



Unpacking the Disconnect Between Wholesale and Retail Electric Rates

Peter Cappers & Sean Murphy
August 2019

This analysis was funded by the Transmission Planning and Technical Assistance Division within the Office of Electricity of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231



Background

- *2017 DOE Staff Report to the Secretary on Electricity Markets and Reliability* noted a disconnect between falling wholesale electricity prices and flat or rising retail investor-owned utility electricity prices between 2008 and 2016
- DOE asked LBNL to develop an assessment of any trends and drivers for utility costs, retail sales, and/or retail rates vis-à-vis wholesale market prices at a regional level over some historical time period

Research Plan

Lit Review

- Perform literature review to better understand recent historical analyses of utility cost, retail sales, and retail rate drivers vis-à-vis wholesale market prices

Assess Data

- Gauge data availability based on areas identified in literature
- Determine what data to collect and analyze

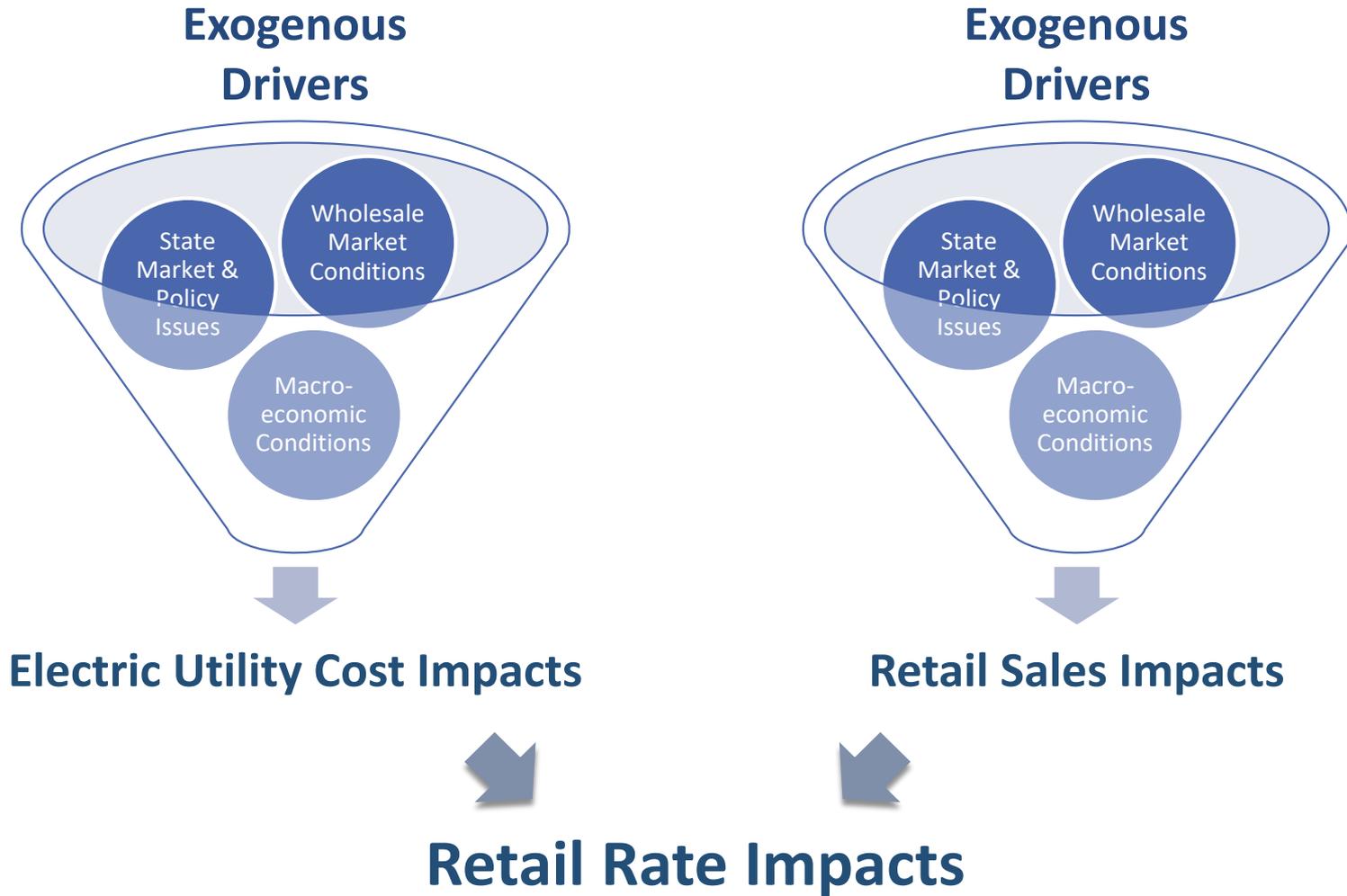
Analyze Data

- Perform analysis on data set that seeks to validate and build upon a subset of findings in the literature

Report Results

- Present results of data analysis

Possible Drivers of Retail Electric Rate Changes



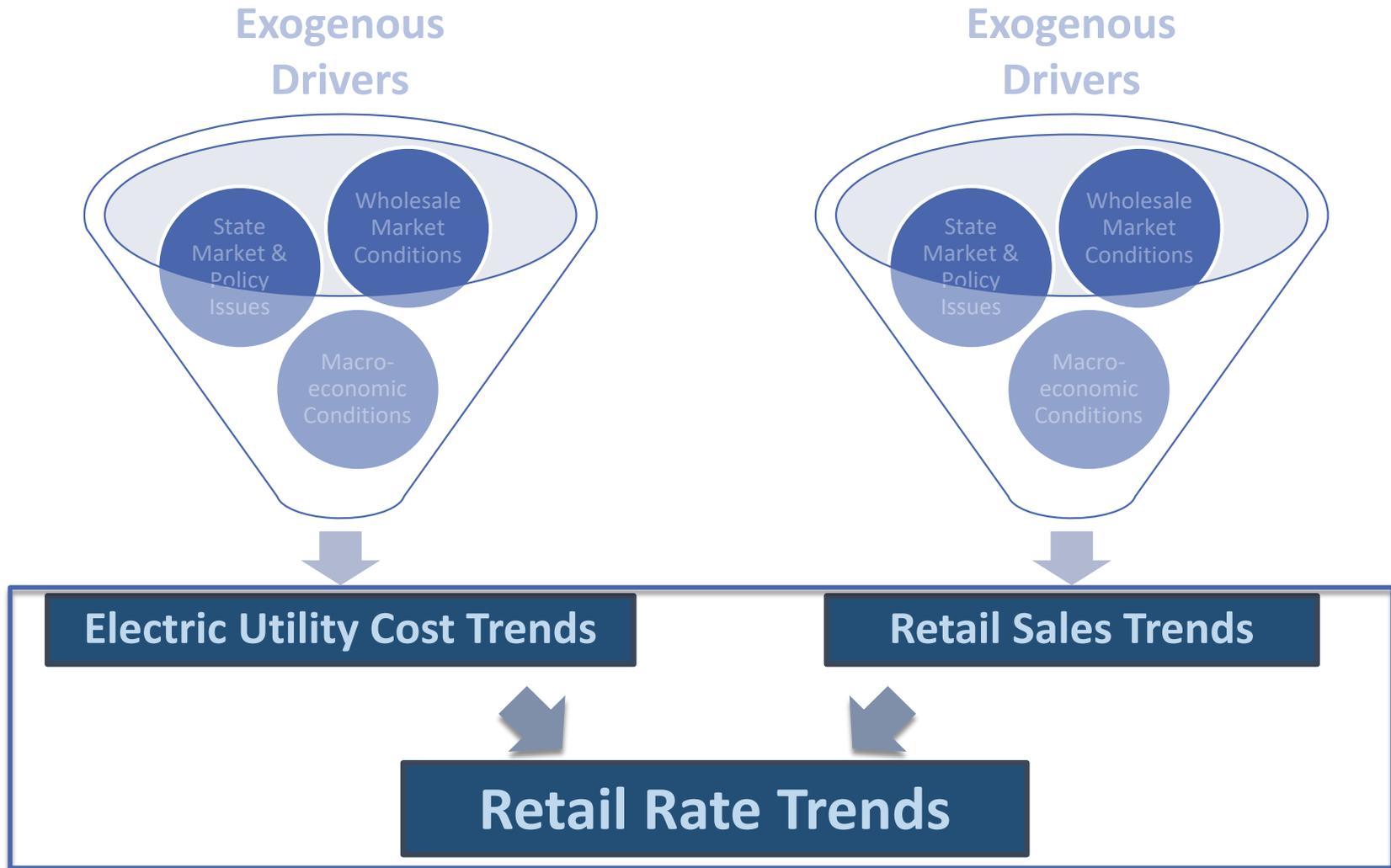
Literature Review

- Lots of literature on historical analysis of retail electric utility rate trends
 - ▣ Concentrated on Investor Owned Utilities (IOU) or industry as a whole
 - ▣ Very little attention paid to Public Power and Cooperative utilities
- Analytical results generally reported at national level
 - ▣ State/regional characteristics are frequently incorporated (see below)
- Many analyses focus on quantifying the rate impacts from a specific set of state-level market & policy issues:
 - ▣ Retail competition & industry restructuring [1-7]
 - ▣ Wholesale market development [4]
 - ▣ State clean energy standards [3, 7-9]
 - ▣ Natural gas price declines [7]
 - ▣ Economic recession [3, 7]

