



Load Forecast Analysis

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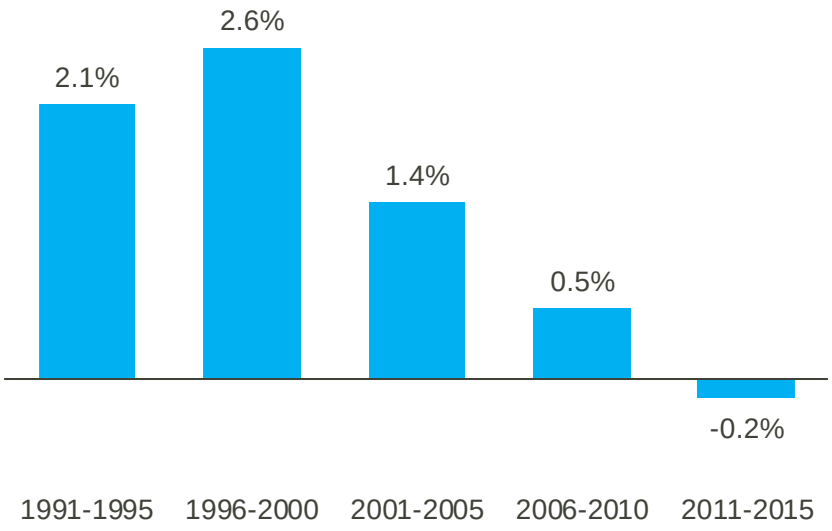
Discussion

Once again, the U.S. Energy Information Administration (EIA) is reporting a decline in retail electricity sales in the United States.[1] Sales fell 1.1 percent in 2015. Five of the past eight years have had year-over-year electricity sales decline in the U.S.[2] Longer-term, the trend is only further reinforced: in every five-year period since 1996 growth rates have declined (see chart).

Declining rates of electricity demand growth reflect a combination of factors, including slower economic growth in a mature U.S. economy, the changing composition of the economy toward service industries, energy efficiency programs and policies, and increased deployment of distributed solar technology. By sector, the data show an overall decline in demand from the industrial sector since 2007 and little to no growth in the residential and commercial sectors.

Lackluster demand, among other factors, has contributed to: declining CO_2 emissions, moderate wholesale electricity prices, and power plant retirements.

U.S. Electricity Consumption Growth Rates



Source: U.S. EIA, Sales to Ultimate Customers

1. U.S. EIA. Today in Energy: Total electricity sales fell in 2015 for 5th time in past 8 years. March 14, 2016.
2. Ibid.

Discussion, continued

Keeping pace with these structural trends has been a challenge for electric industry forecasters. Also, the Great Recession, which officially lasted from December 2007 to June 2009, has also contributed to significant overestimates of projected electricity demand prior to the recession and underestimates of demand as the economy emerged from recession.

System planners, utilities, and other analysts depend on forecasts of annual electricity use and peak demand to make critical resource and policy decisions. The following analysis compares historic and actual electricity demand from a range of sources, including:

- The U.S. Energy Information Administration (Annual Energy Outlook)
- Regional Transmission Organizations (ISO-NE, NYISO, and PJM)
- Utility Integrated Resource Plans (Ameren Missouri, Tampa Electric Company, Duke Florida, Duke Indiana, and AEP Indiana Michigan Power)

Three basic patterns emerge from evaluating the forecasts:

- Demand forecasts are sometimes more than 10 percentage points higher than actual demand, particularly when made 3-5 years in advance of the forecast year.
- The forecasts typically improve within 1-2 years of the forecast year. Although, it is the longer-term forecasts that are generally used for regional transmission planning and resource procurement decisions. Generation and transmission investments have largely already been made 1-2 years prior to the forecast year.
- Demand forecasts over the past decade have been significantly downward revised.

Discussion, continued

Updating modeling assumptions can improve forecast accuracy and therefore result in significant differences in trends when comparing across report years. For example:

- In the 2016 Load Forecast, PJM implemented changes to its forecasting methodology in an effort to represent increased energy efficiency and behind the meter generation, which had not been captured in past reports. The treatment of weather has been restructured to provide more variable load response to weather across a wide range of conditions. Three variables (cooling, heating, and other) were added to account for trends in equipment/appliance saturation and efficiency, and a separately-derived solar forecast is used to adjust load forecasts.
- Similarly, NYISO has reduced its energy growth forecasts in recent years, which is attributed to the impact of existing energy efficiency programs and increased distributed generation due to future initiatives coming into effect.
- Recent IRPs have also reduced energy growth forecasts due to new energy efficiency programs that have been incorporated into the models and slower than expected economic growth after the recession.

Key Takeaways

The U.S. Energy Information Administration (EIA Annual Energy Outlook)

- EIA forecasts seem to be improving over time. The forecast five years prior to 2009 actual data overestimated consumption by 9% whereas the forecast 5 years prior to 2014 actual data overestimated consumption by just 2%.

Regional Transmission Organizations (ISO-NE, NYISO, and PJM)

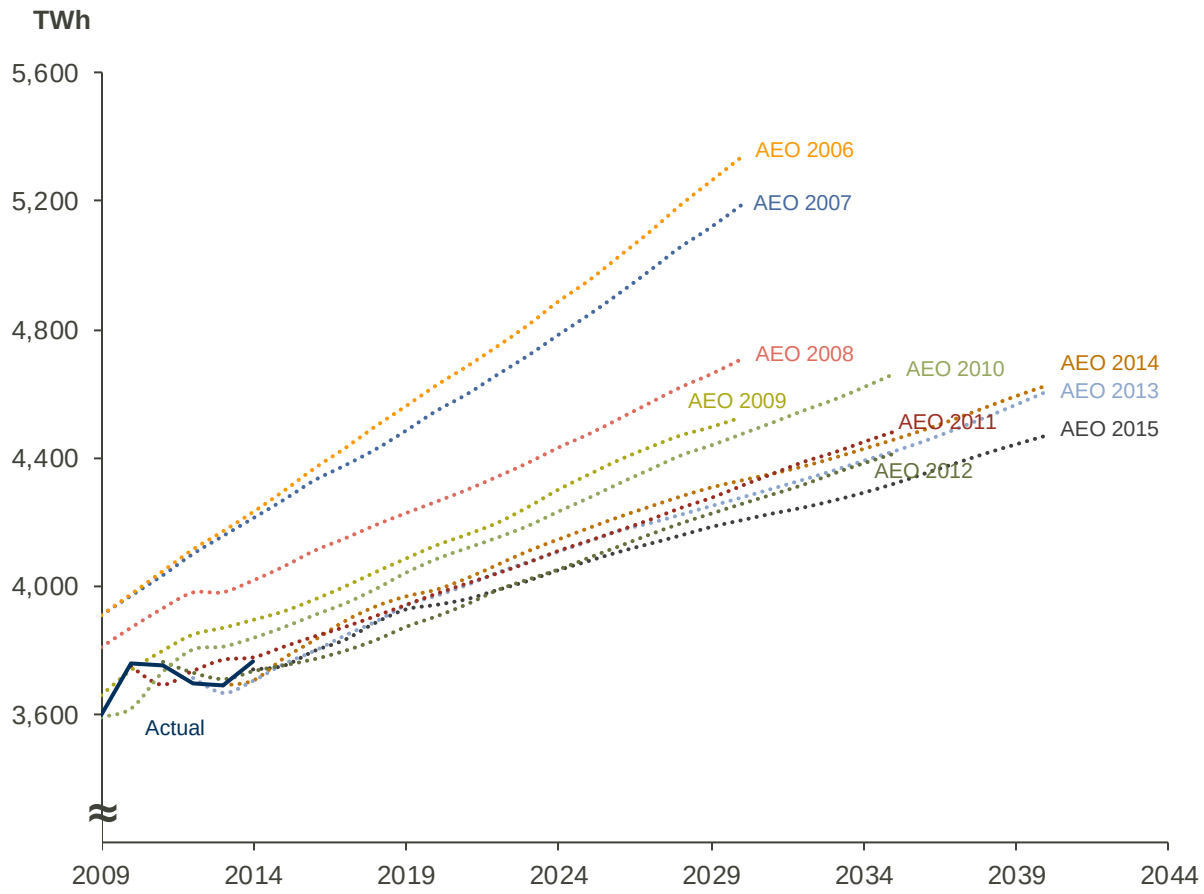
- Broadly speaking, transmission organizations have reduced their consumption and peak demand forecasts, compared to forecasts made prior to 2008. In the next ten to 15 years, RTOs and ISOs are expecting to see lower demand each year than originally anticipated.
- Not only is annual projected energy demand lower, but the rate at which it increases into the future has declined in recent forecasts, as well.

