MANAGEMENT/PERFORMANCE AND FINANCIAL AUDIT OF THE ALTERNATIVE ENERGY RIDER OF OHIO POWER COMPANY

Prepared for

Public Utilities Commission of Ohio

By

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January 16, 2019

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London Economics International ("LEI") was engaged by the Public Utilities Commission of Ohio ("the Commission" or "PUCO") to conduct a management/performance and financial audit of the Alternative Energy Rider ("AER") of Ohio Power Company d/b/a AEP Ohio. The Commission engaged LEI through RFP No. RA18-AEPAER-1.

LEI's scope of work encompassed an assessment of the management performance and financial aspects of the AER recovery mechanism of AEP Ohio for the period of January 1, 2015, through December 31, 2017. The scope of work included an assessment of:

- ***AEP Ohio's AER rates compared to other Ohio utilities;***
- ***AEP Ohio's status relative to the 3 percent cap on the cost of compliance with renewables standards;***
- ***AEP Ohio's methodology for calculating RECs costs;***
- ***AEP Ohio's capacity cost assumptions;***
- ***AEP Ohio's loss factors used in the AER; and***
- ***the impact of a proposed change in the AER true-up period on customers.***

LEI's approach to this management/performance and financial audit was to rely on information LEI requested from AEP Ohio, primarily through formal data requests. LEI also relied on publicly-available data, which is used throughout this report to provide context, comparison, and benchmarks.

Overall, regarding the management performance audit, LEI found that AEP Ohio's compliance activities generated high AER costs. LEI found some areas that could be improved upon and result in opportunities for AEP Ohio to reduce costs to customers.

Regarding the financial audit of the AER recovery mechanism, Maloney + Novotny ("M+N"), recommends that AEP Ohio consider two new approaches to calculating AER rates: (i) include only the billed rider revenue component to the renewable revenue calculation; and (ii) use a simpler true-up process to help mitigate AER rate volatility.

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Table of Contents

Table of Figures

1 Executive summary and recommendations

1.1 Objective and purpose

Ohio's Revised Code (R.C.) 4928.64(B)(2) established a benchmark for distribution utilities such as AEP Ohio to acquire a portion of its supply of electricity for Ohio retail customers from renewable energy sources. The benchmarks are widely referred to as renewable portfolio standards ("RPS") and can be met through the purchase of renewable energy credits ("RECs") or solar renewable energy credits ("SRECs"), as well as through the purchase of renewable energy. In the case of AEP Ohio, the vast majority of the standard has been met each year by power purchase agreements ("PPAs) with renewable energy generation facilities. The alternative energy rider ("AER") is the mechanism used by Ohio's electric distribution utilities to recover RPS requirement compliance costs.

On May 2, 2018, the Commission issued Request for Proposal ("RFP") No. RA18-AEPAER-1 to perform a management/performance and financial audit of the Ohio Power Company d/b/a AEP Ohio.[1] On June 20, 2018, the Commission selected London Economics International LLC ("LEI") to perform the audit; LEI engaged Maloney + Novotny ("M+N"), an Ohio-based accounting firm, to conduct the financial portion of the audit.

1.1.1 LEI general scope of work

LEI was selected by the Commission to investigate the management performance and financial aspects of the AER recovery mechanism of AEP Ohio for the period of January 1, 2015 through December 31, 2017. The assessment of the management performance included:

- ***RPS compliance:*** review of the AEP Ohio's compliance activities as they relate to RECs and SRECs procurement and utilization;
- ***RECs and SRECs cost:*** assessment of the reasonableness of the prices paid by AEP Ohio compared with market prices; and
- ***utility industry perspective:*** a discussion of the current dynamics of the industry in which AEP Ohio operates, and the impact that these dynamics have on the AER.

The financial audit, performed by M+N, included:

- a review of AEP Ohio's AER quarterly filings during the audit period to verify the accuracy of the information and calculations;
- a review of the individual components of the AER rates in order to verify that the costs were appropriately included;

[1] PUCO Case No. 18-0080-EL-RDR

- a comparison of the costs recovered through AEP Ohio's AER during the audit period to the costs incurred.

1.1.2 Other specific areas of focus

In addition to the general scope of work, the Commission specifically asked LEI to examine:

- AEP Ohio's AER rates compared to other Ohio utilities;
- AEP Ohio's status relative to the 3 percent provision contained within R.C. 4928.64(C)(3);
- AEP Ohio's methodology for calculating RECs costs;
- AEP Ohio's capacity cost assumptions;
- AEP Ohio's use of loss factors in the AER; and
- the impact of a potential change in the AER true-up period on customers.

1.2 LEI's audit approach

LEI's approach to the management/performance and financial audit was to rely on information LEI requested from AEP Ohio, primarily through formal data requests. In-person interviews at site visits and conference calls were also performed:

- LEI issued formal data requests over the time period July 18, 2018 through November 19, 2018, and kept a database and numbering system which logged requests issued and requests received; and
- M+N made a site visit to AEP Ohio headquarters in Columbus, OH on October 24-25, 2018.

LEI's compared AEP Ohio's AER costs against industry data from publicly-available data sources, to provide insight into the reasonableness of AEP Ohio's compliance activities.

This audit report is presented in nine chapters:

Chapter 1: Executive summary and recommendations
Chapter 2: Introduction
Chapter 3: Utility industry context
Chapter 4: Verifying RPS compliance
Chapter 5: Total cost of compliance compared to 3 percent cost cap
Chapter 6: Examining AEP Ohio's approach to calculating AER costs
Chapter 7: AEP Ohio's RECs procurement and inventory strategy
Chapter 8: Other assumptions which impact the AER
Chapter 9: Financial audit

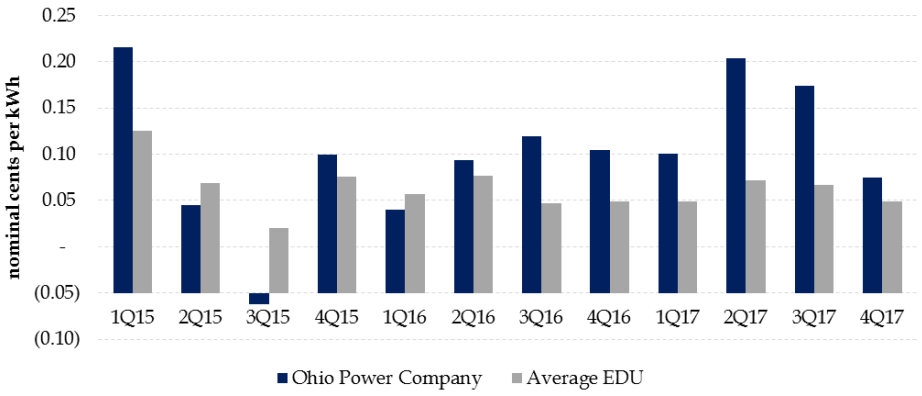
Chapters 4 through 8 are organized in the same way, beginning with a statement of the scope of the audit and background information to provide context, followed by the evaluative criteria used in the audit, LEI's findings, and finally LEI's recommendations.

The financial audit, in Chapter 9, is organized in a similar way, beginning with a statement of the scope and objectives of the audit; followed by the standards utilized in the audit, M+N's findings, and finally M+N's recommendations.

1.3 LEI's findings and recommendations

Overall, LEI found that AEP Ohio's compliance activities generated relatively high AER rates. This is the result of high-priced (compared to current energy price levels) PPAs that the company carries (namely the Renewable Energy Purchase Agreements ("REPAs")) and the residual methodology used by AEP Ohio to calculate the RECs price. The REPAs account for the vast majority of AEP Ohio's AER compliance costs, and the REPAs are discussed in detail in this audit report. AEP Ohio's higher cost of compliance created higher than average AER rates during most of the audit period (see Figure 1).

Figure 1. AER rates during the audit period



Source: PUCO[2]

LEI found some areas that could be improved upon, to reduce costs to customers. Below is a summary of LEI's findings and recommendations.

1.3.1 AEP Ohio appears to have met its RPS targets

AEP Ohio appears to have met the RPS requirements during the 2015 – 2017 audit period, as discussed in Section 4. The vast majority of compliance was met through the REPAs.

As discussed in Section 7, the REPAs generate more RECs than were needed for compliance during the audit period and at a higher cost than what was available in traded markets. As a result, AEP Ohio is building up REC inventory at a very high cost. LEI recommends that AEP

[2] PUCO. "Ohio renewable portfolio standard." Accessed on October 2018. <https://www.puco.ohio.gov/industry-information/industry-topics/ohioe28099s-renewable-and-advanced-energy-portfolio-standard/>

Ohio study alternatives to its current banking strategy with a view to reducing the cost of RECs to its customers. AEP Ohio should also review the terms of its PPAs to take advantage of any flexibility that could allow AEP Ohio to buy less generation and therefore slow the large buildup in RECs inventory.

1.3.2 AEP Ohio compliance cost seems to be mostly within the 3 percent cost cap

AEP Ohio currently has not calculated its cost of compliance relative to the cost of serving customers in the absence of the renewable energy requirement. It argues this is not necessary, citing its interpretation of Ohio Revised Code 4928.641 as discussed in more detail in Section 5.

LEI created its own estimate of the 3 percent compliance cap with data provided by AEP Ohio, assuming the cap refers to the cost of energy generation only (and not the other costs of delivering power to customers). LEI feels this is the appropriate comparison to use because the cost of renewable compliance is an energy—only requirement. Using LEI's assumption, the company seemed to be within the 3 percent cap in 2015 and 2016, but not in 2017. The calculation performed by LEI is an estimate, as discussed in Section 5.

In order to assist the Commission with its evaluation of the 3 percent cap, LEI recommends AEP Ohio develop such calculation at a quarterly level. As detailed in Section 5, AEP Ohio could perform the calculation for the audit period using historical AEP Ohio load zone prices (locational marginal prices ("LMPs")) and energy delivered to standard service offer ("SSO") less Economic Development customers. It can be performed for forecast periods using reasonable estimates of energy and RECs prices.

1.3.3 AEP Ohio's costs are relatively high owing to use of PPAs and the residual methodology for calculating RECs costs

AEP Ohio's AER costs are higher than other utilities in Ohio because, rather than purchasing RECs on traded markets, AEP Ohio entered into three PPAs with wind and solar plants. As discussed in Section 7, these long-term contracts were secured between 2009 and 2013 when energy prices were higher than during the audit period. AEP Ohio uses a residual methodology to calculate the renewable component of the cost of the PPAs (discussed in Section 6), such that the renewable component (REC price) is equal to the total cost of the PPA, less capacity and energy revenues. As energy prices have declined, the residual REC cost has increased.

LEI does not believe AEP Ohio's residual methodology accurately reflects the cost of renewable energy because any long-term contract incorporates many factors. These factors (discussed in more detail in Section 6) make it illogical to assign a given portion of a long-term contract to REC costs in a given year or quarter. LEI believes using RECs and SRECs market values reported publicly in trade publications for the quarterly periods of the audit to calculate the AER is the most appropriate approach.

AEP Ohio argued that the company is allowed to recover the full cost of the PPAs from customers, stating:

> *"Ohio revised code 4928.641 states, "If an electric distribution utility has executed a contract before April 1, 2014, to procure renewable energy resources and there are ongoing costs associated with that contract that are being recovered from customers through a bypassable charge as of the effective date of S.B. 310 of the 130th general assembly, that cost recovery shall continue on a bypassable basis until the prudently incurred costs associated with that contract are fully recovered." …[t]he REPAs entered into by AEP Ohio, and supported by the Commission, fall within this category and, as such, are to remain recoverable as a bypassable charge for the term of the contracts."* [3]

It is LEI's understanding that with this statement AEP Ohio is arguing that, whatever methodology is used for calculating the AER, it will not change the bottom line for rate payers. Consumers will pay the whole cost of the REPAs one way or another. However, the Energy Security Plan which authorized the AER states:[4]

> *As to the allocation of cost components. Staff agrees with the Company's proposal to allocate cost components of bundled products but suggests that the auditor detail how to best determine the cost components and how to apply the allocation to specific situations in the context of the FAC/AER audits. Staff recommends, and the Company agrees, that the auditor's allocation process be applied to AEP-Ohio's renewable generation from existing generation facilities. (Staff Ex. 104 at 2-3).*

Therefore, as noted above, LEI believes using market values for RECs and SRECs to calculate the AER is the most appropriate approach. This could serve as an initial allocation for the purposes of the AER calculation. If the total of market-based RECs, energy, and capacity prices fall short of the total bundled cost of the PPA, then the shortage could be spread over the three components based on an agreed-upon proportion.

LEI also recommends that any PPAs that AEP Ohio solicits for the purposes of acquiring renewable energy be scrutinized by the Commission and compared to RECs market prices.

1.3.4 Use of loss factors for different voltage classes is not necessary and results in over-charging secondary voltage customers

AEP Ohio applies loss factors to the AER rate calculation. AEP Ohio recovered about $50,000-$100,000 more per year using voltage class loss multipliers combined with generation-level kWh sales in calculating the AER rates than they would have if they had calculated their AER rates based on delivered kWh sales with no loss multipliers. In Section 8.3.1, LEI concludes that the over-recovery of costs was at the expense of secondary voltage customers. LEI recommends

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[3] AEP Ohio. "3rd Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." October 11, 2018. DR LEI-6-4.

[4] PUCO Opinion and Order. Docket No. 11-346-EL-SSO, et al. P. 18. <http://dis.puc.state.oh.us/TiffToPDf/A1001001A12H08B40046F08138.pdf>

simplifying the recovery calculation by spreading the AER cost across delivered kWh sales rather than kWh generated, which would eliminate the need to use loss factor multipliers.

1.3.5 Quarterly true-up period should not be changed to semi-annual

AEP Ohio currently updates the AER rates on a quarterly basis and has proposed changing the true-up period from quarterly to semiannually. The goal of this would be to help reduce volatility of customer bills.

LEI does not recommend changing the true-up period from quarterly to semi-annually because, as discussed in Section 8.3.2, there is already a six-month lag for customers to be trued-up. AEP Ohio can change its methodology for forecasting RECs needs if it wishes to produce more accurate forecasts and smooth out bills.

1.4 M+N's findings and recommendations

1.4.1 Renewable revenue should only include billed rider revenue

As discussed in Section 9, AEP Ohio's AER monthly revenue is comprised of three components: Billed Rider Revenue, Estimated Rider Revenue, and Unbilled Rider Revenue. Some of those components reflect previous rates.

M+N recommends that, when AEP Ohio prepares reconciliation adjustment ("RA") Schedule 4, Renewable Revenue should only include Billed Rider Revenue, which is the actual amount billed to a customer.

1.4.2 A simpler RA true-up process can avoid AER rate volatility

As discussed in Section 9, AEP Ohio currently includes a beginning balance in the calculation of the RA component of the AER rate, which reflects past results from potentially every period prior to the current period.

M+N recommends AEP Ohio adopt a simpler methodology which fully trues up every quarter independently and without reference to historical quarters.

1.5 Issues and recommendations identified in previous audit

The most recent audit, performed by Energy Ventures Analysis and Larkin Associates and published November 30, 2015, focused on the Fuel Adjustment Clause rider ("FAC") and did not have specific recommendations to the AER rider.[5] Before that, the audit performed by Energy

[5]PUCO. "Report of the management/performance and financial audits of the FAC of the Ohio Power Company." Case No. 11-5906-EL-FAC, 12-3133-EL-FAC, 13-572-EL-EFC, 13-1286-EL-EFC, and 13-1892-EL-FAC, et al. November 30, 2015.

Ventures Analysis and Larkin Associates published May 9, 2014, recommended that AER results should be recalculated to reflect the $188.88/MW-day capacity charge that the Commission determined in Case No. 10-2929-EL-UNC was fair and reasonable.[6] LEI does not agree with this recommendation; as noted above, LEI believes RECs and SRECs market prices should be used to calculate AER costs and rates.

[6] PUCO. "management/performance and financial audits of the Fuel and Purchased Power Rider and the Alternative Energy Rider of the Ohio Power Company. Case No. 13-1892-EL-FAC. May 9, 2014. P. 1-28.

2 Introduction

2.1 Ohio's renewable portfolio standards

Ohio, like most other states in the PJM regional transmission organization ("RTO"), has targets for renewable energy. In 2008, S.B. 221 broadly restructured the electricity industry, and included an Alternative Energy Portfolio Standard ("AEPS," now referred to as a Renewable Portfolio Standard ("RPS")) which set out renewable generation and advanced energy resources procurement requirements (see Figure 2). In 2014, S.B. 310 froze the RPS for two years; ramp-up resumed in 2017.

