	4,650
2019	17,515	12,488	8,484	9,648	8,461	17,478	21,329	7,374	17,950	4,712
2020	17,693	12,600	8,649	9,654	8,491	17,658	21,442	7,417	18,255	4,774
2021	17,850	12,707	8,750	9,681	8,548	17,823	21,444	7,465	18,290	4,831
2022	18,002	12,831	8,827	9,712	8,605	17,927	21,431	7,488	18,259	4,882
2023	18,170	12,948	8,889	9,731	8,636	18,044	21,453	7,528	18,373	4,938
2024	18,316	13,066	8,920	9,759	8,671	18,138	21,449	7,599	18,445	4,997
2025	18,464	13,175	8,991	9,784	8,704	18,279	21,469	7,660	18,581	5,052
2026	18,635	13,308	9,100	9,811	8,734	18,433	21,571	7,725	18,755	5,102
2027	18,838	13,461	9,196	9,849	8,775	18,557	21,623	7,790	18,818	5,150
2028	19,058	13,630	9,308	9,887	8,854	18,707	21,667	7,853	18,950	5,216
2029	19,260	13,812	9,422	9,924	8,927	18,847	21,766	7,927	19,108	5,285
2030	19,468	13,987	9,531	9,968	9,010	19,003	21,850	8,015	19,275	5,350
2031	19,661	14,190	9,646	10,029	9,083	19,155	21,953	8,102	19,440	5,422
2032	19,864	14,385	9,759	10,090	9,151	19,309	22,063	8,200	19,621	5,495
2033	20,062	14,577	9,863	10,157	9,214	19,473	22,215	8,307	19,818	5,567
2034	20,270	14,784	9,980	10,231	9,279	19,638	22,382	8,429	20,080	5,645
2035	20,502	14,973	10,107	10,305	9,348	19,802	22,578	8,551	20,310	5,723
2036	20,747	15,174	10,229	10,376	9,415	19,966	22,746	8,664	20,533	5,798
2037	20,976	15,377	10,355	10,446	9,482	20,122	22,899	8,777	20,741	5,873
Compound Annual Growth Rates (%)										
2018-2022	0.89	0.96	1.24	0.20	0.43	0.86	0.17	0.57	0.55	1.22
2018-2027	0.90	0.96	1.01	0.25	0.41	0.77	0.17	0.70	0.58	1.14
2018-2037	1.00	1.16	1.11	0.43	0.60	0.79	0.38	0.96	0.79	1.24

Gross Winter Non-Coincident Peak Demand (Metered Load in MW) —Low

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	14,715	9,615	7,203	7,656	6,846	15,424	14,615	6,309	16,966	3,615
2017	14,336	9,583	6,876	7,731	7,191	15,616	14,741	6,121	16,247	3,894
2018	14,455	9,693	6,794	7,762	7,185	15,665	14,726	6,168	15,872	3,934
2019	14,573	9,800	6,861	7,774	7,188	15,803	14,754	6,215	15,950	3,986
2020	14,721	9,887	6,995	7,779	7,214	15,966	14,832	6,251	16,220	4,039
2021	14,852	9,971	7,076	7,801	7,262	16,115	14,834	6,292	16,251	4,087
2022	14,978	10,069	7,138	7,826	7,310	16,209	14,824	6,311	16,224	4,130
2023	15,118	10,161	7,188	7,841	7,337	16,315	14,840	6,344	16,325	4,178
2024	15,239	10,253	7,214	7,864	7,366	16,400	14,837	6,404	16,390	4,227
2025	15,363	10,339	7,271	7,884	7,394	16,528	14,851	6,456	16,510	4,274
2026	15,504	10,443	7,359	7,906	7,420	16,667	14,921	6,511	16,664	4,317
2027	15,674	10,563	7,437	7,937	7,454	16,779	14,957	6,566	16,721	4,357
2028	15,857	10,695	7,528	7,967	7,522	16,915	14,988	6,619	16,838	4,413
2029	16,024	10,838	7,619	7,997	7,584	17,041	15,056	6,681	16,978	4,471
2030	16,198	10,976	7,707	8,032	7,655	17,182	15,114	6,755	17,127	4,526
2031	16,358	11,135	7,800	8,081	7,717	17,319	15,185	6,828	17,274	4,587
2032	16,527	11,288	7,892	8,131	7,774	17,459	15,262	6,911	17,434	4,649
2033	16,692	11,439	7,976	8,184	7,827	17,607	15,367	7,001	17,609	4,710
2034	16,865	11,601	8,071	8,245	7,883	17,756	15,482	7,104	17,842	4,776
2035	17,058	11,750	8,173	8,304	7,941	17,905	15,618	7,207	18,047	4,842
2036	17,262	11,907	8,272	8,361	7,998	18,053	15,734	7,302	18,245	4,905
2037	17,452	12,066	8,374	8,418	8,055	18,194	15,840	7,397	18,429	4,968
Compound Annual Growth Rates (%)										
2018-2022	0.89	0.96	1.24	0.20	0.43	0.86	0.17	0.57	0.55	1.22
2018-2027	0.90	0.96	1.01	0.25	0.41	0.77	0.17	0.70	0.58	1.14
2018-2037	1.00	1.16	1.11	0.43	0.60	0.79	0.38	0.96	0.79	1.24