Utility Integrated Resource Plans (Ameren Missouri, Tampa Electric Company, Duke Florida, Duke Indiana, and AEP Indiana Michigan Power)

- Utility demand forecasts vary by source but have generally decreased overall in more recent reports, with reductions in annual growth rates compared to older reports, as well.

U.S. EIA: Annual Energy Outlook

U.S. EIA (nationwide)
Actual vs. Long Term Energy Forecast

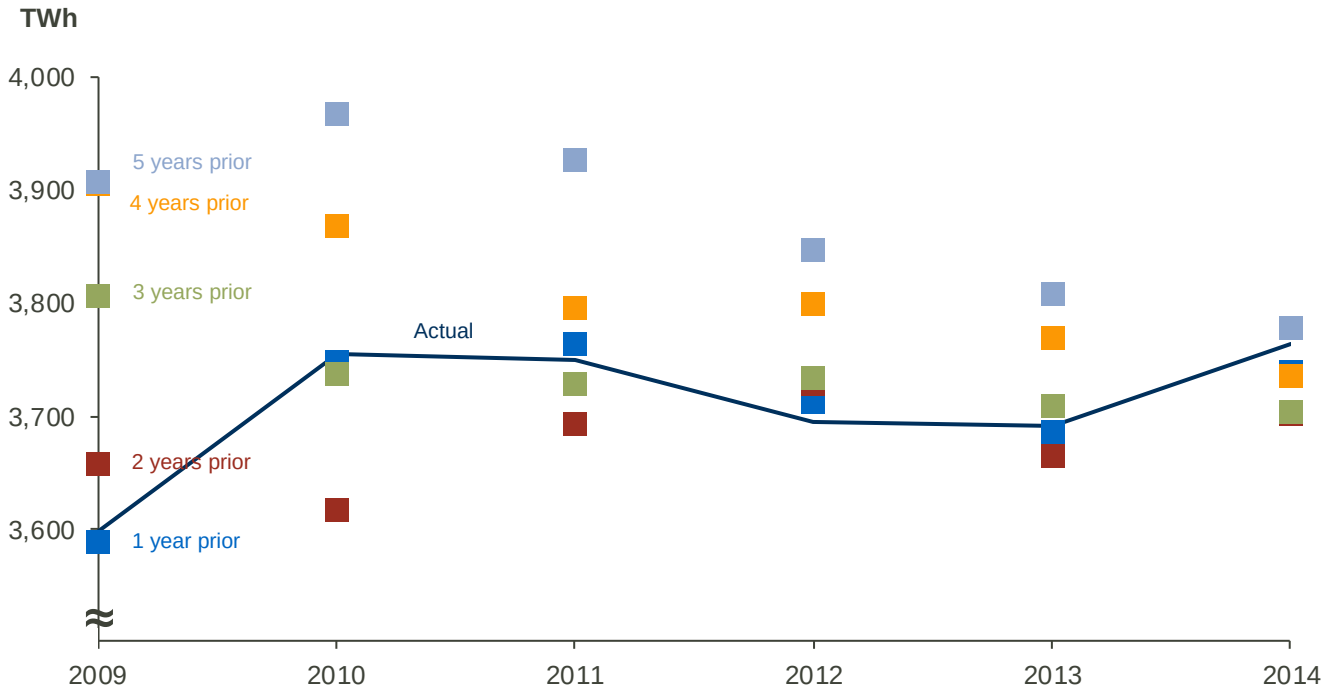


The Annual Energy Outlook, prepared by the U.S. Energy Information Administration (EIA), presents long-term annual projections of energy supply, demand, and prices out several decades.

AEO demand forecasts have decreased significantly over time. For example, projected demand for 2030 was reduced by 21% in AEO 2015 when compared to AEO 2006.

Prior to the recession, demand forecasts were significantly higher than actual consumption.

U.S. EIA (nationwide)
Actual vs. Long Term Energy Forecast



Note: 1 year prior is the first year forecasted in the Annual Energy Outlook.

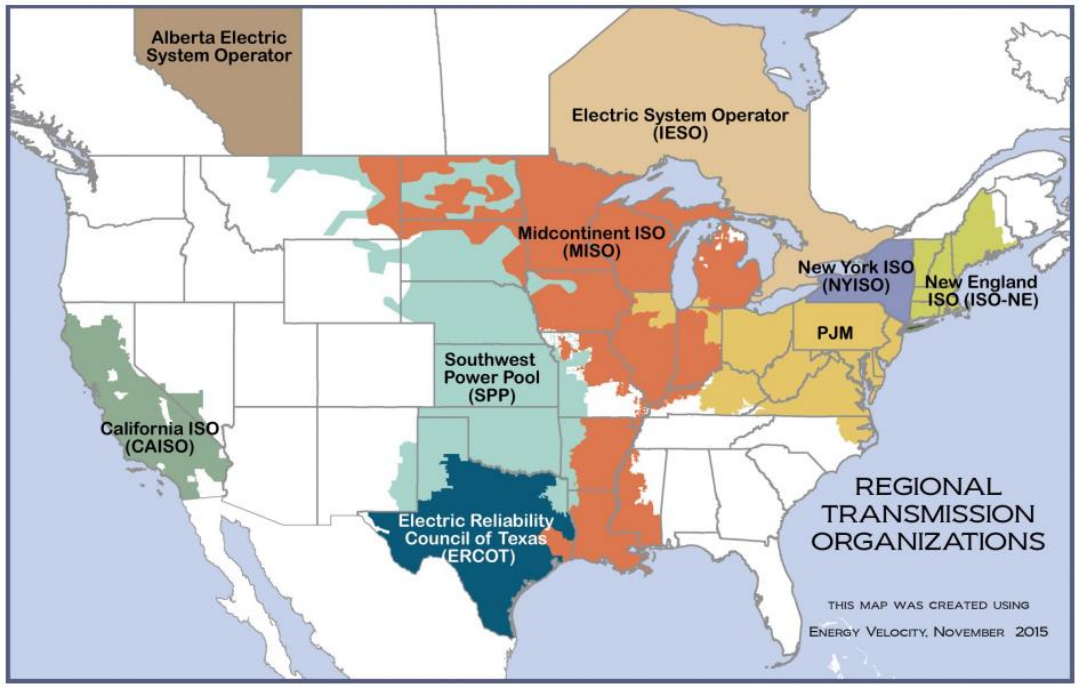
	2009	2010	2011	2012	2013	2014
1 year prior	99.8%	96.3%	98.5%	100.9%	99.3%	98.3%
2 years prior	101.7%	99.5%	99.4%	101.1%	100.5%	98.4%
3 years prior	105.8%	103.0%	101.3%	102.8%	102.1%	99.2%
4 years prior	108.6%	105.7%	104.7%	104.1%	103.2%	100.3%
5 years prior	108.6%	105.8%	107.5%	107.7%	104.8%	101.9%

EIA forecasts steadily improve as they approach the actual year of consumption.

Forecasts five years prior over-estimate consumption by 2% to 9%, and three years prior over-estimate consumption by 1% to 6%.