Literature Review (2)

- Other analyses focus on characterizing the key trends at the utility that may act as drivers of retail electric rates
 - ▣ Higher distribution system capital investments [10-14]
 - ▣ Higher transmission system capital investments [11-17]
 - ▣ Higher generation capital investments [12-14]
 - ▣ Lower fuel and purchased power costs [18]
 - ▣ Lower electricity sales [3]
- Limited research on impacts from state-level regulatory or ratemaking mechanisms
 - ▣ Very small retail rate impacts due to decoupling (+/- 2% of retail rates) [19-21]
 - ▣ Modest longer term cost reductions due to multi-year rate plans, but little to no discussion of retail rate impacts [22]

Focus on Utility Costs and Retail Sales Trends Instead of Drivers for These Trends



Observations Based on Literature Review

1. Retail electricity sales have exhibited very modest increases or decreases
2. Fuel and purchased power (FPP) costs have generally declined putting downward pressure on retail rates
3. Capital expenditures have generally been increasing, putting upward pressure on retail rates
4. The degree of expansion in capital expenditures by category (i.e., generation, distribution, transmission) varies and has seen inconsistent growth over time

Available Data Sources – Retail Electric Utilities

□ FERC Form 1

- Reporting required of all major U.S. electric utilities (1M+ MWh annual sales)
- Contains detailed data on revenues, costs, and sales
- ABB Ventyx includes data from 2007-2016

□ EIA Form 861

- Reporting required of all US electric industry distributors
- Contains aggregate data on revenues and sales; no cost information at a utility level
- ABB Ventyx includes data from 2007-2016

Choosing Between FERC Form 1 & EIA Form 861

- We chose to focus on the single data source that was most robust and consistent with the literature we were able to review
 - Focus analysis on investor-owned utilities (IOUs)
 - Limited literature to guide any analysis of non-IOUs
 - FERC Form 1 limited to larger IOUs; EIA includes many different types of utilities, including IOUs of all sizes
 - Focus analysis on utility cost trends
 - FERC Form 1 has utility-level cost data; EIA Form 861 does not
 - Focus analysis on retail sales trends
 - EIA Form 861 provides both delivery-only and bundled service retail sales data; FERC Form 1 only has total retail sales data
- FERC Form 1 provided complete reporting of utility costs, at various levels of granularity, and sufficient detail on retail sales to understand broader trends driving retail rates
 - Dataset constructed of only IOUs that had all data elements of interest in all years in the analysis period 2007-2016
 - Converted all dollars to Real \$2016 using CPI
 - Aggregated utility-level data up to NERC Region

Data Collection – Retail Electric Utilities

- **Retail Sales:** Electric sales to ultimate consumers (Annual kWh)
- **Revenue:** Collected revenue from electric sales to ultimate consumers (Annual \$)
- **Utility Costs:** Incurred costs by the utility grouped by major category (Annual \$)
 - **Fuel:** Costs incurred to procure fuel for utility-owned generation facilities
 - **Purchased Power:** Costs incurred to procure electricity from third-parties for ultimate consumers
 - **Operations & Maintenance (O&M):** Costs incurred in the operation and maintenance of all utility facilities to generate and deliver electricity to ultimate consumers
 - **Total:** Costs incurred in the operation, maintenance, and financing of all utility facilities to generate and deliver electricity to ultimate consumers
- **Plant in Service Additions:** Capital expenditures incurred by the utility (Annual \$)
 - **Generation:** Capital expenditures towards generation facilities
 - **Distribution:** Capital expenditures towards distribution facilities
 - **Transmission:** Capital expenditures towards transmission facilities
 - **Other:** Capital expenditures towards anything outside of prior 3 categories

Data Assessment Process – Retail Electric Utilities

- Utilities in states with retail competition collect revenues to cover 1) commodity (i.e., generation) costs from only those customers who take commodity service; and 2) transmission and distribution costs from all ratepayers
 - FERC Form 1 does not collect sales data that differentiates between commodity-only customers and all customers
 - Derived all-in retail rate (i.e., collected revenue per unit retail sales) will understate the true all-in retail rate
- Utilities in ERCOT have no commodity service obligations; therefore have no FERC Form 1 reported fuel or purchased power costs
 - Since the research is seeking to better understand the relationship between wholesale and retail rates, an analysis of ERCOT utilities lacks the ability to assess a key component of utility costs that are affected by changes in wholesale electricity costs
 - Dropped all utilities in ERCOT from this analysis

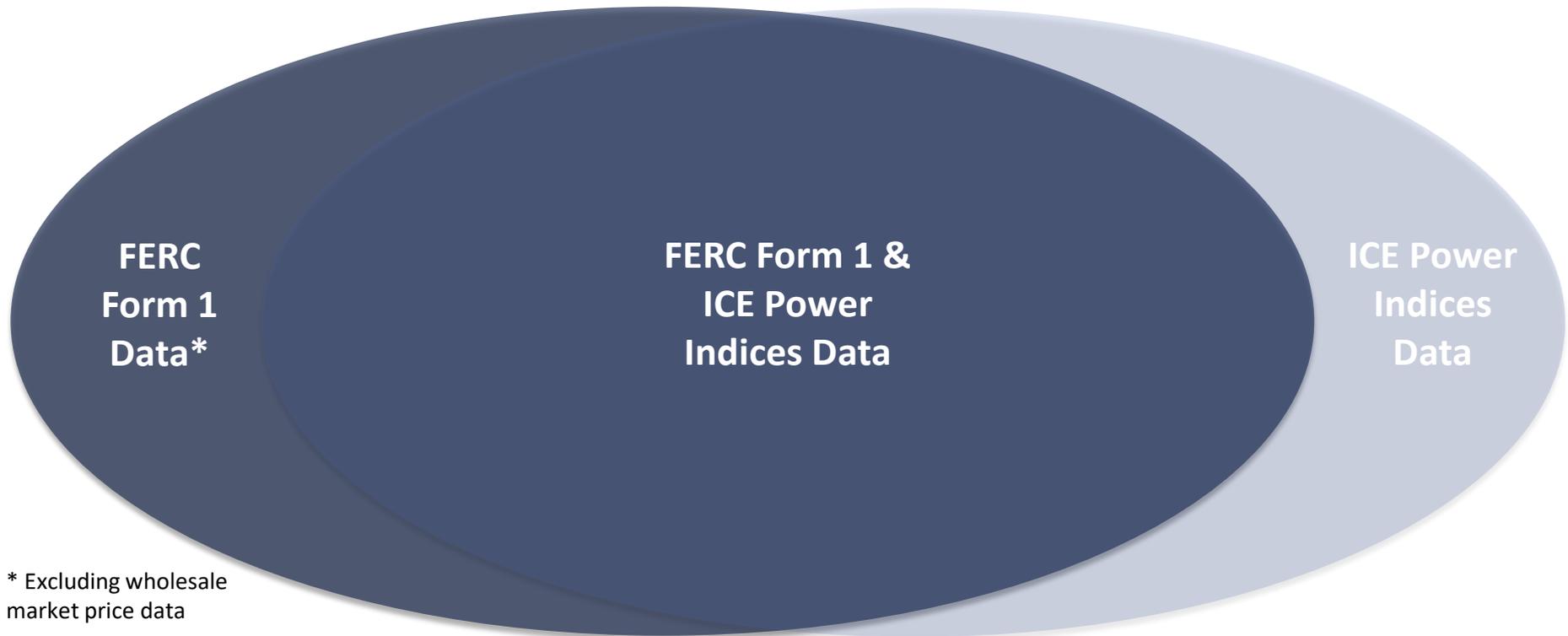
Available Data Sources – Wholesale Market Prices

- FERC Form 1
 - ▣ Reporting required of all major U.S. electric utilities (1M+ MWh annual sales)
 - ▣ Contains detailed data on wholesale market transactions
 - ▣ ABB Ventyx includes data from 2007-2016
- ICE Power Indices
 - ▣ Contains wholesale market transactions at key hubs across the U.S.
 - ▣ ABB Ventyx includes data from 2007-2016

Choosing Between FERC Form 1 & ICE Power Indices

- FERC Form 1
 - Reflects utility-specific short-term wholesale market transactions resulting in better representation of wholesale market prices that utilities in our sample faced
 - Data quality issues
 - Low volumes for some regions (e.g., FRCC) resulting in no price data in certain years (e.g., 2008, 2015, 2016)
 - Produced annual average prices (\$/MWh) that substantially exceeded retail rates for specific utilities (e.g., Delmarva, PPL, West Penn Power)
- ICE Power Indices data
 - Hub-level prices are based on short-term wholesale market transactions of utilities that may or may not be in our FERC Form 1 sample
 - Data quality issues
 - ABB Ventyx does not have any hubs for certain regions (e.g., ASCC, FRCC, HICC, SPP)
 - High volume of transactions in some regions; less so for some others BUT reasonable annual average wholesale market prices are produced
- Elected to use ICE Power Indices data over FERC Form 1
 - Aggregated up to NERC regions
 - All dollars converted to Real 2016 using CPI

