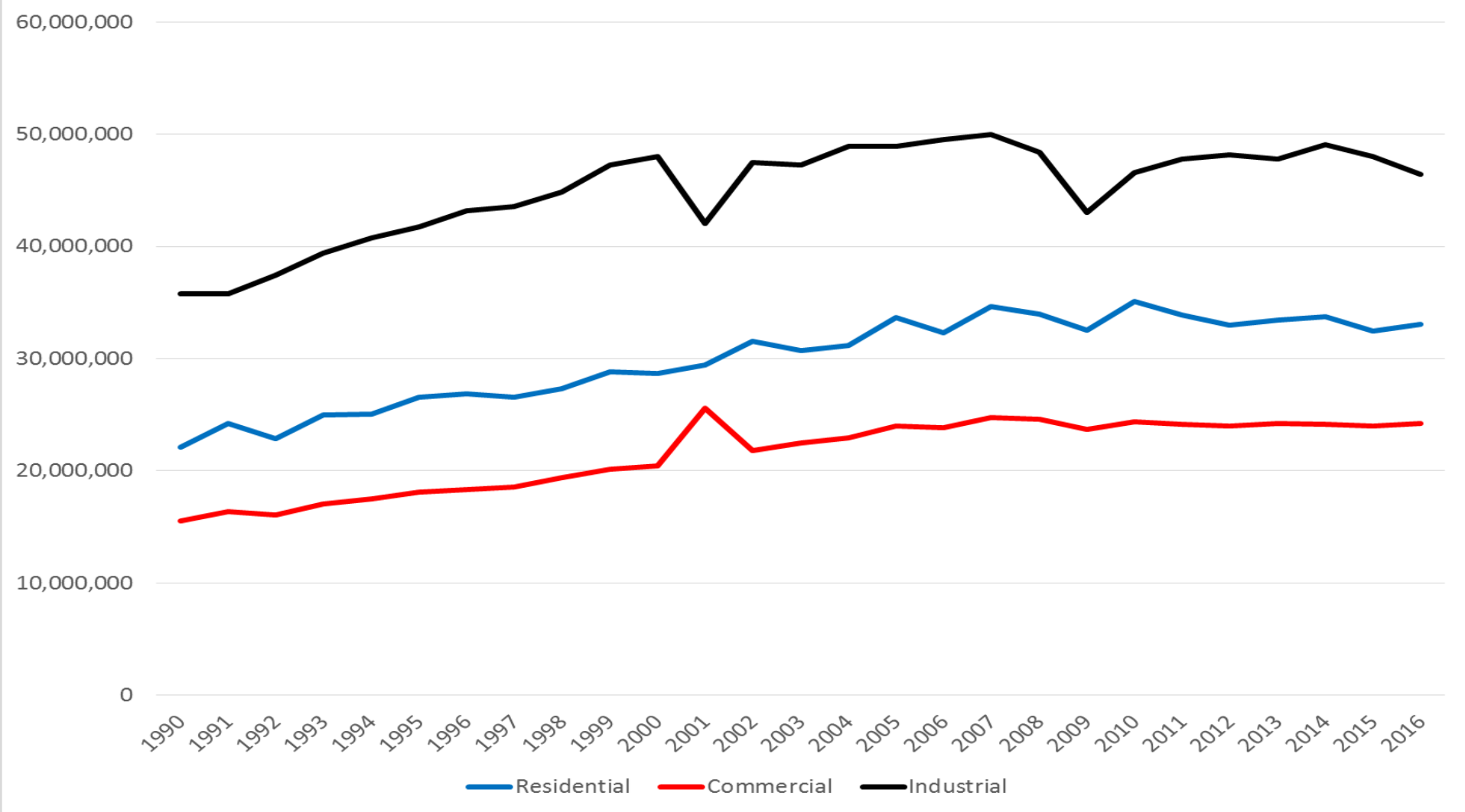


Is the Recent Trend of Little to No Load Growth an Indication of the Next 20 Years?

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Indiana Electricity Sales (GWh) by Sector (EIA data)



Note: The EIA data contain a classification error in 2001 for Commercial and Industrial sales

Flat Forecasts???