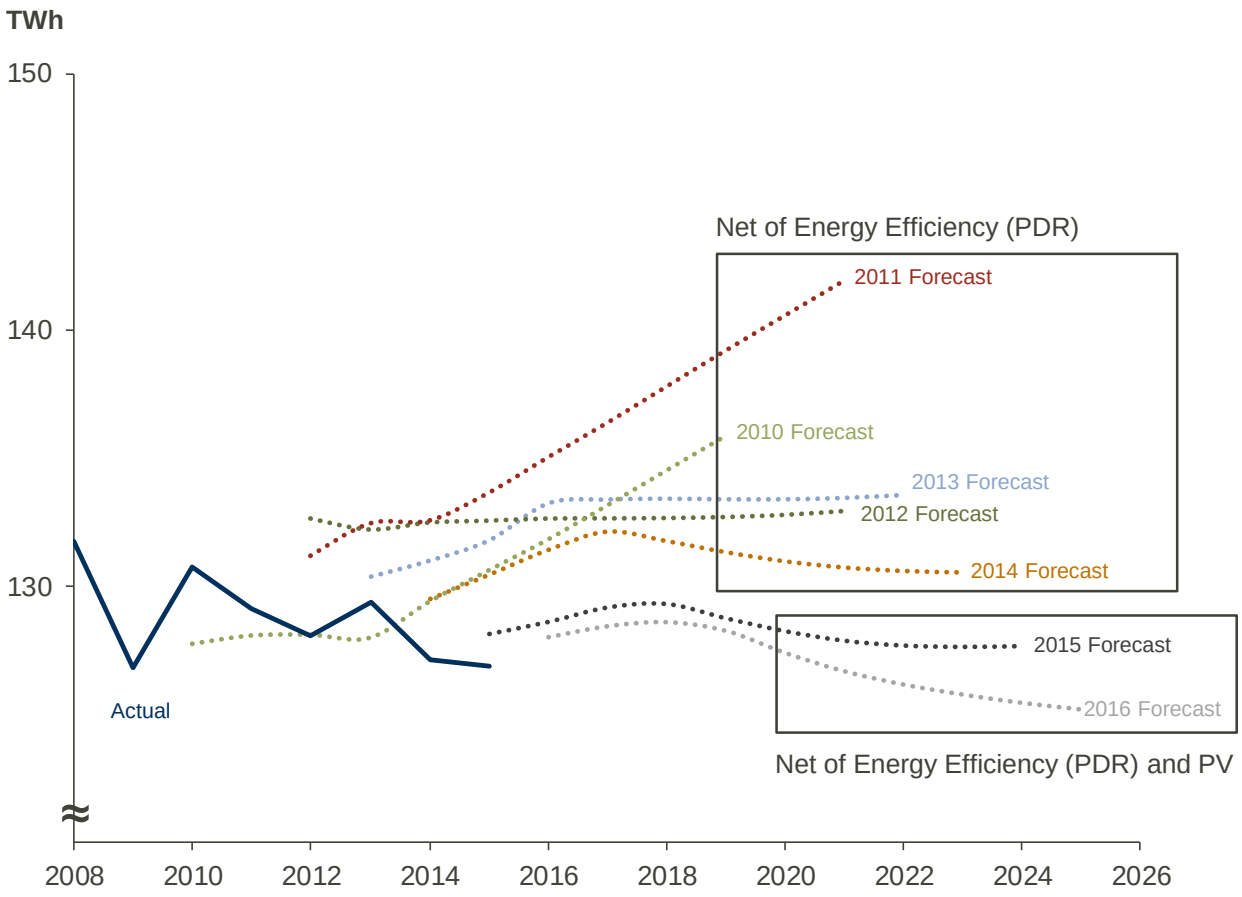
The AEO is typically used for federal policymaking, where long-term forecasts (10-20 years) are critical.

Regional Transmission Organizations



Source: Federal Energy Regulatory Commission

ISO-NE
Actual vs. Long Term Energy Forecast



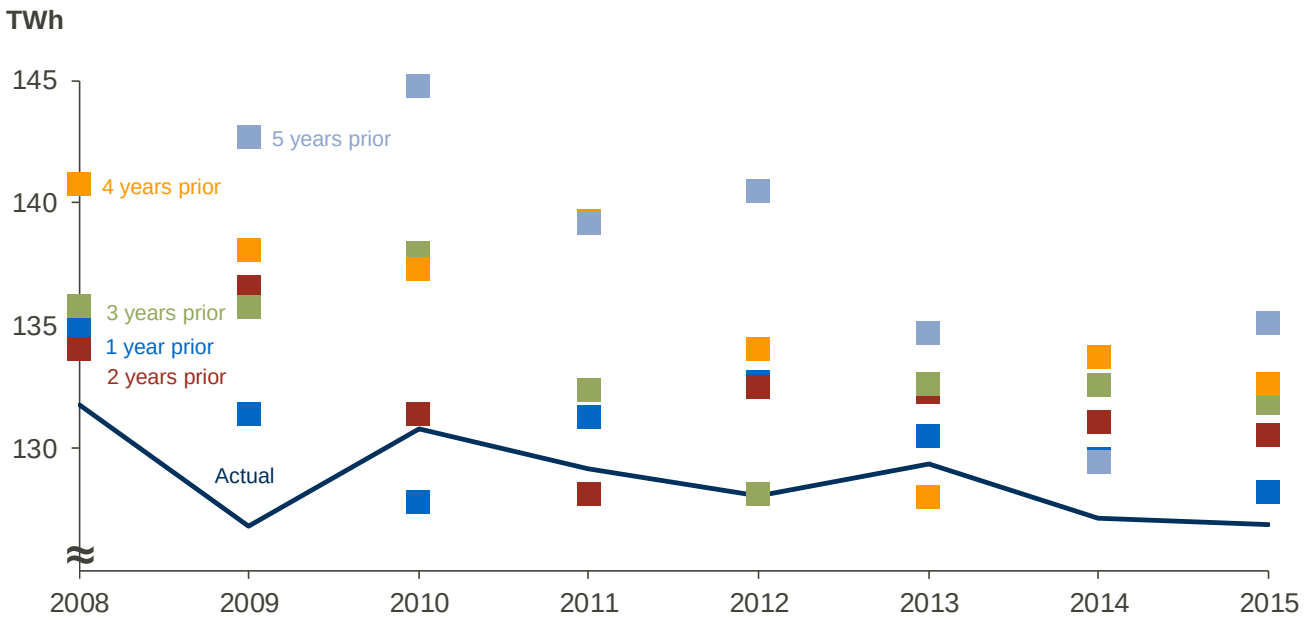
Each year, ISO New England publishes a Forecast Report of Capacity, Energy, Loads, and Transmission (CELT). These CELT reports include 10-year projections used for reliability studies and service territory planning.

The energy forecasts integrate state historical demand, weather and economic data, and utility-driven programs on conservation and peak-load management.

ISO-NE has revised downward its long-term forecasts of demand, and has begun to include projections for behind-the-meter solar PV beginning in 2015.

Note: These forecasts are all the "Base" Forecast (Net) of each report. ISO-NE also provides "High" and "Low" forecasts. Net Forecasts 2010-2014 include adjustment for passive demand response (PDR) while Forecasts for 2015 and 2016 are net of both PDR and behind-the-meter solar PV.

ISO-NE
Actual vs. Long Term Energy Forecast



ISO-NE has maintained fairly consistent forecasting over the years, occasionally slightly under-predicting energy needs 1 year prior.

