Independent Load Forecast Workshop

September 15, 2014

Caveat

- The results provided here are subject to revision if necessary as a result of stakeholder feedback

Topics

- Review of previous work
- Energy efficiency/DSM adjustments
- State-level energy forecasts
- LRZ-level energy forecasts
- LRZ non-coincident peaks
- MISO-level forecasts

Previous Work

State Econometric Models

- We developed econometric models to project annual retail sales for each of the 15 MISO states, using various economic, demographic, and weather variables
- Presented at April workshop
- Some updates presented at July workshop

Dependent and Explanatory Variables

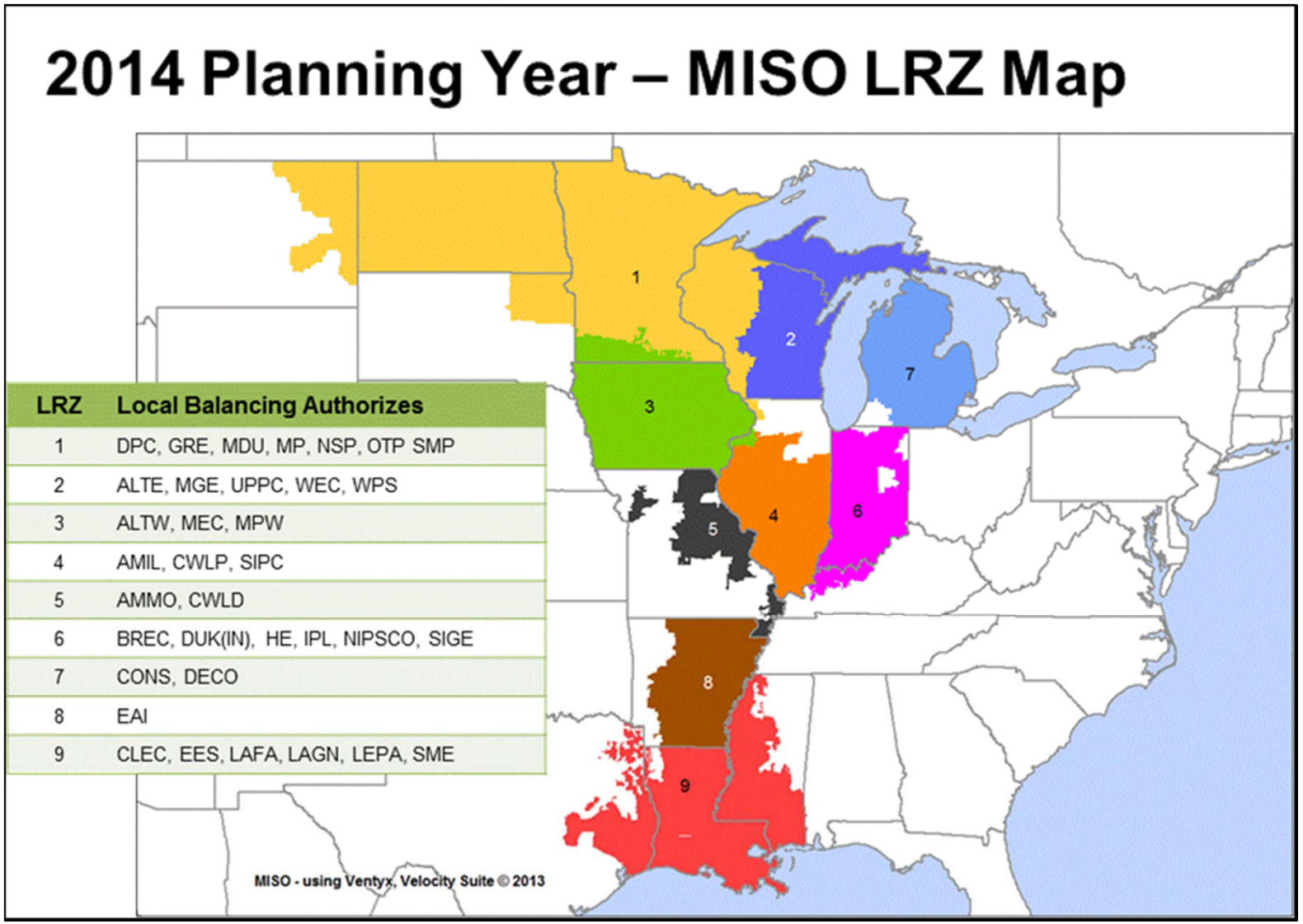
Variables	Eviews name	Data Source
Dependent variable:		
Electricity sales	**ELECTRICITY_SALES**	**EIA**
Explanatory variables:		
Electricity prices	**REAL_ELECTRICITY_PRICE**	**EIA***
Natural gas prices	**REAL_NATURAL_GAS_PRICE**	**EIA***
Real personal income	**REAL_INCOME**	**BEA***
Population	**POPULATION**	**IHS Global Insight**
Manufacturing employment	**MANUFACTURING_EMP**	**BLS**
Non-manufacturing employment	**NON_MANUFACTURING_EMP**	**BLS**
Non-farm employment	**NON_FARM_EMP**	**BLS**
Gross state product	**REAL_GSP**	**BEA**
Cooling degree days	**CDD**	**NOAA**
Heating degree days	**HDD**	**NOAA**

**** Original data was in nominal dollars. SUFG converted it to real 2005 dollars using state level CPI from IHS Global Insight.***

Allocation Factors

- Allocation factors were determined to convert state annual retail sales to LRZ retail sales
- Based on historical data
- Presented at July workshop
- Some modifications have been done based on stakeholder and MISO staff feedback

2014 Planning Year – MISO LRZ Map



LRZ	Local Balancing Authorizes
1	DPC, GRE, MDU, MP, NSP, OTP SMP
2	ALTE, MGE, UPPC, WEC, WPS
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, DUK(IN), HE, IPL, NIPSCO, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA, SME

MISO LRZ	State	Allocation Factor	
		Basis	Result
1	IA	Historical average	Constant at 1.8%
	IL	Historical average	Constant at 0.0002%
	MI	Historical average	Constant at 0.1%
	MN	Historical average	Constant at 96.1%
	ND+MT	Historical trend	Declining from 32.7% to 32.1%
	SD	Historical average	Constant at 24.7%
	WI	Historical average	Constant at 14.9%
2	MI	Last observed	Constant at 4.9%
	WI	Historical average	Constant at 84.9%
3	IA	Last observed	Constant at 91.5%
	IL	Historical average	Constant at 1.4%
	MN	Historical average	Constant at 1.3%
	SD	Historical average	Constant at 1.8%
4	IL	Chicago vs. state growth	Declining from 32.4% to 31.9%
5	MO	St. Louis vs. state growth	Declining from 50.0% to 49.0%
6	IN+KY	Historical trend	Increasing from 48.8% to 49.0%
7	MI	Historical average	Constant at 90.2%
8	AR	Historical average	Constant at 69.7%
	MO	Historical average	Constant at 0.3%
9	LA	Historical average	Constant at 91.8%
	MS	Historical average	Constant at 43.7%
	TX	Historical average	Constant at 5.4%

Energy to Peak Conversions

- We developed conversion factors to translate LRZ energy to LRZ peak demand under normal weather conditions
- Based on historical hourly loads and temperature
- Presented at July workshop

State Annual Retail Energy Forecasts

Explanatory Variable CAGR* (%)

Variables	AR	IL	IN	IA	KY	LA	MI	MN	MS	MO	MT	ND	SD	TX	WI
REAL_ELECTRICITY_PRICE	0.75	0.33	0.99	1.09	0.84	0.92	1.05	1.21	0.96	1.20	0.76	1.16	1.25	0.69	0.90
REAL_NATURAL_GAS_PRICE	-0.72		-0.43		-0.03			-0.59			-0.62	-0.40	-0.44		-0.58
REAL_INCOME								2.68							
POPULATION					0.52					0.51			0.84		
REAL_INCOME/POPULATION		2.11		2.21		2.10	1.93		2.36		2.56			2.18	2.40
REAL_GSP	2.51		2.40	2.58			2.08		2.37					3.61	2.19
NON_MANUFACTURING_EMP		0.70								0.88		0.79			
MANUFACTURING_EMP						-0.10					0.32				

* CAGR – Compound Annual Growth Rate

Energy Efficiency/DSM

- Adjustments were made to the state forecasts based on each state's energy efficiency requirements per the Database of State Incentives for Renewables & Efficiency (DSIRE) and contact with some regulatory commissions
- For those states that have mandates that are unspecified for some future year, the last specified requirement was assumed

Energy Efficiency/DSM

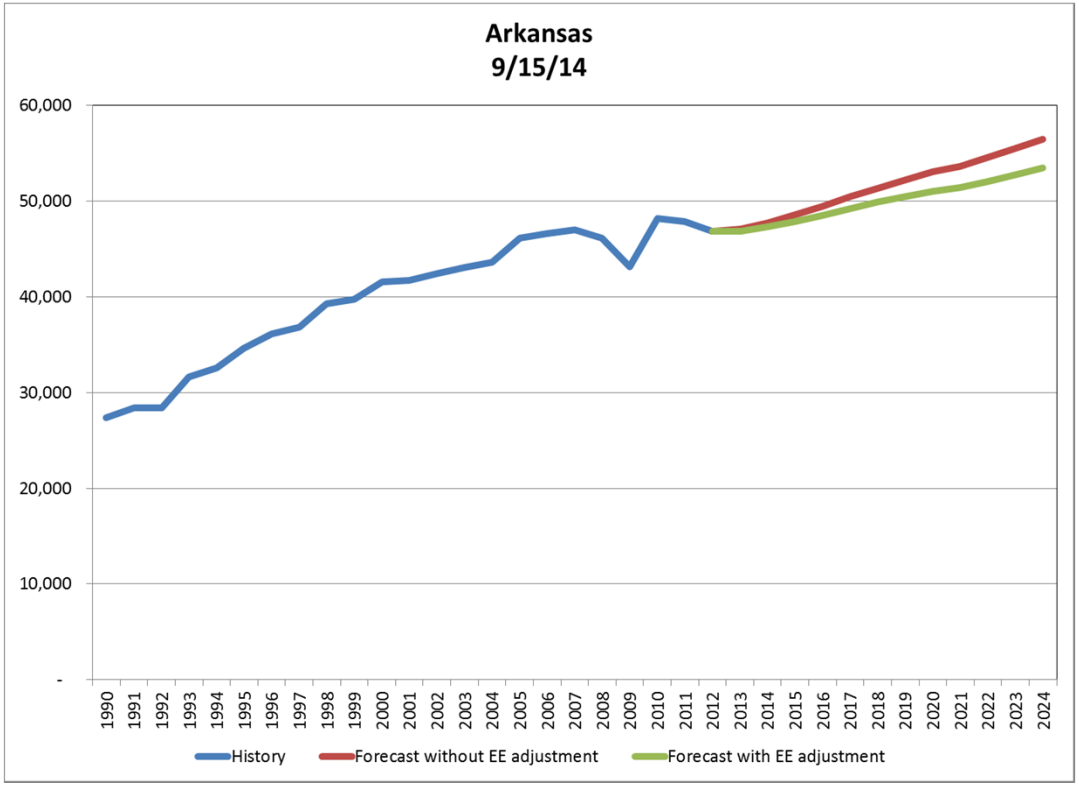
- Past energy efficiency efforts are included in the historical data and affect the econometric model coefficients
- The econometric models will project efficiency improvements consistent with those experienced in the past
- The adjustments done here represent incremental efforts beginning in 2013

State EE Requirements

State	Applies to:	Savings
Arkansas	Investor-owned Utilities	0.75% (2013 and 2014), 0.9% (2015 and beyond) of 2010 demand
Illinois	Investor-owned Utilities	1.0% (2013), 1.4% (2014), 1.8% (2015),2.0% (2016 and beyond)
Indiana	Investor-owned Utilities	0.9% (2013) and 1.1% (2014)of preceding three year average
Iowa	Mid-American Energy and Interstate Power & Light	420 GWh (2014, 2015), 416 GWh (2016), 422 GWh (2017), 427 GWh (2018 and beyond)
Michigan	Investor-owned Utilities	1.0% annually
Minnesota	Investor-owned Utilities	1.5% of three year average annually
Missouri	Utilities	0.5% (2013), increasing by 0.2% each year until reaching 1.9% (2020 and beyond)
Texas	Investor-owned Utilities	30% of incremental load growth each year
Wisconsin	Utilities	Savings goal set by PSC on a 4-year basis; most recent averaged 454 GWh/year, which was assumed constant throughout

Arkansas Retail Sales (GWh)