Figure 2. Ohio RPS for renewable sources

S.B. 221	S.B. 310	Renewable (%)	Solar (%)	Non-solar (%)
2009		0.25	0.004	0.246
2010		0.50	0.010	0.490
2011		1.00	0.030	0.970
2012		1.50	0.060	1.440
2013		2.00	0.090	1.910
2014		2.50	0.120	2.380
2015		2.50	0.120	2.380
2016		2.50	0.120	2.380
	2017	3.50	0.150	3.350
	2018	4.50	0.180	4.320
	2019	5.50	0.220	5.280
	2020	6.50	0.260	6.240
	2021	7.50	0.300	7.200
	2022	8.50	0.340	8.160
	2023	9.50	0.380	9.120
	2024	10.50	0.420	10.080
	2025	11.50	0.460	11.040
	2026 +	12.50	0.500	12.000

Source: Ohio Revised Code ("ORC") 4928.64(B)(2) <http://codes.ohio.gov/orc/4928.64>

Ohio utilities may meet their renewable and solar-specific obligations by purchasing qualified RECs. These are defined as the environmental attributes associated with one megawatt hour ("MWh") of electricity generated by a renewable energy resource. Under the RPS, RECs have a

lifetime of five years following their acquisition.[7] To use RECs for compliance, a utility must be registered with PJM's generation attribute tracking system ("GATS"), the Midwest Renewable Energy Tracking System ("M-RETS") or other tracking system approved by PUCO.[8]

The variety of state targets, requirements, and eligibility criteria for RPS programs across the states neighboring Ohio creates a wide and complex market for RECs.

2.2 Introduction to AEP Ohio

AEP Ohio is a regulated utility serving almost 1.5 million customers in Ohio and the northern panhandle of West Virginia. AEP Ohio is a subsidiary of American Electric Power ("AEP") and the largest of its regional utility divisions. The company is headquartered in Gahanna, Ohio, with regulatory and external affairs offices in downtown Columbus.

Figure 3. AEP Ohio Facts

Customers	1,467,072
Employees	1,551
Transmission Lines	8,195 circuit miles
Distribution Lines	45,718 miles
Assets	$9.8 Billion

Source: AEP Ohio[9]

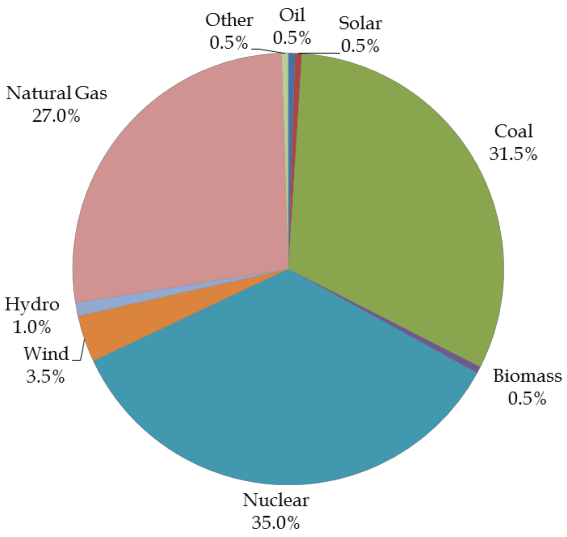
As of June 2018, AEP Ohio's load was served from mainly by nuclear, coal, and natural gas resources (see Figure 4).

[7] Ohio Administrative Code ("OAC") 4901:1-40-04(D)(3) <http://codes.ohio.gov/oac/4901:1-40-04>

[8] OAC 4901:1-40-04(D)(2) <http://codes.ohio.gov/oac/4901:1-40-04>

[9] AEP Ohio. "AEP Ohio Facts." Accessed on October 2018. <https://www.aepohio.com/info/facts/Facts.aspx>

Figure 4. Energy generation mix for serving AEP Ohio's load 01/01/18 to 06/30/18



Note: Generation sourced from wholesale energy auctions, not self-generated by AEP Ohio.
Source: AEP Ohio[10]

2.3 Alternative Energy Rider ("AER")

The AER is used by Ohio's electric distribution utilities ("EDUs") to recover RPS requirement compliance costs (except for the Alternative Compliance Payment discussed in more detail below). The AER passes the cost of RECs along to customers based on a volumetric charge.[11] AER rates are updated quarterly and become effective unless the Commission raises issues prior to the billing cycle.

In the fourth quarter of 2018, the AER rates in Ohio ranged between 0.01354 cents per kWh and 0.07850 cents per kWh depending on the EDU (see Figure 5).[12] The average monthly bill impact for residential customers – assuming monthly usage of 750 kWh – ranged between $0.10 and $0.59.

[10] AEP Ohio. "Environmental Disclosure Information – Quarterly Comparisons." June 30, 2018. Accessed on October 2018. <https://www.aepohio.com/global/utilities/lib/docs/environment/2018JuneQuarterlyComparison.pdf>

[11] Industrial and large customer that consumes a larger volume of electricity experience a larger average bill impact than a residential customer with a relatively small electricity usage.

[12] PUCO. "Renewable Portfolio Standard / Rate Impacts 4th Quarter 2018." Accessed on October 2018. <https://www.puco.ohio.gov/industry-information/industry-topics/ohioe28099s-renewable-and-advanced-energy-portfolio-standard/renewable-portfolio-standard-rate-impacts-4th-quarter-2018/>

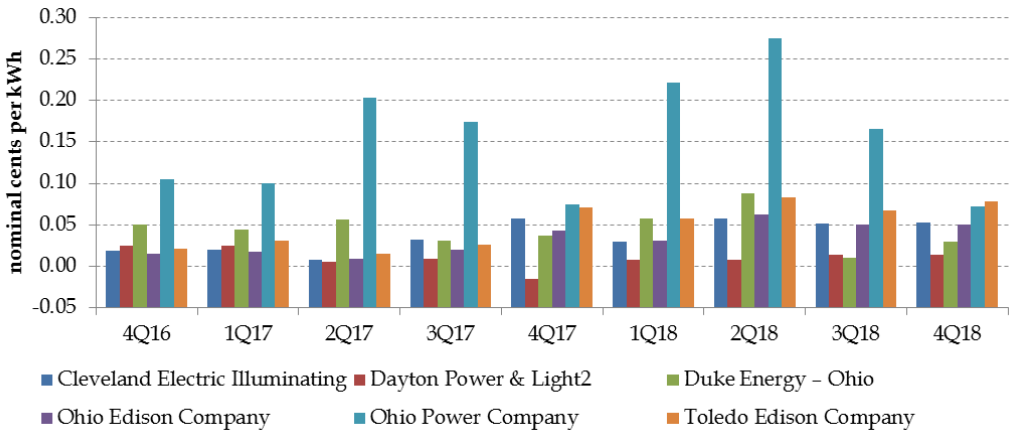
Figure 5. Sample AER rates - 4Q2018

EDU	AER Rate ($/kWh)	Average Monthly Bill Impact (total $)
Cleveland Electric Illuminating	0.0005270	$0.40
Dayton Power & Light2	0.0001354	$0.10
Duke Energy – Ohio	0.0002970	$0.22
Ohio Edison Company	0.0005050	$0.38
Ohio Power Company	0.0007250	$0.54
Toledo Edison Company	0.0007850	$0.59

Source: PUCO[13]

The Ohio Power Company's AER rates were significantly higher than other EDUs in Ohio until the fourth quarter of 2018 (see Figure 6).

Figure 6. AER rates – historical



Source: PUCO

For AEP Ohio, the AER includes: i) recovery of the cost of company-owned solar panels installed on company service centers, as well as ii) recovery of REC and SREC expenses (predominately from REC and SREC cost of three REPAs, which will be discussed in more detail later), and other costs such as: incremental internal labor, GATS fees, and broker fees (see Figure 7).[14]

[13] Ibid.

[14] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. DR LEI-1-1.

Figure 7. AER chart of accounts

Source: 2nd Set of Responses to PUCO Auditor LEI 18-0080_LEI-5-10

"Choice" customers, i.e., customers who buy generation from Competitive Retail Electric Service Providers ("CRES providers") are not charged the AER. Only standard service offer ("SSO") customers (excluding "Economic Growth customers", discussed in more detail later) are charged the AER rider.

2.3.1 Role of the Alternative Compliance Payment

In most states, if a load-serving entity ("LSE") cannot meet the RPS, the LSE may resort to an alternative compliance payment ("ACP"). The non-solar ACP in Ohio was initially set at $45 per MWh in 2010; it is adjusted annually by the Commission according to the federal Consumer Price Index; for 2017 it was $50.24/MWh.[15] The solar ACP was $300/MWh for 2015 and 2016; and $250/MWh for 2017. ACPs can generally be recovered from customers by regulated utilities,[16] but, as LEI understands it, not in Ohio.[17]

[15] PUCO. "ACP: Annual adjustment of the non-solar alternative compliance payment." Accessed on October 2018. <https://www.puco.ohio.gov/industry-information/industry-topics/acp-non-solar-alternative-compliance-payment-under-orc-492864/>

[16] EPA Energy and Environment Guide to Action. Accessed on October 2018. <https://www.epa.gov/sites/production/files/2017-06/documents/guide_action_chapter5.pdf>

[17] ORC 4928.64(C)(2)(c) <http://codes.ohio.gov/orc/4928.64>

3 Utility industry context

Like the rest of the PJM region, AEP Ohio has seen a decrease in electricity demand (load) over the last few years. For AEP Ohio, the decrease in peak load has been notable. The adoption of energy efficiency measures and distributed generation may further reduce load. On the other hand, electrification of transport and new electricity-intensive industries, such as data centers and crypto-currency mining, might support load growth in the future.

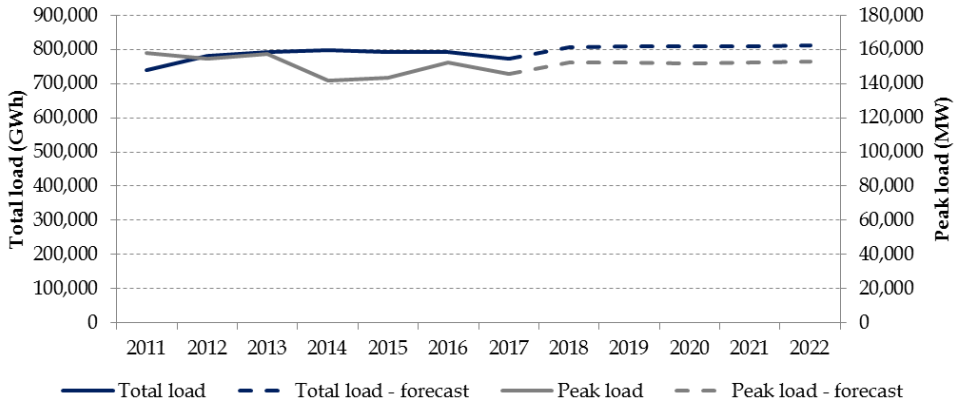
The share of load in utility service territories in Ohio served by CRES providers is growing. CRES providers account for over 70 percent of retail sales in Ohio.

3.1 Trends in load growth in PJM, Ohio, and AEP Ohio

Total annual electricity consumption in the PJM territory has been relatively flat since 2012 (see Figure 8). Prior to that, total load in PJM had grown following the financial crisis and accompanying recession in 2008/2009. Although total load fell 4.3 percent in 2017 owing to weaker demand from industrial sectors, PJM (the independent system operator) expects it to grow only gradually.[18]

Peak load (i.e. the maximum demand in the peak hour) in the PJM region decreased sharply by 10.1 percent in 2014. It grew again in the two years after 2014, but peak load in 2017 was still 7.5 percent lower than what it was in 2013. The PJM system operator forecasts very slow load growth after 2018.[19]

Figure 8. Total load (energy consumed) and peak load trends - PJM



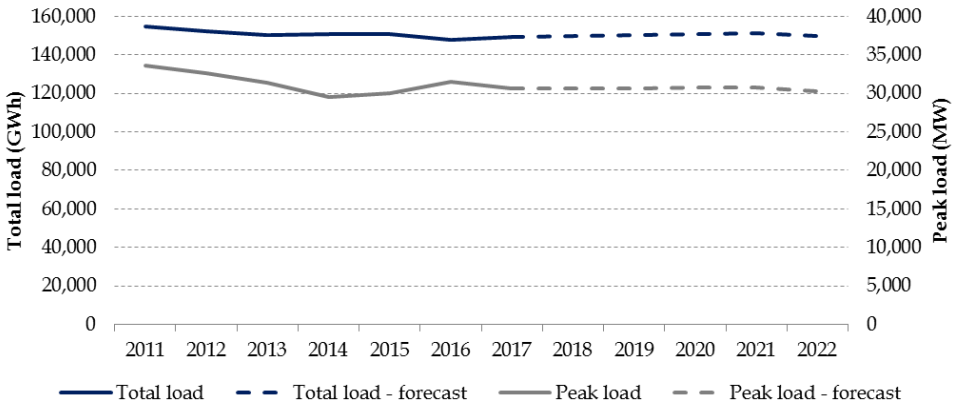
Source: PJM Metered Load Data 2011 – 2017; PJM 2018 Load Forecast Report Data.

[18] PJM 2018 Load Forecast Report Data.

[19] PJM 2018 Load Forecast Report Data.

In Ohio, peak load declined more sharply than overall load between 2011 and 2014; just as in PJM, peak load was lowest in 2014 but recovered somewhat since then. In the longer run, the PUCO expects both overall and peak load to remain flat or decline after 2018.

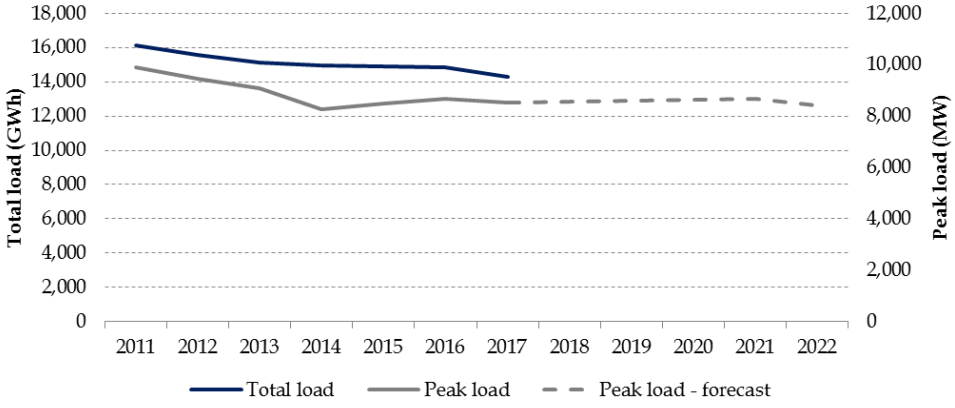
Figure 9. Total load and peak load trends - Ohio



Source: PUCO. *Ohio Long-Term Forecast of Energy Requirements. 2017-2036.* May 7, 2018.

Peak load in AEP Ohio's territory has also declined since 2011, with the steepest decrease in 2014. Even though peak load grew by 3.4 percent between 2014 and 2017, peak load in 2017 was 13.6 percent lower than what it was in 2011. Going forward, PUCO projects peak load to decline slightly in the AEP Ohio's territory. Peak load fell more sharply in AEP Ohio's territory than in PJM or the state of Ohio (see Figure 11).

Figure 10. Total load and peak load trends - AEP Ohio



Source: PUCO. *Ohio Long-Term Forecast of Energy Requirements. 2017-2036.* May 7, 2018; PUCO. *Electric customer choice switch rates and aggregation activity.*

Note: Load data includes load served by AEP Ohio as well as CRES suppliers.

Figure 11. Comparison of peak load growth rates

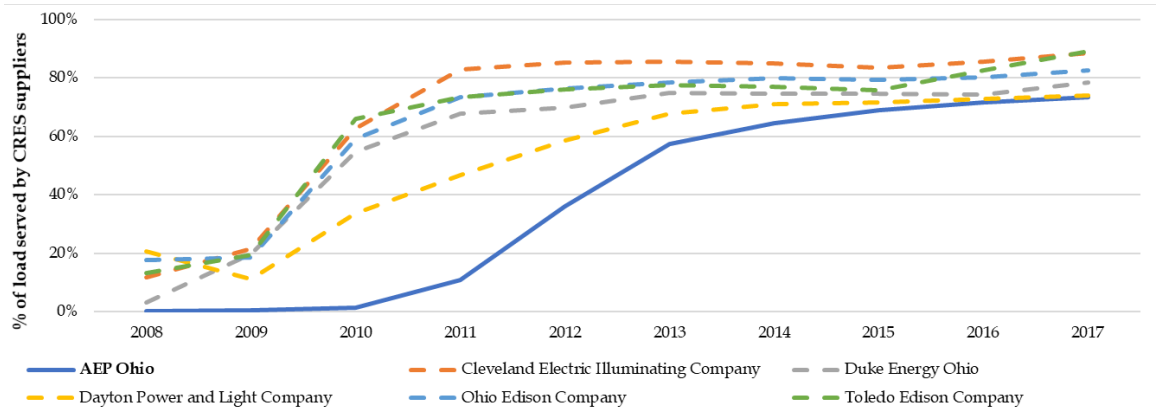
	Year-over-year change in peak load						Change in peak load between 2011 - 2017
	2012	2013	2014	2015	2016	2017	
PJM	(2.3%)	2.1%	(10.1%)	1.4%	5.9%	(4.3%)	(7.8%)
Ohio	(2.8%)	(3.8%)	(5.9%)	1.4%	5.0%	(2.8%)	(9.0%)
AEP Ohio	(4.5%)	(3.7%)	(9.3%)	2.8%	2.4%	(1.7%)	(13.6%)

3.2 Trends in customer shopping

Ohio restructured its energy market in 1999 with Senate Bill 3 ("S.B. 3"), which became effective beginning in 2001. With S.B. 3, customers could choose between their monopoly utility and CRES providers to buy energy.