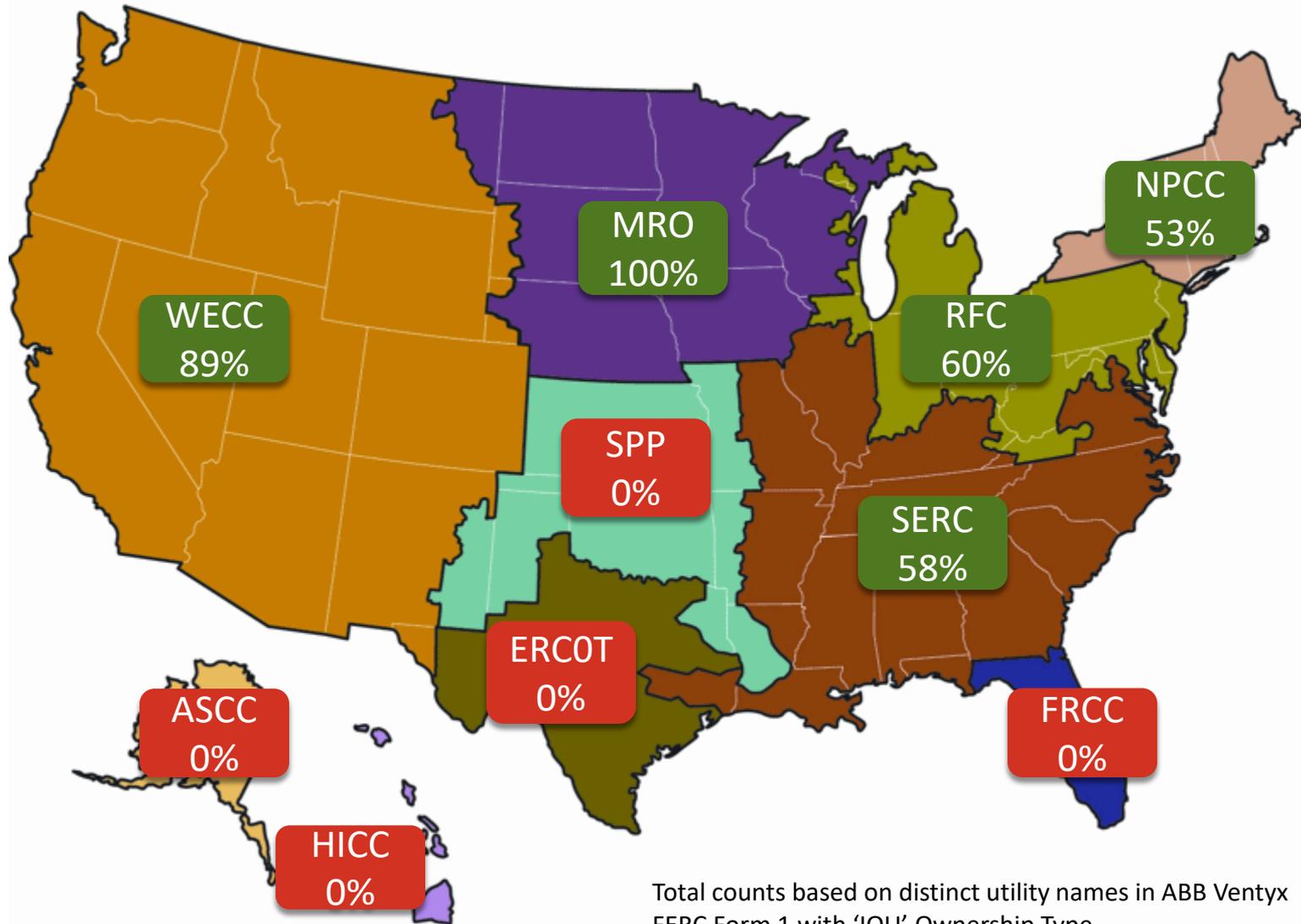
Data Assessment Process – Wholesale Market Prices



- All data from FERC Form 1 for utilities in ASCC, ERCOT, FRCC, HICC, and SPP were dropped from the analysis because no ICE Power Indices data was available

Final Data Sample

% of All IOUs reporting FERC Form 1 in ABB Ventyx



Total counts based on distinct utility names in ABB Ventyx FERC Form 1 with 'IOU' Ownership Type

Final Data Sample

Investor Owned Utilities

NERC	
Region	Utility Name
MRO	ALLETE Inc
MRO	Interstate Power & Light Co
MRO	MDU Resources Group Inc
MRO	MidAmerican Energy Co
MRO	Northern States Power Co (Minnesota)
MRO	Northern States Power Co (Wisconsin)
MRO	Northwestern Wisconsin Electric Co
MRO	Otter Tail Power Co
MRO	Superior Water Light & Power Co
MRO	Wisconsin Power & Light Co
MRO	Wisconsin Public Service Corp
NPCC	Central Hudson Gas & Electric Corp
NPCC	Central Maine Power Co
NPCC	Connecticut Light & Power Co (The)
NPCC	Consolidated Edison Co of New York Inc
NPCC	Emera Maine
NPCC	Fitchburg Gas & Electric Light Co
NPCC	Green Mountain Power Corp
NPCC	Massachusetts Electric Co
NPCC	NSTAR Co d/b/a Eversource Energy
NPCC	Narragansett Electric Co
NPCC	New York State Electric & Gas Corp
NPCC	Niagara Mohawk Power Corp
NPCC	Orange & Rockland Utilities Inc

NERC	
Region	Utility Name
NPCC	Public Service Co of New Hampshire
NPCC	Rochester Gas & Electric Corp
NPCC	Rockland Electric Co
NPCC	United Illuminating Co (The)
NPCC	Unitil Energy Systems
NPCC	Western Massachusetts Electric Co
RFC	Appalachian Power Co
RFC	Atlantic City Electric Co
RFC	Baltimore Gas & Electric Co
RFC	Cleveland Electric Illuminating Co (The)
RFC	Commonwealth Edison Co
RFC	Consolidated Water Power Co
RFC	Consumers Energy Co
RFC	DTE Electric Co
RFC	Dayton Power & Light Co (The)
RFC	Duke Energy Indiana
RFC	Duke Energy Kentucky
RFC	Duke Energy Ohio
RFC	Duquesne Light Co
RFC	Indiana Michigan Power Co
RFC	Indianapolis Power & Light
RFC	Jersey Central Power & Light Co
RFC	Kentucky Power Co
RFC	Kingsport Power Co

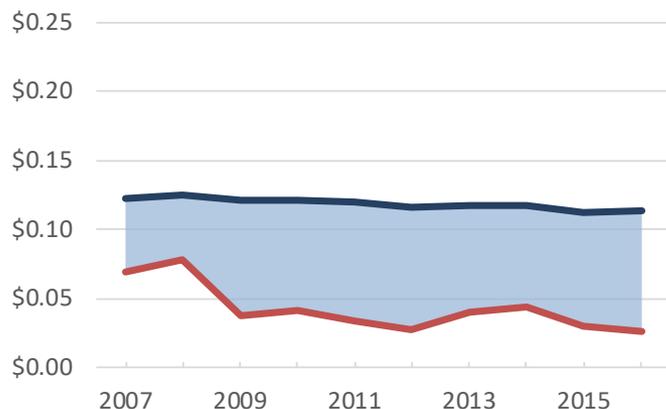
NERC	
Region	Utility Name
RFC	Madison Gas & Electric Co
RFC	Metropolitan Edison Co
RFC	Northern Indiana Public Service Co
RFC	Ohio Edison Co
RFC	Ohio Power Co
RFC	Ohio Valley Electric Corp
RFC	PECO Energy Co
RFC	Pennsylvania Electric Co
RFC	Pennsylvania Power Co
RFC	Potomac Edison Co (The)
RFC	Potomac Electric Power Co
RFC	Public Service Electric & Gas Co
RFC	Southern Indiana Gas & Electric Co
RFC	Toledo Edison Co (The)
RFC	Wheeling Power Co
RFC	Wisconsin Electric Power Co
SERC	Alabama Power Co
SERC	Duke Energy Carolinas
SERC	Duke Energy Progress
SERC	Entergy Arkansas Inc
SERC	Entergy Mississippi Inc
SERC	Entergy New Orleans Inc
SERC	Georgia Power Co
SERC	Gulf Power Co

NERC	
Region	Utility Name
SERC	Kentucky Utilities Co
SERC	Lockhart Power Co
SERC	Louisville Gas & Electric Co
SERC	Mississippi Power Co
SERC	South Carolina Electric & Gas Co
SERC	Virginia Electric & Power Co
WECC	Arizona Public Service Co
WECC	Avista Corp
WECC	Black Hills Power Inc
WECC	El Paso Electric Co
WECC	Idaho Power Co
WECC	Nevada Power Co
WECC	PacifiCorp
WECC	Pacific Gas & Electric Co
WECC	Portland General Electric Co
WECC	Public Service Co of Colorado
WECC	Public Service Co of New Mexico
WECC	Puget Sound Energy Inc
WECC	San Diego Gas & Electric Co
WECC	Sierra Pacific Power Co
WECC	Southern California Edison Co
WECC	Tucson Electric Power Co
WECC	UNS Electric Inc