- There has been little to no load growth since the end of the recession
- Will this trend continue in the long term?
- If no, when will we start to see load growth start to pick up?
- I don't have answers to these questions, so I will try to look at some of the factors that may determine the answer
- I am considering forecast prior to adjustments for utility programs (gross)

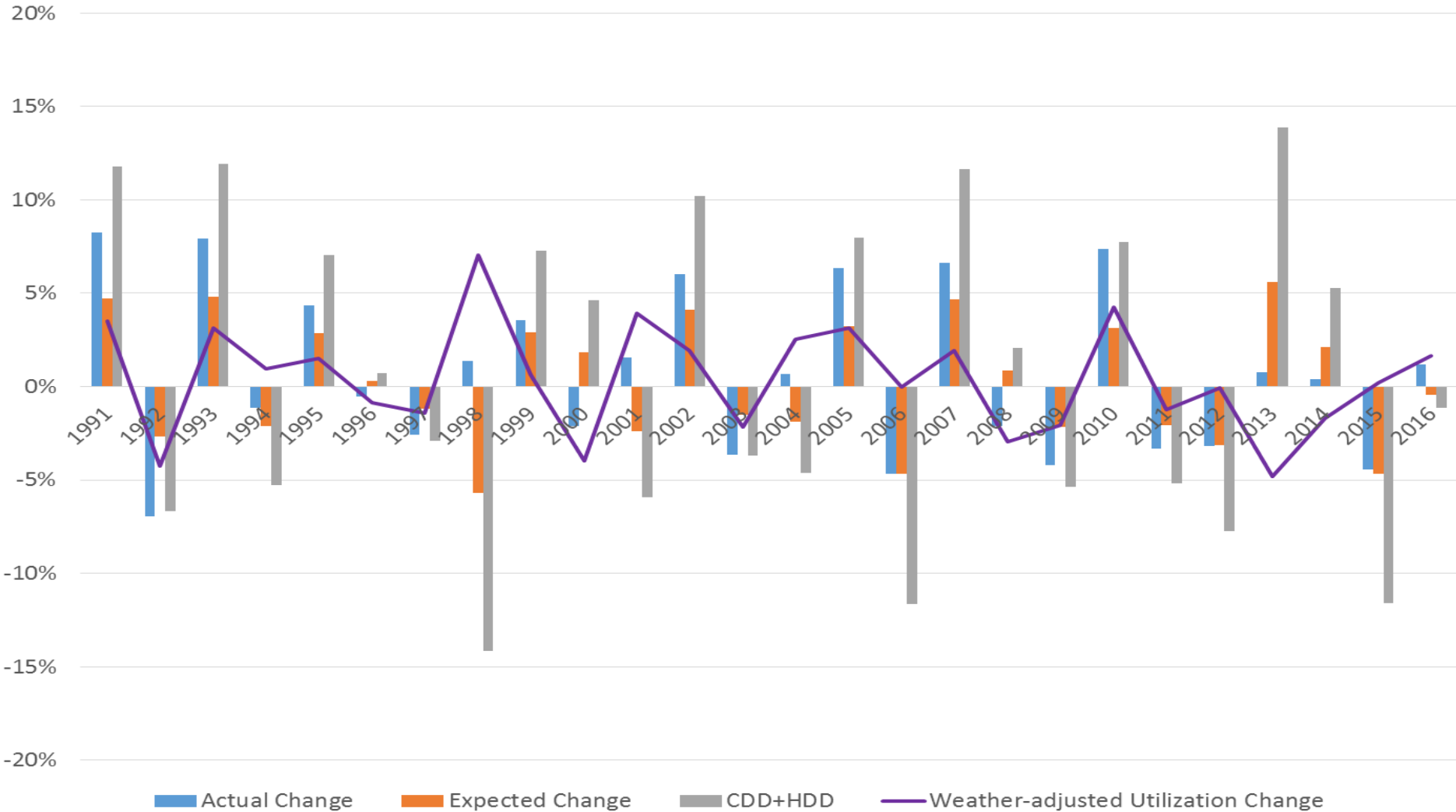
Utilization

- Residential utilization (sales per customer) has generally been dropping since 2007, but year-to-year changes are sensitive to weather
 - Commercial utilization has also dropped, but to a lesser degree
- I looked at year-to-year changes and adjusted for corresponding changes in weather