In AEP Ohio's territory, customer load started switching to CRES suppliers in meaningful numbers in 2011. In 2017, AEP Ohio still had the lowest percentage of load served by CRES suppliers amongst the Ohio IOUs, but it was closer to the percentage at other utilities. More customers continued to switch to CRES suppliers in 2017.

Figure 12. Percentage of retail sales by CRES Providers in each IOU service territory

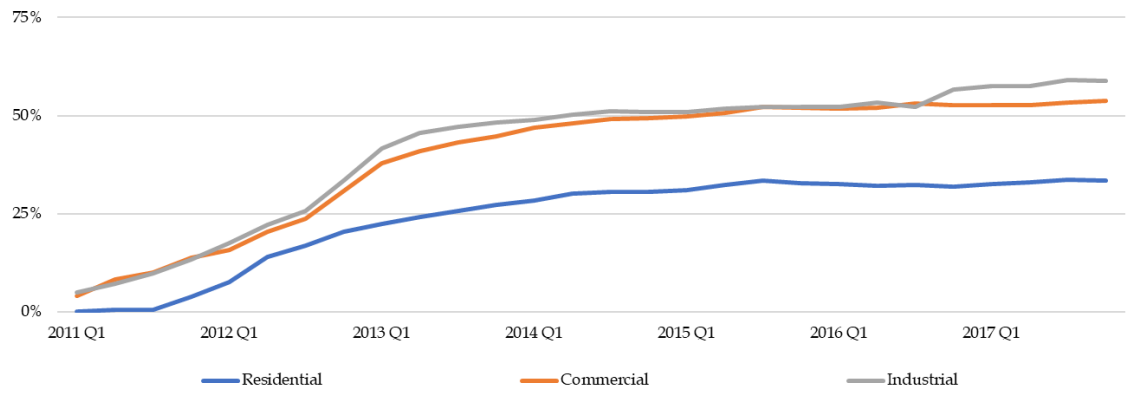


Source: PUCO. *Electric customer choice switch rates and aggregation activity.*

As of Q4 2017, over half of commercial and industrial customers of AEP Ohio have switched, but only about a third of residential customers have done so. Of AEP Ohio's 1.5 million customers (as of Q4 2017), residential customers comprised 87.2 percent, commercial customers 12.1 percent, and industrial customers 0.7 percent.[20] Switch rates among all three customers classes have been growing slowly since 2015.

[20] PUCO. "Electric customer choice switch rates and aggregation activity." May 14, 2018. <https://www.puco.ohio.gov/industry-information/statistical-reports/electric-customer-choice-switch-rates-and-aggregation-activity/>

Figure 13. Percentage of AEP Ohio customers switching to CRES providers



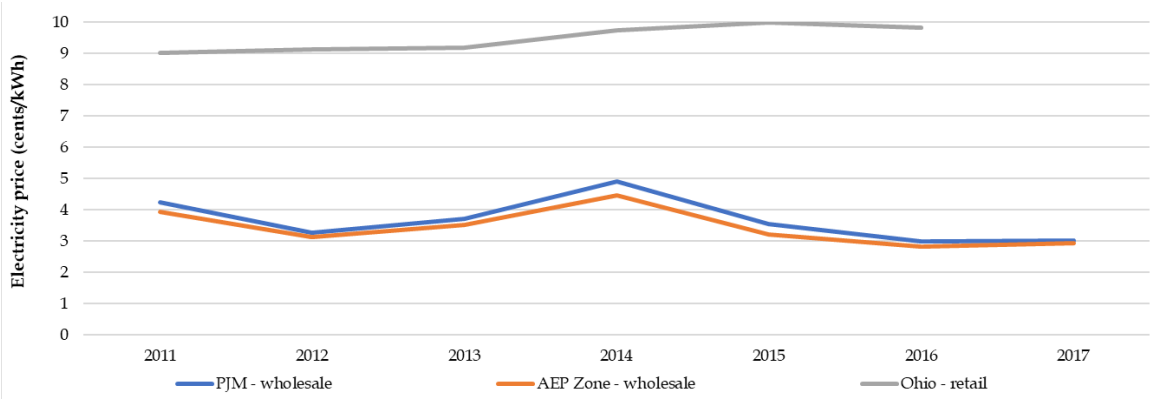
Source: PUCO. *Electric customer choice switch rates and aggregation activity.*

3.3 Trends in energy, capacity, RECs, and SRECs prices

3.3.1 Wholesale energy and capacity prices

Wholesale electric energy prices have generally declined since 2011 in the PJM region, except for a large spike in 2014 caused by extremely cold weather during the Polar Vortex. Between 2011 and 2017, average annual energy prices decreased by 29 percent across the PJM RTO and by 25 percent in PJM's AEP Zone.

Figure 14. Electric energy prices (2011 - 2017)



Source: Energy Velocity Suite; EIA State Electricity Profiles.

PJM runs a capacity market to ensure long-term reliability, conducting three-year forward auctions to procure the supply needed to meet predicted demand. Capacity clearing prices in PJM have fluctuated in recent years. PJM's transition to procure only capacity performance ("CP") products starting in the 2020/2021 delivery year may result in higher capacity prices in the future. Also, new entry, retirements, and changes in parameters impacting the demand curve may impact capacity prices.

Figure 15. PJM capacity auction clearing price by delivery year ($/MW-day)

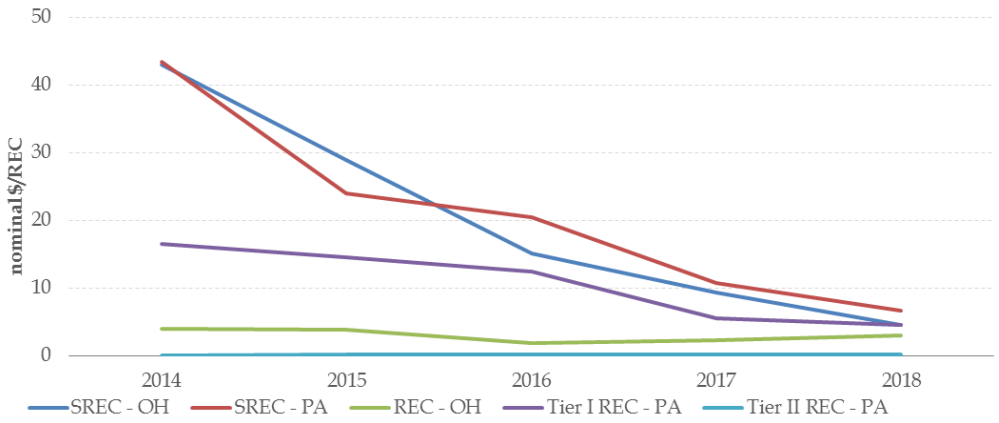
2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
$110.00	$16.46	$27.73	$125.99	$136.00	$59.37	$120.00	$164.77	$100.00	$76.53	$140.00

Source: PJM.

3.3.2 RECs and SRECs prices

Utilities in Ohio can purchase RECs to meet their annual obligation under the RPS. SRECs can be used for compliance with the solar carve-out. As noted previously, each credit is equal to one MWh of electricity generated from a renewable energy resource. Once a utility uses a REC or an SREC to meet its RPS obligation, the REC or SREC is retired. A utility can keep RECs and SRECs on its books for five years after acquisition before they must be retired or lose their value.[21] REC and SREC prices decreased sharply between 2014 and 2018 (see Figure 16).

Figure 16. REC/SREC prices



Source: SNL.

3.4 Impact on AEP Ohio's AER

3.4.1 Trends in load

The generally declining load in AEP Ohio's service territory is having an impact on the AER. As LEI discusses in more detail in Section 8.3.2, during the audit period AEP Ohio frequently overestimated monthly forecasted REC needs for billing purposes. The method AEP Ohio used to project the need for RECs is simply to use the previous year's annual total RECs retired and then divide it by 12 months. In a period in which load is declining, this will systematically over-estimate the need for RECs.

[21] OAC 4901:1-40-04(D)(3) <http://codes.ohio.gov/oac/4901:1-40-04>

3.4.2 Trends in RECs prices

As LEI discusses further in Section 6, AEP Ohio uses a residual methodology to calculate REC prices. Through this methodology, AEP Ohio's REC prices depend on three components: PPA prices, wholesale energy prices, and capacity prices. This means that the RECs costs which appear in customer bills have no relation to RECs prices in the Ohio and other PJM markets. The steep decline in market SRECs prices shown in Figure 16 does not reduce the AER which AEP Ohio's customers must pay.

3.4.3 Trends in wholesale energy prices

Declining wholesale energy prices can increase AER rates. Because of the residual methodology, lower energy prices will generate higher REC prices for Ohio customers, and automatically lead to a higher AER.

4 Verifying RPS compliance

4.1 Scope and background

4.1.1 Scope

This section focused on the question of whether AEP Ohio was compliant with the RPS renewable requirements during the audit period. It addresses the single topic:

- Verification that targets were met.

4.1.2 Background

AEP Ohio's renewable targets during the audit period were 0.12 percent and 0.15 percent for solar, and 2.38 percent and 3.85 percent for non-solar (see Figure 17). The percentages are applied to a portion of AEP Ohio's retail SSO load, as discussed below, to arrive at a Baseline Requirement for compliance. For planning purposes, the SSO load used to calculate the baseline requirements and costs are based on a forecast of MWh usage. This forecast is replaced after-the-fact with the actual MWh usage to determine the actual adjusted baseline, which is used to adjust (or "true-up") customer bills.[22]

Figure 17. Ohio renewable energy portfolio standard for 2015-2017

	Solar (%)	Non-solar (%)
2015	0.120	2.380
2016	0.120	2.380
2017	0.150	3.350

Source: OAC 4901:1-40-04(D)(3) <http://codes.ohio.gov/oac/4901:1-40-04>

4.2 Evaluative criteria

1) What was the Baseline Requirement?
2) Did AEP Ohio meet the Baseline Requirement, i.e., was AEP Ohio compliant?

4.3 Findings and conclusions

4.3.1 AEP Ohio complied with targets

The methodology AEP Ohio used for arriving at the Baseline Requirement is subtractive (based upon historical data), as illustrated in Figure 18. It begins with total retail load (Column A), then

[22] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. DR LEI-1-6.

subtracts Choice customers (the negative of Column B), to arrive at the SSO load. Then AEP Ohio subtracts Economic Growth customers (the negative of Column D). The target percentages apply only to AEP Ohio's SSO retail non-shopping load (Column E) which is referred to as the proposed "Adjusted Baseline."[23] Multiplying the target percentages by the proposed Adjusted Baseline gives the Benchmark volumes of renewables required. AEP Ohio's proposed Adjusted Baseline, if approved by the Commission, is the Baseline Requirement for solar and non-solar generation it must meet.

Figure 18. Actual historical AEP Ohio loads, renewable energy targets, and benchmarks, 2015-2017 (MWh)

Year	Quarter	Actual Retail Sales Unadjusted A	Choice B	Actual Retail Sales (SSO Load) C = A+B	Adjustment for Industrial Load (economic growth rider) D	Adjusted Baseline E = C+D	Year-End Solar Target F	Year-End Solar Benchmark G = F *E	Year-End non-Solar Target H	Year-End non-Solar Benchmark I = H*E
2015	1	11,662,447	(7,649,536)	4,012,911	(256,334)	3,756,577	0.12%	4,508	2.38%	89,407
2015	2	10,373,994	(7,162,051)	3,211,943	(280,496)	2,931,447	0.12%	3,518	2.38%	69,768
2015	3	11,456,278	(7,996,969)	3,459,309	(232,220)	3,227,088	0.12%	3,873	2.38%	76,805
2015	4	9,925,371	(7,089,538)	2,835,833	(205,083)	2,630,750	0.12%	3,157	2.38%	62,612
2015 Annual		**43,418,090**	**(29,898,094)**	**13,519,996**	**(974,133)**	**12,545,862**	**0.12%**	**15,055**	**2.38%**	**298,592**
2016	1	10,782,631	(7,752,299)	3,030,333	(411,793)	2,618,540	0.12%	3,142	2.38%	62,321
2016	2	10,215,628	(7,187,262)	3,028,366	(412,767)	2,615,598	0.12%	3,139	2.38%	62,251
2016	3	12,132,105	(8,522,259)	3,609,846	(410,538)	3,199,308	0.12%	3,839	2.38%	76,144
2016	4	10,263,044	(7,535,752)	2,727,292	(427,071)	2,300,221	0.12%	2,760	2.38%	54,745
2016 Annual		**43,393,408**	**(30,997,572)**	**12,395,836**	**(1,662,170)**	**10,733,666**	**0.12%**	**12,880**	**2.38%**	**255,461**
2017	1	10,723,528	(7,747,756)	2,975,772	(529,414)	2,446,358	0.15%	3,670	3.35%	81,953
2017	2	10,134,476	(7,468,985)	2,665,490	(549,149)	2,116,341	0.15%	3,175	3.35%	70,897
2017	3	11,187,594	(8,236,946)	2,950,648	(547,530)	2,403,118	0.15%	3,605	3.35%	80,504
2017	4	10,669,567	(7,772,911)	2,896,656	(521,017)	2,375,639	0.15%	3,563	3.35%	79,584
2017 Annual		**42,715,165**	**(31,226,598)**	**11,488,567**	**(2,147,110)**	**9,341,457**	**0.15%**	**14,012**	**3.35%**	**312,939**

Source: DR LEI-1-6 Attachment 1. Data is reported at the meter level (DR LEI-5-9).

To meet the Baseline Requirement, AEP Ohio retires RECs and SRECs in each calendar year (usually in April) to meet the requirements of the previous year. LEI examined detailed retirement data which included serial numbers for each REC or SREC retired by AEP Ohio into the PJM-GATS system, and the retirement date (aka deposit date).[24] LEI summarized this data to arrive at total RECs and SRECs retired each year (see Figure 19). The numbers in Figure 19 match the annual total Benchmarks in columns G and I in Figure 18 above. This indicates that AEP Ohio

[23] LEI notes that, as of this writing, AEP Ohio's proposed baseline reductions to account for economic growth are still pending before the Commission for the 2015, 2016, and 2017 compliance years. Therefore, the final compliance baseline – and thus overall compliance status - has not yet been determined.

[24] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. LEI_2.5_Confidential_Attachment 1.xlsx.

appears to have met its RECs and SRECs targets, assuming the use of AEP Ohio's proposed baselines.

Figure 19. Number of SRECs and RECs retired (one REC or SREC = one MWh)

Deposit date	SRECs	RECs
3/15/2016	15,055	298,592
4/3/2017	11,805	255,461
4/4/2017	1,075	
4/11/2018	14,012	312,939

Source: DR LEI-2-5 Confidential Attachment 1.

4.4 Recommendations

LEI has no recommendations regarding overall compliance with RPS requirements, as AEP Ohio appears to have met its targets. As LEI will discuss in other sections of this report, AEP Ohio had no trouble meeting targets, as it has a large and growing inventory of RECs (see Section 7). LEI will have specific recommendations in certain sections with respect to the cost of meeting the targets, and the accuracy of projections of the targets used in calculating the AER.

5 Total cost of compliance compared to 3 percent cost cap

5.1 Scope and background

5.1.1 Scope

This section describes LEI's calculations of AEP Ohio's historical cost of compliance compared to the 3 percent cost cap. The 3 percent cap refers to the cost to provide power assuming no RPS compliance, versus the cost including RPS compliance. The single topic covered is:

- Cost of RPS compliance compared to energy cost to serve SSO load.

5.1.2 Background

Ohio law allows utilities not to comply with RPS targets if the cost of compliance exceeds 3 percent of the cost of producing or acquiring electricity, as per R.C. 4928.64(C)(3):

> *"An electric distribution utility or an electric services company need not comply with a benchmark under division (B)(2) of this section to the extent that its reasonably expected cost of that compliance exceeds its reasonably expected cost of otherwise producing or acquiring the requisite electricity by three per cent or more. The cost of compliance shall be calculated as though any exemption from taxes and assessments had not been granted under section 5727.75 of the Revised Code.*[25]

The law refers to a forward-looking calculation of the cost. It is not explicit in the law whether electricity refers to energy only, or energy plus capacity, plus ancillary services, etc. LEI interprets the phrase "producing or acquiring" as referring to the energy component, as this would be consistent with the RPS requirements, which are energy-based targets.