National Trend in Retail vs. Wholesale Prices

Retail Rate = Σ Collected Revenue / Σ Retail Sales

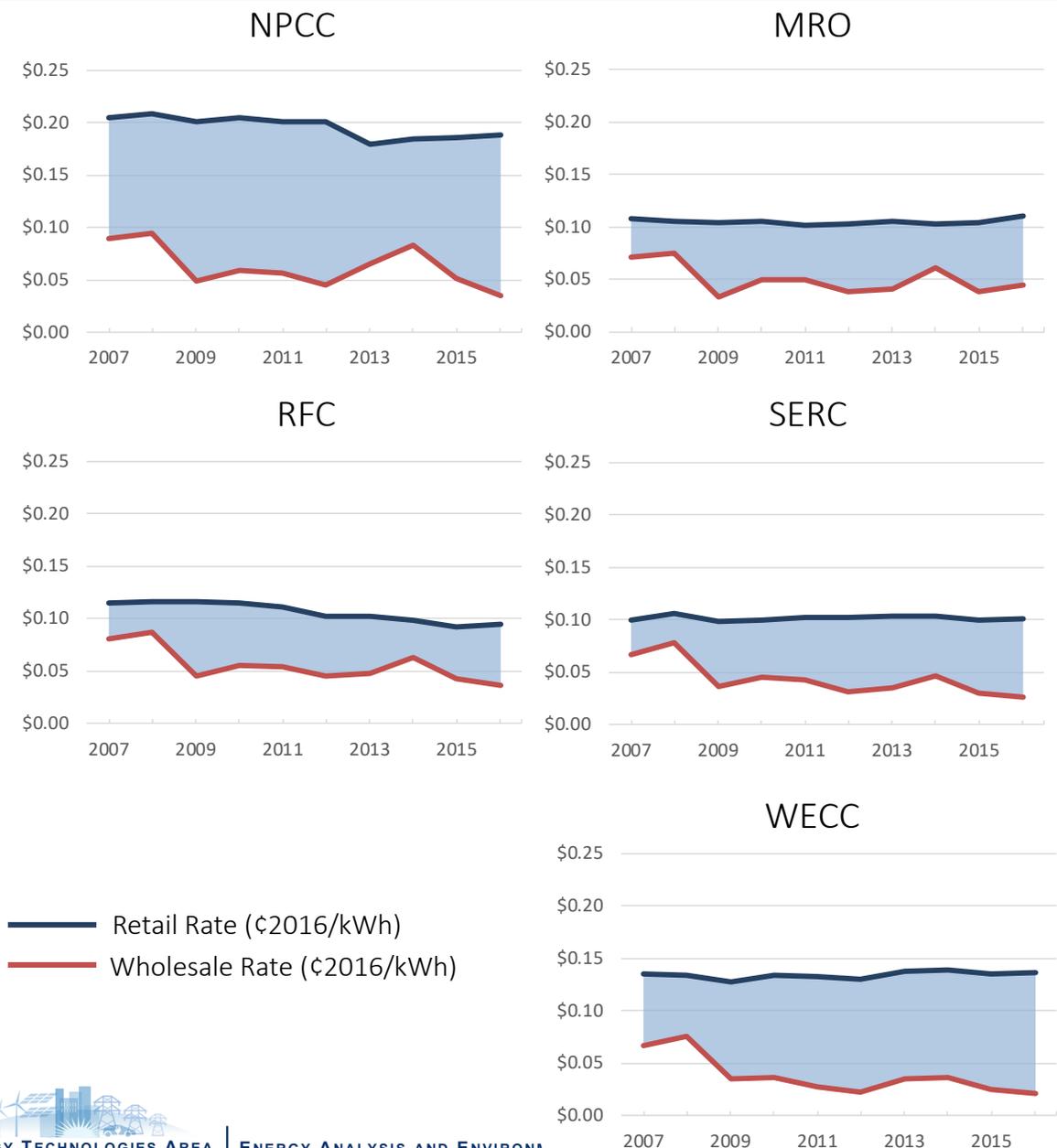
Wholesale Rate = Σ ICE Hub Revenues / Σ ICE Hub Volume



— Retail Rate (¢2016/kWh)
— Wholesale Rate (¢2016/kWh)

- Retail rates have declined (annual average change of -0.8%/yr) much less than wholesale rates (annual average change -6.2%/yr)
- Divergence between wholesale and retail rates has grown between 2007 (5.4 ¢/kWh) and 2016 (8.8 ¢/kWh)
 - Most of that divergence occurred between 2008 and 2009 when wholesale rates dropped from 7.8 to 3.8 ¢/kWh
- Assessment of long-term trends in divergence depends greatly on the starting point for analysis and is likely complicated by greater volatility in wholesale prices over time

Regional Trends in Retail and Wholesale Rates



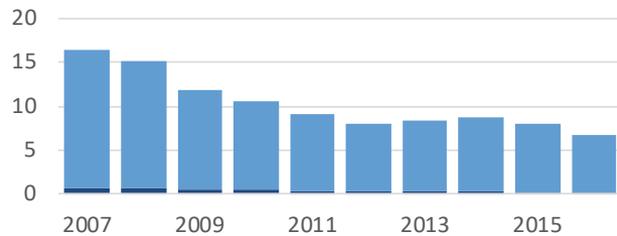
- All included NERC regions between 2007 and 2016 saw increasing divergence between retail and wholesale rates
- Utilities in 2 regions (NPCC, RFC) saw average annual retail rate decreases (-0.9%/yr and -2.2%/yr, respectively)
- Utilities in 3 regions (MRO, SERC, WECC) experienced slight average annual retail rate increases (<0.2%/yr) despite reductions in wholesale costs

Research Questions based on Literature Review

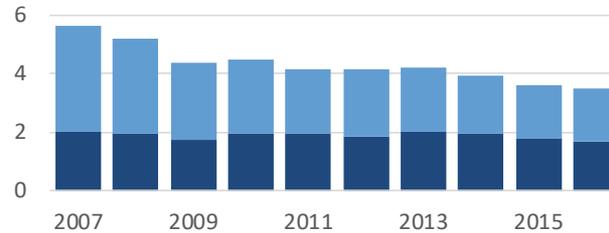
- Are IOUs seeing reductions in fuel and purchased power costs over time?
- Are total IOUs costs coming down over time?
- Are some non-fuel IOU cost categories increasing over time, thereby offsetting the reductions in fuel and purchased power costs? If so, which ones?
- What types of capital investments are IOUs making?

All Regions Experienced FPP Cost Declines

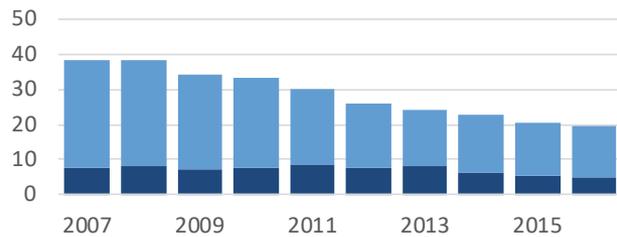
NPCC



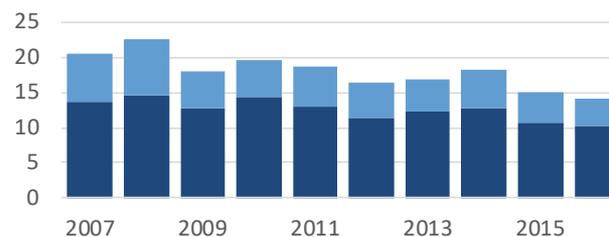
MRO



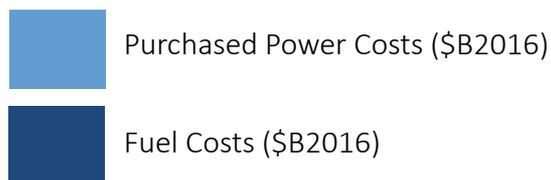
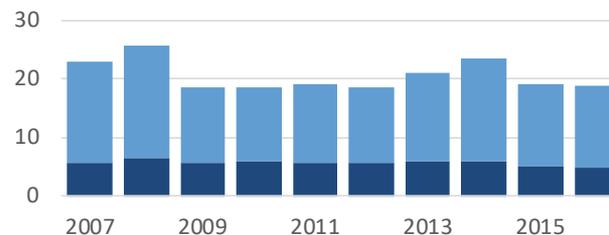
RFC