Net Summer Non-Coincident Peak Demand (Metered Load in MW)[30] —Low

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	17,571	12,128	8,906	9,541	7,962	16,727	21,013	7,324	19,812	4,617
2017	17,218	12,212	8,467	9,567	8,451	17,257	21,277	7,261	18,282	4,603
2018	17,348	12,353	8,332	9,589	8,432	17,301	21,237	7,315	17,854	4,650
2019	17,476	12,488	8,383	9,587	8,424	17,443	21,259	7,370	17,936	4,712
2020	17,640	12,600	8,516	9,576	8,442	17,612	21,352	7,413	18,233	4,774
2021	17,781	12,707	8,583	9,586	8,486	17,765	21,334	7,460	18,260	4,831
2022	17,915	12,831	8,627	9,599	8,530	17,856	21,299	7,482	18,221	4,882
2023	18,064	12,948	8,656	9,600	8,548	17,958	21,300	7,521	18,325	4,938
2024	18,190	13,066	8,653	9,609	8,569	18,038	21,273	7,591	18,387	4,997
2025	18,318	13,175	8,689	9,616	8,589	18,163	21,270	7,651	18,510	5,052
2026	18,466	13,308	8,763	9,624	8,605	18,301	21,348	7,716	18,672	5,102
2027	18,646	13,461	8,824	9,642	8,632	18,407	21,375	7,780	18,722	5,150
2028	18,840	13,630	8,900	9,660	8,696	18,539	21,393	7,841	18,838	5,216
2029	19,015	13,812	8,976	9,676	8,755	18,659	21,465	7,914	18,980	5,285
2030	19,196	13,987	9,046	9,701	8,823	18,795	21,521	8,001	19,130	5,350
2031	19,359	14,190	9,122	9,741	8,881	18,925	21,595	8,087	19,277	5,422
2032	19,532	14,385	9,195	9,781	8,933	19,057	21,677	8,183	19,438	5,495
2033	19,698	14,577	9,259	9,827	8,980	19,198	21,799	8,289	19,615	5,567
2034	19,872	14,784	9,335	9,881	9,030	19,339	21,934	8,411	19,855	5,645
2035	20,069	14,973	9,419	9,932	9,082	19,479	22,099	8,531	20,063	5,723
2036	20,278	15,174	9,498	9,982	9,132	19,617	22,234	8,642	20,262	5,798
2037	20,469	15,377	9,581	10,030	9,183	19,745	22,355	8,754	20,445	5,873
Compound Annual Growth Rates (%)										
2018-2022	0.81	0.96	0.87	0.02	0.29	0.79	0.07	0.56	0.51	1.22
2018-2027	0.80	0.96	0.64	0.06	0.26	0.69	0.07	0.69	0.53	1.14
2018-2037	0.87	1.16	0.74	0.24	0.45	0.70	0.27	0.95	0.72	1.24