AEP Ohio does not calculate these costs on a forward-looking basis, nor does the company examine them historically (for reasons discussed below).

5.2 Evaluative criteria

1) Is the cost of AER for AEP Ohio within the 3 percent provision contained within R.C. 4928.64(C)(3)?
2) What have been the trend in costs? Have there been any outliers?

[25] R.C. 4928.64 Electric distribution utility to provide electricity from alternative energy resources. Section C, Sub-section 3. <http://codes.ohio.gov/orc/4928.64>

5.3 Findings and conclusions

5.3.1 LEI's calculation of the 3 percent cap

As requested by the Commission staff, LEI asked AEP Ohio for its calculations of the 3 percent cap.[26] AEP Ohio informed LEI that it does not calculate this cap and argued that:

> *Ohio revised code 4928.641 states, "If an electric distribution utility has executed a contract before April 1, 2014, to procure renewable energy resources and there are ongoing costs associated with that contract that are being recovered from customers through a bypassable charge as of the effective date of S.B. 310 of the 130th general assembly, that cost recovery shall continue on a bypassable basis until the prudently incurred costs associated with that contract are fully recovered." The Company has not performed the 3% cap as our interpretation of that rule is that a Company has the option of whether or not to comply with the mandates if there is a 3% cost difference.*[27]

LEI believes the intent of the AER audit is to check AEP Ohio's 3 percent calculations and not for the auditor to prepare such calculations independently. However, because AEP Ohio did not prepare these calculations, LEI did so independently.

In LEI's calculation of the 3 percent cap, the cap can be thought of as the cost of compliance (a numerator) divided by the cost of generation (a denominator). LEI chose to use the cost of generation provided to SSO customers as the denominator to calculate the 3 percent. As noted above, LEI feels this is the appropriate denominator to use because the cost of renewables compliance is an energy-only cost: RECs are valued in the market in terms of an hourly price in MWh, and do not include delivery or capacity costs, for example.

This provides the smallest denominator, because if LEI had included capacity charges and all other charges it would make this denominator larger. LEI's generation-only denominator therefore provides the most stringent test of the 3 percent cap. LEI calculated the 3 percent by dividing the cost of renewables by the total cost of generation to customers.

LEI requested the total cost of generation from AEP Ohio, but AEP Ohio did not provide it, arguing that LEI could calculate this cost based on other information that AEP Ohio provided. Therefore, LEI used the Generation Energy Rider rate in AEP Ohio's tariff and multiplied the rate by the number of billed kWh (provided by AEP Ohio) to arrive at an estimate of the energy generation cost to serve load (see Figure 20, Figure 21, and Figure 22).

[26] AEP Ohio. "3rd Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." October 11, 2018. DR LEI-6-4.

[27] Ibid.

Figure 20. SSO load by voltage class and quarter (kWh)

	2015 Q1	2015 Q2	2015 Q3	2015 Q4
SSO Primary	55,600,204	36,528,781	35,532,844	28,457,417
SSO Sec	4,051,620,170	2,686,873,674	3,020,810,110	2,483,344,690
SSO Sub/Tran	305,989,428	311,980,646	334,997,662	329,324,808

	2016 Q1	2016 Q2	2016 Q3	2016 Q4
SSO Primary	30,677,847	34,279,168	37,243,352	44,303,300
SSO Sec	3,265,780,137	2,412,997,276	3,409,850,959	2,638,288,467
SSO Sub/Tran	156,729,274	144,323,803	76,173,155	45,758,861

	2017 Q1	2017 Q3	2017 Q3	2017 Q4
SSO Primary	56,058,054	37,424,785	46,790,081	31,753,083
SSO Sec	3,166,908,772	2,353,519,735	2,934,665,478	2,634,467,279
SSO Sub/Tran	45,190,980	31,654,638	33,842,054	36,651,621

Figure 21. Generation Energy Rider by voltage class and quarter (¢/kWh)

	2015 Q1	2015 Q2	2015 Q3	2015 Q4
SSO Primary	4.5737	4.4710	4.4710	4.4710
SSO Sec	4.7222	4.6320	4.6320	4.6320
SSO Sub/Tran	4.4584	4.3810	4.3810	4.3810

	2016 Q1	2016 Q2	2016 Q3	2016 Q4
SSO Primary	4.4710	4.5040	4.5040	4.5040
SSO Sec	4.6320	4.6660	4.6660	4.6660
SSO Sub/Tran	4.3810	4.4140	4.4140	4.4140

	2017 Q1	2017 Q3	2017 Q3	2017 Q4
SSO Primary	4.5040	3.9070	3.9070	3.9070
SSO Sec	4.6660	4.0480	4.0480	4.0480
SSO Sub/Tran	4.4140	3.8290	3.8290	3.8290

Source: DR LEI-1-8 Attachment_1 (rider) and DR LEI-6-3 Attachment_1 (load). Data for 2015Q1 was not provided by AEP Ohio, it was estimated by LEI.

The resulting estimate of total cost of generation by voltage is shown in Figure 22.

Figure 22. Estimated total cost of generation by voltage class and quarter (nominal $)

	2015 Q1	2015 Q2	2015 Q3	2015 Q4
SSO Primary	$ 2,543,006	$ 1,633,202	$ 1,588,673	$ 1,272,331
SSO Sec	$ 191,324,932	$ 124,455,989	$ 139,923,924	$ 115,028,526
SSO Sub/Tran	$ 13,642,146	$ 13,667,872	$ 14,676,248	$ 14,427,720

	2016 Q1	2016 Q2	2016 Q3	2016 Q4
SSO Primary	$ 1,371,607	$ 1,543,934	$ 1,677,441	$ 1,995,421
SSO Sec	$ 151,270,936	$ 112,590,453	$ 159,103,646	$ 123,102,540
SSO Sub/Tran	$ 6,866,309	$ 6,370,453	$ 3,362,283	$ 2,019,796

	2017 Q1	2017 Q3	2017 Q3	2017 Q4
SSO Primary	$ 2,524,855	$ 1,462,186	$ 1,828,088	$ 1,240,593
SSO Sec	$ 147,767,963	$ 95,270,479	$ 118,795,259	$ 106,643,235
SSO Sub/Tran	$ 1,994,730	$ 1,212,056	$ 1,295,812	$ 1,403,391

For the numerator, the total forecasted cost of compliance was based on quarterly AER data provided by AEP Ohio (see Figure 23).

Figure 23. AEP Ohio's forecasted renewable energy credit cost by quarter (nominal $)

	2015 Q1	2015 Q2	2015 Q3	2015 Q4
Renewable Cost	$5,700,000	$2,501,000	$2,831,000	$2,701,000

	2016 Q1	2016 Q2	2016 Q3	2016 Q4
Renewable Cost	$2,932,000	$3,248,000	$3,621,000	$3,692,000

	2017 Q1	2017 Q3	2017 Q3	2017 Q4
Renewable Cost	$3,732,000	$5,444,000	$3,830,000	$3,875,000

Source: DR LEI-1-10 Attachment_1-12 (2015 Q1 and Q2 from Schedule 5; 2015 Q1 to 2017 Q4 from Schedule 3)

LEI then divided the cost of compliance by the estimated total cost of generation (see Figure 24).

Figure 24. Calculation of the 3 percent cap – annual level

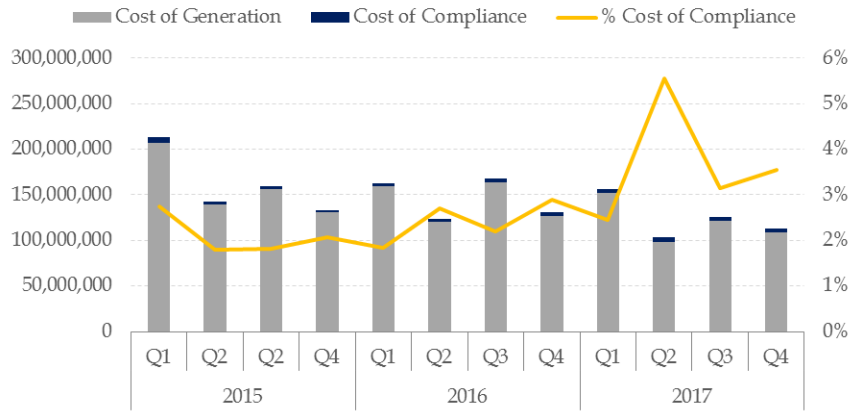
	2015	2016	2017
Cost of Compliance	$ 13,733,000	$ 13,493,000	$ 16,881,000
Cost of Generation	$ 634,184,569	$ 571,274,817	$ 481,438,647
% Cost of Compliance	2.1%	2.3%	3.4%

LEI's analysis shows that AEP Ohio was below the 3 percent cap during the audit period on an annual level, with the exception of 2017. When analyzing the same data on a quarterly level, AEP Ohio exceeded the 3 percent cap during the last three quarters of 2017 (see Figure 25).

LEI's approach to this analysis was not exact. The Generation Energy Rider rate is based on expected generation costs and does not represent the actual realized cost to AEP Ohio. However,

given that AEP Ohio would not provide the calculations, LEI believes this method provides a reasonable "ballpark" estimate of the cost of compliance relative to the cost of generation.

Figure 25. Estimate of cost of compliance compared to the 3 percent cap – quarterly level



AEP Ohio's methodology for calculating the cost of compliance has a built-in bias towards exceeding the cost cap when wholesale energy and capacity prices are low. This is because the methodology results *de facto* in higher RECs costs when energy and capacity prices are low. LEI discusses the residual methodology in more detail later in this report.

5.3.1.1 Hypothetical compliance cost using REC market prices

LEI also analyzed what the cost of compliance would be if RECs and SRECs had been purchased at market prices. LEI performed the 3 percent calculation using the same cost of generation and changing only the cost of compliance.

To calculate the cost of compliance, first LEI calculated the solar and non-solar annual requirements by multiplying the same SSO load in Figure 20 above by the solar and non-solar RPS annual requirements. LEI then multiplied the solar and non-solar requirements by the average traded price for RECs and SRECs to arrive at a hypothetical cost of compliance (see Figure 26).

Figure 26. Hypothetical cost of compliance using market prices (nominal $)

	2015	2016	2017
Cost of Compliance	$ 2,395,632	$ 737,517	$ 1,151,960
SSO Load (MWh)	*13,681,060*	*12,296,406*	*11,408,927*
Non-solar requirement (%)	*2.380%*	*2.380%*	*3.350%*
Solar requirement (%)	*0.120%*	*0.120%*	*0.150%*
REC Price ($/REC)	*$ 5.60*	*$ 1.79*	*$ 2.64*
SREC Price ($/SREC)	*$ 34.95*	*$ 14.39*	*$ 8.31*

Source: DR LEI-6-3 Attachment_1 (load); ORC 4928.64(B)(2) (RPS); third-party data provider (REC prices)

LEI then divided this cost of compliance by the cost of generation (see Figure 27). LEI's analysis shows that AEP Ohio cost of compliance would be significantly lower if RECs and SRECs had been purchased at market prices.

Figure 27. Hypothetical calculation of the 3 percent cap using market prices (nominal $)

	2015	2016	2017
Cost of Compliance	$ 2,395,632	$ 737,517	$ 1,151,960
Cost of Generation	$ 634,184,569	$ 571,274,817	$ 481,438,647
% Cost of Compliance	0.4%	0.1%	0.2%

5.4 Recommendations

In order to assist the Commission with its evaluation of the 3 percent cap, LEI recommends AEP Ohio develop its own calculation and prepare it quarterly. AEP Ohio should use a methodology which complies with OAC 4901:1-40-07:28

> *Calculations involving a three per cent cost cap shall consist of comparing the total expected cost of generation to customers of an electric utility or electric services company, while satisfying an alternative energy portfolio standard requirement, to the total expected cost of generation to customers of the electric utility or electric services company without satisfying that alternative energy portfolio standard requirement.*

For example, AEP Ohio can use a methodology which multiplies the wholesale price of energy at the AEP Ohio load zone (the LMP) on an hourly, daily average, or monthly average basis by the hourly, daily, or monthly delivered energy to SSO (less Economic Development) customers. This would provide the cost of delivered energy to SSO (less Economic Development) customers. Multiplying this cost by 0.03 would arrive at the 3 percent cost cap. This could be done for the 2015/17 audit period, to establish a baseline for comparison. For going-forward estimates, reasonable expectations for the cost of energy at the AEP Ohio load zone should be used.

[28] OAC 4901:1-40-07 <http://codes.ohio.gov/oac/4901:1-40-07v1>

6 Examining AEP Ohio's approach to calculating AER costs

6.1 Scope and background

6.1.1 Scope

This section addresses:

- The approach used by AEP Ohio to calculate the cost of RPS compliance; and
- Implications of the approach on AER rates.

This analysis is focused on RECs created by the operations of the REPA wind assets Fowler Ridge and Timber Road, and SRECs created by Wyandot solar plant. The way in which these RECs and SRECs are valued by AEP Ohio determines the inventory value of RECs and SRECs. The inventory value in turn determines the cost to customers, as RECs and SRECs are retired from inventory to meet RPS requirements.

6.1.2 Background

In 2015, the PUCO approved AEP Ohio's third Energy Security Plan ("ESP"), which was in effect until May 31, 2018.[29] In the third ESP, AEP Ohio incorporated a residual methodology to estimate the cost of its compliance for the purpose of calculating the AER. In November 2016, AEP Ohio filed a proposal to modify and extend its third ESP by six years, through May 31, 2024. The PUCO modified and approved the revised ESP. PUCO Staff asked LEI to examine AEP Ohio's methodology, as part of the management/performance audit.

6.2 Evaluative criteria

1) Is the methodology reasonable and fair to ratepayers?
2) Are the assumed capacity de-rates for the wind and solar plants reasonable?

6.3 Findings and conclusions

6.3.1 AEP Ohio uses a residual methodology to calculate the RECs and SRECs values for the AER

As noted previously, the majority of AEP Ohio's RPS requirements were met by PPA from three REPA plants. These are the Fowler Ridge and Timber Road wind plants, and the Wyandot solar plant. For cost recovery under the AER, the implied RECs or SRECs values are calculated by AEP

[29] PUCO. "AEP Ohio's electric security plan IV." Accessed on November 2018. <https://www.puco.ohio.gov/be-informed/consumer-topics/aep-ohios-electric-security-plan-iv/>

Ohio as a residual value, based on the total (or "bundled") cost of each PPA. AEP Ohio assumes that the total bundled cost of a PPA includes three parts:[30]

- ***Implied energy value:*** The value of the energy produced under each of the three agreements is assumed by AEP Ohio to be equal to the monthly average spot clearing price for nearest PJM pricing point multiplied by the power produced during the month. This approach would *very roughly approximate to what the company would have received if it sold the output on the open market*."[31] The PJM pricing point AEP Ohio uses to calculate the monthly (arithmetic) average spot clearing price for each of the REPA assets (Fowler Ridge, Timber Road, and Wyandot) is the AEP load zone.[32] The prices are not load-weighted average prices and nor are they weighted by hourly generation from the plants.[33]
- ***Implied capacity value:*** For calculating the residual REC price, AEP Ohio uses the realized PJM capacity price.
- ***Implied REC value:*** This is calculated by AEP Ohio as the residual of the total PPA cost less implied energy value and implied capacity value.

AEP Ohio confirmed that the REPA [redacted] are bid into PJM capacity markets,[34] although intermittent renewables like wind and solar are exempted from the must-offer requirement of PJM's capacity market. PJM de-rates the wind assets' total capacity to percent (of installed capacity); this de-rate impacts the capacity value used in AEP Ohio's AER RECs price calculation. PJM de-rates solar capacity to 38 percent, and AEP Ohio uses this for the purposes of calculating its capacity value for the AER calculation, but [redacted] is not bid into the PJM capacity market.

LEI believes the capacity de-rates for wind and solar are reasonable, as they are consistent with PJM rules.

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[30] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. DR LEI-2-8 (and follow up DRs).

[31] Confidential Report of the management/performance and financial audits of the FAC of the Ohio Power Company Audit. Prepared for the Public Utilities Commission of Ohio by Energy Ventures Analysis and Larkin $ Associates PLLC. Case numbers 11-5906-EL-FAC, 12-3133-EL-FAC, 13-675-EL-FAC, 13-1286-EL-FAC, and 13-1892-EL-FAC. November 30, 2017. P. 8.

[32] AEP Ohio. "2nd Set of Responses to PUCO Auditor LEI 18-0080." September 12, 2018. DR LEI-4-1.

[33] Conference call with AEP Ohio on September 24, 2018.

[34] Conference call with AEP Ohio on September 24, 2018.

6.3.2 The implied energy value does not represent actual energy revenues generated from the REPAs

The energy component of the residual methodology is calculated using monthly arithmetic average prices. This arithmetic average approach may underestimate the implied energy value component (revenues) if the REPA assets generated more energy during peaking hours when energy prices are higher. Alternatively, it may overestimate the energy revenues if the REPA assets generated more energy during non-peaking hours where energy prices are lower.