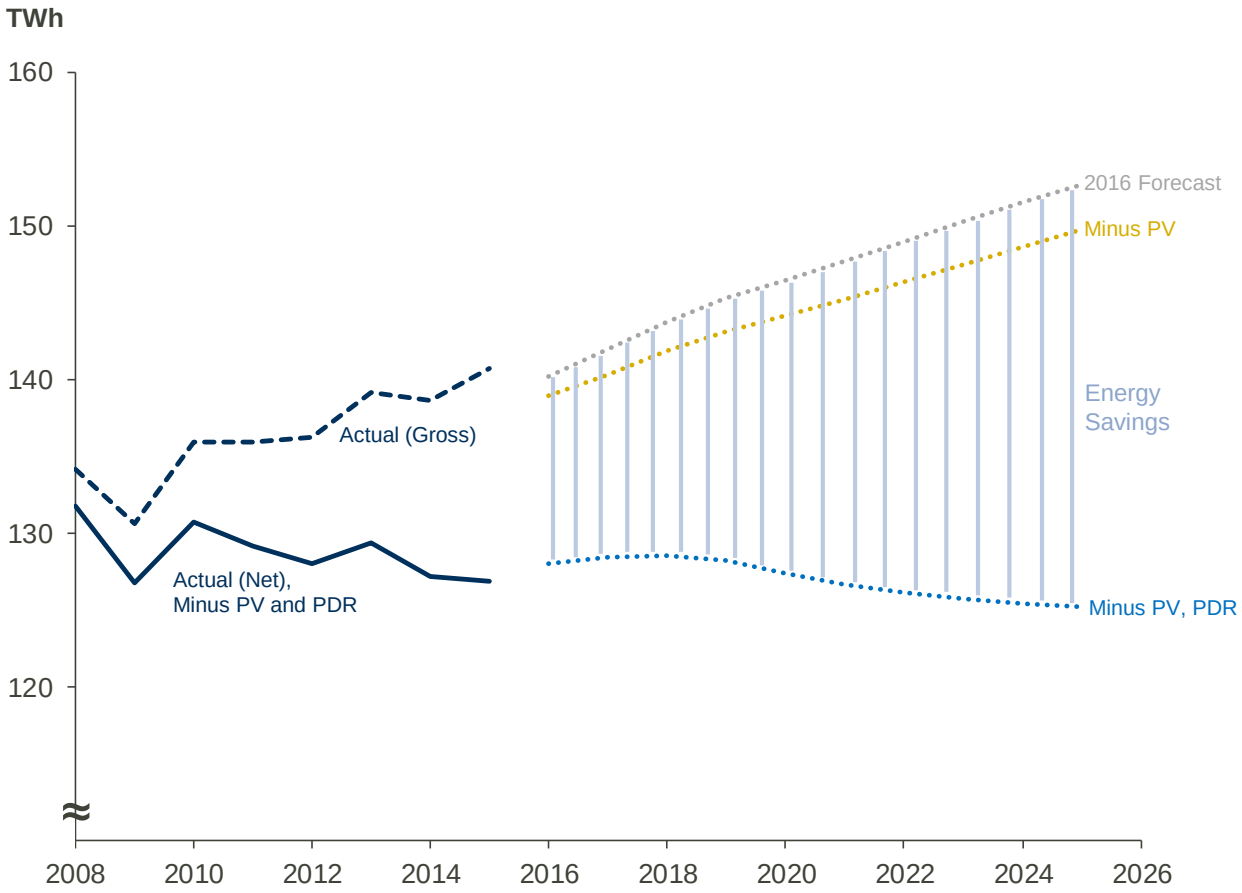
Shown here are consumption forecasts. RTOs also forecast peak demand, which is used to aid generation and transmission planning in time frames of 3-5 years prior, but sometimes as advanced as 10 years earlier.

ISO-NE has tended to overestimate peak demand (see next slide).

	2008	2009	2010	2011	2012	2013	2014	2015
1 year prior	102.5%	103.5%	97.7%	101.6%	103.6%	100.8%	101.9%	101.0%
2 years prior	101.7%	107.6%	100.4%	99.2%	103.4%	102.2%	103.0%	102.8%
3 years prior	103.1%	107.0%	105.4%	102.5%	100.0%	102.5%	104.2%	103.9%
4 years prior	106.8%	108.8%	104.9%	107.8%	104.6%	98.9%	105.1%	104.5%
5 years prior		112.5%	107.3%	107.7%	109.6%	104.1%	101.7%	106.4%

Note: These forecasts are all the "Base" Forecast (Net) of each report. ISO-NE also provides "High" and "Low" forecasts. Net Forecasts prior to 2010 have not been adjusted for passive demand response (PDR); Forecasts 2010-2014 include adjustment for PDR; Forecasts for 2015 and 2016 are net of both PDR and behind-the-meter solar PV.

ISO-NE
Actual vs. Long Term Energy Forecast

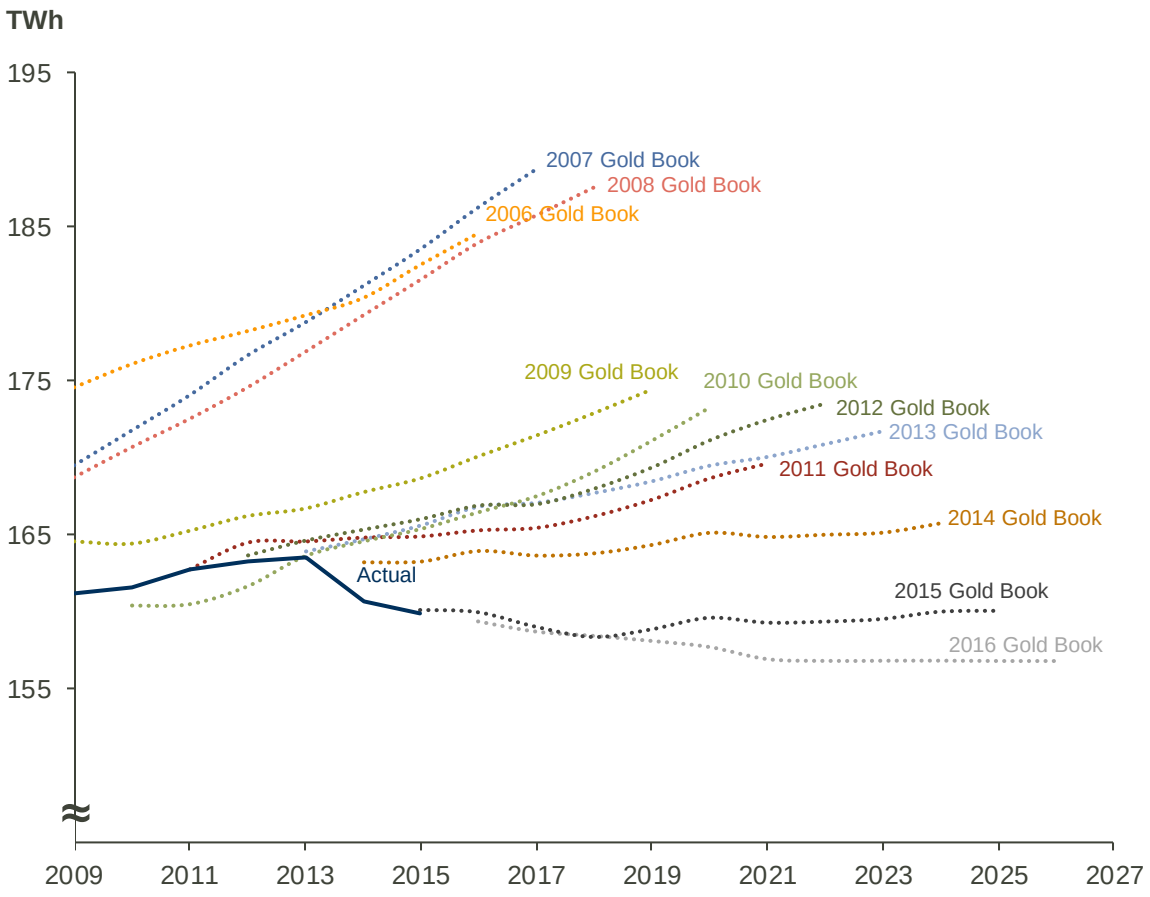


Recent CELT reports (2015, 2016) have begun to report a break out of Net Energy for Load (NEL) after adjustments for behind-the-meter solar PV and passive demand resources (PDR).

The 2016 CELT reported that historic NEL has flattened in the last couple of years, after accounting for these effects. The forecast expects this flattened trend to continue until 2019, when the energy forecast begins to decline.

Note: This forecast is the "Base" Forecast of the 2016 CELT report. ISO-NE also provides "High" and "Low" forecasts. Passive demand resources are principally designed to save electricity use at all times. Examples include energy-efficiency measures, such as the use of energy-efficient appliances and lighting, advanced cooling and heating technologies, electronic devices to cycle air conditioners on and off, and equipment to shift electricity use to off-peak hours. By contrast, active demand resources are called on only when needed.