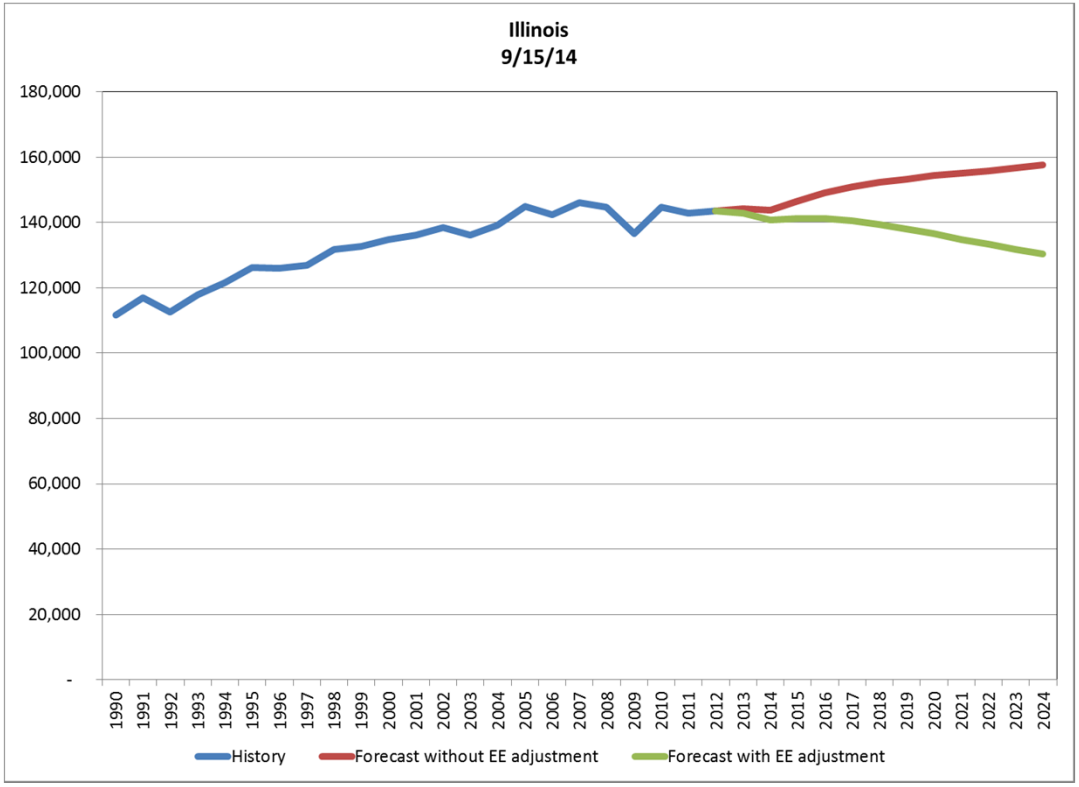
- 2015-2024 projected CAGR
  - gross 1.70%
  - net 1.23%
- 1990-2012 actual CAGR
  - 2.48%



CAGR – Compound Annual Growth Rate

Illinois Retail Sales (GWh)

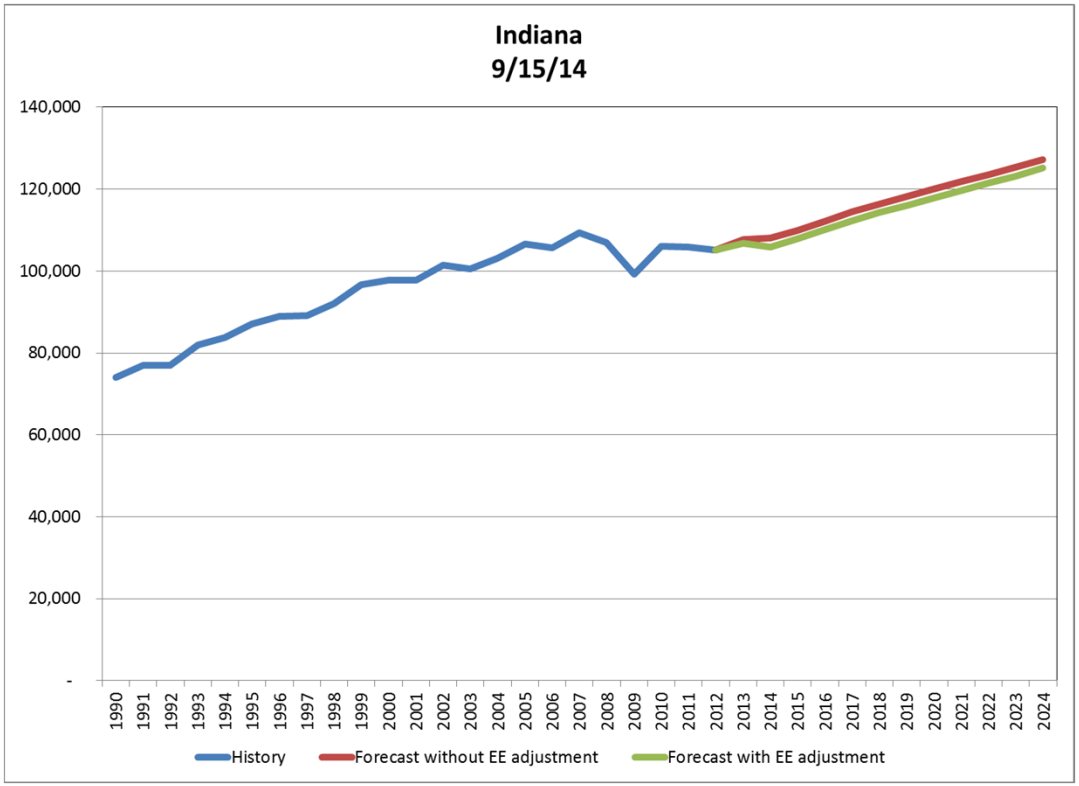
- 2015-2024 projected CAGR
  - gross 0.82%
  - net -0.89%
- 1990-2012 actual CAGR
  - 1.15%



CAGR – Compound Annual Growth Rate

Indiana Retail Sales (GWh)

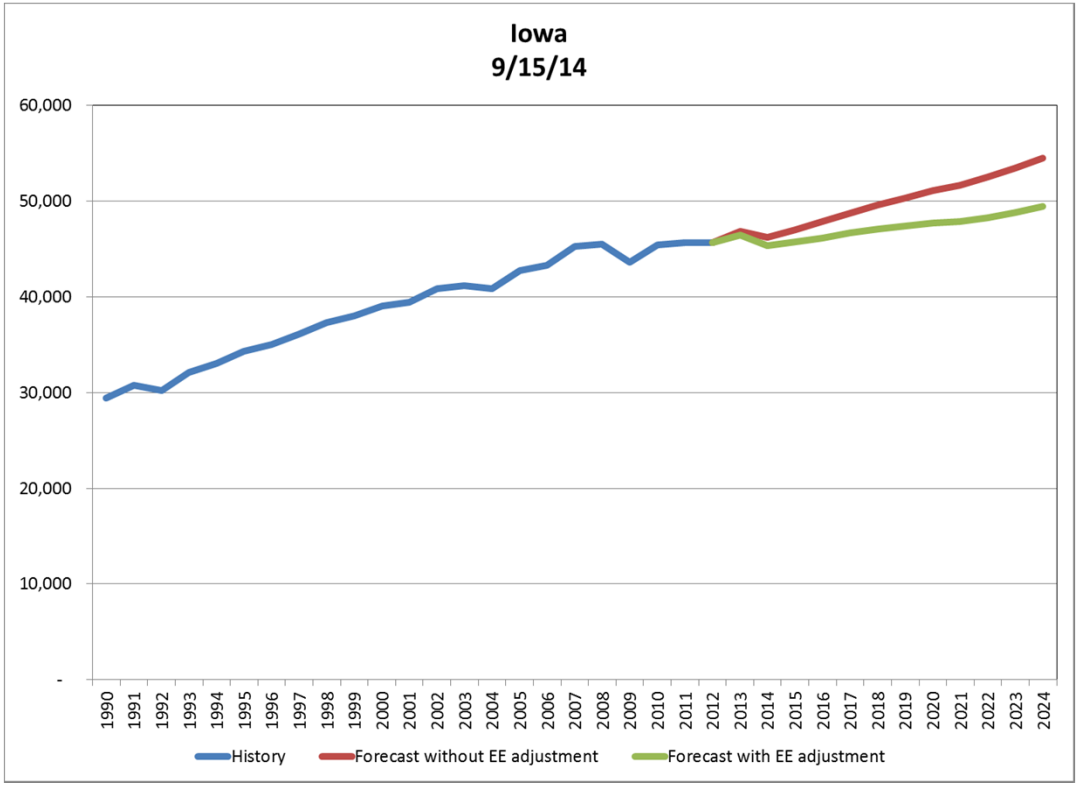
- 2015-2024 projected CAGR
  - gross 1.64%
  - net 1.67%
- 1990-2012 actual CAGR
  - 1.61%



CAGR – Compound Annual Growth Rate

Iowa Retail Sales (GWh)

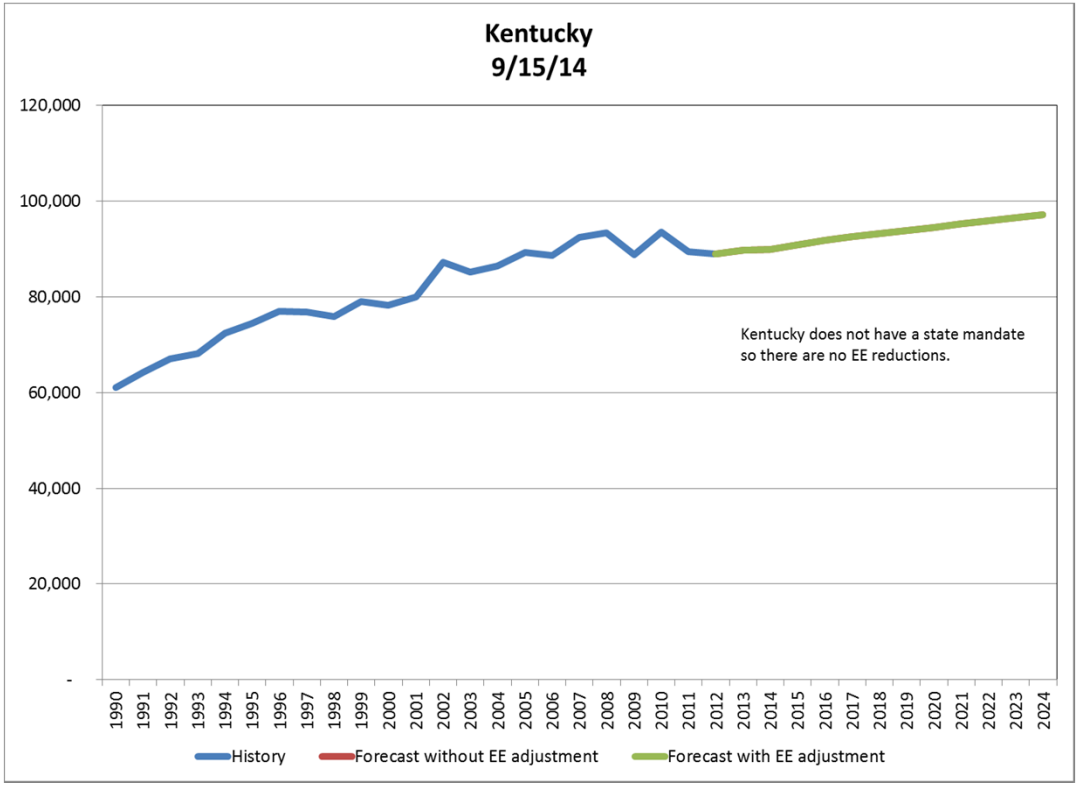
- 2015-2024 projected CAGR
  - gross 1.66%
  - net 0.86%
- 1990-2012 actual CAGR
  - 2.02%



CAGR – Compound Annual Growth Rate

Kentucky Retail Sales (GWh)

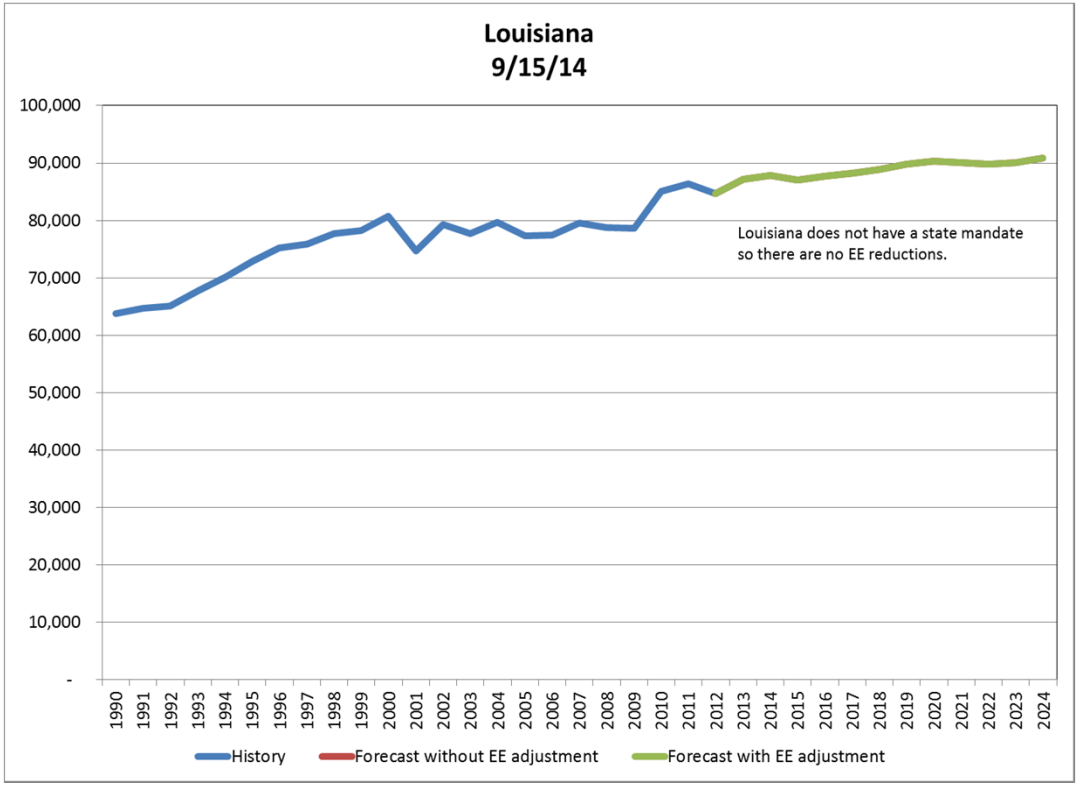
- 2015-2024 projected CAGR
  - gross 0.75%
  - net 0.75%
- 1990-2012 actual CAGR
  - 1.73%