A volume weighted approach would be more appropriate to calculate a more accurate energy revenue.

6.3.3 Residual methodology assumes total PPA is a sum of only three parts

LEI does not agree that the value of the PPAs (or REPAs) consists only of three components: energy, capacity, and RECs. The PPAs are long-term contracts (20 years). Any long-term contract price reflects many attributes, including, typically:[35]

1) Allocation of volume risk between the contracting parties;
2) Allocation of price risk between contracting parties;
3) Reduction of transaction costs;
4) Reduction of switching costs; and
5) Creation of a long-term relationship between parties without the need for vertical integration.

Because there are so many attributes incorporated in long-term contract prices, it is not possible to assign value to simply the energy, capacity, and/or RECs components.

6.3.4 The residual methodology results in anomalies which do not reflect the value of renewable energy

The residual methodology results in anomalies which do not reflect the value of renewable energy at any given time:

- The residual methodology means the dollar-amount of RECs compliance costs will always rise when energy prices fall; and conversely, the dollar-amount of compliance costs will fall when energy prices rise; and
- The percentage of the cost of AER compared to the cost of generation will increase when energy prices fall (both because the residual RECs cost is higher and because the energy price is lower), so the possibility of exceeding the 3 percent cap will be greater when energy prices are low, and lower when energy prices are high.

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[35] "Long-term Contracting for Natural Gas: Examination of the Issues that Affect the Potential for the Increased Use of Contracting to Stabilize Consumer Prices." Brice B. Henning, VP, Energy and Regulatory Market Analysis, ICF International, June 9, 2011.

6.3.5 Over-priced RECs create high-cost inventories

The residual methodology has created an incentive for AEP Ohio to hold large inventories of RECs as discussed in greater detail in Section 7. AEP Ohio's REC inventory levels are increasing at much higher levels than the annual RPS requirements.

6.4 Recommendations

Absent any regulatory constraint, LEI would recommend using current market values for RECs and SRECs to calculate the AER, because AEP Ohio's current methodology does not accurately reflect the value of RECs:

i) There is no logical foundation to assume the value of a long-term PPA contract reflects only the value of energy, capacity, and renewable attributes;

ii) The residual approach results in anomalies that do not reflect the value of RECs; and

iii) High RECs costs create high inventory costs.

LEI believes using market values for RECs and SRECs to calculate the AER is the most appropriate approach. As noted in Section 1, this could serve as an initial allocation of costs to the AER. If the total of market-based RECs, energy, and capacity prices fall short of the total bundled cost of the PPA, then the shortage could be spread over the three components based on an agreed-upon proportion, assuming that AEP Ohio is entitled to full cost recovery from the REPAs.

7 AEP Ohio's RECs procurement and inventory strategy

7.1 Scope and background

7.1.1 Scope

This section focuses on AEP Ohio's procurement and inventory strategy. This chapter addresses the following topics:

- Overview of RECs and SRECs purchase processes;
- RECs and SRECs purchased versus retired; and
- RECs and SRECs inventory strategy.

LEI's findings and conclusions rely on numerous formal data requests and conference-calls with key managers, as well as data collected from outside research.

7.1.2 Background

As described in Section 2, a portion of AEP Ohio's total load must be met by alternative energy sources. To comply with this requirement, AEP Ohio must surrender RECs from qualified renewable resources, classified as solar and non-solar. AEP Ohio's process for procuring RECs involves securing long-term REPAs, the Renewable Energy Technology ("RET") program for customer-sited distributed generation, and REC market purchases.

7.2 Evaluative criteria

1) Is the strategy coherent and proactive?
2) Do resulting costs reflect prudency and market awareness?
3) What is its impact on AER costs?

7.3 Findings and conclusions

7.3.1 RECs procurement strategy is primarily based on REPAs

As noted previously, AEP Ohio complies with its renewable energy requirements primarily through long-term PPAs (the REPAs) with three facilities: Timber Road, Fowler Ridge II, and the Wyandot solar facility.[36] The RET program supplements the long-term REPAs, and REC market purchases are used when the REPAs and RET program are not enough to meet compliance. AEP

[36] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. DR LEI-2-1.

Ohio also owns two 70 kW solar facilities located atop the Athens and Newark Service Centers which produce some SRECs.[37]

AEP Ohio purchases a relatively small number of RECs in the spot or broker REC market, and these are usually retired (used for compliance) within the same year. RECs from the RET program are also usually retired within same year.

The RECs generated from the REPAs are saved as inventory, because they are usually more than needed for compliance.[38] Inventory must be tracked and managed, as RECs have a five-year lifetime following their acquisition.

The Alternative Energy Resources Manager for AEP Ohio is responsible for the RECs procurement strategy and is assisted by the Energy Marketing Renewables & Joint Ventures team as well as by energy traders.[39]

LEI finds that the AEP Ohio RECs compliance strategy is not proactive in the sense of a forward-looking strategy, or one that seeks to opportunistically take advantage of large supplies of low-cost RECs available from the traded markets. It relies on PPAs entered into nearly a decade ago. LEI recommends that AEP Ohio take advantage of volume flexibility in the REPAs, if any exists, to reduce the volume of renewable energy AEP Ohio must buy, to help slow the build-up of RECs and SRECs inventories.

7.3.1.1 Overview of the long-term REPAs

AEP Ohio's long-term REPAs, with the Timber Road and Fowler Ridge II wind farms, and the Wyandot solar facility, were entered into effect in 2009 and 2010.[40] The contracts were secured through competitive procurement processes, with three separate Requests for Proposal ("RFPs").

[37] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. DR LEI-1-3.

[38] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. DR LEI-2-3.

[39] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. DR LEI-2-1.

[40] Ibid

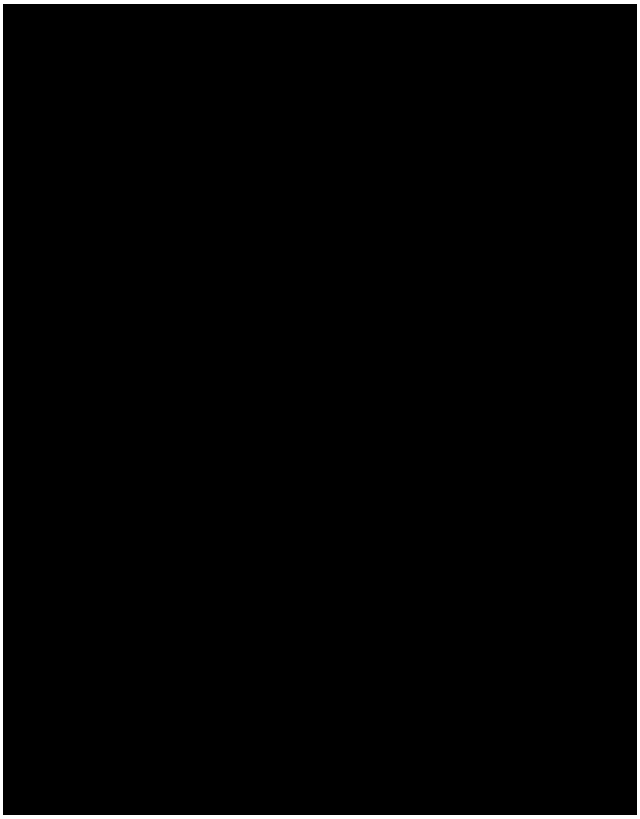
Figure 28. REPA assets

Plant name	State	Technology	Contracted Capacity (MW)	COD	Expiry date
Timber Road	Ohio	Wind	99.00	1/1/2013	12/31/2032
Fowler Ridge II	Indiana	Wind	100.00	12/17/2009	12/16/2029
Wyandot	Ohio	Solar	10.08	5/26/2010	5/31/2030

Source: DR LEI-5-29 and DR LEI-6-12.

All the REPAs have a duration of 20 years and the PPA price is a single price for a bundle of products including energy, capacity, and renewable energy credits (see Figure 29).[41]

Figure 29. REPAs PPA prices



Note: Wyandot prices provided only through 2017.
Sources: DR LEI-3-2 Confidential Attachment 1; and DR LEI-5-29 Confidential Attachments 1 and 4.

[41] AEP Ohio. "2nd Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." September 12, 2018. DR LEI-5-9.

Timber Road had an initial price of [redacted]. Fowler Ridge has [redacted] Wyandot has [redacted].

For the purposes of the AER, AEP Ohio calculates the cost of RECs from the REPAs on a monthly basis using the residual formula described in Section 6.

7.3.1.2 Overview of the Renewable Energy Technology program

The RET program was launched in 2011 and consisted of providing grants to Ohio customers to install qualified renewable energy resources in exchange for committing to providing a portion of their RECs to AEP Ohio for 15 years. The grants for the behind the meter installations paid for up to 50 percent of the total system cost, or a maximum of $12,000 for a residential system, and a maximum of $75,000 for a commercial system.[42]

AEP Ohio's RET program created 166 small renewable energy installations; it expired in June 2013.[43] The costs incurred by AEP Ohio to provide these grants have been fully recovered and the company currently collects the RECs from the program at a zero cost per REC.[44]

7.3.2 RECs compliance during the audit period was met almost entirely by REPAs

During the 2015 – 2017 audit period, the vast majority of RPS compliance was achieved through the long-term REPA contracts.[45] The Fowler Ridge and Timber Road wind plants REPAs accounted for most of the non-solar RECs retirements, with a few RECs retired from the RET program, and the Wyandot solar plant REPA accounted for all the solar RECs retirements, with the exception of 2015 that also retired two solar REC purchases (see Figure 30). Note that the retirements from a given plant in a given year are not the same as the generation from a given plant in the same year. The RECs that are retired in a given year would have been generated up to five years earlier and are retired out of inventory.

[42] Dovetail. "Ohio Grants for Non-Residential Systems." Accessed on September 2018. <http://www.dovetailsolar.com/Incentives/Ohio-Grants-for-Non-Residential-Systems.aspx>

[43] Environment Ohio Research & Policy Center. "Ohio's Clean Energy Success Story, Year 4." November 2013

[44] Conference call with AEP Ohio on September 24, 2018.

[45] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. DR LEI-2-2.

Figure 30. Retired RECs and SRECs during the audit period

Source: LEI_1-6_Confidential_Attachment_1 and LEI_2-5_Confidential_Attachment_1.

As previously mentioned, AEP Ohio RECs purchases are comprised of the RECs generated from the REPAs and the RET program, plus supplemental REC market purchases.

The REC cost of REPAs is calculated monthly based on the residual formula described in Section 6. The RECs from the RET program have a $0 cost, and the cost of REC market purchases depends on the time of the purchase and the category (solar or non-solar).

7.3.2.1 REPA's solar REC cost

During the audit period, [redacted] SRECs were generated from the Wyandot REPA, with a total cost of [redacted] (see Figure 31). Based on the residual methodology, AEP Ohio reported that the unit cost of the SRECs ranged between [redacted]. LEI verified this calculation using the methodology illustrated in Figure 31. First, the "Bundled Purchase" component represents the values from the PPA bundle including energy, capacity and SRECs, where the bundled purchase "Quantity" is the monthly amount of energy and SRECs generated by the solar plant (one MWh = one REC) and the "Total Value" is the total cost of the PPA bundle. The "Energy Component" represents the energy revenues generated by the solar plant (the implied energy value, based on PJM average monthly LMPs) and the "Capacity Component" represents the capacity revenues generated by the solar plant (implied capacity value, based on PJM capacity market prices). The resulting REC component (implied REC value) represents the cost of REC calculated from the residual methodology (the PPA bundled cost minus energy and capacity revenues).

Figure 31. Wyandot solar RECs value

Source: LEI_2-8_Confidential_Attachment_1.

Although cost data was provided by AEP Ohio, LEI nevertheless performed an independent analysis and was able to reproduce the same costs using publicly-available market data for energy (monthly average spot clearing price for the PJM AEP load zone pricing point) and capacity (PJM clearing capacity price) prices.

In addition to the solar RECs provided by Wyandot, AEP Ohio made additional solar REC purchases in the spot market as described in Section 7.3.2.4.

AEP Ohio also produces a small volume of SRECs at zero cost from the two 70 kW solar facilities located atop the Athens and Newark Service Centers as noted previously.[46]

7.3.2.2 Non-solar REPA costs

During the audit period, the non-solar REPAs generated [redacted], significantly above compliance needs (see retired non-solar RECs in Figure 30 above), with a total cost of [redacted] dollars. Based on AEP Ohio's residual methodology unit cost of the RECs generated by Fowler Ridge ranged between [redacted] (see Figure 32).

Figure 32. Fowler Ridge Non-Solar RECs value

Source: LEI_2-8_Confidential_Attachment_1; LEI_6.11_Confidential_Attachment_1-3.

[46] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. DR LEI-2-5. Confidential Attachment 1.

For Timber Road, prices were lower and ranged between [redacted] (see Figure 33).

Figure 33. Timber Road Non-Solar RECs value

Source: LEI_2-8_Confidential_Attachment_1; LEI_6.11_Confidential_Attachment_1-3.

LEI checked the unit energy cost component shown in Figure 32 and Figure 33 by referring to the AEP Load Zone PJM energy pricing point (the day-ahead LMP) which is publicly-available data. The energy prices do not match those provided by AEP Ohio, though AEP Ohio identified the AEP Load Zone as the pricing point they used for energy prices. The publicly-available prices are higher. This implies AEP Ohio underestimated the energy revenues in the REC cost residual calculation for the non-solar REPAs, and therefore overestimate the RECS cost (see Figure 34).

Figure 34. Annual Energy Revenue from non-solar REPAs – AEP Ohio value vs LEI calculated value

Source: LEI_6.11_Confidential_Attachment_1-3 and LEI_2-8_Confidential_Attachment_1

*Note: LEI calculated the energy revenue at a monthly-level using AEP Load Zone DA LMP price (energy price) from a third-party data provider and the total energy generated by each REPA (which was provided by AEP Ohio on LEI_2-8_Confidential_Attachment_1).

Underestimating the energy component increases the cost of RECs because of the residual methodology. LEI replicated the REC cost residual calculation using publicly available data and found lower REC costs, especially for the Fowler Ridge plant (see Figure 35).[47]

Figure 35. Non-solar REPAs REC cost – AEP Ohio value vs LEI calculated value

Source: LEI_2-8_Confidential_Attachment_1; LEI_6.11_Confidential_Attachment_1-3; and third-party data provider

[47] LEI calculated the REC cost using monthly generation, bundle cost, and capacity revenues from AEP Ohio (provided on LEI_2-8_Confidential_Attachment_1 and LEI_6.11_Confidential_Attachment_1-3), and the calculated energy revenue from Figure 34 on a monthly basis.

7.3.2.3 RET program REC cost

During the audit period, the RET program generated [redacted]. RECs generated from the RET program [redacted].

Figure 36. RET RECs

[redacted]

Source: LEI_2-8_Confidential_Attachment_1.

7.3.2.4 Spot market purchase REC cost

During the audit period, there were three solar REC market purchases. The first one took place in September 2014 and was retired in 2015. The other two took place in 2015 and are yet to be retired.

Figure 37. SREC market purchases

[redacted]

Source: LEI_2-5_Confidential_Attachment_1 and LEI_2-8_Confidential_Attachment_1

SREC prices secured by AEP Ohio were competitive when compared to market prices (see Figure 38). The average market price in the month of the purchase was above the AEP Ohio purchase price, with the exception of the 2 RECs purchased in September 2014. It is not clear why these purchases were needed, since AEP Ohio had enough inventory to cover their SRECs obligation.