NYISO
Actual vs. Long Term Energy Forecast



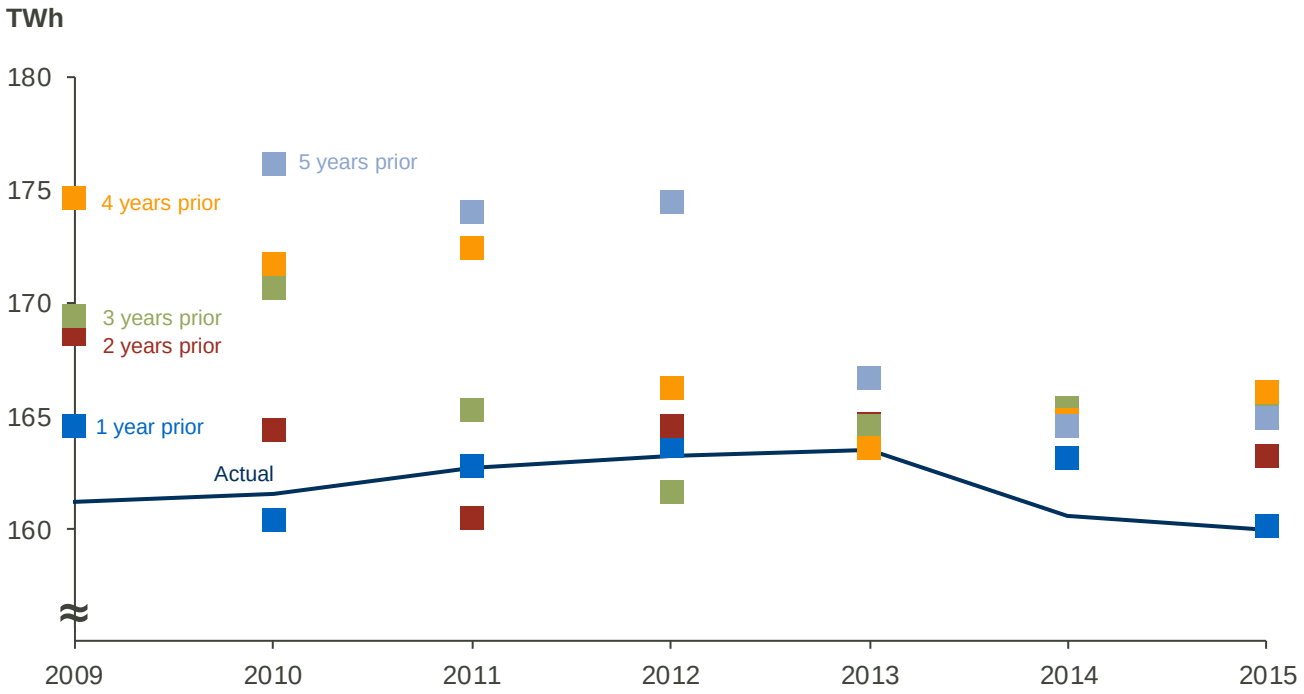
The Gold Book is the New York Independent System Operator's load and capacity data forecast report. It provides historic and forecast peak demand, energy usage, and energy efficiency impacts, among other generating and transmission topics.

After 2008, NYISO consumption projections have decreased significantly. For example, the consumption forecast for 2016 dropped 13% from the 2008 Gold Book to the 2016 Gold Book.

The 2015 and 2016 Gold Books project a slight decline and flattening out of electricity consumption through 2025, which NYISO attributes to the projected impact of existing energy efficiency programs and increasing distributed energy resources due to state programs and initiatives coming into effect.

Note: These forecasts are all the "Baseline" Forecast (Net) of each report. NYISO also provides "High" and "Low" forecasts.

NYISO
Actual vs. Long Term Energy Forecast

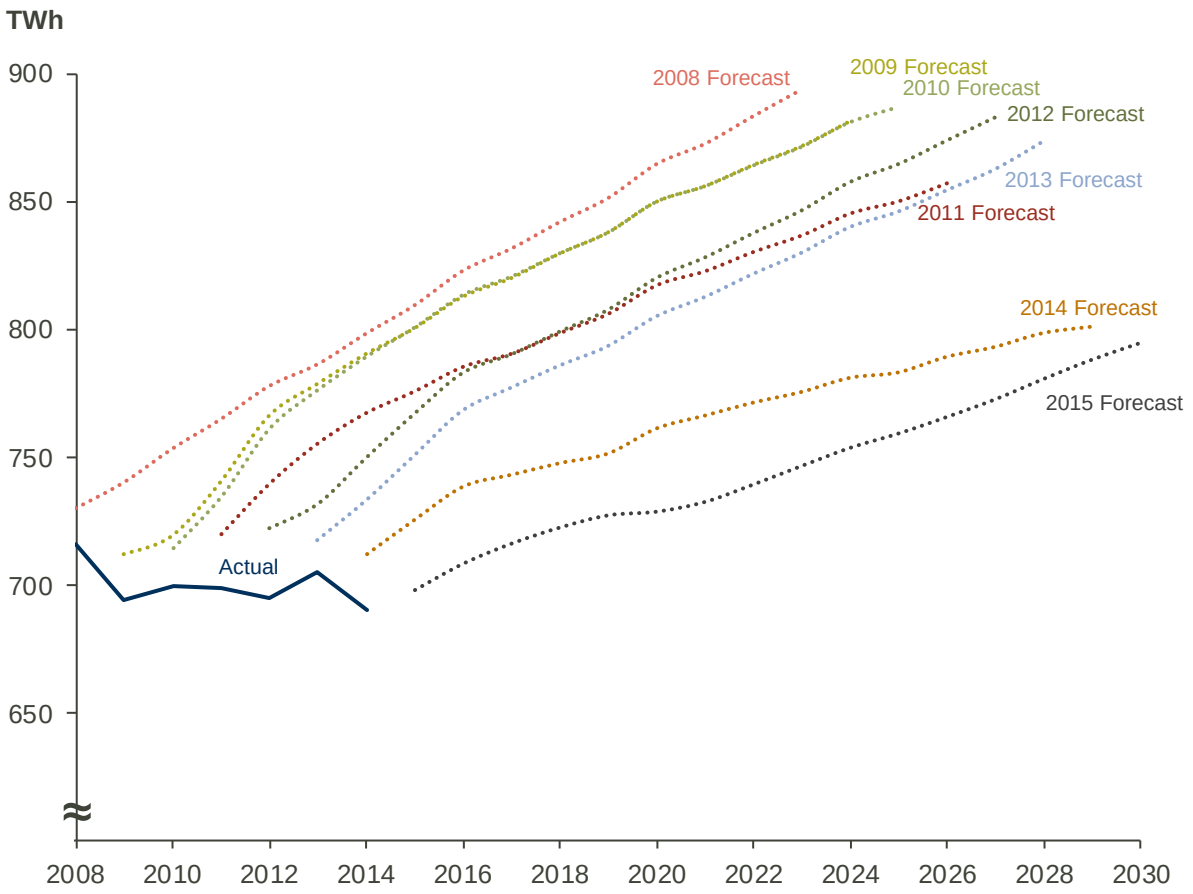


NYISO's forecasts show improvement as the forecast period declines. The forecasts are also more accurate for recent years.

Forecasts five years prior over-estimate consumption by 2% to 9%.

	2009	2010	2011	2012	2013	2014	2015
1 year prior	102.1%	99.2%	100.1%	100.3%	100.2%	101.6%	100.1%
2 years prior	104.6%	101.8%	98.6%	100.8%	100.7%	102.5%	102.1%
3 years prior	105.1%	105.6%	101.6%	99.0%	100.7%	103.0%	103.5%
4 years prior	108.3%	106.3%	106.0%	101.9%	100.0%	102.6%	103.8%
5 years prior		109.0%	107.0%	106.9%	102.0%	102.5%	103.1%