Weather Adjustment

- Change in utilization estimated as a function in the change in weather through linear regression
- A 10% change in weather results in about a 4% change in utilization
- Weather is based on the sum of cooling degree days and heating degree days for Evansville, Indianapolis, and South Bend (population weighted average)

IN residential utilization and annual weather (% year-to-year change)



Takeaways

- Weather-adjusted utilization increases through mid-2000s
 - actual change exceeds expected change from weather differences
- For 2011-2014, weather-adjusted utilization appears to be decreasing
 - expected change exceeds actual change
- 2015 and 2016 do not show weather-adjusted utilization decreases

Caveats

- Analysis is admittedly rough and approximate
- Two years is not sufficient to indicate a trend, but it bears watching in the future

Lighting

- Energy Independence and Security Act (EISA) Phase 1 lighting efficiency standard phased in from 2012 to 2014
 - phase out of traditional incandescent bulbs
 - halogen, CFL, LED bulbs compliant
- EISA Phase 2 standard to go in effect in 2020
 - halogen no longer compliant, along with elimination of exemptions

Adoption of LEDs

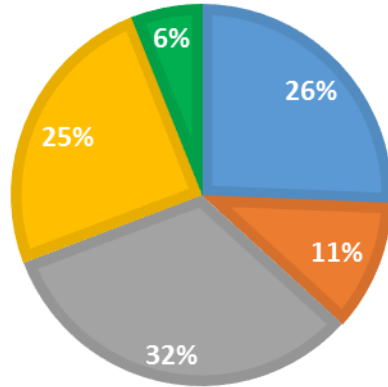
- The adoption of LED lighting has progressed much faster than originally forecast
 - Navigant report (2014) for DOE projected 3% sales (number of lumen-weighted bulbs) in 2015
 - BPA report (2017) shows actual sales of LED bulbs around 25% in 2015, with halogen/incandescent less than 50%

My Personal Lighting Survey

- Out of curiosity, I did a census of the indoor lighting in our home, classifying bulbs by type and frequency of use
 - rarely: less than 10 hours per year
 - occasionally: between 10 and 200 hours per year
 - often: more than 200 hours per year

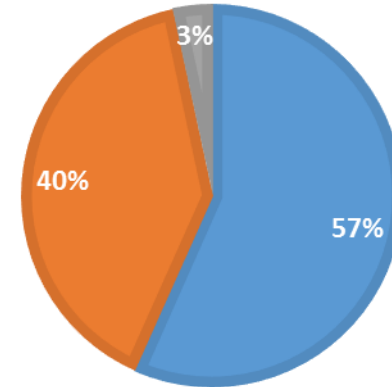
TOTAL BULBS

■ Incandescent ■ Halogen ■ CFL ■ LED ■ Unknown/Other



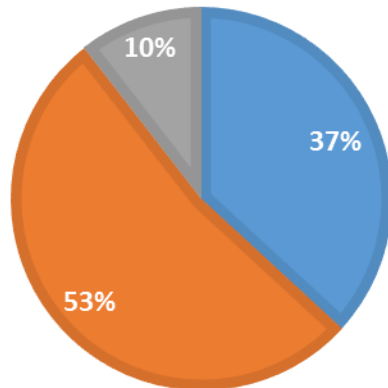
INCANDESCENT

■ Rarely ■ Occasionally ■ Often



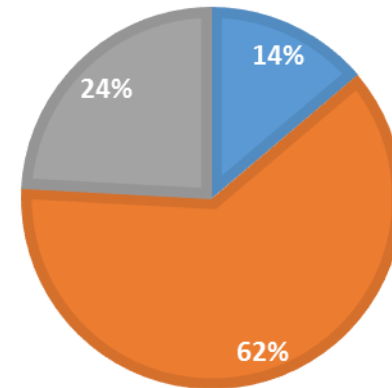
CFL

■ Rarely ■ Occasionally ■ Often



LED

■ Rarely ■ Occasionally ■ Often



Takeaways

- We have a lot more light bulbs in the house than I thought we did
- Simply counting the number of bulbs misrepresents the actual usage
 - Incandescent bulbs are 26% of total but only 7% of the most frequently used
- Frequently used bulbs burn out more often and are replaced with current technology

Saturation of Efficient Lighting

- Most of the recent overall efficiency gains in the residential sector appear to be coming from more efficient lighting
 - The commercial sector seems to be changing more slowly
- When will we approach saturation of high efficient lighting?
 - Phase 2 impacts could be reduced if most of the energy savings are already in place by 2020

Will We See Similar Savings in Other End Uses?