CAGR – Compound Annual Growth Rate

Louisiana Retail Sales (GWh)

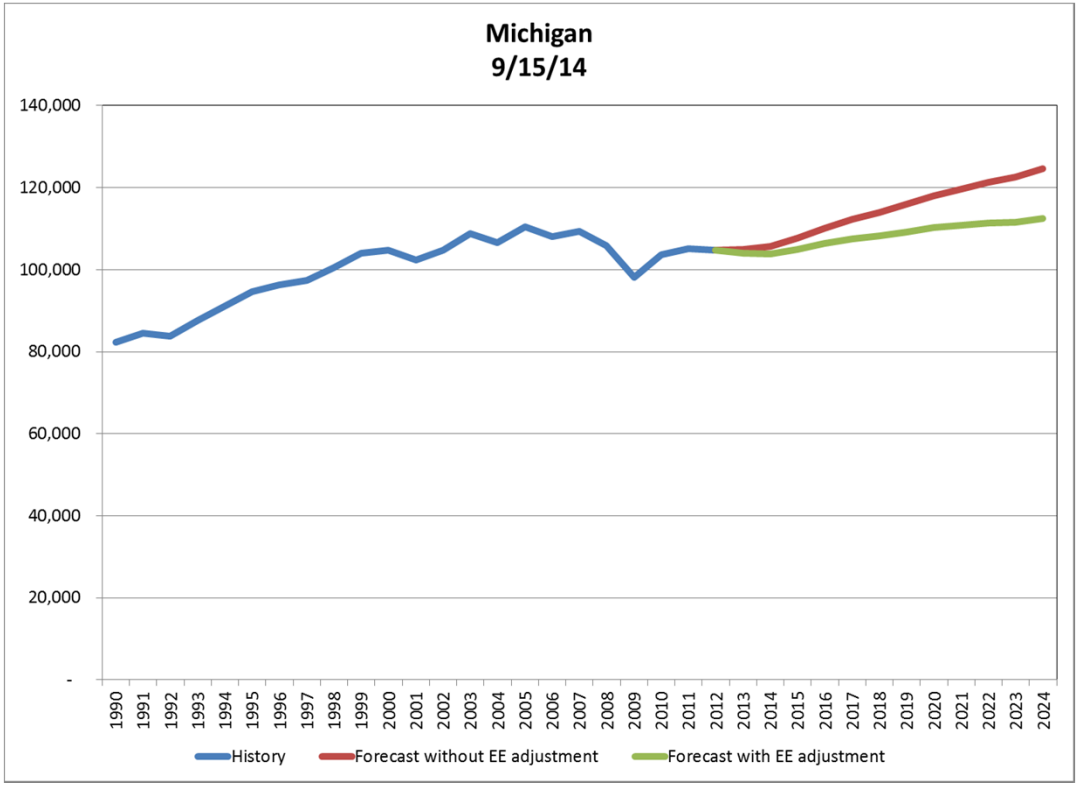
- 2015-2024 projected CAGR
  - gross 0.47%
  - net 0.47%
- 1990-2012 actual CAGR
  - 1.30%



CAGR – Compound Annual Growth Rate

Michigan Retail Sales (GWh)

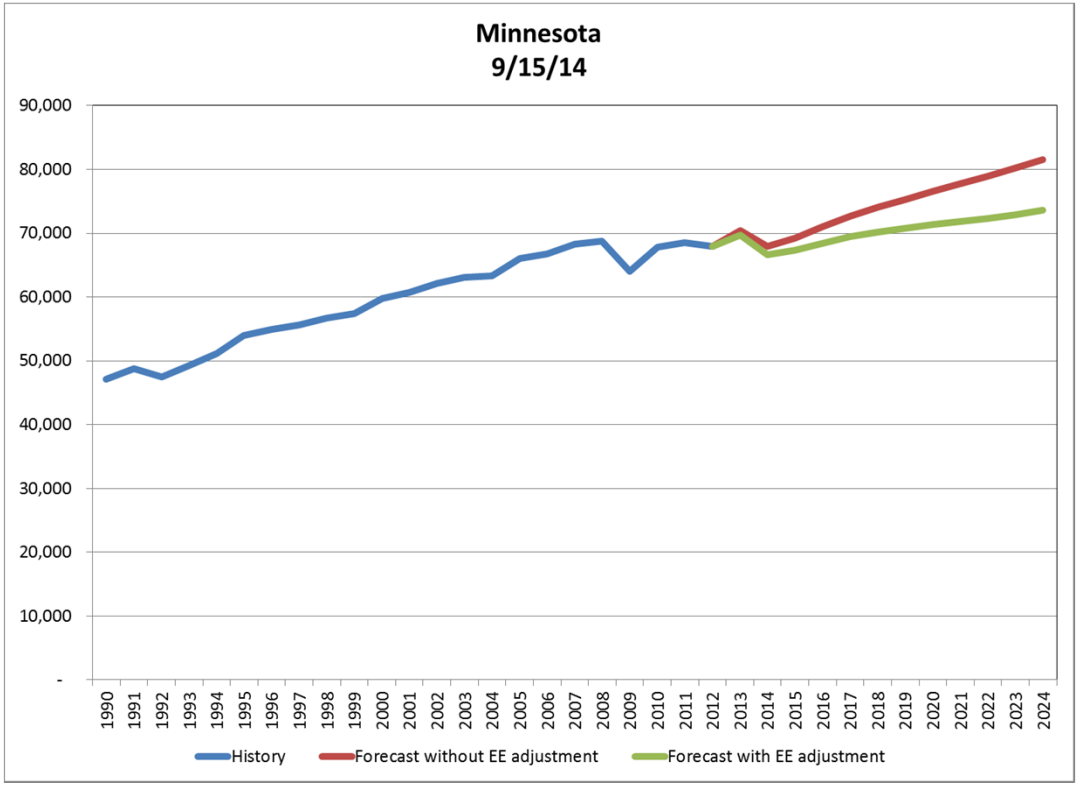
- 2015-2024 projected CAGR
  - gross 1.62%
  - net 0.77%
- 1990-2012 actual CAGR
  - 1.10%



CAGR – Compound Annual Growth Rate

Minnesota Retail Sales (GWh)

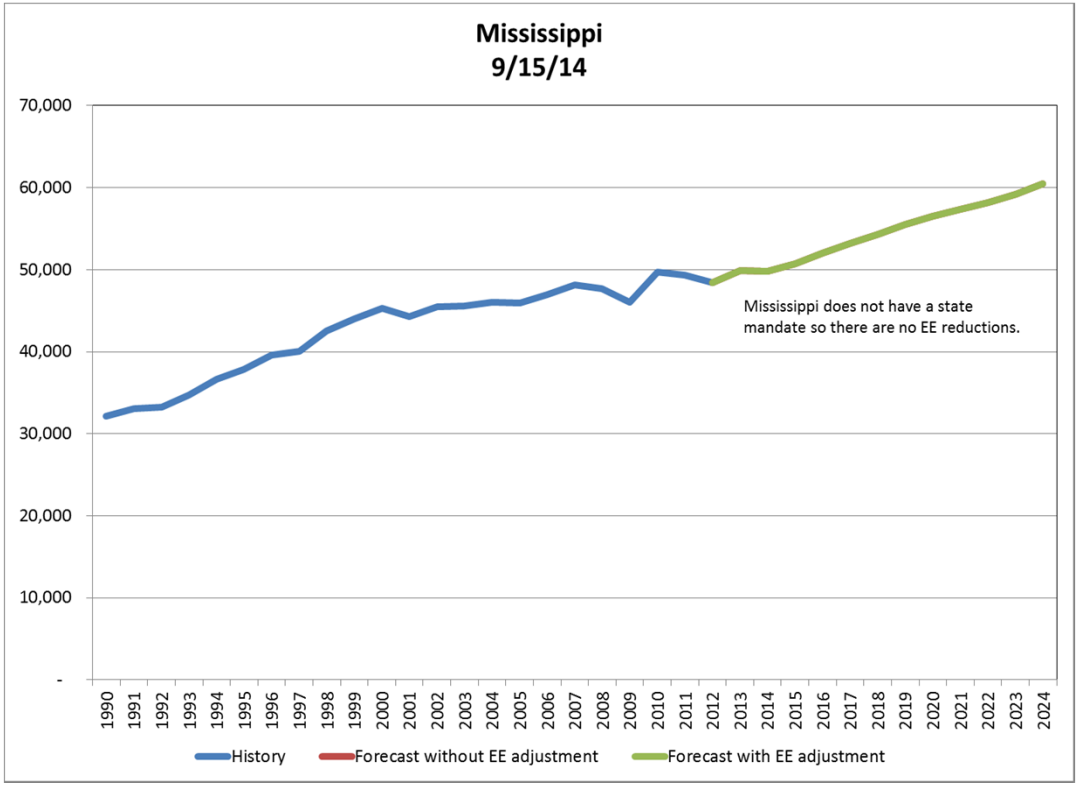
- 2015-2024 projected CAGR
  - gross 1.83%
  - net 0.99%
- 1990-2012 actual CAGR
  - 1.68%



CAGR – Compound Annual Growth Rate

Mississippi Retail Sales (GWh)

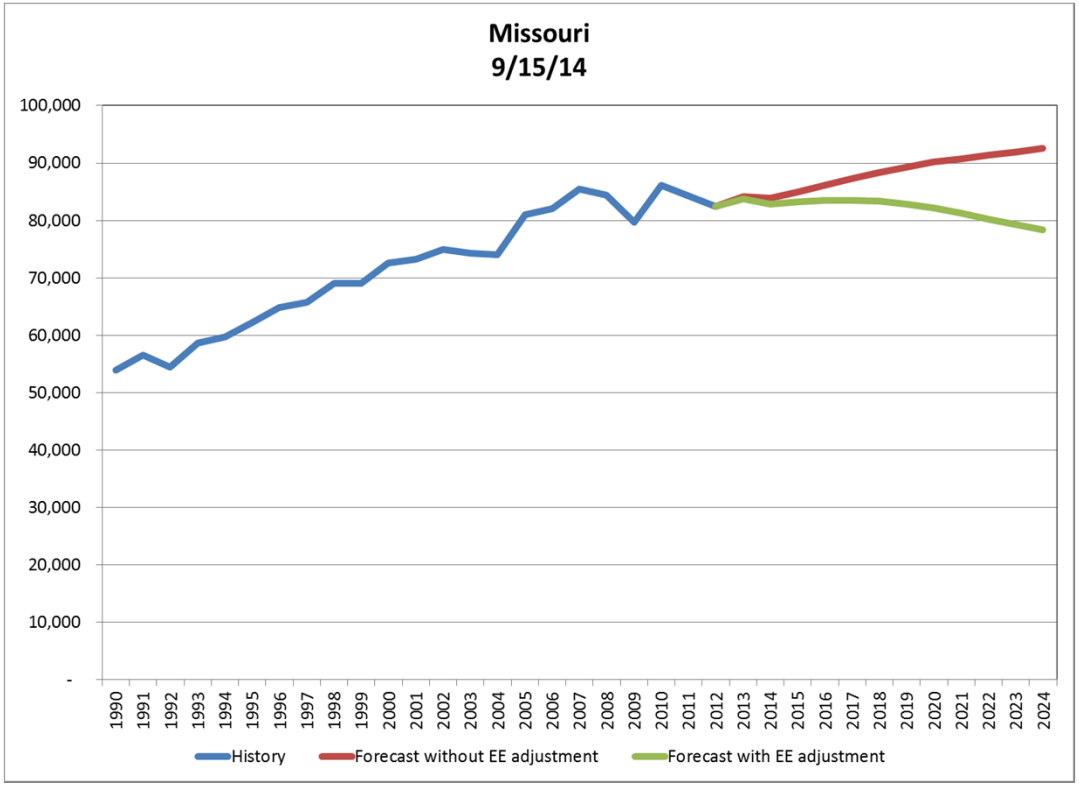
- 2015-2024 projected CAGR
  - gross 1.97%
  - net 1.97%
- 1990-2012 actual CAGR
  - 1.88%