PJM
Actual vs. Long Term Energy Forecast



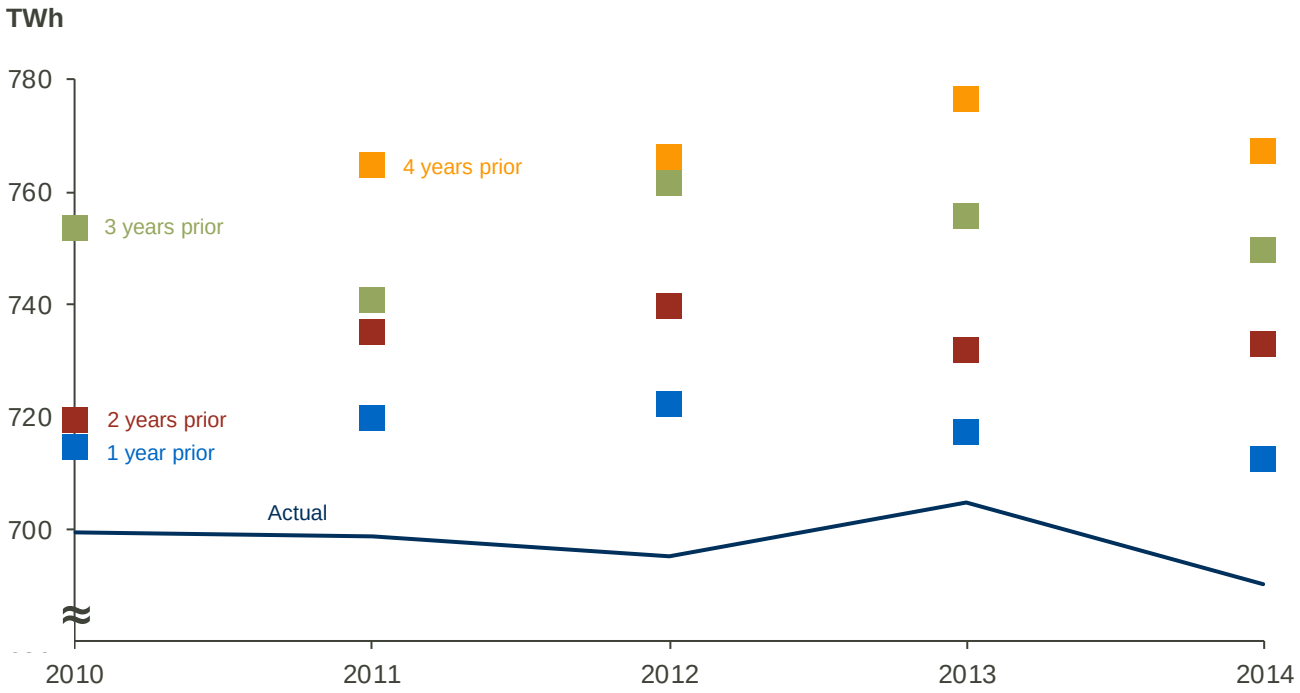
The PJM Load Forecast Report uses demand forecast models that incorporate historic load and weather data, and the economic forecast from Moody's Analytics.

PJM has significantly revised its load forecast model to factor in energy efficiency and behind-the-meter generation. PJM is projecting lower demand growth and peak load. However, industry analysts (CreditSights) believe that PJM is still underestimating growth in rooftop solar.

The two most recent reports have seen a significant reduction in both annual demand and annual growth rates. For example, the consumption forecast for the year 2016 dropped 14% from the 2008 Report to the 2015 Report.

Note: This figure plots Net Energy. American Transmission Systems (ATSI), Duke Energy Ohio and Kentucky, and East Kentucky Power Cooperative joined PJM during the timeframe of this analysis. They were therefore excluded in order to simplify the study while still representing the majority of the service area, which for the purposes of this analysis is defined as regions incorporated into PJM prior to 2011.

PJM
Actual vs. Long Term Energy Forecast



Note: Includes regions incorporated into PJM prior to 2011

	2010	2011	2012	2013	2014
1 year prior	102.2%	103.0%	103.9%	101.8%	103.2%
2 years prior	102.9%	105.2%	106.4%	103.8%	106.2%
3 years prior	107.7%	106.0%	109.5%	107.2%	108.6%
4 years prior		109.5%	110.2%	110.2%	111.2%

PJM's forecasts show clear improvement as the forecast period declines. Forecasts four years prior over-estimate consumption by 9% to 11%.

Forecasts one year prior are within 2% to 4% of actual consumption.