Figure 38. SREC price comparison

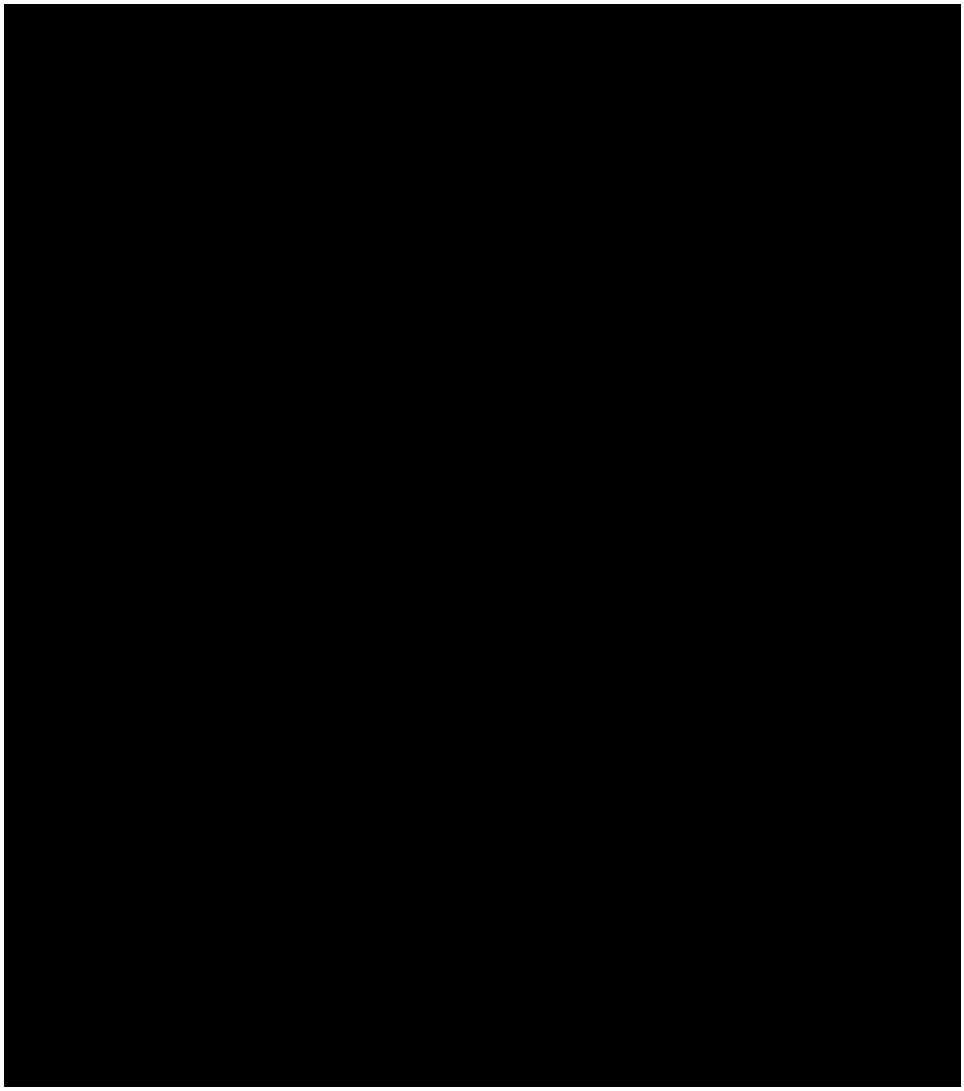
[redacted]

Source: Third-party data provider; LEI_2-5_Confidential_Attachment_1 and LEI_2-8_Confidential_Attachment_1.

7.3.3 REC inventory is high-cost

As mentioned before, AEP Ohio maintains REC inventories for solar and non-solar RECs (see Figure 39).

Figure 39. Monthly REC inventory



Source: LEI_2-8_Confidential_Attachment_1.

Solar RECs inventory levels remained stable during the audit period, however wind increased significantly, almost tripling in size. The current non-solar REC inventory is much higher than the annual RPS requirements for non-solar RECs (see Figure 40).

Figure 40. RECs inventory and REC compliance needs

Source: LEI_2-8_Confidential_Attachment_1.
Note: one MWh = one REC

The weighted average cost of REC inventory ("WACI") has also increased sharply for both solar and non-solar RECs since early 2015. According to AEP Ohio, the REC cost at the beginning of 2015 was low for two reasons:

> *"First, early in 2015, AEP Ohio chose to reflect its solar obligation using the one-year "Actuals" method. This new method had the effect of greatly reducing the solar obligation for 2014. At that time, AEP Ohio management chose to retain the solar inventory dollars at the beginning of 2015, but to reduce the average cost by adding back the number of RECs that would not be included in the filing as retired. This had the effect of reducing solar REC expense in 2015. Secondly, in January/February, there were a couple of polar vortex events that had the effect of increasing PJM prices for those months, which lowered REC addition dollars for those months. From then and through 2017, the REC WACI has steadily rose reflecting the typical residual REC value each month."*[48]

7.3.4 Cost of REC retirements during the audit period increased significantly

AEP Ohio retires REC inventory in quantities sufficient to comply with the RPS requirements. The RECs retired in 2018 are based on actual RECs usage to comply with the 2017 RPS requirements. Although the retirement occurs in 2018, the 2017 compliance expenses are built into rates throughout 2017.

The number of retired RECs equals the REC RPS requirements (see Figure 30 shown earlier in this chapter).

[48] AEP Ohio. "3rd Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." October 11, 2018. DR LEI-6-8.

The remaining RECs (mostly generated by the wind REPAs) are carried as inventory. This implies that, if REC prices are high (owing to low energy costs) the high price impacts the cost of inventory, which impacts the cost of the AER to consumers.

7.3.4.1 AEP Ohio REC retirement cost

The cost of RECs retired in a given year may differ from the cost of purchased RECs in the same year, as the retired REC comes from an inventory composed of several years of purchased RECs.

The weighted average cost of retired non-solar RECs increased [redacted]. The cost increase in solar RECs was even higher, almost tripling from [redacted]. To calculated the weighted average, LEI multiplied the RECs costs from all providers (REPA assets, RET program, and REC purchases) by the retired RECs from all providers (see Figure 41 and Figure 42).

Figure 41. Cost of AEP Ohio retired RECs during the audit period

[redacted]

Source: LEI_2-5_Confidential_Attachment_1.

Figure 42. Retired RECs and SRECs during the audit period (shown earlier on Figure 30)

[redacted]

Source: LEI_1-6_Confidential_Attachment_1 and LEI_2-5_Confidential_Attachment_1.

For the next audit period, LEI expects the cost of retired RECs to increase even further because the cost of inventory has increased.

7.3.5 AEP Ohio REC cost is much higher than market REC prices

LEI compared AEP Ohio's REC retirement costs with the average traded price for RECs in Ohio. While solar RECs in Ohio were much higher when the REPAs were secured, non-solar RECs were traded at a low price (see Figure 43).

Figure 43. AEP Ohio REC cost versus market traded REC prices

Source: third-party data provider and LEI_2-5_Confidential_Attachment_1.

AEP Ohio REC costs during the audit period were much higher than the traded market price.

7.4 Recommendations

The non-solar REPAs generated more RECs than AEP Ohio needed for compliance and at a higher cost than what was available in the market. As a result, AEP Ohio is building up REC inventory at a very high cost.

LEI recommends that AEP Ohio:

i) Sell some of the excess non-solar REC inventory as it already holds the equivalent amount necessary to meet four years of RPS requirements (as of December 2017); and

ii) A noted before, if the non-solar PPAs allow for volume flexibility, AEP Ohio should take less generation from the PPAs.

LEI also noted that in 2015, AEP Ohio made three purchases of solar RECs in the spot market and had not retired them as of the end of 2017. In this instance, LEI recommends that AEP Ohio:

iii) Comply with its internal procurement and inventory strategy, which is to purchase and retire REC spot market within the same year and only when the REPAs and RET program are not enough to meet compliance in that particular year.

8 Other assumptions which impact the AER

8.1 Scope and background

8.1.1 Scope

This section addresses two additional topics the Commission asked LEI to examine:

- AEP Ohio's loss factor utilized in the AER calculation; and
- AEP Ohio's proposed change to the true-up period from quarterly to semiannually.

8.1.2 Background

AEP Ohio applies loss factors to the AER rate calculation. The Commission requested that LEI evaluate the impact of the loss factors used by AEP Ohio.

AEP Ohio currently updates the AER rates on a quarterly basis and has proposed changing the true-up period from quarterly to semiannually. The Commission requested that LEI evaluate the impact of the proposed change on AEP Ohio customers.

8.2 Evaluative criteria

1) Is AEP Ohio's use of loss factors in its AER calculation accurate and justified? What is the impact of those assumptions on ratepayers?
2) Would ratepayers be served better by a semi-annual true-up than the currently quarterly approach?

8.3 Findings and conclusions

8.3.1 Use of loss factors in calculating the AER

To deliver one megawatt hour of energy to a customer, a power plant must generate more than one megawatt hour. Some of the energy that is generated by the plant is lost as heat, as the power travels through transformers and power lines from the plant to the customer load center. This is referred to as line losses.

In calculating the AER rates for its customers, AEP Ohio applies loss factors to its forecast component ("FC") of the AER and the adjustment ("RA") component. In this section LEI first verified whether the loss factors as such were consistent with tariff and market rules.

Then LEI then examined whether AEP Ohio's methodology, which uses kWh generated as the basis for rates and then adjusts using loss factors is fair to customers and/or results in over-collection of the AER.

8.3.1.1 Analysis

LEI verified whether the loss factors used by AEP Ohio were consistent with its tariff and PJM market rules, and whether AEP Ohio calculated them correctly. LEI confirmed that the

information and calculations were correct (see Figure 44). AEP Ohio subtracted the marginal losses (2.975 percent) which are already included in LMPs in PJM in AEP Ohio's calculation of losses (the "Energy Loss Multiplier" in Figure 44). This avoids double-counting the price impact of losses on customers.

Figure 44. AEP Ohio's calculation of loss factors

AEP - Ohio
Calculation of Losses to Metered Delivery Voltage

AEP Ohio	At Generation/ Interconnection	Transmission	Primary	Secondary	Loss Divider	Total Loss Multiplier	PJM Marginal Losses (Incl. in LMP)	Energy Loss Multiplier
		3.3%	2.0%	5.4%			2.975%	
	1,000.00							
Subtransmission/Transmission	1,000.00	967.00			0.9670	1.0341	0.0308	**1.0033**
Primary	1,000.00		947.66		0.9477	1.0552	0.0314	**1.0238**
Secondary	1,000.00			914.78	0.9148	1.0932	0.0325	**1.0607**

Transmission Loss Factor	3.3%	PJM OATT, Attachment H-14, Paragraph 4.
Primary Loss Factor	2.0%	Ohio Power Tariff Sheet 103-25D, Section 28.
Secondary Loss Factor	5.4%	Ohio Power Tariff Sheet 103-25D, Section 28.

Source: DR LEI-1-9 Attachment 1.

The column "Energy Loss Multiplier" in Figure 44 is the multiplier used for each voltage class (primary, secondary, and sub/trans) in the AER.

To examine how the use of this multiplier impacts the AER rates, note that AEP Ohio uses the total cost of renewable energy credits by sales at the generation level (see line 2 in Figure 45) to arrive at a rate at which to bill customers (for example 0.06663 cents per kWh as in line 3 in Figure 45). This first step divides the cost of the RECs by the number of hours generated (the 4,400 million kWh in line 2 in Figure 45). The 4,400 million kWh is the total delivered to customers multiplied by the company-wide loss factor of 5.1 percent.[49] This loss factor is used is because the actual number of kWh that reach the customers' meters will be smaller than the kWh generated (because of line losses).

If the company were to apply the 0.06663 cents per kWh to customers' bills, they would collect less than the total forecast cost of the credits (the $2,932,000 in line 1 of Figure 45). To ensure that the whole $2,932,000 can be recovered, AEP Ohio uses the multiplier based on line losses (the loss factor, line 5 in Figure 45, which is the Energy Loss Multiplier column from Figure 44) to increase the rate that each voltage group must pay.

[49] The company-wide 5.1 is referenced in Page 2 of 4 in AEP Ohio's application for ESP Case number 13-23285-EL-SSO docket date December 20, 2013.

Figure 45. Example of AEP Ohio's application of losses to AER billing, FC component

OHIO POWER COMPANY and COLUMBUS SOUTHERN POWER COMPANY
Calculation of Quarterly AER For Billing During
January 2016 through March 2016
FC Component

Line	Description		Forecast Period - 1st Quarter 2016 January	February	March	Total
	TOTAL COMPANY					
1	Renewable Energy Credits		958,000	978,000	996,000	$ 2,932,000
2	Retail Non-Shopping Sales - Generation Level Kwh		1,600,603,087	1,479,471,131	1,320,165,270	4,400,239,489
3	FC Component of AER Rate At Generation Level - Cents/kWh					0.06663
			Secondary	**Primary**	**Sub/Trans**	
4	FC Component of AER Rate At Generation Level		0.06663	0.06663	0.06663	
5	Loss Factor		1.0604	1.0235	1.0031	
6	**FC at the Meter Level - Cents/kWh**	**Line 4 x Line 5**	**0.07065**	**0.0682**	**0.06684**	

Source: DR LEI-1-10 Attachment 5, Schedule 3.

8.3.1.1.1 Why use a loss factor at all?

The reason that AEP Ohio needs to use a loss factor multiplier is because it calculates the overall AER rate (line 3 in Figure 45) based on generation-level kWh (line 2 in Figure 45). That generation-level kWh is calculated by AEP Ohio as billed generation multiplied by 1.051.[50]

This appears to be an unnecessary step. If AEP Ohio simply calculated the AER rate using delivered generation (a number which is 5.1 percent smaller than the generation number)[51], the AER rate would be higher, and it could charge that same rate to all its customers. For example, instead of a using generation of 4,400 million kWh to arrive at a rate of 0.0663 cents per kWh, AEP Ohio could simply have used 4,187 million kWh (the delivered kWh) and arrived at a rate of 0.07003 cents per kWh, and charged that rate to every voltage class.

8.3.1.1.2 Using loss factors results in higher rates for secondary customers

LEI performed a four-step process to examine the impact of the use of different loss factor multipliers for the three different voltage classes on the total AER recovered by AEP Ohio, and then compared it to simply using delivered kWh with the same rate to all customers.

- ***Step one:*** LEI requested data from AEP Ohio on actual kWh delivered (billed) by voltage class (see Figure 46);

[50] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. DR LEI-1-10. Attachment 1-2 Schedule 5; Attachment 3-12 Schedule 3.

[51] DR LEI-1-10. Attachment 1-2 Schedule 5; Attachment 3-12 Schedule 3.

- ***Step two:*** LEI multiplied the actual billed (delivered) kWh in Figure 46 by the loss factor multipliers for each of the three voltage classes to arrive at the FC component of the AER bill, and we summed them to arrive at the total bill (see Figure 47);
- ***Step three:*** LEI calculated the customer-wide AER rate based on delivered kWh and multiplied that rate by each voltage class's delivered energy. These were summed to arrive at the total bill (see Figure 48); and
- ***Step four:*** LEI compared the results of step two and step three to determine the impact on customers and on AEP Ohio (also see Figure 48).

Figure 46. Step one of line loss analysis: Actual delivered (billed) kWh by voltage class

Actual billed kWh by voltage class by quarter 2015-2017					Annual total billed kWh by voltage class
	2015 Q1	**2015 Q2**	**2015 Q3**	**2015 Q4**	**2015 total**
SSO Primary	55,600,204	36,528,781	35,532,844	28,457,417	156,119,246
SSO Secondary	4,051,620,170	2,686,873,674	3,020,810,110	2,483,344,690	12,242,648,644
SSO Sub/Tran	305,989,428	311,980,646	334,997,662	329,324,808	1,282,292,544
Total actual	**4,413,209,802**	**3,035,383,101**	**3,391,340,616**	**2,841,126,915**	**13,681,060,434**
	2016 Q1	**2016 Q2**	**2016 Q3**	**2016 Q4**	**2016 total**
SSO Primary	30,677,847	34,279,168	37,243,352	44,303,300	146,503,667
SSO Secondary	3,265,780,137	2,412,997,276	3,409,850,959	2,638,288,467	11,726,916,839
SSO Sub/Tran	156,729,274	144,323,803	76,173,155	45,758,861	422,985,093
Total actual	**3,453,187,258**	**2,591,600,247**	**3,523,267,466**	**2,728,350,628**	**12,296,405,599**
	2017 Q1	**2017 Q3**	**2017 Q3**	**2017 Q4**	**2017 total**
SSO Primary	56,058,054	37,424,785	46,790,081	31,753,083	172,026,003
SSO Secondary	3,166,908,772	2,353,519,735	2,934,665,478	2,634,467,279	11,089,561,264
SSO Sub/Tran	45,190,980	31,654,638	33,842,054	36,651,621	147,339,293
Total actual	**3,268,157,806**	**2,422,599,158**	**3,015,297,613**	**2,702,871,983**	**11,408,926,560**

Source: LEI 6.3 Attachment 1.xlsx.