CAGR – Compound Annual Growth Rate

Missouri Retail Sales (GWh)

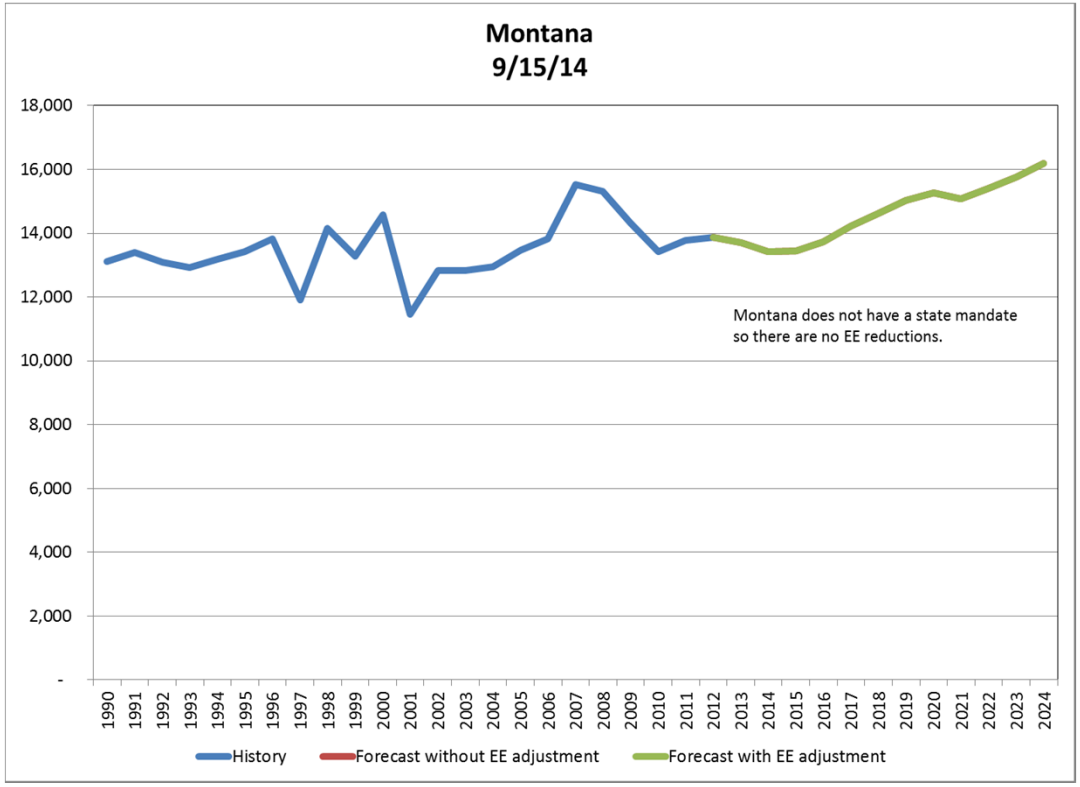
- 2015-2024 projected CAGR
  - gross 0.96%
  - net -0.65%
- 1990-2012 actual CAGR
  - 1.95%



CAGR – Compound Annual Growth Rate

Montana Retail Sales (GWh)

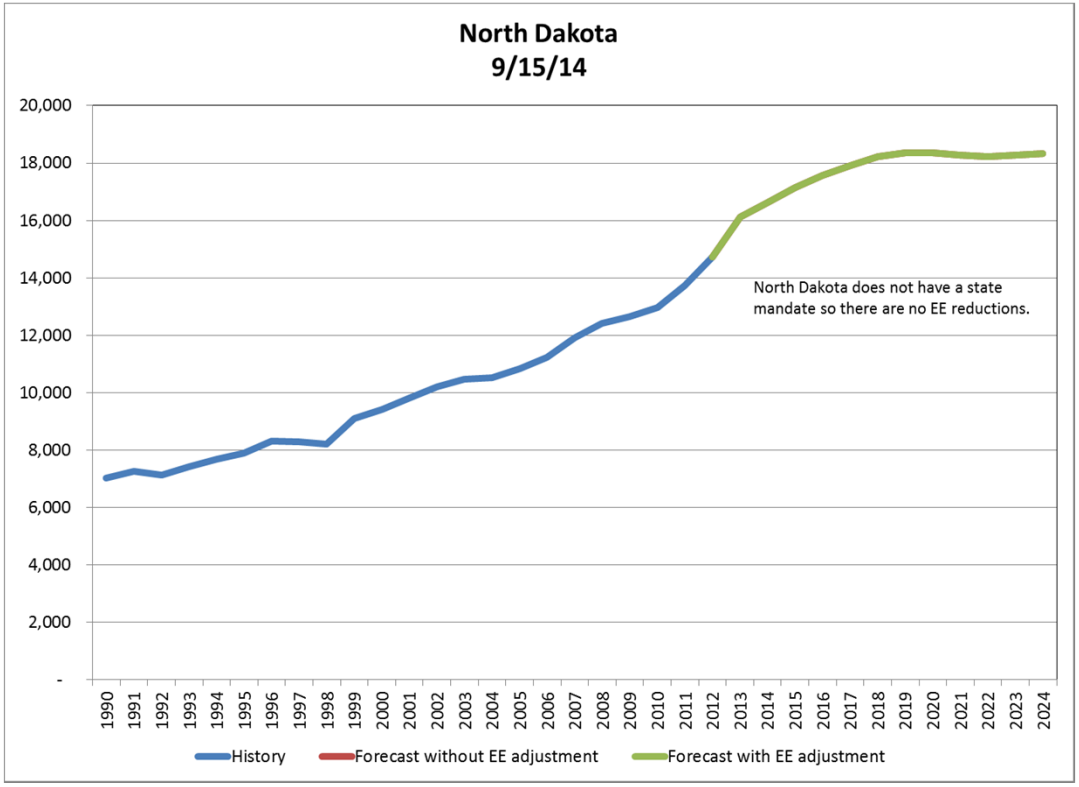
- 2015-2024 projected CAGR
  - gross 2.09%
  - net 2.09%
- 1990-2012 actual CAGR
  - 0.25%



CAGR – Compound Annual Growth Rate

North Dakota Retail Sales (GWh)

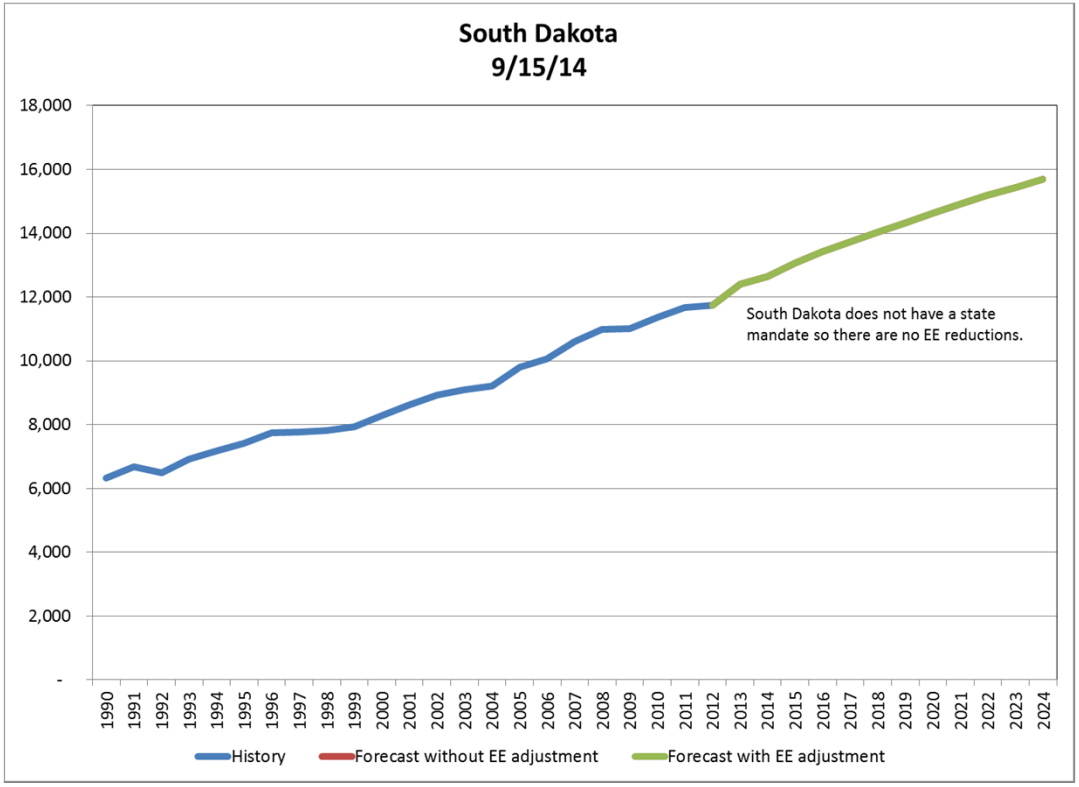
- 2015-2024 projected CAGR
  - gross 0.75%
  - net 0.75%
- 1990-2012 actual CAGR
  - 3.43%



CAGR – Compound Annual Growth Rate

South Dakota Retail Sales (GWh)

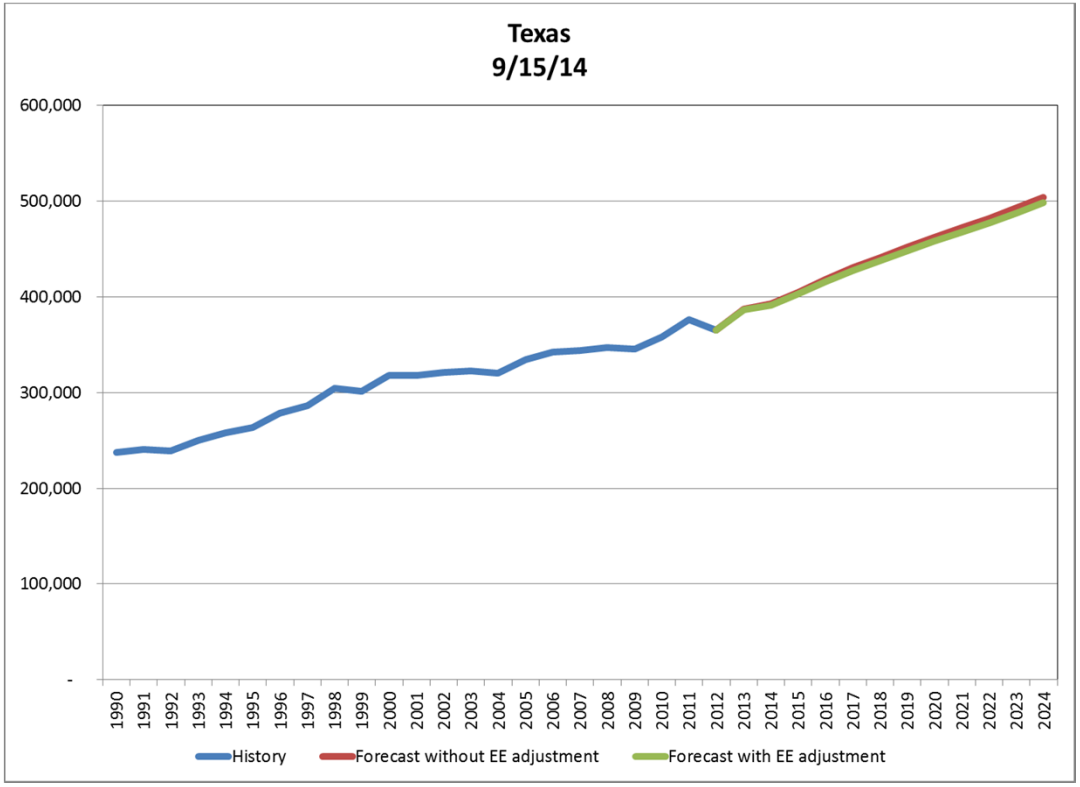
- 2015-2024 projected CAGR
  - gross 2.06%
  - net 2.06%
- 1990-2012 actual CAGR
  - 2.84%



CAGR – Compound Annual Growth Rate

Texas Retail Sales (GWh)