- While it is certain that other end uses will experience efficiency gains, lighting has some unique characteristics
 - significant energy use (~10% of residential and commercial sector loads)
 - huge efficiency gains (~8 times more efficient)
 - modular, low-cost replacement (can be done a single bulb at a time for a few dollars)

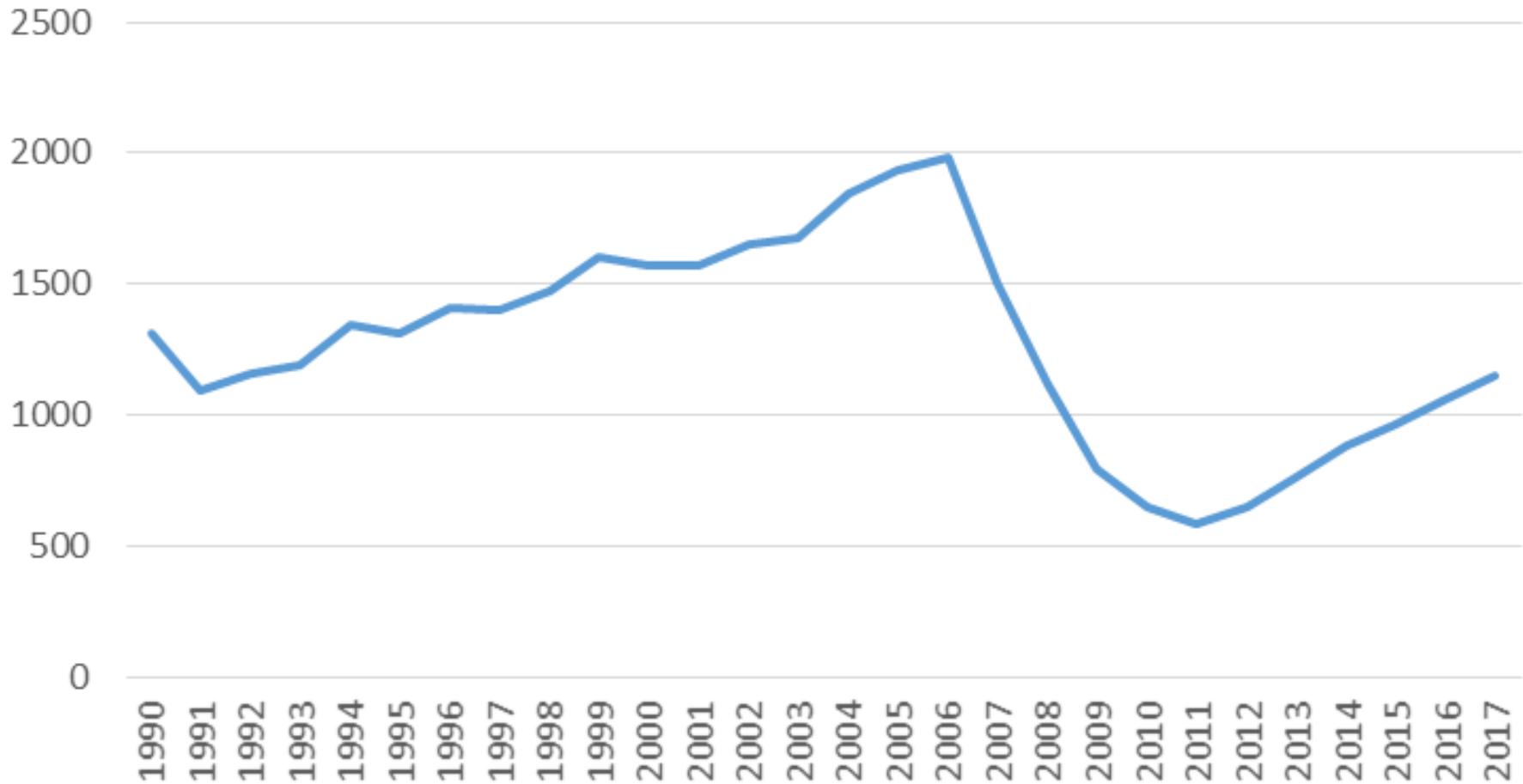
Programmable/Smart Thermostats

- Thermostats hold some potential for significant efficiency gains
 - both heating and cooling are large uses of electricity
- However, programmable thermostats are already relatively common
 - According to EIA's 2015 RECS, 41% of US homes have them (compared to 65% that have central air conditioning)
- Most consumers do not use them
 - Only 12% of homes actually do