Figure 47. Step two of line loss analysis

Voltage class	Loss factor multiplier	FC rate, at generation level, cents/kWh				Implied total FC bill component in $ using loss factor multipliers for each voltage class				Step two: Yearly total FC billings, using rate class loss factors and actual billed kWh (dollars)
		2015 Q1	2015 Q2	2015 Q3	2015 Q4	2015 Q1	2015 Q2	2015 Q3	2015 Q4	2015 total
Primary	1.02350	0.13772	0.07926	0.06985	0.07713	$ 78,372	$ 29,633	$ 25,403	$ 22,465	$ 155,873
Secondary	1.06040	0.13772	0.07926	0.06985	0.07713	$ 5,916,917	$ 2,258,245	$ 2,237,482	$ 2,031,094	$ 12,443,738
Sub/trans	1.00310	0.13772	0.07926	0.06985	0.07713	$ 422,715	$ 248,042	$ 234,721	$ 254,796	$ 1,160,274
Company-wide										**$ 13,759,885**
		2016 Q1	**2016 Q2**	**2016 Q3**	**2016 Q4**	**2016 Q1**	**2016 Q2**	**2016 Q3**	**2016 Q4**	**2016 total**
Primary	1.02350	0.066630	0.09529	0.08908	0.10403	$ 20,921	$ 33,432	$ 33,956	$ 47,172	$ 135,481
Secondary	1.06040	0.066630	0.09529	0.08908	0.10403	$ 2,307,419	$ 2,438,226	$ 3,220,960	$ 2,910,386	$ 10,876,991
Sub/trans	1.00310	0.066630	0.09529	0.08908	0.10403	$ 104,752	$ 137,952	$ 68,065	$ 47,751	$ 358,521
Company-wide										**$ 11,370,992**
		2017 Q1	**2017 Q2**	**2017 Q3**	**2017 Q4**	**2017 Q1**	**2017 Q2**	**2017 Q3**	**2017 Q4**	**2017 total**
Primary	1.02350	0.090210	0.16948	0.09834	0.11551	$ 51,758	$ 64,918	$ 47,095	$ 37,540	$ 201,311
Secondary	1.06040	0.090210	0.16948	0.09834	0.11551	$ 3,029,423	$ 4,229,665	$ 3,060,261	$ 3,226,875	$ 13,546,225
Sub/trans	1.00310	0.090210	0.16948	0.09834	0.11551	$ 40,893	$ 53,815	$ 33,383	$ 42,468	$ 170,559
Company-wide										**$ 13,918,095**

Source: Billed kWh by voltage class, LEI 6.3 Attachment 1.xlsx; Voltage class loss factor multiplier, LEI 1-9 Attachment 1.xlsx; LEI 1.10. Attachment 1-2 Schedule 5; Attachment 3-12 Schedule 3.

Figure 48. Steps three and four of line loss analysis

Voltage class	FC rate if delivered kWh hours are used rather than generation to calculate the billed rate				Implied total FC bill component in $ if total billed kwh is used to calcuate the billed rate				Step three: Yearly total FC billing based on delivered kWh (dollars)	Step four: Difference between yearly FC totals based on voltage class loss factors and rates based on delivered kWh (dollars)
	2015 Q1	2015 Q2	2015 Q3	2015 Q4	2015 Q1	2015 Q2	2015 Q3	2015 Q4	2015 total	2015 total
Primary	0.1447	0.0833	0.0734	0.0811	$ 80,476	$ 30,428	$ 26,085	$ 23,070	$ 160,059	$ (4,186)
Secondary	0.1447	0.0833	0.0734	0.0811	$ 5,864,315	$ 2,238,166	$ 2,217,577	$ 2,013,248	$ 12,333,305	$ 110,433
Sub/trans	0.1447	0.0833	0.0734	0.0811	$ 442,889	$ 259,880	$ 245,922	$ 266,984	$ 1,215,674	$ (55,400)
Company-wide	**0.1447**	**0.0833**	**0.0734**	**0.0811**	**$ 6,387,680**	**$ 2,528,474**	**$ 2,489,583**	**$ 2,303,302**	**$ 13,709,039**	**$ 50,847**
	2016 Q1	**2016 Q2**	**2016 Q3**	**2016 Q4**	**2016 Q1**	**2016 Q2**	**2016 Q3**	**2016 Q4**	**2016 total**	**2016 total**
Primary	0.0700	0.1002	0.0936	0.1093	$ 21,484	$ 34,331	$ 34,871	$ 48,441	$ 139,126	$ (3,645)
Secondary	0.0700	0.1002	0.0936	0.1093	$ 2,287,026	$ 2,416,617	$ 3,192,643	$ 2,884,705	$ 10,780,991	$ 96,000
Sub/trans	0.0700	0.1002	0.0936	0.1093	$ 109,758	$ 144,540	$ 71,321	$ 50,033	$ 375,651	$ (17,131)
Company-wide	**0.0700**	**0.1002**	**0.0936**	**0.1093**	**$ 2,418,267**	**$ 2,595,488**	**$ 3,298,835**	**$ 2,983,179**	**$ 11,295,769**	**$ 75,224**
	2017 Q1	**2017 Q2**	**2017 Q3**	**2017 Q4**	**2017 Q1**	**2017 Q2**	**2017 Q3**	**2017 Q4**	**2017 total**	**2017 total**
Primary	0.0948	0.1781	0.1034	0.1214	$ 53,149	$ 66,665	$ 48,362	$ 38,548	$ 206,724	$ (5,413)
Secondary	0.0948	0.1781	0.1034	0.1214	$ 3,002,546	$ 4,192,325	$ 3,033,270	$ 3,198,243	$ 13,426,384	$ 119,840
Sub/trans	0.0948	0.1781	0.1034	0.1214	$ 42,846	$ 56,386	$ 34,979	$ 44,495	$ 178,706	$ (8,147)
Company-wide	**0.0948**	**0.1781**	**0.1034**	**0.1214**	**$ 3,098,540**	**$ 4,315,376**	**$ 3,116,612**	**$ 3,281,287**	**$ 13,811,814**	**$ 106,280**

Source: Billed kWh by voltage class, LEI 6.3 Attachment 1.xlsx; Voltage class loss factor multiplier, LEI 1-9 Attachment 1.xlsx; LEI 1.10. Attachment 1-2 Schedule 5; Attachment 3-12 Schedule 3.

LEI's four-step analysis shows that AEP Ohio's use of different voltage class loss multipliers, instead of simply using delivered kWh, resulted in secondary voltage customers paying between $96,000 – $119,840 per year more as a group (see Figure 48 above). AEP Ohio recovered between $50,847 – $106,280 more per year using voltage class loss multipliers than they would have if they had calculated their AER rates based on delivered energy. The over-recovery of costs was at the expense of secondary voltage customers.

8.3.1.1.3 Use of loss factors for different voltage classes is unnecessary if AEP Ohio switches to calculating the AER rate using delivered energy

AEP Ohio notes that the use of loss factors in calculating the rider is consistent with the regulatory principal of cost causation: "for a secondary customer, more power must be generated to serve a similar level of load."[52] In other words, one kWh of energy delivered to a residential customer is assumed to required 1.054 kWh of generation (5.4 percent more than generated); one kWh delivered to a sub-transmission customer is assumed to require 3.3 percent more, or 1.033 kWh.

LEI does not disagree with this definition. However, renewable energy is procured to meet delivered energy (not generated energy) targets; therefore, delivered energy should be the basis on which to charge the AER. Delivered energy is a smaller number than generated energy, so it will result in a higher AER rate, which will eliminate the need for loss factors for AEP Ohio to recover its costs.

8.3.1.1 Recommendations

LEI believes AEP Ohio should simplify its AER formula, and base its AER rate on delivered energy, not generated energy. There will be no need to use loss factors or loss factor multipliers to ensure cost recovery for AEP Ohio, and secondary customers will not be penalized.

8.3.2 Impact of change in true-up, or RA period

Each quarter AEP Ohio charges customers for the forecast component ("FC") of the AER rates, plus the RA which returns over-charges or collects under-charges. Although charges and credits are calculated on a quarterly basis, there is a six-month lag in the RA period. In other words, over-charges from Q1 in a given year are returned in Q3 of that year; over-charges in Q2 are returned in Q4, etc.[53]

AEP Ohio has proposed changing the true-up process from quarterly to semiannually:

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[52] AEP Ohio. "2nd Set of Responses to PUCO Auditor LEI 18-0080." September 12, 2018. DR LEI-5-15.

[53] AEP Ohio. "1st Set of Responses to PUCO Auditor LEI 18-80-EL-RDR." August 7, 2018. DR LEI-1-10 Attachment 1-2, Schedule 6, and Attachments 3-12, Schedule 4.

"Monthly (quarterly) forecasted REC quantities are basically based on prior year's annual quantities divided by 12 months. These are trued up after A[p]ril 1 annual filing. No seasonality factor is used to forecast retail non-shopping sales requirement.[54]

[b]ecause the AER is filed quarterly, there is a fluctuation in load that will always occur due to seasonality…. The Company has requested to file semiannual to flatten out this seasonality…."[55]

However, LEI's analysis, below, found that:

1) AEP Ohio has captured the seasonal fluctuation in load in its Adjusted Baseline;
2) had AEP Ohio used the same seasonal pattern for forecasting its RECs requirements that it used for forecasting the Adjusted Baseline, it would dampen the seasonal fluctuations without needing a longer true-up period; and
3) AEP Ohio currently needs over 6 months to true-up its AER quarterly billings. If it switches to 6-month billings, the time to true-up customers could go well beyond a year.

8.3.2.1 Analysis

8.3.2.1.1 AEP Ohio's forecasts of Adjusted Baseline capture seasonal fluctuations

To forecast its RECs and SRECs needs, AEP Ohio begins with a forecast of its SSO load and Choice load. AEP Ohio develops these based on quarterly forecasting models.[56] These forecasts allow for seasonal variation in load based on past seasonal trends—for example, load is usually higher in the third quarter compared to the rest of the year because hot summer weather boosts demand for electricity for air conditioning.

AEP Ohio then subtracts its expected Economic Growth load, to arrive at the proposed Adjusted Baseline. AEP Ohio forecasts its Economic Growth load by using the average of the previous year.[57] This load is not included in the target or Benchmark volume which AEP Ohio is required to meet with renewable power. AEP Ohio's forecast of its Adjusted Baseline compared with actual Adjusted Baseline is shown in Figure 49. AEP Ohio's forecast methodology captured the typical seasonal spikes in load.

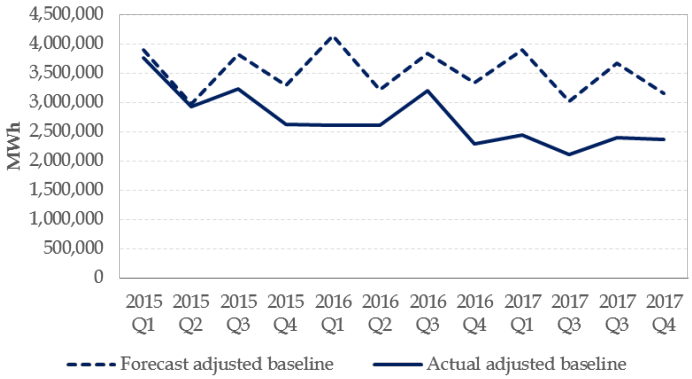
[54] AEP Ohio. "2nd Set of Responses to PUCO Auditor LEI 18-0080." September 12, 2018. DR LEI-5-6.

[55] AEP Ohio. "2nd Set of Responses to PUCO Auditor LEI 18-0080." September 12, 2018. DR LEI-5-18.

[56] Conference call with AEP Ohio on September 18, 2018.

[57] Conference call with AEP Ohio on September 24, 2018.

Figure 49. Actual and AEP Ohio forecast of Adjusted Baseline



Source: DR LEI-6-1 Attachment 1; DR LEI-1-10 Attachments 1-12 Schedules 4, 6.

AEP Ohio's outlook did not match actual seasonal ups and downs perfectly—in the historical data, a strong spike in actual demand in the third quarter of 2016 was at least in part driven by a hotter-than-normal summer.[58] Most outlooks for energy demand assume normal weather, and LEI would not expect AEP Ohio to capture those weather-driven events in its forecast. Therefore, in terms of seasonal patterns, LEI believes AEP Ohio's outlooks adequately captured quarterly fluctuations.

8.3.2.1.2 Quarterly fluctuations were forecasted, but overall downward trend was not

However, as is clearly shown in Figure 49, AEP Ohio's outlooks for its Adjusted Baseline were consistently higher than actual Adjusted Baseline. The bias in AEP Ohio's outlooks was not the result of failing to capture seasonal trends, as AEP Ohio did a reasonable job of capturing seasonality per the previous discussion. Instead, the bias was the result of consistently overestimating the overall trend in demand, which declined in general during the audit period (see Figure 49 above).

8.3.2.1.3 RECs quantities used for billing purposes do not reflect quarterly load forecasts

As explained by AEP Ohio, during the audit period each quarter's forecast REC quantities (for billing purposes) are based on the prior year's annual quantities divided by 12 months.[59] On an annual basis, therefore, they are equal to the actual number of RECs retired in the previous year.

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[58] NOAA. Ohio degree day statistics. http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/degree_days/

[59] "Monthly (quarterly) forecasted REC quantities are basically based on prior year's annual quantities divided by 12 months." Source: AEP Ohio. "2nd Set of Responses to PUCO Auditor LEI 18-0080." September 12, 2018. DR LEI-5-6.

Because demand was often falling over the time period, AEP Ohio's assumption that the number of RECs needed would be the same as the previous year inevitably led to the overestimation of the number of RECs needed in the current year. AEP Ohio's approach has a built-in overestimation of RECs costs in a world of declining SSO load; and a built-in underestimation if in a world of increasing load.

8.3.2.2 Recommendations

LEI does not recommend changing the true-up period from quarterly to semi-annually because:

1) Customers already must wait six months for true-up. Accounting best practices include timely-true up of costs, rather than extending the time for such true-ups; and

2) If AEP Ohio is really concerned about the impact of seasonality, AEP Ohio could address it upfront. For instance, it could change its methodology for forecasting RECs needs. Instead of using 1/12 of the previous years' actuals, AEP Ohio could use its quarterly outlook for the proposed Adjusted Baseline and calculate its RECs needs based on that outlook. This will create a seasonality for the AER rates that will match the seasonality of load.

LEI also recommends that AEP Ohio improve their load forecast. The persistent bias could be the result of underestimating underlying trends in the data used for the load forecast, and AEP Ohio should investigate this by back-casting or other analysis.

9 Financial audit

9.1 Background, scope and objectives

AEP Ohio is an electric distribution utility, as defined by ORC 4928.01(A)(6) and a public utility as defined in ORC 4905.02.

ORC 4928.64(B)(2) establishes benchmarks for an electric distribution utility to acquire a portion of its electricity supply for retail customers in Ohio from renewable energy sources. ORC 4928.645 provides that an electric distribution utility may use RECs and SRECs to meet its respective renewable energy and solar benchmarks.

On August 8, 2012, the PUCO issued its Opinion and Order in Case No. 11-346-EL-SSO, et. al, which approved, with certain modifications, AEP Ohio's application for an ESP effective with the first billing cycle of September 2012 through May 31, 2015. Included in the approved ESP was AEP Ohio's request to establish the AER for the recovery of renewable energy credit expenses, subject to an annual audit.

In Case No. 13-2385-EL-SSO, et. al., the PUCO modified and approved an ESP for AEP Ohio, including approval of the continuation of the AER, for the period of June 1, 2015 through May 31, 2018.

The August 8, 2012 Opinion and Order indicated that AEP Ohio is to make quarterly filings of the AER on March 1, June 1, September 1, and December 1 each year for rates to be applied in the subsequent quarter.

The AER is comprised of two components. The Forecasted Cost ("FC") Component divides forecasted REC and SREC costs by forecasted SSO usage and applies established loss factors based on voltage for Secondary, Primary, and Sub/Transmission customers.

The second component is a Reconciliation Adjustment ("RA"). This component reports the over/under-recovery from previous periods and calculates the rate adjustment necessary to effectively repay/recover such over/under-recovery. Similar computation metrics are applied to this component (forecasted SSO usage and established loss factors by voltage) to calculate the RA.

Maloney + Novotny, LLC's ("M+N") stated audit objective is to apply sufficient procedures necessary to assist the Commission with the review of AEP Ohio's AER for the period January 1, 2015 through December 31, 2017.

9.2 Standards utilized

While no specific standards have been established to audit AEP Ohio's quarterly AER filings, M+N applied Generally Accepted Auditing Standards ("GAAS") for Compliance and Substantive testing metrics and procedures.

9.3 Tests, findings, and conclusions

As previously stated, the financial audit objective was to audit AEP Ohio's quarterly AER filings for the period January 1, 2015 through December 31, 2017. AEP Ohio prepared three schedules which accompanied each of the quarterly filings.

The first schedule, Schedule 2, reported the current AER rate being charged by delivery voltage category, as well as the mathematical sum of the FC and RA components to arrive at the AER rate for the following quarter, also by delivery voltage category.

The second schedule, Schedule 3, reported AEP Ohio's forecasted estimates of REC cost by month and calculated rates by the delivery voltage category to recover those costs (FC component).

The third schedule, Schedule 4, reported the over/under-recovery of REC expenses from previous quarters, and calculated the adjustment to the AER rates that would be necessary to recover the over/under-recovery by delivery voltage category (RA component).

The AER is a bypassable rider, therefore it is only applicable to SSO customers.

All of the quarterly filings within the scope period were audited by M+N utilizing uniform audit procedures.

9.3.1 Schedule 2

As stated above, Schedule 2 was a summary schedule, and reported the current quarter AER rate by delivery voltage category, as well as the summary of the Proposed AER rate by component. A sample quarterly filing was selected for exhibit and reference purposes (see Figure 50).