Integrated Resource Plans

Ameren Missouri

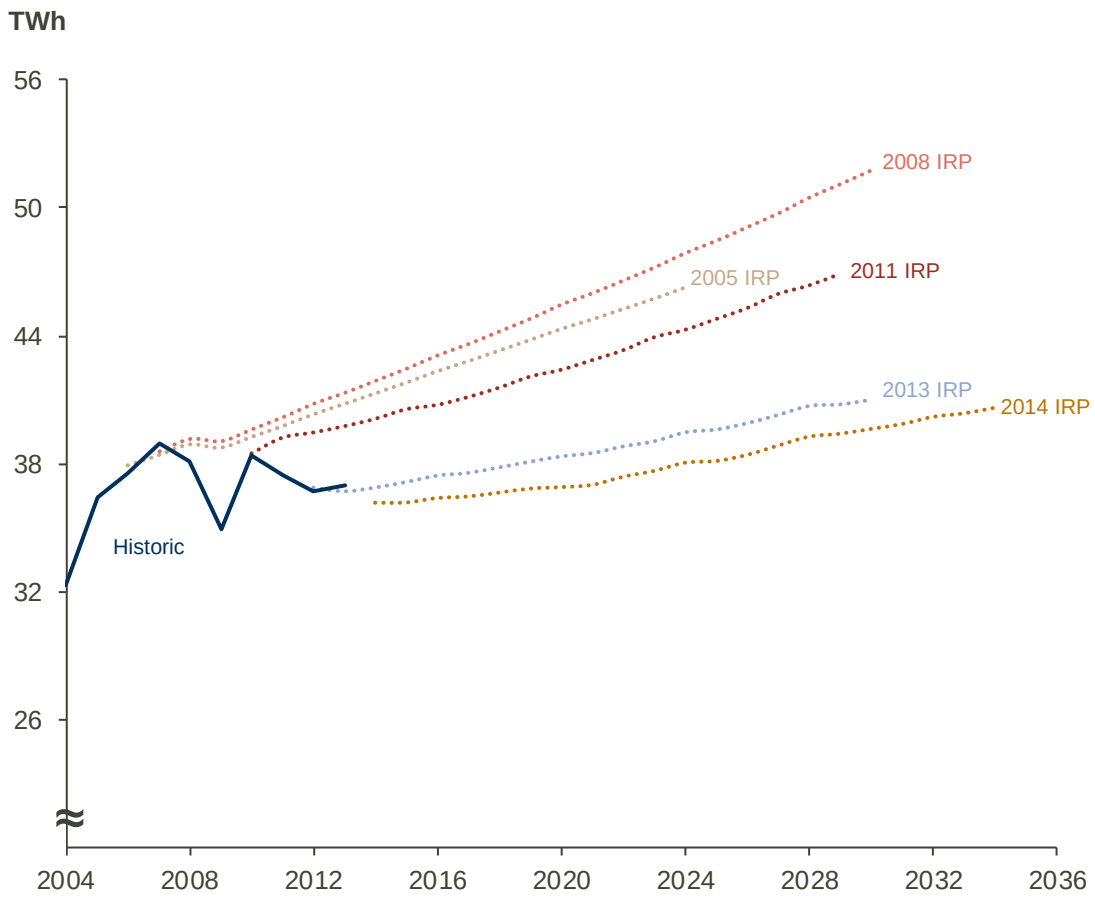
Tampa Electric

Duke Energy Florida

Duke Energy Indiana

AEP Indiana Michigan Power

Ameren Missouri
Actual vs. Long Term Energy Forecast



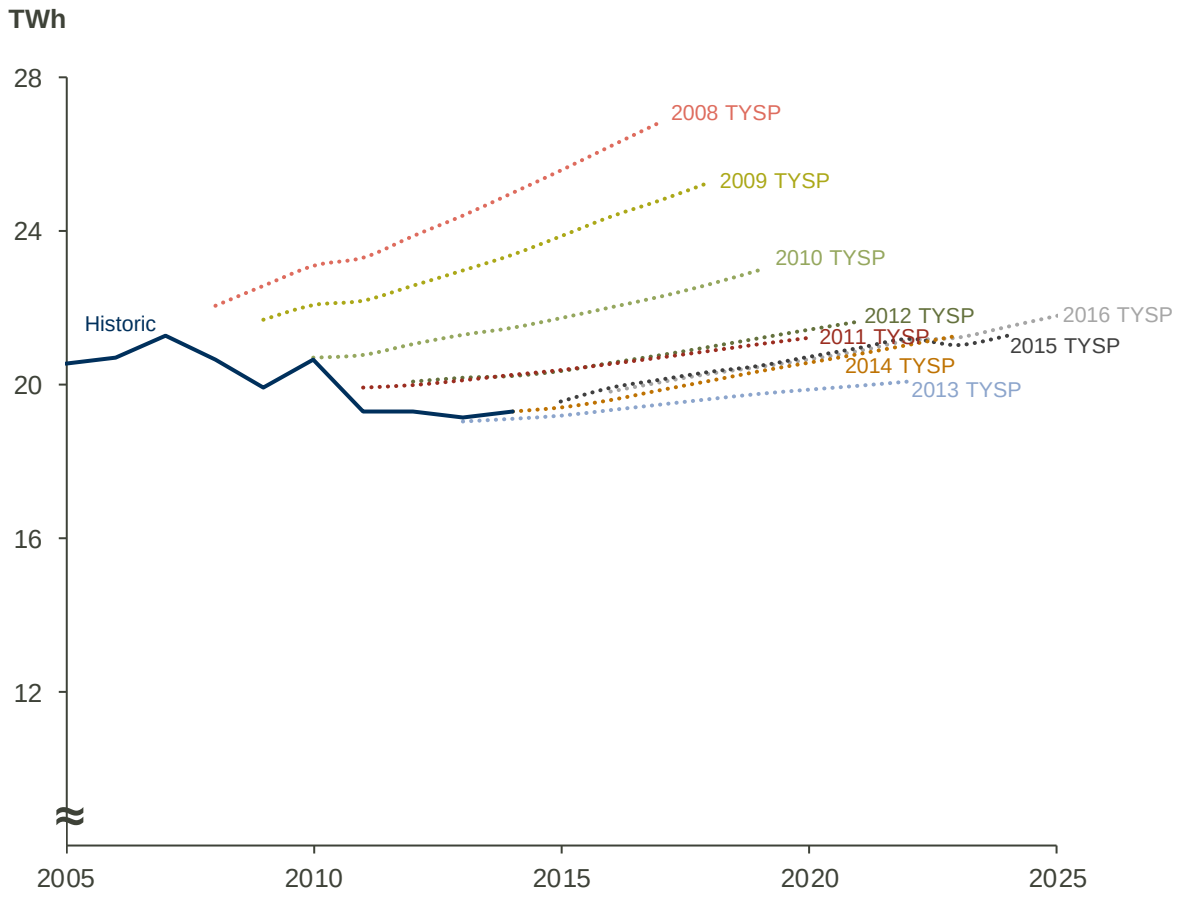
Source: Ameren Missouri 2014 Integrated Resource Plan, Chapter 3, Appendix A: Previous IRP Energy Forecasts and Actual Historical Energy Usage

As part of its Integrated Resource Plan, Ameren Missouri includes an analysis of its historic energy sales and past IRP energy forecasts. This type of comparison is recommended as a best practice in preparing an IRP.

Compared to its prior IRP (2011), Ameren Missouri explains in its 2014 IRP that the energy forecast has been lowered due to slower than expected economic growth in the aftermath of the recession and significant new energy efficiency programs that were still under review at the time that the 2011 IRP was being prepared.

For 2025, Ameren reduced its projected energy consumption forecast from the 2008 IRP to the 2014 IRP by 10.3 TWh. This is equivalent to the output of a 1,500 MW power plant operating at an 80% capacity factor.

Tampa Electric Company
Actual vs. Long Term Energy Forecast



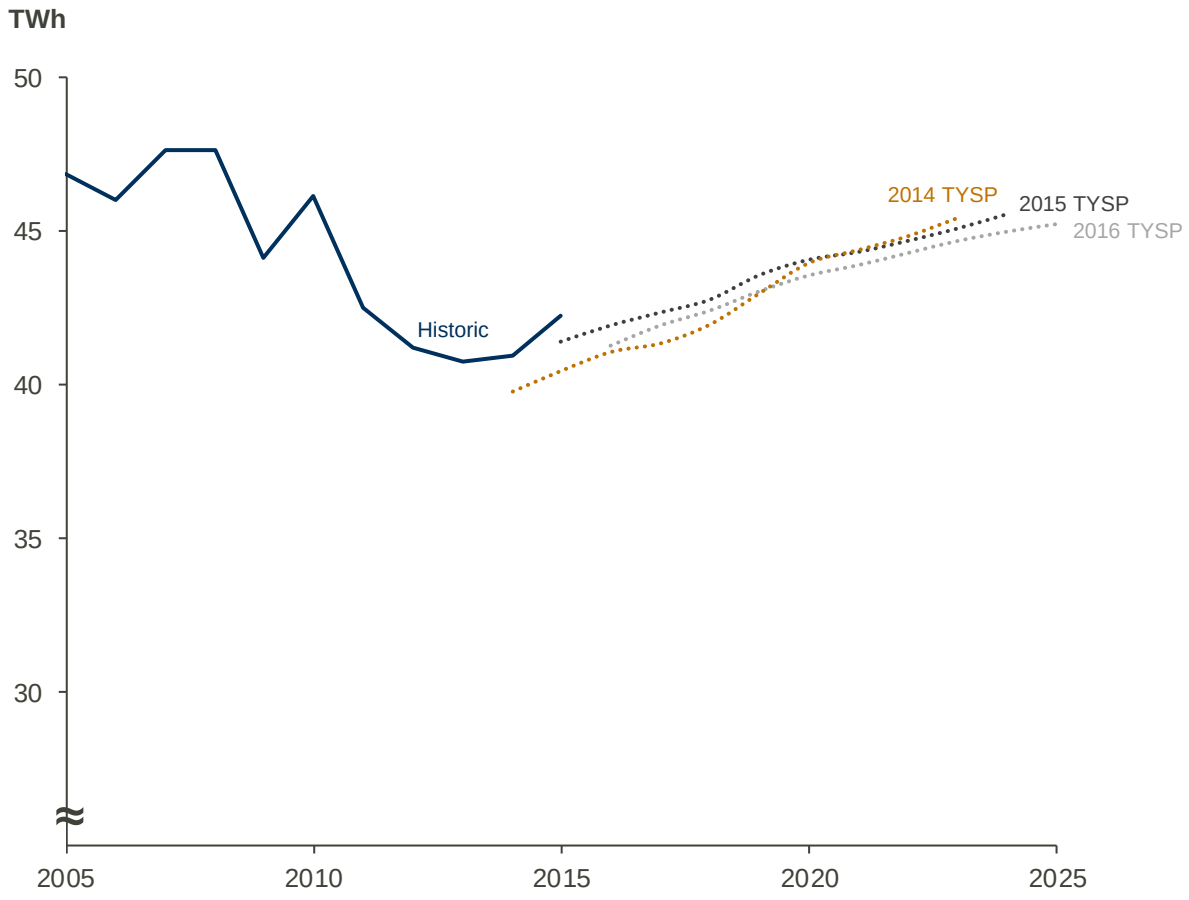
Source: Tampa Electric Company Ten Year Site Plans, Base Case Net Energy for Load

Each year, Florida utilities submit a Ten-Year Site Plan (TYSP) to the Public Service Commission estimating electric generation needs and proposed steps that would be taken in order to maintain reliability under growing consumption forecasts.

TECO's IRP process evaluates demand-side and supply-side resources to meet future energy requirements in a cost-effective and reliable way.

In the six most recent TYSPs, TECO has reduced its projected growth rate and is currently projecting a 1.1% growth rate through 2025.