[30] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

Net Winter Non-Coincident Peak Demand (Metered Load in MW) [31] —Low

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10
2016	14,715	9,615	7,203	7,656	6,846	15,424	14,615	6,309	16,966	3,615
2017	14,324	9,583	6,840	7,704	7,178	15,602	14,708	6,119	16,244	3,894
2018	14,430	9,693	6,725	7,719	7,159	15,641	14,675	6,165	15,863	3,934
2019	14,534	9,800	6,760	7,714	7,151	15,768	14,684	6,211	15,935	3,986
2020	14,668	9,887	6,861	7,702	7,164	15,920	14,742	6,247	16,199	4,039
2021	14,782	9,971	6,909	7,706	7,200	16,057	14,723	6,287	16,222	4,087
2022	14,891	10,069	6,938	7,713	7,235	16,138	14,693	6,305	16,186	4,130
2023	15,012	10,161	6,955	7,710	7,248	16,229	14,686	6,337	16,278	4,178
2024	15,113	10,253	6,947	7,714	7,265	16,300	14,661	6,396	16,331	4,227
2025	15,216	10,339	6,969	7,716	7,279	16,412	14,652	6,447	16,440	4,274
2026	15,335	10,443	7,022	7,719	7,291	16,534	14,698	6,501	16,581	4,317
2027	15,481	10,563	7,064	7,729	7,311	16,629	14,709	6,555	16,624	4,357
2028	15,639	10,695	7,119	7,740	7,364	16,746	14,714	6,607	16,726	4,413
2029	15,780	10,838	7,173	7,749	7,411	16,853	14,755	6,668	16,851	4,471
2030	15,926	10,976	7,223	7,765	7,467	16,974	14,786	6,741	16,982	4,526
2031	16,056	11,135	7,277	7,793	7,514	17,090	14,828	6,813	17,111	4,587
2032	16,195	11,288	7,328	7,822	7,556	17,207	14,875	6,894	17,252	4,649
2033	16,328	11,439	7,372	7,855	7,593	17,332	14,950	6,983	17,407	4,710
2034	16,467	11,601	7,425	7,894	7,633	17,457	15,035	7,085	17,617	4,776
2035	16,625	11,750	7,485	7,931	7,675	17,581	15,139	7,187	17,800	4,842
2036	16,793	11,907	7,541	7,967	7,716	17,703	15,222	7,280	17,974	4,905
2037	16,946	12,066	7,600	8,002	7,756	17,817	15,295	7,374	18,133	4,968
Compound Annual Growth Rates (%)										
2018-2022	0.79	0.96	0.78	-0.02	0.26	0.78	0.03	0.56	0.50	1.22
2018-2027	0.78	0.96	0.55	0.02	0.23	0.68	0.03	0.68	0.52	1.14
2018-2037	0.85	1.16	0.65	0.19	0.42	0.69	0.22	0.95	0.71	1.24

[31] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

HIGH AND LOW FORECASTS

Gross and Net MISO System Energy (Annual Metered Load in GWh) [32] —Low

Year	MISO Energy without EE Adjustments	MISO Energy with EE Adjustments
2016	666,730	666,730
2017	659,722	658,918
2018	659,236	657,814
2019	663,415	661,351
2020	669,856	667,124
2021	673,928	670,498
2022	677,004	672,846
2023	681,024	676,115
2024	684,513	678,823
2025	688,823	682,323
2026	694,259	686,920
2027	698,988	690,777
2028	704,742	695,626
2029	710,841	700,787
2030	717,138	706,112
2031	723,655	711,620
2032	730,339	717,265
2033	737,334	723,190
2034	745,122	729,878
2035	752,969	736,592
2036	760,668	743,124
2037	768,100	749,366
Compound Annual Growth Rates (%)		
2018-2022	0.67	0.57
2018-2027	0.65	0.54
2018-2037	0.81	0.69

[32] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.

Gross and Net MISO System Coincident Peak Demand (Metered Load in MW) [33] —Low

Year	MISO Summer CP without EE Adjustments	MISO Summer CP with EE Adjustments	MISO Winter CP without EE Adjustments	MISO Winter CP with EE Adjustments
2016	120,364	120,364	99,899	99,899
2017	119,324	119,183	98,850	98,708
2018	119,262	119,013	98,782	98,534
2019	120,004	119,645	99,410	99,051
2020	121,142	120,667	100,374	99,899
2021	121,867	121,271	100,994	100,398
2022	122,417	121,696	101,462	100,741
2023	123,129	122,278	102,068	101,217
2024	123,749	122,763	102,599	101,613
2025	124,512	123,386	103,251	102,125
2026	125,481	124,210	104,065	102,795
2027	126,326	124,905	104,776	103,355
2028	127,352	125,775	105,645	104,068
2029	128,445	126,706	106,563	104,824
2030	129,572	127,666	107,512	105,606
2031	130,742	128,662	108,493	106,413
2032	131,941	129,682	109,498	107,239
2033	133,199	130,755	110,548	108,105
2034	134,597	131,964	111,717	109,084
2035	136,010	133,181	112,893	110,065
2036	137,393	134,363	114,048	111,018
2037	138,728	135,493	115,163	111,928
Compound Annual Growth Rates (%)				
2018-2022	0.65	0.56	0.67	0.56
2018-2027	0.64	0.54	0.66	0.53
2018-2037	0.80	0.68	0.81	0.67

[33] It should be noted that the adjustment used in this update only includes future energy efficiency, while the adjustments in Years 2 and 3 also included demand response and distributed generation.