Figure 50. Schedule 2 - October 2015 through December 2015

OHIO POWER COMPANY and COLUMBUS SOUTHERN POWER COMPANY
Calculation of Quarterly AER For Billing During
October 2015 through December 2015
Summary - Proposed AER Rate

COLUMBUS SOUTHERN POWER RATE ZONE

		A	B	C	D
			Schedule 3	Schedule 4	
Line	Delivery Voltage	Current AER Rate	Forecast (FC) Component	Reconciliation (RA) Adjustment Comp.	Total of FC and RA Components
1	Secondary	-0.06259	0.08179	0.01751	0.09930
2	Primary	-0.06042	0.07895	0.01690	0.09585
3	Sub/Transmission	-0.05921	0.07737	0.01657	0.09394

OHIO POWER RATE ZONE

		A	B	C	D
			Schedule 3	Schedule 4	
Line	Delivery Voltage	Current AER Rate	Forecast (FC) Component	Reconciliation (RA) Adjustment Comp.	Total of FC and RA Components
1	Secondary	-0.06259	0.08179	0.01751	0.09930
2	Primary	-0.06042	0.07895	0.01690	0.09585
3	Sub/Transmission	-0.05921	0.07737	0.01657	0.09394

Source: DR LEI-1-10 Attachment 4, Schedule 2.

M+N cross-referenced the current AER rate reported by delivery voltage and agreed with the prior quarter filing. The rates identified for the FC and RA components were matched to Schedule 3 for FC and Schedule 4 for RA. Finally, M+N tested the sum of the two components for mathematical accuracy.

To verify that the reported rates were being properly applied to customer billings, M+N selected one customer from each delivery voltage class and matched the rate charged on the customer's bill to the rate reported on Schedule 2 for three months in each of the three years audited. The rates were traced through AEP Ohio's billing system to the actual bill provided to the customer. No exceptions were noted.

M+N requested and hoped to receive AEP Ohio's Service Organization Controls Report ("SOC") on internal billing system policies and procedures to support selected sample sizes and provide compliance verification, but had not received this as of the report date.

9.3.2 Schedule 3

To audit the forecasted REC cost by month as well as load (see Figure 51), M+N engaged in a discussion with AEP Ohio's Economic Forecast Group to understand the factors and data used to develop forecasted load. AEP Ohio considers multiple quantitative and qualitative factors to develop their load forecast, including demographics, weather/seasonality, and economic climate.

Forecasts are prepared annually and applied for the whole year. As noted previously in Figure 49 in Section 8.3.2, AEP Ohio forecasts consistently overestimate load.

Figure 51. Schedule 3 - October 2015 through December 2015

OHIO POWER COMPANY and COLUMBUS SOUTHERN POWER COMPANY
Calculation of Quarterly AER For Billing During
October 2015 through December 2015
FC Component

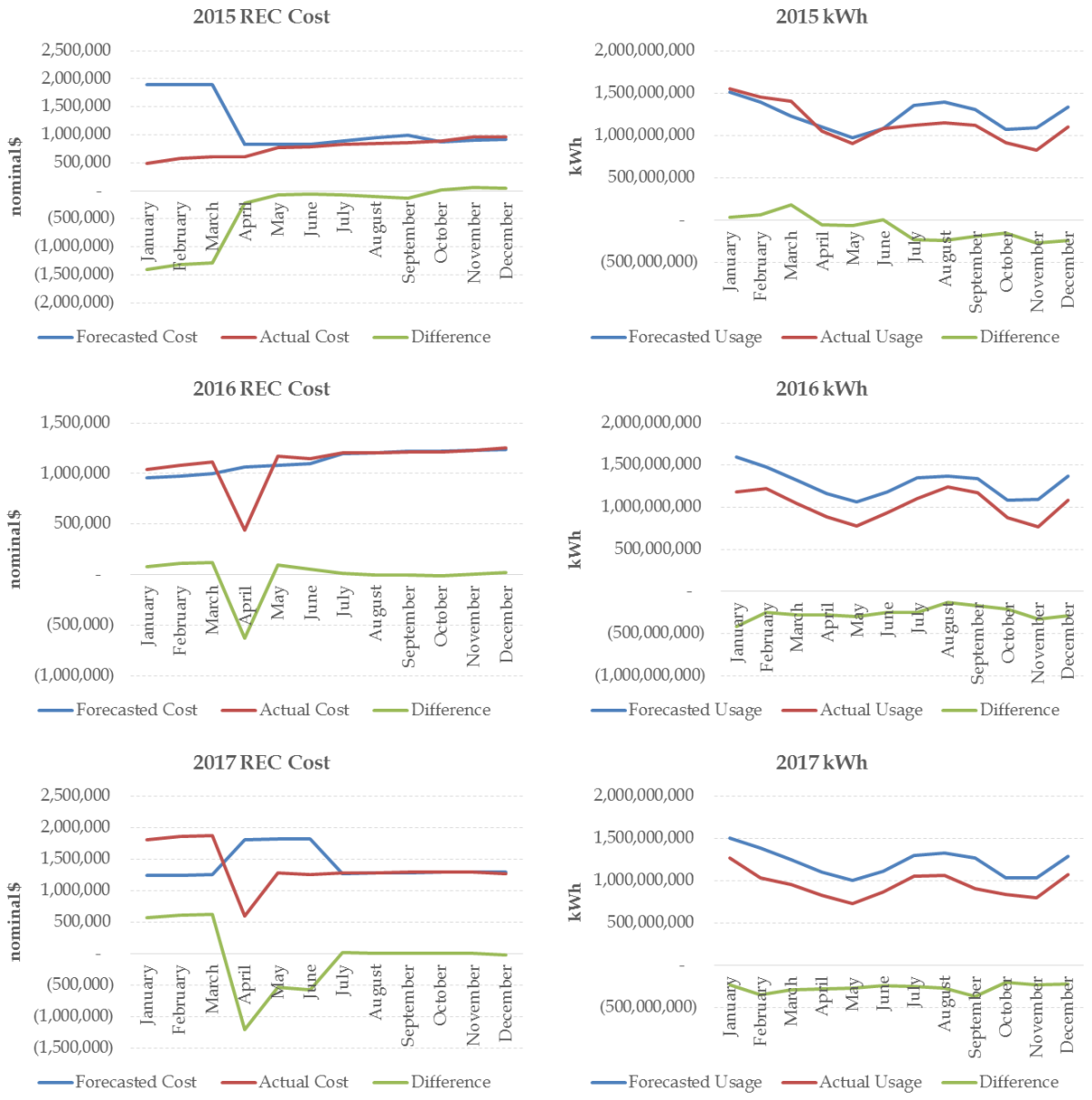
Line	Description		Forecast Period - 4th Quarter 2015 October	November	Decmber		Total
	TOTAL COMPANY						
1	Renewable Energy Credits		880,000	901,000	920,000	$	2,701,000
2	Retail Non-Shopping Sales - Generation Level Kwh		1,071,343,711	1,092,152,263	1,338,162,675		3,501,658,650
3	FC Component of AER Rate At Generation Level - Cents/kWh						0.07713
			Secondary	**Primary**	**Sub/Trans**		
4	FC Component of AER Rate At Generation Level		0.07713	0.07713	0.07713		
5	Loss Factor		1.0604	1.0235	1.0031		
6	**FC at the Meter Level - Cents/kWh**	**Line 7 x Line 8**	**0.08179**	**0.07895**	**0.07737**		

Source: DR LEI-1-10 Attachment 4, Schedule 3.

M+N obtained the forecasts for years ending December 31, 2015, 2016 and 2017 and traced the data back to the forecasted REC and usage figures that were reported on Schedule 3. There were no exceptions noted. This task was performed on site.

Forecasted REC Costing and SSO kWh usage (load) for the months listed on Schedule 3 were compared to the actual amounts, with a plotted trend analysis reporting the variances (see Figure 52).

Figure 52. Forecasted versus actual REC cost and load by calendar year



Source: DR LEI-1-10 Attachments 1-12, Schedules 3 and 4.

To arrive at an FC component rate, AEP Ohio applied a loss factor to forecasted kWh usage as noted previously. The company-wide line loss rate used was 5.1 percent, and was traced to Exhibit DMR-2, Page 2 of 4 in AEP Ohio's application for ESP Case number 13-23285-EL-SSO docket date December 20, 2013.

M+N recomputed the FC Component of AER Rate at Generation Level. M+N noted one exception for Third Quarter 2015 filed June 1, 2015, which was subsequently corrected in a filing dated June

10, 2015. The correction was necessary due to the lack of rate conversion from Dollars/ kWh to Cents/kWh.

Finally, loss rates by delivery voltage were applied to the computed generation rate to arrive at the meter level FC. M+N reviewed the line loss rate for reasonableness and its consistent application with no exceptions noted.

9.3.3 Schedule 4

As mandated, AEP Ohio files its AER quarterly. To calculate any over/under-recovery of the AER, quarterly data is also reported in Schedule 4 for use in truing-up the AER. To achieve a full calendar quarter of actual REC billings and costs, AEP Ohio reports actual data which occurred four, five, and six months prior to the enactment date of the AER rate (see Figure 53).

Figure 53. Schedule 4 - October 2015 through December 2015

OHIO POWER COMPANY and COLUMBUS SOUTHERN POWER COMPANY
Calculation of Quarterly AER For Billing During
October 2015 through December 2015
RA

Line	Month	Renewable Revenue	Renewable Cost	AER (Over)/Under Recovery
1	**Beginning Balance**			$ (1,168,424)
2	Apr-15	$ (506,816)	$ 614,182	$ 1,120,998
3	May-15	$ 397,189	$ 765,242	$ 368,053
4	Jun-15	$ 523,246	$ 780,938	$ 257,692
5	**Ending Balance**	$ 413,619	$ 2,160,362	$ 578,319
6	Total (Over)/Under Recovery Balance			$ 578,319
7	Loss Adjusted Retail Sales Billing Period - kWh			3,501,658,650
8	RA Component at Generation - Cents/kWh			0.01652

			Secondary	Primary	Sub/Trans
9					
10	RA Component of FAC Rate At Generation Level		0.01652	0.01652	0.01652
11	Loss Factor		1.0604	1.0235	1.0031
12	**RA at the Meter Level - Cents/kWh**	Line 10 x Line 11	**0.01751**	**0.01690**	**0.01657**

Source: DR LEI-1-10 Attachment 4, Schedule 4.

For example, to prepare a third quarter filing, the submission is prepared in May and filed with the PUCO on June 1. As such, actual results are not fully available for April, May, and June. Thus, actual over/under-recovery information is reported for the months of January, February, and March, the most recent completed quarter.

The final factor of over/under-recovery is the inclusion of a beginning balance. The beginning balance is used to provide for a continuum of past results. The amount of beginning balance represented on Schedule 4 is the ending over/under-recovered balance from the filing two quarters before the current filing.

For example, to prepare a third quarter AER Rate filing, the beginning balance for the RA to be made June 1 would be the ending balance from the RA adjustment of the first quarter filing made December 1 of the previous year.

M+N traced and verified the AER over/under-recovered beginning balances to the ending balances on previous filings with no exception. Actual monthly renewable revenues were traced and agreed to AEP Ohio's subsidiary billing records, as well as unbilled and estimated AER revenue reports. REC costs were traced and agreed through AEP Ohio's subsidiary ledgers with no exception noted. Sample individual REC costs were selected from subsidiary records and traced to supporting documentation.

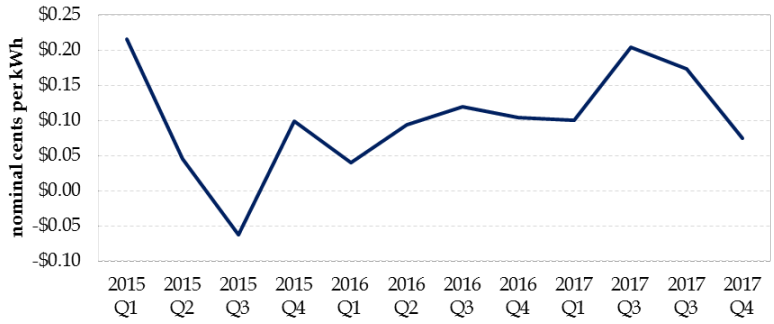
M+N noted no inclusion of non-compliance overhead costs in the AER.

9.4 Recommendations

9.4.1 M+N recommends renewable revenue should only include billed rider revenue

No matter how thorough and detailed the process, forecasting is an inexact science. While the process was applied uniformly, the AER rates for the audit period experience fluctuation (see Figure 54). With AEP Ohio filing quarterly, these fluctuations manifest themselves in the "collar months."

Figure 54. Current AER Rate for Secondary voltage class



Note: Primary and Sub/Trans voltage classes demonstrate the same fluctuation and have similar rates.

AEP Ohio's AER monthly revenue is comprised of three components: Billed Rider Revenue, Estimated Rider Revenue, and Unbilled Rider Revenue. Billed Rider Revenue is the actual amount billed to a customer.

Estimated Rider Revenue represents large power customers, typically billed in the later cycles of a month, that are unable to be processed by the monthly cutoff at the end of the first work day each month. Their usage is estimated and included to ensure that all connected customers are represented in billing. Estimated Rider Revenue from the previous month is reversed.

Unbilled Rider Revenue utilizes an estimate of kWh usage consumed from the meter read date to the end of a month. As with Estimated Rider Revenue, Unbilled Rider Revenue recorded in the previous month is reversed.

The "collar months" are January, April, July, and October. These are the months where the current month revenue is computed using a differing rate than the previous month. While amounts billed to customers are consistent with the rate in effect for that month, the reversal of Estimated and Unbilled Rider Revenue from the previous month reflect the previous rate.

Thus, for example, the Primary AER rate for March 2015 was 0.20802 cents/kWh. That same Primary AER customer rate in April 2015 was 0.04323 cents/kWh (an approximate 80 percent reduction). Unbilled and Estimated Revenue computed for March 2015 totaled $1,163,298.47 using the March rate whereby the usage was billed in April using the new reduced rate. Unbilled and Estimated Revenue in April totaled $189,006.50, resulting in total AER Rider Revenue, after accounting for actual customer bills, in the amount of negative $506,816.05 despite a positive rate being billed to customers.

The theory behind the utilized revenue recognition methodology is consistent with Generally Accepted Accounting Standards. However, from a ratemaking standpoint, these collar month fluctuations contribute to the rate variances.

M+N recommends that, when AEP Ohio prepares RA Schedule 4, Renewable Revenue should only include Billed Rider Revenue.

9.4.2 M+N recommends simpler RA true-up process to avoid volatility

AEP Ohio includes the beginning balance of AER Over/Under Recovery on Schedule 4 (see Figure 53 above). This beginning balance reflects past results from potentially every period prior to the current period. M+N agrees that reconciliations are necessary, but recommends AEP Ohio adopt a simpler methodology which fully trues up every quarter independently and without reference to historical quarters.

The RA adjustment used by AEP Ohio is meant to "true up" the results of past forecasts and apply prospectively based on forecasted usage. Thus, for example, the RA for October through December 2015 totaled $578,319 as an under-recovery. Applying the forecasted loss adjusted retail SSO kWh usage of 3,501,658,650, resulted in an AER rate adjustment of 0.01652 cent/kWh to be applied to customer billings for the period.

When AEP Ohio filed its RA for April through June 2016, the beginning balance on the RA schedule was $578,319 and, after accounting for Renewable Revenue and REC costing, the result reflected a net over-reimbursement of $242,798.

Using the beginning balance seems inconsistent with the intent of the schedule. Instead, M+N recommends that the only forecasted number included in the RA schedule is the usage. A comparison of actual to forecasted usage should be made to previous RA schedules resulting in a recalculation of over/under collection. This number would replace the beginning balance which is currently used.

9.4.3 M+N recommends correction to the SREC costs calculation

Net REC and SREC costs, after deducting PJM liquidation value in the case of Wind Purchases and Energy and Capacity Components in the case of Solar, were inventoried and added to previous REC credit inventory to determine an available bank of credits to meet targeted RPS requirements as previously noted. REC inventory was then consumed/expensed as needed to meet AEP's monthly estimated RPS requirement, after accounting for the cost/contribution of company-owned solar panels. Additionally, incremental labor, GATS fees, and other overhead associated with administering RPS compliance were recorded as recoverable REC costs.

As individual REC costs were audited, M+N noted that PJM liquidation values from Wind Purchases were not inventoried and removed from the REC costing regime as prescribed. However, while the Energy and Capacity components from SREC purchases were not inventoried, they were not removed from REC costs included in the AER rate. For the period under audit, the total Energy and Capacity Component costs totaled $1,716,806.12.

M+N recommends that AEP remove Energy and Capacity Component costs from SREC purchases listed on future quarterly filings and provide relief to customers for inclusion of these costs as identified above.

Summary: Report of the Management/Performance and Financial
Audit of the Alternative Energy Rider of the
AEP Ohio electronically filed by Mark C Bellamy on behalf of London Economics International