SERC



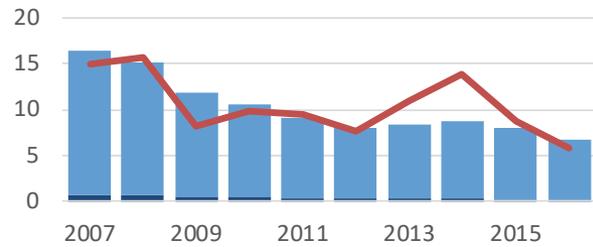
WECC



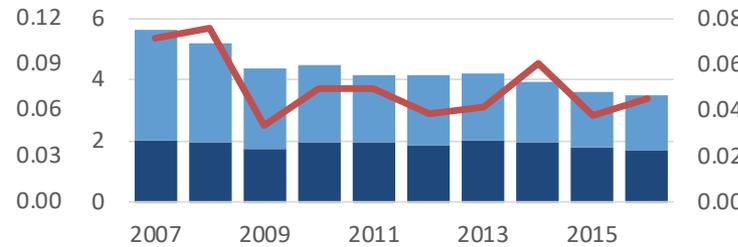
- General trend in all regions was for fuel and purchased power costs to decline over time
- Regional differences existed in how stable and consistent those reductions are throughout the analysis period (e.g., NPCC & RFC vs. SERC & WECC)
- This may suggest regional differences in underlying drivers of FPP costs - wholesale market price trends and/or retail sales trends

All Regions Experience Wholesale Market Price Declines

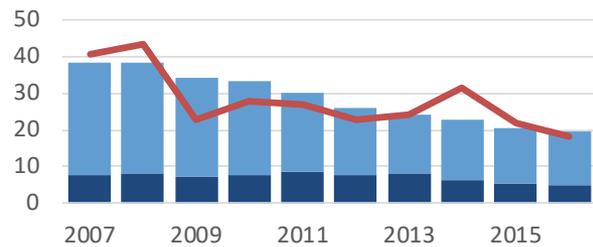
NPCC



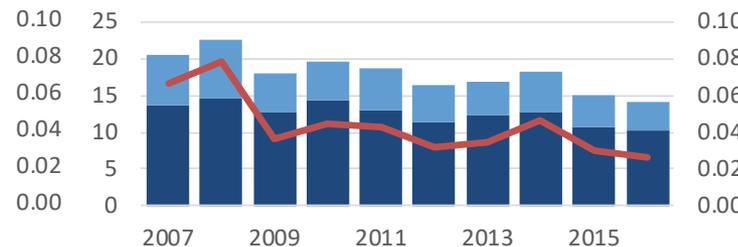
MRO



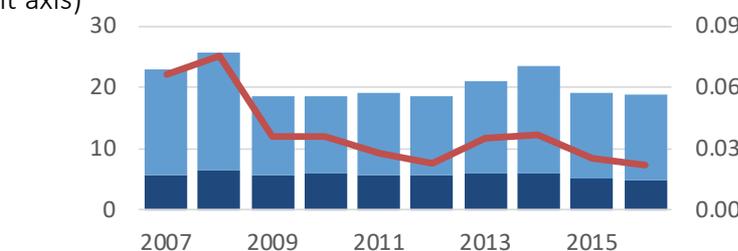
RFC



SERC



WECC



□ Trends in fuel and purchased power costs over analysis period coincides with broader wholesale market price trends

□ Wholesale market prices enter FPP through short-term purchases and long-term contracts

▣ Also act as a proxy for broader fuel cost changes

□ Regional differences exist in how FPP costs reflect annual wholesale market cost trends

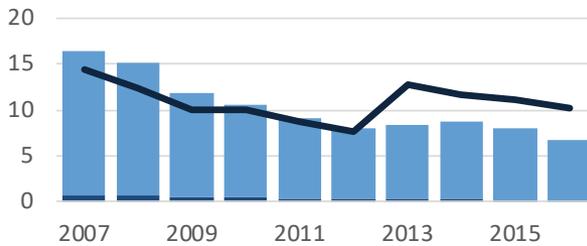
— Wholesale Rate (\$2016/kWh – right axis)

■ Purchased Power Costs (\$B2016)

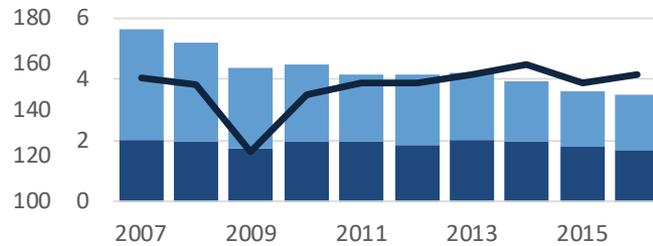
■ Fuel Costs (\$B2016)

2 of 5 Regions Experienced Retail Sales Decrease

NPCC

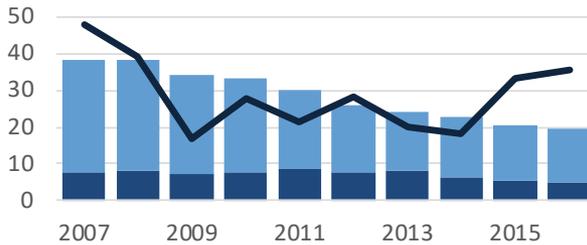


MRO

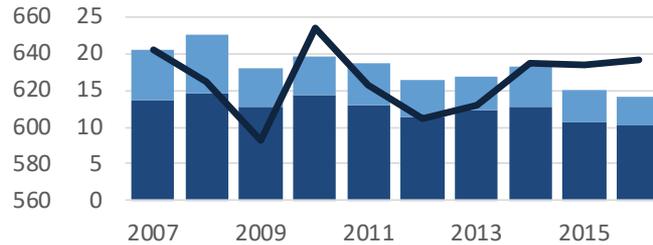


- NPCC saw measurable reduction in retail sales (-1.1%/yr)
- WECC saw modest annual load expansion (0.5%/yr) while RFC saw modest load contraction (-0.4%/yr)

RFC

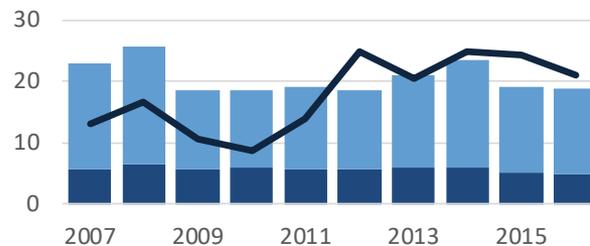


SERC



- MRO and SERC saw negligible average annual changes in sales (+/- 0.1%/yr), but varying levels of annual changes

WECC

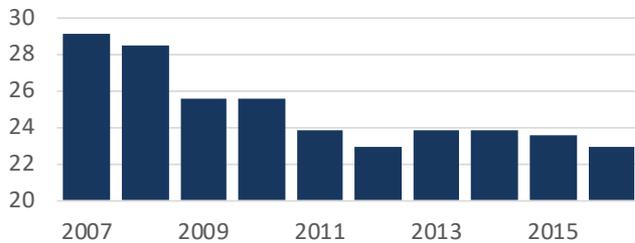


- Consistent regional FPP cost declines were not necessarily due to reductions in retail sales

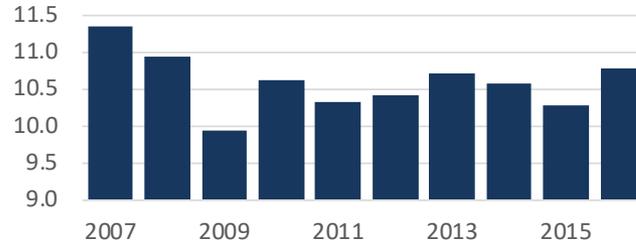
 Retail Sales (TWh – right axis)
 Purchased Power Costs (\$B2016)
 Fuel Costs (\$B2016)

2 of 5 Regions Experienced Total Utility Cost Declines

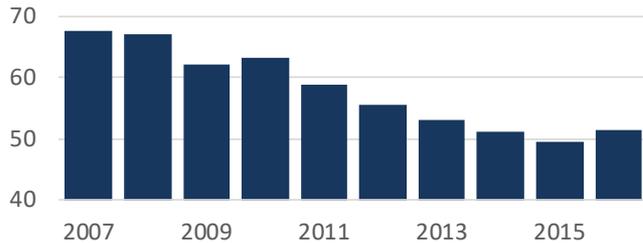
NPCC



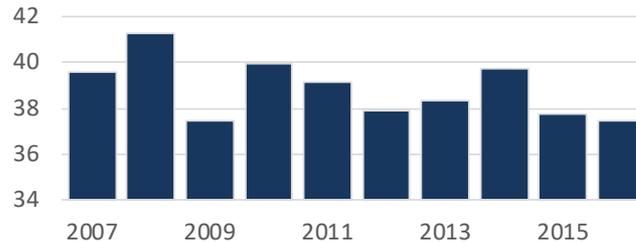
MRO



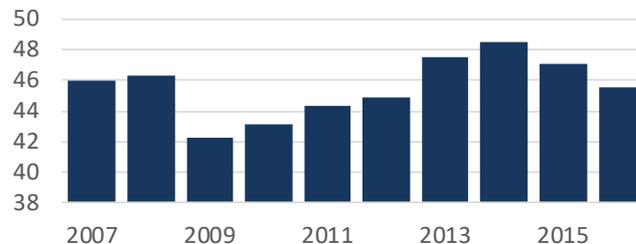
RFC



SERC



WECC

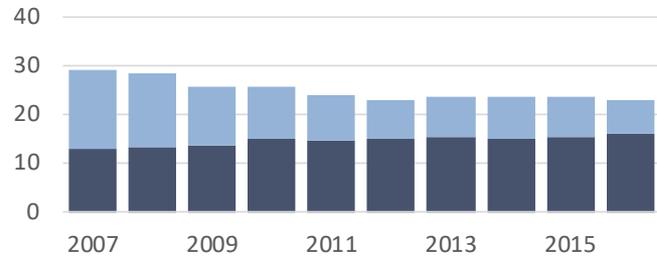


 Total Utility Costs (\$B2016)