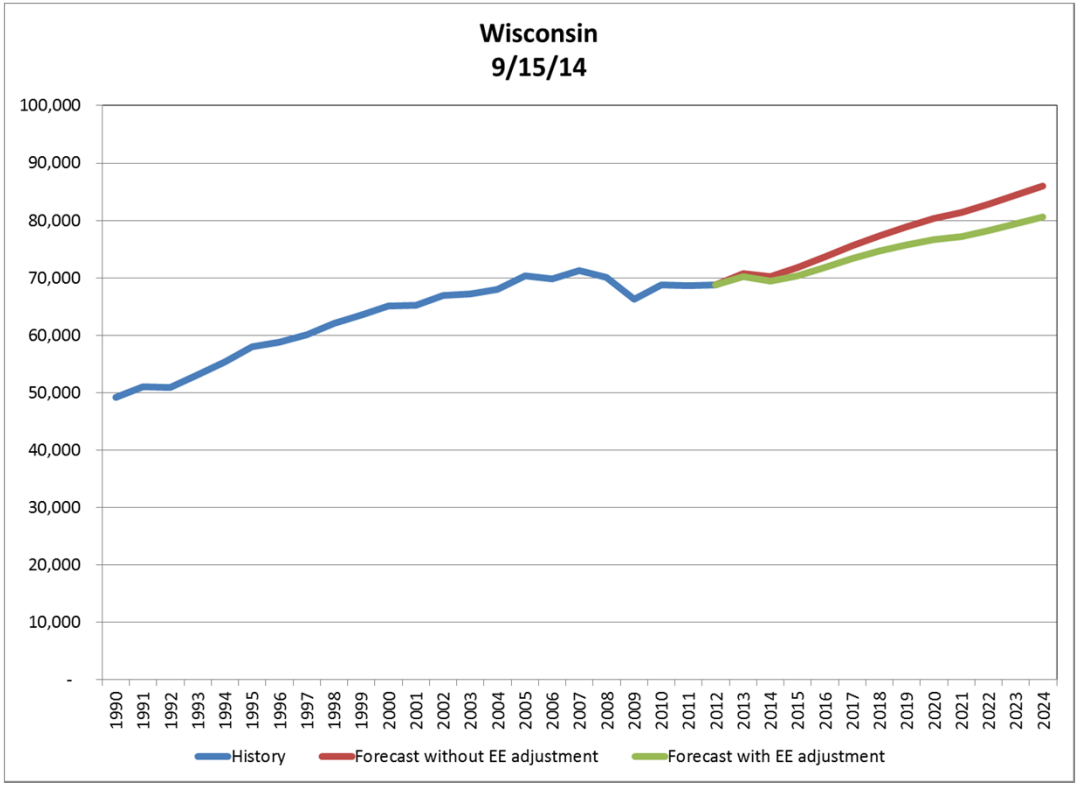
- 2015-2024 projected CAGR
  - gross 2.47%
  - net 2.39%
- 1990-2012 actual CAGR
  - 1.98%



CAGR – Compound Annual Growth Rate

Wisconsin Retail Sales (GWh)

- 2015-2024 projected CAGR
  - gross 2.04%
  - net 1.51%
- 1990-2012 actual CAGR
  - 1.54%



CAGR – Compound Annual Growth Rate

LRZ Energy Forecasts

Retail Sales vs. Metered Load

- The state-level forecasts are developed for retail sales (customer level) but the LRZ forecasts need to be for metered loads (substation level)
- The difference is primarily due to losses on the distribution system
- We have calculated an adjustment based on historical data

Distribution Losses

- Distribution losses were calculated by comparing EIA retail sales numbers to LBA metered load numbers and are expressed as a % of retail sales

LRZ	Dist. Losses
1	8.85%
2	2.26%
3	3.33%
4	6.65%
5	4.98%
6	5.79%
7	7.19%
8	3.57%
9	3.23%

LRZ Gross* Metered Load (GWh)

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9
2013	100,101	66,632	47,573	49,944	44,254	102,125	101,553	34,223	126,543
2014	97,543	66,319	46,938	49,798	44,088	102,431	102,244	34,711	127,405
2015	99,431	67,687	47,736	50,660	44,566	103,957	104,223	35,300	127,803
2016	101,926	69,412	48,592	51,459	45,130	105,628	106,536	35,960	129,682
2017	104,369	71,276	49,532	52,034	45,625	107,233	108,547	36,688	131,421
2018	106,478	72,884	50,335	52,388	46,086	108,562	110,182	37,349	133,175
2019	108,269	74,360	51,110	52,690	46,464	109,811	112,150	37,983	135,153
2020	109,996	75,631	51,859	52,972	46,847	111,101	114,134	38,561	136,718
2021	111,375	76,613	52,406	53,112	47,062	112,438	115,744	39,002	137,287
2022	113,067	77,991	53,254	53,314	47,263	113,703	117,245	39,668	138,095
2023	114,938	79,425	54,187	53,540	47,479	114,929	118,487	40,344	139,287
2024	116,829	80,923	55,201	53,759	47,686	116,236	120,489	41,049	141,210
Compound Annual Growth Rates (%)									
2013-2018	1.24	1.81	1.14	0.96	0.81	1.23	1.64	1.76	1.03
2013-2024	1.41	1.78	1.36	0.67	0.68	1.18	1.57	1.67	1.00
2015-2024	1.81	2.00	1.63	0.66	0.75	1.25	1.62	1.69	1.11

* Without adjustment for state EE programs

LRZ Net* Metered Load (GWh)

Year	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9
2013	99,334	66,191	47,149	49,502	44,037	101,633	100,651	34,065	126,495
2014	96,003	65,437	46,083	48,739	43,563	101,336	100,438	34,395	127,309
2015	97,123	66,364	46,441	48,823	43,650	102,861	101,507	34,794	127,698
2016	98,854	67,647	46,859	48,757	43,738	104,532	102,893	35,263	129,552
2017	100,536	69,067	47,355	48,469	43,668	106,137	103,955	35,801	131,264
2018	101,874	70,232	47,710	47,968	43,479	107,466	104,624	36,271	132,992
2019	102,885	71,263	48,036	47,424	43,125	108,715	105,612	36,713	134,948
2020	103,824	72,087	48,336	46,871	42,697	110,005	106,597	37,099	136,491
2021	104,409	72,623	48,435	46,188	42,110	111,342	107,192	37,348	137,038
2022	105,302	73,553	48,835	45,580	41,523	112,607	107,663	37,822	137,825
2023	106,368	74,539	49,321	45,008	40,963	113,833	107,861	38,306	138,996
2024	107,449	75,588	49,888	44,440	40,407	115,140	108,809	38,820	140,897
Compound Annual Growth Rates (%)									
2013-2018	0.51	1.19	0.24	-0.63	-0.25	1.12	0.78	1.26	1.01
2013-2024	0.72	1.21	0.51	-0.98	-0.78	1.14	0.71	1.19	0.99
2015-2024	1.13	1.46	0.80	-1.04	-0.85	1.26	0.77	1.22	1.10

* With adjustment for state EE programs

LRZ Peak Demand

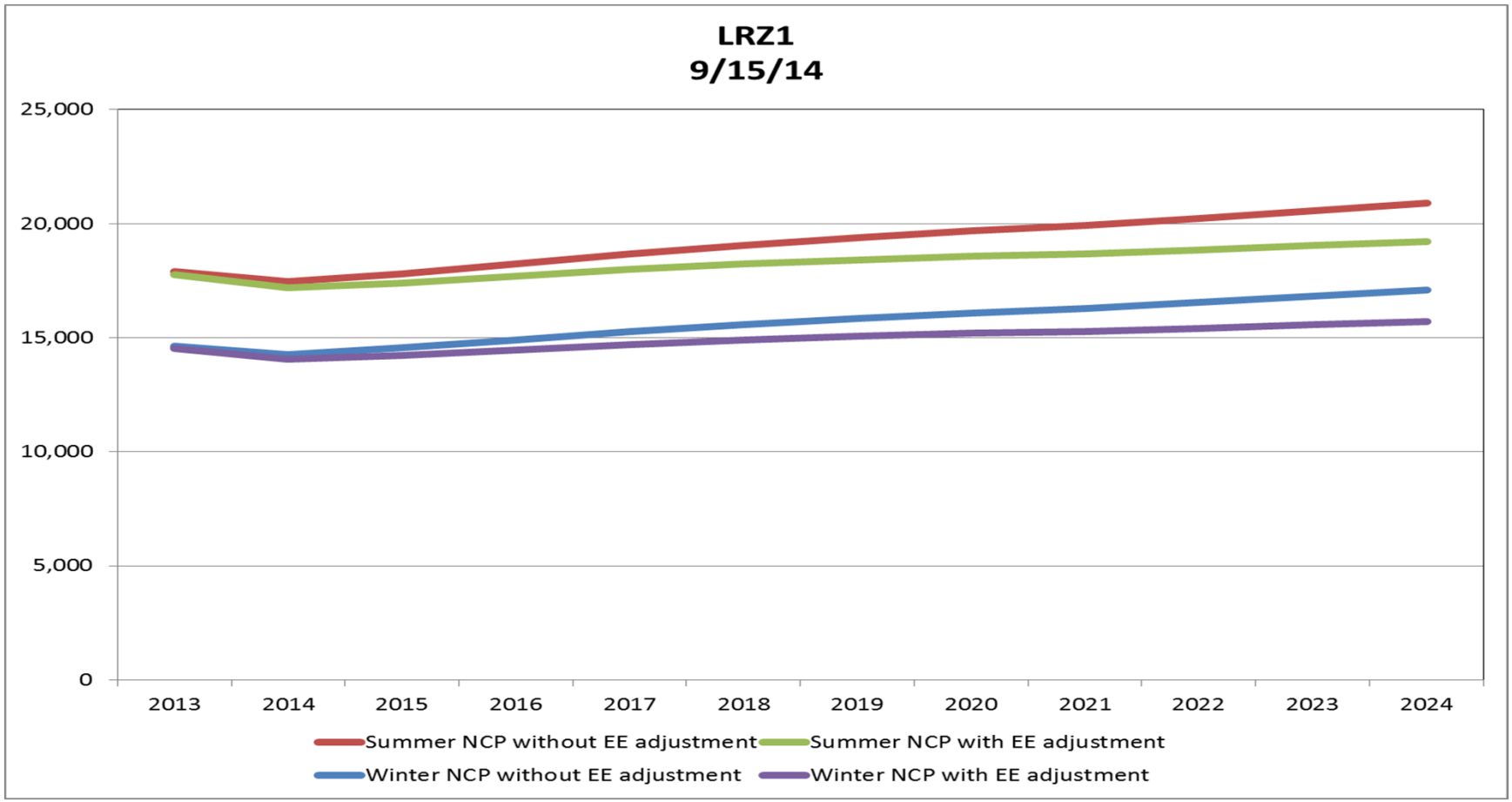
Metered Load vs. Resource Needs

- The peak demand forecasts are developed for metered loads (substation level) but resource needs are determined at the generator level
- The difference is primarily due to losses on the transmission system
- We have NOT calculated an adjustment because we do not have the necessary data
- We will work with MISO to get that data

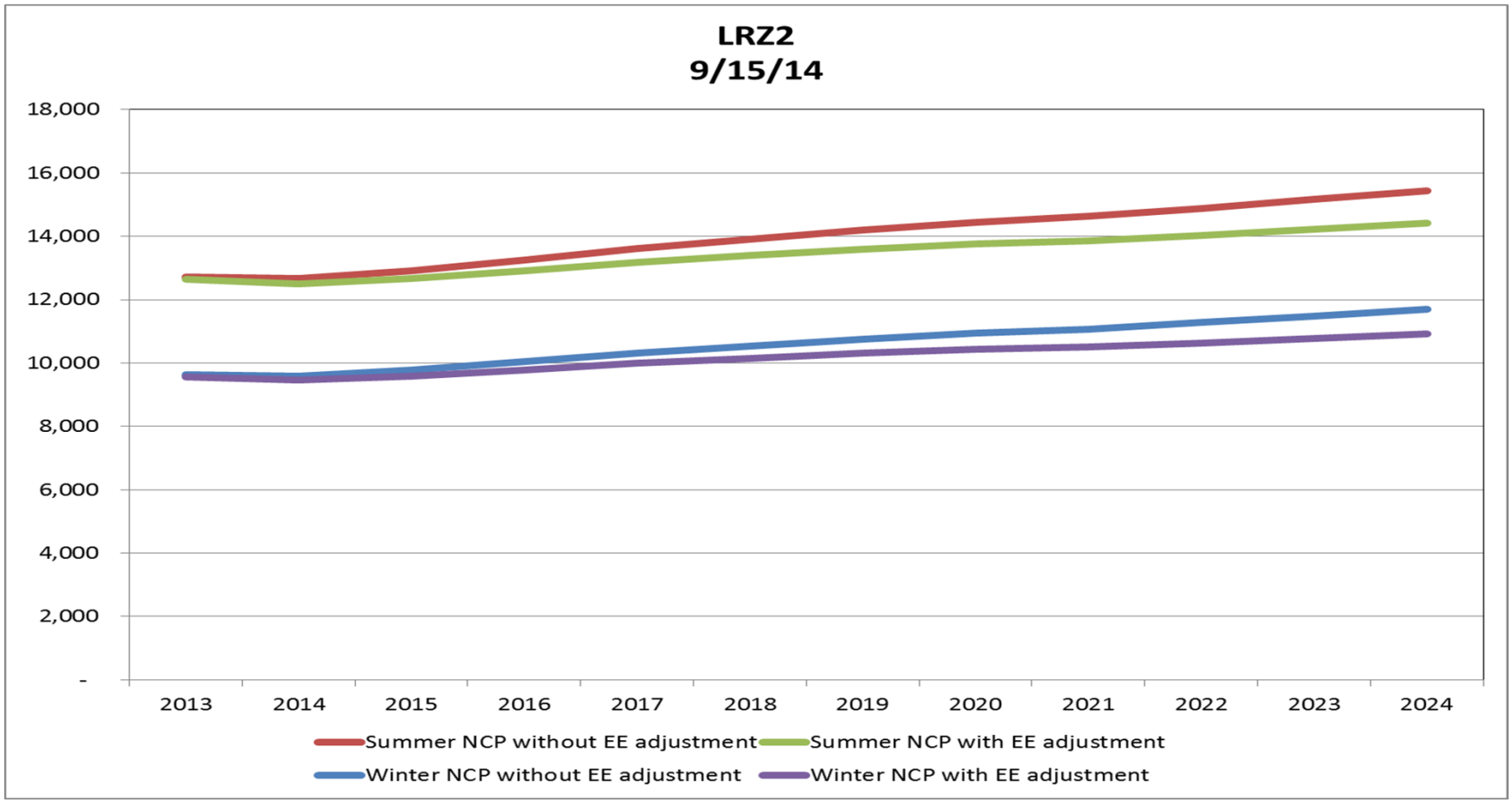
LRZ Non-coincident Peaks

- The following slides provide LRZ summer and winter peak demands that are non-coincident with the MISO peak
- Thus, the arithmetic sum of the LRZ peaks is greater than the MISO coincident peak