Number of Customers

- From 1990-2006, the number of residential customers in Indiana grew at 1.30% per year and household size dropped
- From 2007-2016, customers grew at 0.38% and household size flattened
 - note this is roughly equal to long-term population projections

New Homes in US (1000s)



Housing Construction Rebound

- Completed new home construction exceeded one million housing units nationally in 2016 for the first time since 2008
- 2009 was the first time in the data series (starting in 1968) where new homes were less than 1 million
- Averaged 1.33M in 1990s, 1.72M from 2000-2007 during bubble, then collapsed in 2009; it bottomed out at 585k in 2011 (about 70% drop from 2006 high); average over last ten years (2008-2017) was 860k
- Projections for continued increases in the next few years; realtors say there is a lack of inventory
- If housing additions return and remain at more normal levels (perhaps around 1.5M), it would require additional efficiency gains to keep load flat

Demographics

- Aging population usually coincides with decreasing household size
 - Projections indicate that the number of people eligible for Medicare will increase by 40% over the next 15 years
- As number of retirees grow, the energy savings from programmable thermostats may be limited
 - Homes are not unoccupied as much

Plug-in Electric Vehicles

- Not currently significant, but most automobile manufacturers planning significant push in the next few years
- Rough analysis for Indiana indicates that for every percent of urban vehicle miles that come from PEVs, residential energy consumption increases by a half percent
 - if based on total miles, residential consumption increases by 0.8 percent
 - EPRI (2018) electrification study reference scenario projects about $\frac{1}{4}$ of all miles by 2030

Government Policy

- Currently, the federal government does not appear to favor efficiency efforts
 - Proposed budget from POTUS would have eliminated the Energy Star program
 - House Energy & Commerce Committee considering revision to the Energy Policy and Conservation Act to eliminate the requirement that efficiency standards be reviewed every six years
- Probability of a change of course is uncertain and may change again in the long term

Tariffs on Steel & Aluminum

- Tariffs would likely increase production in the primary metals sector but decrease production in downstream manufacturing industries, with overall drops in GDP and employment (NERA Consulting report)
- A global trade war would put additional downward pressure on the economy
- The primary metals sector is extremely electric energy intensive, using more than four times as much electricity to produce a dollar of output compared to the remainder of Indiana's manufacturing sector
- It is likely that increases in electricity usage from the primary metals sector will more than offset decreases from other manufacturers

Labor Availability

- Labor availability may limit future economic growth (SF Fed, 2016), which may be affected by US immigration policy (Cato Institute, 2017; REMI, 2017)
- Electricity usage may not be affected as much since labor shortages tend to drive increased automation in manufacturing, which increases electricity usage

Prices

- From 1990 to 2007, Indiana average real (inflation-adjusted) electricity prices (across IOUs) dropped by 1.1% per year on average
- From 2007 to 2016, they increased by 3.3% per year on average
- Real prices are projected to increase in the future, but not as fast as in the past decade

Other Factors

- Customer-owned generation
 - increased DG would reduce electricity sales growth
- E-commerce
 - Closure of brick-and-mortar stores could reduce demand in the commercial sector

Questions

- Will we continue to see declines in utilization in the long term, especially as we approach saturation of high efficiency lighting?
- Will customer growth continue to match population growth or will it exceed it as the population ages?
- Will plug-in vehicles be significant in the long term?
- Will federal policy slow or delay the development of future efficiency standards?
- What will be the impacts of tariffs on steel and aluminum?
- What are the long-term prospects for the economy?
- What will happen to electricity prices?
- Will customer-owned generation expand to the point where it significantly reduces electricity sales?
- Will traditional brick-and-mortar stores continue to close?