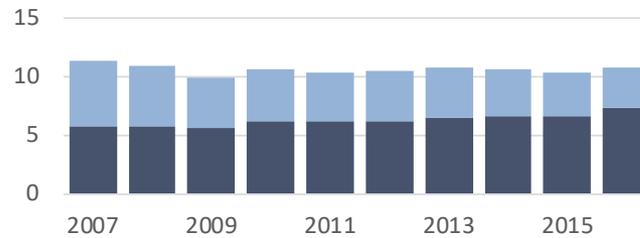
- Utilities in NPCC and RFC experienced clear downward trends in total utility costs
- MRO, SERC, and WECC showed substantial variability over time but ended the analysis period with slightly lower utility costs than at the beginning
- With fuel costs shrinking over time but total utility costs fluctuating, regional differences may be driven by changes in non-fuel costs

5 of 5 Regions Experienced Total Non-Fuel Utility Cost Increases

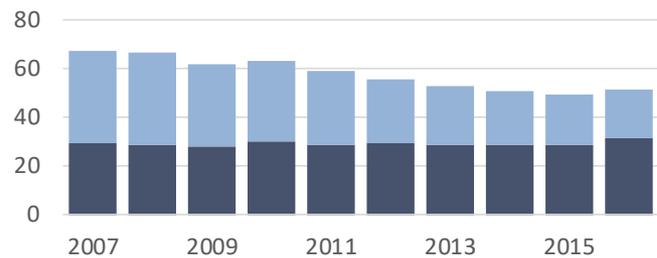
NPCC



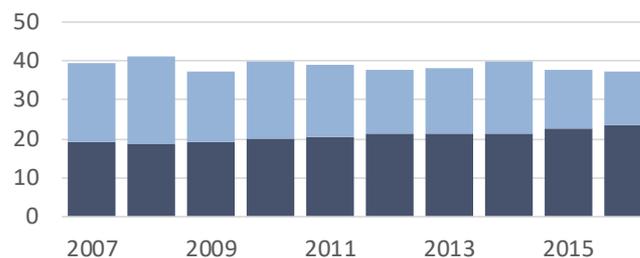
MRO



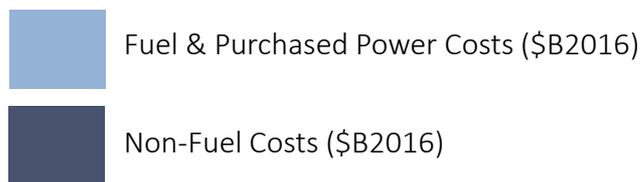
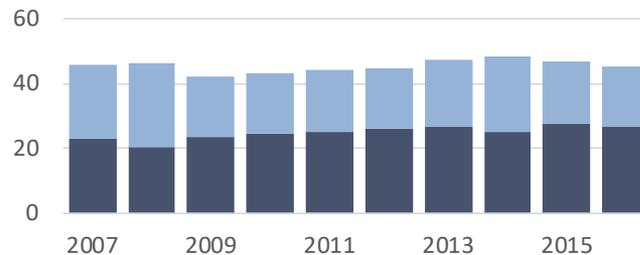
RFC



SERC



WECC

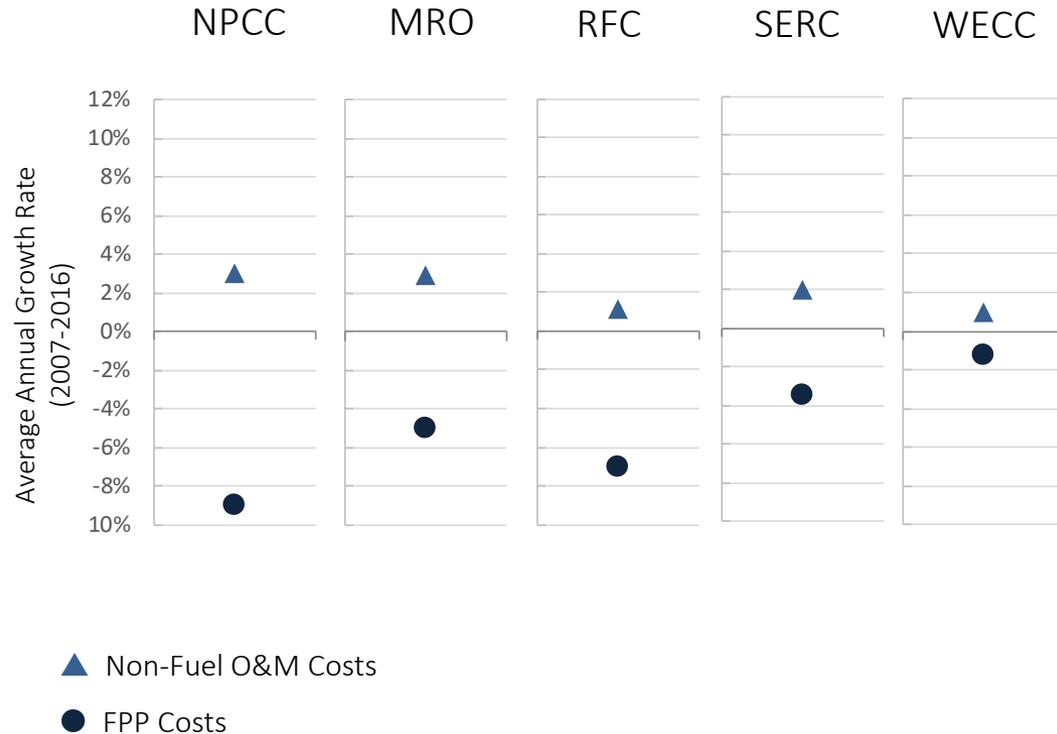


- Utilities in RFC experienced a modest upward trend in total non-fuel utility costs
- NPCC, MRO, SERC, and WECC showed much clearer year-over-year increases in non-fuel costs
- This suggests there are regional differences in the degree to which non-fuel cost increases are offsetting FPP cost reductions

Non-Fuel Cost Elements

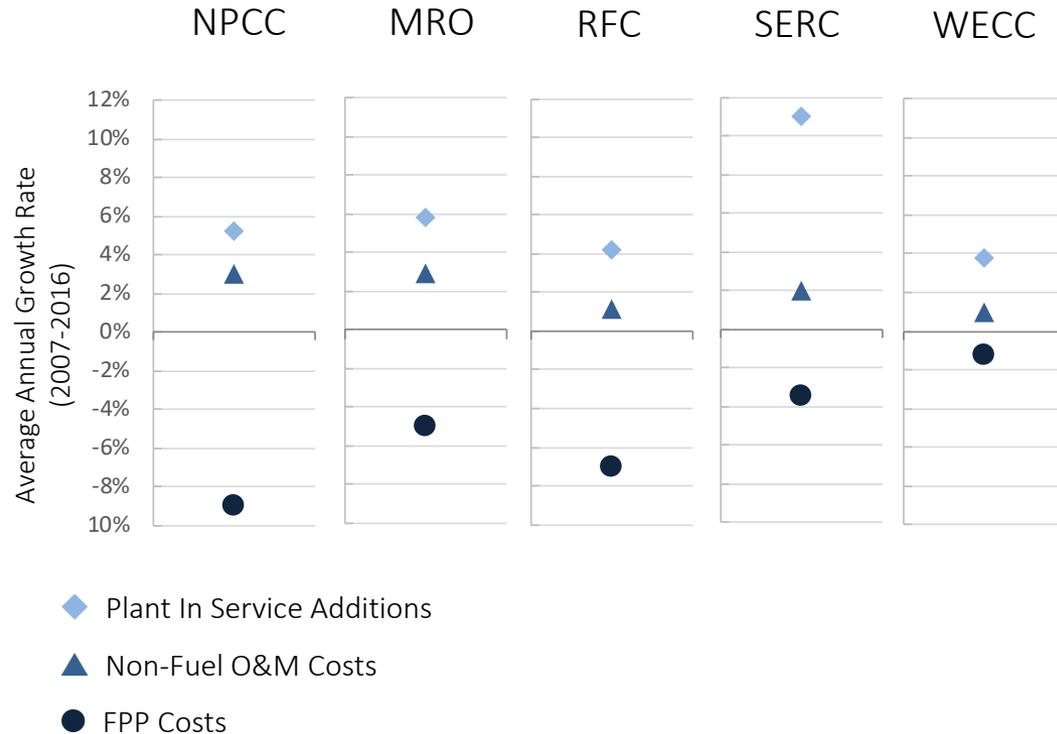
- Non-fuel related cost elements are comprised of:
 - ▣ **Non-fuel O&M:** Operations and maintenance activities associated with all utility facilities to generate and deliver electricity to ultimate consumers, except for fuel and purchased power related costs
 - ▣ **Capital-related expenditures:** Costs incurred from past and present investments in utility plant (e.g., debt service costs, taxes, depreciation)
- Unlike non-fuel O&M costs which generally exhibit modest annual changes, utility investments are often times quite large but infrequently incurred
 - ▣ Accordingly, expect to see substantial annual variability in utility plant in service additions (i.e., investments)
- To better compare/contrast trends among all major utility cost elements, focus on:
 - ▣ Average annual changes over the entire analysis period rather than annual changes each and every year
 - ▣ Plant in service additions as a proxy for capital-related expenditures to understand if and what types of current investment may be driving broader increases in non-fuel costs