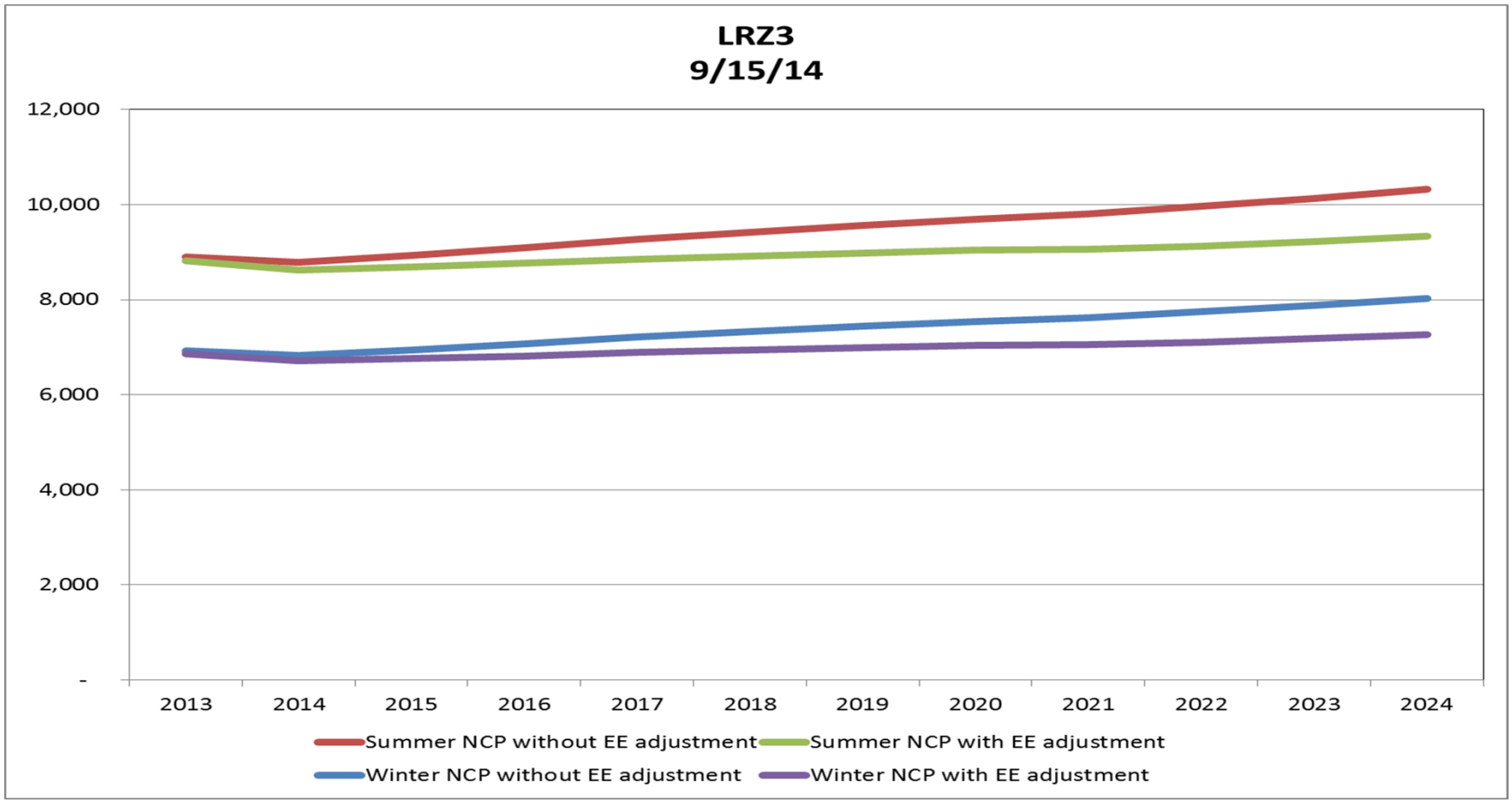
LRZ 1 Non-coincident Peak (MW)



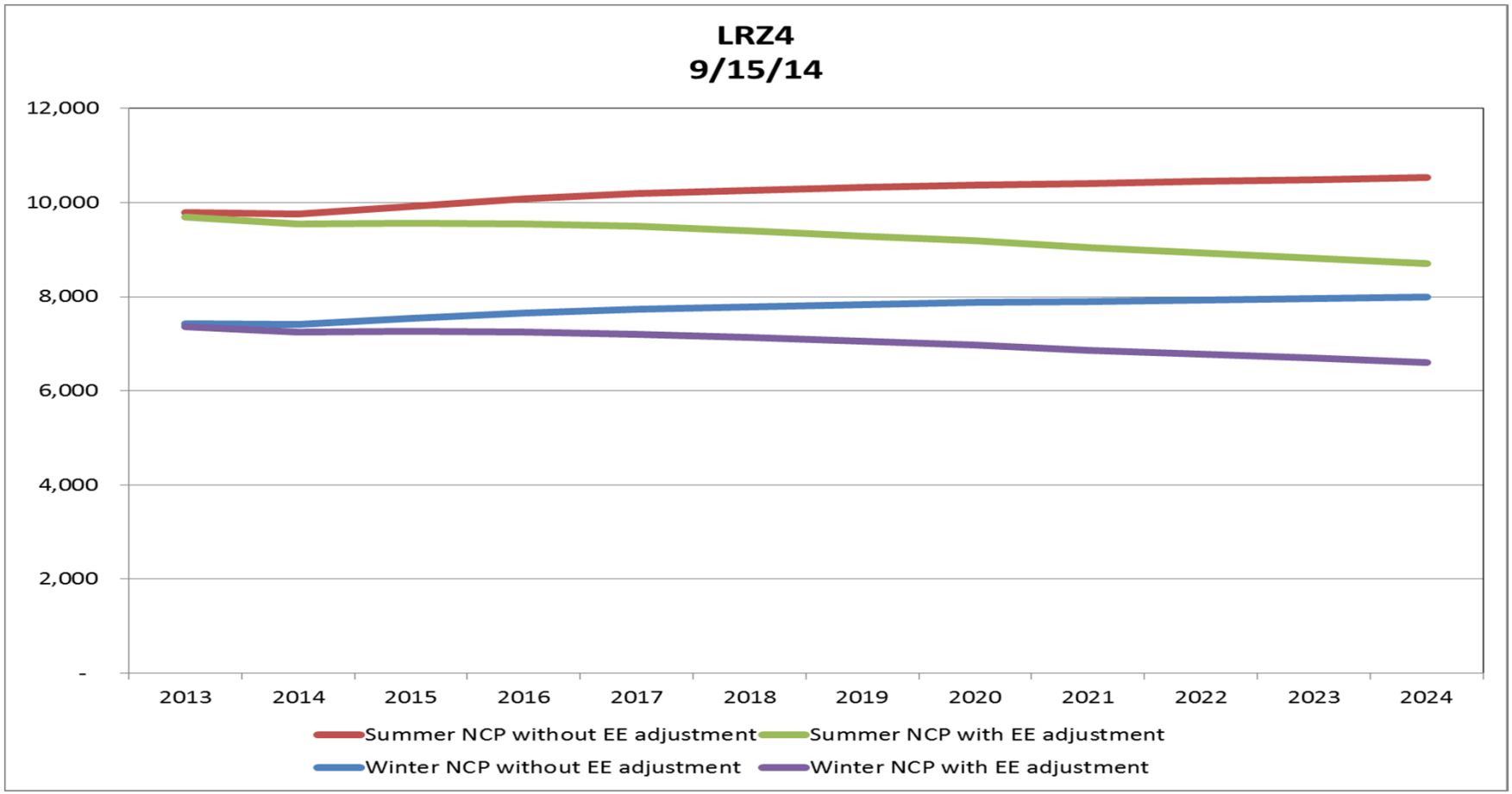
LRZ 2 Non-coincident Peak (MW)



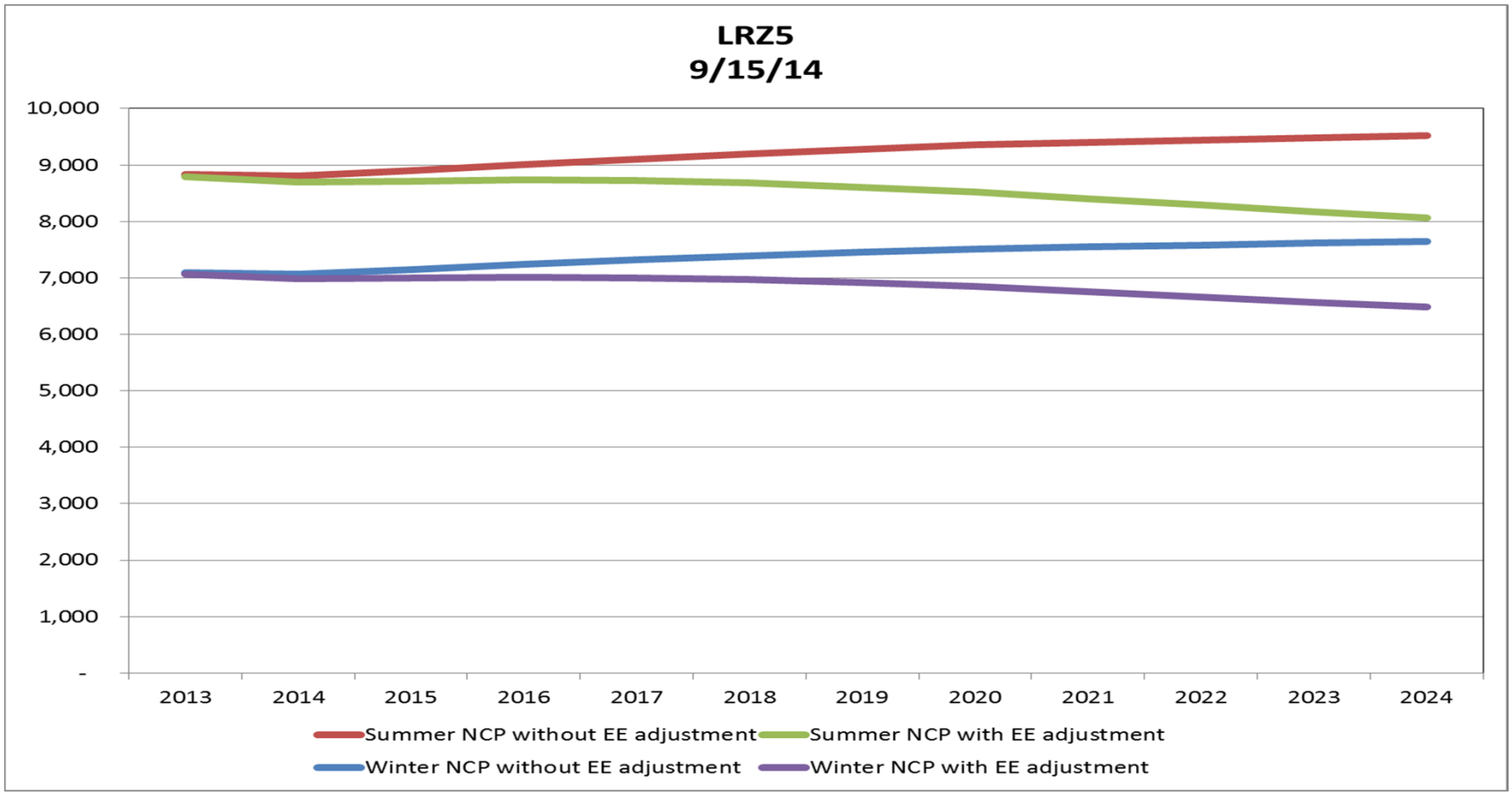
LRZ 3 Non-coincident Peak (MW)