Duke Florida
Actual vs. Long Term Energy Forecast



Source: Duke Energy Florida Ten Year Site Plans, Base Case Net Energy for Load

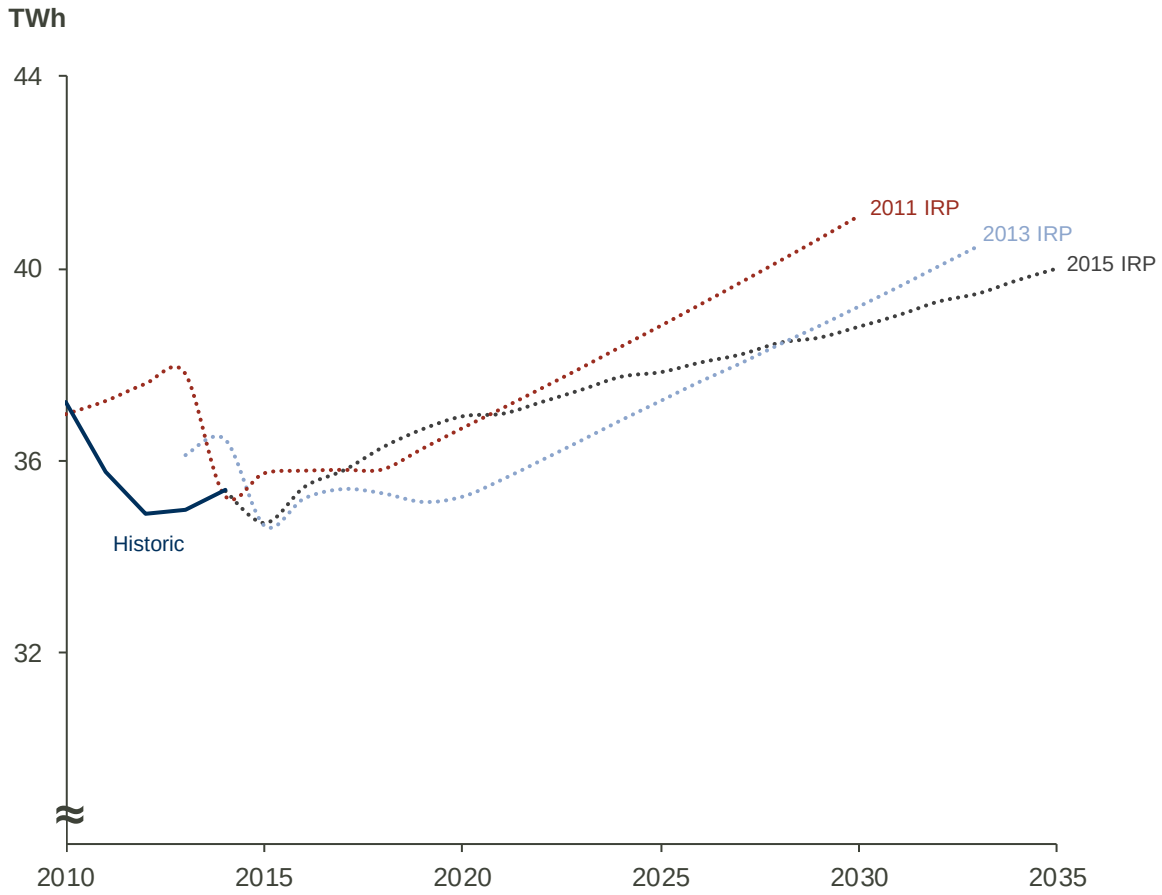
Each year, Florida utilities submit a Ten-Year Site Plan (TYSP) to the Public Service Commission estimating electric generation needs and proposed steps that would be taken in order to maintain reliability under growing consumption forecasts.

Duke FL's IRP process evaluates demand-side and supply-side alternatives to reliably meet customers' future energy demand.

Of the data publically available, Duke's forecasts have remained fairly consistent for the past three years with an average growth rate of 1% in the 2016 TYSP.

Only a limited number of load forecasts were publically available, preventing the ability to provide a longer time frame of analysis.

Duke Indiana
Actual vs. Long Term Energy Forecast



Source: Duke Energy Indiana Integrated Resource Plans, Net Energy for Load

Note: Historic data reflect the impact of energy efficiency programs and have not been weather normalized. Forecast data reflect the impact of historical energy efficiency programs up to 2014 and are based on weather normal projections.

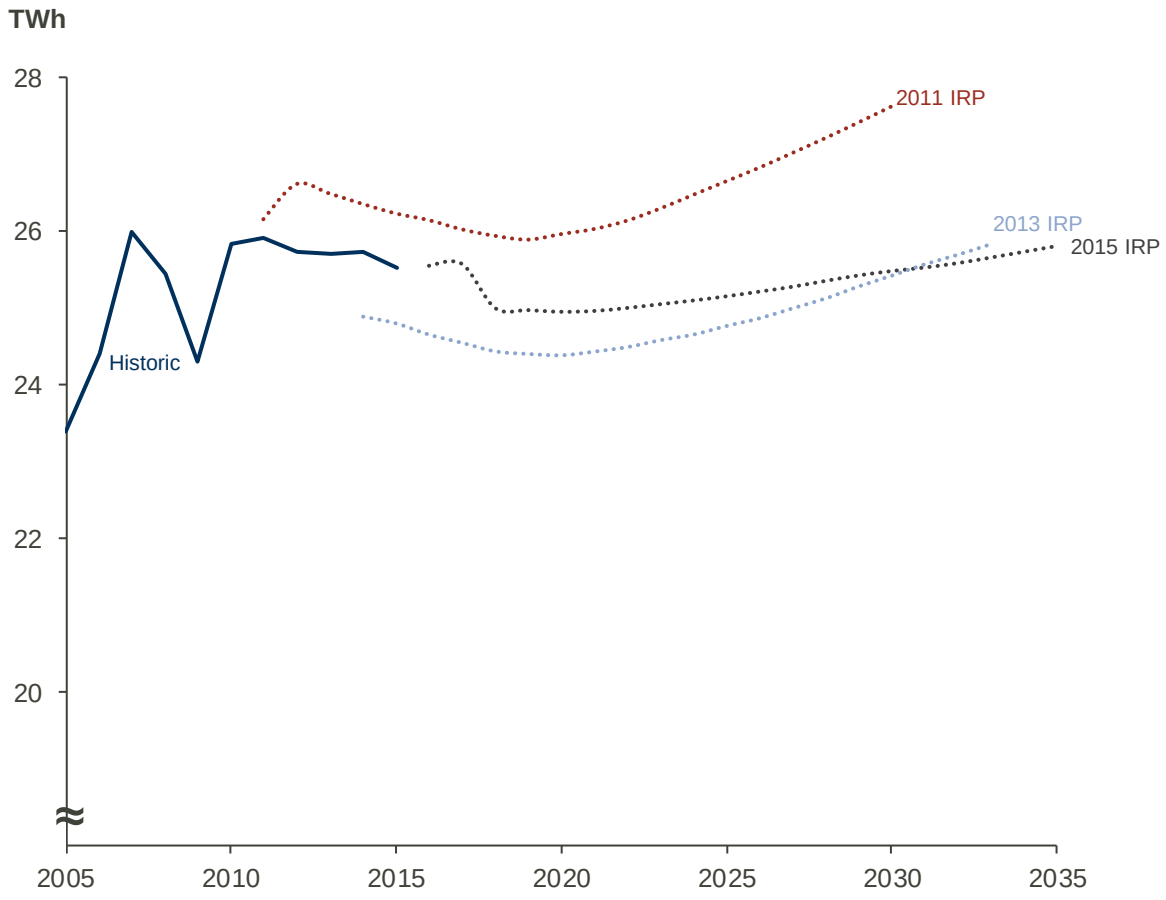
Duke Indiana's most recent IRP has aimed to incorporate additional uncertain factors by including carbon costs, compliance with new EPA regulations, enhanced retirements of the existing generating fleet, and supply-side energy efficiency programs.

Duke IN's long-range load forecasts have been decreasing in recent years due to lower expected demand from residential and commercial customers.

For 2030, projected energy consumption from the 2011 IRP to the 2015 IRP has been reduced by 1.8 TWh. This output is equivalent to a 500 MW power plant operating at a 42% capacity factor.

Only a limited number of load forecasts were publically available, preventing the ability to provide a longer time frame of analysis.

AEP Indiana Michigan Company
Actual vs. Long Term Energy Forecast



Source: AEP Integrated Resource Plans, Actual and Forecast Annual Energy Requirements

AEP Indiana Michigan Power's IRP, published every two years, includes a 20-year forecast period using the company's current assumptions for customer load requirements, commodity prices, supply-side alternative costs, and demand-side program costs.

While the three most recent forecasts project a dip in demand around 2020, annual growth rates from 2020 through 2030 have declined from 0.6% in the 2011 IRP, to 0.2% in the 2015 IRP.

Only a limited number of load forecasts were publically available, preventing the ability to provide a longer time frame of analysis.

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