5 of 5 Regions Saw Annual Increases in Non-Fuel O&M Costs



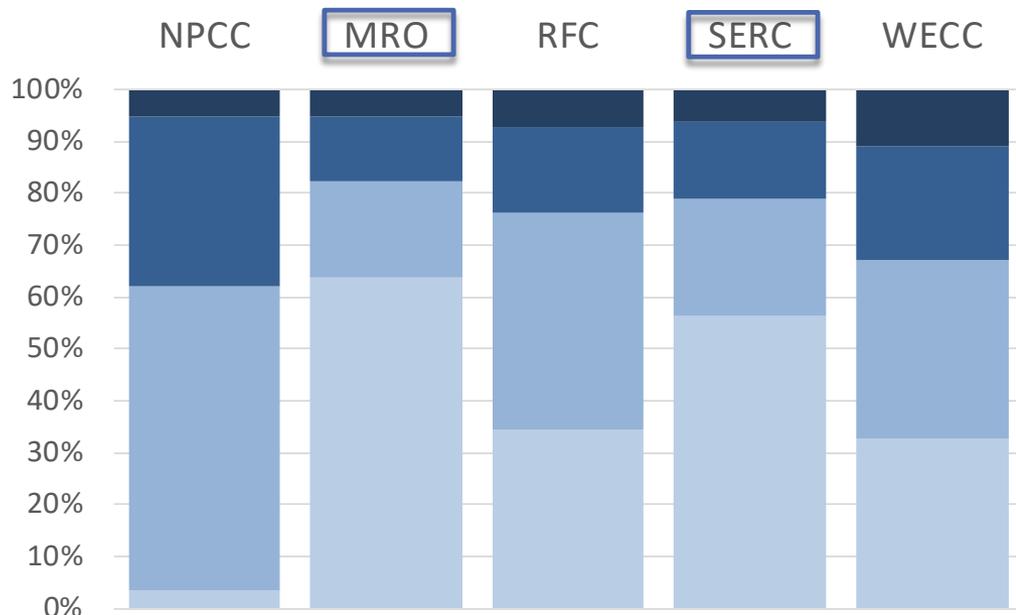
- Utilities in NPCC and MRO saw average annual non-fuel O&M cost increases of nearly 3.0%/yr
- RFC, SERC, and WECC experienced increases of 2.0%/yr or less
- Annual FPP cost reductions were considerably larger, in most cases, than annual increases in non-fuel O&M costs
- Expect that this would erode some but not all of the FPP cost savings

5 of 5 Regions Saw Increases in Plant in Service Additions

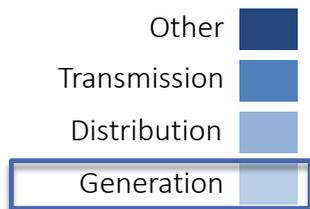


- SERC experienced 11%/yr average annual growth rate in plant in service additions
- All other regions saw average annual growth of ~4%/yr to 6%/yr
- This suggests there may have been regional differences in the magnitude and type of capital expenditures which were increasingly being undertaken

2 of 5 Regions Focused on Generation Investments

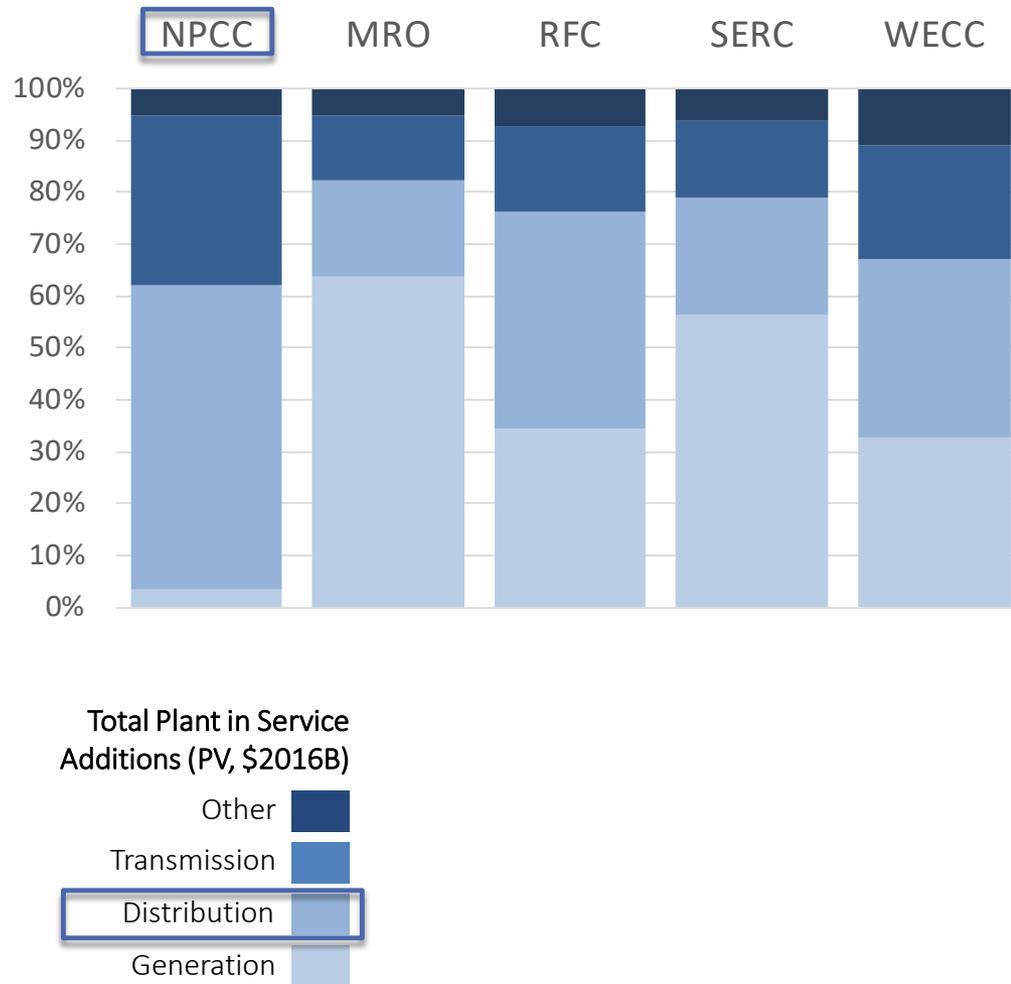


Total Plant in Service Additions (PV, \$2016B)