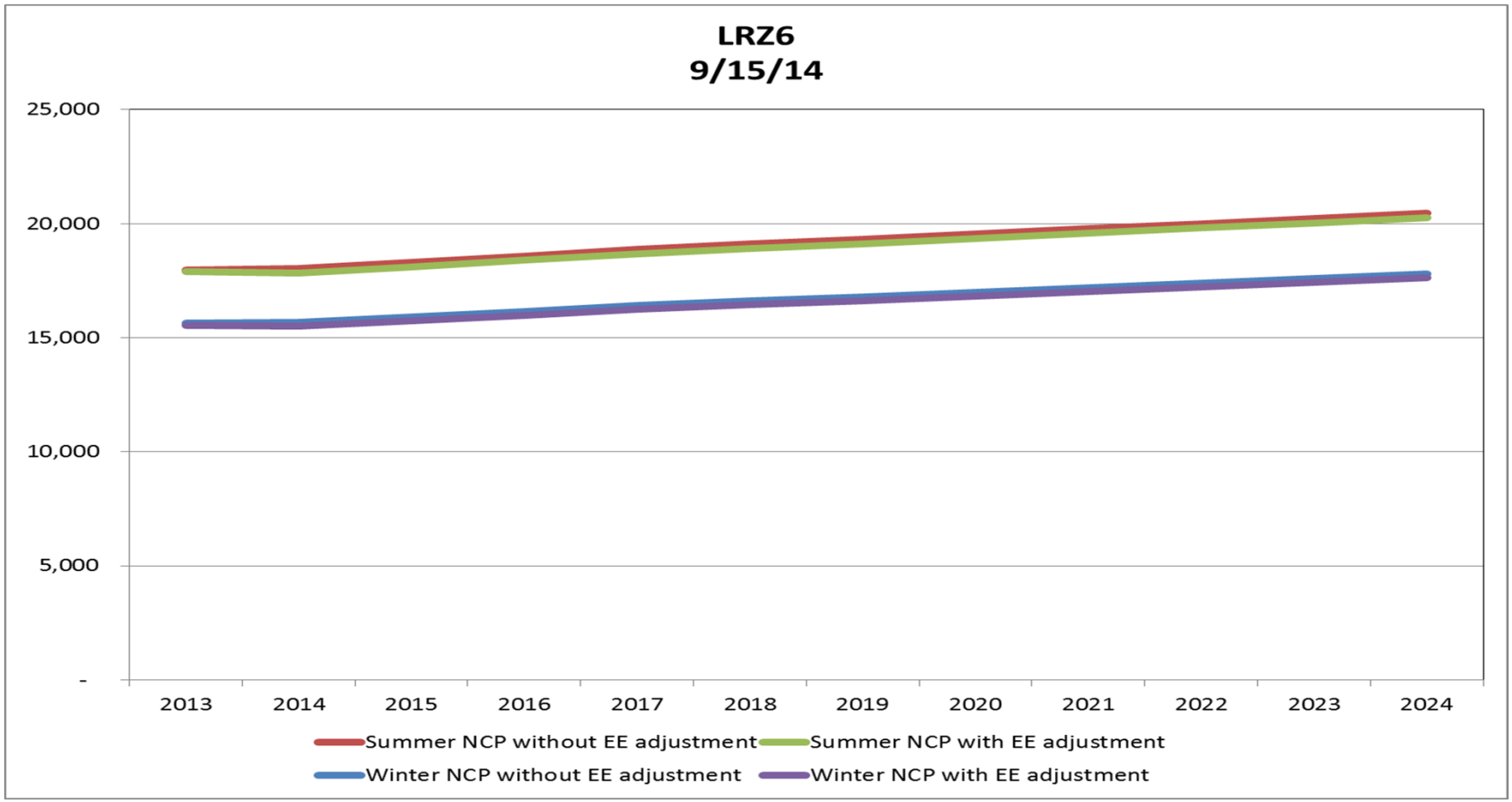
LRZ 4 Non-coincident Peak (MW)



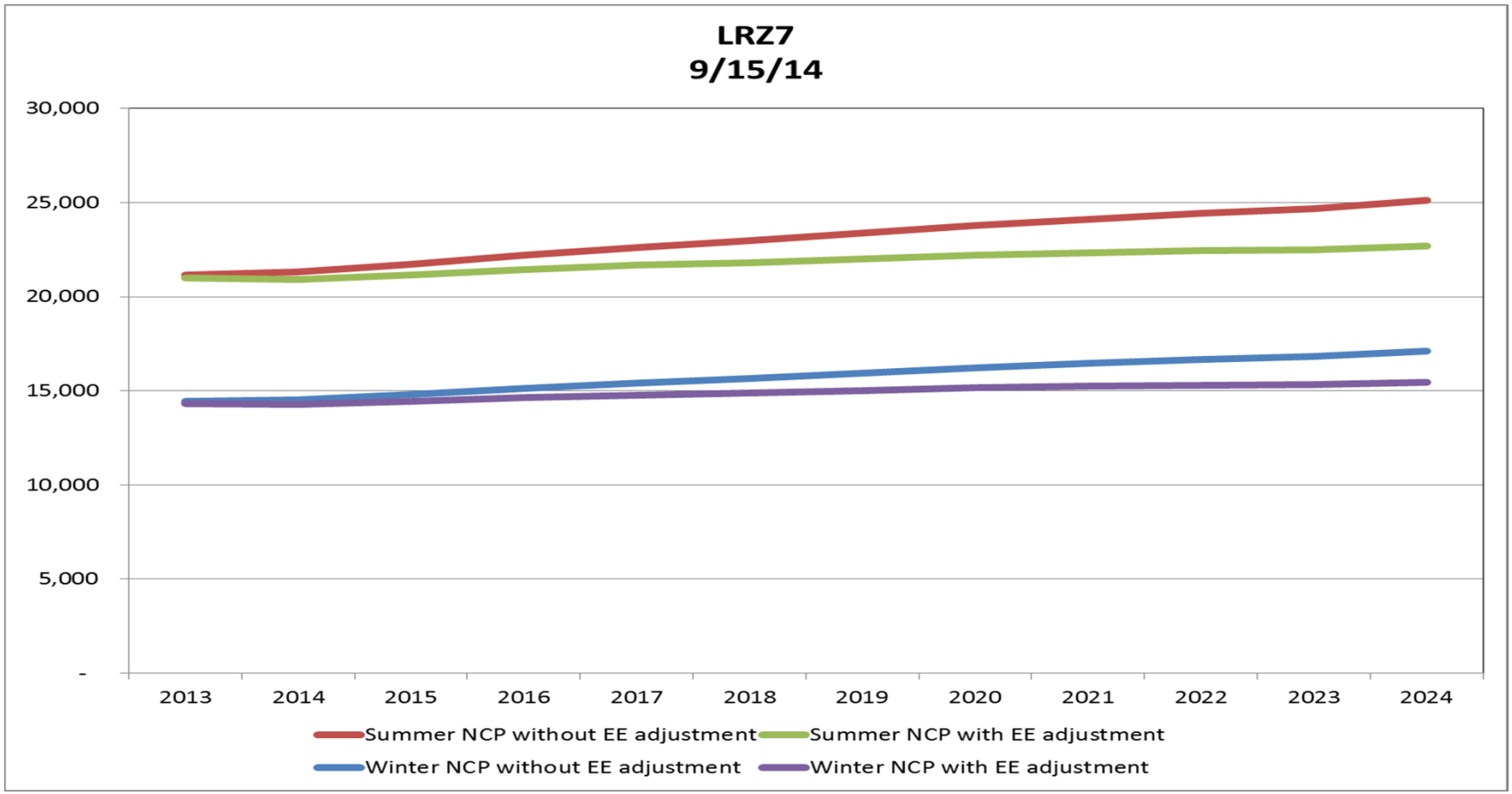
LRZ 5 Non-coincident Peak (MW)



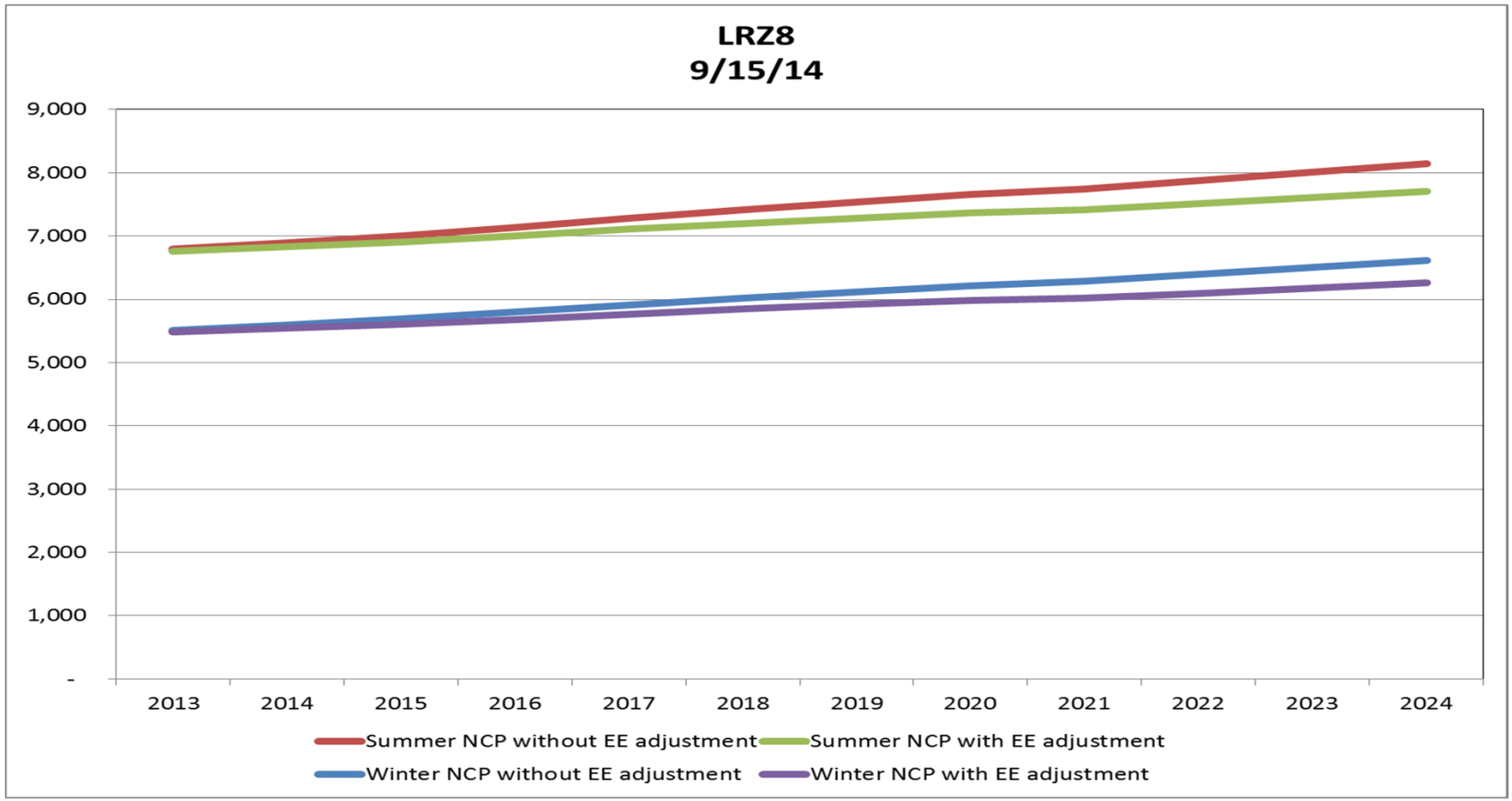
LRZ 6 Non-coincident Peak (MW)