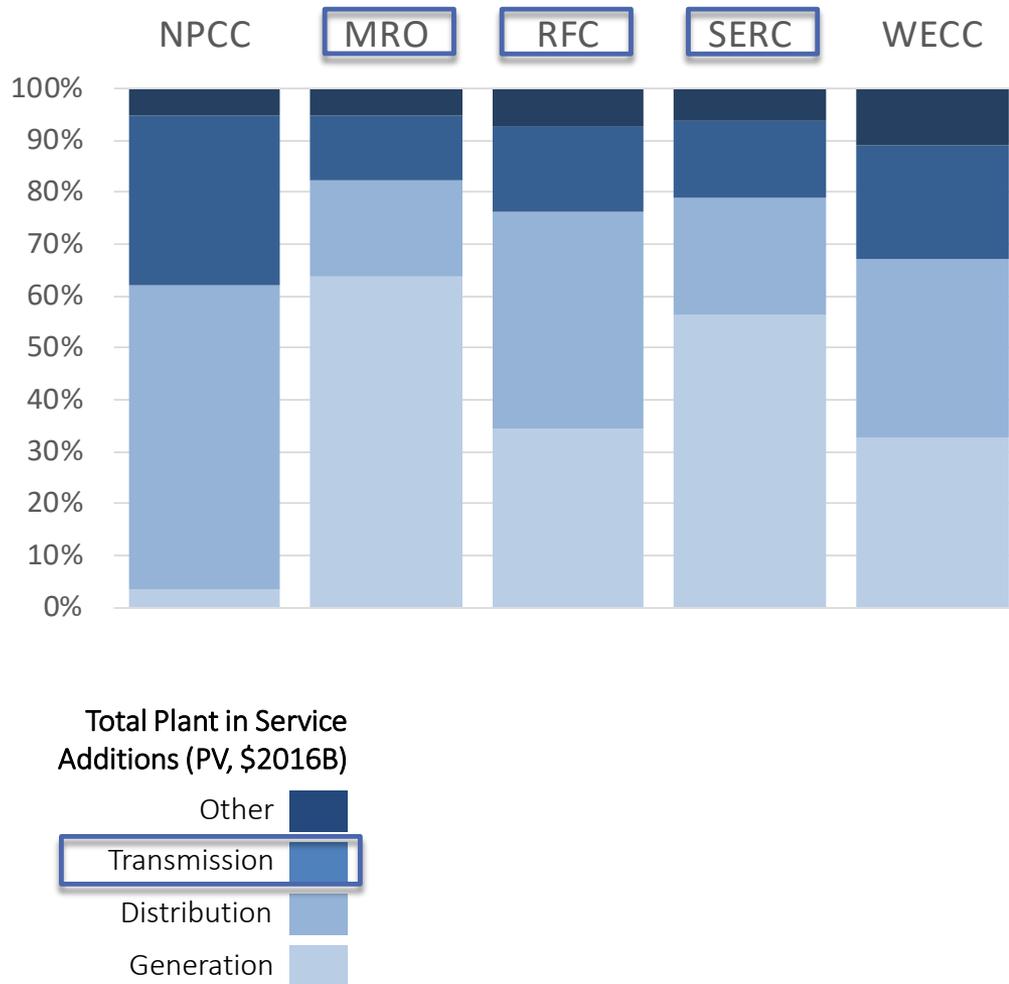
- Utilities in MRO and SERC were predominantly investing in generation assets (64% and 56% of total plant in service additions, respectively)
- RFC and WECC also sizably invested in generation resources (~35%)
- Utilities in NPCC divested of generation assets during industry restructuring (i.e., 1990s), so focused on T&D investments

1 of 5 Regions Focused on Distribution Investments



- Utilities in NPCC were predominantly investing in distribution assets (59% of total plant in service additions)
- RFC and WECC also invested sizably in distribution resources (42% and 35%, respectively)
- SERC and MRO spent less than 25% of their total plant in service additions on distribution system infrastructure

3 of 5 Regions Saw Modest Transmission Investments



- NPCC spent 33% while utilities in WECC spent 22% of total plant in service additions on transmission assets
- The other three regions invested 16% or less of their plant in service additions on transmission

Study Results – Key Reasons for the Disconnect

- **Retail and wholesale rates were increasingly disconnected across all included NERC regions between 2007 and 2016**
 - RFC and NPCC saw sizable average annual retail rate decreases (-2.2%/yr and -0.9%/yr) while utilities in MRO, SERC, and WECC experienced slight average annual retail rate increases (<0.2%/yr)
 - All NERC regions experienced substantial reductions in wholesale market prices (-4.9%/yr to -7.1%/yr)
- **Reductions in wholesale prices happened concurrently with reductions in IOU fuel and purchased power costs, but sizable regional differences in the degree of FPP cost reductions existed**
 - NPCC experienced average annual reduction in FPP costs of ~9%/yr while WECC saw slightly more than a 1%/yr contraction

Study Results – Key Reasons for the Disconnect (2)

- **Reductions in IOU FPP costs were offset in part by increases in Non-Fuel O&M costs**, but modest regional differences in the degree of these cost impacts existed
 - Utilities in MRO and NPCC generated ~3%/yr average annual growth in Non-Fuel O&M costs while utilities in all other regions produced average annual increases that were 2%/yr or less
- **Reductions in IOU FPP costs were also offset in part by increases in capital expenditures**, but regional differences in the magnitude and type of investments existed
 - SERC saw 11%/yr average annual growth in Plant in Service additions while WECC saw less than 4%/yr growth
 - NPCC saw majority of Plant in Service additions come from Distribution investments while utilities in SERC and MRO invested predominantly in Generation assets; WECC spent roughly similarly on Distribution and Generation

Study Results – Key Reasons for the Disconnect (3)

- **Reductions in retail sales tended to mitigate the effect on retail rates from reductions in total utility costs**, but regional differences existed that were sometimes counterintuitive and suggest the value in a more detailed analysis of utility costs vis-à-vis general rate case filings and decisions to better understand retail rate changes over time
 - WECC saw annual average growth in retail sales of 0.5%/yr while operating costs remained flat (on average) which would be expected to produce lower retail rates; instead the annual average change in retail rates was 0.1%/yr
 - MRO saw annual average growth in retail sales of 0.1%/yr and annual average reduction in operating costs of 0.5%/yr which would be expected to produce lower retail rates; instead ratepayers saw an average increase in retail rates of 0.2%/yr

Future Research Opportunities

- Quantitatively analyze general rate case filings, especially cost of service studies, to develop a more detailed and robust understanding of utility cost trends
- Qualitatively assess the regulatory, market, and policy drivers of these observed cost trends that may have contributed to the disconnect between retail and wholesale electric rates historically
- Quantitatively estimate the marginal effect of different key regulatory, market, and policy drivers of these observed cost trends that produced the disconnect between retail and wholesale electric rates historically
- Identify key regulatory, market, and policy drivers of retail rates over the next 10 years and quantify the range of possible impacts to determine the degree to which the current disconnect between retail and wholesale rates will increase or decrease

References

1. Ros AJ: **An Econometric Assessment of Electricity Demand in the United States Using Utility-specific Panel Data and the Impact of Retail Competition on Prices.** *The Energy Journal* 2017, **38**(4).
2. Zummo P: **Retail Electric Rates in Deregulated and Regulated States: 2017 Update.** In. Edited by American Public Power Association; 2018.
3. Morey MJ, Kirsch LD: **Retail Rate Impacts of State and Federal Electric Utility Policies.** *The Electricity Journal* 2013, **26**(3):35-49.
4. Morey MJ, Kirsch LD: **Retail Choice in Electricity: What Have We Learned in 20 Years?** In. Edited by Christensen Associates Energy Consulting: Electric Markets Research Foundation; 2016.
5. Swadley A, Yücel M: **Did residential electricity rates fall after retail competition? A dynamic panel analysis.** *Energy Policy* 2011, **39**(2011):7702-7711.
6. Su X: **Have customers benefited from electricity retail competition?** *Journal of Regulatory Economics* 2015, **47**(2):146-182.
7. Barbose G: **Putting the Potential Rate Impacts of Distributed Solar into Context.** In. Edited by Lawrence Berkeley National Laboratory; 2017.
8. Wang H: **Do Mandatory U.S. State Renewable Portfolio Standards Increase Electricity Prices?** *Growth and Change* 2016, **47**(2):157-174.

References

9. Tra CI: **Have Renewable Portfolio Standards Raised Electricity Rates? Evidence from U.S. Electric Utilities.** *Contemporary Economic Policy* 2016, **34**(1):184-189.
10. EIA: **Electricity distribution investments rose over the past two decades.** In: *Today in Energy*. Edited by U.S. Energy Information Administration; 2014.
11. Fares RL, King CW: **Trends in transmission, distribution and administration costs for U.S. investor-owned electric utilities.** *Energy Policy* 2017, **105**:354-362.
12. ASCE: **Report for America's Infrastructure.** In. Edited by American Society of Civil Engineers; 2013.
13. McCue J, Slaughter A, Sanborn S: **From growth to modernization: The changing capital focus of the US utility sector.** In. Edited by Deloitte Center for Energy Solutions; 2016.
14. EEI: **EEI Industry Capital Expenditures with Functional Detail.** In. Edited by Edison Electric Institute. Washington, D.C.; 2016.
15. EIA: **Electricity transmission investments vary by region.** In: *Today in Energy*. Edited by U.S. Energy Information Administration; 2014.
16. EIA: **Investment in electricity transmission infrastructure shows steady increase.** In: *Today in Energy*. Edited by U.S. Energy Information Administration; 2014.
17. Pfeifenberger J, Chang J, Tsoukalis J: **Investment Trends and Fundamentals in US Transmission and Electricity Infrastructure.** In: *JP Morgan Investor Conference: July 17, 2015* 2015.
18. EIA: **Electricity prices reflect rising delivery costs, declining power production costs.** In: *Today in Energy*. Edited by U.S. Energy Information Administration; 2017.

References

19. Morgan P: **A Decade of Decoupling for U.S. Energy Utilities: Rate Impacts, Designs, and Observations**. In. Edited by Graceful Systems LLC; 2012.
20. Lang K: **The Effects of Electric Utility Decoupling on Energy Efficiency**. *The Energy Journal* 2016, **37**(4).
21. Lesh P: **Rate Impacts of Key Design Elements of Gas and Electric Utility Decoupling: A Comprehensive Review**. *The Electricity Journal* 2009, **22**(8):65-71.
22. Lowry MN, Makos M, Deason J, Schwartz L: **State Performance-Based Regulation Using Multiyear Rate Plans for U.S. Electric Utilities**. In. Edited by Lawrence Berkeley National Laboratory. Berkeley, CA; 2017.
23. **Electricity distribution investments rose over the past two decades - October 24, 2014**
[<http://www.eia.gov/todayinenergy/detail.cfm?id=18531>]