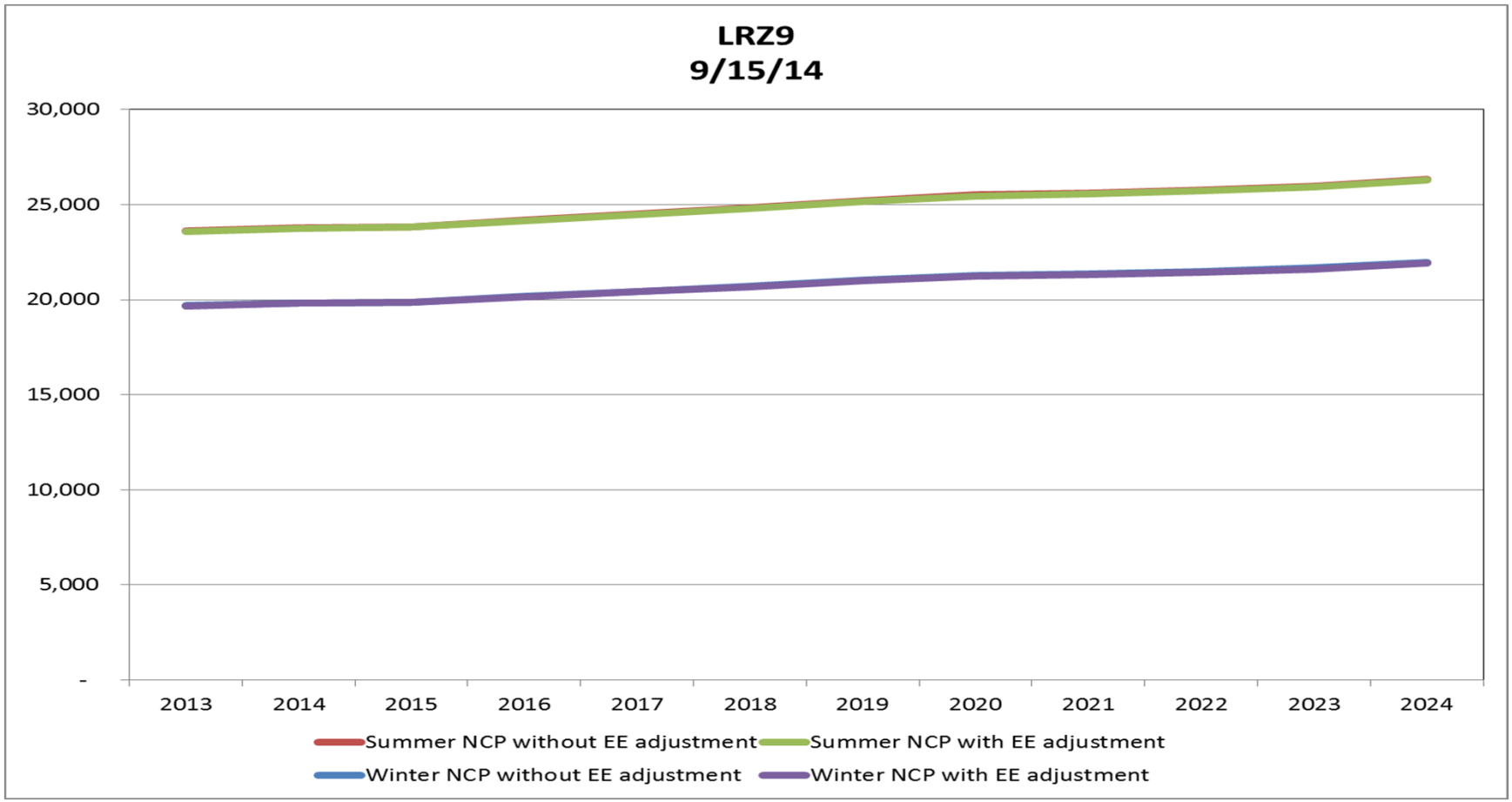
LRZ 7 Non-coincident Peak (MW)



LRZ 8 Non-coincident Peak (MW)



LRZ 9 Non-coincident Peak (MW)



MISO Level Forecasts

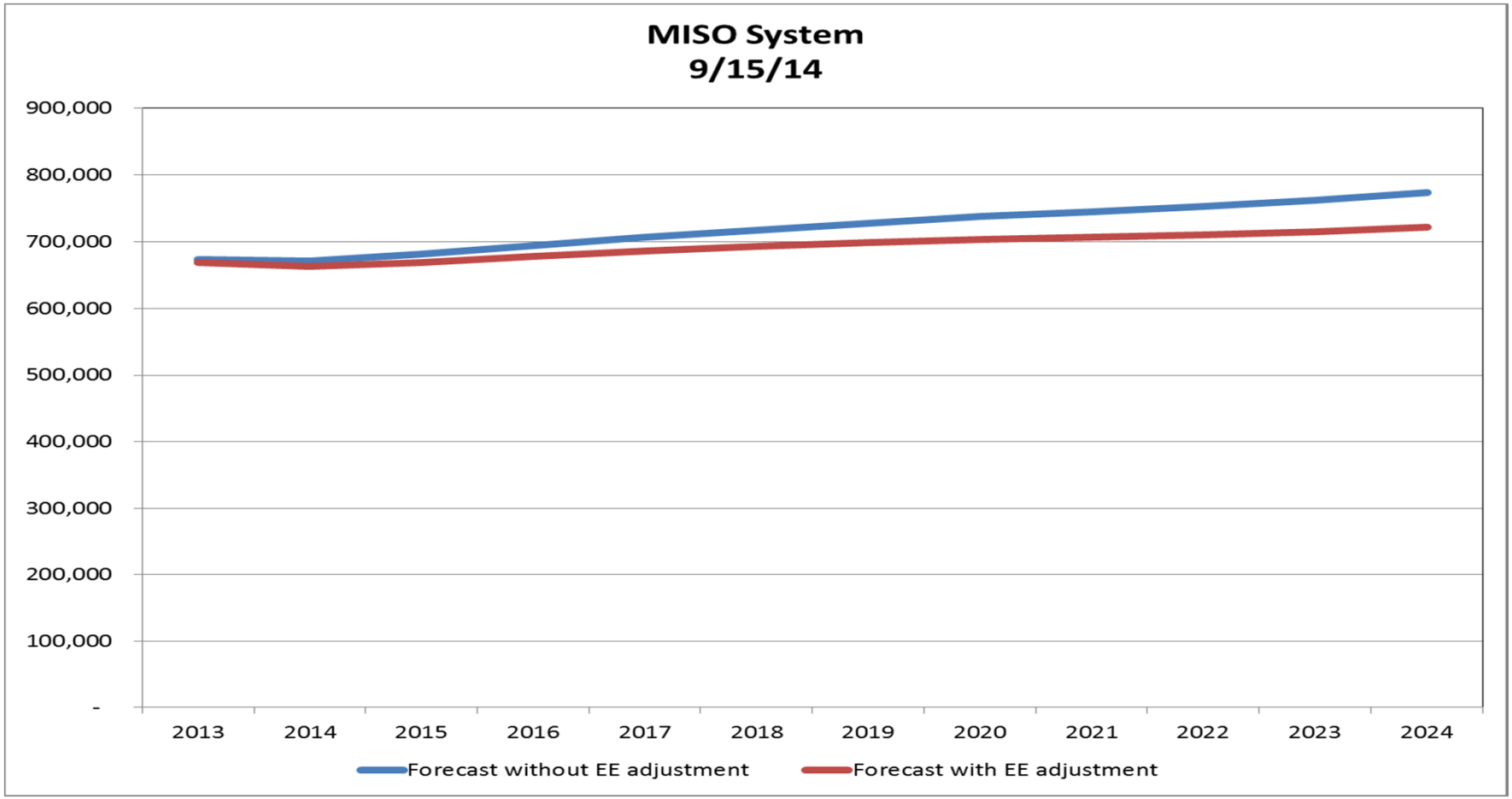
Energy and Peak Demand

- The MISO system energy and peak demand projections here are at the metered load (substation) level
- Energy is the arithmetic sum of the LRZ energy forecasts
- Peak demand is determined using coincidence factors

MISO Energy (Metered Load in GWh)

Year	MISO energy without EE adjustment	MISO energy with EE adjustment
2013	672,947	669,056
2014	671,478	663,303
2015	681,362	669,262
2016	694,326	678,095
2017	706,724	686,252
2018	717,440	692,615
2019	727,990	698,720
2020	737,819	704,009
2021	745,039	706,685
2022	753,600	710,710
2023	762,615	715,195
2024	773,382	721,439
Compound Annual Growth Rates (%)		
2013-2018	1.29	0.69
2013-2024	1.27	0.69
2015-2024	1.42	0.84

MISO Energy (Metered Load in GWh)



Coincidence Factors

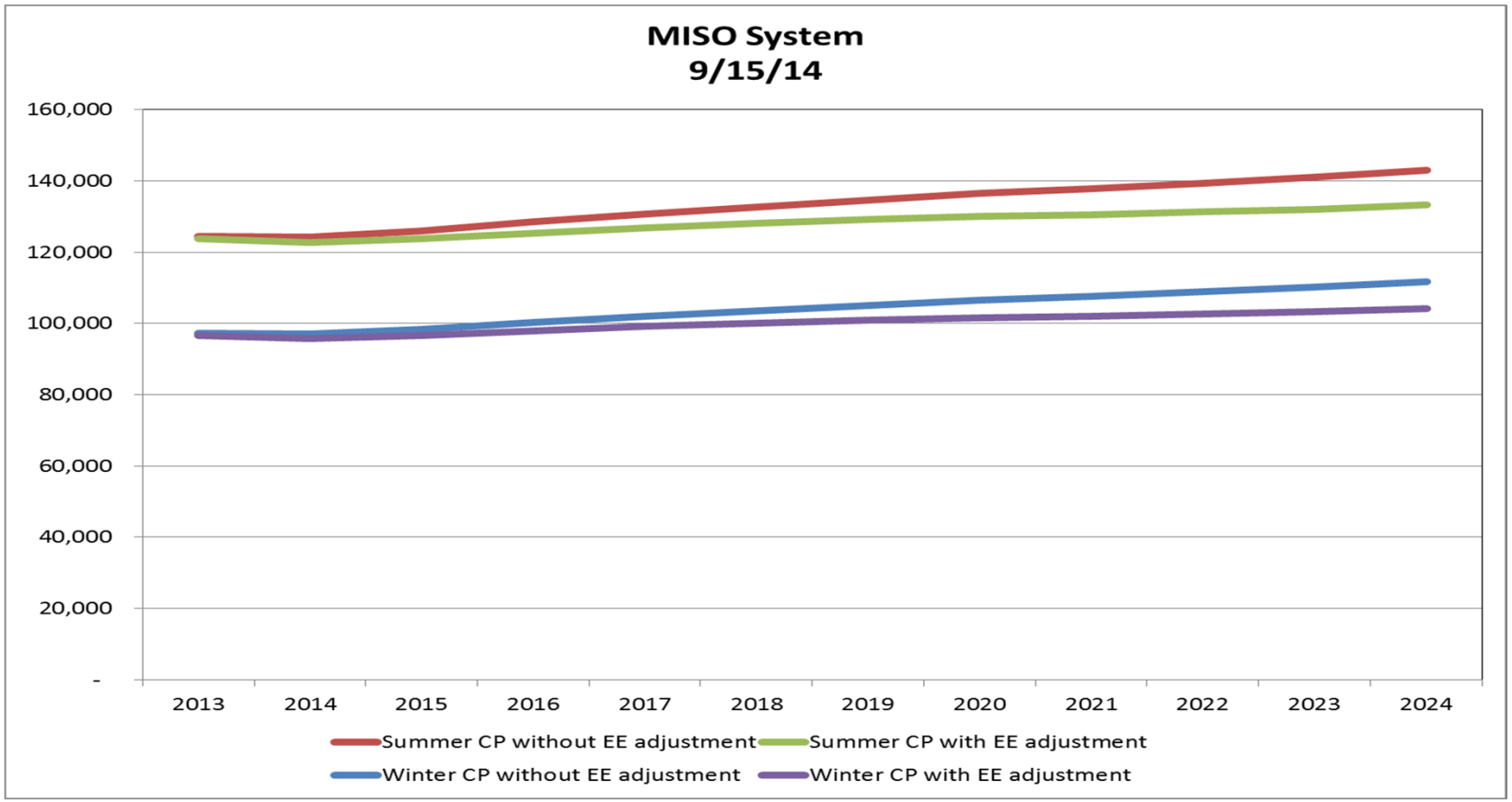
LRZ	Summer	Winter
1	0.972	0.983
2	0.983	0.977
3	0.982	0.989
4	0.980	1.000
5	0.976	0.987
6	0.995	0.986
7	0.965	0.961
8	0.966	0.920
9	0.964	0.905

Summer coincidence factors from MISO
Winter coincidence factors calculated from historical data

MISO Coincident Peak Demand (Metered Load in MW)

Year	MISO Summer CP without EE adjustment	MISO Summer CP with EE adjustment	MISO Winter CP without EE adjustment	MISO Winter CP with EE adjustment
2013	124,498	123,770	97,258	96,697
2014	124,258	122,729	97,041	95,859
2015	126,098	123,825	98,468	96,719
2016	128,499	125,443	100,333	97,985
2017	130,791	126,930	102,116	99,153
2018	132,769	128,082	103,657	100,062
2019	134,723	129,191	105,169	100,927
2020	136,545	130,151	106,579	101,676
2021	137,884	130,625	107,617	102,052
2022	139,467	131,346	108,847	102,622
2023	141,126	132,145	110,143	103,260
2024	143,118	133,277	111,684	104,143
Compound Annual Growth Rates (%)				
2013-2018	1.29	0.69	1.28	0.69
2013-2024	1.28	0.68	1.27	0.68
2015-2024	1.42	0.82	1.41	0.83

MISO Coincident Peak Demand (Metered Load in MW)



Comments

- Stakeholder comments are welcome
- Please provide comments by October 17th to allow for incorporation in the final report, which is due November 1st